A study of hairs and wools belonging to the mammalian group of animals : including a special study of human hair, considered from the medico-legal aspects / by John Glaister.

EGYPTIAN UNIVERSITY

FACULTY OF MEDICINE.

A STUDY OF HAIRS AND WOOLS

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THE MAMMALIAN GROUP OF ANIMALS,

INCLUDING A SPECIAL STUDY OF HUMAN HAIR,

CONSIDERED FROM THE MEDICO-LEGAL ASPECT.

By

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By Gracious Permission, this volume is dedicated by His Majesty's most humble and faithful servant, the Author, to His Majesty, King Fuad, in respectful appreciation of His Majesty's deep interest in, and earnest endeavours for, the advancement of Medicine and Science, both at home and abroad.

PREFACE

In presenting this volume, the author desires to record his appreciation of the generosity of the Egyptian Government which has made possible the publication of this work with its large collection of plates.

He would also express his special thanks to Mr. Thomas Newton, Technical Assistant, The Department of Forensic Medicine, The University, Glasgow, for the reprinting of the entire collection of photo-micrographs necessary for reproduction purposes and to the Staff of the Survey Department of the Egyptian Government for the care exercised in the production of the plates.

It is hoped that the ubiquitous errors in text will not be censured overharshly, since technical nomenclature must almost inevitably produce difficulties under the unusual conditions encountered.

The Department of Forensic Medicine,
The Faculty of Medicine,
Kasr-el-Aini,
Cairo.

April, 1931.

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SECTION I.

INTRODUCTION.

During the past century, numerous criminal cases have occurred in which the identification of hairs belonging to the mammalian group of animals has played an important part in furnishing strong circumstantial evidence of the guilt of accused persons. In order to verify this contention the reader need but refer to the following British cases:— Reg. v. Teague, (Cornwall Assizes 1851), Reg. v. Harrington (Essex Lent Assizes 1852), Reg. v. Hansen, (Bodmin Lent Assizes), and Reg. v. Steed (Maidstone Summer Assizes 1863). These are representative of the earlier English cases in which the medico-legal examination of hairs and fibres proved of great value in the course of justice. Taylor, states that "the necessity for an acquaintance with the character of hair will be apparent from the case of Reg. v. Teague. In this case it was alleged that the fatal wounds to the head of deceased involving both eyebrows, had been produced by a hammer found on a hedge. There was not any blood upon the hammer, but there were two short stiff white hairs at the smaller end. It was suggested that these might have been goat hairs as the hammer was used for beating out portions of goat skin which were hanging in the same hedge. Two medical witnesses deposed that they were hairs from the human eyebrow and having compared them with deceased's eyebrow, they found they agreed. The hair of the eyebrow was described as conical or pyramidal and the hair on the hammer had this character. It appeared as if it had been bruised or squeezed between two blunt substances, but this appearance might have been equally presented on the theory of defence that it was goat's and not human hair. Assuming the medical evidence to be correct, it pointed to the weapon and not to any act on part of prisoner. The witnesses were severely cross-examined upon the structural

differences of the hair of man and animals." Among the more recent Scottish criminal cases which may be cited in this regard are:— Rex v. Gibson, High Court Justiciary, Glasgow, December, 1924, Rex v. Thomson, Sheriff Court, Ayr, (Winter 1924), and Rex v. Handley, High Court Justiciary, Glasgow, October 1926. The first, refers to a case in which a man was accused of cutting a boy's throat. The prisoner was found to be insane and unable to plead. At the enquiry, evidence was led to show that he was affected with an insane impulse to kill cats. It was stated that he had killed twenty. Hairs of this animal were found upon his clothing. The second, concerns a case of theft in which a superficial examination of the clothing belonging to the accused man revealed the presence of several hairs upon its surface. The microscopic appearances of these hairs were identical to those found composing a fur necklet which the accused man was alleged to have stolen. This evidence assumed a very important rôle in bringing the accused to justice. The third case was one of rape and murder in which a hair found upon the trousers of the accused was very similar in all respects to the pubic hair of the victim. With this case, the writer was associated as one of the medico-legal examiners for the Crown.

In passing, allusion should be made to the notable English trial of H. H. Crippen, October 1910, in which the question of hair identity arose.

The study of hair characteristics is also of very great value when an examiner is called upon to investigate cases of bestiality or cases of cattle and animal maiming. There are in addition many other types of cases in which an intimate knowledge of the appearances of hairs is essential. In a case of animal maiming which was tried at the Reading Assizes in the early summer of 1926, the accused, James May, was sentenced to seven years penal servitude by Mr. Justice Avory. Evidence was led to show that the hairs which were found on his coat were those of short-horns, similar to the herd some of which had been maimed.

A study of French bibliography reveals the fact that the medico-legal experts in France have also been utilising the examination of hairs as an almost routine procedure when circumstance permitted. Olivier[2] in an article describes the

value of a microscopic examination of fibres found on the handle of a hatchet at the locus of a murder and the differentiation between human and animal hairs, while Robin[3] writes on the medico-legal importance of microscopic examination of hairs found at the locus of a crime and those of the victim. Lassaigne[4] states that the different published works of legal medicine up to date treat the subject of the examination of hairs lightly, and in the article deals with the identification of hairs found on productions.

The Study of Hairs from the Medico-Legal Aspect and the Value of a Photographic Record.

This avenue of medico-legal investigation, which is becoming more important annually, suggested to the writer that useful work lay in an exhaustive and careful scientific study of all available hairs and wools belonging to members of the mammalian group of animals — to which Man belongs. It appears to him to be of little practical value to read in medico-legal treatises and text-books that a personal study of hairs will yield much practical and important information from the jurist's standpoint. Greater confidence would be established in the mind of the examiner, if he had a more or less standard photographic "catalogue" of hair characteristics as actually seen microscopically, to which he could turn for corroboration in cases of difficulty. It is necessary to refer to the Atlases of Marcelle Lambert and V. Balthazard[5], Friedenthal[6], Waldeyer and Grimm[7] and Fritsch[8], the first two of which are apparently composed of drawings, the third, of highly enlarged photographs of certain animal and human hairs, and the last of highly enlarged photographs of hair of the different human races. These do not furnish the natural appearances which are seen microscopically by the observer, on account of the subjects having been drawn or greatly enlarged after having been photographed and thereby convey a different impression to that obtained by direct microscopic observation. In this regard Lucas[9] writes "There are few subjects that will repay the chemico-legal expert better than a study of the microscopical appearances of fibres, and certain-

ty of recognition can only be attained by long practice. The published illustrations of the structure of fibres, although sometimes helpful, are on the whole disappointing, and anyone relying upon a book illustration and not on his own experience is apt to be misled. The only certain method of recognition is by means of careful comparison with other fibres known to be genuine. It is impossible to convey any reliable impression of the appearance of fibres by means of a written description, and this can only be learnt by direct observation from fibres of known origin, aided to some extent by illustration". In conclusion he writes "The only useful photographs of fibres are micro-photographs and these are often helpful for attaching to a report or for demonstration purposes in Court". The Atlas of Friedenthal contains drawings of one hundred and eight transverse sections of different coloured hairs of Europeans and other races, also a few of Primates. Briand and Chaudé[10] in their text book remark that "an optical examination of animal and human hairs will enlighten an expert in a large number of criminal cases", with which assertion the writer is in complete agreement. For this reason the present work has been undertaken in order to acquire as much information as is possible regarding the characteristics of mammalian hairs, and at the same time to place this on record in permanent form, departing from diagrammatic representation and relying solely upon unenlarged and unaided photographs. A collection of this character, in addition to providing data to the jurist in the course of his investigations, should prove of great value to the furrier and taxidermist in addition to others engaged in commercial pursuits which deal with fur and hairs. The standard classification here adopted should permit of easy reference to any particular order, sub-order or family of animals in the mammalian group. Reproduction of the appearances of hairs may to some extent be attained by drawings of their microscopic appearances, undertaken by a skilled artist, but after careful examination of the existing atlases containing drawings, in the opinion of the writer, the result is not convincing. For this reason the complete information gleaned by him during a prolonged laboratory investigation of hair characteristics, has been recorded photographically by means of a microphotographic camera. By this method, it is

hoped that those who are desirous of obtaining experience in the identification of hairs may achieve their objective with but a trivial percentage of the labour and time which the writer was obliged to devote.

Method adopted for the Investigation.

The investigation was approached from the following aspects :—

A. The Study of Hairs and Wools of the mammalian group of animals excluding Human Hairs.

B. The Study of Human Hairs.

C. The Study of cross-sections of the hairs in groups *A* and *B*.

The reasons for this division of the subject of study lay in the facts that an effort was made to determine whether the hairs and wools of animals belonging to the same zoological order, suborder or family revealed similar characteristics which could be relied upon for the identification of the animal order, suborder or family to which the hair or wool belonged. In the case of human hair, whether there were any specific differences in the appearance of hairs having regard to sex, the age of subject, the site of the body from which the hair was taken and the colour of the hairs. The study of transverse sections of hairs and wools was undertaken to supplement the information derived from a study of the hairs longitudinally, having regard to the previous lines of investigation, in addition to providing a photographic record of the cross-sections of hairs of the various members of the mammalian group. The cross-sectioning of hair was found to be a very difficult and delicate laboratory manoeuvre, fraught with many obstacles, and demanding untiring patience and perseverance. The consistence of the hair or wool under examination determined the process necessary to obtain satisfactory cross-sections. For this purpose hairs were classified into three clases:— (a) bristles, (b) wiry hairs and (c) soft hairs. The wools formed a separate group. A variety of qualities of paraffin wax were employed. These possessed different melting points and there-

fore different degrees of adherence to the cross-sections. If, for example, a wiry hair is embedded in a wax which melts at a low degree of temperature, it will be found that when the paraffin sections have been made with the microtome, the actual sections of the hair embedded therein will leave the wax when the film is floated upon water preparatory to being passed on to the microscope slide. The selection of the proper wax in regard to the type of hair under examination is of vital importance in order to ensure the adherence of the sections to the wax film. Time and care were devoted to experiment before it was realised that a suitable wax could with experience be selected for any particular hair having regard to its general character and consistence. A word is necessary in relation to the treatment of hairs and wools prior to the process of embedding. It is essential that the hairs be thoroughly cleansed and softened to a requisite degree prior to cutting the sections. Two parts of 2 per. cent. alcohol added to one part of a solution of liquor ammonium fortis or ammonium hydrate will be found an efficient cleansing solution, and the duration of the immersion should be continued for a minimum period of five minutes. The next step in the process is constitued by immersing the hair in a solution of potassium hydrate at a temperature of 50°C. and of varying strength depending upon the character and quality of hair under preparation. The duration of steeping depends upon the strength of the potassium hydrate which is required. The hairs should now be washed, first in a mixture of equal parts of 1 per. cent. sulphuric acid and absolute alcohol, then in xylol, and thereafter dried between sheets of blotting or filter paper. It will be evident that some arrangement of the hairs or wools undergoing the above process is necessary. The optimum method found, consisted in the formation of hair bundles of about three quarters of an inch in length. These were constructed by lashing the hairs or wool together at intervals with a fine silk thread and by cutting the bundles thereafter.

Although the cross-sections of hairs have been relegated to a separate section in the text, an examination of the photographs will reveal that they are not contained in a separate pictorial group. The photographs of the hairs and wools in the longitudinal plane were classified as soon as available, but as

the majority of the photographs of the transverse sections were not taken at that time, they were added later. In dealing with such a large number of specimens, method and routine were necessary in order to prevent error and confusion. The method adopted on receipt of hair samples consisted in giving a serial number to each, commencing at unity; thereafter these specimens were entered in a book in the form of a list, regardless of their zoological classification or relationship, together with a note of any important detail regarding them. The packets containing the hair or wool, or both, were marked with the corresponding number. In the case of a wool the numeral allocated to each specimen bore the letter A, so that at sight the specimens of hair could be distinguished from those of wool. When photographs were taken, the numbers previously given to the specimens were maintained and inscribed upon the plate container. On removal of the plate for the purpose of developing, the number was inscribed upon it. Later when the print was made, the number was transfered to it and finally when the print was examined the number inscribed thereon was exchanged for the name of the animal from which the hair or wool was taken and the part of its body which bore the hair, by reference to the list made in the first instance. In this manner error was eliminated. Photographic albums were kept for the zoological classification of the photographs as they were available. The system was found to be an essential part of the work undertaken, as samples were delivered from time to time, and only on the completion of all the photographs was final classification made possible. On receipt of the specimens, examination revealed that in many instances the hairs and wools of the animals were adherent to the skin, while in others the hair and wool had been previously cut from the skin surface : this fact rendered the description of the macroscopic characters of hairs and wools occasionally rather difficult. The description of the specimens having been recorded, the specimen of hairs and of wools when present, were placed upon a slide previously prepared with a drop or two of canada balsam and the cover-slip applied. Cleansing of the hairs, with few exceptions, was not found necessary for examination in the longitudinal plane. The specimens were not examined microscopically until a minimum period

of 72 hours had elapsed after mounting, as experience had shown that a greater definition of the cellular structure and pigment was obtained after the hairs had been immersed in balsam for this period. The specimens of hairs as received, the mounted specimens, and their photographic plates each bearing their correct number, their identity being revealed in the entry list, were placed in boxes in serial order to ensure their quick location should further examination be required.

Photographic Methods Employed.

In obtaining the micro-photographs, three varieties of photographic plates were used, the Ortho-Process plate, the Anti-Screen plate, and the ordinary plate. The first named required a minimum exposure of 2 minutes. Over-exposure was not readily encountered as this could be avoided when developing and it was of oustanding merit when dark coloured detail was desired. The Anti-Screen or backed plate was of value when it was found necessary to exclude high lights in light subjects, and the necessary exposure varied from 30 seconds to 50 seconds. The ordinary plate was used in simple studies and usually required an exposure of from 15 seconds to 30 seconds, depending upon the density of the specimen. After a careful study of the photographs contained in the accompanying atlas, it may be thought that some of these do not show much detail. Such criticism may be justified, but it should be mentioned that the photographs reveal as much detail as the eye of the examiner could perceive when examining the specimens microscopically. Many of the photographs were taken when the subjects were under high power magnification, but it was found that certain hairs did not permit of this on account of their great breadth, which permitted only a portion of their lumen in the microscopic field. Example Plate No. 83. Photograph No. 5. (Section I).

The photographs of the wools were taken under high-power except in a few instances, when it was desirable to show a length of the wool on account of graduations in thickness, or wool merging into hair, as in the case of the Common and Water Shrews or for other reasons of this character, when the lower

power was found to be more suitable. The degrees of magnification of the low and high powers used in this work were 62 and 280 respectively. In several of the photographs, the studies can only be seen in faint outline, but having regard to the difficulty in obtaining microscopic detail in these cases, on account of their light shade almost merging into that of the background, the writer was gratified to obtain photographic records of these.

SECTION II.

The Zoological Classification Adopted.

The zoological classification which has been adopted is that contained in the excellent treatis by Flower & Lydekker[11]. The table inserted hereunder has been modified by the writer so as to exclude those suborders and families now extinct. More detailed classification has been omitted, as it was not thought necessary and might prove confusing, since the subject is considered from a medico-legal viewpoint.

Table of Classification.

Subclass	I.	Prototheria.
Order	I.	Monotremata—Monotremes.
Family	1	Ornithorhynchidae—Duck-billed Platypus.
	2.	Echidnidae—Spiny Anteater.
Subclass	II.	Metatheria.
Order	II.	Marsupialia—Marsupials.
Suborder	1.	Polyprotodontia—Polyprotodonts.
Family	5.	Didelphyidae—Opossums.
	6.	Dasyuridae—Thylacine and Dasyures.
	7.	Peramelidae—Bandicoots.
Suborder	2.	Diprotodontia—Diprotodonts.
Family	8.	Phascolomyidae—Wombats.
	9.	Phalangeridae—Phalangers.
	12.	Macropodidae—Kangaroos.
Subclass	III.	Eutheria.

Order III. Edentata—Edentates.

Family 1. Bradypodidae—Sloths.
3. Myrmecophagidae—Anteaters.
4. Dasypodidae — Armadillos.
6. Manidae—Pangolins.
7. Orycteropodidae—Aard-varks.

Order IV. Sirenia—Sirenians.

Family 1. Manatidae—Manatees.
3. Halicoridae—Dugongs.

Order V. Cetacea—Cetaceans.

Suborder I. Mystacoceti—Baleen Whales.

Family 1. Balaenidae—Greenland Whale, etc.

Suborder 3. Odontoceti—Toothed Whales.

Family 3. Physeteridae—Sperm Whale.
4. Platanistidae—Freshwater Dolphins.
5. Delphinidae—Dolphins, Porpoises, etc.

Order VI. Ungulata—Hoofed Mammals.

Suborder 1. Artiodactyla—Artiodactyles.

Section A. Suina—Pig-like Artiodactyles.

Family 1. Hippopotamidae—Hippopotamus.
2. Suidae—Pigs and Peccaries.

Section B. Tragulina—Chevrotains.

Family 9. Tragulidae—Chevrotains.

Section C. Tylopoda—Camels.

Family 10. Camelidae—Camels and Llamas.

Section D. Pecora—True Ruminants.

Family 12. Cervidae—Deer.
13. Giraffidae—Giraffe.
14. Antilocapridae—Prong-buck.
15. Bovidae—Sheep, Cattle, etc.

Suborder 2. Perissodactyla—Perissodactyles.

Family 16. Tapiridae—Tapirs.
19. Equidae—Horses.
20. Rhinocerotidae—Rhinoceroses.

Suborder 5. Hyracoidea—Hyraces.

Family 30. Hyracidae—Hyrax.

Suborder 7. Proboscidea—Proboscideans.

Family 35. Elephantidae—Elephants.

Order VII. Rodentia—Rodents.

Suborder 1. Simplicidentata.

Family 1. Anomaluridae—Anomalurus.
2. Sciuridae—Squirrels and Marmots.
3. Haplodontidae—Haplodon.
5. Castoridae—Beavers.
6. Myoxidae—Dormice.
7. Lophiomyidae—Lophiomys.
Family 8. Muridae—Rats, Mice, and Voles.
9. Spalacidae—Mole-rats.
10. Geomyidae—Pouched Rats.
11. Dipodidae—Jerboas.
13. Octodontidae—Spiny Mice.
15. Hystricidae—Porcupines.
16. Chinchillidae—Chinchillas.
17. Dinomyidae—Dinomys.
18. Caviidae—Cavies.
19. Dasyproctidae—Agouties.

Suborder 2. Duplicidentata.

Fam. 20. Lagomyidae—Picas.
21. Leporidae—Hares and Rabbits.

Order VIII. Carnivora—Carnivores.

Suborder 1. Carnivora Vera—Fissipedes.

Fam. 1. Felidae—Cats.
2. Hyaenidae—Hyaenas.
3. Proteleidae—Earth Wolf.
4. Viverridae—Civets and Ichneumons.

5. Canidae—Wolves and Foxes.
6. Ursidae—Bears.
7. Mustelidae—Weasels and Otters.
8. Procyonidae—Raccoons and Cat-bear.

Suborder 2. Pinnipedia—Pinnipedes.

Fam. 9. Otariidae—Eared Seals.
10. Trichechidae—Walrus.
11. Phocidae—Seals.

Order IX. Insectivora—Insectivores.

Suborder 1. Insectivora Vera.

Fam. 1. Tupaiidae—Tupaias.
2. Macroscelididae—Elephant-Shrews.
3. Erinaceidae—Hedgehogs.
4. Soricidae—Shrews.
5. Talpidae—Moles.
6. Potamogalidae—Potamogale.
7. Solenodontidae—Solenodon.
8. Centetidae—Centetes.
9. Chrysochloridae—Golden Moles.

Suborder 2. Dermoptera.

Fam. 10. Galeopithecidae—Galeopithecus.

Order X. Chiroptera—Bats.

Suborder 1. Megachiroptera—Frugivorous Bats.

Fam. 1. Pteropodidae—Flying Foxes.

Suborder 2. Microchiroptera—Insectivorous Bats.

Fam. 2. Vespertilionidae—Common Bats.
3. Nycteridae—Nycteris.
4. Rhinolophidae—Leaf-nosed Bats.
5. Emballonuridae—Emballonura.
6. Phyllostomatidae—Vampyres.

Order XI. Primates.

Suborder 1. Lemuroidea—Lemuroids.

Fam. 2. Chiromyidae—Aye-Aye.
4. Tarsiidae—Tarsier.
3. Lemuridae—Lemurs.

Suborder 2. Anthropoidea—Anthropoids.
Fam. 5. Hapalidae—Marmosets.
6. Cebidae—American Monkeys.
7. Cercopithecidae—Old World Monkeys.
8. Simiidae—Gibbons and Man-like Apes.
9. Hominidae—Man.

Although a very large collection of different mammalian hairs has been obtained, and all the orders to which hair-bearing animals belong are represented by one hundred and fifty different specimens, it was not found possible to obtain hairs from every family of mammals. Special investigation, however, has been made of the more common hairs and those which might be encountered even on rare occasion in medico-legal investigation. Specimens representing Order V to which whales, dolphins and porpoises belong, have been omitted on account of the fact that the general surface of the skin of these mammals is devoid of hair, there being only a few fine bristles in the neighbourhood of the mouth in many of the species. These bristles may persist through life or be present only in the young animals. Again specimens from the Pangolin are naturally absent from the collection as this mammal is practically devoid of hair, being covered dorsally with large horny imbricated scales. The animal belongs to Order III, (Family 6, Manidae,) to which the scaly Anteaters also belong. For the same reason, Order IV is not represented in the collection. The Manatee, of the family Manatidae, has a fish-like body which in young animals possesses very scanty delicate hairs. The Dugong, representative of the family Halicoridae, is more marine in habit than the Manatee and is practically hairless. Orders I, II, III, VI, VII, VIII, IX, X and XI are for the scope of this work fully represented by specimens of hairs and wools. The writer is indebted to Mr. D. Wotherspoon, of Charles Kirk, Taxidermist, Glasgow and to Mr. Julius Samuel, of Messrs. Samuel Ltd., Furriers, Glasgow, for the great majority of the specimens which have been examined and photographed.

He would also acknowledge the help of Mr. T. C. T. Brotchie, Curator of The Glasgow Corporation Art Galleries, in this connection. It will have been noted that the writer alludes to hairs as opposed to wools. The term wool has been adopted advisedly, since wool-hairs present very definite and important characteristics, the details of which will be considered later. Strict adherence to these terms is important, if error in the microscopic interpretation of the specimens is to be avoided.

General Observations upon the Coats of Mammalian Animals.

Some general observations regarding the characteristics of the coats of animals of the mammalian group form a suitable and important introduction to the more detailed examination and description of mammalian hairs, for their characters account for the different appearances of the hairs and wools belonging to the same animal. "Mammalia[12] is the name invented by Linnaeus (from the Latin mamma) and now commonly used by zoologists, for one of the five great classes of vertebrated animals, which is the best known and undoubtedly the most important group of the animal kingdom."

The skin of the animals included in this group is more or less clothed or covered by a modified form of epidermis called hair, the epidermal origin of which will be clearly demonstrated when the microscopic characters presented by the various hairs are considered. Hairs take the form of unbranched filaments which grow from papillae embedded at the base of follicles situated in the cutis or true skin. The hairs of different animals or indeed of different parts of the same animal possess different macroscopic and microscopic characteristics as shown by colour, size, and structure variation. For example, there is the fine silky hair of the rabbit, the spiky or bristly outer covering of the hedgehog, and the very thick yet pliable hair of the elephant's tail. Depending upon the approximation of a hair to a bristle, so is there an increase in the central lumen or medulla, as seen in the hedgehog. In the family Cervidae, the medulla is very cellular in character as is shown in the photographs, and on this account the internal structure is very readily broken, as seen in transverse sections. With certain exceptions, which will

receive adequate consideration at a later stage, the transverse sections of hairs are generally more or less circular or oval in contour.

The coat of the average animal is more or less uniform in thickness and texture, but in many instances a stiffer, longer-pointed hair will be seen scattered throughout the coat and rising above its level. Certain areas of the bodies of some mammals may present hairs of finer, coarser or longer character than those comprising the main coat. These may form tufts as seen in the formation of the tail, or as thinly-distributed whisker-hairs of many animals such as the cat, dog and rabbit. The eyelashes of animals are usually characteristic in uniformity and texture, possessing tapering ends which terminate in fine points. In the instance of the Order Cetacea to which whales, porpoises and dolphins belong, the skin is almost devoid of hairs with the exception of a few of coarse texture situated in the region of the mouth. The coats of animals generally undergo changes throughout each year, being shed and renewed at intervals. The alterations in the density and character of winter as opposed to summer coats is generally recognised. A seal belonging to show-clad countries usually exhibits a uniformly white coat in winter and a brownish coat in summer. The ermine and mountain-hare among others, may be referred to in this regard. As the function of the coat is apparently protective, the seasonal variation, so far as density is concerned, is readily appreciated. Among the Cetacea the absence of hair is compensated by the presence of a thick coat of fat lying under the skin. Protection by the coat against cold is not, however, its only function, as it is a commonly accepted fact that many animals exhibit a hairy covering which possesses a colour or colours most suitable in harmonising with those of their habitat, so as to be almost identical with their surroundings. In this way many animals readily evade the hunter and beasts of prey. The white of the polar bear, the iridescent hue of the water-mole, the vivid colours of many of the baboons, the striping of the tiger and the spotting of the leopard are but a few of the many examples which could be cited. The most common colour range of animals is from grey to brown, although many exhibit a lighter hue on their ventral aspect. Among other colours are black, yellow and

dark brown. Many animals exhibit mottling, striping, spotting and variations of colour over different parts of the body. Striping may be transverse to the body axis, as in the tiger or zebra, or longitudinal, as in the civets. There are many animals belonging to the mammalian group which possess a dense black or uniformly white hair covering. These conditions are termed melanism and albinism respectively. The former, is produced by the presence of a dense black pigment in the hairs as evidenced in the black rabbit, cat or dog among others, whereas the latter condition is the result of the absence of pigment, the animals usually possessing pink eyes, as the white rabbit, the white ferret and white mouse. The condition of partial albinism is also met with in animals whose hair is white in colour but whose eyes are of ordinary colour, as for example the Polar Bear.

The writer would emphasise that he has written this short account of the coats of animals in a very sketchy manner as he realised fully that not being a zoologist it would be dangerous to enter this special field of study other than in a very modest way. It has been mentioned previously that hair is merely a modified form of epidermis, and that wool fibres differ from hair fibres macroscopically. To the naked eye, wool appears to be composed of a large number of very fine filaments which possess the property of matting or lying in very close contact, due to the rough surfaces causing cohesion. These show a tendency to curl and exhibit a wavy contour, being very much softer to the touch than hairs. The microscopic characters shall be dealt with later.

The Macroscopic Appearances of the Specimens of Hairs Comprised in the Collection.

Having classified the specimens of the hairs and wools of the animals into their Zoological Orders, Suborders and Families, in accordance with the table already recorded, it is now expedient to examine these macroscopically so that some information may be obtained regarding their texture, length, colour and distribution.

PROTOTHERIA.

Order I. MONOTREMES.

Family 1. ORNITHORHYNCHIDAE.

Duck-billed Platypus.

A short coat composed of hair and wool, the general colour of which is brown. The hairs possess a whitish-grey colour in their lower halves. The upper portions, which are of dark brown, expand and assume a flattened shape resembling a spear-head or shield in many respects, and terminate in a fine tip of greyish hue. The hairs are about 1/2'' in length. The wool is of smoke-grey colour and possesses a very fine texture.

Family 2. ECHIDNIDAE.

Spiny Anteater.

Quills or Spines. Yellow, with black terminations, measuring 1 1/2''-2'' in length and 1/4'' diameter at base. The tips are sharp-pointed. Smaller quills or spines are present which resemble the larger quills. Interspersed between the spines is a short hair of black or dark brown colour. Wool absent in specimen.

METATHERIA.

Order II. MARSUPIALS.

Suborder 1. POLYPROTODONTS.

Family 5. DIDELPHYIDAE—OPOSSUMS.

Opossum.

A fine hairy coat, greyish in colour, showing light yellow areas. The hairs measure about 1/2'' in length. Wool of greyish colour is present.

Family 6. DASYURIDAE — THYLACINE AND DASYURES.

Viverrine Dasyure.

A very fine coat of brownish-grey colour. The hairs measure about 1'' in length. The upper half of each hair is of black colour. A light brownish-grey wool is present. The coat is very frequently profusely spotted with white.

Suborder 2. DIPROTODONTS.

Family 12. MACROPODIDAE—KANGAROOS.

Wallaby.

Fairly fine coat, the hairs of which measure about an inch. The coat contains a greyish wool. The hairs from the base upwards show the following colours, smoke-grey, light brown, light yellow and black tip.

Order III. EDENTATES.

Family 1. BRADYPODIDAE—SLOTHS.

Three-toed Sloth.

Specimen is composed of hair and wool. The former is of coarse texture, measures 1 1/2'' in length and presents a black colour. The pigment is less dense in the upper third of the hairs which terminate in long tapering points. The wool is of russet-brown colour.

Family 3. MYRMECOPHAGIDAE.

Two-toed Anteater.

Specimen consists of very fine hairs which measure 1/2'' in length, and are of white colour except for the presence of a black area near the tips.

Tamandua Anteater.

The hairs measure 2 1/4''-2 1/2'' in length and are of coarse texture. The base of the hairs is of dark colour; further up the shaft a light brown hue is noticeable, and the hairs terminate in dark brown tips. Wool is not available.

FAMILY 4. DASYPODIDAE.

Armadillo.

Coarse black to dark brown coloured hair. The longest hair in the specimen measures 2'', but it has apparently been cut from the skin. Wool absent.

ORDER IV. SIRENIANS,

and

ORDER V. CETACEANS.

Omitted on account of the animals in these groups not bearing hair upon the body surface.

ORDER VI. UNGULATA—HOOFED MAMMALS.

SUBORDER 1. ARTIODACTYLES.

SECTION A. PIG-LIKE ARTIODACTYLES.

FAMILY 2. SUIDAE.

North African Wild Boar (Head).

Blackish, bristly hairs, just exceeding 2'' in length. Hairs very dry and wiry. Many of the hairs show tufting or splitting into numerous fibres at their tips, probably the result of friction. Wool absent.

Wart-Hog.

Dark brown coloured hairs, with same consistence as those of Wild Boar, measuring 3 1/2'' in length. Tufting or splitting of hair-ends also present. Wool absent.

Section C. TYLOPODA-CAMELS.

Family 10. CAMELIDAE.

Vicuna.

A very fine light yellow coloured coat composed of fluffy wool with scanty fine fair hairs projecting from surface of coat. Wool exhibits a wavy contour, and measures about 3/4''-1'' in length.

Camel.

Coarse coat of lustreless tow-coloured hair varying in colour from greenish-black to fawn. Scanty wool of tow colour. Hair on specimen has a ''wiry'' feel and measures 6'' in length. Occasional splitting of hairs present.

Llama.

Coarse coat of lustreless tow-coloured hair, in places greenish-grey in colour. Hairs measure 4 1/2'' long generally, but may be of greater length. Scanty fine wool of yellowish colour present.

Section D. PECORA—TRUE RUMINANTS.

Family 12. CERVIDAE.

The Elk or Moose.

Coarse hair, discrete in character, with wavy contour, measuring 3''-3 1/2'' in length. At base of hairs a fine short needle-like projection is present. This is embedded in the base. The lower half of the hair is of white colour which merges above into a light brown colour, finally terminating in a fine tip of very dark brown or black colour. The hairs are of a friable nature. Wool is absent.

Red Deer.

Hairs in this specimen had been cut at the skin level and the bases therefore could not be examined for the projections

alluded to in the hair of the moose. Occasional hairs however, had apparently not been cut and at the bases of these the needle-like projections were found to be present.

The hairs show a wavy contour and measure 1 1/2'' in length. The lower two-thirds of the hairs are light brown in colour and the upper third of russet brown, terminating near the tip with black. Wool absent.

Roe Deer.

Hairs have been cut, but present a wavy contour and measure 1 1/2'' in length. The lower two-thirds are of silver-grey colour, whereas the upper third is of a light-brown colour terminating in a short black tip. Wool absent.

Reindeer or Caribou

Needle-like projections present at base of hairs. Wavy contour present. Hairs measure 2 1/4'' in length. Lower two-thirds of hair are of white whereas upper third is of fawn colour. Wool absent.

Fallow Deer.

Hairs have been cut. Contour wavy. Hairs measure 1 1/2'' long. Lower half of fawn colour, upper half of dark brown colour terminating in a black tip. Wool absent.

Chital or Axis Deer.

Fairly fine coat, showing white spots. Hairs either completely white in colour, or of brown colour with black tip. Hairs measure 3/4''. Wool is absent.

NOTE. Before resuming the description of the hairs examined, comment should be made regarding the general gross characteristics of the hairs of Cervidae to which the Moose, Red deer, Roe deer, Caribou, Fallow deer and Chital or Axis deer belong. The following features appear to be characteristic of the hairs belonging to this family:—

(1) The regular wavy contour of the hairs.
(2) The needle-like projection at the base of the hairs.
(3) The waxy friable nature of the hairs and their discrete appearance.

It will be seen later that not only are the macroscopic appearances of the hairs of this familly characteristic, but also that the microscopic characters are distinctive. This finding is of importance in relation to the identification of these hairs.

Family. 13. GIRAFFIDAE.

Giraffe.

The hairs which possess a slightly coarse texture measure in length from 3''—4 1/2''. They are of sandy-brown colour. The lower two-thirds are of a grey hue, whereas the upper third is of light brown colour which assumes a slightly darker shade at the tip. Wool absent.

Family 15. BOVIDAE.

Barbary Sheep.

Body. The hairs have been cut and measure 2 3/4'' in length. The contour is wavy. The colour is of pale fawn colour except at tip which is black. Wool is absent.

Beard. Coarse wiry hair measuring 9 1/4'' in length. Straight contour. Colour is pale fawn except at termination which is black.

Goat.

The specimen had been dyed Goat and is therefore not described.

Rocky Mountain Goat.

Coat. Wiry hair measuring 3 1/2'' in length. Lower two-thirds are of light brown, and upper third of black colour. Wool is of white colour.

Beard. Coarse wiry hair, measuring, 3 1/2'' in length. On dividing the hair into thirds for the purpose of facilitating the description of the colours, from below upwards are seen white, dark grey, and yellowish-grey respectively. The contour of the hairs is straight.

Roan Antelope.

Coarse hair, measuring 3 3/4'' in length. Contour is straight. The colour of the lower two-thirds is almost white, the upper

third is of fawn colour merging into reddish-brown and finally into black at the termination. Wool is absent from specimen.

Somali Dik-Dik or Antelope.

The coat presents a mottled light and dark brown appearance. The texture is not very coarse. The hairs show alternate bands of light brown and dark brown until the black hair tip is reached. The contour is straight. Wool is not present in specimen.

Bison.

Description cannot be given, as the specimen used had been mounted on a microscope slide prior to receiving it.

African Buffalo.

Blackish-brown coarse hair measuring 3'' in length. The hairs were uniform in colour. Wool absent.

Indian Black Buck.

Short fairly fine coat, the hairs measuring 1'' in length. The hair is of grey colour merging into reddish-brown towards the upper end which terminates in a black tip. Wool absent.

The Palla or Impala.

(South African Antelope) *Neck.*

Sandy-brown coloured hair of coarse texture and of short length. Wool absent from specimen.

Highland Bull.

Hairs of fairly fine texture, measuring 2'' in length and of a uniform reddish-yellow hue. Wool absent.

Ayrshire Cow.

Hair from coat. Certain of the hairs are of black colour, others of fawny-brown colour. They measure 1 1/4'' in length and have a slightly coarse texture. Wool is absent.

Hair from tail. The hairs are of dull-fawn colour, possess a coarse wiry texture and measure about 9'' in length. Wool is absent.

Belted Galloway Bullock.

Hair from coat. The hairs which measure 2 1/2"—3" in length possess a uniform black colour and a texture which is slightly more coarse to the touch than human hair. Wool absent,

Hair from tail. The hairs which are of dull fawn colour, measure about 9" in length and possess a coarse texture. They are wiry to the touch. Wool absent.

Red Polled Bullock.

Hair from coat. The hairs which are sandy-red in colour measure 2"—2 1/2" in length and possess a texture which resembles that of human hair. Wool is absent.

Hair from tail. The characteristics described under hair from tail of Belted Galloway Bullock are present here.

African Eland or Elk (Forehead).

Coarse dark sandy-brown hair. The hair exhibited evidence of having been cut. The length is 2". The contour is straight, but the ends show splitting of the fibres. Wool absent.

African Reitbok or Reedbuck.

Coarse brownish-red hair measuring 1" in length. The tips are black. Wool absent.

Thomson's Gazelle.

Sandy-brown coloured hair measuring 1" in length. The texture is slightly coarse. The tips are black. Wool absent.

Grant's Gazelle.

Very coarse hair measuring 3/4" in length. The colour of the hairs is uniformly sandy-brown. Wool absent.

Krimmer Lamb.

(Furrier's term denoting the fleece of Persian Lamb). Coat of slightly coarse texture. The hairs measure 1 1/2" in length. Uniformly coloured white and black hairs are present, giving a smoke-grey appearance to coat. Wool of grey colour. Both hair and wool show definite curling.

Wildebeest or Gnu.

Very coarse brittle hair measuring from 3/4'' to 1'' in length. The base of the hair is of greyish hue merging into a russet-brown colour at tip. Wool absent.

Hartebeest.

Coarse hair measuring from 1/2'' — 3/4'' in length and of brown colour, terminating in a whitish-coloured short tip, imparting a flecked appearance to the coat. Wool absent.

Mrs. Gray's Kob.

A fairly fine hair of brownish colour merging into a very dark brown tip. The hair measures 2'' in length and possesses a wavy contour. Wool absent.

Topi.

Slightly coarse short hair of blackish colour terminating in a brown-coloured tip. Wool absent.

Goral.

The hairs are coarse in texture. Their bases possess a dark brown shade ,the middle thirds a light brown colour and the terminal portions are black. A coarse wave is noted in the contour of the hairs, which measure 1 3/4'' in length, but the specimen had obviously been cut. Wool absent.

Suborder 2. Perissodactyles.

FAMILY 16. TAPIRIDAE.

Tapir.

A coarse, dry, lustreless, mousy-coloured hair, measuring 3/4'' in length. Wool absent.

FAMILY 19. EQUIDAE.

Pony.

Sight yellowish-brown coloured hair, silky to the touch, and measuring 1 1/2'' in length. Wool absent.

Clydesdale Gelding — Grey.

Slightly coarse hairs measuring 1 1/2'' in length. Hairs of grey and of black colours are present. Wool absent.

Clydesdale Gelding — Brown.

Body. Slightly coarse hair measuring 1 3/4'' in length, and of uniform chestnut colour. Wool absent.

Tail. Wiry black and brown hairs varying in length from 4'' upwards. Wool absent.

Hackney Brown Mare (Inside of thighs).

Fine chestnut-coloured hair also a few grey hairs. The hairs measure 1 1/2'' in length. Wool absent.

Chestnut Racing Thoroughbred (Inside of thighs).

Fine short hair of chestnut colour. The hairs measure from 1/4'' — 1/2'' in length. Wool absent.

Hackney Chestnut Mare (Inside of thighs).

Slightly coarse hairs chiefly of chestnut colour and a few of grey colour. The hairs measure 1 1/2''—1 3/4'' in length. Wool absent.

Zebra.

Very coarse, short, black and also brown coloured hairs. Hairs had been cut and measured 1/4'' in length. Wool absent. The black hairs enter into the formation of the characteristic bands which give the well known appearance to the zebra.

FAM. 20. RHINOCEROTIDAE.

African Rhinoceros (Ear).

Black, slightly curly, dry, coarse and lustreless hair measuring 2 1/4'' in length. Wool absent.

Suborder 5. HYRACES.

Family 30. HYRACIDAE.

Hyrax.

Fine coat exhibiting yellow and black mottling and a golden yellow spot of about one inch in diameter. The hairs constituting the "spot" are of uniform yellow colour. The colour of the hairs of coat commences as greyish-black and merges into yellow just below tips which are black. The hairs measure 1 1/4" in length. The wool is of smoke-grey colour.

Suborder 7. PROBOSCIDEANS.

Fam. 35. ELEPHANTIDAE.

Elephant (Tail).

The hairs of the elephant's tail resemble fine whalebone in appearance and pliability. They are black in colour, are 10 1/2" in length, 1/5 cmm. in breadth and 1/10 cmm. in thickness.

Order VII. RODENTS.

Suborder 1. SIMPLICIDENTATA.

Family 2. SCIURIDAE

Marmot.

The hairs which are of fine texture and of dark reddish-brown colour, possess a lustre and measure one inch in length. A fine wool of greyish-brown colour is present.

Viatka Squirrel.

In view of the fact that the specimen had been dyed, no description is here given, as only hairs in their natural state are included in this section.

British Squirrel.

The specimen is composed of fine brown hairs which measure 3/4'' in length and project above the level of the wool which is of smoke-grey colour.

Grey Squirrel.

Very fine coat of grey-coloured hair and wool. The hair measures 1/2'' in length.

FAMILY 5. CASTORIDAE.

Beaver.

A very fine brownish mole-coloured coat which is chiefly composed of wool and which exhibits hairs of the same colour. The wool, which measures 1/2'' in length, shows a fine wavy contour. The hairs measure 3/4'' in length.

FAMILY 8. MURIDAE

Short-Tailed Field-Vole.

Very fine and very short coat, composed of hair and wool. The hairs are of grey colour in their lower half and golden-brown in the upper half. The wool is of smoke-grey colour. The general colour of the coat is greyish-brown.

Lustered Musquash — Musk-Rat.

Was dyed and is therefore not described.

Natural Black Musquash or Musk-Rat.

Fine coat composed of hair and wool. The hairs are of grey colour in their lower half, whereas the upper half is of a brown colour including the tip. They measure 1'' in length. The hairs are elevated above the level of the wool and therefore stand out prominently. The wool is of a smoke-grey colour terminating in a mole or light fawn tip and presents a wavy contour.

St. Kilda Field-Mouse

The coat is practically identical to that of the short-tailed Field-Vole. The hairs measure 1/2'' in length and are slightly longer than the Field-Vole.

Hamster.

A fine light brown coat with black striations composed of hair and wool. The hairs lack lustre, and their lower two-thirds are of dark grey colour. whereas the terminal third is of yellow merging into dark brown and finally terminating in a black tip. The length of the hairs is 1/2''. The wool is of smoke-grey colour terminating in a light fawn tip.

Brown Rat.

Fine coat of greyish-brown colour composed of hair and wool. The hairs measure 3/4'' in length and are of grey colour in the lower two-thirds, terminating in a black upper third. The wool is grey in colour with a light-brown tip.

St. Kilda House-Mouse.

The characters of the coat are those described under Short-Tailed Vole and St. Kilda Field-Mouse.

FAMILY 13. OCTODONTIDAE.

Coypu Rat.

(The fur is termed *Nutria*).

The coat is chiefly composed of wool of fawn or light brown colour. The hairs which measure 1/4'' in length, are of fawn colour. The coat is of fine texture.

SUBORDER 2. DUPLICIDENTATA.

FAMILY 20. LAGOMYIDAE.

Guinea Pig.

The hairs possess a fine texture of fawn colour with an almost imperceptible black fleck just below termination of tip, and measure about an inch in length. The wool is of whitish-yellow colour.

FAMILY 21. LEPORIDAE.

White Rabbit.

Fine white coat, composed of hair and wool. The hairs are

elevated above the wool level and therefore stand out prominenly. The coat exhibits a lustre. The hairs measure 1 1/2'' in length.

Chinchilla Rabbit. (Partially unhaired).

A smoke-grey or silver-grey coat of very fine quality possessing a lustre, and composed of hair and wool. The hairs present exhibit a grey base, a middle portion of white colour, and a black tip. The hairs measure 3/4'' in length. The wool possesses a light smoke-grey colour. In the haired specimen, i.e. the coat from which hairs have not been removed artificially, the surface of the coat presents a whitish-grey colour due to the abundance of grey hairs which rise above the level of the wool and therefore stand out prominently.

Coney Rabbit.

The specimen had been dyed and is therefore not described.

Angora Rabbit.

An extremely fine coat composed of grey wool and hairs; the latter, which are grey in their lower halves and black in the upper halves, measure 2'' in length.

Common Hare.

Fairly fine coat of greyish-brown colour composed of hair and wool. The hairs are of a light brown colour with black tips and measure 1'' in length. The wool is of a whitish-grey colour.

Scotch Mountain Hare

A very fine coat of whitish-grey colour which is composed of hairs and wool. The hairs commencing at the base are of a brownish-black colour which higher up the shaft merge into a light brown colour, to terminate at the tip with black. Occasionally the light brown coloured portion is replaced by -a silver-grey shade. The hairs measure 1 1/2'' in lenght. Many of the hairs are of a uniform black colour. The wool is of a whitish-grey colour.

Order VIII. CARNIVORES.

Suborder 1. FISSIPEDES.

Family 1. FELIDAE.

British Wild Cat.

A fine coat composed of hair and wool, and presenting a "mousy" yellowish-brown colour. The hairs measure 1 3/4" in length and their lower two-thirds are of light brown hue whereas the upper third shows a black band, a light brown band and finally a black tip. The wool is of a "mousy" colour.

Ocelot or Tiger-Cat.

A very fine coat of light brown colour, showing black bands running through it, which is composed of hair and wool. The black bands are about 1/2" in breadth. The wool is scanty and is of brown colour. The hairs are short.

Household Cat.

Fine brownish-black-grey coloured coat composed of hair and wool. The hairs measure 3/4" in length and present the following colours from base to tip:— Whitish-grey, light brown, and black. The wool is of grey or fawn colour.

Grey Persian Cat.

Very fine coat of smoke-grey colour composed of hair and wool. The hairs are of uniform blue-grey colour as is the wool. The hairs measure from 1 1/2"-2" in length.

African Lion.

Coarse coat of light brown hairs which measure 1 1/4" in length. An occasional black band is seen in the continuity of the hairs. Wool absent from specimen.

Jaguar.

Fairly fine coat composed of light brown or blackish hairs depending upon area of body from which specimen was taken.

The light brown hairs have black tips. The hairs measure 1/2" in length. Wool absent from specimen.

Lynx.

Very fine coat composed of hair and wool, exhibiting a light grey to fawn colour. The hairs measure 2" in length, and the hair tips are of a very dark brown hue. The wool is of a mole and fawn colour from below upwards.

Snow Leopard or Ounce.

Slightly coarse, lustered, greyish-yellow coat composed of hair and wool. The lighter coloured hairs terminate in a tip of black colour. Occasional hairs of uniform black hue are present. The hairs measure 1 1/2" in length. The wool is curly and presents a greyish colour.

African Leopard.

Fairly fine coat composed of hair and wool. The hairs which measure 1" in length are of light brown colour with black tips. The hairs which form the spots are black. The wool is dark brown.

Tiger.

A coat of coarse texture composed of hair. An occasional wool fibre is seen in specimen. The hairs available measure 1/2" in length, and are of a reddish-brown colour, whereas the hairs from the stripes show black pigment in their upper halves.

Black Panther.

A coat of fairly fine texture composed of hairs, which vary in colour from very dark brown to black and measure 1/2" in length. Wool absent from specimen.

Cheeta.

Fairly fine coat composed of hair and wool. The hairs measure 1" in length and vary in colour from very dark brown to black. The wool is of light brown colour.

African Serval Cat.

Fine coat composed of hair and wool. The hairs measure 3/4'' in length and are of light brown colour terminating in a black tip. The wool is of light fawn colour.

African Lynx.

Fine coat composed of hair and wool. The hairs measure 1'' in length and are or reddish-brown colour with a black tip. The wool is of light fawn colour.

FAMILY 2. HYAENIDAE.

Hyaena.

A coarse, dry, lustreless hair, measuring 3 1/4'' in length, and of dark reddish-brown colour with a black tip. Wool absent from specimen.

FAMILY 4. VIVERRIDAE.

African Civet-Cat.

Very coarse coat composed of hair and wool. The hairs measure 3'' in length and are of light brown colour terminating in a black tip. The wool is of fawn colour.

Genet-Cat.

Coarse coat composed of hair and wool. The hairs measure 3/4'' in length, possess a good lustre and are of dark brown colour. The wool is of light brown hue.

FAMILY 5. CANIDAE.

Black and White Wire-Haired Fox Ferrier.

Coarse coat of white hair with black areas. Scanty wool of light colour is present in specimen. The hairs measure from 1'' — 2 1/2'' in length and are either all white or all black in colour, depending upon the area from which they were taken.

Red Fox.

A coat of fairly soft texture composed of hair and wool. The latter is mole-coloured. The hairs project above the wool level and measure about 1'' in length. They possess a smoke-grey colour in their lower halves, while their upper halves are of white colour which merges into a reddish-brown shade at the tips.

Dingo or Australian Dog.

Slightly coarse coat composed of hair and wool. The hairs measure 3/4''—1'' in length and are of fawn colour terminating in a tip of nut-brown colour. The wool is of light fawn colour.

Jackal.

Coarse coat composed of hair and wool. The hairs measure 2 1/2'' — 3 1/2'' in length. The hairs show alternate bands of fawn and black colour and terminate in a black tip. The wool is of fawn colour.

Silver Fox.

Slightly coarse coat composed of hair and wool. The hairs measure 2 1/2'' — 2 1/4'' in length and are of smoke-grey colour terminating in black tips. The wool is of dark smoke-grey colour.

Jap Fox.

Slightly coarse brownish-coloured coat composed of hair and wool. The hairs measure 2'' — 2 1/2'' in length and commence with a dark brown or black base, which merges into a light grey colour terminating in a light brown tip. In some parts of the coat the hairs are entirely black. The wool possesses a dark brown colour.

Arctic Fox.

Soft white fluffy coat composed of hair and wool. The hair is of fine quality and measures 2 1/4'' in length. The wool is of white colour.

Arctic Fox-Club.

Mousy-coloured and slightly coarse coat composed of hair and wool. The hairs are of blackish-grey colour and measure 1 1/2'' in length.

North American Kitt Fox.

The coat is almost identical to that of the Jackal exept that it possesses a slightly less dark colour. The hairs measure 2'' — 2 1/2'' in length. Wool scanty.

Sahara Desert Fox.

A fine coat of greyish-black speckled appearance composed of hair and wool. The hairs measure 1 1/2'' — 2'' in length and vary in colour from all black to grey with a black tip. The wool is of fawn-grey colour.

American Timber Wolf.

Coarse hair of light brown colour with black tips, which measure about 1/2'' in length. The hairs measure 2'' in length. The wool is slightly coarse in texture and is brown or fawn in colour.

Common Wolf.

Mounted specimen only available.

Indian Wolf.

The hairs are coarse in texture and are of tow colour except for the presence of black coloured portions which alternate with those of light colour. The hair tips are of dark brown or black. The hairs measure 3 1/2'' in length. The wool is of light greyish-yellow colour.

FAM. 6. URSIDAE.

Polar or White Bear.

A coarse coat of white colour composed of hair and wool and showing irregular patches of syrupy-yellow shading which

vary in size and distribution. The coat presents a glistening appearance. The hairs measure 3 1/2'' in length. The wool is of light yellow colour.

Common Brown Bear.

A very coarse coat of milk-chocolate colour or deeper brown shade composed of hair and wool. The hairs are of a brown colour which merges into light fawn or pale brown and golden colours near the tips which are of the same brown tone as those present at the base of the hair. They measure 2 1/2'' — 3 1/2'' in length. The wool is of dark brown colour.

North American Black Bear.

A coarse coat of black colour composed of hair and wool; the latter possesses a mousy-brown colour while the former measures 3'' in length.

FAMILY 7. MUSTELIDAE.

''Baum'' Marten or Tree Marten.

A very fine greyish light brown fur composed of hair and wool. The wool is of the above colour whereas the hair is brown in its lower half and black in its upper half, measuring 2''—2 1/2'' in length.

Stone Marten.

Slightly coarse coat of brown colour composed of hair and wool. The hairs measure 2'' — 2 1/2'' in length, are of greyish-fawn colour in their lower half and of reddish-brown shade in their upper half. The wool possesses a greyish-fawny colour.

Stone Marten Tail.

As above described, with the exception that a greater amount of hair is present. The hairs measure 2 1/2'' in length and possess a uniform reddish-brown shade. The texture of the hairs is coarse.

Ermine.

A very fine coat of white hue with patchy irregular faint yellow-tinged areas. The hairs measure 1/2'' in length. The wool is very fine in texture and is of white colour. The black tip at the end of the tail is characteristic.

Ferret.

A fine coat of light brown colour composed of hair and wool; the former is whitish-yellow in colour, while the latter possesses a light fawny-brown colour. The hairs measure 1 1/4'' in length and exhibit a lustre.

Common British Otter.

A very fine coat of dark mole-brown colour which is composed of hair and wool. The hairs measure 3/4'' in length, and are of mole-brown colour whereas the wool is of greyish-mole colour.

Sea Otter.

A deep brown coloured coat exhibiting a definite lustre. The hairs are coarse in texture, measure 1/2'' in length, and are of light fawn colour. The longer hairs present silvery tips. The wool is of silver-grey colour with fawn brown tips and possesses a sheen.

African Otter.

Coat is fairly fine and possesses a dark fawny-brown shade. The hairs measure 1/2'' in length and are of russet-brown colour. The wool is lustered in character and is of fawn colour with light brown tips.

Common Skunk.

A coarse coat of dark brownish-black colour, which is composed of hair and wool. The hair is of black shiny hue and is of a wiry texture measuring 2 1/4'' in length. The wool is of a greyish colour.

South American Skunk.

The colour of coat is dark brownish-black and the average length of the hairs is about 1 3/4''. The coat is, however, finer in texture than common skunk, the hairs being less wiry. The wool possesses a fawny-brown colour. There were bands composed of white hair present in the specimen examined.

North American Mink.

A lustered coat of light brown colour, composed of hair and dense wool. The hairs measure 1/2'' — 3/4'' in length, are of light brown colour and are slightly coarse in texture, being wiry to the touch. The hairs stand out prominently. The copious wool possesses a fawn hue.

Polecat.

A fairly fine coat which possesses a reddish-brown or dark yellow colour. The hairs which stand out prominently measure 3/4'' — 1'' in length and exhibit a light brown or dark brown colour. The coat shows the presence of patches of a rich brown hue. The wool is of light fawn colour.

Stoat (Winter Coat).

As described under "Ferret," but the coat is of white or light yellow colour.

Common Badger.

A coarse coat of marled appearance composed of hair and wool. The hairs, which measure 3'' in length, exhibit a wave, are light fawn at basal portion, and black near tip, which is of light fawn. The wool is of greyish-yellow colour.

American Sable or Marten.

A slightly coarse coat of fawny-brown colour which shows transverse lines of dark brownish colour. The hairs measure 1 1/2'' in length, the lower halves are light brown and the upper halves dark brown in colour. The wool which is abundant is of greyish-brown colour.

Russian Sable.

As above described, but is of a darker brown or blackish-brown shade and possessing a richer colour.

FAMILY 8. PROCYONIDAE.

North American Raccoon.

A coarse coat which is broken by striations of white, black and fawn. The white hairs possess black tips. Other hairs are composed of coloured portions of black, fawn, and black respectively from below upwards. The hairs measure 1 1/2'' in length. The wool is of smoke-grey colour.

White-Nosed Coati.

A coarse coat of mottled appearance which is composed of hairs and wool. The latter, which is of light brown colour, is scanty. The hairs measure 1 1/2'' in length and are of reddish colour at their bases, with black middle and upper portions, the latter terminating with red tips.

Panda.

A coat of fairly fine texture composed of hair and wool, and possessing a smoke-grey colour near to the skin but a reddish-brown hue when viewed from the surface. The hairs show a smoke-grey base while the upper two-thirds are of reddish-brown colouration. They measure 2'' in length. The wool which is of grey colour possesses a very fine texture.

SUBORDER 2. PINNIPEDES.

FAMILY 9. OTARIIDAE.

Alaska Fur-Seal.

A very shiny, coarse, short coat composed of black hairs with reddish coloured tips, which measure 1/4'' in length. The wool is of reddish-brown colour.

FAMILY 11. PHOCIDAE—SEALS.

Common Seal.

The hairs are coloured either black or grey and measure 1/4''—1/2'' in length. The wool is very scanty and is of dark grey colour.

Greenland Seal.

The specimen was dyed and is therefore not described.

Gray Baby-Seal.

A slightly coarse coat of greyish-yellow colour which exhibits a high gloss. The hairs are of greyish-yellow colour as is the wool and they measure 1"-1 1/4" in length.

Order IX. INSECTIVORES.

Suborder 1. INSECTIVORA VERA.

Family 3. ERINACEIDAE.

Common Hedgehog.

The skin is protected by a wall of bristles of leaf-brown shade, which measure about 1 1/2" in length. The hairs are dark brown in colour with light brown tips. They exhibit a golden tinge and measure 3/4" in length. The wool is fairly fine in texture and is of fawny colour.

Family 4. SORICIDAE—SHREWS.

Common Shrew.

A very fine woolly coat composed of hair and wool. The depth of coat is about 1/5" of an inch. The hairs have bluish-grey bases and light brown tips.

Water Shrew.

A very fine woolly coat composed of hair and wool, the depth of which is 1/4". The hair is of dark blue-grey colour with black marking at tip.

Family 5. TALPIDAE.

Common Mole.

A very fine coat which is composed mostly of wool which possesses a glossy greyish-black colour. The hairs, which are scanty, are of the same colour and measure about 1/4", or less, in length.

Order X. CHIROPTERA-BATS.

Suborder 1. MEGACHIROPTERA-FRUGIVOROUS BATS.

Large Fruit Bat.

Reddish-brown coat composed of hair and scanty wool. The hairs measure 1/4" in length and their texture is fairly fine.

Family 1. PTEROPODIDAE.

Flying Fox.

Only a mounted specimen available.

Order XI. PRIMATES

Suborder 1. LEMUROIDS.

Family 2. CHIROMYIDAE.

Aye-Aye.

Only a few hairs were available. These are of a wiry character and measure 4 1/2" in length. The lower two-thirds are black and the upper third, light brown in colour terminating in a fine black tip. The wool is dark brown in colour and shows a wavy contour.

Family 3. TARSIIDAE.

Tarsier.

Only a few hairs were available. These measure 1 1/2 cmm. in length, possess a dark smoke-grey colour and exhibit a brownish shade near the tips. They are of very fine texture. A few filaments of wool present.

Family 4. LEMURIDAE.

Ruffed Lemur.

Only a few hairs were available. These measure 1 1/2" in length, are of silver-grey lustre with a dark portion at bases

and a smaller but similarly coloured area at tips. They show a slightly wavy contour. A few filaments of wool present.

Suborder 2. ANTHROPOIDS.

Family 5. HAPALIDAE.

Common Marmoset.

A very fine coat. Wool not available. The hairs show black and reddish-brown bands alternately, and measure 1'' in length.

Fam. 7. CERCOPITHECIDAE.

Arabian Baboon.

Cut specimens. The hairs measure 6 1/2'' long, are of coarse texture and exhibit alternate bands of silver and dark-brown or black colour imparting a striated appearance. The tips of the hairs are of black colour. Wool absent.

Chacma Baboon.

Cut specimens. The hairs measure 4'' long, show alternate bands of black and brown, and are of coarse texture. Wool absent.

Diana Monkey.

Cut specimens. Slightly coarse coat composed of hair and wool. The hairs are of two types, some being of russet-brown colour with black tips and others showing alternate bands of black and grey but less distinctly than in the case of Chacma Baboon. The hairs measure 1''-1 1/2'' in length. The wool is of fawny-grey colour.

Colobus Monkey.

Cut specimens. The hairs measure 4'' in length and are of slightly coarse texture. The hairs are either uniformly black or white in colour. Wool absent.

Family 8. SIMIIDAE.

Chimpanzee.

Black coarse hairs—cut specimens. The longest portions available measure 2'' in length. Wool absent.

Female Gorilla—Young.

The hairs, which are of an almost uniform brownish-black shade, are slightly more coarse in texture than human scalp hair. They exhibit a faint wavy contour and measure 1''-1 3/4'' in length. No appreciable wool present.

Male Gorilla — Adult.

The hairs had been mounted prior to receiving them.

SECTION III

The Microscopic Appearances of Animal Hairs observed in the Longitudinal Plane.

Having described the macroscopic appearances of the specimens of hairs and wools, it is now expedient to make a detailed microscopic examination. The pictorial record which is embodied in the accompanying Atlas will enable the reader to follow the microscopic characteristics of the hairs and wools as they are described in the text. It is necessary at the outset to emphasise that, although in certain of these photographs detail may appear to be lacking, the same absence of detail was noted, when the specimens, which have been photographed, were microscopically examined. The photographs are regarded by the writer, who took them, as being most successful in that all the detail which was observed at the time of the examination is clearly shown. The reason for detail being partially obscured in certain instances, lies in the facts that the pigment in these hairs was of very dense character and was almost uniformly distributed throughout the cortical and medullary layers. Before commencing the detailed description of the various hairs and wools in this collection, it is expedient that the structure of a hair be studied carefully, so that having gained an accurate conception of its structure, the many modifications which exist in the hairs of the mammalian group of animals may be detected readily. A hair is composed of three separate layers, from the external margin inwards, until the central core is reached. These layers may be described as :—

(A) An outer layer, termed the cuticle, which is composed of a single layer of epithelial cells.

(B) A middle layer which varies in thickness and is termed the cortex. It is composed of longitudinal fibres and a varying amount of pigment.

(C) A central layer or medulla composed of variously shaped cells which usually contain more or less copious pigment.

It may be asserted as a general rule that the thickness of the medullary layer is less in the hairs of the higher, than in the lower grade mammals. In very young wool the cuticle is represented by serrated or ragged margins, the medulla or central pigmented layer is also present, but generally the middle or cortical layer is very narrow. The most characteristic and almost constant features of the wool-hairs, are the presence of a cuticle of irregular contour and a definitely cellular, pigmented, and broad medulla or one which is composed of longitudinal fibres. The cells which show a very clear contour, are of varying size and shape, and are usually discrete. It is unnecessary to particularise further upon the detailed structure of hair or wool, since so many varieties are encountered as will be perceived when the collection of photographs is studied carefully. It therefore would be preferable to depend upon such study for the assimilation of these important and varied characters.

PROTOTHERIA.

Order I. MONOTREMES.

Plate No. 1. Family 1. ORNITHORHYNCHIDAE.

Duck-billed Platypus.

Photographs 1, 2 and 6 are of hair. The cuticular layer is seen in these. The medulla is absent except in No. 6. In 1 and 2, the longitudinal fibres of the cortex are clearly shown. In 1, the diffuse pigment is evident. In 2, the irregular distribution of the pigment is noteworthy. Photographs 3 and 4 show the hairs at the tips; the former reveals the flattened shield-like tip, whereas the latter shows that the terminal portion has been broken off. No. 5, depicts the hair expanding at the shaft to form the flattened spear-like termination alluded to in Section II. No. 6, is a photograph of the narrow portion of the hair and the three layers are readly seen. No. 7 and 8 are of wool under low and high-power respectively and reveal the presence of a broad, discrete-celled medulla.

Family 2. ECHIDNIDAE.

Plate No. 2. *Spiny Anteater.*

Photographs numbers 1-5, indicate the appearance of a fine short spine. These show the tapering contour. The medulla is readly discernible, is of dense black pigment, and shows a gradual narrowing of its lumen as it passes towards the tip. These photographs, in addition to those numbered 6-8, are of low-power magnification. Photographs Nos. 4-8, do not show the medulla well. Numbers 6-8, are of hairs which are characterised by a narrower lumen and a more or less uniform dark pigment. Differentiation between cortex and medulla is difficult. In number 7, the hair tip is well seen.

METATHERIA.

Order II. MARSUPIALS.

Plate No. 4. Suborder 1. POLYPROTODONTS.

Family 5. DIDELPHYIDAE—OPOSSUMS.

Opossum.

Photograph number 1, is that of young hair and shows slightly irregular, imbricated or serrated margins. The cortex is composed of longitudinal fibres with transverse fibres passing inwards from the serrations. The medulla is represented by slightly irregular lozenge-shaped cells the contour or outline of which is clearly depicted. A clear central area is noted in nearly all of these cells. The margins of the medullary layer are irregular. Photograph number 2 is of wool. The caracteristics consist of a serrated cuticle, a narrow cortex, and a cellular medulla which is composed of globular or ovoid-shaped cells which give the appearance of having been linked together. The chief differences between the young hair in photograph number 1, and the wool in number 2, iie in the more serrated margins, the more ovoid or circular shape of the medullary cells, and the narrowness of the cortical layer of the latter.

FAMILY 6. DASYURIDAE — THYLACINE AND DASYURES.

Plate No. 5. *Viverrine Dasyure.*

Photographs numbers 1-4 are of hairs. Numbers 1 and 2 show a broad, dense, uniformly-pigmented medulla which is regularly defined at the margins. The cortex is narrow. In the first four photographs the cuticle is straight and regular. In number 3, it will be noted that the cortex has a granular appearance and that the medulla is less dense although well-defined. Number 4 shows a slightly imbricated cuticle, an indefinite medulla and a cortex of granular appearance, in which pigment is irregularly deposited. Photograph number 5 is of wool. The cuticle is irregular, the cortex granular and the medulla composed of globular cells containing dense pigment except for their central portions which exhibit a refractile appearance.

SUBORDER 2. DIPROTODONTS.

FAMILY 12. MACROPODIDAE—KANGAROOS.

Plate No. 4. *Wallaby.*

Photograph number 1 is of a mature hair. The cuticle exhibits a faint serration at fairly wide intervals. The cortex is very narrow and the medulla very broad, densely pigmented and possessing irregular margins. The cortex reveals a slightly granular appearance. The general appearance of the hair is typical of a mature hair with the exception that the cuticle is not perfectly straight. Photograph No. 2 shows a wool fibre. The following points are noteworthy :—

(1) The intervals between the serrations are short.
(2) The cells of the medulla vary in shape, being rectangular to globular in outline. Some of these are discrete.

ORDER III. EDENTATES.

FAMILY 1. BRADYPODIDAE — SLOTHS.

Plate No. 7. *Three-toed Sloth.*

The photographs are of hairs. The first two show the structure of the hair-tip. The pigment is dense and uniformly

distributed. The imbrication of the hair margins is clearly seen and is regarded by the writer as important. Photograph number 4 is of hair, the lumen of which reveals the presence of longitudinal fibres with irregularly distributed light pigment.

The photograph to the right of number 3 shows the appearance of hairs under low-power magnification.

Family 3. MYRMECOPHAGIDAE.

Plate No. 8. *Two-toed Anteater.*

The photographs are of hairs, the first containing much more pigment than the second. It will be noted that the cuticular margins in both are even. Number 3, is of an immature hair and a degree of imbrication of the cuticular margins is evident. No. 4 shows the tip of a hair.

Plate No. 9. *Tamandua Anteater.*

All the photographs are of hairs, the uneven calibre of which is noteworthy. The pigment is irregularly distributed and varies in density. The lateral position of the pigment in number 4 is interesting. The medulla cannot be detected in any of the photographs. Photograph number 7, is of a hair-tip.

Family 4. DASYPODIDAE.

Plate No. 10. *Armadillo.*

The photographs show three hairs. The lumen of these possesses an almost uniformly dense pigment and little detail can be seen. In numbers 1 and 2, the cuticle is shown and in the latter, a dense medulla is faintly visible.

Order VI. UNGULATA — HOOFED MAMMALS.

Suborder 1. ARTIODACTYLES.

Section A. SUINA — PIG-LIKE ARTIODACTYLES.

Family 2. SUIDAE.

Plate No. 12. *North African Wild Boar (Head).*

On account of the dense and widely-distributed pigment, little detail can be observed in these photographs of hairs. In

several, however, the edges of the cortex contain lighter pigment. The splitting of the hair is well illustrated. In several instances the outer margins are slightly irregular in contour.

Plate No. 12. *Wart-Hog.*

Owing to the density of the pigment, detail cannot be perceived. It will be noted that the outer margins of the hair are uneven.

Section C. Tylopoda — Camels.

Family 10. CAMELIDAE.

Plate No. 14. *Vicuna.*

Photographs numbers 1, 2 and 3 depict adult hairs. A narrow cortex and a broad dense medulla are seen in No. 1. In No. 2, the cortex is broadest and of granular appearance, whereas the medulla is absent. Number 3 shows an irregular and broken medulla. A portion of wool in the horizontal plane is seen in photograph number 7 on the extreme right. The serrated external margins are evident, as are also a narrow clear cortex and a broad medulla which is here composed of longitudinal fibres. Photograph No. 4, is of hairs as seen under the low-power.

Plate No. 15. *Camel.*

The photographs are of hair. The cuticular, cortical and medullary layers can readily be seen in all. The medulla occupies about one-third to one-half of the total breadth of the hair, and the density of the pigment varies as the photographs show. Numbers 4, 5 and 6 show deficient pigment in the medulla whereas numbers 1, 2 and 3 show copious dense pigment. The cortex is clearly shown and does not require description. Number 7, depicts the tip of a hair.

Plate No. 16. *Llama.*

The photographs are of hair. The three layers are readily seen. It will be noted that the breadth of the medulla varies very greatly, thereby decreasing or increasing the breadth of the

cortex. The pigment in the medulla varies in amount but the density is constant in these studies. Photographs numbers 2 and 5 show hairs which have been cut and have undergone partial regeneration. The regeneration of hair will, however, be studied in greater detail in section No. VI which deals with human hair.

Section D. PECORA—TRUE RUMINANTS.

Family 12. CERVIDAE.

Plate No. 18. *The Elk or Moose.*

Photographs 1 and 2 are of hair, and on account of the uniform and general distribution of the dense pigment, detail is obscured. Number 3 is a photograph of wool. The three layers are clearly seen. The cuticle is very definitely "notched". The rudimentary medulla shows the presence of longitudinal fibres.

Plate No. 18. *Red Deer.*

Numbers 1 and 2 are of hairs. Number 1, in the upper right portion shows an irregularity of pigment which will be seen more clearly in subsequent photographs, when further comment will be made. Number 2, shows a tapering of the lumen near to the tip and very definite imbrication of the margins. Number 3 is of wool and, with the exception of the presence of a broader rudimentary medulla than in the wool of Moose, does not call for further description.

Plate No. 19. *Roe Deer.*

Numbers 1 and 2, are of hair and the slightly irregular cuticular margins are seen. Number 3, is of wool. Number 1, shows a very faint marled-appearance in the centre of the hair. Number 3, resembles the wool of the Moose and Red Deer, with the exception that there is practically no differentiation between cortex and medulla and the cuticular margins are less serrated. The wool is fairly mature.

Plate No. 19. *Reindeer or Caribou.*

Numbers 1-4, show a marled, "snake" or "lizard skin" appearance, which results from thinning or absence of the pigment

permitting the cellular network of these hairs to become evident. In number 3, where the pigment has been voided, the cellular structure can be seen clearly as can also the narrow cortical layer in which cellular detail is lacking and the medullary layer in which it is pronounced. Photograph number 5, shows a wool the characters of which are almost identical to that of the Roe Deer.

Plate No. 19. *Fallow Deer.*

The hairs characteristics are already described.

Plate No. 20. *Chital or Axis Deer.*

The photographs are of hair. Number 1, shows the cuticle, the narrow cortex, and the broad densely-pigmented medulla which presents a faint, marled appearance already described. The irregular character of the medullary margins is clearly shown. Number 2, illustrates the breaking up and disappearance of pigment in a portion of the hair, and No. 3, the tapering of the hair at the tip.

Family 13. GIRAFFIDAE.

Plate No. 22. *Giraffe.*

Photographs 1-5, are of hairs in the horizontal plane. In numbers 1 and 3, the three layers are readily seen. The fibrous appearance of the cortex in the latter is noteworthy, as are the very fine imbrications of the cuticular margins. In photograph number 2, the pigment is dense in character and distributed uniformly. Number 4 shows the lumen of a hair near to the tip, which is seen in the fifth photograph.

Family 15. BOVIDAE.

Plate No. 23. *Barbary Sheep.*

Photographs 1-5 are of hairs of the body, whereas numbers 6-9 are of hairs of the beard. Most of the photographs show the three layers clearly. In number 3, the transverse fibres of the cortex are distinct. Number 4, shows the tapering of the hair approaching the tip. Number 5, depicts the breaking up of pig-

ment. In all these photographs the density of the pigment is manifest, and the outstanding characteristic is the breadth of the medullary layer.

Plate No. 23. *Goat* (Hair Dyed).

On account of the dyeing and the pigment, detail of the hair interior is obscured. Number 2 is of wool and the serrated cuticle is very clearly seen.

Plates No. 23 and 24. *Rocky Mountain Goat* (Coat).

Photographs number 12 in the former plate, and those numbered 1-3 in the latter plate are of hair. The cuticle, cortical and medullary layers are particularly distinct. The pigment has disappeared in Number 2, Plate No. 24, and a fine, irregular, cellular structure is evident in the medullary area. Number 1 on the same Plate, shows the partial disappearance of pigment in the medullary layer. It should be noted that the cellular formation differs from that found in Cervidae where the cells are much larger. Number 3 is of wool which shows a faint medulla composed of longitudinal fibres. There are wide intervals between the serrations.

Plate No. 24. *Rocky Mountain Goat* (Beard).

Numbers 4-6 are of hair and demonstrate a very much narrower and irregular medulla which is deeply pigmented, due to the thick bristly nature of the hair. The cortex exhibits a granular appearance. Number 7 is of wool which shows very definite imbrication giving the appearance that a number of sections have been placed upon and fitted into each other.

Plate No. 24. *Roan Antelope.*

Photographs numbers 1-4 are of hair. Numbers 2 and 3 reveal the cortex composed of longitudinal fibres. Numbers 3 and 4 show a granular-like medulla, due to the irregular distribution of the pigment. In all, the medulla is very broad.

Plate No. 25. *Somali Dik-Dik or Antelope.*

The photographs are of hair. Number 1 shows very irregular pigmentation distributed throughout the cortex. The

medulla is absent. Numbers 2 and 3 permit of differentiating the layers and show the breaking up of pigment which imparts to number 3 a "flaky" or "bark"-like appearance.

Plate No. 25. *Bison.*

The hair in the forefront of the photograph is not regarded as being very clear, however the cortex and medulla can be differentiated with difficulty, the latter occupying a little more than half the breadth of the hair.

Plate No. 26. *African Buffalo.*

Photograph number 1 is of hair, but owing to the uniform distribution and the density of the pigment, details of the internal structure of the hair cannot be seen.

Plate No. 26. *Indian Black Buck.*

The photographs are of hairs. In numbers 1 and 3, the three layers are distinctly visible. The medulla is very broad. Number 2 shows a "marled" appearance due to the breaking up of the pigment in the medulla, whereas number 3 exhibits the same condition in a more exaggerated form. Number 4 shows the tapering of the hair close to the tip.

Plate No. 26. *The Palla or Impala.*

(South African Antelope) *Neck.*

The photographs are of hair. The only points which call for comment are the breadth of the medulla in number 1, the transverse striae of the cortex seen in number 2, and the breaking up of pigment in number 3.

Plate No. 26. *Highland Bull.*

The photograph is of hair, the cortex and medulla being distinguishable, the latter occupying about a third of the lumen.

Plate No. 27 *Ayrshire Cow.*

Coat. All the photographs are of hair. Number 1 shows a dense and uniform pigment which occupies the whole lumen. Numbers 2 and 3 exhibit the three layers. In the former, the medulla is densely pigmented and its margins are slightly un-

even, whereas in the latter it is broken and very thin. Photograph number 4 is that of a crushed hair as indicated by the broken cuticle, the narrowed medulla and cortex. Numbers 5 and 6 are of hair tips.

Tail. The photographs of these hairs are characterised by their great width. In the first, an irregularly pigmented and indefinite medulla is seen. In the second, very scanty medullary pigment is present. Numbers 3 and 4 do not reveal a medulla. The longitudinal fibres composing the cortex, in which a varying amount of pigment is present, are seen in each of the four photographs.

Plate No. 28. *Belted Galloway Bullock.*

Coat. The density of the pigment in these hairs is clearly seen. In number 2, the three layers can be differentiated. Number 3 shows a hair which has been broken and which has partially regenerated. Photograph number 4 is of a hair-tip.

Tail. The hairs are of a fairly broad type, with the exception of those in photographs 4 and 5. The latter shows a hair-tip with the terminal portion broken off. The variation in amount of the medullary pigment is noteworthy. Photographs numbers 2 and 4 do not show a medulla, but the cortex of the latter contains an appreciable amount of pigment which is distributed in a very irregular manner.

Plate No. 29. *Red Polled Bullock.*

Coat. These photographs do not require explanation.

Tail. The broad character of the hairs in photographs 1, 3, 4 and 5 is noteworthy. Photograph number 2 is of a hair at a point near to the tip. Number 6 is of a hair-tip, the terminal portion of which has been broken off.

Plate No. 30. *African Eland or Elk* (Forehead)

The three layers are faintly seen, as are the broad, densely pigmented redulla and the longitudinal fibres of the cortex.

Plate No. 30. *African Reitbok or Reedbuck.*

Photographs numbers 1-3 show the detail efficiently. In number 3, the medullary pigment has disappeared to a great extent imparting a "craterlike" appearance.

Plate No. 30. *Thomson's Gazelle.*

Photograph number 1 shows the layer of cells composing the cuticle. The cortex is also distinct. Number 2 shows the tapering of a hair near to the tip. Number 3 shows the breaking up of the pigment giving a "marled" appearance.

Plate No. 30. *Grant's Gazelle.*

Photograph number 1 does not reveal the presence of a medulla.

Photographs 2 and 3 exhibit the different layers satisfactorily.

Breaking up of the central medullary pigment is seen in number 3.

Plate No. 31. *Krimmer Lamb.*

(Furrier's term denoting the fleece of Persian Lamb).

Photographs 1 and 2 show the irregular contour of the cuticle and medulla. In No. 1, the longitudinal fibres of the cortex are well marked. Number 3 is of wool and the outer margins depict an irregularity.

Plate No. 31. *Persian Lamb and Broad-Tailed Lamb.*

The photograph of the former shows a peculiar angular appearance of the hair. Both photographs, however, have their detail obscured on account of the dyeing of the subjects.

Plate No. 31. *Wildebeest or Gnu.*

The photograph is of hair, and shows the cortex and medulla clearly. The former reveals the presence of longitudinal fibres and the latter of dense pigment.

Plate No. 31. *Hartebeest.*

The photograph is almost identical to that of Wildebeest so far as the characteristics are concerned.

Plate No. 31. *Mrs. Gray's Kob.*

These two photographs are of hair and are very similar to Wildebeest and Hartebeest.

Plate No. 32. *Topi (Head).*

Photographs 1-7 are of hair. Numbers 1-3 do not call for comment except that in numbers 2 and 3, the longitudinal fibres of the cortex are clearly seen and the cellular character of the medulla is partially retained. Numbers 3 and 5 show the medulla placed laterally. Numbers 6 and 7 show the termination of the hairs and in the latter a partially-bent tip.

Plate No. 33. *Goral.*

All the photographs are of hairs. Numbers 1-4 show very dense and widely-distributed pigment. In No. 1, a faint medulla can be seen. Number 2 shows a hair-tip the terminal portion of which appears to be tufted. In No. 3, the end portion of the hair is curved. Number 4 shows tapering as the hair-tip is approached. Nos. 5 and 6 do not call for comment. In Nos. 7 and 8, the breaking up of the medullary pigment is well marked. The former possesses a "flaky" appearance, while the latter exhibits clearly a single layer of cells.

Suborder 2. PERISSODACTYLES.

Family 16. TAPIRIDAE.

Plate No. 46. *Tapir.*

The photograph shows a serrated cuticular layer, and a fairly broad, irregularly-margined medulla. The cortex has a granular appearance although the fibres run longitudinally.

Family 19. EQUIDAE.

Plate No. 40. *Pony* (Dyed).

Apart from an irregular cuticle, detail is obscured by the dye.

Plate No. 40. *Pony* (Natural).

Number 1 shows the three layers faintly also a uniform distribution of dense pigment. Numbers 2 and 3 reveal slightly

irregular cuticular margins. In the former photograph a faint medulla can be discerned, while in the latter, the longitudinal fibres of the hair, with irregular pigment scattered therein, are readily seen.

Plate No. 40. *Clydesdale Gelding — Grey.*

The photograph is of a greyish-black hair. The medulla is densely pigmented and slightly irregular in outline but the cortex is of very pale colour.

Plate No. 40 *Clydesdale Gelding — Brown.*

The three layers can be seen, but both cortex and medulla show transverse and longitudinal fibres, and the pigment is irregular in its distribution in addition to being scanty in amount.

Plate No. 41. *Clydesdale Mare — Brown.*

The photographs are of hair. Number 1 is hair which has been taken from thighs ; number 2 from tail, in which a dense uniform pigment is seen, due to the coarse character of the hair.

Plate No. 41. *Clydesdale Gelding — Brown*

The hair is from the tail, and a dense, narrow, irregularly pigmented medulla is present. The longitudinal fibres of the cortex are clearly seen.

Plate No. 41. *Clydesdale Gelding — Grey.*

The hair has been taken from the thighs, and the photograph is of a white hair, as indicated by the broken, scantily-pigmented medulla and clear cortex.

Plate No. 41. *Hackney Mare — Brown.*

Hair taken from thighs. A well-defined fairly broad, densely-pigmented medulla is seen.

Plate No. 41. *Chestnut Racing Thoroughbred Mare.*

(Hair from Thighs).

Plate No. 41. *Chestnut Driving Mare* (Thighs).

The two photographs of the above do not call for comment. The latter was specially focussed for the purpose of showing up the medulla.

Plate No. 42. *Zebra.*

The photographs are of hair. Number 1 shows a very broad, deeply-pigmented medulla and a correspondingly narrow cortex. Number 2 shows the hair-tip with a gradual narrowing of the medulla and the whole lumen of the hair. The termination of the hair is clearly seen in photograph number 3.

Family 20. RHINOCEROTIDAE.

Plate No. 44. *African Rhinoceros* (Ear).

All the photographs are of hairs. In number 2, the irregularity of the cuticle attracts attention. In number 4, an open-angle is formed by the hair. Angulation usually indicates a curling or waving of the hair.

Suborder 5. HYRACES.

Family 30. HYRACIDAE.

Plate No. 44. *Hyrax.*

The outstanding character of these photographs lies in the marked serration of the cuticular layers. The medulla also shows an irregular contour. Numbers 4 and 5 are photographs of hairs taken from « the yellow spot » of the coat. In number 4, the scanty, irregular medullary pigment attracts attention. Number 6, is a photograph of a young and immature hair. The medulla still retains its cellular character.

Order VII. RODENTS.

Suborder 1. SIMPLICIDENTATA.

Family 2. SCIURIDAE.

Plate No. 48. *Marmot.*

Photograph number 1 is that of a fully mature hair, the three layers of which can be clearly seen. The cortex shows transverse striation. The medulla is slightly irregular in contour. The second photograph is that of an immature hair as shown by the retention of a faint cellular outline. The fibres of the cortex are clearly seen. The cuticle is very irregular, which is characteristic of wool.

Plate No. 48. *Viatka Squirrel.*

The specimen has been dyed and the detail obscured to a great extent, although reticulation of the medulla can be seen faintly.

Plate. No. 48. *British Squirrel.*

Number 1, shows a very broad medulla which almost completely fills the lumen of the hair. The transverse striation of the cortex is seen. Number 2, is of a less deeply pigmented hair and its cellular character is prominent. The lumen presents a reticulated appearance on account of the scanty pigment which permits the cells to be seen clearly. Number 3 is of wool ; the cellular central layer composed of partially fused, globular-shaped cells, is clearly depicted.

Plate No. 48. *Grey Squirrel.*

Number 1 shows the reticulated, deeply and fairly-uniformly pigmented medulla, the outer edges of which are more or less irregular. The cuticle and cortex are only seen faintly on account of the focus of the microscope having been adjusted to show up the details of the medulla. Number 2, is of hair and shows the details mentioned above, in addition to the cuticle and cortex. Here again the medulla almost fills completely the lumen of the hair. Number 3 is as already described, except that the loss of

pigment in the medulla is clearly shown. Number 4-8, are photographs of hairs and wools at various stages of maturity. In the first of these, the central pigment is breaking up and the cellular contour is disappearing, whereas in the second, the amount of pigment has increased and there has been proliferation of the cells which have coalesced to form an irregular mass. The transverse striae can be seen faintly. In the third, several strands of wool are seen under the low-power of the microscope. The fourth and fifth studies show the details of wool satisfactorily. In the former, the cells are rectangular in shape and are discrete, whereas in the latter, the cells are ovoid and are fused laterally. In both, the cuticle shows the characteristic serrated appearance.

Family 5. CASTORIDAE.

Plate No. 51. *Beaver.*

The first five photographs are of hair, the sixth of wool. Photographs number 1 and 2 do not call for comment. Number 3, exhibits faint, irregular, medullary pigmentation. In it, the cuticle and the longitudinal fibres of the cortex are seen. Number 4, shows a very narrow, irregular, and broken medulla. Number 5, is of a hair-tip. Number 6, which is a photograph of wool, shows the single, centrally-placed layer which is composed of fused ovoid cells, as also the coarsely serrated cuticular margins.

Family 8. MURIDAE.

Plate No. 52. *Short-Tailed Field-Vole.*

The first three photographs are of hair, the fourth and fifth of wool. In 1 and 2, the three layers can be seen clearly. Number 3, is of a hair nearing maturity and the appearance is similar to photograph number 5, under Grey Squirrel (Plate 52). Number 4, shows the single cellular layer of fused, ovoid cells and the serrated cuticle. Number 5, shows wool nearing maturity and approaching the tip.

Plate No. 52. *Lustered Musquash or Musk-Rat.*

The wool shows the effects of dyeing and treatment at the

hands of the furrier. The appearance of the cortex and medulla indicates the presence of dye in a distinctive manner.

Plate No. 48. *Natural Black Musquash or Musk-Rat.*

Number 2, is of immature hair as shown by the irregularity of the pigment and the serrations of the cuticle. Numbers 3 and 4 are of wool. The former, shows the elliptical-shaped cells to the left of the photograph and a castellated or fortification pattern in the middle and to the right of the photograph. The latter, shows a similar cellular contour except that the cells are thinner and less prominent.

Plate No. 53. *St. Kilda Field-Mouse.*

Plate No. 53. *Hamster.*

Plate No. 53. *Brown Rat.*

Plate No. 53. *St. Kilda House-Mouse.*

A description of these photographs is not considered necessary as all the characteristics therein have been described in relation to the previous specimens of Order VII, there being very definite features common to this Order, which shall receive detailed description at a later stage.

Family 13. OCTODONTIDAE.

Plate No. 56. *Coypu Rat.* (The Fur is called *Nutria*).

The first three photographs are of hairs. The second of these reveals a thin irregular medulla. The third, does not show a medulla. Photograph number 4 is of a fairly mature wool.

Suborder 2. DUPLICIDENTATA

Family 20. LAGOMYIDAE.

Plate No. 57. *Guinea Pig.*

The first photograph is of a mature hair and, apart from the fine irregularity of the edges of the medulla, does not call for comment. Numbers 2 and 4 are of immature hairs, as evidenced by the single layer of cells in the medulla and in the

latter instance, by the serrated cuticular margins. Number 3, is of a hair tip and number 5, of a wool, in which the cuticle is very slightly but more or less regularly serrated.

Family 21. LEPORIDAE.

Plate No. 58. *White Rabbit.*

Plate No. 58. *Chinchilla Rabbit.*

Plate No. 58. *Coney Rabbit.* (Dyed Specimen).

Plates No. 58 and 59. *Angora Rabbit.*

Plate No. 59. *Common Hare.*

Plate No. 59. *Scotch Mountain Hare.*

A careful examination of the photographs of the hair and wool belonging to the above mentioned six animals, which are very representative of their family, will reveal the fact that they closely resemble each other, in many instances being almost identical. Photograph number 3 of Chinchilla Rabbit calls for comment. In this study, three separate and distinct layers of discrete cells can be seen clearly. Throughout the whole of Order VII, the single layer of cells present in the young wool multiplies and forms a number of cellular layers which later fuse and present a reticulated appearance, which has previously been commented upon and which is again seen in this family.

Order VIII. CARNIVORES.

Suborder 1. FISSIPEDES.

Family 1. FELIDAE.

Plate No. 63. *British Wild Cat.*

The first two photographs which are of hair show clearly the deep broad pigmented medulla, as also the cortex. From a study of many hairs of this group, it would appear that the cortex possesses both longitudinal as well as transverse fibres but that the latter are more prominent in some instances only. The outer edges of the medulla are finely irregular in contour.

Number 3 is of wool, and the globular contour of the cells composing the medullary layer is clearly seen.

Plate No. 63. *Ocelot or Tiger-Cat.*

In the photograph of the hair, the cuticle is slightly irregular, as are the borders of the medulla. The cortex is granular in appearance. In the photograph of the wool, the serration of the margins is very evident. The central layer consists of longitudinal, pigmented fibres.

Plate No. 63. *Common Household Cat.*

The photograph is of a light brown portion of a hair. A narrow, irregular, central medulla is seen. The cortex is broad and contains lightly pigmented, longitudinal fibres. The cuticular margins possess an indefinite character.

Plate No. 63. *Persian Cat* (Smoke-Grey).

The first photograph, which is of hair, shows a broad deeply-pigmented medulla which possesses irregular margins. The second photograph which is of wool shows imbrication of the margins of the cuticle.

Plate No. 63. *African Lion.*

Plate No. 63. *Jaguar.*

Plates No. 64. and 65. *African Lynx. (Undyed).*

Plate No. 64. *African Lynx (Dyed).*

Plate No. 64. *Snow Leopard or Ounce.*

Plate No. 64. *African Leopard.*

Plate No. 64. *Tiger.*

Plate No. 64. *Black Panther*

Plate No. 66 and 67. *Cheeta.*

The photographs of the hairs and wools of the above eight animals, all of large size, do not call for description, as they are regarded as being self-explanatory, very similar generally, and in certain instances almost identical, as in the case of African Lion, Jaguar, African Lynx. (Plates No. 63, 64 and 65).

The hairs of African Leopard, Tiger, and Cheeta resemble those of the British Wild Cat. The transverse striation of the cortex is well seen in African Leopard, Tiger, Lynx, (Plates No. 64 and 65), Cheeta, (Plate No. 67), and British Wild Cat (Plate No. 63).

The dyed specimens of Lynx hair and wool are not worthy of consideration, as the detail is obscured except in the case of the wool where the serration of the cuticular margins has been rendered very clear by the process of dyeing.

It should be noted that the photograph on Plate No. 66 is of an immature hair of Cheeta.

Plate No. 67. *African Serval Cat.*

The first six photographs are of hair, the last two of wool. Number 5 shows the hair-tip, and number 6 and 7, the breaking up of the medullary pigment.

Family 2. HYAENIDAE.

Plate No. 46. *Hyaena.*

The photograph is of a hair. The three layers are clearly depicted. All that remains to be stated is that the specimen closely resembles the hair of Lion, Jaguar, and African Leopard, which belong to Order VIII, Suborder 1, Family 1, except for the presence of the very definite longitudinal fibres in the cortical layer.

Family 4. VIVERRIDAE.

Plate No. 72. *African Civet-Cat.*

Photographs 1 and 2 reveal little detail on account of the uniform, dense pigment present. Number 3, shows the uneven calibre of the hair and its medulla. Numbers 4 and 5, show the breaking down of the pigment in a striking manner. Photograph number 6 is of wool taken under high-power magnification. The details are clearly shown.

Plate No. 73. *Genet Cat.*

Photographs 1 and 2 are of hair. The former, shows a hair narrowing in lumen towards the tip the latter, the actual hair-

tip. In both, the dense uniform pigment obscures detail. Photograph number 3 is of wool in which the serrated cuticular margins, the central cellular layer and the narrow cortex are clearly seen.

Family 5. CANIDAE.

Plates No. 74 and 79.

Dog (Wire-Haired Fox-Terrier).

The photographs are of black hair.

Plate No. 74.	*Red Fox.*
Plate No. 74.	*Dingo or Australian-Dog.*
Plates No. 74 and 75.	*Jackal.*
Plate No. 75.	*Silver Fox.*
Plate No. 75.	*Jap Fox.*
Plate No. 76.	*Arctic Fox.*
Plate No. 76.	*Arctic Fox-Cub.*
Plate No. 76.	*North American Kitt Fox.*
Plate No. 77.	*Sahara Desert Fox.*
Plate No. 77.	*American Timber Wolf.*
Plate No. 77.	*Common Wolf.*
Plate No. 78.	*Indian Wolf.*

The hairs of the above animals closely resemble Family 1, (Felidae), of the same order, as a careful study of the photographs will reveal. It will be seen that the cortex possesses transverse fibres in several specimens, e.g., Red Fox, Arctic Fox, Timber Wolf and Indian Wolf, in which they are readily seen. The wools belonging to Canidae have a similar spiky serration of the cuticular margins to those of Felidae but the intervals existing between the serrations are longer. In the case of Silver Fox, Plate No. 75, photographs numbers 8 and 9, and Sahara Desert Fox, Plate No. 77, photograph No. 2, a similar reticulated appearance to that which is commonly met with in the families Muridae and Leporidae of the Rodents, is seen.

Family 6. URSIDAE.

Plate No. 81. *Polar or White Bear.*

Plate No. 81. *Brown Bear.*

The hairs closely resemble those of Family 1, Felidae, and 5, Canidae, of Order VIII. Photograph number 2 is of wool of Polar Bear, and although almost devoid of pigment, imbrication is clearly seen, whereas No. 5 which is of wool of Brown Bear, has its central portion composed of longitudinal pigmented fibres.

Plate No. 81. *American Black Bear.*

In the case of photograph number 1 which is of mature hair, the presence of melanism or dense black pigment prevents the detection of detail. Nmber 2, is of wool in which the cellular medulla and irregular cuticular margins are evident.

Family 7. MUSTELIDAE.

Plate No. 83. *"Baum" Marten or Tree Marten.*

Plate No. 83. *Stone Marten.*

Plate No. 83. *Ermine.*

Plate No. 83. *Ferret.*

Plate No. 84. *British Otter.*

Plate No. 84. *Sea Otter.*

Plate No. 84. *African Otter.*

Plate No. 84. *English Otter.*

Plate No. 85. *South American Skunk.*

Plate No. 85. *North American Mink.*

Plate No. 86. *Polecat.*

Plate No. 86 *Stoat.* (Winter Coat).

Plate No. 86. *Common Badger.*

Plate No. 86. *American Sable or Marten.*

Plate No. 86. *Russian Sable.*

The hairs of the above animals belonging to the family Mustelidae are very similar in appearance from a practical aspect. The hair of Ermine, Ferret, Skunk, Polecat and Stoat shows a fine irregularity along the margins of the medulla, as is seen in Grey Squirrel (Order VII, Rodents, Fam. 2 Sciuridae, Plate No. 48, Nos. 7 and 8). That of British Otter, Sea Otter and African Otter possesses a narrower medulla and the longitudinal fibres of the cortex are marked. The wools belonging to Mustelidae can, for purposes of description, be relegated to two separate classes; the first, in which the serration of the wool-margin is moderate in degree as in the wool of "Baum" or Tree Marten, Stone Marten, Ermine, Mink, Polecat, British Badger and Sable; the second, in which the serrations are very conspicuous and show wider intervals between them, as in the wools of Sea Otter, African Otter, British Otter, Stoat, and Ferret. It is of interest to note further, that the wool of Sea Otter, African Otter, and British Otter does not exhibit any central cellular structure which is such a marked feature in the other wools of the family, there being instead only longitudinal fibres among which can be seen irregular pigment. Photograph number 5, Plate No. 83, shows a portion of hair under the high-power of the microscope. It was hoped that under high magnification, greater detail might be available from a photographic point of view, but this was not found to be so in practice, on account of the development of high lights on opening the diaphragm of the microscope in order to illuminate the dense pigment. The immature hairs of the Ferret, Plate No. 83. Photograph No. 12, the American Sable, Plate No. 86, Photograph No. 9, and Russian Sable, Plate No. 86, Photograph No. 11, show a similar central cellular structure to those of Common Hare, Leporidae, Order VII, Plate No. 59, Photographs No. 4 and 5, several members of Muridae, Order VII, Plates No. 52 and 53, and Silver Fox, Canidae, Order VIII, Plate No. 75, Photograph No. 8.

Family 8. PROCYONIDAE-RACCOONS.

Plate No. 90. *North American Raccoon.*

Photograph number 1 is of hair and the three layers are clearly shown. The second photograph is of wool and the

central pigment is more or less uniform in character although the cellular contour is not readly discerned.

Plate No. 90. *White-Nosed Coati.*

The four photographs are of hairs. Certain features call for comment; these being, the varying breadth of the pigment in medulla and the partial loss of the pigment, which is readly seen in the two latter photographs. In the fourth photograph the hair is lacking in pigment, is immature, and the irregular margins of the cuticle can be seen. The cellular character of the medulla is visible on account of on the diminished amount of pigment. The vertical wavy appearance of the cortex is outstanding.

Plate No. 91. *Panda.*

Photographs 1-7 are of hairs. Number 1, shows the three layers efficiently. Numbers 2, 3 and 7 reveal the breaking up of the medullary pigment. Number 4, is of a hair-tip. Numbers 5 and 6 are of immature hair as shown by the very irregular cuticular margins and the proliferation of the medullary cells which still partly retain their outline. Numbers 8 and 9, are of wool. The former shows the chain-like cellular layer of the medulla and the serrated cuticle.

Suborder 2. PINNIPEDES.

Family 9. OTARIIDAE.

Plate No. 94. *Alaska Fur-Seal.*

Family 11. PHOCIDAE-SEALS.

Plate No. 94. *Common Seal.*

Plate No. 94. *Greenland Seal (Dyed).*

Plate No. 94. *Common Seal (Dyed).*

Plate No. 94. *Grey Baby-Seal.*

The photographs of the wool of the members of the families Otariidae and Phocidae closely resemble the wools of the Otters which were described under Order VIII, Suborder 2, Family 7,

Plate No. 84, Photographs number 4, 8 and 12, in that there is a complete absence of any cellular contour in the medullary region, that the pigment is more or less uniform, not dense in character, and that the cuticular margins show the characteristic spiking with fairly long, regular intervals of space between them. The latter fact is clearly seen in the wool of Alaska Fur-Seal and the dyed wool of Common Seal. The wool of Greenland Seal, however, although exhibiting the characteristic serration of the cuticular margins, reveals a regular cellular medulla. The photographs of the hairs of Common Seal, Alaska Fur-Seal, Greenland Seal and Grey Baby-Seal show a more or less uniform distribution of the pigment and the absence of a medullary layer. In the case of the hair of Baby Grey-Seal, in which the pigment is of small amount, the longitudinal fibres can be very clearly seen. Photograph number 3 of Common Seal and number 2 of Alaska Fur-Seal are of hair near to the tip. Photograph number 1 of hair of Greenland Seal is not important on account of its having been dyed, but as hairs so treated are encountered from time to time in medico-legal investigation it. along with others previously described, has been included in this collection.

Order IX. INSECTIVORES.

Suborder 1. INSECTIVORA VERA.

Family 3. ERINACEIDAE.

Plate No. 96. *Common Hedgehog.*

Photographs number 1—3 are of hair. There is little that is characteristic of these hairs. In number 1, the medulla retains a faint cellular contour. In number 2, the right cuticular margin is serrated. Number 3, is of the hair approaching its termination.

Family 4. SORICIDAE-SHREWS.

Plate No. 97. *Common Shrew.*

The first photograph is of a hair-tip. The second, is of wool merging into hair at the uppermost portion of the picture.

The third, shows the thinning in calibre of the fibre which occurs frequently. Number four shows a bundle of hairs and wools and reveals the characteristics referred to. These photographs were taken under the low-power of the microscope in order to show the alternations occuring in the fibres, since the use of the high-power failed to reveal these points clearly on account of the limitation of the microscopic field. Number five, is a photograph of a hair. Number six, is of wool. The central cellular layer and the serrated cuticular margins are well seen. In both the Common Shrew and the Water Shrew the wool is continuous with the hair. This can be seen clearly in Plate No. 97, Photographs number 2, 3, 4, 10 and 11.

Plate No. 97. *Water Shrew.*

Photographs number 1—3 are of hair and do not call for comment. Number 4, shows the thinning in the lumen of the fibre; number 5, the tip of a hair. Number 6, shows the spiky or "dragons tail" appearance of the wool at its tip which is also a feature of the wool of Common Shrew and can be seen in photograph number 4, in the lower portion of the fibre to the left of the field. Number 7, is a photograph of wool which is reaching maturity as shown by the presence of a cortex, and the organisation of the medulla.

Family 5. TALPIDAE.

Plate No. 96. *Common Mole.*

The first photograph is that of a hair near to the tip. It will be seen that the medullary pigment tapers almost proportionatelly with the lumen of the hair, but that it terminates before reaching the tip. The second photograph, which is of wool, exhibits finely serrated cuticular margins, but the medullary portion almost completely fills the lumen of the wool and possesses a very striking cellular contour which resembles the heads of dumb-bells in close contact.

Order X. CHIROPTERA-BATS.

Suborder 1. MEGACHIROPTERA-FRUGIVOROUS BATS.

Plate No. 99. *Large Fruit Bat.*

The three photographs are of hairs. In the first of these, the three layers can be discerned rather faintly. Very definite imbrication of the cuticular margins is seen in photographs number 2 and 3.

Family 1. PTEROPODIDAE.

Plate No. 99. *Flying Fox.*

In this photograph it is seen that absorption of the central pigment has occurred in many instances. The photograph is of hairs which had been mounted in Canada Balsam for some years. The specimen was loaned to the writer. It is not considered very satisfactory.

Order XI. PRIMATES.

Suborder 1. LEMUROIDS.

Family 2. CHIROMYIDAE.

Plate No. 101. *Aye-Aye.*

All the photographs are of hair. In 1 and 2, there is a dense uniform pigment which obscures detail, although the cuticle is seen. No. 3, does not çall for comment. In numbers 5 and 6, the central pigment is scanty and irregular. Number 7, is of a hair-tip. Number 8, shows a hair near to the tip in which a narrow medulla can be discerned. Number 9, is of wool hair in which the cuticular margins are irregular but the fibrous cortex and the cellular medulla are evident.

Family 3. TARSIIDAE.

Plate No. 102. *Tarsier.*

Photographs 1 and 2 are of hair. In the former, a narrow

cortex and wide medulla are present. The latter, shows a hair-tip which is curved in rather an extraordinary fashion. A few portions of debris adhere to the margins. Numbers 3—5, are of wool, the first of which shows but slight imbrication of the margins. Number 5, is almost devoid of pigment, but the serration of the cuticular margins is a feature.

Family 4. LEMURIDAE.

Plate No. 103. *Ruffed Lemur.*

All the photographs are of hair. In No. 1, the cortex presents a granular appearance and in No. 2 the medullary pigment is scanty and irregular. Number 3, shows a hair near to the tip. Nos. 4 and 5, are of wool hair the characteristics of which have been dealt with previously.

Suborder 2. ANTHROPOIDS.

Family 5. HAPALIDAE.

Plate No. 104. *Common Marmoset.*

Photograph number 1 is of a wool hair, as shown by the serrated cuticle and the cellular contour of the medulla. Number 2, is of a hair in which the pigment has been absorbed to an appreciable degree and is similar to the immature hair of Silver Fox, Plate No. 75, photograph No. 9, Ferret, Plate No. 83, photograph No. 12, and Sable, Plate No. 86, photographs 9 and 11. Number 3, is of the same hair, but the photograph was taken under low-power.

Family. 7. CERCOPITHECIDAE.

Plate No. 105. *Arabian Baboon.*

The four photographs are of hairs, and do not, in the opinion of the writer, call for description further than that in numbers 2, 3 and 4 the moderately narrow, deeply pigmented medulla and the corresponding breadth of the cortex resemble the appearance of certain human hairs to some extent ;for example, if numbers 2 and 4 are contrasted with the photograph

of human red hair on Plate No. 1, Photograph number 1, a similarity will at first sight be found to exist. It must not be forgotten, however, that the Arabian Baboon belongs to Family 7, Suborder 2 of Order XI and man, to Family 9 of the same Suborder and Order.

Plate No. 105. *Chacma Baboon.*

The photographs are of hair. Number 2, resembles human hair to a slight extent.

Plate No. 106. *Diana Monkey.*

The first two photographs are of hair which show the dense character of the pigment and its wide distribution in the lumen of the hair. Number 3, shows a young hair under high-power. Number 4, is of wool and numbers 5 and 6 are of young wool; the appearance of these last two wools is of interest as only one similar wool has previously been described in this writing, viz:— the wool in the beard of the Rocky Mountain Goat, Plate No. 24, Photograph No. 7. The general appearance of number 5 might be said to resemble "The Monkey Puzzle" or Araucaria tree on account of the nature of the imbrications which give the appearance of a series of sections which have been superimposed and set into each other.

Plate No. 106. *Colobus Monkey.*

The photographs are of hairs and do not call for comment.

Family 8. SIMIIDAE.

Plate No. 104. *Chimpanzee.*

The two photographs are of hairs, and when compared with certain photographs of human hair they will be found to bear a very distinct resemblance.

Plate No. 106. *Male Gorilla-Adult.*

This photograph along with that of number 1 under Chimpanzee, Plate No. 104, more closely resemble typical human hairs in appearance than any other mammalian hair in the collection, as will seen when they are contrasted respectively

with the photographs of human hair which will be found on Plates number 16 and 7, Photographs number 1 and 6. There are, however, several important differentiating features which shall receive attention later.

Plate No. 107. *Gorilla-Young-Female.*

The photographs are of hairs and these do not call for comment.

Miscellaneous Dyed Hairs and Wools of Animals.

Photographs Nos. 6-8, contained on Plate No. 109, have been included in the collection in order to show the alteration in the appearance of these fibres as the result of the process of dyeing, so frequently encountered in the examination of hairs composing furs. The photographs of these in their horizontal plane indicate the general and uniform darkening of the hair structure. In nearly all cases, the presence of dye is readily appreciated by the appearance of the hairs in transverse section, although examination in their longitudinal plane may in some cases give rise to doubt in this regard, unless similar specimens in the undyed state are at hand for comparison. In addition to the photographs contained on the above plate, several specimens of dyed fibres have been included elsewhere in this collection and are marked accordingly.

Although the microscopic examination of the appearances of the hair and wool specimens in their longitudinal plane has been concluded, it is not yet considered opportune to deal with those characteristics which may be found useful in their identification. Before so doing it is necessary to examine carefully the transverse sections of the hair fibres, in order to determine whether this will yield additional information, of value in determining their origin.

SECTION IV.

The Microscopic Appearances of the Cross-Sections of Animal Hairs.

Pruner-Bey 13 states that "whilst the inspection of the hair in a longitudinal direction is indispensable for the appreciation of the value of the indicated appearances, it is nevertheless insufficient to establish a convenient basis of classification. There is another method to attain our object; by subjecting to the microscope the transverse section." The writer is in agreement with the opinion of Dr. Pruner-Bey and for this reason examined with care the transverse sections of all the hairs which were available in his collection. In the examination of sections of hairs special regard should be given to the following points:—

(1) The relative size of the sections.

(2) The presence of distinctive cuticular, cortical and medullary layers, their character and proportions.

(3) The contour of the sections.

It must be borne in mind by the examiner that in cross-sectioning a bundle of hairs they are cut at different points in their calibre and at slightly different angles, for this cannot be avoided absolutely, and therefore in their microscopic interpretation due regard must be given to the varied appearances. It is expedient to select a number of specimens showing predominant characters for special examination, and for ultimate interpretation. The size of the sections is of importance in the estimation of the thickness of the hairs, whereas the appearance of their contour yields much important information in relation to their shape. Having regard to the different points through which hairs in a bundle are cut and to their varying

calibre, it will be appreciated readily that in the same microscopic field varying proportions of the structural elements will be seen. In the following description of about 220 photographs of sections, emphasis has been laid upon the characters most uniformly present in the microscopic fields.

Order I. MONOTREMES.

Family I. ORNITHORHYNCHIDAE.

Plate No. 3. *Duck-billed Platypus.*

Photographs number 1 and 2 are of sections through the shield-like tip of the hairs. The contour is elongated, one side being flat, the other being slightly convex; a medulla is not seen. The third photograph, taken under high-power magnification is of a section through the shaft of the hair below the shield-like termination. The cuticular margins are very irregular, the cortex narrow, the medulla broad and irregular in contour. Number 4, shows sections of hairs under low-power magnification. Photograph number 5 shows sections of wool; these which have been photographed under high-power magnification reveal an irregular cuticular margin, a narrow cortex, and a prominent, almost circularly shaped medulla. The sections are circular in contour as opposed to those of hair which are oval in shape.

Family 2. ECHIDNIDAE.

Plates No. 2 and 3. *Spiny Anteater.*

Spine.— The section is composed of a dense, irregularly-celled structure in which an irregular outer margin is seen. On account of the breadth of the section only a portion is seen in the field. The spine is composed of a keratin-like material.

Hair and Small Spines.— The sections vary in contour from an oval to an almost circular shape. The medulla, which is present in two of the sections of the small spines, is irregular and slit-like in character. The cortex is broad and is flecked with dark pigment. The sections of hair do not reveal a medullary layer.

METATHERIA.

Order II. MARSUPIALS.

Suborder I. POLYPROTODONTS.

Family 5. DIDELPHYIDAE—OPOSSUMS.

Plate No. 6. *Opossum.*

The sections present a slightly flattened, ovoid contour. They are not of large size. The three layers are readily seen, more especially under high-power magnification. The medulla is very large and is much broader than the cortex.

Family 6. DASYURIDAE—THYLACINE and DASYURES.

Plate No. 6. *Viverrine Dasyure.*

The contour of the sections is for the most part either elliptical or almost completely circular. The three layers are seen. The cuticle around the circular sections reveals an irregular and slightly crenated appearance. The medulla is very much smaller than in the hair of Opossum and Wallaby and it is densely pigmented. The inner half of the cortex contains dense but irregular granular pigment.

Suborder 2. DIPROTODONTS.

Family 12. MACROPODIDAE—KANGAROOS.

Plate No. 6. *Wallaby.*

The most constant characters present are those described under Opossum. In several of the sections, however, a unilateral concavity is present which in certain instances is of a pronounced character and imparts to the sections a "kidney" or "bean" shaped appearance. The sections are larger than those of the hairs of Opossum or Viverrine Dasyure.

Order III. EDENTATES.

Family 1. BRADYPODIDAE—SLOTHS.

Plate No. 11. *Three-toed Sloth.*

The margins of the sections are finely irregular. The cortex is densely pigmented, whereas the medulla appears to contain little pigment. The medulla, which is of circular or oval shape, appears to be as broad as the cortex. The sections vary from being oval to elliptical in contour ,although in many cases a slightly distorted diamond shape is seen.

Family 3. ANTEATERS.

Two-toed Anteater.

After repeated attempts to secure transverse sections of these hairs, the endeavour was abandoned on account of the very fine character of the hairs and the resultant difficulties.

Plate No. 11. *Tamandua Anteater.*

The contour varies from an oval to an almost triangular shape, the latter resulting from the almost flat appearance of one portion and the marked curving of the other. The medulla is absent in all the sections.

Family 4. DASYPODIDAE.

Plate No. 11. *Armadillo.*

The sections are narrow and ovoid or elliptical in contour. The medulla is slit-like and is very narrow. The cortex contains irregular pigment.

Order VI UNGULATA—HOOFED MAMMALS.

Suborder 1. ARTIODACTYLES.

Section A. PIG-LIKE ARTIODACTYLES.

Family 2. SUIDAE.

Plate No. 12 *North African Wild Boar (Head).*

The section is very large, almost circular in contour, and shows the three layers. The cuticle is absent at one portion. The cortex is remarkably broad and irregularly pigmented. The medulla is very small, narrow and irregular in its slit-like appearance.

Plate No. 13. *Wart-Hog.*

The section which is very large, is slightly oval in shape and the cuticle and cortex are seen. The medulla is not discernible. The cortex contains irregular pigment which is more dense at the periphery.

Section C. TYLOPODA—CAMELS.

Family 10. CAMELIDAE.

Plate No. 14. *Vicuna.*

Photograph number 5 is of wool, number 6 of hair, numbers 7 and 9 of hair under high-power magnification and number 8, of wool under high-power magnification. The sections of hair possess an ovoid shape. The medulla is elliptical and is much narrower than the cortex. The cuticle, which has been separated from the section in places, is seen. Number 8, shows the cuticle and cortex. The medulla is absent.

Plate No. 17. *Camel.*

The sections are oval or nearly circular in shape. The three layers are clearly demonstrated. The medulla which is irregular in contour, is about the same breadth as the cortex.

Plate No. 17. Llama.

The characters of the cross-sections are almost identical with those of Camel, exept that the medulla possesses a more lobulated appearance

Section D. PECORA—TRUE RUMINANTS.

Family 12. CERVIDAE.

Plate No. 21. *The Elk or Moose.*

The sections are distinctive from those previously considered. One aspect exhibits a flattened contour whereas, the other forms a semicircular outline. The cuticle is very thin, as is the cortex, which is composed of a single layer or cells. The medulla is remarkably large and is composed of cells of varying shape and size which impart a reticulated, open-meshed appearance. The pigment is localised in the cortex to a very great extent.

Plate No. 18. *Red Deer.*

Photographs 4 and 5 do not call for description other than to comment upon their more or less oval contour. In number 6, the pigment is more dense and uniformly distributed than is usually met with in the cross-sections of hairs belonging to this family.

Plate No. 21. *Roe Deer.*

The reticulated appearance of the medulla is but faintly seen.

Plate No. 21. *Reindeer or Caribou.*

The transverse sections are large, almost completely circular in contour, and the cortical pigment is absent. The fine net-like appearance of the medulla is faintly seen.

Plate No. 21. *Fallow Deer.*

The section shows a bilateral constriction resulting from damage. The details, however, are clearly seen.

Plate No. 21. *Chital or Axis Deer.*

The sections are oval in contour and in structure resemble Photograph Number 6 of Red Deer, Plate No. 18, although they are of small size.

FAMILY 13. GIRAFFIDAE.

Plate No. 22. *Giraffe.*

The cross-sections are almost completely circular in contour and show the three layers clearly. Both the cortex and medulla contain irregularly distributed pigment. The sections are moderately large. The cortex is narrow, the medulla circular and roomy.

FAMILY 15. BOVIDAE.

Plate No. 23. *Barbary Sheep (Beard).*

The transverse section reveals a bilateral concavity. The cuticle is not clearly seen, although the irregularly pigmented cortex can be readily discerned. The medulla is absent.

Plate No. 38. *Barbary Sheep (Body).*

The section is circular in contour and the three layers are clearly seen. The cortex is narrow and the medulla, broad, circular in shape and of fine cellular structure.

Plate No. 24. *Rocky Mountain Goat (Beard).*

The sections exbhibit a unilateral marked concavity of angular appearance. The cortex and medulla which are nearly equal in breadth, are readily seen. The former is densely pigmented.

Plate No. 38. *Rocky Mountain Goat (Body).*

The section are either oval or circular in contour. Their characters are very similar to those of Barbary Sheep (Body), although very much smaller in size.

Plate No. 34. *Roan Antelope.*

The sections are more or less circular in contour; in the case of photographs 2 and 3, a very wide medulla with a cellular structure is seen. Photograph number 1 reveals sections of oval shape with a very much smaller medulla.

Plate No. 35. *Somali Dik-Dik or Antelope.*

The sections are similar in contour to those of Beard of Rocky Mountain Goat. The cortex is very narrow and the medulla large.

Bison.

Transverse sections could not be made, as the specimen had been mounted before it was received.

Plate No. 26. *African Buffalo.*

The sections are large and almost circular in shape. The margins of the sections in the first photograph are irregular in contour, displaying a crenated appearance. The three layers are clearly seen. The cortex is irregularly pigmented, imparting a granular appearance. The medulla, in certain instances, is almost circular in outline whereas in others it is very irregular. The sections in the second photograph possess an almost completely circular contour, and a very small medulla.

Plate No. 35. *Indian Black Buck.*

The sections are of kidney-like shape resulting from a slight unilateral concavity. The medulla, which is much broader than the cortex, is of oval shape. The pigment in the cortex is clearly seen. The cellular character of the medulla is faintly discernible.

Plate No. 26. *Highland Bull.*

The sections show the cuticle and cortex, but the medulla cannot be discerned except in a few instances, when it is found to be small. The cortex is irregularly pigmented and its fibrous nature is clearly seen. The sections are smaller than those of the hairs of other members of Bovidae.

Plate No. 36. *Ayrshire Cow.*

Coat. The sections are of oval shape, possess a fairly densely pigmented cortex and an oval medulla of moderate size.

Tail. The upper section is of circular contour and the lower, of slightly oval contour. The cortex is very broad, the medulla disproportionately small and oval shaped.

Plate No. 36. *Red Polled Bullock.*

Coat. The sections are as above described, with the exception of the cortex which contains less pigment.

Tail. The sections are very large. The cortex in the lower section is exceptionally broad. In the case of the upper section, it completely fills the lumen, the medulla being absent.

Plate No. 36. *Belted Galloway Bullock.*

Coat. The sections possess the same shape as the foregoing, but on account of the density of the pigment the structural detail cannot be seen.

Tail. The sections are circular in contour. The cortex is broad, the medulla small and irregular in outline.

Plate No. 34. *The Palla or Impala (South African Antelope) (Neck.)*

Photograph number 1 is of high-power magnification. The transverse section presents an almost triangular shape. The margins of the cuticle are irregular and ill-defined. The narrow cortex and the wide medulla are clearly seen. Photograph number 2 is of low-power magnification and shows clearly the characters indicated.

Plate No. 34. *African Eland or Elk (Forehead)*

Although the sections are slightly smaller than those of Roan Antelope, Plate No. 34, Photographs 1-3, they closely resemble them and apart from revealing a smaller medulla do not call for further comment.

Plate No. 35. *African Reitbok or Reedbuck.*

The sections closely resemble those of Roan Antelope and African Eland (Forehead), Plate No. 34, Photographs 2, 3 and 4, except that the latter possess a thicker cortex and a cellular medulla.

Plate No. 35. *Thomson's Gazelle.*

The sections are smaller than those of Roan Antelope, African Eland or African Reedbuck but are otherwise very similar. Although smaller in structure they resemble those of Giraffe, Plate 22, Photograph No. 6.

Plate No. 35. *Grant's Gazelle.*

The sections are "kidney shaped", and apart from being larger and less concave unilaterally, they closely resemble those of Somali Dik-Dik, Plate No. 35, Photograph No. 1.

Plate No. 37. *Krimmer Lamb.*

(Furrier's term denoting the fleece of Persian Lamb).

Some of the sections do not permit of satisfactory interpretation on account of the density of the pigment which is present in the dark hairs. The sections of the light hairs, however, reveal the cortex and medulla.

Plate No. 31. *Wildebeest or Gnu.*

The sections are reniform in shape and slightly elongated. The cortex cannot be readily differentiated from the other layers. The pigment is most dense in the cortex, on the convex aspect of the sections. The medulla is elongated and not well defined marginally.

Plate No. 38. *Hartebeest.*

The transverse sections are very similar to those of Wildebeest, except that they are smaller and that the cortex is more clearly defined and its cellular structure more evident. The cortical pigment is most dense at the lateral aspects of the sections.

Plate No. 38 and 39. *Mrs. Gray's Kob.*

The sections are of moderately large size. The three layers can be easily seen. The medulla is large and irregularly pigmented. One aspect of the section is slightly flattened in photograph No. 1, although the general contour may be described as oval in number 2.

Plate No. 32. *Topi (Head).*

The sections are more or less oval in contour although flattened or slightly concave unilaterally. The three layers are seen. The cortex is broad and pigmented and the medulla is small and slit-like or oval in appearance.

Plate No. 39. *Goral.*

Photograph 1 is under low-power. The cuticle, the narrow, deeply pigmented cortex, and the broad, oval medulla are well seen. Number 2, is under high-power and does not call for comment on account of the clearness of the details in the photograph.

Suborder 2. PERISSODACTYLES.

Family 10. TAPIRIDAE.

Plate No. 47. *Tapir.*

The cross-sections are oval in shape. The three layers are seen. The cortex is thin, the medulla broad and filled with a faintly discernible cellular structure. The sections are of moderate size.

Family 19. EQUIDAE.

Plate No. 43. *Pony (Natural Coat).*

The sections which are fairly small, are oval or circular in contour. In most of the sections, a small pigmented or unpigmented medulla is visible.

Plate No. 40. *Clydesdale Gelding Tail (Grey).*

The sections are large and are either oval or circular in contour. In all, the medulla of appreciable size is seen. The cortex is irregularly pigmented.

Plate No. 40. *Clydesdale Gelding Tail (Brown).*

These do not call for comment being almost identical to those of Clydesdale Gelding (Tail-Grey).

Plate No. 43. *Clydesdale Mare (Brown).*

(Hairs from around tail).

In these, the density of the cortical and medullary pigment should be noted.

Plate No. 43. *American Chestnut Driving Mare.*

(Hair from thighs).

Plate 43. *Racing Thoroughbred Mare (Chestnut).*
(Hair from thighs).

The sections of these hairs are almost identical to those of American Chestnut Mare on account of their oval or circular contour, the presence of a small, almost circular, pigmented medulla and the fairly broad, pigmented cortex. The sections of the former hairs are slightly larger than those of the latter.

Plate No. 43. *Zebra.*

The sections are fairly large and are similar in appearance to the sections of hair from the tail of the horse. They are oval in contour, possess a deeply pigmented cortex and an oval medulla.

Family 20. RHINOCEROTIDAE.

Plate No. 45. *African Rhinoceros (Ear).*

The sections are circular in contour. The cuticle and cortex are readily seen but the medulla is absent. The cortex contains irregularly-distributed pigment. The sections are of fairly small size.

Suborder 5. HYRACES.

Family 30. HYRACIDAE.

Plate No. 45. *Hyrax.*

Number 1, is of low-power magnification, and in this photograph, the sections are small and of oval or lanceolate contour. The three layers are clearly seen in number 2, which is of high-power magnification. The medulla is of fairly large size and the pigment is dense in the cortical layer.

Suborber 7. PROBOSCIDEANS.

Family 35. ELEPHANTIDAE.

Plate No. 46. *Elephant (Tail).*

The photographs show the intimate structure of the hair clearly. In the first, the irregular contour of the edge of the

section is evident. The characteristic cellular appearance of the blackground of the sections, with the inclusion of numerous whorl-shaped masses, is important from a taxonomic aspect.

Order VII. RODENTS.

Suborder 1. SIMPLICIDENTATA.

Family 2. SCIURIDAE.

Plate No. 50. *Marmot.*

The contour of the sections presents a thin and elongated character. Many exhibit a slight unilateral concavity, few, a bilateral concavity, and there is an occasional specimen of small size and oval shape. The cortex is narrow and the medulla moderately wide and very elongated.

Plate No. 49. *British Squirrel.*

Th contours of the sections vary greatly in shape, being oval, elongated with a bilateral concavity, or reniform in contour. The second variety is the most common. In it, the narrow cortex and the disproportionately large medulla are seen. In the elongated forms, the medulla presents a cellular structure.

Plate No. 50. *Grey Squirrel.*

The first photograph was taken under low-power magnification and is similar to that of British Squirrel. The second photograph, having been taken under high-power magnification, shows the details of the sections in an efficient manner. The sections present either an oval or a reniform shape. The latter closely resemble hair-sections of British Squirrel. The medulla is large and irregularly pigmented.

Family. 5. CASTORIDAE.

Plate No. 50 *Beaver.*

Both photographs show sections of very fine hair. The

second, which was taken under high-power, reveals the oval contour of the sections, the narrow cortex and the disproportionately large medulla.

Family 8. MURIDAE.

Plate No. 54. *Short-Tailed Field-Vole.*

The second photograph, shows several oval-shaped sections with a narrow cortex and oval-shaped, deeply-pigmented medulla. On account of the short character of the hairs, great difficulty was encountered in making sections.

Plate No. 54. *Black Musquash or Musk-Rat.*

The sections are elliptical in shape and reveal a deeply and irregularly pigmented, narrow cortex and slit-like medulla. They are of moderate size.

Plate No. 54. *St. Kilda Field-Mouse.*

The sections are very small due to the fine, thin hair which was extremely difficult to cut transversely. They are, for the most part, oval in shape and very like those of Short-Tailed Field-Vole. The more elongated forms are the result of the fibres having been cut at an angle.

Plate No. 54. *Hamster.*

The sections are either oval or slightly reniform in shape. The cortex is narrow and the medulla is deeply and irregularly pigmented and possesses a kidney-shaped contour.

Plate No. 55. *Brown Rat.*

The first photograph is of low-power magnification. In it, the sections are circular or oval in contour. The second photograph, which was taken under high-power magnification, shows the cuticle, the cortex and the small, irregular medulla. The cortex is irregularly pigmented, being light at its periphery and very dark around the medulla.

Family 13. OCTODONTIDAE.

Coypu Rat.

(The fur is called *Nutria*).

The first photograph, is of sections of a few, very fine hairs and of wool. The second, which was taken under high-power magnification, shows the sections of the fine, wool-like hairs, in which the three layers can be differentiated. The contour of the sections is more or less circular.

Suborder 2. DUPLICIDENTATA.

Family 20. LAGOMYIDAE.

Plate No. 57. *Guinea Pig.*

The cross-sections are of elongated and slightly reniform contour. Their degree of elongation is similar to the sections of Marmot, Plate 50. The sections of Guinea Pig hair are broader and larger. The medulla is large, cellular and of reniform shape.

Family 21 LEPORIDAE.

Plate No. 60. *White Rabbit.*

Plate No. 60. *Chinchilla Rabbit.*

Plate No. 60. *Coney Rabbit* (Dyed Specimen).

Plate No. 60. *Angora Rabbit.*

Plate No. 61. *Common Hare.*

Plate No. 61 *Scotch Mountain Hare.*

Plate No. 62. *Australian Rabbit.*

The cross-sections of the hairs of the above seven members of the Leporidae family are almost identical in appearance. These present an unique contour, being bilaterally concave. One aspect, however, is less concave than the other and possesses broad terminal portions. The medulla appears to be cellular in character, the cells presenting a honey-comb appearance. The distribution of pigment is irregular. It was at first

thought, that the fibres must have been cut at an angle, thus accounting for the extraordinary contour of the sections. Repeated sectioning, however, produced the same results. Comment has already been made regarding the large number of cells in the medulla of the hairs and wool fibres belonging to this family, when they were examined microscopically in their horizontal plane and to the very broad medulla which they possess. It is thought, therefore, that these facts may account for the appearance of the sections, more especially if the fibres are broad and thin.

Order VIII. CARNIVORES.

Suborder 1. FISSIPEDES.

Family 1. FELIDAE.

Plate No. 68. *British Wild Cat.*

Plate No. 68. *Ocelot or Tiger-Cat.*

Plate No. 68. *Common Household Cat.*

Plate No. 68. *Persian Cat (Smoke-Grey).*

Plate No. 69. *African Lion.*

Plate No. 69. *Jaguar.*

Plates No. 69 and 71. *African Lynx.*

Plate No. 69. *Snow Leopard or Ounce.*

Plate No. 70. *African Leopard.*

Plate No. 70. *Tiger.*

Plate No. 70. *Black Panther.*

Plate No. 70. *Cheeta.*

Plate No. 70. *African Serval Cat.*

The transverse sections of the hairs of the above thirteen animals are very similar in appearance, and on this account can be treated together for purposes of description. The features of the sections, which are most constant in all, are constituted by

the circular contour, the narrow cortex and the circular-shaped, roomy medulla. In a few odd sections elongation may be noted, but this appearance is the exception and not the rule, being accounted for by the inclusion of an odd thin, flat hair in the bundle embedded. This is seen in British Wild Cat and in the first photograph of African Lynx. The sections of the hairs of Ocelot, Common Household Cat, Persian Cat, Snow Leopard and Cheeta are smaller than those of the other specimens submitted. The largest sections are those of the hairs of British Wild Cat, African Lion, Jaguar, Tiger, and African Lynx. The distribution of the pigment in the cortical and medullary layers can be appreciated most fully by an examination of the photographs.

Family 2. HYAENIDAE.

Plate No. 47. *Hyaena.*

Comment is unnecessary in the interpretation of the features of these sections, as they simulate those of the hairs of Felidae very closely. The medulla, however, is smaller.

Family 4. VIVERRIDAE.

Plate No. 72. *African Civet-Cat.*

The section shows the cortex and medulla clearly. The former is narrow and deeply pigmented, the latter is circular and large, and contains irregularly distributed pigment. The contour is circular.

Plate No. 72. *Genet Cat.*

The sections, although smaller and containing more pigment, are very similar to those of the hairs of African Civet-Cat.

Family 5. CANIDAE.

Plate No. 79. *Dog. (Wire-Haired Fox-Terrier).*

Plate No. 79. *Red Fox.*

Plate No. 79. *Dingo or Australian-Dog.*

Plate No. 75. *Jackal.*

Plate No. 80. *Silver Fox.*

Plate No. 80. *Jap Fox.*

Plate No. 79. *Arctic Fox.*

Plate No. 79. *Arctic Fox-Cub.*

Plate No. 79. *North American Kitt Fox.*

Plate No. 80. *Sahara Desert Fox.*

Plate No. 77. *American Timber Wolf.*

Plate No. 80. *Indian Wolf.*

The characters of the transverse sections of the hairs belonging to the above thirteen animals permit of their being described together. If the two photographs of the transverse sections of hair of Jackal, which were taken under high-power magnification, are first examined, Plate No. 75, the details of the cortex and medulla which are common to nearly all the sections in this family will be seen clearly. The cortex, which is irregularly pigmented, presents a granular appearance and the medulla, which is wide, is similarly, if less densely pigmented. The oval contour of the sections is common to nearly all representatives of this family. In a few instances, notably in the case of sections of the hairs of Red Rox, Arctic Fox and Silver Fox, the contours are more flattened bilaterally. The largest sections are those of the hairs of Dingo, Indian Wolf and Jap Fox. Emphasis should be laid upon the appearance of the irregular pigmentation of the cortex, as being a characteristic of the transverse sections of the hairs belonging to this family.

Family. 6. URSIDAE.

Plate No. 81. *Polar or White Bear.*

Plate No. 82. *Brown Bear.*

Plate No. 81. *American Black Bear.*

The cross-sections of the hairs of the above three animals are much alike and are characterised by the broad, irregularly

pigmented cortex and the narrow, oval medulla. The contour of the sections is oval.

FAMILY 7. MUSTELIDAE.

Plate No. 87. *"Baum" Marten or Tree Marten.*

Plate No. 87. *Stone Marten.*

Plate No. 87. *Ermine.*

Plate No. 88. *Ferret.*

Plate No. 88. *British Otter.*

Plate No. 88. *Sea Otter.*

Plate No. 88. *African Otter.*

Plates No. 85 and 89. *South American Skunk.*

Plate No. 89. *North American Mink.*

Plate No. 89. *Polecat.*

Plate No. 89. *Stoat (Winter Coat).*

Plate No. 86. *Common Badger.*

Plate No. 89. *American Sable or Marten.*

Plate No. 89. *Russian Sable.*

The cross-sections of the hairs and wools of the above members of the Mustelidae family are so similar, in general characters, that they can be described together. The contour of the sections is usually oval in shape with a slight degree of bilateral flattening, and in some cases the sections are elongated. The contour of the sections of the hairs of British Otter, Sea Otter, an African Otter is elliptical. The sections of the hairs from the tail of Stone Marten are more circular than any of the other specimens. In all cases, the three layers are distinct. The cortex, which usually contains an appreciable amount of irregularly distributed pigment is narrow, whereas the medulla is roomy and oval in shape. The cortex, in the sections of the hairs of the Otters, is slightly broader than in the other sections and the medulla is less roomy. The sections of the wool of the animals belonging to Mustelidae are very similar in appearance. In these, the irregular cuticular margin.

the cortex and the large, densely pigmented medulla are seen. In some instances, elongated and larger sections, presenting the characters of wool, are seen. They are sections of more mature wool fibres. Special mention must be made regarding the appearance of the sections of the wool of the Otters which do not exhibit a medullary layer.

Family 8. PROCYONIDAE — RACCOONS.

Plate No. 92. *White-Nosed Coati.*

The sections are oval in shape and exhibit the three layers. The cortex possesses about the same breadth as the medulla and contains a varying amount of irregularly distributed pigment. The contour of the medulla is slightly irregular.

Plate No. 93. *North American Raccoon.*

The characters of the sections of the hair of White-Nosed Coati are very similar to those of Raccoon. The sections, through the lower halves of the hair of the latter, possess a broader cortex, in proportion, and the medulla is very much narrower, being slit-like in appearance. The sections through the upper halves of the hairs, although slightly smaller, are very similar to those of White-Nosed Coati.

Plate No. 93. *Panda.*

The sections are small and resemble those of Mustelidae, except that their contour is less oval and more irregular.

Suborder 2. PINNIPEDES.

Family 9. OTARIIDAE.

Plate No. 95. *Alaska Fur-Seal.*

The sections are very elliptical in shape, are irregularly but deeply pigmented, and possess a granular appearance. In a few instances, a very narrow slit-like medulla can be seen.

Family 11. PHOCIDAE.

Plate No. 95. *Common Seal.*

The sections are cigar-shaped and the medulla is absent in

all of the specimens shown. Apart from their more elongated shape, the sections are very similar to those of the hair of Alaska Fur-Seal.

Plate No. 95. *Grey Baby-Seal.*

The sections present a "sausage" shape, do not reveal a medulla and are devoid of pigment. They are smaller than those of the hairs of Alaska Fur-Seal or Common Seal.

Order IX. INSECTIVORES.

Suborder 1. INSECTIVORA VERA

Family 3. ERINACEIDAE.

Plate No. 96. *Common Hedgehog.*

The section is almost completely circular in contour, with a moderately-sized, irregularly-pigmented cortex of granular appearance and a circular, medium-sized medulla. The three layers are seen clearly. The cortex is of about the same breadth as the medulla.

Family 4. SORICIDAE — SHREWS.

Plate No. 98. *Common Shrew.*

The sections are those of wool fibres and of a few hairs. The wools are characterised by their irregular cuticle and deeply pigmented, large, circular or oval medulla; the hairs by the more elongated contour of the sections, with bilateral concavity, smooth cuticular margins and flattened medulla.

Family 5. TALPIDAE.

Plate No. 98. *Common Mole.*

The first photograph shows sections of wool fibres. The second photograph is of transverse sections of hairs. The contour is oval, and the cortex of about the same breadth as the medulla, which is elongated in shape and deeply pigmented.

Order X. CHIROPTERA — BATS.

Suborder 1. MEGACHIROPTERA — FRUGIVOROUS BATS.

Plate No. 100. *Large Fruit Bat.*

The contours of the sections are circular, oval, or reniform in shape. The medulla is small and the cortex is densely and uniformly pigmented.

Family 1. PTEROPODIDAE.

Flying Fox.

Cross-sections are not available, as only a mounted specimen was obtained.

Order XI. PRIMATES.

Suborder 1. LEMUROIDS.

Family 2. CHIROMYIDAE.

Plate No. 108. *Aye-Aye.*

The sections reveal an irregular shape. Some are elongated and bilaterally concave, others are flattened on one aspect and curved upon the other, giving the appearance of a circle, a portion of the circumference having been cut off. The cortex is broader than the medulla and is deeply and more or less uniformly pigmented. The medulla is oval or elliptical in shape.

Family 3. Tarsiidae.

Plate No. 108. *Tarsier.*

The first photograph is of sections of hair under low-power magnification. The second photograph is of sections under high-power. In it, the oval contour of the sections is clearly depicted. The medulla, which is oval or circular in shape, is densely pigmented and is broader than the cortex.

Family 4. LEMURIDAE.

Plate No. 108. *Ruffed Lemur.*

The section reveals the cuticular and cortical layers. The medulla is absent. Its contour is irregularly oval. The cortex is deeply pigmented.

Suborder 2. ANTHROPOIDS.

Family 5. HAPALIDAE.

Plate No. 108. *Common Marmoset.*

The sections are small, oval in shape, and show the three layers. The breadth of the cortex and the medulla are about the same. The medulla is regular in contour and is elliptical in shape. Many of the sections are uniformly and densely pigmented, and on this account the differentiation of the various layers is rendered impossible.

Family 7. CERCOPITHECIDAE.

Plate No. 105. *Arabian Baboon.*

The sections are large and of circular or oval shape. The cortex is very broad, and is irreguiarly pigmented, which imparts a granular appearance. The medulla is of moderate size and pigmented in a more or less uniform manner.

Plate No. 105. *Chacma Baboon.*

The sections are fairly small, and are oval in contour. The cortex is broad and irregularly pigmented, whereas, the medulla is moderately small.

Plate No. 104. *Diana Monkey.*

The sections, which possess an oval contour, are of moderate size. The cortex is fairly narrow and the medulla moderately large. The pigment is distributed in both cortex and medulla, rendering their differentiation very difficult in several of the sections.

Plate No. 106. *Colobus Monkey.*

The sections are of moderate size and possess an oval contour. The cortex is fairly broad, the medulla lobulated and of medium size.

FAMILY 8. SIMIIDAE.

Plate No. 108. *Chimpanzee.*

The cross-sections are of large size. The cuticular and cortical layers are clearly seen. The cortex is irregularly, but somewhat densely, pigmented. The medulla is absent. The sections possess an irregularly oval shape.

Gorilla — Female — Young.

Plate No. 108. *Gorilla—Female—Young.*

The sections are of moderate size and possess an almost completely circular contour. The three layers can be seen. The cortex is broad and irregularly pigmented imparting a granular appearance. The medulla is small and in many cases deeply pigmented. It possesses an almost completely circular shape. In many respects, these sections resemble those of human hair at first sight. (Vide Atlas, Part II, Plates No. 20 and 22, Photographs No. 4 and 1 respectively). The differences between the sections of the hairs of the higher-grade monkeys and those of human hair will receive some detailed consideration later.

Photographs of the Transverse

Sections of Miscellaneous Dyed Hairs.

Plates No. 109 and 110.

An examination of the transverse sections of the dyed hair of Raccoon, Opossum, Lynx, Greenland Seal, Goat and Persian Lamb, will reveal the fact that the process of dyeing nearly always darkens the structure of the cortex and medulla. In certain cases, differentiation of the layers is rendered impossible, on account of the dense and uniform distribution of the dye.

SECTION V.

The Taxonomic Value of the Appearances of Animal Hairs, as observed in their Horizontal and Transverse Planes.

Having examined the microscopic apearances of all the specimens of hairs and wools which comprise the collection, in their horizontal and transverse planes, it is now opportune to review the information obtained therefrom. In securing a permanent photographic atlas, showing the common appearances of the hairs and wools of the mammals comprising Orders I, II, III, VI, VII, VIII, IX, X and XI, one of the chief objects of this work has been accomplished. In referring to the differentiation of animal hairs, Sidney Smith[14] remarks "In every case, a series of hairs of different animals must be at hand for comparison and as a rule the species of animal from which the hair was obtained may be decided. The question put to the expert is whether certain hair is that of a particular animal, or more frequently whether it is human hair." The introduction of this photographic atlas should facilitate greatly the answering of these two questions. It is evident from the examination of the photographs, that hairs reveal great variation in their structural appearance, not only in those animals belonging to different Orders, but in the hairs of animals belonging to the same Order, Suborder or Family, as also in those belonging to different parts of the same animal or to the same part of the same animal. Griffith and Henfrey[15] remark in this connection that "The hair of Mammalia generally is formed upon the same plan as that of man; great variety, however, exists in its complexity of structure and the arrangements of the component parts."

One of the best descriptions of the general appearances of animal hairs, which the writer has read, is that by Paget[16] which is here submitted: "In some hairs, moreover, the fibres appear at certain parts either irregularly, or at definite

distances enlarged; and thus the whole shaft sometimes assumes a beaded appearance. Besides these longitudinal striae indicating the fibrous structure of its cortical part, the surface of the hair is marked by transverse and oblique and sometimes apparently spiral, wavy lines arranged in a very close series. The interior medullary portion of the hair is darker than the exterior and granular. It is composed, for the most part, of very minute globules, like pigment granules or drops of oil agglomerated in small lumps. Sometimes these form one dark mass, continued along the whole shaft of the hair; but more commonly the mass seems broken up, so that there are intervals of different sizes along the axis of the shaft. These are sometimes filled by a substance like the cortical part, and the medullary matter then seems altogether deficient; but more often they are occupied by a colourless substance, clearer and softer than the exterior fibrous tissue. The diameter of this medullary part when it is completely formed, is about 1/3 or 1/4 of that of the whole shaft ; transverse sections of hairs exhibit it like a nucleus, with a clear ring around it; along its walls there are often complete pigment cells, with clear nuclei and transparent membrane. At the tip, the hair gradually becomes more and more fine and usually ends in a rounded point, at and near which neither striae nor medullary substance can in general be seen."

Let us now consider the second object of the research undertaken, which is to ascertain whether or not hairs and wools of animals belonging to the same zoological Order, Suborder, or Family reveal similar characteristics which may be relied upon for purposes of their identification.

Plates No. 1—3. Order I. MONOTREMES.

This order comprises two families, *Ornithorhynchidae* and *Echidnidae*. The Duck-billed Platypus is representative of the former and Spiny Anteater of the latter. The hairs of the Duck-bill are easily identified both from their macroscopic and microscopic appearances. Viewed by the naked eye, the basal portions of the fibres are seen to be composed of wool which

further up the shaft merge into hair and ultimately flatten out to terminate in an elliptical, shield-like formation. Examined microscopically both in the horizontal and transverse planes, these features are clearly seen. The quills of the Spiny Anteater are readily identified by their macroscopic appearance. When sectioned and examined, their keratin-like structure is characteristic. The hairs when viewed microscopically in the horizontale plane resemble those of the Duck-bill, inasmuch as the medulla cannot be seen, and the cortex is composed of irregularly-pigmented, coarse, longitudinal fibres which are less pigmented in the centre of the hairs. The hair-tip is also characteristic, being "poker-like" in contour. When viewed in section they present an oval or accasionally a partially circular contour, but do not show a medulla. Sections of the small spines are of similar shape and possess a small slit-like medulla. Spencer and Sweet[17] state that "In Echnida the large hairs are easily distinguishable from the spines, and this feature is most marked in the case of the Central Australian specimen, owing to the fact that whereas the spines are always circular in section, the large hairs are flattened though there is not the distinct division of the hair into shaft, shield and tip as in the case of Ornithorhynchus."

Plates No. 4—6. ORDER II. MARSUPIALS.

The microscopic appearances of the hairs and wools belonging to the animals of the Families *Didelphyidae*, *Dasyuridae* and *Macropodidae* of this Order, when viewed in the longitudinal plane, are not such that they can be depended upon alone for purposes of identification. The appearances of the cross-sections of the hairs of Opossum, Wallaby, and Viverrine Dasyure are of value in this regard, so far as, they do not resemble closely any other sections in the collection. These are of small size, are flattened bilaterally and elongated in contour, with the exception of those of Viverrine Dasyure, which are more circular, possess a very narrow cortical layer and a disproportionately large medulla.

Plates No. 7—11. ORDER III. EDENTATES.

The three families which are to receive consideration are:—

Family 1. *Bradypodidae* — Sloths, represented by the *Three-toed Sloth.*

Family 2. *Myrmecophagidae* — *Anteaters*, represented by the *Two-toed Anteater* and *Tamandua Anteater.*

Family 4. *Dasypodidae*, represented by the *Armadillo.*

Plates No. 7. and 11. *Three-toed Sloth.*

The hairs are characterised by their long, tapering points, the imbricated character of the cuticular margins, the seeming absence of a medulla and the unique character of their transverse sections. The sections are irregular in contour, varying from an uneven, oval contour to a distorted diamond shape. The margins of the sections are uneven, the cortex is broad and densely but irregularly pigmented, the medulla is uneven in contour and is occassionally situated slightly laterally. The appearance of the sections, once seen, is not readily forgotten or confused with those of other animal hairs. It should be noted that Ridewood[18] in a paper drew attention to the absence of a medulla in the hairs of sloths and quotes Welcher, who first noticed the fact.

Plate No. 8. *Two-toed Anteater.*

For purposes of identification the points of importance consist of:—

(1) The naked-eye appearance of the hair which is characteristic on account of its fine texture and the presence of the black "fleck" near the tip.

(2) The absence of much pigment, the presence of slender hair-tips and the fine character of their structure microscopically.

Plates No. 9. and 11. *Tamandua Anteater.*

For identification, the general appearance of the sections and their contour, which are characteristic, should be relied upon.

Many of these present the appearance of a triangle which possesses slightly convex sides. The medulla is absent, and the cortex is irregularly but slightly pigmented.

Plates No. 10 and 11. *Armadillo.*

The hairs are coarse, broad, and uniformly but deeply pigmented. The transverse sections are characteristic. They are elliptical in contour and the medulla is shown as a long, thin slit. The cortex is very broad. It should be noted that Lambert and Balthazard[19] regard the hairs of this animal as being without a medulla.

It will be seen that there are no characters common to all the animals in this Order which could be relied upon for the identification of the Order. There are, however, definite peculiarities in the hairs of each of the family representatives which can be relied upon for the identification of the animal itself.

Order VI. UNGULATA—HOOFED MAMMALS.

It is advisable to consider the common appearances of the hairs of animals belonging to this Order after grouping them in the following manner:—

Suborder 1. *Artiodactyles.*

Section A. *Suina — Pig-like Artiodactyles.*

Family 2. SUIDAE.

Section C. *Tylopoda — Camels.*

Family 12. CERVIDAE.

Family 13. GIRAFFIDAE.

Family 14. BOVIDAE.

Suborder 2. *Perissodactyles.*

Family 16. TAPIRIDAE.

FAMILY 19. EQUIDAE.

FAMILY 20. RHINOCEROTIDAE.

SUBORDER 5. *Hyraces.*

FAMILY 30. HYRACIDAE.

SUBORDER 7. *Proboscideans.*

FAMILY 35. ELEPHANTIDAE.

Plates No. 12 and 13. *Suidae.*

The hairs in this group more especially when belonging to the head or dorsal region of the coat, excepting domestic pigs, are coarse and large. They show dense pigmentation and occasional fraying at the tips as the result of friction. The sections of the hairs of boars are characterised by the great depth of the cortex, the absence of a medulla as in Wart-hog or the presence of a very small medulla, irregular and slit-like in contour, as in North African Wild Boar.

Plates No. 14-17. *Tylopoda — Camels.*

Vicuna. Since the coat of this animal is chiefly composed of wool, the great majority of the cross-sections present this character and the cuticular margins are thus irregular. In the sections of hairs of Camel and Llama this irregularity is noteworthy, as it is very pronounced. In many instances the medulla presents a distinctly lobulated appearance, which is not encountered in any other hairs of this size contained in the collection.

Plates No. 18-21. *Cervidae.*

The characters presented by the hairs of animals belonging to this large family are regarded by the writer as taxonomic, thus permitting their ready identification. These are :—

Macroscopically.

(1) The regular, wavy cotour of the hairs.
(2) The presence of a needle-like projection at the base of each hair.
(3) The waxy appearance of the hairs, their friable character, and their discrete character in the coat, each appearing to stand aloof from its neighbours.

Microscopically.

In Longitudinal plane.

(1) The deeply pigmented appearance of the lumen of the hairs.

(2) The breaking up of the pigment which reveals a cellular network and resembles a "Snake or Lizard Skin" appearance.

In Cross-Section. The cellular character of the cortex and medulla is clearly seen and is characteristic of the family. It should be noted that the wools do not reveal a cellular structure and that the pigment, which occupies an appreciable portion of the lumen, is situated in a mass of longitudinal fibre. It is important to allude to a passage from the text book of Briand and Chaude[20] in regard to the foregoing observations. Referring to the characters of the hairs of the Ruminants they state that "they are short, and include air cavities more or less regular which permit of distinguishing the hairs immediately." The writer is of the opinion that the appearances referred to by him are seen only in Cervidae, not in the hairs of the animals which belong to the other families composing Ruminants, and that they are produced by the presence of a definite cellular structure.

Plate No. 22. *Giraffidae.*

In the identification of hairs belonging to this family, the attention of the examiner should be directed to the sections. These are outstanding in that they possess the most circular contour of any sections, approximating this size, contained in the collection. The medulla is also completely circular in outline and possesses a very fine cellular structure.

Plates No. 23-39. *Bovidae.*

In the Longitudinal Plane. The sharp definition of the cortical as opposed to the medullary layer, which in many instances appears as a definite line of demarcation, is important. The breaking up and flaking of the pigment is a very constant feature of the hairs of this family. The denuded areas reveal a cellular structure of small character. Their appearance is very different from that found in the hairs of Cervidae.

In Cross-Section. The coarse body hairs and beard hairs reveal contours which vary in shape; some are elongated and bilaterally concave others fairly broad and reniform. The hair of African Buffalo is very large in transverse section, and in the coarser hairs the cuticular margins are wavy in outline. The medulla is small for the breadth of the hair, and its contour is irregular in shape. The sections of hairs of Palla or Impala, taken from the neck, present a definitely identifiable appearance which closely resembles the contour of a human vertebral bone on account of the spine-like process which they possess. In these the cortex is very narrow and the pigment is dense in the spine-like process. The sections of the hairs of Hartebeest and Wildebeest are elongated and reniform in shape with a deposit of dense pigment at the apex of each lobe. Those of Somali Dik-Dik, Indian Black Buck, and Grant's Gazelle are also veniform in contour but are less elongated. Moreover, with the exception of Indian Black Buck, there is a more angular unilateral concavity than is found in the sections of Wildebeest and Hartebeest. In the remainder of the animals belonging to Bovidae, the cross-sections of the hairs vary from an almost completely circular contour to one of oval shape. In all the cross-sections of hairs of animals belonging to this family a narrow cortex and a large medulla, which exhibits a fine cellular appearance are found, with the exception of hairs from the tail or those of a very broad character when the lumen of the medulla is usually very small.

Plates No. 46 and 47. *Tapiridae.*

The microscopic examination of the hairs in their longitudinal plane does not reveal any outstanding characteristic which could be relied upon for purposes of identification unless compared with known hairs.

The appearance of the sections is very similar to those belonging to Bovidae. (Vide Plate 35, Photograph No. 3, of African Reedbuck). The sections are, however, smaller and slightly more oval but a narrow cortex and a fine cellular medulla are present in both.

Plates No. 40-43. *Equidae.*

Marshall[21], in a paper which deals with the study of Equine

hairs, describes certain peculiarities in the hairs of members of this group which in his opinion are probably of specific value. He writes as follows:— "The characters by which hairs of different animals can be distinguished from one another apart from their length, shape and colour, the latter being of little or no taxonomic value, are the nature of the cuticle, the extent of development of the medulla in different parts of the hair, the relative thickness of the medulla and the arrangement of the pigment in the cortex. The cuticle presents comparatively slight modifications, and consequently the characters of this layer are not of much value for taxonomic purposes. In the hairs of the different members of the Equidae it is so far as I have observed, almost identical, being smooth or only slightly imbricated. In transverse sections it appears little more than a line bounding the cortex on the exterior. The medulla on the other hand shows very great variability in different animals and the accounts of it by various writers differ widely from one another. In all the equine hair that I have examined, even in the very finest, the medulla is present, though its degree of development is somewhat variable. It is usually absent for a considerable distance, both from the point and from the base of the hair, and may have broken down in an unaccountable fashion in one or more places on the hair shaft. Another character by which equine hairs may be distinguished from other hairs and from the hairs of other species in the genus, is the distribution and arrangement of the pigment in the cortex. Nathusius$_{22}$ has called attention to the fact, which I have often observed, that in some species of the genus Equus, the pigment granules on one side of the medulla may present a different colouration to those on the other side; in other words, that the hair may be striped longitudinally. This character so far as I have observed, does not hold good for horse hairs, but it is very general in other members of the family. The hairs in such cases are coloured by at least two different sorts of pigment which have blended unequally on the two sides of the hair." The writer has quoted Marshall at considerable length because he is in agreement with the views expressed by him, that the appearance of the cuticle is of no taxonomic value, that the medulla is consistently present except near the hair-tip and at the base, and that the distribu-

tion and arrangement of the pigment in the cortex are important in identifying horse hairs. He would, however, prefer to add a qualification to the last view, namely that the distribution and arrangement of pigment in the cortex are of importance only in the less uniformly and densely pigmented horse hairs. This qualification will be appreciated if the photographs on Plates numbered 40 and 41 be examined. Photograph numbered 1-4 on Plate 40 and numbers 2, 5, 6 and 7 on Plate 41 do not reveal any characteristic distribution of cortical pigment. Photograph No. 5, Plate 40, does however reveal a very characteristic pigmentation of the cortex in addition to transverse striation.

The cross-sections of horse hairs which have been photographed for this collection show the presence of a medulla which is more or less proportionate in size to the breadth of the hair. The contour of the sections and of their medulla is usually circular or slightly oval. The irregular pigmentation of the cortex is clearly seen in the lighter subjects. The cortex and the medulla are of about equal breadth. The sections of Zebra hairs do not differ from those of horse.

Plates No. 44 and 45. *Rhinocerotidae.*

The hairs are fairly uniformly and densely pigmented. Certain of them show slight curving in contour and fine imbrication of the cuticular margins. The cross-sections are characterised by their circular contour, their granular cortex of very great breadth, and the very frequent absence of a medulla which when present is of small size.

Plates No. 44 and 45. *Hyracidae.*

The imbrication or serration of the cuticular margins of those hairs is important. In transverse section this irregularity is shown. The contour of the sections is elliptical and one aspect is more convex than the other. The apices appear to be slightly lanceolate. The cortex is irregularly pigmented and is of about the same breadth as the medulla which is elliptical in shape. The sections are regarded as distinctive.

Plate No. 46. *Elephantidae.*

The macroscopic appearance of the hairs of the tail is sufficient for the purposes of identification. In cross-section, the dense epidermal structure in which are embedded numerous whorled masses, is corroborative.

Order VII. RODENTS.

It is advisable to consider the common appearances of the hairs of animals belonging to this Order, after grouping them in the following manner:

Suborder 1. *Simplicidentata.*

Family 2. SCIURIDAE.

Family 5. CASTORIDAE.

Family 8. MURIDAE.

Family 13. OCTODONTIDAE.

Suborder 2. *Duplicidentata.*

Family 20. LAGOMYIDAE.

Family 21. LEPORIDAE.

Plates No. 48-50.

Sciuridae.

The commonest feature which is seen in the microscopic examination of the hairs and wools belonging to this family, when viewed in their longitudinal plane, is the cellular character of the medulla which appears to be composed of large numbers of small cells which are more or less fused. When the pigment is copious the cellular outline is but faintly observed except at the medullary margins, but when the pigment is partly absent a reticulated cellular structure is readily seen.

The cross-sections present an elongated, unilateral or bilateral concave appearance. In all the cortex is very narrow and the medulla very broad. The latter exhibits a cellular appearance.

Plates No. 50-51.

Castoridae.

The coat is composed of particularly fine fibres which are for the most part wool. The mature hairs which are scanty reveal the cellular medulla alluded to above, when examined microscopically.

The sections present the characters of wool fibres of which the coat is chiefly composed. Beyond appreciating the fact that the sections are of wool and not hair, little useful information can be derived from their study in relation to identification.

Plates No. 52-55. *Muridae.*

With the exception of the hairs and wools of Black Musquash, or Musk-Rat, those of the other specimens of the family which are represented in this collection, show the cellular character of the medulla to which allusion has been made.

The sections of hairs of Black Musquash are elliptical in shape, possess a wide cortex and a slit-like medulla. The sections of the hairs of Short-Tailed Field-Vole and St. Kilda Field-Mouse are very small, of oval shape and possess a fairly narrow cortex and large medulla. The sections of the hair of Hamster are either oval or slightly reniform in contour. The cortex is narrow, the medulla broad, kidney-shaped, and of cellular character. The sections of hair of Brown Rat are circular in contour, as is the medulla which is small. The cortex is irregularly pigmented in its inner zone.

Plate No. 56. *Octodontidae.*

Coypu Rat is here the representative of this family. An examination of the hairs reveals the fact that the medulla when present is not well defined. In many of the hairs it is absent, the lumen being filled with longitudinal fibres containing irregular pigment. The wool is similar to that belonging to Castoridae. The cross-sections of the hairs which are interspersed among many sections of wool, show the presence of a medulla in several instances.

Plate No. 57. *Lagomyidae.*

The mature hairs resemble those of Muridae and Castoridae.

The sections resemble those of Marmot Plate 50, Photograph number 1, in that they are elongated and narrow but they exhibit a more definite and constant unilateral concavity. The cortex is of the same very narrow type and the medulla possesses a fine cellular character.

Plates No. 58-62. *Leporidae.*

The hairs and wools reveal the presence of a very broad cellular medulla which has been referred to in the hairs and wools of the previous families belonging to Order VII.

For the identifiable characteristics of this family an examination of the cross-sections is essential. These reveal appearances which are regarded by the writer as being of considerable taxonomic value. The contour of the sections of the hairs, which is uniform in character throughout the whole family, closely resembles the shape of a metacarpal or phalangeal bone of the hand. The sections are elongated, bilaterally concave, the concavity being more pronounced unilaterally, and possess rounded thickened ends. In certain odd instances they show a unilateral concavity, the remaining aspect being either straight or very slightly convex in outline. In the case of a few sections of hairs from Coney Rabbit, the contour resembles a "three bladed propellor" but this is regarded as the result of occasional sections having been cut at a slight angle. The cellular character of the lumen of the sections is important and the facetting of the cells, more especially at the terminal portions, is of interest. In many of the photographs sections of wool fibres which have been included in the hair bundles are seen.

ORDER VIII. *Carnivores.*

SUBORDER 1. *Fissipedes.*

FAMILY 1. FELIDAE.

FAMILY 2. HYAENIDAE.

FAMILY 4. VIVERRIDAE.

FAMILY 5. CANIDAE.

FAMILY. 6. URSIDAE.

FAMILY 7. MUSTELIDAE.

FAMILY 8. PROCYONIDAE.

SUBORDER 2. *Pinnipedes.*

FAMILY 9. OTARIIDAE.

FAMILY 11. PHOCIDAE.

Plates No. 63-71. *Felidae.*

The noteworthy characters of hairs from the animals belonging to this family consist of the clearly defined, densely pigmented medulla which varies in width, occupying from a half to almost the entire lumen, its finely irregular margins and the almost general presence of transverse striations in the cortical layer which is narrow. Although the majority of the wools exhibit a central cellular layer, those of certain animals, notably Ocelot, Snow Leopard, African Leopard, and Black Panther show a fibrous pigmented layer.

As the result of a casual examination of the cross-sections, they might be mistaken for those of hairs from a few of the animals belonging to Bovidae, but a more detailed examination will reveal that the hair sections of Felidae are appreciably smaller. The contour of the sections of hair from Felidae is most generally circular or slightly oval, although in the instances of British Wild Cat and Lynx, a definite elongation is encountered. In nearly all the sections the medulla is roomy and broader than the cortex which is moderately narrow. The rounded contours of the sections of hairs from Ocelot, African Lion, Jaguar, and Tiger are noteworthy. In most of the sections, the cortex shows very appreciable irregular pigmentation.

Plates No. 46 and 47. *Hyaenidae.*

The contour of the transverse sections is circular or slightly oval and the cortex is broader than the medulla. They are smaller than those of Bovidae and possess a broader cortical layer which, however, is less broad than that found in the sections of Equine hair.

Plates No. 72 and 73. *Viverridae.*

The cross-sections present a contour which is circular or oval and in detail they resemble closely those of Felidae, but are of larger size.

Plates No. 74-80. *Canidae.*

The appearance of these hairs is similar to that of the hairs of Felidae, including the transverse striation of the cortex.

The contour of the sections in many instances assumes an irregular shape which is seen in the hairs of Timber Wolf, Red Fox, Arctic Fox, Indian Wolf, Silver Fox and Jap Fox. The sections of the hairs of Jackal, Dog (Domestic) and North American Kitt Fox possess an oval shape. In nearly all the sections, a broad irregularly-shaped medulla is seen, which is a noteworthy feature of the hairs of Canidae. In many instances the cortex shows a granular appearance, which is best seen in the sections of the hairs of Jackal, Timber Wolf, Dog (Domestic) Dingo, Indian Wolf and Jap Fox. The sections are of moderate size and their appearance is regarded as having taxonomic value.

Plates No. 81 and 82. *Ursidae.*

The microscopic appearances of the hairs resemble those of Felidae and Canidae.

The transverse sections possess an oval shape, a very broad irregularly-pigmented cortex, with the exception of the hairs of Polar Bear the cortex of which is but faintly pigmented, and a proportionately small medulla. They are of about the same size as the larger hairs of Canidae.

Plates No. 83-89. *Mustelidae.*

The microscopic characters of the hairs of Ermine, Ferret, Polecat, Stoat and Sable are very similar to those of the Leporidae group when viewed in the horizontal plane. Those of the Marten, Otter, Skunk, Mink, and Badger reveal somewhat different characters. These hairs generally show a well-defined and broader cortex which is irregularly pigmented and composed of longitudinal fibres. The medulla is moderately narrow but the breadth varies The presence of definite longitudinal, pigmented fibres in the cortex is of taxonomic importance in differentiating between these two groups of animals belonging to the same family. The wools of the Otters are characterised by their markedly spiky cuticular margins, the absence of a cellular medulla and the presence of a faint and irregularly-pig-

mented fibrous lumen. The wools belonging to the other members of this family show a cellular medullary layer and a less coarse serration of the cuticular margins.

The general shape of the sections is oval with a varying degree of elongation and bilateral flattening. The cortex is narrow and the medulla large and broad. The cortex as a rule contains a considerable amount of irregularly-distributed and dense pigment. In many of the specimens portions of pigment may be seen in the medulla. The sections of hairs from the tail of the Stone Marten are more circular in shape than the sections of hairs from the coat, and those of the hairs of British Otter, and African Otter are much more elliptical in contour than any of the other sections in this group. The hair sections of British Otter and Sea Otter are slightly lanceolate in shape. The medulla in the hairs of the Otters is narrow and the cortex, which is heavily pigmented, broad. The cross-sections of all the wools excepting those of the Otters, possess a roomy and irregular medulla and exhibit serrated cuticular margins. The sections of the wool of Ferret possess a small medulla, whereas those of the Otters do not show one.

Plates 90-93. *Procynidae.*

The medulla of the hairs of the animals belonging to this family is of varying breadth and is well defined; its margins are finely irregular and it is composed of cells similar in character to those present in the medulla of the hairs of the animals belonging to the other families in Order VIII.

The sections are oval in shape. The cortex and medulla are of about equal breath. The former contains a varying amount of pigment which imparts a granular appearance, the later possesses an irregular contour.

SUBORDER 2. *Pinnipedes.*

Plates No. 94 and 95. *Otariidae and Phocidae.*

The hairs of the seals are fairly broad. Their tips are characteristic, in that, commencing in a broad base they quickly taper to form a fairly fine tip. (Vide Plate number 94, Photo-

graph No. 5.). They do not possess a medulla. The wools are almost identical to that of the Otters (Mustelidae).

The sections of the hairs of Common Seal and Alaska Fur-Seal are cigar-shaped, deeply pigmented and do not possess a medulla. Those of Grey Baby-Seal are less elongated, are almost devoid of pigment, and do not show a medulla. The shape and characters of all these sections are regarded as being such that identification of the hairs is rendered easy and they are therefore of very great taxonomic value.

Order IX. *Insectivores.*

Suborder 1. *Insectivora Vera.*

Family 3. ERINACEIDAE.

Family 4. SORICIDAE.

Family 5. TALPIDAE.

Plate No. 96. *Erinaceidae.*

The only specimens of hair available are those of the Hedgehog. The bristles of this animal are readily identified by the naked eye. The microscopic appearances of the hairs in the longitudinal plane are not sufficiently characteristic to warrant comment from a taxonomic point of view.

The contour of the transverse sections is almost completely circular. The cortex, which is as broad as the circular medulla, is irregularly pigmented, imparting a granular appearance.

Plates No. 97 and 98. *Soricidae.*

The microscopic appearances of the hairs of Common Shrew and Water Shrew are regarded by the writer as being sufficiently characteristic to permit of immediate identification. The fibres commence from the skin surface as wool and in that portion show great irregularity of the cuticular margins which resembles a « dragon-tail » in appearance. Following the fibres upwards, the lumen of the wool is seen to expand and narrow at more or less regular intervals, until the fibres assume the appearances of hair, when after a short interval they terminate in fine hair-tips.

A few of the sections are of hair and these although very similar to the sections of wool, show a smooth cuticular layer, a large medulla, and the contour exhibits a slightly elongated appearance. The sections of wool possess an irregular cuticle and a large but irregularly-shaped medulla.

Plates No. 96 and 98. *Talpidae.*

The soft, short character of the hair and wool is important. The microscopic appearances in the longitudinal plane are not of much importance from a taxonomic aspect.

The sections of hair are oval in shape. The cortex and medulla are almost equal in breadth. The medulla, which is of irregular elliptical shape, is densely pigmented. The sections of wool show an irregular cuticle, a very narrow cortex, and a large irregular, densely-pigmented medulla.

Order X. Chiroptera.

Suborder 1. *Megachiroptera — Frugivorous Bats.*

Plates No. 99 and 100.

The definite imbrications of the cuticular margins of the hairs are of importance. Reissner[23] refers to the partial absence of the medullary substance in some animals, and its total absence in some of the Chiroptera. In this regard it should be noted that the medulla is faintly but definitely seen in photographs 1 and 3. (Plate 99).

The sections vary from a circular to a reniform shape. The medulla when present is moderately small, lightly pigmented and of circular contour. The cortex is broad and densely pigmented.

Plate No. 99. *Pteropodidae.*

The photograph of the hair was taken from a specimen which had been mounted for some years. It is considered advisable therefore to withhold an opinion regarding the taxonomic value of its appearances.

ORDER XI. *Primates.*

SUBORDER 1. *Lemuroids.*

FAMILY 2. CHIROMYIDAE.

FAMILY 3. TARSIIDAE.

FAMILY 4. LEMURIDAE.

SUBORDER 2. *Anthropoids.*

FAMILY 5. HAPALIDAE.

FAMILY 7. CERCOPITHECIDAE.

FAMILY 8. SIMIIDAE.

Plates No. 101, 102, 103, and 108.

Chiromyidae, Tarsiidae and Lemuridae.

The hairs of the animals from these families will be considered collectively. They are generally very broad, uniformly and deeply pigmented, and in many instances resemble closely the hairs of moustache and beard of the human male or the pubic hair of human male and female, unless a careful examination of the respective cross-sections be made, when definite differences will be found. The method of differentiation will receive consideration at a later stage. In the young hairs and in the wools of the members belonging to the above families, a definite cellular medulla is frequently seen, which is never met with in the examination of young or mature human hairs. In the adult hair of the Primates of Suborder 1, the medulla is usually very broad as compared with human hair in which it is narrower than in any of the hairs belonging to the Mammalian group of animals.

The sections of the hairs of Aye-Aye possess an irregular contour, some being elongated and bilaterally concave, others of partly circular shape with a flattened base. The cortex is broad, deeply but irregularly-pigmented and the medulla is fairly large and of irregular shape. The sections of the hair of Tarsier are moderately small, are oval in shape and possess a large and densely pigmented medulla. Those of the hairs of

Ruffed Lemur are ovoid in shape, the cuticular margin is finely irregular, and the cortex fills the lumen, the medulla being absent. The appearances of the foregoing sections are such that they need never be mistaken for those of human hair and are sufficiently characteristic to permit of the identification of the animals to which the hairs belong.

Plates No. 104-108.

Hapalidae, Cercopithecidae and Simiidae.

The cellular character of the medulla is very frequently seen in the older hairs of Hapalidae and almost constantly in the young hair. The medulla is broad. The hairs of Arabian Baboon and Chacma Baboon when viewed horizontally, may simulate human hair, but the cortical pigment is more copious and possesses a coarser character than is met with in hairs of human origin, the entire lumen and medulla of which are as a rule narrower as will be revealed in cross-section. In nearly all the specimens of the more immature hairs of the animals belonging to the above families a cellular medulla may be seen. Many of the wools show very definite cuticular serration and imbrication (Vide Plate No. 106, Photographs 5 and 6). The appearance of the wool in number 5 resembles closely the pattern on the trunk of the Araucaria Tree. It is necessary to refer also to Section II of Atlas, Plate No. 33, Photograph No. 9, which is of a very young hair or wool-hair from the abdomen of a male human subject. Considerable confusion might arise in differentiating between the second of the two photographs first alluded to and the last mentioned. Examination will reveal, however, that in the case of human wool-hair the cuticular serrations are very much less marked. This is a constant difference.

The finer hairs of Chimpanzee, several of the hairs of young female Gorilla and adult male Gorilla which belong to Simiidae, strongly resemble human hair. There is a striking resemblance between Gorilla hair, (Plate No. 106, Photograph No. 12), and human hair (Section II of Atlas, Plate No. 16, Photograph No. 1). Differentiation is rendered easy, however, by a careful examination of the cross-sections.

The sections of the hair of Common Marmoset are small, oval, and possess a fairly large medulla for the size of the section. Those of Arabian Baboon are very large, almost cir-

cular, and possess a wide medulla. The sections of hairs of Chacma Baboon are of moderately small size and are circular or oval in shape, the medulla is fairly large; those of Diana Monkey are oval, and the medulla is large; and those of Colobus Monkey are very similar except that the pigment when present is more uniformly distributed. The sections of the hairs of Chimpanzee are large, irregularly-pigmented and do not reveal a medulla, whereas the sections of the hairs of young female Gorilla are small, more or less circular, and possess a small pigmented medulla. The sections of the hairs of Gorilla more closely resemble sections of human hair than those of any other hairs belonging to the Mammalian group. The means of distinguishing between the cross-sections of hairs of the higher grade monkeys and of man will receive consideration in later Sections.

SECTION VI.

The Macroscopic Appearances of Human Hair.

The study of the macroscopic and microscopic appearances of human hair is of the greatest importance to the medical jurist, as the information derived therefrom is by no means infrequently of great value as an aid to the elucidation of a murder or assault by helping to establish the guilt or innocence of an accused person or persons. The diversity in appearance of human hairs is very great on account of the many shades it may assume, the alterations due to age, and to the different characters it presents having regard to the part of the body from which it has been removed. The hair of the body may possess a black, dark brown, light brown, auburn, golden, grey or white colour depending upon the nature of the pigments present or as in the case of white hair the almost complete absence of pigment, which is commonly the result of age or disease. Griffith[24] holds the view that "The appearance considered as an accumulation of pigment into little heaps, arises from a number of air cavities existing in the medullary portion of the hair; the air contained within them refracts the rays of light beyond the field of the microscope, and thus they appear black; they are, however, rarely perfectly black, there being generally a minute white spot in the centre. These air spaces probably arise from the evaporation and escape of the fluid which in the younger hair filled the cells of the medulla." In opposition to this view Sorby[25] states that "Human hair is a colourless horny substance variously coloured by three or four distinct pigments. Only in a few extreme cases is it that any of them occurs alone." He holds the view that golden hair results from the presence of a small amount of red pigment and relatively more of a yellow pigment. In the case of dark red hair, the colour is due to an admixture of red and black pigments; sandy brown hair, to a mixture of black, red and yellow pigments; dark brown hair to an increase in the

amount of black pigment; black hair, to the presence of black pigment to such an extent that the other pigments are overpowered; and white hair, to the absence of pigments. In conclusion he adds that "In some specimens nearly every hair is solid, whereas in others nearly all possess pith cavities. In many cases some hairs are solid and some not." So far as Griffith's views are concerned the writer is not in agreement that pigment is confined to the medulla and that air cavities appear to be present in the cortex.

The most conclusive proof obtained by Sorby in support of his theory consists in his ability to dissolve out the pigments from hair and to obtain them in solution. Nathusius[26] appears to favour a combination of these theories, when he says that "The colour of a hair is commonly supposed to depend on the presence or absence of pigment granules of different shades in the cortex. This is of course largely the case. But there is often in addition a diffuse colouration throughout the cortex, and as above remarked the colour of a hair is affected not inconsiderably by the degree of development of the medulla and what is related to it, the presence or absence of air vacuoles in the medullary canal." Alternate transverse black and white mottling of human hair was not encountered by the writer; although Frazer[27] reports this condition.

The areas of the body of the adult human subject of either sex upon which appreciable hair groupings are found are the scalp, the eyebrows, the eyelashes, the axillae, the pubes, and perineum. The body of the mature and virile male displays hairs upon the side of the face, the upper lip and jaws, the floor of the external canals of the ears, the nostrils, the neck, the front of the chest and abdomen in varying amount, the arms, the backs of the hands, and the legs. In the case of the mature female a few hairs may be encoutered on the abdomen, forearms and legs and, in rarer instances, upon the upper lip and on the chin. In the case of children of either sex below the age of puberty, with the exception of very odd instances of precocious development, the only hairs that are of importance from the medico-legal aspect are those of the scalp, the eyebrows and eyelashes. Hairs from certain areas of the body surface present special macroscopic and microscopic appearances. Todd and Bowman[28] state

that "Hairs are found on all parts of the body surface except the palms of the hands and the soles of the feet and differ much in length, thickness, shape and colour, according to situation, age, sex, family or race. The shape of the hairs in different situations offers some variety. In general they taper towards their free end. Those of the head are often not cylindrical, but compressed on one or both sides, in that their transverse section is reniform or oval. Those of the eyebrows and eyelashes taper towards both extremities. Hairs also vary in being lank or woolly, permanent or deciduous."

This thesis does not deal with the racial differences in hairs; but in this regard reference is made to the excellent contribution upon the subject by Turner[29] and Fritsch[30].

In both sexes and at practically all ages the hairs which compose the eyebrows and eyelashes are more or less alike, being short in length, more wiry than the scalp hairs and terminating in a point or tip. Certain reservations are, however, necessary to the foregoing statement. The greater the maturity of the subject, the more usual is it to find a coarsening of the texture and in the case of the eyebrows, generally an increase of length, more especially in the male subject. It is not uncommon to encounter the "bushy" eyebrows of the male in middle life, which in addition to being very wiry in texture possess very appreciable length. The eyelashes also tend to be much longer in certain individuals than others and on occasion may exceed an inch in length. The tip of the eyelash is more pronounced than the tip of the eyebrow hair. In the male when a beard or moustache is worn, the hairs are characterised by their thick, wiry consistency, the length depending upon the nature of the beard or moustache worn. Since these hairs are as a rule trimmed periodically, it must not be expected that a tip will be found in all cases. In the male sex when appreciable hair is present upon the chest or abdomen, it usually possesses a wiry character, as does the pubic and perineal hair in both sexes. The hair covering the pubes in both male and female frequently assumes a curly contour and may rarely attain a length exceeding four inches. The axillary hair in the male is usually coarser in texture than that of the female. The hair upon the surfaces of the arms and backs of hands and legs in the male is usually

of a fairly fine character, and when present in the female is silky to the touch. Pruner-Bey[31] states that "In man excepting some regions, as the face (in the male), the armpits, the pubes etc., the surface presents generally only the rudiments of the fleece of animals; it is the hair of the head which distinguishes man in this respect." He also remarks that "The shaft, when subjected to microscopic examination in the direction of its length, presents differences according to the state of its development. For, before attaining its full growth, the hair passes, so to say, through an embryonic stage; and it is noteworthy that the down is abundantly intermingled with the hair in the polar races." It must not be forgotten that at the present time fashion is an important factor in altering the naked eye appearance of hair upon certain areas of the female body. "Bobbing", "Shingling," or "Eton Cropping", of the hair of the scalp reduces the length of the hair, and in the last of these three procedures it may be cut so short as not to exceed the length of the hair upon the male scalp. The shaving of the axillary hair, from a cosmetic point of view, is by no means an uncommon procedure, as is the cutting of the pubic hair for hygienic reasons.

The hair upon the scalp as a rule possesses a fairly fine character, more especially in the case of the female. The periodic cutting of male hair produces a coarsening in the texture. It is worthy of mention that at the present time many of the younger males, especially those belonging to the lower classes, cultivate the length of the scalp hair in order to permit it being brushed straight back from the forehead. As a result of this practice the hair when displaced forward frequently reaches the tip of the nose. In such cases the length of the hairs may closely approximate that of the female and might without further examination, lead to fallacy as to which sex the hair belongs. Having due regard to the great variations in the length of hairs, the writer has purposely omitted measurements, as such being only approximate are not considered reliable and therefore valueless.

Although there can be little doubt that a detailed examination of human hair reveals much important information, the writer is strongly of the opinion, which he has reached after the careful examination of many thousands of hairs, that an accurate de-

termination of the sex of the subject from which the hairs have been removed cannot be deduced in all cases from the microscopic appearances of the hairs alone. In a number of instances, however, the macroscopic appearances, in conjunction with the microscopic examination, will however, be such as to permit of an accurate opinion being given by a skilled observer as to whether the hair belongs to the male or female subject. Before considering this point in greater detail, the microscopic characters of human hairs demand careful consideration. It is unfortunate that the colours of the pigment cannot be revealed in these micro-photographs, for if this had been possible, an examiner would have been able to classify hairs into their various colour groups with considerable accuracy from the colour appearances shown microscopically. Before describing the microscopic characters of human hars when examined in their horizontal plane, it is expedient to allude to the opinions of two writers upon the subject, so that as the photographs are examined and interpreted their findings may receive attention. Pruner-Bey[32] states that "With regard to the volume of the hairs, the lighter the colour, the finer the hairs and vice-versa. This rule is, however, subject to exceptions; there are three specimens of golden-light shade, the hair of which attains the thickness of the black hair." Mertsching[33] after referring to certain statements made by Kollicker in 1888, regarding the frequent absence of a medulla in coloured human head hairs and its almost regular occurrence in white hairs, remarks "That this points to the inference that the formation of the medulla is connected with the turning grey of the hair." Let us now examine the photographs of human hairs contained in the accompanying Atlas, Section II.

The Microscopic Appearances of Human Hair in the Longitudinal Plane.

ORDER XI. PRIMATES.

SUBORDER 2. ANTHROPOIDS.

Plate No. 1. FAMILY 9. HOMINIDAE.

Photograph number 1 is of red hair ; the rich character of the granular-like pigment in the cortex is clear to the observer and the medulla is well defined, whereas the second photograph which forms a great contrast in appearance, is of white hair in old age. In it, there is a great deficiency of pigment due to age and consequent degeneration of the bulb and hair. Photograph number 3 is of a healthy hair bulb as shown by its uniform contour and inner structure. Number 4 is of a diseased hair-bulb which clearly reveals the degenerative changes present also the ruptured sheath.

The last photograph upon the plate is of a cut hair in which the severed fibres can be seen faintly.

FEMALE HEAD HAIR.

Plates 2-11.

Plate No. 2.

The subject of the photographs is indicated above each upon the plate.

Numbers 2-4 are narrow, and but slightly pigmented. The medulla is not seen. Photographs 5 and 6 show very much broaders hairs which are uniformly and densely pigmented. These hairs are of black colour. Photographs 7 and 8 are of dark brown hairs. The former reveals a thin and irregular medulla, the latter is devoid of medulla. The same description is applicable to photographs number 9 and 10.

Plate No. 3.

These six photographs do not call for comment.

Plate No. 4.

Photographs 1-4 show hairs of fairly narrow calibre which are uniformly pigmented and do not reveal the presence of a medulla. Numbers 5-9 are of light brown hair and, with the exception of photograph number 8, all are much broader than the four hairs first described. The last five subjects show considerable variance in the medulla. In the first of these it is entirely absent and in the second and last almost absent.

Plate No. 5.

In this collection of photographs there are examples of brown, fair, brunette, and black head hairs which have been taken from female subjects aged 17 to 18 years. The medulla is seen only in photograph number 3 of brown hair and number 11 of black hair. In these two instances it possesses a broken appearance. The lighter coloured hairs are broader generally than those of very dark colour and the longitudinal fibres of the cortex are clearly seen. Photograph number 4 shows the regeneration of a cut hair, the terminal portion having assumed a cone-shaped contour.

Plate No. 6.

These photographs are of female head hair of dark brown, auburn, and reddish colour. The age of the subjects was 19 years. It will be noted that a medulla is seen only in the cases of auburn and one specimen of reddish hair. In the former, it is represented by an almost clear, thin line whereas in the latter, by a dense and fairly uniform pigmentation.

Plate No. 7.

These photographs do not call for special comment.

Plate No. 8.

Attention is directed to photograph number 6 which shows a hair from the head of a female brunette aged 27 years. The absorption of medullary pigment is evident as is the absence of cortical pigment. This specimen is regarded as interesting from a medico-legal viewpoint as showing the danger of arriving at a definite opinion based upon the examination of the characters of a single hair. In this instance the characters would justify

the conclusion that the specimen was a grey hair as in point of fact it was, but not that of an old person as revealed by an examination of the other hairs available. This is an example of finding a grey hair among normally coloured hair in a fairly young subject, which is not uncommonly encountered in the examination of hairs.

Plate No. 9.

Photographs 6-8 show the transitional stages in the process of a reddish coloured hair becoming grey. In number 6, there has been some absorption of the rich pigment usually found in a hair of reddish colour. Number 7 shows the unilateral density of the pigment. Number 8 shows the hair after nearly all the pigment has disappeared. Photograph number 9 is the first of a series which is continued on the next plate.

Plate No. 10.

Photographs 4 and 5 are of hairs originally black in colour which have turned almost completely white. The absence of pigment is clearly seen in both. Photograph number 6 is of the tip of a fine hair from the upper lip of a female subject.

Plate No. 11.

These photographs are intended to show the various stages in different coloured hairs during the process of turning grey or white. The gradual and progressive reduction in the amount of pigment should be noted specially.

Male Head Hairs.

Plates No. 13-17.

The age of the subject from which the hairs were removed together with the colour of the hairs is inserted upon the plates above each group of photographs.

Plate No. 13.

In the first group comprising three photographs, a thin medulla is present in the first photograph. In number 2, the medulla is absent but the thin cuticle is observed as is the broad cortex,

which is composed of longitudinal fibres and contains fine granules of pigment. The last photograph in the group shows the end of a hair which has been cut and in which the process of regeneration is advanced.

In the second group, the first photograph reveals a very light pigmentation of the hair. A well-defined narrow medulla is seen in the second photograph. The last of the three hairs is densely pigmented and is without a medulla. In the last group of four photographs, a medulla is seen in numbers 2 and 3. In the former it is very narrow and irregular.

Plate No. 14.

Photographs numbered 1 and 3 are of broad hairs. The former reveals the presence of the cuticle, cortex and medulla in a striking manner. Photograph number 4 is of fair hair and reveals the presence of light pigment, whereas photographs numbered 6 and 7 are of black hair, the presence of dense dark pigment almost obscuring the medulla which is present.

Plate No. 15.

Photographs numbered 2, 6 and 8 are of broad hairs. Numbers 3, 4, 6, 7 and 8 reveal the presence of a medulla. The absence of medulla and the slightly coarse character of the pigment granules in number 2 are noteworthy. Number 3 shows a thin irregular medulla which is characteristic of the medulla of human head hair. The partial absorption of pigment in numbers 4, 7 and 8 is worthy of comment.

Plate No. 15. A.

In these photographs the process of the absorption and disappearance of pigment which occurs when hairs turn grey through age, is well marked. This is clearly evident in both the cortex and medulla. The cuticle is readily seen in the photographs.

Plate No. 16.

In the first four photographs, the medulla is evident. In number 1, it appears to be very broad for human head hair and the breadth of the hair itself is considerable. The character of the pigment granules is of importance in such cases as will be appreciated later. The remaining photographs do not call for comment.

Plate No. 17.

The photographs show the degenerative changes with the accompanying disappearance of pigment in the hairs which are encountered in old age. The hair in number 2 is very broad and the pigment granules together with the longitudinal fibres of the cortex are well marked. The breaking down of the medulla is seen in photographs numbered 3, 4 and 6. Number 7 represents a completely white hair which appears to be devoid of pigment.

Let us now examine the characters of the hair derived from different parts of the body of both sexes.

Female.

Plates No. 24-29.

All the photographs are of pubic hair. The medulla when present is broad for human hair, is densely pigmented and somewhat irregular in outline. The great breadth of the hairs is worthy of comment. The irregular appearance of 4 is noteworthy. Numbers 8 and 9 are of very young, immature hairs and possess the characters of wool. The imbrications in the former are interesting.

Plate No. 25.

The hairs are from the female abdomen and possess finer characters than those of the male subject. Plate No. 33, Photographs 7-9. Photograph number 5 is of a very young and immature hair. Number 6 shows the bulb of the hair which has been pulled out, as indicated by the ruptured sheath.

Plate No. 26.

The hairs from head numbered 1-3 are very broad for the type of hair but this is accounted for by the fact that it is of coarse texture near the ends due to constant cutting. In this instance, the subject had been "Eton Cropped." Number 4 shows a very much thinner hair which has been taken presumably from a less frequently cut part of the scalp hair. Number 5 shows a cut hair under high-power magnification. Numbers 6 and 7 are of axillary hair and are fairly broad also due to repeated cutting and consequent thickening. Number 8 shows the cut hair fibres under high-power magnification. Number 9 shows the process of regeneration of a cut hair.

Plate No. 27.

Photographs 1-6 are of hairs from female lower leg and are regarded as being self explanatory. Number 6 shows a very young and therefore fine hair. Numbers 7 and 8 are of very fine hairs from the female forearm.

Plate No. 28.

Photographs 1-6 are of anal hair from the adult female subject. Number 4 shows a hair which has been cut with a blunt pair of scissors, and the tearing of the fibres is clearly seen. Number 6 shows the same under high-power magnification. Number 5 is of wool hair, and the serrated margins should be noted. Photographs 7 and 8 are of eyelashes from the female subject. In the former only a portion of the medulla is present.

Plate No. 29.

Photographs 1-3 are of hairs from the upper lip of female. Numbers 2 and 3 were taken under high-power magnification. It will be noted that the cuticular margins are slightly serrated, indicating the immature character of the fibres. Photographs 4-9 are of hairs from the eyebrow. The first four reveal dense pigment more or less uniformly distributed. Number 5 is of immature hair as shown by the serrated cuticle. Photograph number 9 shows the very fine tip of a thin eyebrow hair.

MALE.

Plates No. 31 — 33.

Plate No. 31.

The first group of three photographs of male eyebrow hair, reveals a more or less uniformly distributed pigment throughout the lumen and the absence of a medulla. The first photograph is of a hair at a broad portion, whereas numbers 2 and 3 are of portions nearer to the tip.

Photographs numbered 4 and 5 are of anal hair. The former is narrow and does not possess a medulla. The latter is fairly broad, and reveals a thin, irregular but deeply pigmented medulla.

Photographs numbered 6 and 7 of forearm hair show that

the former is of fine hair, the latter of wiry hair, which is much more coarse in character than the hair from the forearm of the female (Plate 27, numbers 7 and 8) and possesses an irregular but deeply pigmented medulla.

Plate No. 32.

Photographs 1 and 2 are of hair from the thigh of a male. Number 1 shows a partial break near the middle of the fibre. A faint, very thin medulla of irregular type can be seen. Number 2 is of a hair from the same region. It is broader than the former specimen and exhibits an irregular and densely-pigmented medulla. Number 3 is of a hair from the scalp and on account of the uniform density of the pigment, detail is obscured. Numbers 4 and 5 which are of pubic hair are characterised by their breadth. The former shows a very definite, densely-pigmented but irregular medulla and a cortex which contains longitudinal fibres in which is included a small amount of pigment. The latter shows similar characters with the exception of a medulla. Number 6 is of hair from the leg which is almost identical with number 2 from thigh.

Photographs 7 and 8 are of hairs from the back of the hand. The former is densely and uniformly pigmented and the medulla is absent. The latter shows a scanty medulla.

Plate No. 33.

Numbers 1-5 do not call for comment further than to remark that all the hairs are of fine texture. Numbers 7 and 8 are photographs of hairs from the abdomen of the male. They are fairly broad and reveal a thin, irregular medulla. Number 9 shows a "wool" hair or very immature hair. It is almost devoid of pigment and possesses a serrated cuticle. Photographs 10-12 are of moustache hair. These along with beard and pubic hairs are the broadest human hairs which are encountered. It should be noted that the breadth of the medulla varies greatly. In 1 and 2 it is broad whereas in 3 it is absent, the cortex almost completely filling the entire lumen. In number 1 the middle of the hair has been damaged.

SECTION VII.

The Microscopic Appearances of Human Hair in the Transverse Plane.

Although a macroscopic and microscopic examination of human hairs, when conducted by an experienced observer, will in many cases permit of their differentiation from those belonging to the animals composing Mammalia, a careful study of the appearances of their transverse sections is an essential which should never be omitted, even when only a single hair is available. A solitary hair can be embedded and sectioned. In the opinion of the writer, the taxonomic value of the characters of transverse sections cannot be over-estimated. By their means an examiner is able to assert definitely in all cases whether hairs are human or animal in origin, for reasons which will be submitted at a later stage. In order to appreciate fully the nature of the characters upon which reliance can be placed in this connection, the appearance of the sections of human hairs should first receive detailed consideration.

Transverse Sections of Human Hairs.

Plate No. 1.

Photographs numbered 5.-8 are of transverse sections of human head hairs. Number 5 is of black hair. (This photograph is of a permanent specimen and has been included in this collection by permission of Professor Glaister, The Forensic Medicine Department, The University of Glasgow). The contour of the sections is oval in the majority of the specimens. In practically all, the pigment is more dense peripherally. In many, a very small, centrally-placed medulla is seen. Number 6 reveals larger-sized sections, which are broader in character, more uniformly though lightly pigmented, and possess a centrally-placed small, round

or slit-like medulla, which in the majority of the sections is almost devoid of pigment. The very narrow regular cuticle is clearly seen. Photograph number 7 shows sections which do not possess a medulla, but the accumulation of granular-like pigment in the outer half of the lumen is clearly demonstrated. The sections in photograph number 8 are almost identical to those in number 6.

The following plates contain photographs of sections of head hairs of the female subject. The age of the subject from which the hairs have been taken, together with the colour of the hairs are inserted above each photograph.

Plate No. 18.

The photographs on this plate do not call for much, if any, description as the sections reveal characters which have already received attention. In photograph number 4, which is of light brown hair, a small medulla is seen in a few of the sections. The granular appearance of the pigment and its greater accumulation peripherally are clearly seen in all the photographs.

Plate No. 19.

In the first photograph many of the sections show a medulla, which is also seen in several of the sections in photographs 4 and 5. The sections in number 4 possess a more or less circular contour, while in number 5 one shows a more or less triangular shape, which indicates a wiry type of hair.

Plate No. 20.

The presence of a medulla is seen in photographs 1, 2, 4 and 5. The sections of almost pigmentless hairs which are present in photographs numbered 1, 4 and 5 show the medulla very clearly. The following plates contain photographs of sections of the head hairs of the male subject.

The age of the subject from which the hairs have been taken together with the colour of the hairs, is inserted above each photograph.

Plate No. 21.

The first photograph is of sections of black hair. They are generally irregularly-oval in shape. A few are unilaterally

convex, the remaining side being straight. Pigment is copious and is more dense perpherally. An occasional section exhibits a small darkly-pigmented medulla. A few small sections of hair-tips are seen. Those which are almost circular in contour, denote soft hair. The majority do not show a medulla.

The second photograph exhibits sections which possess a similar contour to those in the former photograph. The pigment is not dense. The cuticle is clearly seen. A few of the sections exhibit a small clear medulla.

In photograph number 3, in addition to the irregular-oval contour of the sections an odd reniform or triangular shape is seen. The sections are of larger size than those shown in the above plate. The pigment, which is of light colour, is seen in granular form. These granules assume a scattered distribution. A medulla is seen in several of the sections.

Photograph number 4 contains elongated irregular-oval contours, which in some of the sections are broader at one end than the other. The peripheral distribution of the pigment is clearly shown. A medulla is frequently seen.

In photograph number 5 the sections possess an oval contour. They are moderately large. The cuticle, cortex and, in several instances, the medulla, are clearly shown. The characteristic pigment is present. The medulla when present is frequently of dark colour.

Plate No. 22.

The first two photographs reveal sections which are ovoid and broad in shape. Several show a medulla. The sections are fairly large. The cuticle is clearly demonstrated. The cortex is irregularly pigmented.

In photograph number 3 the sections are large, irregularly-oval and slightly elongated. The medulla is fairly large and oval or slit-like in shape. The sections of the white hairs are clear but some show scanty pigment granules. The black hairs reveal copious pigment of dark colour which is more dense peripherally. Many of the completely white hairs show a colourless medulla. An occasional section is of reniform shape. Photograph number 4 shows that the contour of the sections varies from an almost circular shape to a slightly reniform contour.

The cortical portions of the grey hairs are devoid of pigment. The brown hairs are pigmented. An occasional triangular shape is seen.

In number 5, broad or elongated irregular-oval shapes are generally present but in addition an occasional triangular form may be seen. Several of the sections are pigmented, but the majority are unpigmented.

Plate No. 23.

In photograph number 1, the sections are large, copiously pigmented, and many show a medulla.

Photograph number 2 shows that the contour of the sections varies from circular to irregularly-oval. The majority are very lightly pigmented. The sections of completely white hairs are colourless except for the presence of a few, scattered, refractile pigment granules. Some sections of pigmented hairs are seen, but these show absorption of the pigment.

In number 3 the sections are irregularly-oval shaped, are almost devoid of pigment, and many possess a dark medulla. The sections are fairly small. The sections of the white hairs possess a refractile appearance.

Photograph number 4 shows that the contours of the sections are of a broad, oval character. They are almost devoid of pigment. A few scattered pigment granules are seen. Some of the sections possess a medulla.

The following plates contain photographs of sections of hairs from the body surface of the female and male subjects. The site of the hairs upon the body has been inserted above the photographs.

FEMALE.

Plate No. 30.

Number 1. Is of the hairs of the leg. The sections are larger than those of the male (Plate 34, No. 6), and this is accounted for by the fact that the subject from which the hairs were taken had, in the past, repeatedly cut the hair in this region. The medulla is absent in these sections, and it should be explained that the simulation of a medulla seen in the section to the extreme right of the field is due to the presence of a coarse pigment granule.

Number 2. The section is more elongated than those of male hairs from the same region (Plate 34, No. 4). It is also larger, due to the fact that the region from which the hair was taken had been frequently shaved for cosmetic purposes. A light coloured but well-defined medulla, which contains a few pigment granules, is present.

Number 3. This section of the hair of the female eyebrow is very much smaller, and less uniformly pigmented than that of the male eyebrow (Plate 34, No. 2). It is also devoid of a medulla, but the peripheral distribution of the cortical pigment is noteworthy. Numbers 4, 5, and 6, are of perineal, pubic and labial or vaginal hairs respectively. The sections of pubic hair are larger than the corresponding hairs of the male. (Plate 34, No. 7.) The sections of female pubic hair contain little pigment and an occasional elliptical medulla is seen. The section of perineal hair of the female which is of ovoid shape and contains a well-defined medulla, is smaller than those of male perineal hair. (Plate 34, No. 8.). The labial hairs are slightly larger, more elongated, and possess a more elliptically-shaped medulla than those of the male scrotal hair. (Plate 34, No. 9).

Several of the photographs of the female body hairs have been selected, in order to show the coarsening of the hair which results from repeated cutting and the consequent difficulty in identifying the sex of the subject from which the hair has been derived. In these instances, mention has been made of the fact in order to obviate misinterpretation.

MALE

Plate No. 34.

Number 1 shows sections which possess a globular contour. They are broad, not densely pigmented, and the majority show a medulla which contains a moderate amount of pigment. The peripheral distribution of the cortical pigment is not as marked as in the case of head hair.

Number 2 is of a section of an eyebrow hair. It is of large size and the cortex is more or less uniformly pigmented. The medulla is absent. The contour of the section is irregularly-oval.

Number 3 shows a section of an eyelash which approximates

to the size of head hair. The contour is elliptical and the three layers are clearly seen. The cuticle is pronounced and clearly demonstrated. A medulla is present. The peripheral distribution of the cortical pigment is distinct.

Number 4. The sections are of about the same size as those of head hairs. Several are elongated, although an occasional triangular form is present. One or two possess a medulla.

Numbers 5 and 6 are of sections of arm and leg hair respectively. Their size is less than that of the average head hair of the adult, and their shape is much more elongated. The medulla is absent in all the sections. The peripheral distribution of the pigment is well marked.

Numbers 7, 8 and 9 are photographs of sections of pubic, perineal, and scrotal hairs respectively. The sections possess an elliptical shape, and are elongated and flattened. The pubic and perineal hairs are larger than scrotal hairs. The sections of pubic hairs are larger and possess a clearer and more defined medulla than in the instance of scrotal hairs. The sections of perineal hair do not show a medulla, whereas those of scrotal hairs frequently reveal its presence although smaller, less well-defined and more pigmented than in sections of pubic hair.

Plate No. 35.

The first photograph is of a section through the base of a hair from the moustache, whereas the second and third are sections through the middle and upper portions of the hair respectively. All possess an irregular triangular shape. The granular pigment of the cortex is clearly seen as is also the medulla. In number 3, the medulla contains a granule of dark-coloured pigment. The sections are large, more especially that shown in the first photograph. In number 4 which is a section of beard hair, the contour, although more regularly triangular than the sections of moustache hair, possesses a very definite similarity. The cortical pigment is very scanty due to the hair being almost pigmentless but the medulla which is moderately large, contains a few definite, dark-coloured pigment granules.

SECTION VIII.

The Taxonomic Value of the Appearances of Human Hairs in their Longitudinal and Transverse Planes.

Following upon the examination of human hairs in their longitudinal and transverse planes, it is now opportune to direct the attention to the facts which have been elicited from this examination. It is necessary to consider the information obtained from seven different aspects, namely :

(1) Is the hair that of a human being?
(2) If it is human hair, is it the hair of a male or female subject?
(3) What is the approximate age of the individual from which the hair has been derived ?
(4) From which part of the body has the hair been derived?
(5) Has the hair been dyed or is it of natural colour?
(6) Has the hair fallen out, been pulled out, or cut?
(7) If it has been cut, was a sharp or blunt instrument used?

(1) *Is the hair that of a human being?*

It is not a very difficult matter to determine whether hairs are animal or human in origin. In many cases the colour of animal hairs will immediately reveal their origin, more especially those which are coloured alternately or possess vivid hues, as such are confined to animals. In other instances the shape of the hairs will be such as to permit of the elimination of the possibility of hairs being human in origin. The length of human hair cannot be relied upon too strongly at the present time, on account of the common practice of cutting the female head hair. A microscopic examination of hairs in their longitudinal and transverse planes will determine whether they are animal or human in origin. In the former, the medulla is much broader than in the latter. Moreover in the hairs of animals it is composed of cells of different shapes and is more or less uniform in calibre.

In the hairs of ran, the medulla is never composed of cells which reveal a definite outline; it is narrow, frequently lacking in uniformity of calibre and is often irregularly distributed and broken. In many human hairs the medulla is absent, and when this is so, the cortex presents a characteristic appearance, being composed of clearly defined longitudinal fibres among which are embedded fine granules of pigment. In animal hairs which are devoid of medulla, the pigment is deposited in granules which possess a much coarser character. In short, the cortex of the hairs of man is more developed than in the case of animals. At first sight the hairs of a few of the higher-grade apes may resemble those of the human subject, but a more detailed examination will reveal a broader medulla, when that is present, and a less highly developed cortex. When doubt exists in cases of this nature the transverse sections will render easy the differentiation between the hairs of the lower primates and those of man. The transverse sections of human hairs reveal a very small medulla which is smaller than is found in any animal hairs. In many cases, however, human hairs do not show a medulla, but the size of the sections in conjunction with the nature of the distribution of the pigment is such as to differentiate them from the hairs of other primates. It is only in an exceptional case that the sections of the hairs of primates (excluding man) fail to show a medulla. The cuticle of human hairs is finer than that found in animal hairs.

The character and appearance of "wool" hairs from the human body are diferent from those of animals which, with few exceptions, contain a definite cellular medullary layer and possess a very serrated cuticular margin. Exceptions to this statement are occasionally found especially in the wools of Seals and Otters, which do not possess a cellular medullary layer, but show a very roughly serrated cuticular margin which results in the felting of the wool, a characteristic of the animals of aquatic habits. The wools of primates, excluding man, frequently reveal a cellular medullary layer. (Vide Plates 102, Nos. 3 and 4, 103, No. 5, 104, No. 2, and 106, No. 4). The wool of Diana Monkey (Plate No. 106, Nos. 5 and 6) however does not show a cellular layer, but the cuticular margins are much more imbricated than is ever seen in the "wool" hairs of man. Further,

the first of these two photographs alluded to possesses the appearance of the Araucaria or "monkey puzzle tree" of which mention has been made previously. By way of contrast, if we examine the "wool" hair of the human subject (Plate No. 33, No. 9) it will be noted that a cellular layer is absent, the lumen being composed of fine longitudinal fibres. The cuticular margins are but very slightly serrated and possess a totally different appearance from those of the wools of any of the animals.

(2) *If it is human hair, is it the hair of a male or female subject?*

Having determined that the hairs are human in origin, an endeavour should next be made to determine the sex of the subject from which the hair has been derived. Lambert and Balthazard[34] say "The diagnosis of the origin of masculine or feminine hair is based on their length and on the shape of the point, intact or broken in the female, always cut in the male." The writer cannot agree with this statement on account of the prevalence of the frequent cutting of hair upon the female body for cosmetic and hygienic reasons. It is, of course, an undisputed fact that the eyelashes and eyebrows of the female are rarely cut but this fact is not helpful in determining sex, since the male eyelashes and eyebrows are also very seldom cut. As a general rule, the head hair of the male is shorter than that of the female. The hairs of the head of the male are as a rule thicker, coarser in structure and more wiry in texture, than those of the female hairs, which less frequently exhibit a medulla. It is a simple matter to determine whether the hairs have been cut. Beard and moustache hairs of the male differ from any hairs found upon the female body. Female pubic hair is the nearest approach to those hairs, but it is less wiry and thick, and more curly than either moustache or beard hair. The eyelashes of the female are frequently longer than the male, and the eyebrows of the male are usually longer and more wiry than those of the female. The uncut hair upon the surfaces of the arms and legs of the female is softer, finer, and shorter

than the corresponding male hairs. The axillary hair of the male is coarser and broader than the female axillary hairs unless the latter have been frequently cut or shaved, when on regrowth they become very coarse and broad. Examination of the hair-tips will reveal this fact. It is not usual for a male to cut the axillary hair. The pubic hair of the female is slightly more coarse than that of the male and on section is more elongated. The beard, moustache, pubic and perineal hairs of the male are thick and usually possess a deeply-pigmented and fairly broad medulla for human hair. The pubic, vaginal and perineal hairs are the broadest and coarsest hairs found upon the female body. They show a well-marked, deeply-pigmented and fairly broad medulla. Before attempting to express an opinion as to the sex from which hairs are derived, very careful consideration should be given to all the facts obtained from the examination of the available hairs. In many cases it will not be possible to state the sex definitely. In addition to what has been stated, an important guiding principle lies in the fact that the hairs of the female generally show a more delicate structure with finer granules of pigment than is seen in hairs of the male sex.

(3) *What is the approximate age of the individual from which the hair has been derived?*

In the opinion of the writer, an examiner should never commit himself regarding this question from the examination of unidentified hairs further than to express the opinion that the hairs may be those of an infant, an adolescent, an adult or old person. In the event of his being informed of the region from which the hair was derived, his task is rendered much more simple for obvious reasons. In the case of infants, the hairs are very fine, short, and frequently present the characters of "wool" hairs. They are narrow, deficient in pigment, and are composed of a very delicate structure. At this age the only hairs of importance are those upon the head and face. The eyebrows and eyelashes are short and possess very fine hair-tips. In adolescence a few downy hairs are present on the extremities and on the pubes. These, although broader and less deficient in pigment as compared with the hairs of an infant,

are much more rudimentary in character than adult hairs, the description of which has received full attention previously. In the case of the hair from aged persons, it is usually white or grey in colour. It is a wise precaution to refrain from expressing an opinion that hair is that of an old person unless a number of hairs are available for examination, as it is by no means uncommon to find relatively young subjects exhibiting an occasional grey hair in an otherwise well coloured mass of head hair. This does not apply to hairs upon the other parts of the body. The hair bulbs in age show degeneration, and the hairs themselves, in addition to revealing the absorption of pigment, show other stigmata of degeneration.

(4) *From which part of the body has the hair been derived?*

When only a few hairs are available, it is occasionally impossible to give an accurate opinion as to the area of the body from which the hairs were derived. Much has already been stated regarding the general macroscopic and microscopic characters of hairs from various parts of the male and female body. In approaching this special line of examination the following points require attention:—

(1) The total length of the hairs;

(2) The texture and contour of the hairs;

(3) The character of both ends of the hairs;

(4) The general thickness of the hairs;

(5) Whether sweat, vaginal secretion, seminal fluid, faecal material, food, nasal secretion or wax adheres to them;

(6) The exact character of the transverse sections.

It is unnecessary to make further comment regarding the length, the general thickness, the texture, or the contour of hairs. These factors have already received consideration to a point compatible with expediency. It is necessary to examine the ends of the hairs under investigation to determine whether they have been cut at both ends or at one end. Should hair-bulbs be found they must be the subject of detailed examination. The

importance of examining the shaft of the hairs microscopically by means of high-power magnification cannot be oevr-estimated, as very often this procedure may yield most important and unexpected results. The hairs on which sweat is most frequently encountered in large amount are those situated in the axillae. Vaginal secretion when found is usually indicative of hair situated near to the vagina or upon the front portion of the perineum. Seminal fluid, the presence of which is indicated by sperm cells or spermatozoa or both, when found on hair generally indicates pubic hair either of the male or female. This is an important finding in a case of rape or other sexual crime. The hairs of the perineum or of those around the anal orifice frequently reveal faecal matter adhering to them. The hair of the nostrils of the male, which is usually more abundant than in the female, as also the moustache hair, often retain portions of nasal secretion. In the case of the moustache which is worn long, or in the case of the beard, the hairs may reveal portions of food debris adhering to them Finally, the hair which grows in the external canal of the male ear often shows adherent cerument or wax particles. In a rare instance the shaft of a hair may exhibit a bright red, blue, purple or orange colour, the result of dyes dissolved out of a coloured garment which has lain in contact with the hair after the garment has been wet; for example if a body has lain in the rain or in a shallow pool. If advantage be taken of the distribution and colour of the garment worn, it is as a rule not difficult to ascertain the source of this accidental dyeing of the hair.

An examination of the transverse sections of hairs is of the greatest importance in the determination of the likely part of the body from which the hair has been derived, on account of the various shapes it assumes, having regard to its site upon the body surface. Advantage is taken of the fact that a soft hair produces a section which is round or oval in shape, whereas a stiff, wiry hair may assume an almost triangular or reniform appearance. As a general rule, the lighter the colour of the hairs the finer is their texture, and the converse also holds. It should be mentioned in this regard that occasionally light coloured or golden hairs may possess a thickness which approximates that of black hair. The lighter hairs are frequently devoid of medulla, whereas the darker hairs show a definite medulla as a gen-

eral rule. The sections of moustache hair usually possess great irregularity in contour, varying from an irregularly-triangular to an elliptical shape, and always exhibiting a small medulla. Sections of pubic, vaginal, and perineal hair are irregular in contour and may show great variation. The medulla is a constant feature. The sections of the hairs of the armpits are usually elliptical in contour, and the medulla when present, is of light shade. The hairs from the backs of the hands or legs usually present an oval-shaped section and are devoid of a medullary layer.

(5) *Has the hair been dyed or is it of natural colour?*

If a considerable quantity of dyed hair be available for examination, it will as a rule reveal a definite lack of uniformity in pigmentation, which can be readily observed by the eye of the examiner. Variation in colour may occasionally be encountered in undyed hair, but not to the extent met with in dyed hair, which not infrequently exhibits almost vivid hues. On applying appropriate chemical tests, the presence of dye is at once revealed. An examination of the photographs of dyed hairs in their longitudinal and transverse planes, which are contained in Plate No. 12, Section II of the Atlas, will show the appearances which they assume. The nature of the dye applied, together with the original colour of the hair, and the duration of the application of the dye, is inserted above each group of photographs. It will be seen that the application of henna dye renders the hair fibres very dark and obscures detail. In the case of peroxide, the hairs are bleached in varying degree, depending upon the number of applications and their duration. In all the photographs, the definition is slightly impaired due to the presence of dye in the hair structure, and the fibres present a uniformity in shade which is not encountered in hairs in their natural state. The microscopic appearance of dyed hair fibres is readily detected after sufficient familiarity with their character has been acquired.

At the present time there is a very large number of different hair dyes and tints upon the market and almost limitless shades may be imparted to the hair by their use.

(6) and (7) Has the hair fallen out, been pulled out or cut? If it has been cut, was a sharp or blunt instrument used?

It is not difficult to arrive at an opinion as to whether hair has fallen or been pulled out. Hairs that have fallen out spontaneously usually do so on account of disease and degenerative changes. An examination of such hairs will reveal these changes, more especially in the bulb and also in the shaft. A diseased bulb is readily discerned, as is the hair shaft which is the seat of degenerative changes. Hairs that have been pulled out forcibly reveal a rupture of the sheat of the bulb provided it has come away with the stalk of the hair. If the shaft has been torn through, a definite tearing of the hair fibres can readily be seen. It is not inappropriate to mention the method of differenttiating between an incised wound which presents the appearance of having been so cut, but which in fact has been produced by the impact of a blunt instrument upon tissues which cover a bony prominence or ridge. Advantage is taken of the condition of the hair and its bulbs to differentiate between the agent producing these injuries. In the former case, the hairs and bulbs in the region of the wound will have been cut, whereas in the latter case they will have been pushed to one or other of the sides of the wound by the impact of the blunt instrument and may be crushed or bruised. In order to determine whether hairs have been cut by a sharp or a blunt blade, the fibres should be examined microscopically under high-power magnification. In the former instance the fibres will be seen to have been clean cut whereas in the latter case they present a torn and ragged appearance.

SECTION IX

Observations and Conclusions based upon the Examination of the Mammalian Hairs contained in the Collection.

A study of the existing bibliography relating to the examination of human and animal hairs reveals the fact that research workers hold somewhat varying views regarding the taxonomic value of the appearances of these structures. It is, therefore, not inopportune to preface the opinions of the writer which have been arrived at after an exhaustive research, with the opinions recorded by a few of the previous writers on the subject. Griffith and Henfrey[35] hold the view that "In regard to the discrimination of the hairs of one animal from those of another, we believe that the examination of individual hairs can in general be but little depended upon; whilst a comparison of their form, length and breadth, with the proportion of the true hair to that of the wool, conjoined with the internal structure, might sometimes enable an observer to arrive at a satisfactory conclusion." Babcock[36] states that "The identification of hairs and fibres is, in most cases conclusive and satisfactory, i.e. it can be asserted with certainty that a given hair is human or from some animal, and in most cases the animal, or at least, the class to which it belongs can be determined. The diameters, length, and peculiar markings of hairs when observed in the microscope furnish the means for distinguishing them. Indeed these are practically the only data by which reliable conclusions can be drawn." Lambert and Balthazard[37] hold the view that animal hairs may be identified and distinguished from human hairs. Pruner-Bey[38] in his preliminary observations states that "From the highest antiquity has human hair attracted the attention of observers; but down to a very recent period, it was merely the contour and the external aspect which were taken into consideration. Modern science has somewhat enlarged the field of observation as regards

colour; but it was only by the use of the microscope that we were enabled to add fresh characters to those accessible to the naked eye." At the present time, it seems almost inconceivable that an examination of hairs would be attempted without the aid of a modern microscope, and the comprehensive collection of micro-photographs in the accompanying Atlas will demonstrate in a practical manner the advances which science has made since the date of Pruner-Bey's article. From the above reference to Griffith and Henfrey, it would appear that they doubt the taxonomic value of the characters of hair, while Babcock asserts with certainty that he has no doubt in the matter although he does not appear to stress the very great importance of the examination of the transverse sections of hairs without which, in the opinion of the writer a definite view regarding the likely source of a hair should never be expressed by an examiner. Several writers allude to the seeming importance of the measurements of the breadth of hairs. This procedure, in the view of the writer, is apparently valueless and has therefore not received consideration in this work. It is obvious that since hairs not only vary very greatly in the thickness of their calibre throughout their shaft, but also individually, that measurement cannot attain much reliability. It is true that many hairs are unduly narrow and others disproportionately thick, but these gross characters can be perceived readily by macroscopic and microscopic examination and, apart from appreciating this fact, the extent of the narrowness or breadth is of no real importance. It appears to be an unfortunate fact that writers occasionally fail to appreciate the important differences which exist between a wool, a young hair, and a mature hair. For this reason, such differences have been frequently alluded to throughout this work. $Smith_{39}$ in describing the characters of wool fibres writes "True wool has no medulla, but there are usually a number of beard hairs irregularly distributed through the fleece which have a medulla." With this statement the writer does not agree, except in the instance of Otters and Seals among a few others, whose wool shows a fibrous lumen instead of a single row of well-defined medullary cells. It must be admitted that hairs show appreciable diversity in appearance depending upon their thickness and the amount and character of pigment present; but

were the fibres relegated to one of three groups i.e. wools, young immature hairs, and mature hairs, in the earlier stages of their examination, identification would be rendered much more easy on account of facilitating comparison with known hairs, at more or less the same stage of maturity. The following points should be determined as the result of the examination of hairs:—

(1) The colour as ascertained by macroscopic and microscopic examination;

(2) The length, by actual measurement;

(3) The texture as ascertained by touch;

(4) The breadth in an approximate manner, i.e. whether narrow, moderately broad, very broad, or bristly; by means of the microscope.

(5) The nature of the tip if present. If absent, whether it has been cut or torn, also whether regeneration has commenced;

(6) The condition of the base of the hair, whether pulled out as shown by the presence and condition of the bulb, or whether it has been cut and, if so, whether by a sharp or blunt instrument as indicated by the appearance of the fibres;

(7) The character of the cuticle, whether smooth, serrated, or imbricated;

(8) The extent and character of the cortex;

(9) The absence or presence of a medulla: if present, its character and breadth;

(10) Whether the hairs are dyed or undyed;

(11) The contour of the transverse sections. The presence of the cuticle, cortex and medulla, their character and extent.

An examination of the transverse sections of hairs is one of the most important lines of examination if the hairs are to be identified.

In relation to determining whether a hair has been dyed, in addition to applying chemical reagents to extract the dye for the purpose of applying liquid chemical tests, the microscopic ex-

amination of the hair will readily suggest the fact. Hairs which have been dyed reveal the condition microscopically by detail being obscured in the case of darker dyes, by the uniformity in shade of the cortical pigmentation when lighter dyes have been employed and by the very scanty amount of pigment present in the hairs which have been bleached. If sufficient hair is available the variation in its shade is of importance. Lambert and Balthazard in their comprehensive and excellent book upon hairs to which allusion has been made previously, adopt a somewhat unique method of classifying hairs. For medico-legal purposes and in fact for identification of hairs generally it was not found satisfactory by the writer. Their classification depended upon the character of the medulla, i.e.

(1) Hairs without a medulla.

(2) Hairs with a medulla in their terminal halves only.

(3) Hairs having a medulla throughout their length.

(4) The nature of the medullary structure, whether containing:—

(*a*) Pavement-like cells, or,

(*b*) Possessing a reticulated appearance.

Since the collection of photographs has been described in great detail and their appearances from a taxonomic viewpoint fully considered, the writer would like to indicate in conclusion, by means of a table, his opinion of the taxonomic value of the appearances of the hairs which have been examined. The taxonomic value will be indicated by the following signs:—

\+ + = permits of identification.

\+ = of value.

D = doubtful.

0 = of no value.

If for example Order II is consulted in the table, it will be noted that the macroscopic and microscopic appearances of the hairs when viewed in their longitudinal plane are of no taxonomic value in identifying them as belonging to that Order, although the character of their transverse sections would be of

value in this regard. Again, the hairs belonging to the animals of Family 5 of the Order do not reveal features which would identify the family, although it is thought that the appearance of the sections would indicate the Order to which the hairs of the animals belong. In several instances it will be evident that although the features of the hairs are not common to all the families in the Order and therefore may not indicate the Order, yet the hairs of the animals belonging to the families in the Order show features which will reveal the family to which the hairs of the animals belong.

MAMMALIA.

(Original classification adhered to).

Plates No. 1-3. Subclass I. *Prototheria.*

Order I. *Monotremes.*

Macroscopically and microscopically.

Generally. Presence of spines and spine-like terminations + +.

Plates No. 1. and 3. Family 1. Ornithorhynchidae.

Duck-billed Platypus.

Macroscopic appearance + +

Microscopic ,, Longitudinally + +.

Transversely + +.

Plates No. 2 and 3. Family 2. *Echidnidae.*

Spiny Anteater.

Macroscopic appearance + +.

Microscopic ,, Longitudinally + +.

Transversely + +.

Plates No. 4-6. Subclass II. *Metatheria.*

Order II. *Marsupials.*

Macroscopic appearance 0.

Microscopic appearance Longitudinally O.
Transversely + +.

SUBORDER 1. *Polyprotodonts.*

Plates No. 4 and 6. FAMILY 5. *Didelphyidae.*

Opossum.

Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely O.

Plates No. 5. and 6. FAMILY 6. *Dasyuridae.*

Viverrine Dasyure.

Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely O.

SUBORDER 2. *Diprotodonts.*

Plates No. 4 and 6. FAMILY 12. *Macropodidae.*

Wallaby.

Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely O.

Subclass III. *Eutheria.*

Plates No. 7.-11 Order III. Edentates.

Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely O.

Plates 7 and 11. FAMILY 1. *Bradypodidae.*

Three-toed Sloth.

Macroscopic appearance O.

Microscopic ,, Longitudinally ++.
Transversely ++.

Plate No. 8. Family 3. *Myrmecophagidae—Anteaters.*
Two-toed Anteater.
Macroscopic appearance ++.
Microscopic ,, Longitudinally +.
Transversely. Hairs too fine to section.

Plates No. 9 and 11. *Tamandua Anteater.*
Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely ++.

Plates No. 10 and 11. Family 4. *Dasypodidae.*
Armadillo.
Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely ++.

Order IV. *Sirenians.*

Omitted from collection as the animals are hairless from a practical aspect.

Order V. *Cetaceans.*

Omitted for the same reason.

Plates No. 12-47. Order VI. *Ungulata—Hoofed Mammals.*
Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely O.

Suborder 1. *Artiodactyles.*

Plates No. 12 and 13. Section A. *Suina—Pig-like.*
Macroscopic appearance +.

Microscopic ,, Longitudinally +.
Transversely O.

Plate 12. FAMILY 2. *Pigs and Peccaries.*
North African Wild Boar (Head).
Macroscopic appearance +.
Microscopic ,, Longitudinally +.
Transversely + +.

Plates No. 12 and 13. *Wart-hog.*
Macroscopic appearance O.
Microscopic ,, Longitudinally +.
Transversely + +.

Plates No. 14-17. SECTION C. *Tylopoda—Camels.*
Macroscopic appearance O.
Microscopic ,, Longitudinally D.
Transversely + +.

FAMILY 10. *Camelidae.*

Plate No. 14. *Vicuna.*
Macroscopic appearance D.
Microscopic ,, Longitudinally D.
Transversely +.

Plates No. 15 and 17. *Camel.*
Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely O.

Plates No. 16 and 17. *Llama.*
Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely O.

Plates No. 18-39. SECTION D. *Pecora—True Ruminants.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely O.

Plates No. 18-21. FAMILY 12. *Cervidae.*

Macroscopic appearance + +.

Microscopic ,, Longitudinally + +.

Transversely + +.

None of the animals represented in the collection which belong to this family shows individual characteristics of taxonomic value, although the general characters of the hairs render easy the identification of their family.

Plate No. 22. FAMILY 13. *Giraffidae.*

Giraffe.

Macroscopic appearanc O.

Microscopic ,, Longitudinally O.

Transversely + +.

Plates No. 23-39. FAMILY 15. *Bovidae.*

Macroscopic appearance O.

Microscopic ,, Longitudinally +.

Transversely + +.

The individual members of the family whose hairs reveal special features of taxonomic value are :—

Plate No. 26. (1) *Buffalo.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely + +.

Plates No. 26 and 34. (2) *Impala (Neck).*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely + +.

Plate No. 31. (3) *Wildebeest.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely ++.

Plates No. 31 and 38. (4) *Hartebeest.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely ++.

Plates No. 33 and 39. (5) *Goral.*

Macroscopic appearance O.

Microscopic ,, Longitudinally +.

Transversely ++.

Plates No. 40-47. SUBORDER 2. *Perissodactyles.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely O.

Plates No. 46 and 47. FAMILY 16. *Tapiridae.*

Tapir.

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely +.

(Slight similarity to certain members of Bovidae).

Plates No. 40-43. FAMILY 19. *Equidae—Horses.*

Macroscopic appearance +

Microscopic ,, Longitudinally D.

Transversely ++.

Plates No. 44 and 45. FAMILY 20. *Rhinocerotidae.*

Rhinoceros (*Ear*).

Macroscopic appearance D.
Microscopic ,, Longitudinally +.
Transversely ++.

Plates No. 44 and 45. SUBORDER 5. *Hyraces.*

FAMILY 30. *Hyracidae.*

Hyrax.

Macroscopic appearance O.
Microscopic ,, Longitudinally D.
Transversely ++.

SUBORDER 7. *Proboscideans.*

Plate No. 46. FAMILY 35. *Elephantidae.*

Elephant (Tail).

Macroscopic appearance ++.
Microscopic ,, Longitudinally (not practicable).
Transversely ++.

Plates No. 48-62. ORDER VII. *Rodentia.*

Macroscopic appearance O.
Microscopic ,, Longitudinally ++.
Transversely D.

SUBORDER 1. *Simplicidentata.*

Plates No. 48-50. FAMILY 2. *Sciuridae.*

Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely ++.

The marmot hairs show specially characteristic transverse sections.

Plates No. 50 and 51. FAMILY 5. *Castoridae.*

Beaver.

Macroscopic appearance +.

Microscopic ,, Longitudinally D.

Transversely +.

Plates No. 52-55. FAMILY 8. *Muridae.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely ++.

The hairs of Musquash and Brown Rat, when sectioned, are characteristic.

Plate No. 56. FAMILY 13. *Octodontidae.*

Coypu Rat (*Nutria*).

Macroscopic appearance D.

Microscopic ,, Longitudinally +.

Transversely +.

SUBORDER 2. *Duplicidentata.*

Plate No. 57. FAMILY 20. *Lagomyidae.*

Guinea Pig.

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely ++.

(They resemble the sections of the hairs of Marmot in general appearance, but are only unilaterally concave).

Plates No. 58-62. FAMILY 21. *Leporidae.*

Hares and Rabbits.

Macroscopic appearance D.

Microscopic ,, Longitudinally +.

Transversely ++.

Plates No. 63-95. ORDER VIII. *Carnivores.*

Macroscopic appearance O.

Microscopic ,, Longitudinally +.

Transversely O.

Plates No. 63-71. SUBORDER 1 *Carnivora Vera—Fissipedes.*

FAMILY 1. *Felidae.*

Macroscopic appearance O.

Microscopic ,, Longitudinally D.

Transversely ++.

Plates No. 46 and 47. FAMILY 2. *Hyaenidae.*

Hyaena.

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely +.

(Liable to be confused with sections of hair from Equidae).

Plates No. 72 and 73. FAMILY 4. *Viverridae—Civets.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely D.

Plates No. 74-80. FAMILY 5. *Canidae—Wolves and Foxes.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely ++.

Plates No. 81 and 82. FAMILY 6. *Ursidae—Bears.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely ++.

Plates No. 83-89. FAMILY 7. *Mustelidae-Waesels, Otters, etc.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely + +.

The hairs and wools of the Otters are characteristic, the former in transverse section, the latter in the longitudinal plane.

Plates No. 90-93.

FAMILY 8. *Procyonidae—Raccoons and Cat-bears.*

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transverse +

Plates No. 94-95. SUBORDER 2. *Pinnipedes.*

FAMILY 11. *Phocidae—Seals.*

Macroscopic appearance +.

Microscopic ,, Longitudinally.

(Hairs) O. (Wool) +.

(Wool likely to be confused with that of Otters).

Transversely. (Hairs) + +.

Plates No. 96-98. ORDER IX. Insectivores.

Macroscopic appearance O.

Microscopic ,, Longitudinally O.

Transversely O.

SUBORDER 1. *Insectivora Vera.*

Plate No. 96. FAMILY 3. *Erinaceidae—Hedgehogs.*

Macroscopic appearance (Spines) + +. (Hairs) O.

Microscopic ,, Longitudinally (Hairs) O.

Transversely (Hairs) + +.

Plates No. 97 and 98. FAMILY 4. *Soricidae—Shrews.*

Macroscopic appearance ++.

Microscopic ,, Longitudinally ++.

Transversely ++.

Plates No. 96 and 98. FAMILY 5. *Talpidae—Moles.*

Macroscopic appearance ++.

Microscopic ,, Longitudinally O.

Transversely ++.

Plates No. 99 and 100. ORDER X. *Chiroptera—Bats.*

Taxonomic value not expressed on account of insufficient specimens being available.

Plates No. 99 and 100.

SUBORDER 1. *Megachiroptera—Frugivorous Bats.*

Large Fruit Bat.

Macroscopic appearance O.

Microscopic ,, Longitudinally +.

Transversely ++.

Plate No. 99. FAMILY 1. *Pteropodidae—Flying Foxes.*

Flying Fox.

Only mounted specimen available.

Microscopic appearanc Longitudinally.

(Opinion regarding taxonomic value not expressed).

Transversely (Not available).

Plates No. 101-108. ORDER XI. *Primates.*

Macroscopic appearance +.

Microscopic ,, Longitudinally

(Hairs) +. (Wools) ++.

Transversely ++.

Plates No. 101, 102, 103 and 108.

SUBORDER 1. *Lemuroids.*

Macroscopic appearance +.
Microscopic ,, Longitudinally O.
Transversely +.

Plates No. 101 and 108. FAMILY 2. *Chiromyidae.*

Aye-Aye.

Macroscopic appearance +.
Microscopic ,, Longitudinally O.
Transversely ++.

Plates No. 102 and 108. FAMILY 3. *Tarsiidae.*

Tarsier.

Macroscopic appearance +.
Microscopic ,, Longitudinally O.
Transversely ++.

FAMILY 4. *Lemuridae—Lemurs.*

Ruffed Lemur.

Macroscopic appearance +.
Microscopic ,, Longitudinally O.
Transversely ++.
(Might be confused with Chimpanzee unless a careful examination of the sections is made).

Plates No. 104-108. SUBORDER 2. *Anthropoids.*

Macroscopic appearance O.
Microscopic ,, Longitudinally O.
Transversely D.

Plates 104 and 108. FAMILY 5. *Hapalidae—Marmosets.*

Common Marmoset.

Macroscopic appearance +.
Microscopic ,, Longitudinally O.
Transversely ++.

Plates No. 104-106.

FAMILY 7. *Cercopithecidae. Old World Monkeys.*

Macroscopic appearance +.
Microscopic ,, Longitudinally O.
Transversely ++.

Plates No. 104, 106, 107 and 108.

FAMILY 8. *Simiidae—Gibbons and Man-like Apes.*

Macroscopic appearance +.
Microscopic ,, Longitudinally D.
Transversely ++.
(May be confused with human hair, without a careful examination).

Plates No. 1-35, SECTION II of Atlas.

FAMILY 9. *Hominidae—Man.*

Macroscopic appearance +.
Microscopic ,, Longitudinally ++.
Transversely ++.

It is hoped that the foregoing summary will indicate the conclusions, which have been arrived at by the writer as the result of his research, in regard to the taxonomic value which may be placed upon the characters of animal hairs and wool. In several cases a negative sign has been inserted, as it was thought that the characters of the hairs in question did not reveal sufficient individuality to permit of their identification.

In these instances, however, it is asserted that with the aid of this collection of photographs and as the result of a careful comparison with identified hairs, they will permit of ready identification should they present themselves to an examiner in their unidentified state..

From the foregoing it will be evident that the appearances of the majority of the animal hairs are such as to permit of the identification of the Order, Suborder or Family of the animal to which they belong. In many instances it is quite easy to identify the actual animal whose hairs have been examined in detail. Special emphasis should be laid upon the importance of the appearance of transverse sections. The characters of the hairs and wools of the animals belonging to all Orders of Mammalia with the exception of a few belonging to Suborder 1 and Suborder 2, *Families* 5-8 of Primates, are such that their macroscopic and microscopic examination in the horizontal plane will reveal that they do not belong to the human race. In the odd instances referred to, a detailed examination of the structure will reveal the facts that the cortical pigment is coarser, the medulla broader and less irregular than is encountered in human hair. An important point is established by the fact that the wool-hairs of man never possess a cellular medulla, which is very commonly found in those belonging to other Primates. Should doubt as to differentiation between animal and human hair persist in the mind of the examiner, the examination of the transverse sections will quickly dispel the dubiety, on account of the fact that the medulla of human hair is always smaller than that of any of the remaining Primates.

Having determined that given hairs are those of the human subject, let it now be determined by the light shed from the work accomplished, how far it is safe for an examiner to qualify this finding. In the view of the writer, it is possible to express an accurate opinion regarding the sex from which hairs have been derived only under certain circumstances. The length of the head hair cannot be depended upon in this connection on account of the prevalence of the cutting of female hair. Speaking generally, however, the head hair of the male is shorter than that of the female, its texture is more wiry, and its structure coarser in character; further, it contains a medullary layer more

frequently. The hairs composing the moustache or beard of the male differ from any of the hairs found upon the body of the female subject. The eyebrow hair of the male is usually longer and more coarse than that of the female. The eyelashes are also coarser in the former than the latter sex. The hair which is present on the surfaces of the legs and arms of the female is much finer in character and structure than that of the male subject. The pubic, vaginal and perineal hairs are the coarsest pubic hairs upon the female body. The pubic hair is slightly more coarse than that of the male, and on section is more elongated. So far as the estimation of the approximate age of the individual is concerned, it is possible, in the opinion of the writer, to express the opinion that it belongs to an infant, an adolescent, an adult or an old person, provided a number of hairs are available for examination. The lines of the examination for this purpose have been dealt with in a previous section. In a large number of cases it appears impossible to state with accuracy from which part of the body hairs have been derived. It is not difficult, however, to identify moustache or beard, eyebrow, eyelash, ear, head, axillary and pubic hairs. Difficulty is met with in the case of hair from the arm, leg, abdomen, scrotum, and perineum. The detection of dye in hair fibres is not a difficult procedure, and in special cases of importance, the identification of the actual dye used is possible by chemical examination. An examination of the end of a hair will reveal the manner in which it has been removed from the skin.

In conclusion the writer would summarise the results obtained from the work undertaken. On the completion of an exhaustive macroscopic and microscopic examination of hair, it should be possible for an examiner to express an opinion upon the following points:—

(1) That it is derived from the human subject or from some other animal belonging to the mammalian group.

(2) That if derived from a mammalian animal, excluding man, the Order, or Suborder to which it belongs, in all cases: in a very large number of instances, the Family to which it belongs, and in many instances, the animal from which the hair was actually derived.

(3) If belonging to the human race, the sex of the subject on an appreciable number of occasions.

(4) The site of the body from which the hair has been derived in most cases, especially when derived from the moustache or beard, eyebrow, eyelash, ear, axilla, and pubes. It is practically impossible, however, to differentiate between the hair from the leg and arm. Difficulty is experienced in identifying the hair from the abdomen and differentiating between scrotal and perineal hair.

(5) The age of the individual in a very approximate manner e.g. whether a very young child, an adolescent, an adult or an aged person, provided a number of hairs are available.

(6) Whether the hairs have been dyed and if so, the nature of the substance which has been used.

(7) The manner in which the hair has been removed from the surface of the body. Whether it has been plucked out, has fallen out or been cut. If cut, whether by a sharp or blunt instrument.

In all cases in which an examiner is called upon to examine and report upon hairs, it is necessary for him to conduct a very exhaustive and patient macroscopic and microscopic examination of the fibres. It is necessary for him to have a large collection of identified human and animal hairs at hand for comparison and consultation. Before expressing a final opinion, it is essential that the specific circumstances of each individual production should receive full consideration.

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(15) African Reitbok or Reedbuck.	Plates 29 and 34.
(16) Thomson's Gazelle.	Plates 29 and 34.
(17) Grants Gazelle.	Plates 29 and 34.
(18) Krimmer Lamb.	Plates 30 and 37.
(19) Persian Lamb.	Plate 30.
(20) Broad-Tailed Lamb.	Plate 30.
(21) Wildebeest.	Plate 30.
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(6) Chestnut Driving Mare.	Plates 41 and 43.
(7) Zebra.	Plates 42 and 43.

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(1) Flying Fox. Plate 99.

ORDER XI. *Primates.* Plates 101-108.

SUBORDER 1. *Lemuroids.*

FAMILY 2. *Chiromyidae.*

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FAMILY 3. *Tarsiidae.*

(1) Tarsier. Plates 102 and 108.

FAMILY 4. *Lemuridae.*

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SUBORDER 2. *Anthropoids.*

FAMILY 5. *Hapalidae.*

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FAMILY 7. *Cercopithecidae.*

(1) Arabian Baboon. Plate 105.
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Male Head Hairs.	Plates 13-17 and 21-23.
Female Body Hairs.	Plates 24-30.
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Dyed Hairs.

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ATLAS OF PHOTOGRAPHS.

SECTION I.

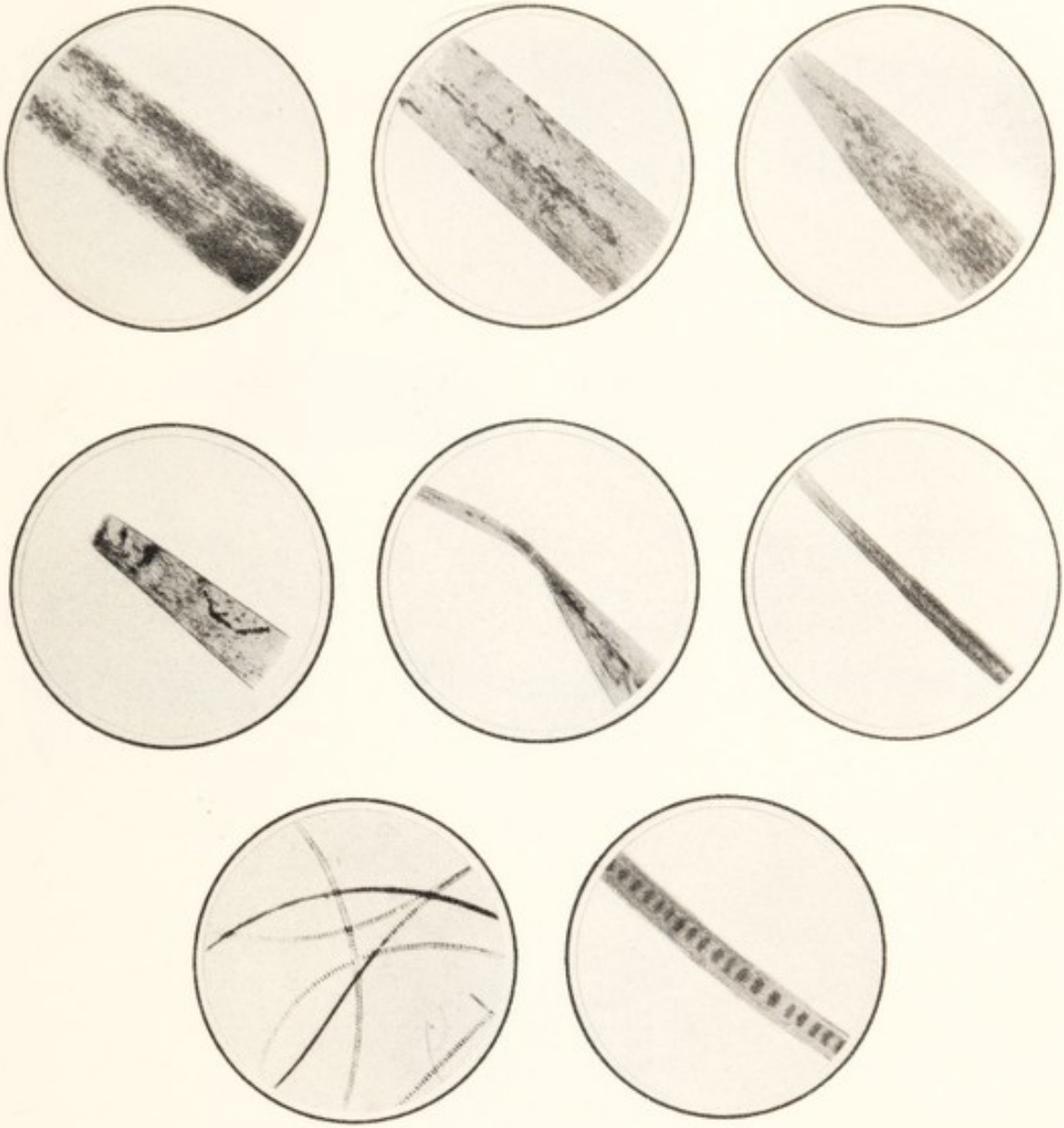
ANIMAL HAIRS.

PROTOTHERIA.

ORDER I. MONOTREMES.

Family 1. Ornithorhynchidæ.

DUCK BILL PLATYPUS.

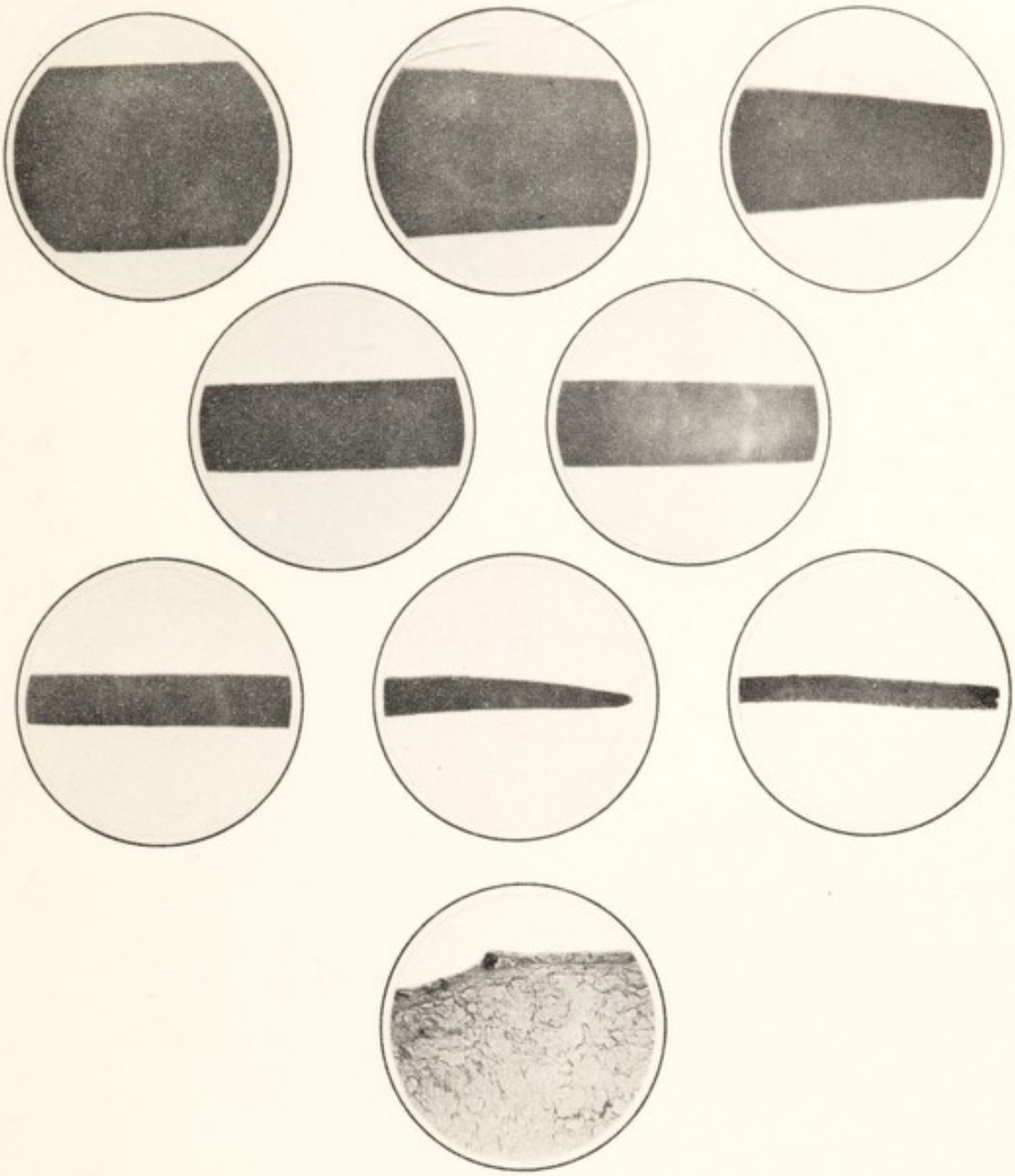


PROTOTHERIA.

ORDER 1. MONOTREMES.

Family 2. Echidnidæ.

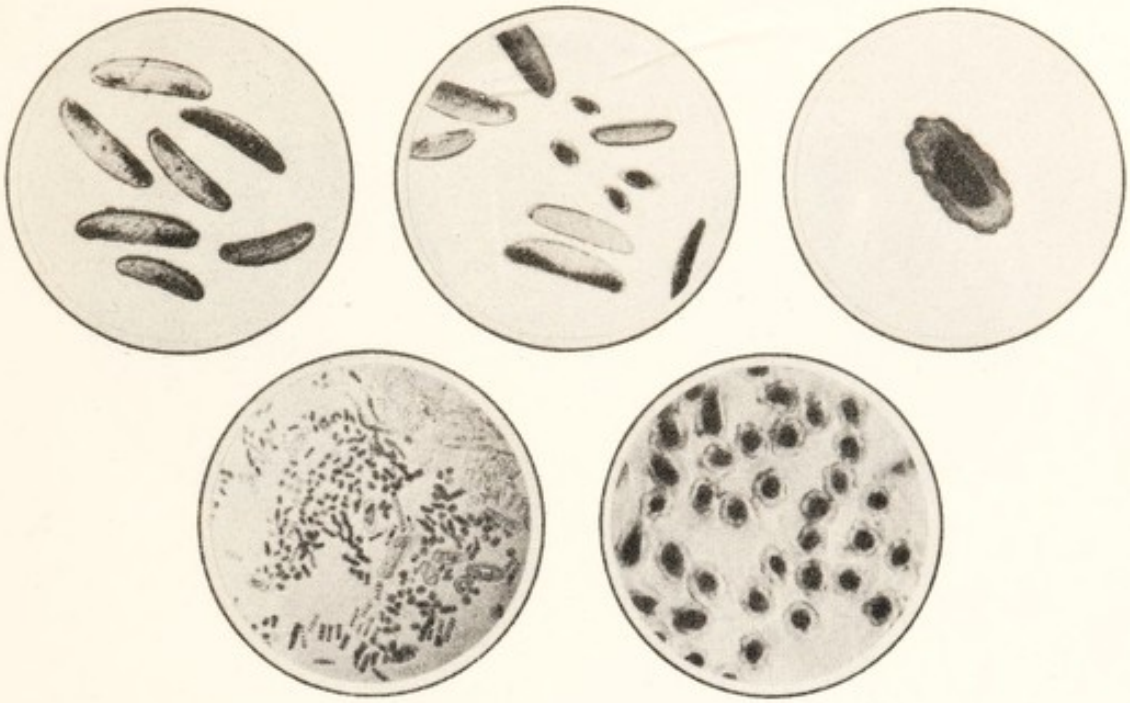
SPINY ANTEATER.



ORDER I. MONOTREMES.

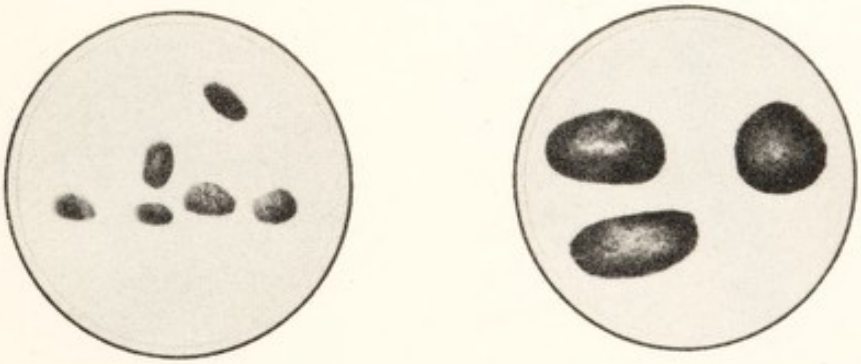
TRANSVERSE SECTIONS.

DUCK BILL PLATYPUS.



SPINY ANTEATER.

Hair. Small Spines.



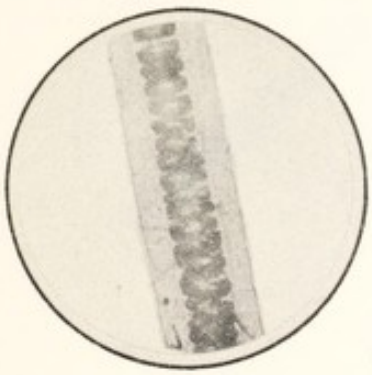
METATHERIA.

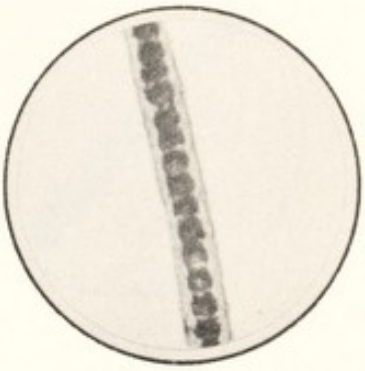
ORDER II. MARSUPIALS.

SUBORDER 1. POLYPROTODONTS.

FAMILY 5. OPOSSUMS.

OPOSSUM.



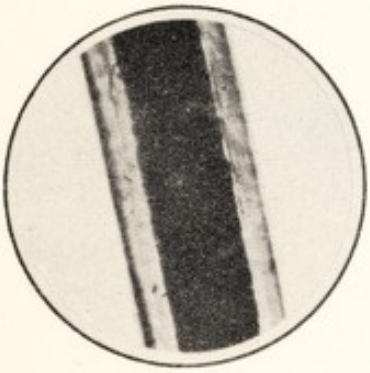


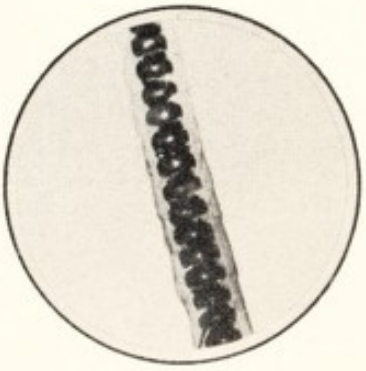
ORDER II. MARSUPIALS.

SUBORDER 2. DIPRODONTS.

FAMILY 12. MACROPODIDÆ.

WALLABY.



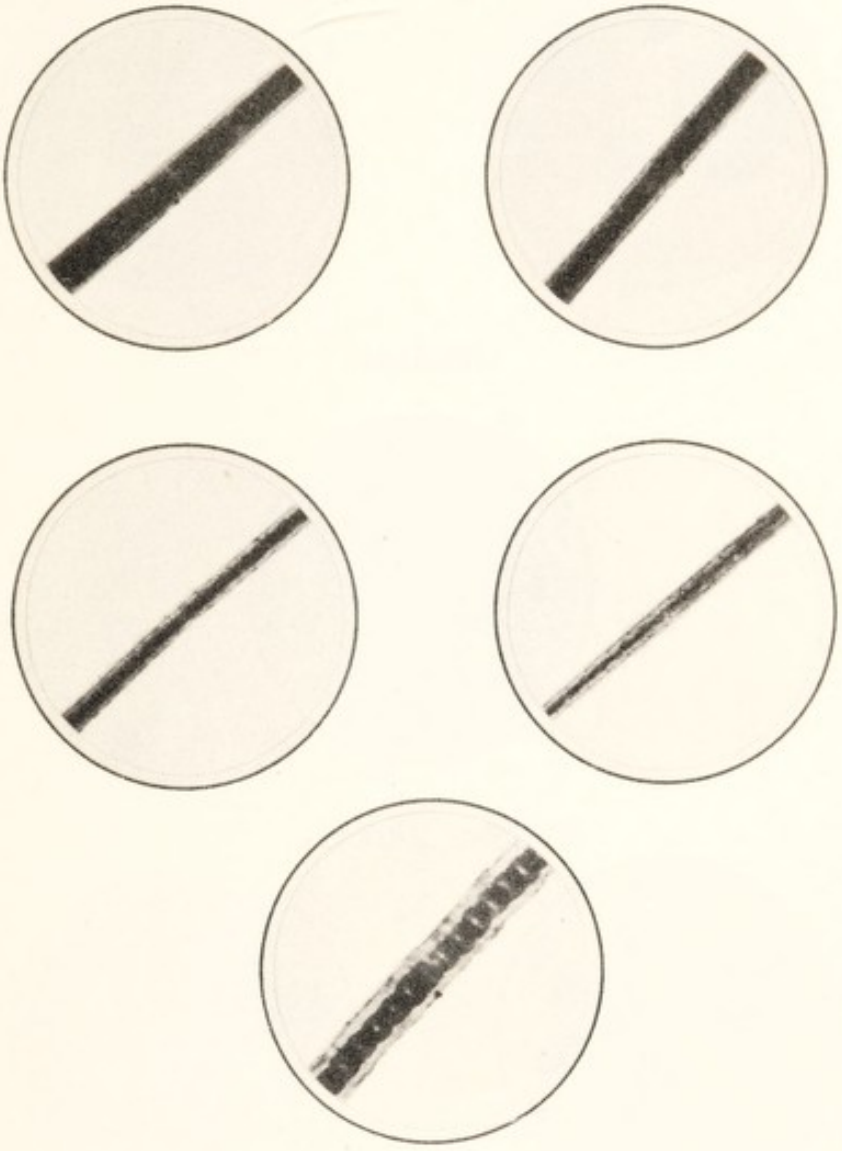


ORDER II. MARSUPIALS.

SUBORDER 1. POLYPROTODONTS.

FAMILY 6. DASYURIDÆ.

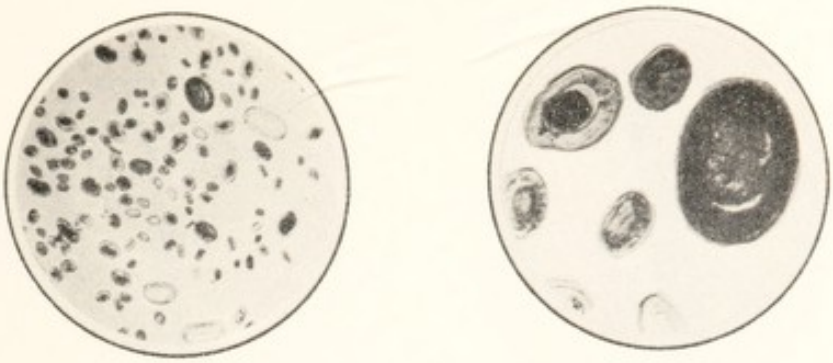
VIVERRINE DASYURE.



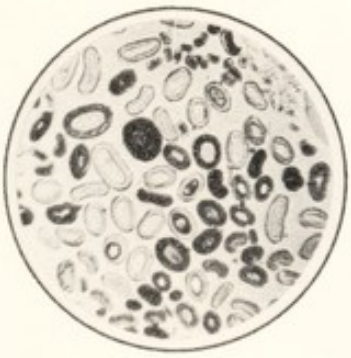
ORDER II. MARSUPIALS.

TRANSVERSE SECTIONS.

OPOSSUM.



WALLABY.



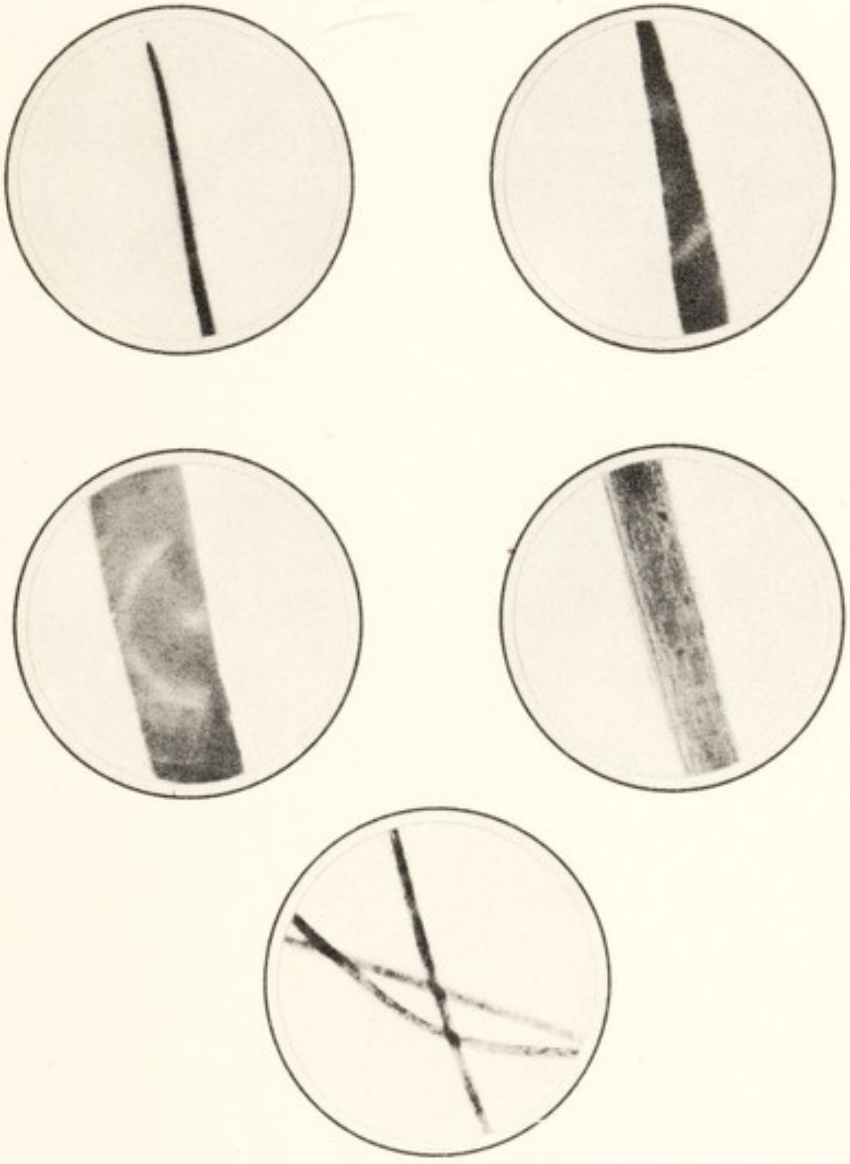
VIVERRINE DASYURE.

SUB-CLASS III. EUTHERIA.

ORDER III. EDENTATA. EDENTATES.

FAMILY 1. BRADYPODIDÆ. SLOTHS.

THREE-TOED SLOTH.

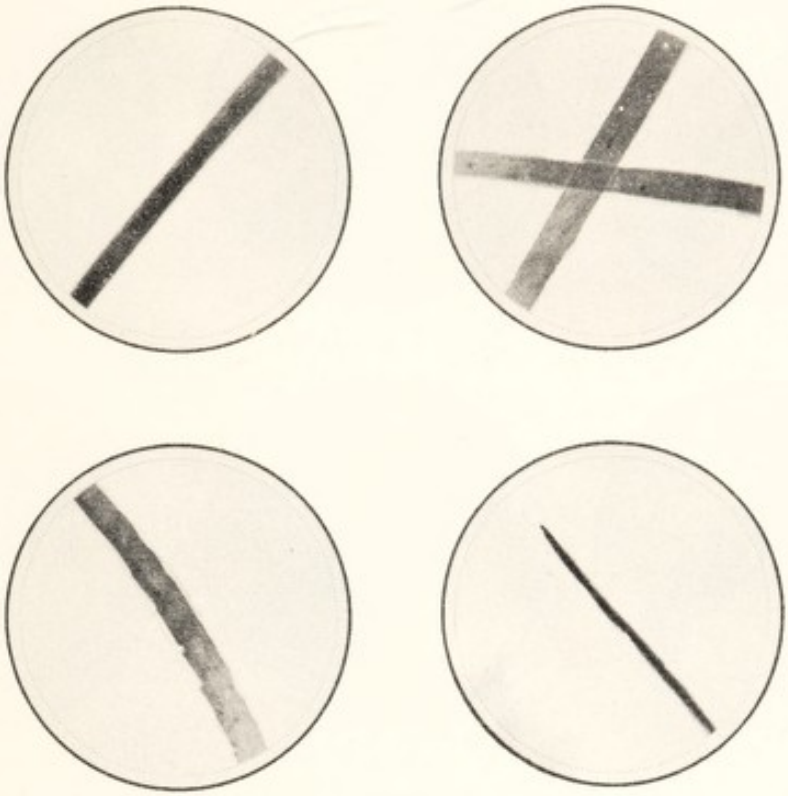


SUB-CLASS III. EUTHERIA.

ORDER III. EDENTATA.

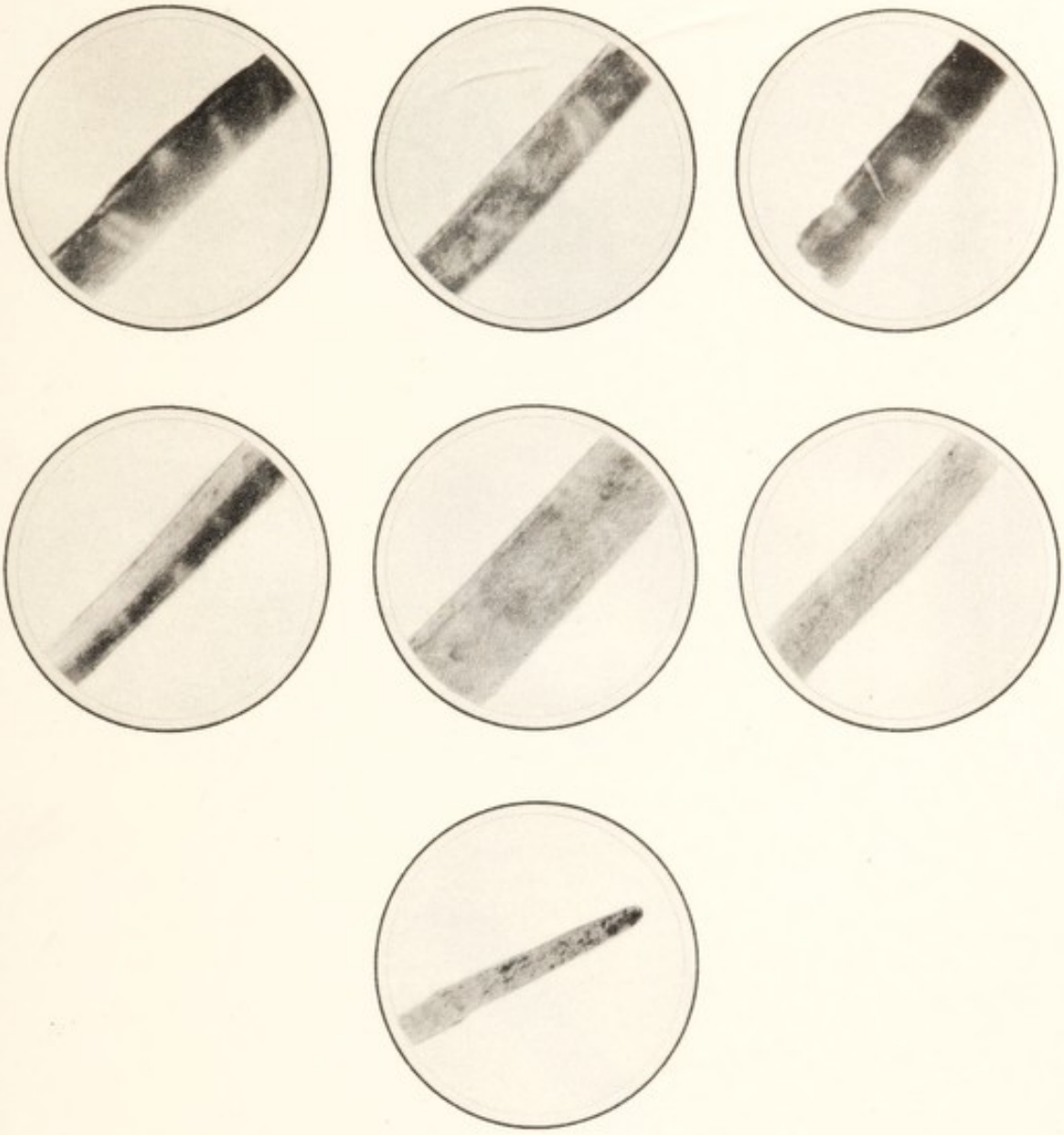
Family 3. Anteaters.

TWO-TOED ANTEATER.



Family 3. Anteaters (continued).

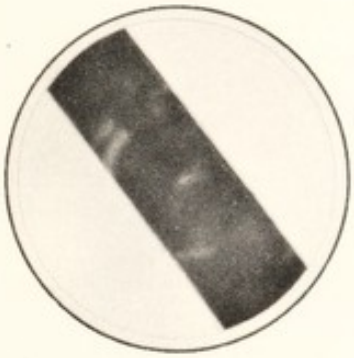
TAMANDUA ANTEATER.



ORDER III. EDENTATES.

Family 4. Dasypodidæ.

ARMADILLOD



ORDER III. EDENTATES.

TRANSVERSE SECTIONS.

Family 4. Dasypodidæ.

ARMADILLO.

Family 3. Myrmecophagidæ.

TAMANDUA ANTEATER.

Family 1. Bradypodidæ.

THREE-TOED SLOTH.

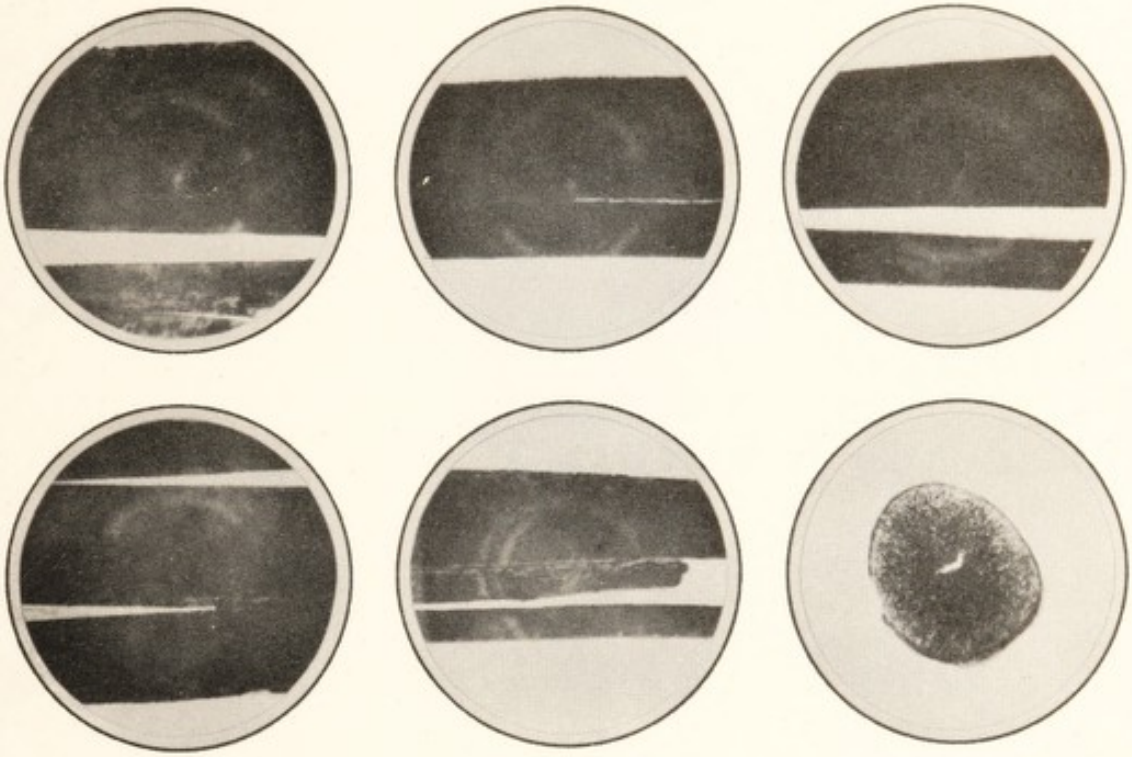
ORDER VI. HOOFED MAMMALS.

SUBORDER 1. ARTIODACTYLES.

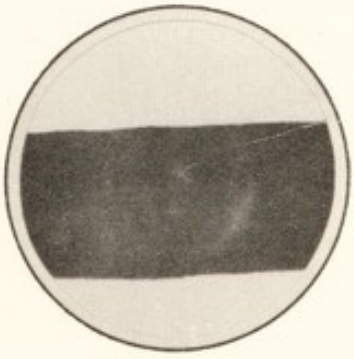
SECTION A. PIG-LIKE.

Family 2. Pigs & Peccaries.

NORTH AFRICAN WILD BOAR (Head). 1-6.



WART-HOG. 7.



Family 2. Pigs & Peccaries (continued).

TRANSVERSE SECTION.

WART-HOG.

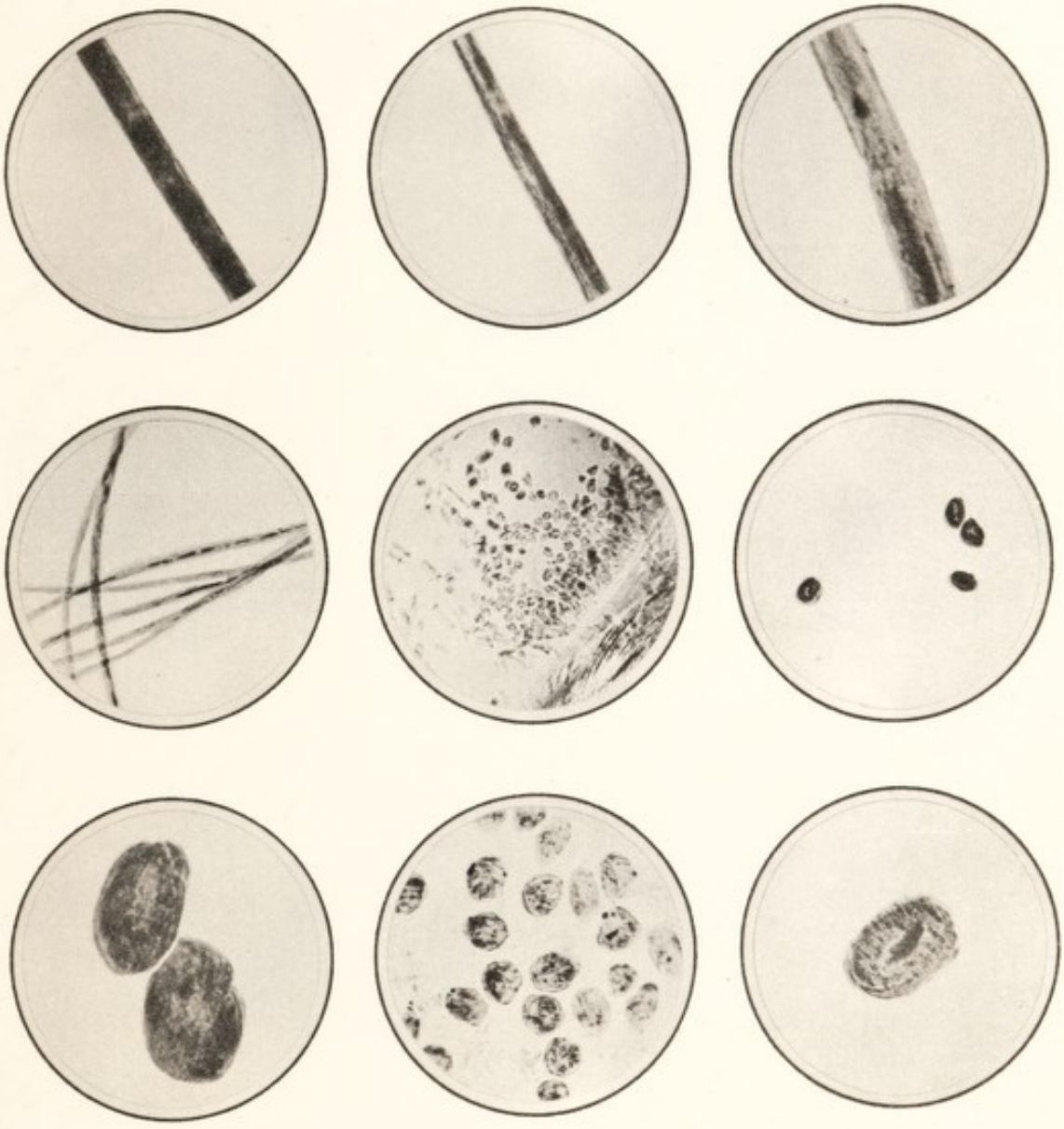
ORDER VI. HOOFED MAMMALS.

SUBORDER 1. ARTIODACTYLES.

SECTION C. CAMELS.

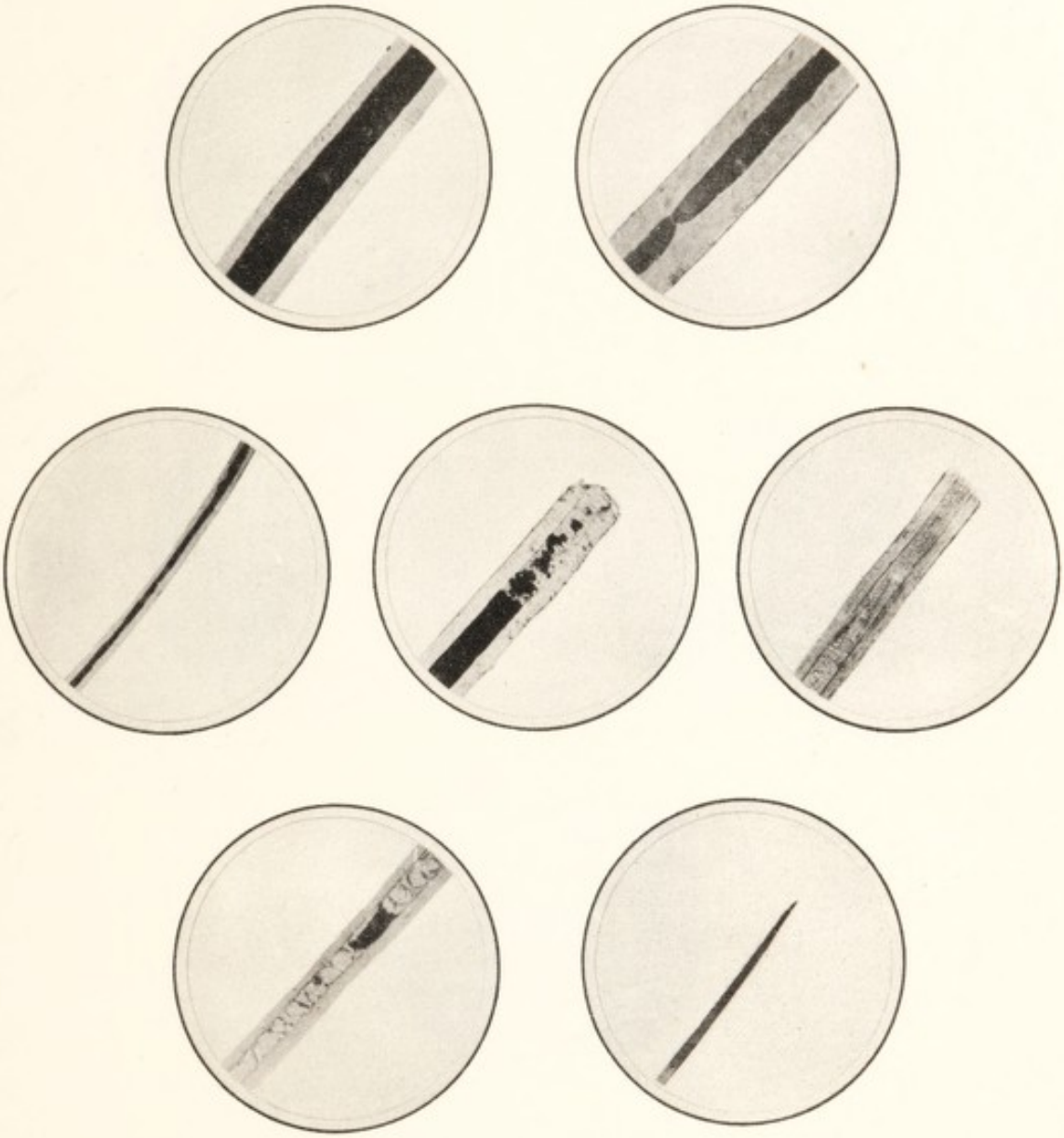
FAMILY 10. CAMELIDÆ.

VICUNNA.



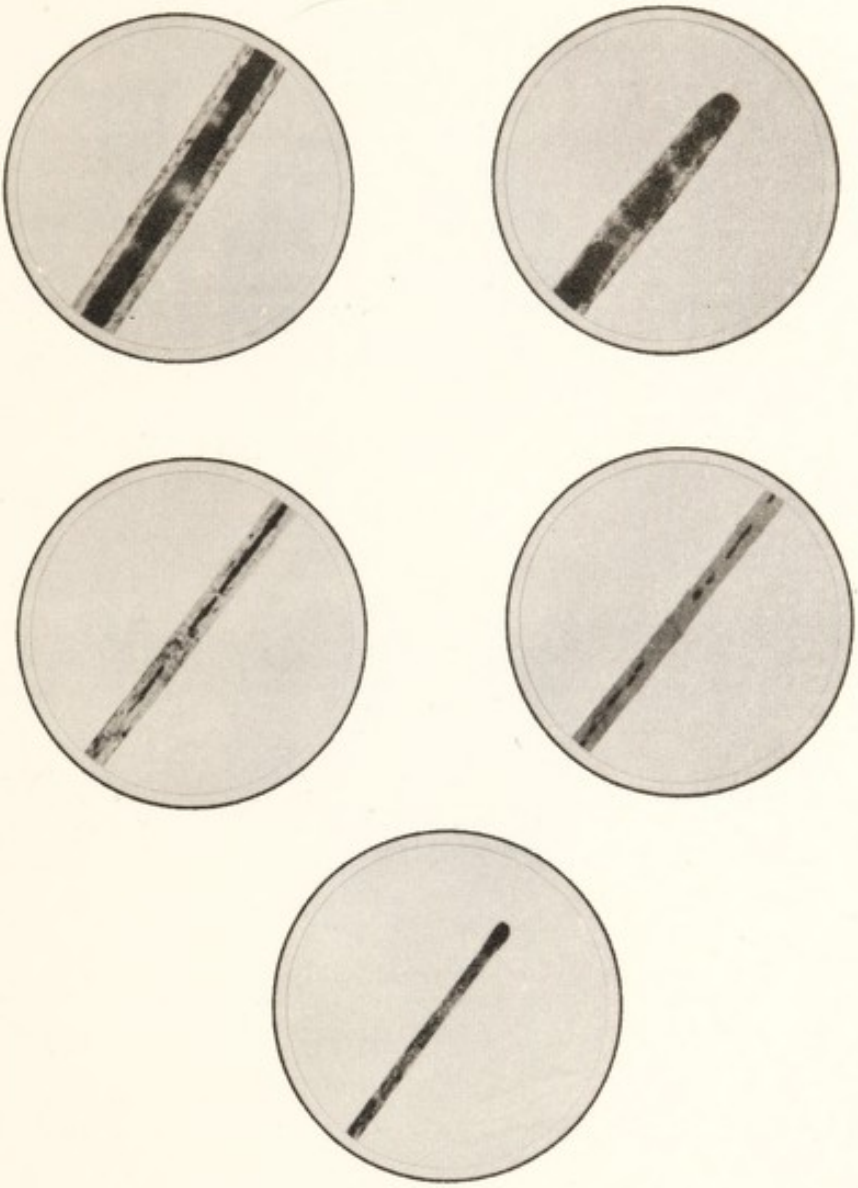
Family 10. Camelidæ (continued).

CAMEL.



Family 10. Camelidæ (continued).

LLAMA.

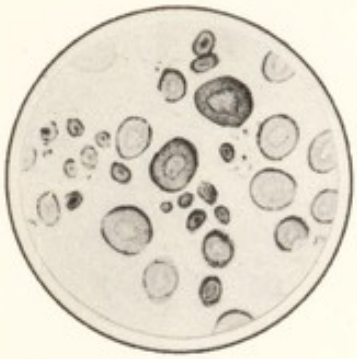


ORDER VI. HOOFED MAMMALS.

FAMILY 10. CAMELIDÆ (continued).

TRANSVERSE SECTIONS.

CAMEL.



LLAMA.

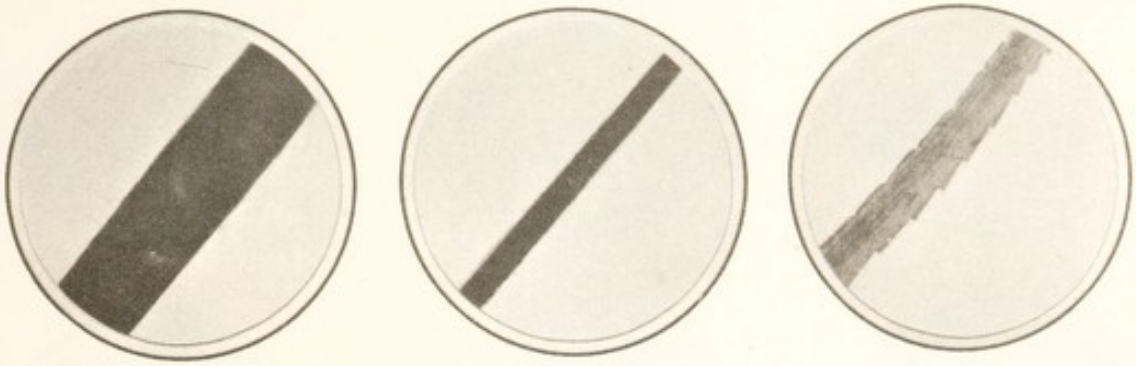
ORDER VI. HOOFED MAMMALS.

SUBORDER 1. ARTIODACTYLES.

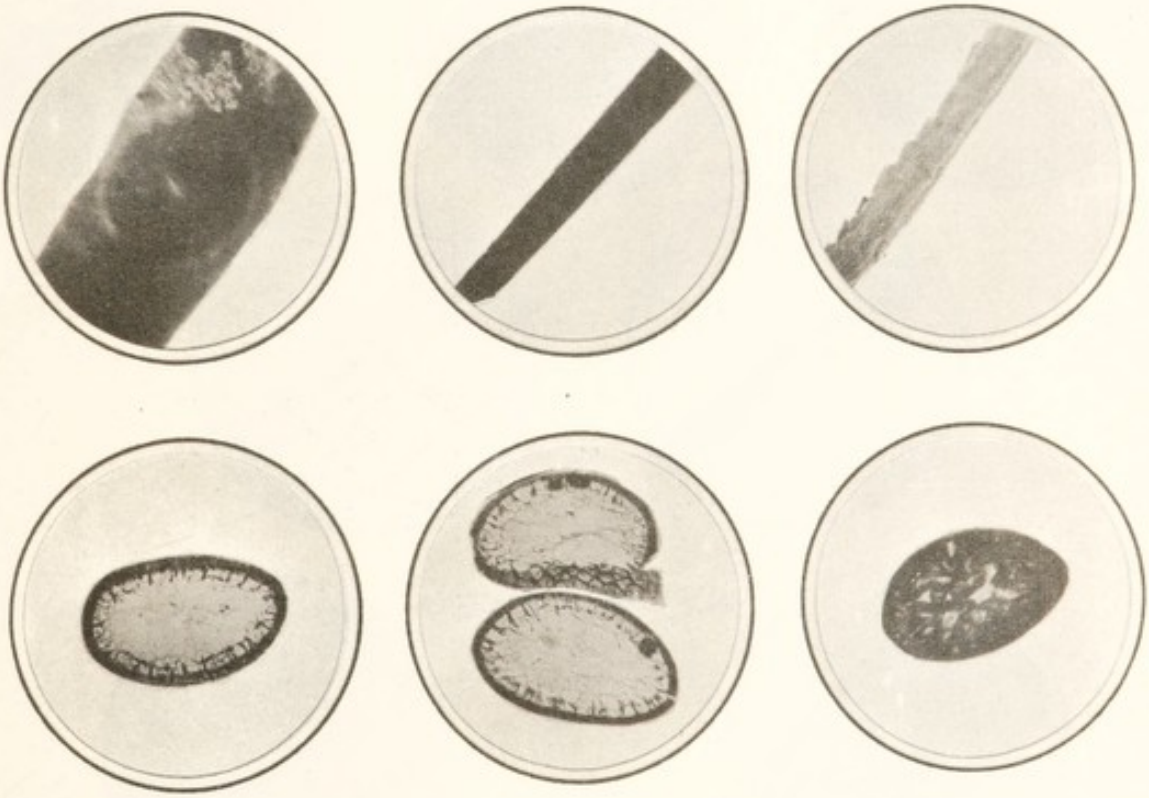
SECTION D. TRUE RUMINANTS.

FAMILY 12. CERVIDÆ.

MOOSE. 1-3.



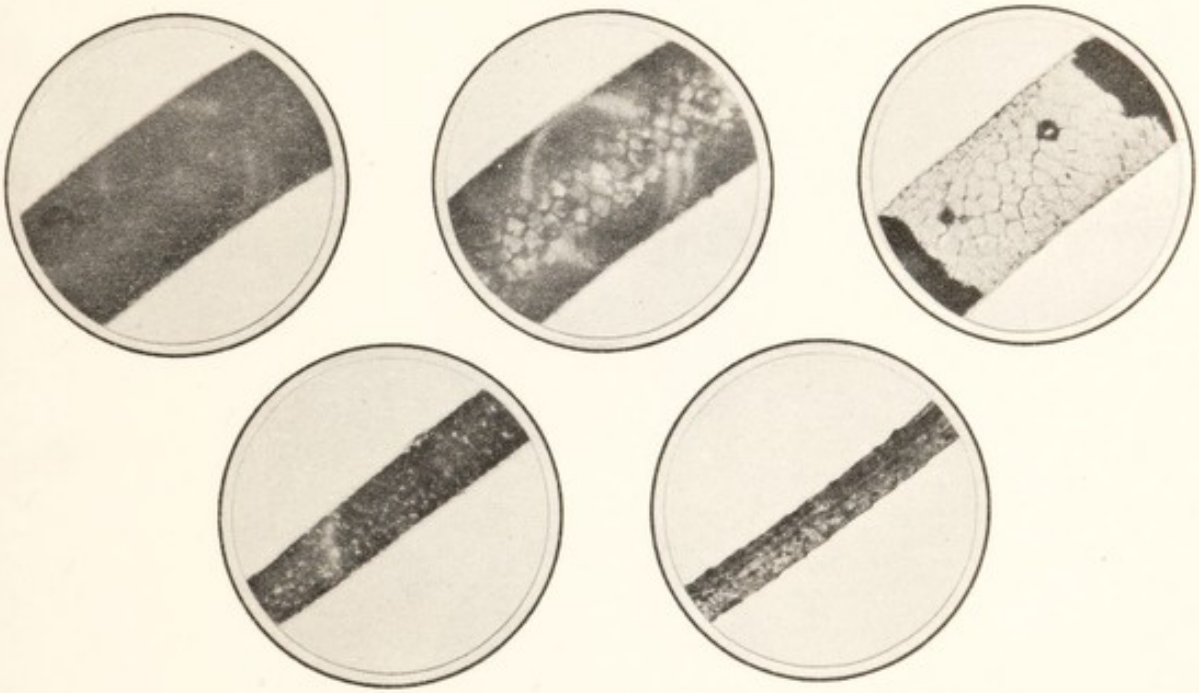
RED DEER. 4-9.



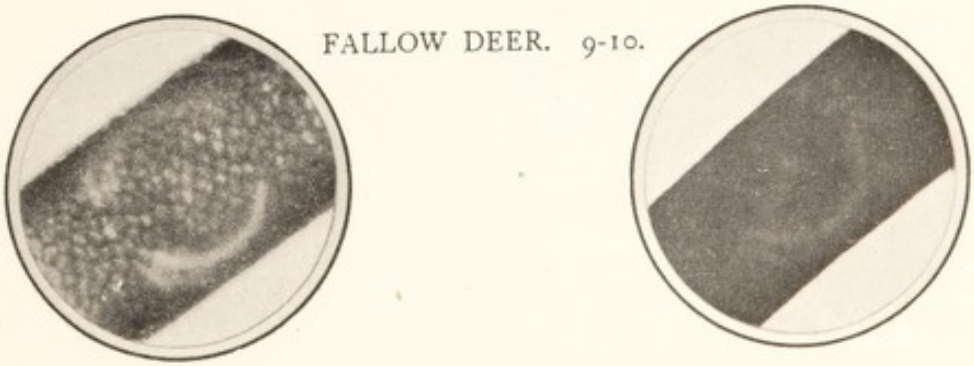
Family 12. Cervidæ (continued).

ROE DEER. 1-3.

CARIBOU. 4-8.

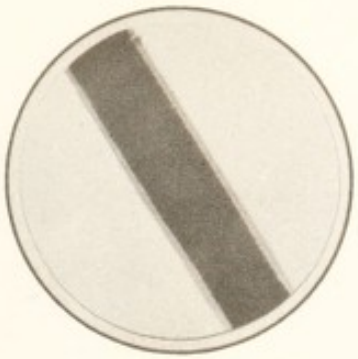


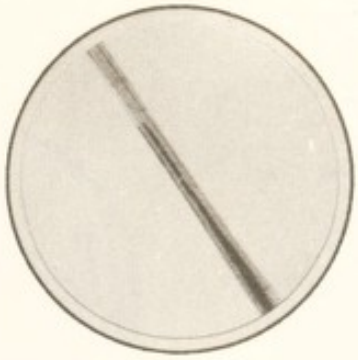
FALLOW DEER. 9-10.

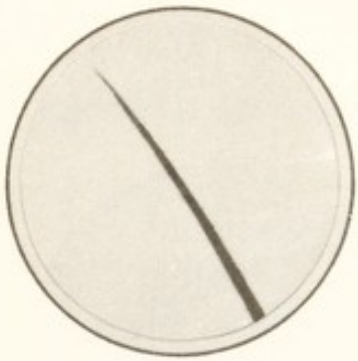


Family 12. Cervidæ (continued).

CHITAL DEER or AXIS DEER.







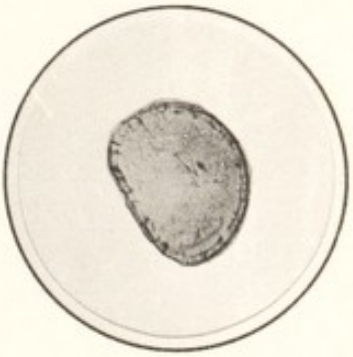
ORDER VI. HOOFED MAMMALS.

Family 12. Cervidæ (continued).

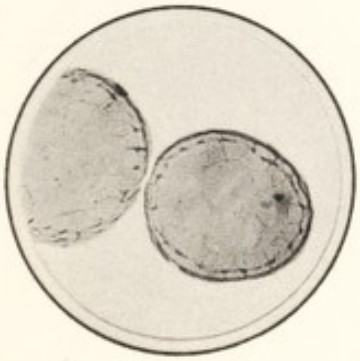
TRANSVERSE SECTIONS.

MOOSE.

ROE DEER.



CARIBOU.



FALLOW DEER.

CHITAL or AXIS DEER.

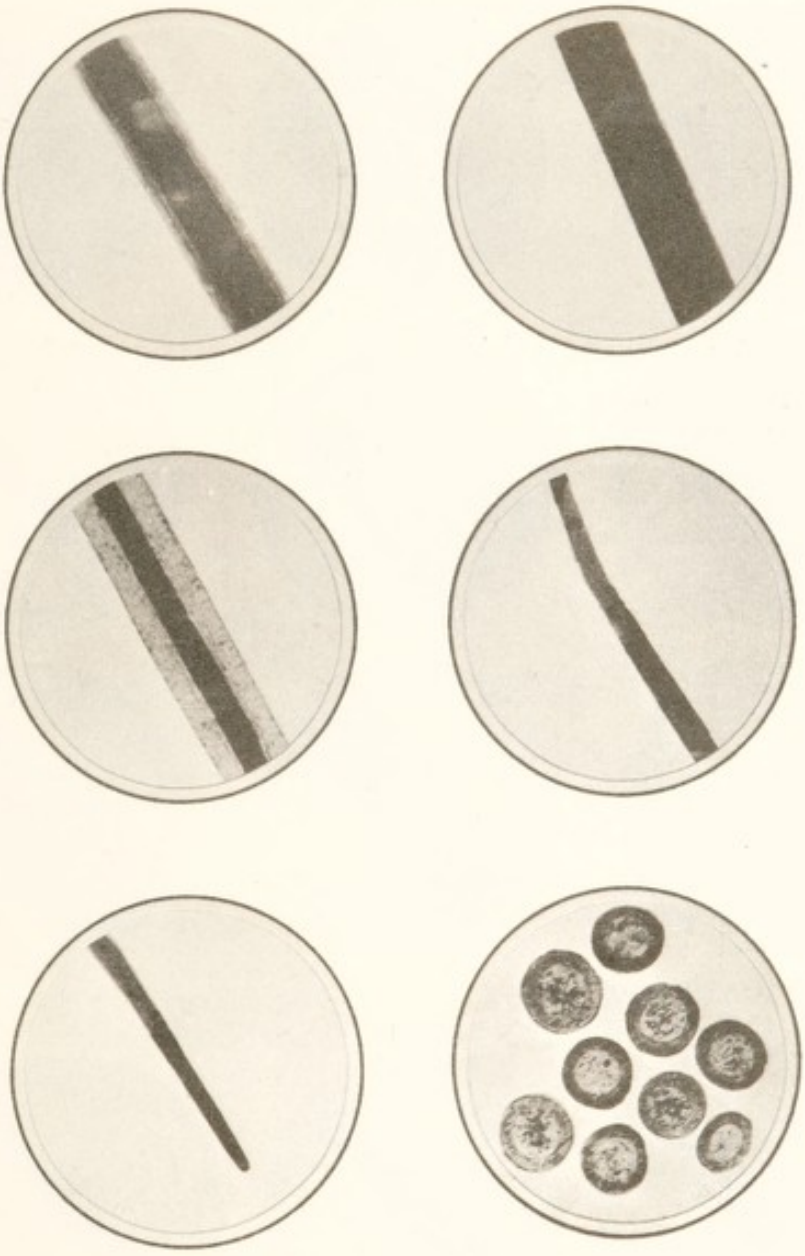
ORDER VI. HOOFED MAMMALS.

SUBORDER 1. ARTIODACTYLES.

SECTION D. PECORA.

FAMILY 13. GIRAFFIDÆ.

GIRAFFE.



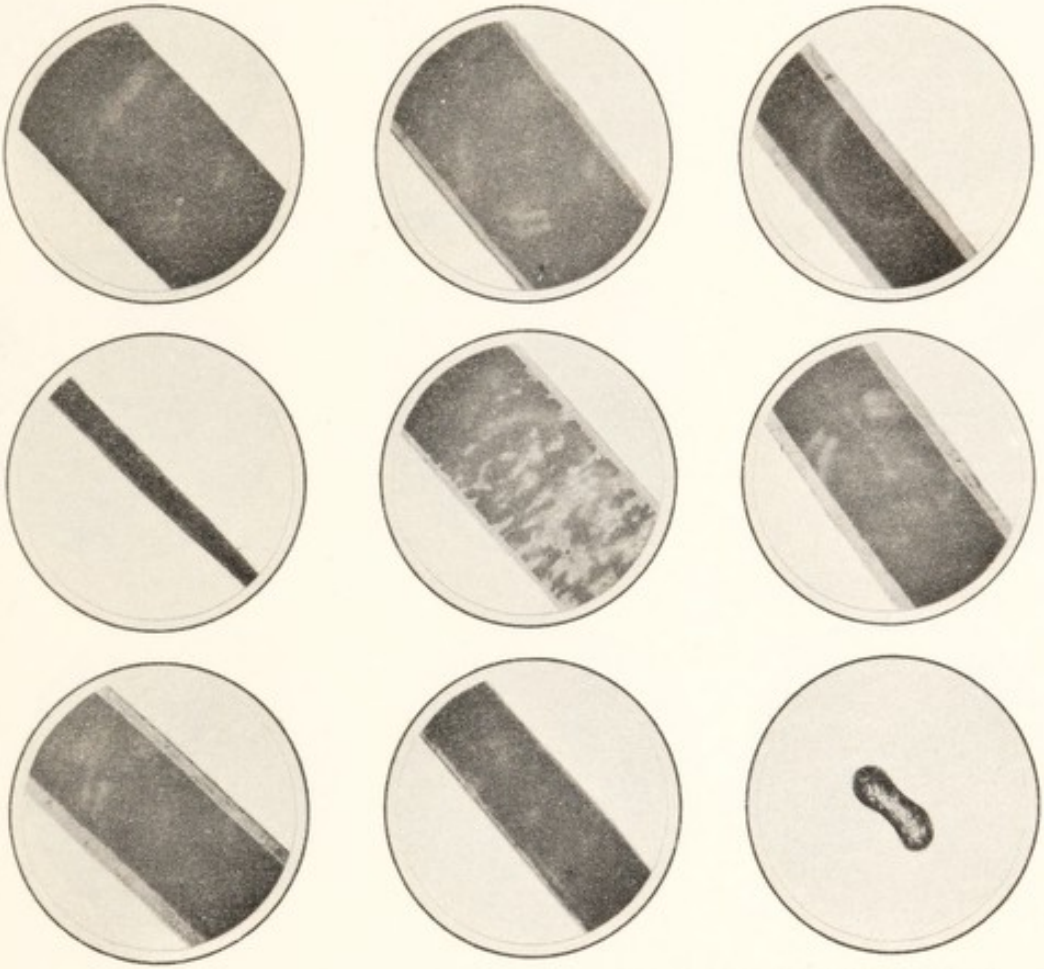
ORDER VI. HOOFED MAMMALS.

SUBORDER 1. ARTIODACTYLES.

SECTION D. PECORA. TRUE RUMINANTS.

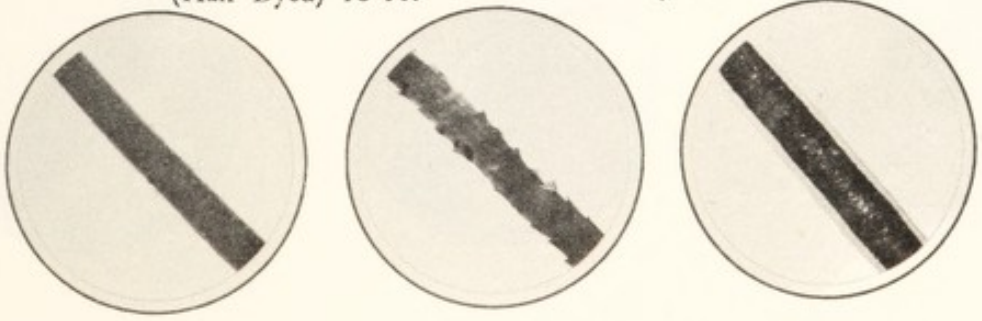
FAMILY 15. BOVIDÆ.

BARBARY SHEEP (BODY) 1-5. (BEARD) 6-9.



GOAT.
(Hair Dyed) 10-11.

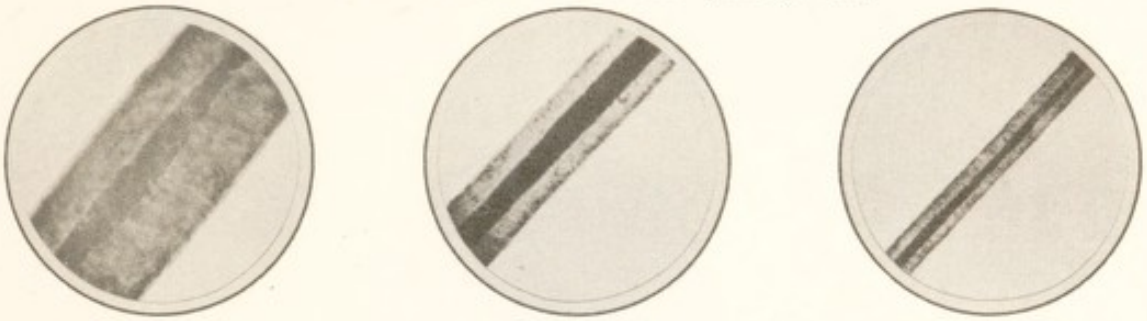
ROCKY MOUNTAIN GOAT.
(Coat Natural) 12.



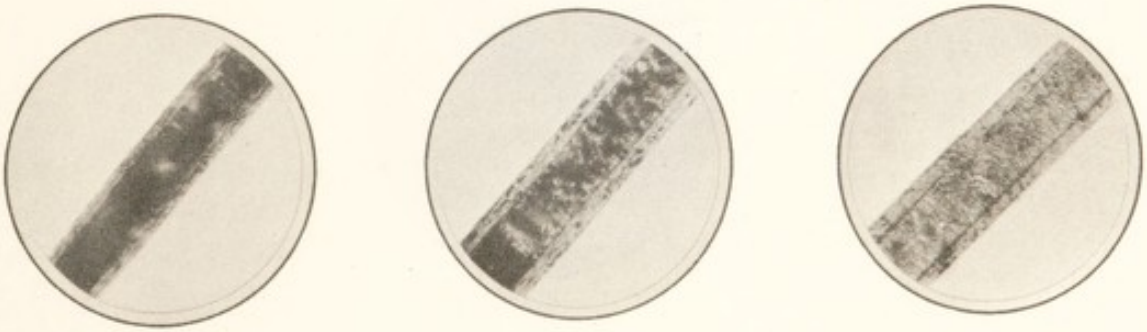
Family 15. Bovidæ (continued).

ROCKY MOUNTAIN GOAT (Coat Natural). 1-3.

ROCKY MOUNTAIN GOAT (Beard). 4-8.



ROAN ANTELOPE. 9-12.

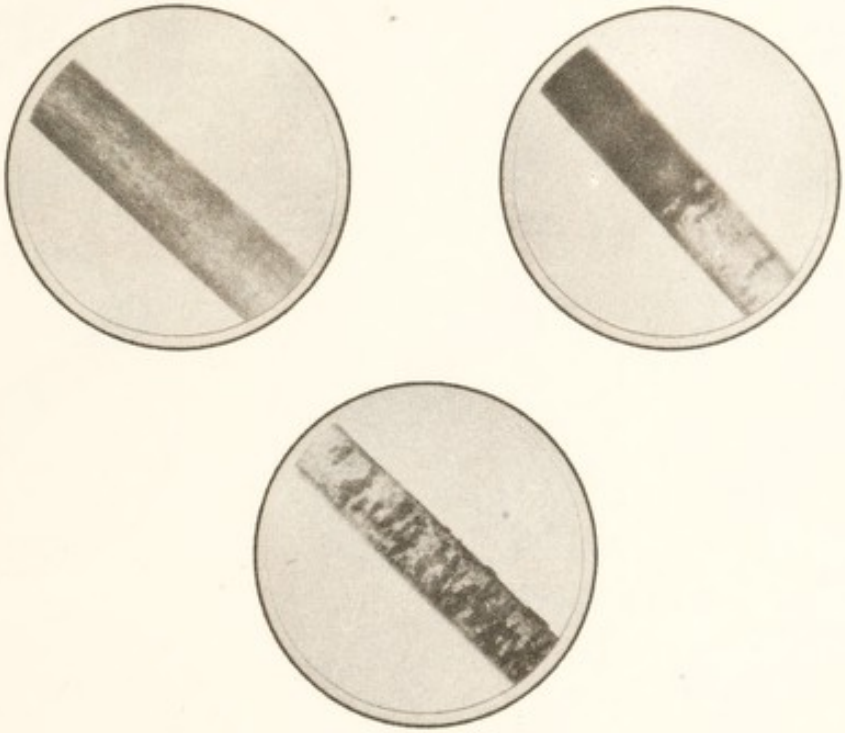


ORDER VI. HOOFED MAMMALS.

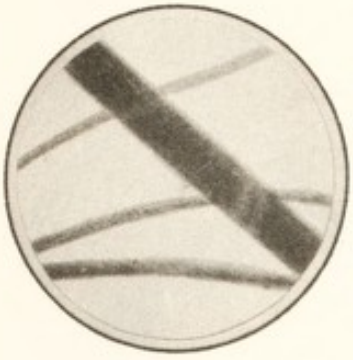
SUBORDER 1. ARTIODACTYLES.

FAMILY 15. BOVIDÆ (continued).

SOMALI DIK-DIK. 1-3.

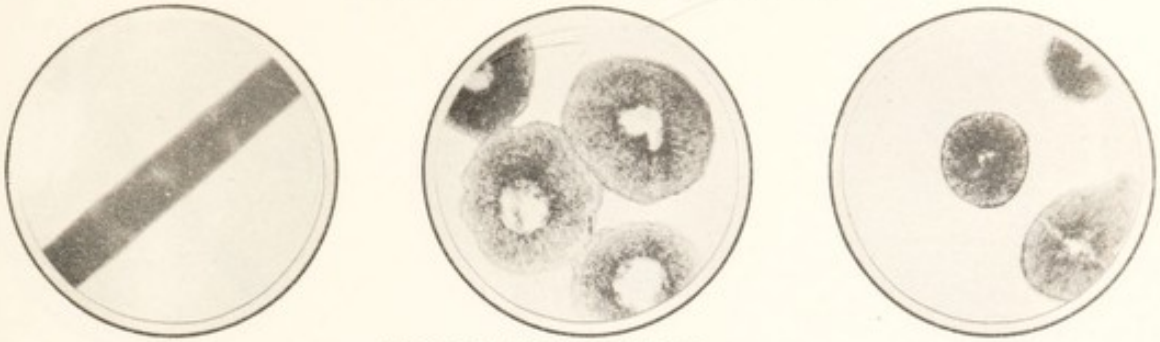


BISON. 4.



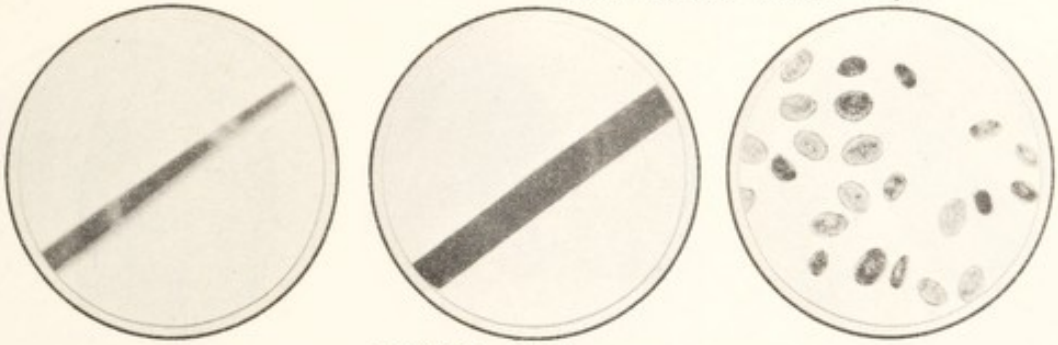
Family 15. Bovidæ (continued).

AFRICAN BUFFALO (African). 1-3.

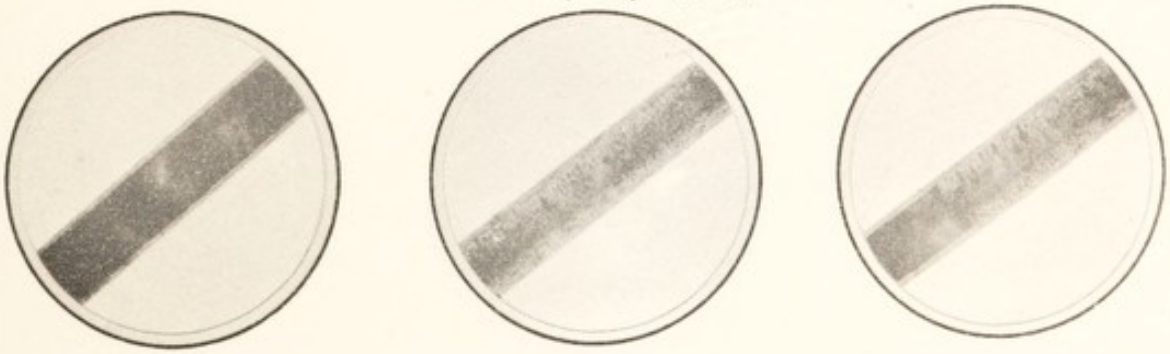


INDIAN BLACK BUCK. 4-7.

HIGHLAND BULL. 8-9.

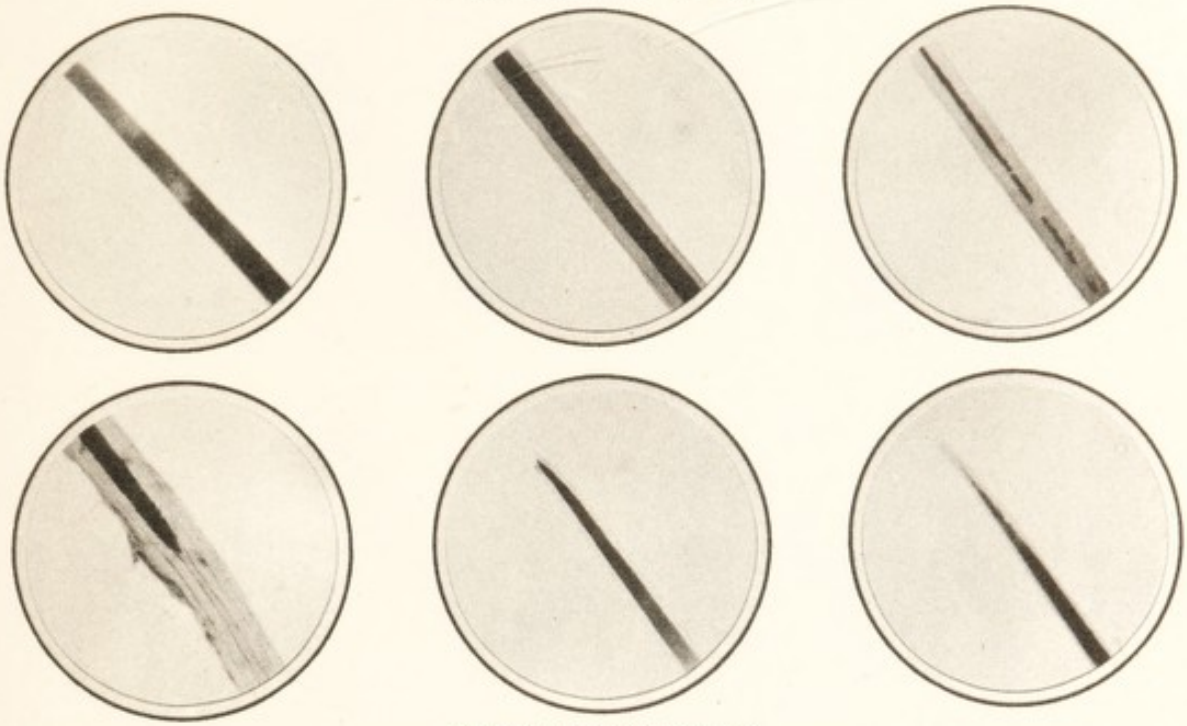


IMPALA (Neck). 10-12.

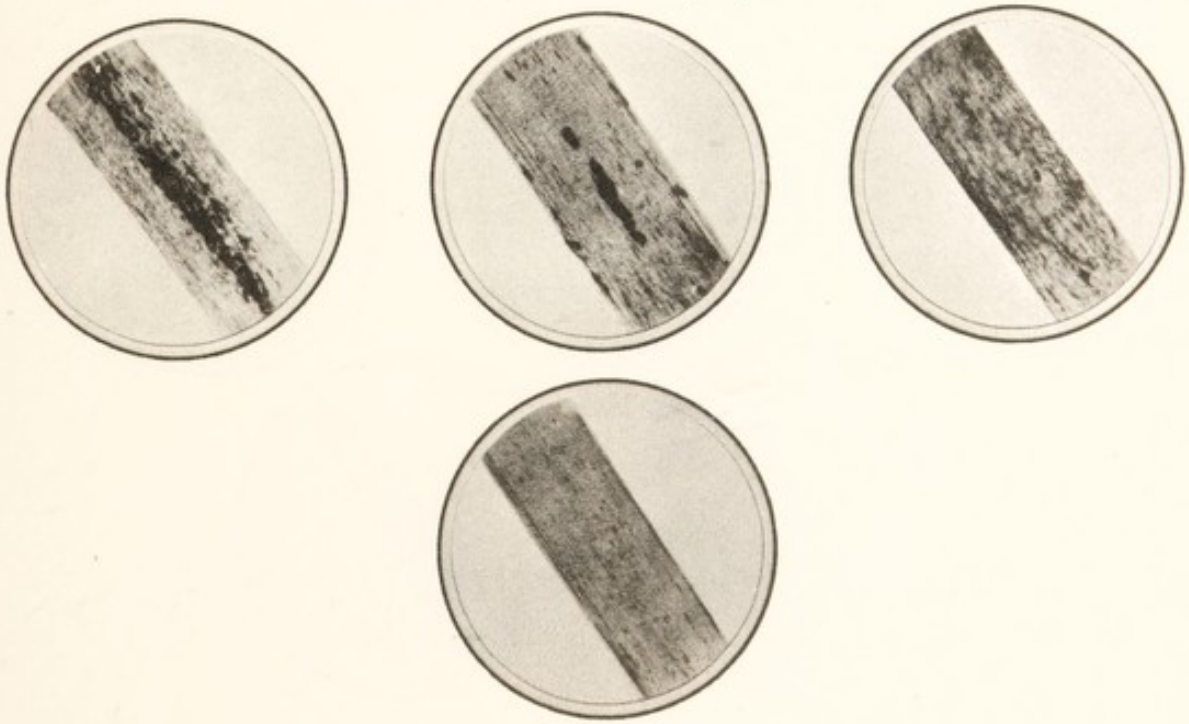


Family 15. Bovidæ (continued).

AYRSHIRE COW (Coat).

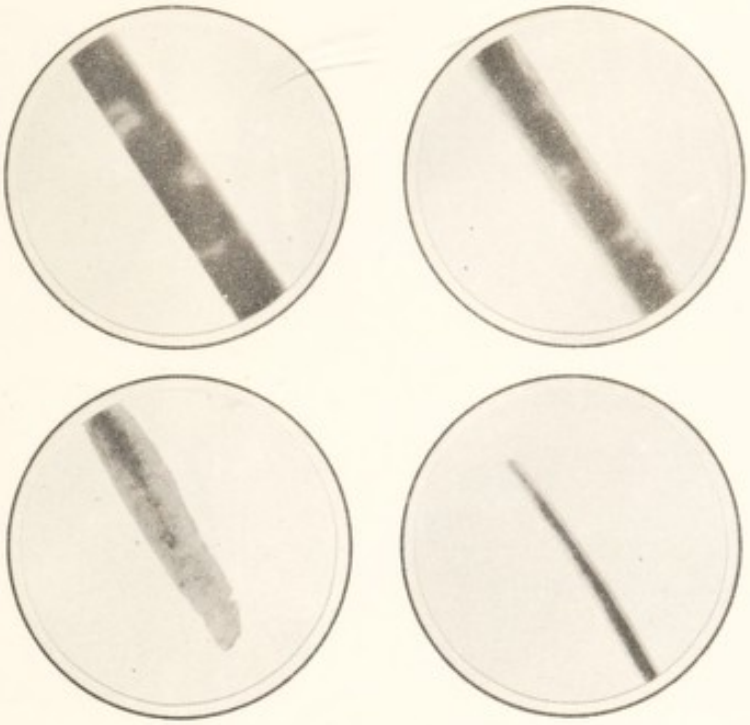


AYRSHIRE COW (Tail).

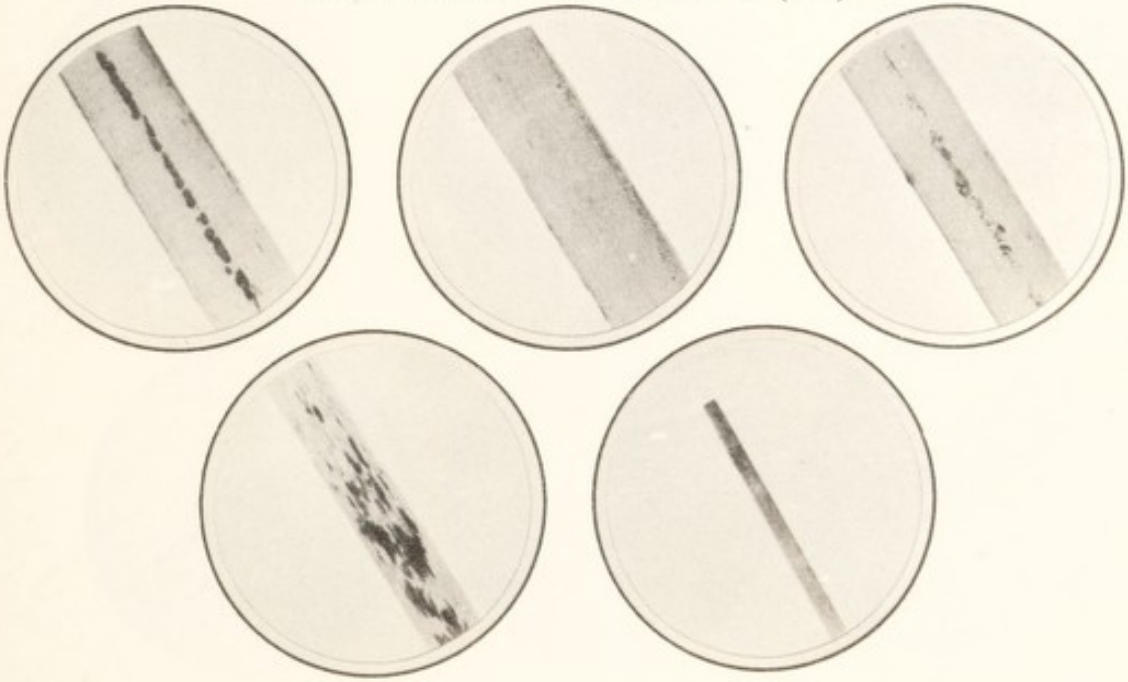


Family 15. Bovidæ (continued).

BELTED GALLOWAY BULLOCK (Coat).

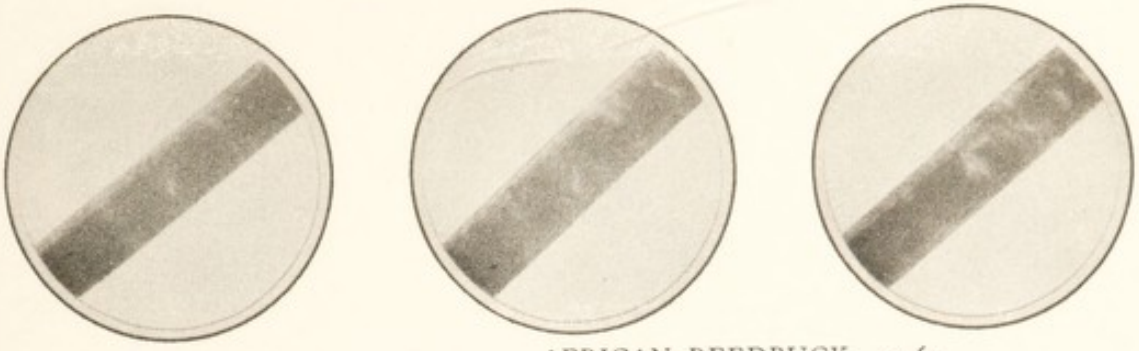


BELTED GALLOWAY BULLOCK (Tail).

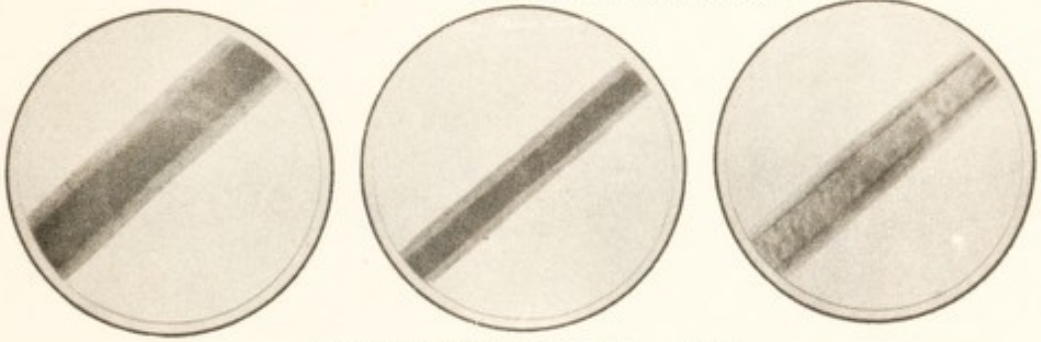


Family 15. Bovidæ (continued).

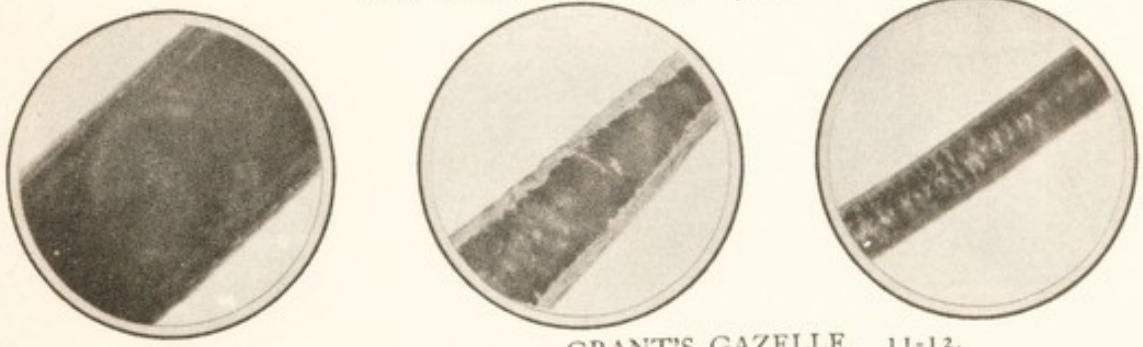
AFRICAN ELAND. 1-4. (Forehead).



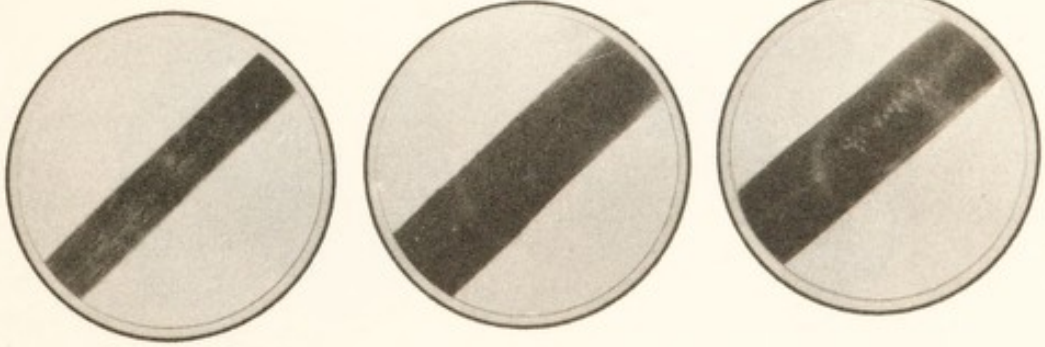
AFRICAN REEDBUCK. 5-6.



THOMSON'S GAZELLE. 7-10.

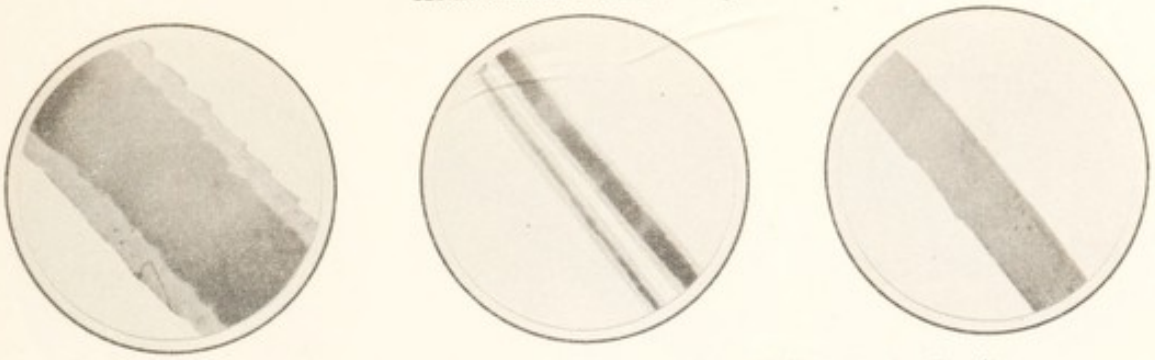


GRANT'S GAZELLE. 11-12.

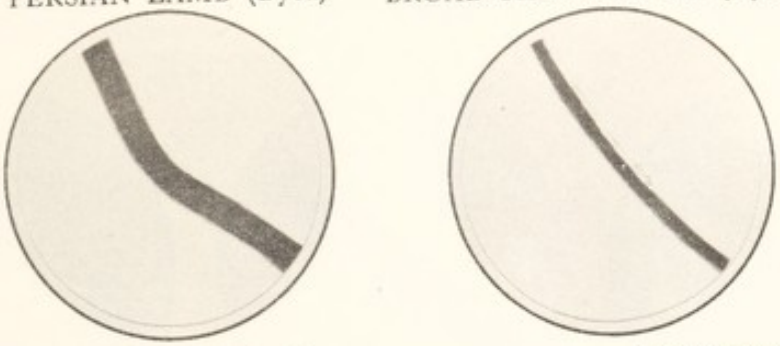


Family 15. Bovidæ (continued).

KRIMMER LAMB. 1-3.

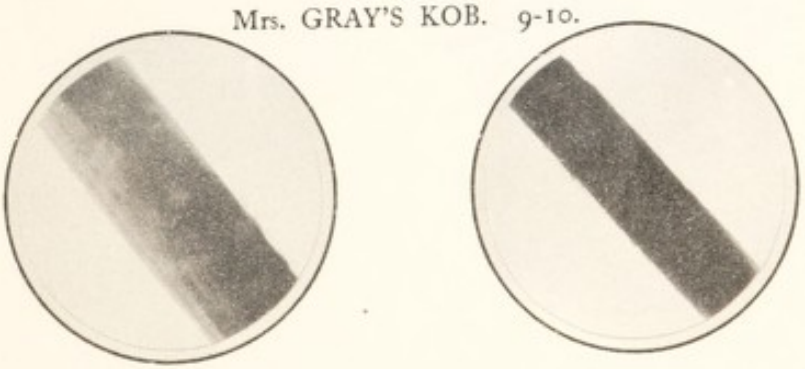


PERSIAN LAMB (Dyed) BROAD-TAILED LAMB (Dyed).



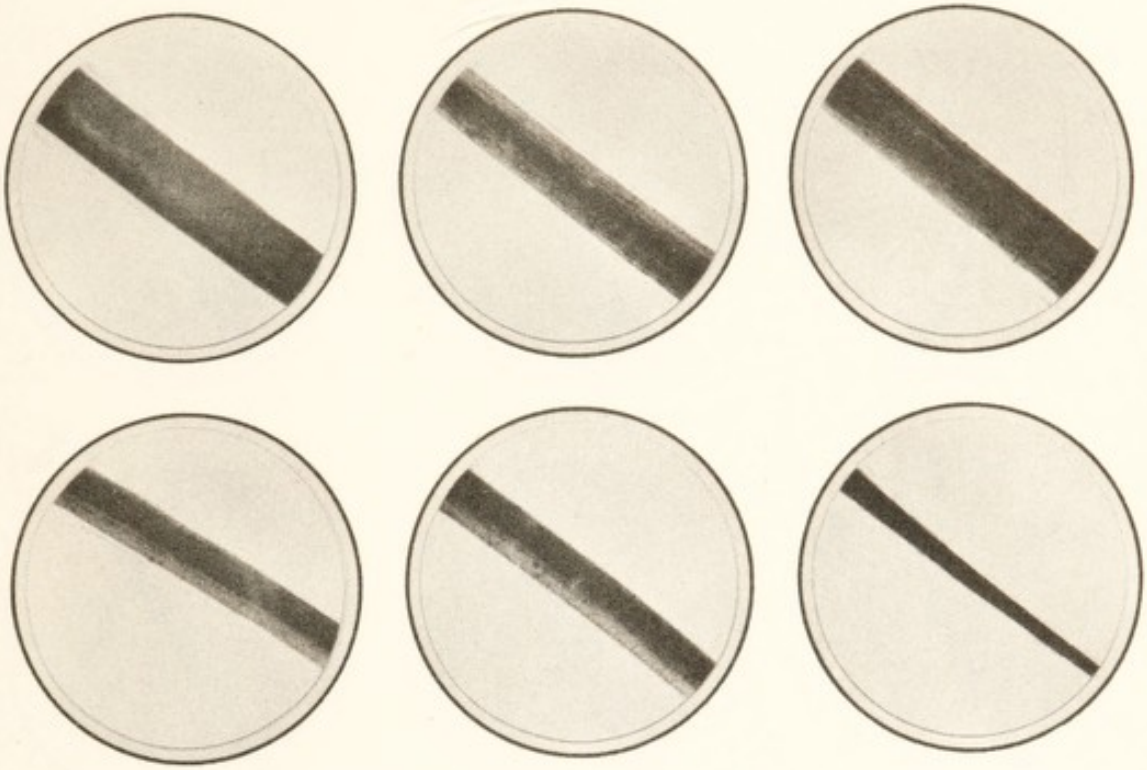
WILDBEEST. 6-7. HARTEBEEST. 8.

Mrs. GRAY'S KOB. 9-10.

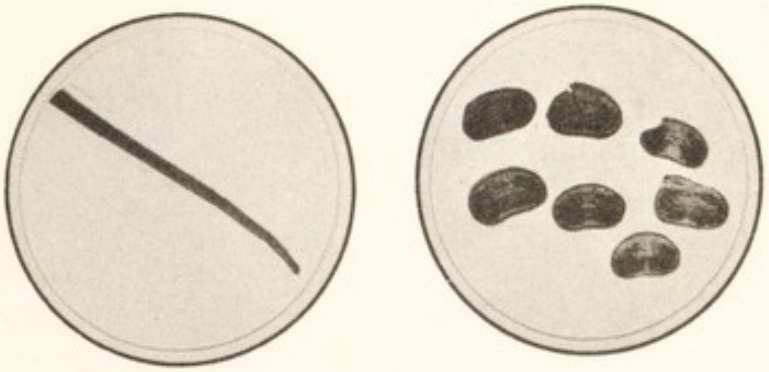


Family 15. Bovidæ (continued).

TOPI (Head).

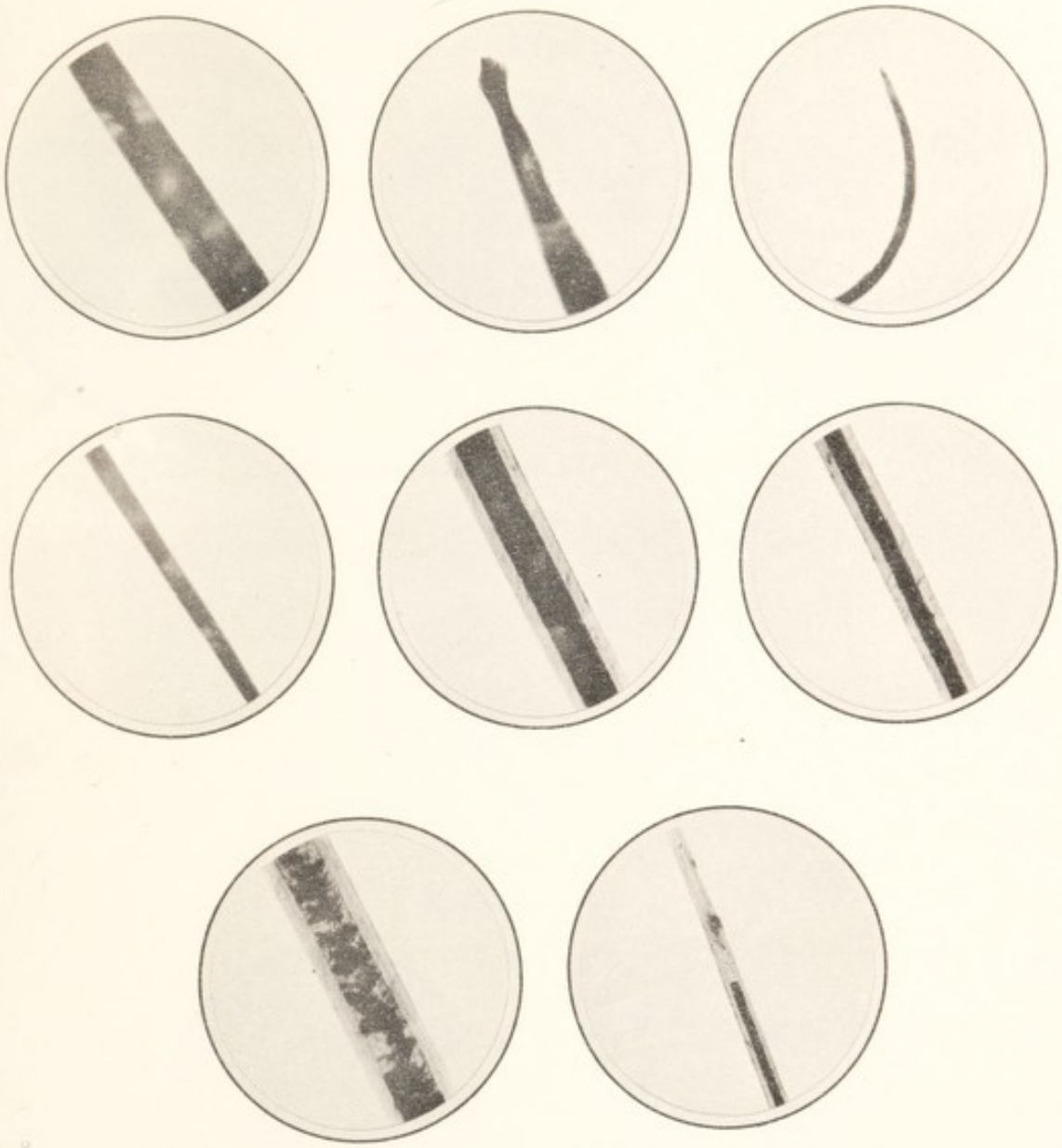


TRANSVERSE SECTION.



Family 15. Bovidæ (continued).

GORAL.



ORDER VI. HOOFED MAMMALS.

SUBORDER 1. ARTIODACTYLES.

FAMILY 15. BOVIDÆ (continued).

TRANSVERSE SECTIONS.

ROAN ANTELOPE.

AFRICAN ELAND OR ELK. (Forehead).

IMPALA (Neck).

ORDER VI. HOOFED MAMMALS.

Family 15. Bovidæ (continued).

TRANSVERSE SECTIONS.

SOMALI DIK-DIK.

INDIAN BLACK BUCK.

AFRICAN REEDBUCK.

THOMSON'S GAZELLE.

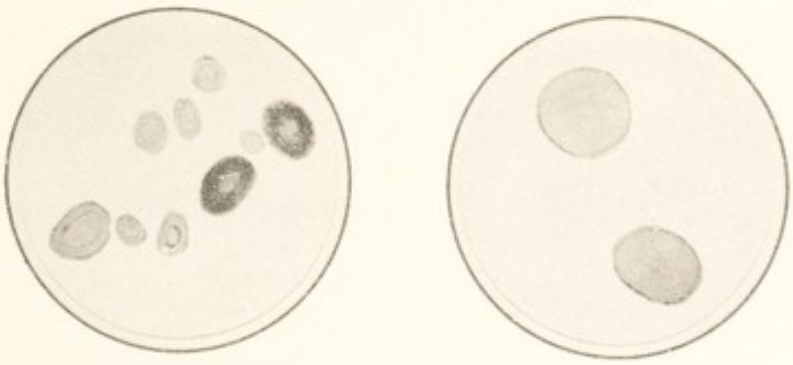
GRANT'S GAZELLE.

Family 15. Bovidæ (continued).

TRANSVERSE SECTIONS.

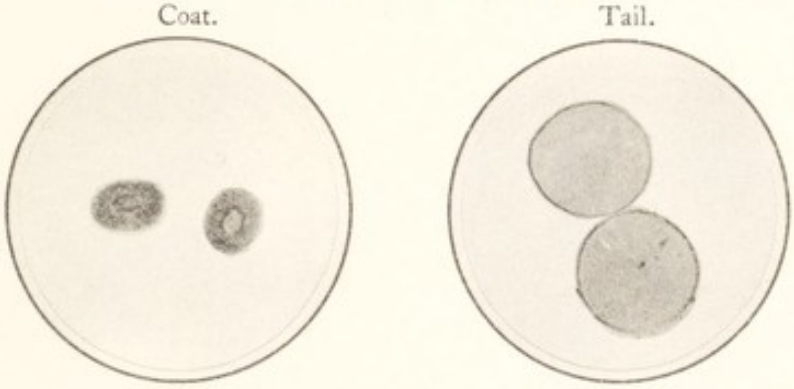
AYRSHIRE COW.

Coat. Tail.



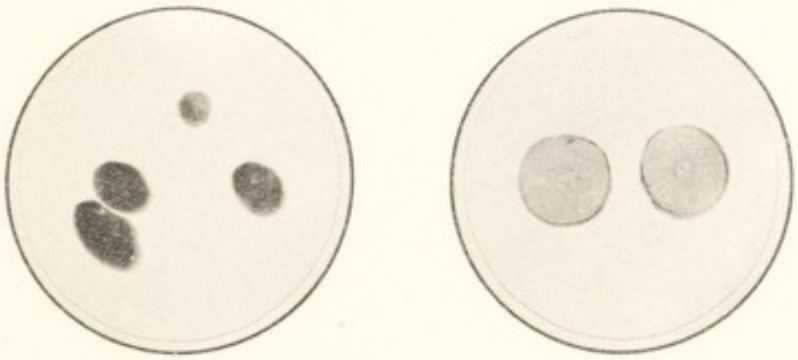
RED POLLED BULLOCK.

Coat. Tail.



BELTED GALLOWAY BULLOCK.

Coat. Tail.



Family 15. Bovidæ (continued).

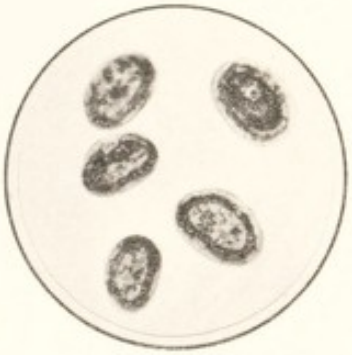
TRANSVERSE SECTIONS.

BARBARY SHEEP (Body).

ROCKY MOUNTAIN GOAT (Body).

HARTEBEEST.

Mrs. GRAY'S KOB.



Family 15. Bovidæ (continued).

TRANSVERSE SECTION.

KRIMMER LAMB.

Family 15. Bovidæ (continued).

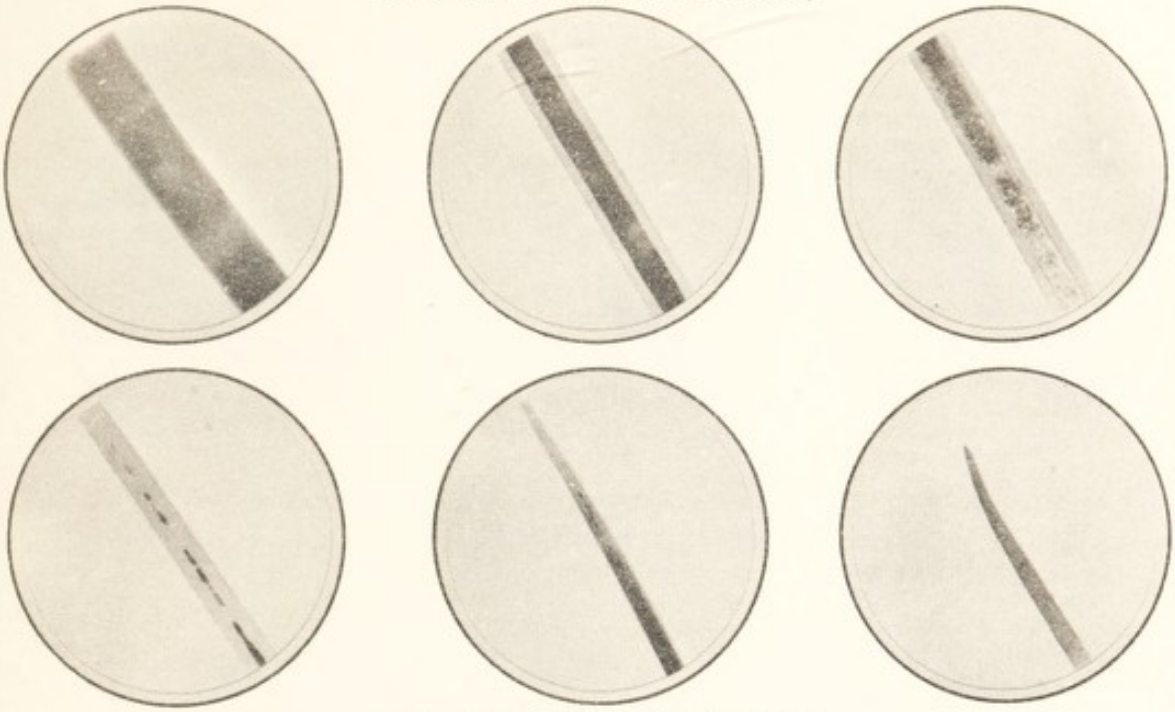
TRANSVERSE SECTIONS.

Mrs. GRAY'S KOB.

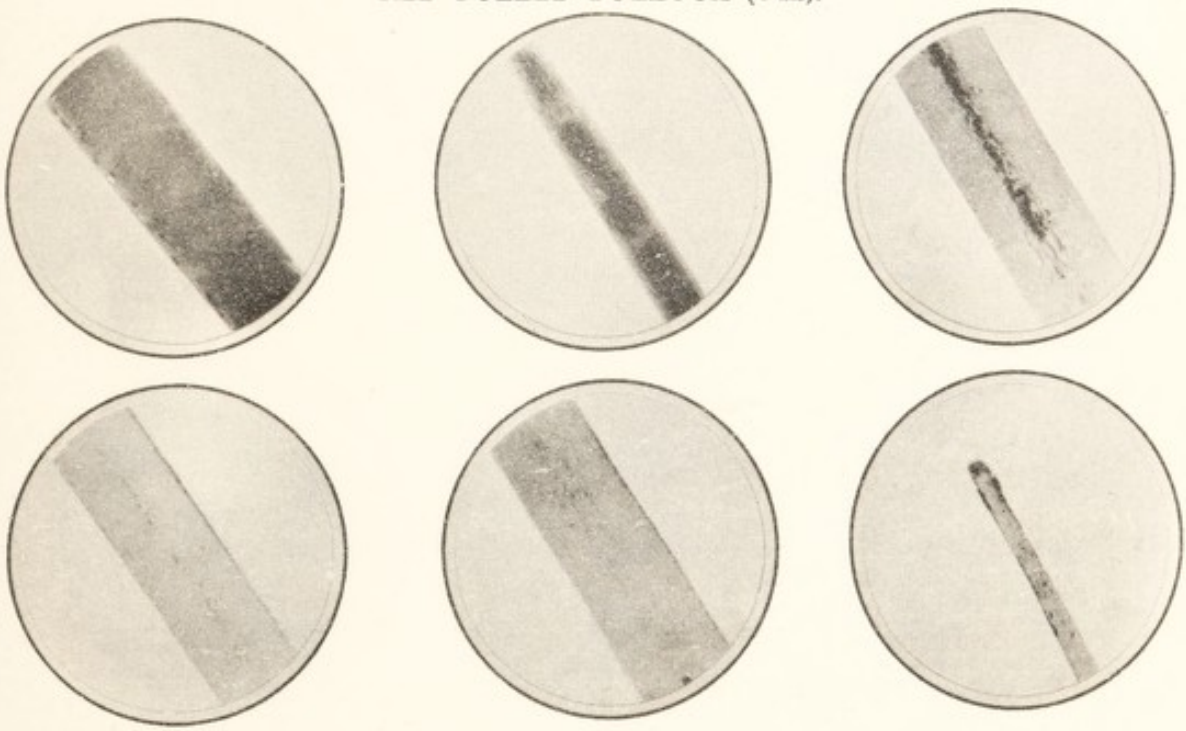
GORAL.

Family 15. Bovidæ (continued).

RED POLLED BULLOCK (Coat).



RED POLLED BULLOCK (Tail).



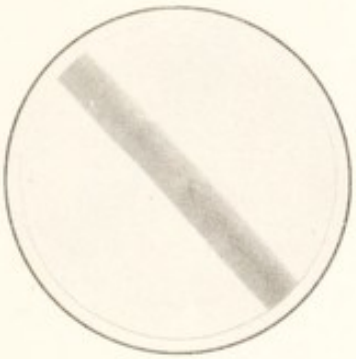
ORDER VI. HOOFED MAMMALS.

SUBORDER 2. PERISSODACTYLES.

FAMILY 19. EQUIDÆ.

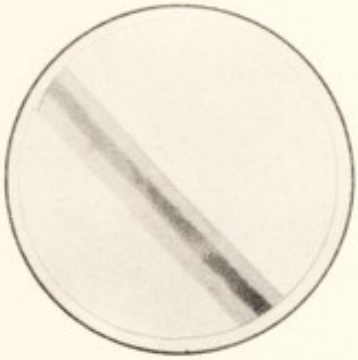
PONY (Dyed).

PONY (Natural).

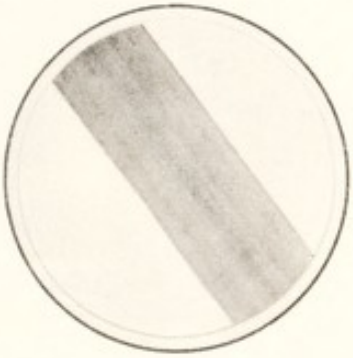


CLYDESDALE GELDING.

Grey.

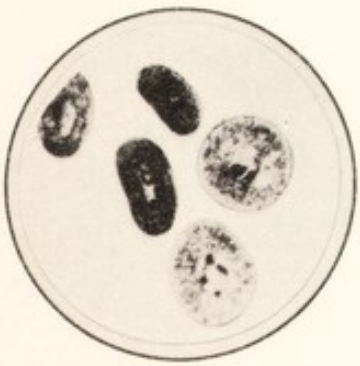


Brown.

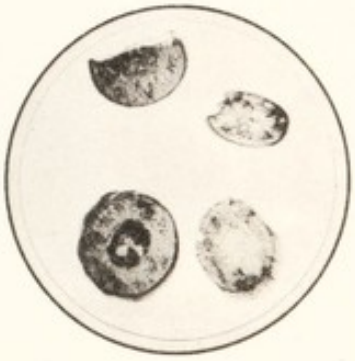


HORSE HAIR.

Grey.

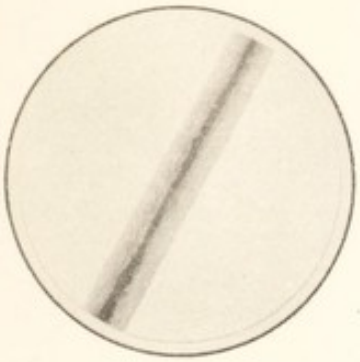


Brown.



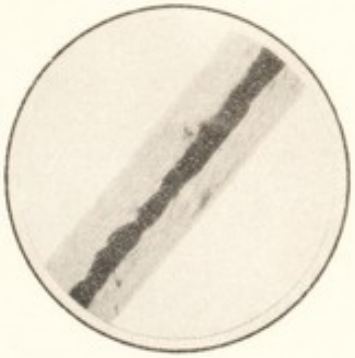
Family 19. Equidæ (continued).

CLYDESDALE MARE (Brown).
Thighs.



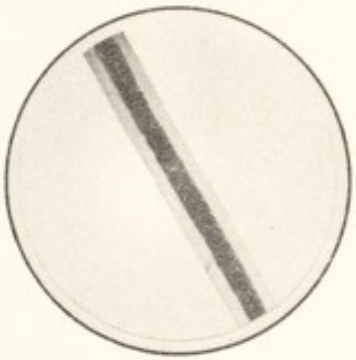
Tail.

CLYDESDALE GELDING (Brown).
Tail.

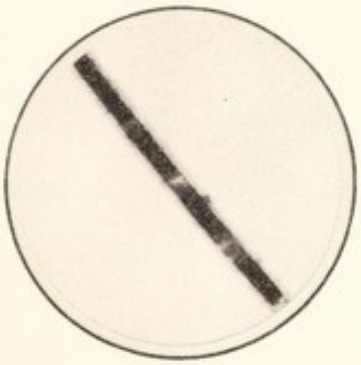


GREY CLYDESDALE GELDING.
Thighs.

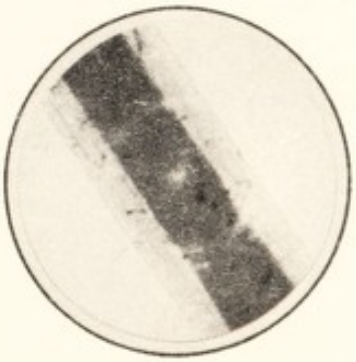
HACKNEY MARE (Brown).
Thighs.



RACING THOROUGHBRED MARE (Chestnut).
Thighs.

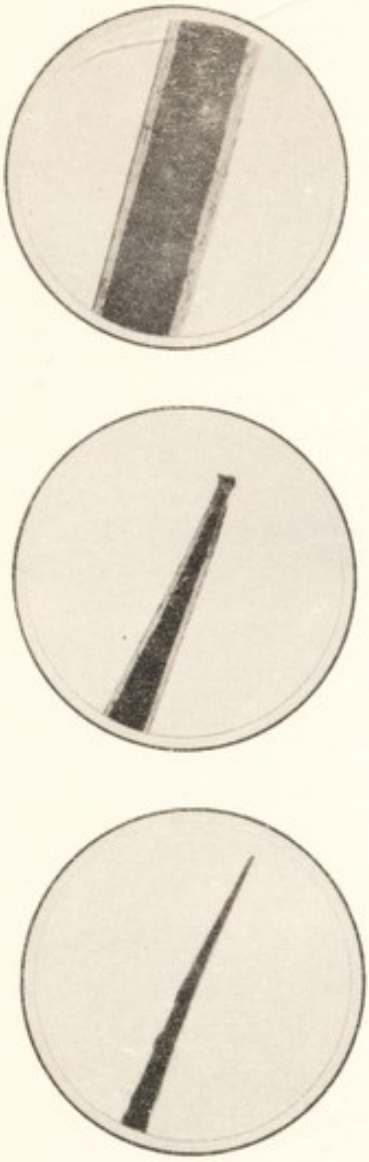


CHESTNUT DRIVING MARE
Thighs.



Family 19. Equidæ (continued).

ZEBRA.



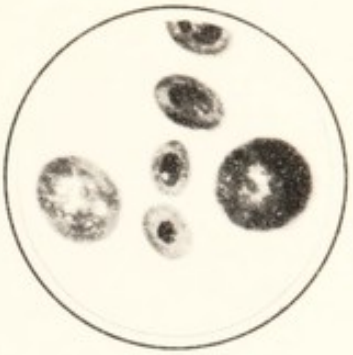
ORDER VI. HOOFED MAMMALS.

FAMILY 19. EQUIDÆ (continued).

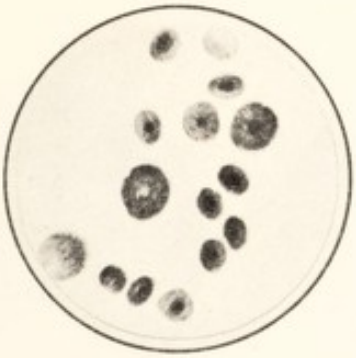
TRANSVERSE SECTIONS.

PONY
(Natural coat).

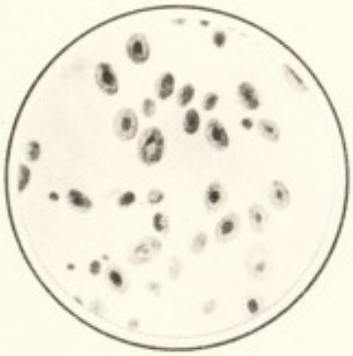
MARE (Clydesdale brown).
HIP AROUND TAIL.



AMERICAN CHESTNUT
MARE (Driving).
INSIDE THIGHS.



RACING THOROUGHBRED
MARE (Chestnut).
INSIDE THIGHS.



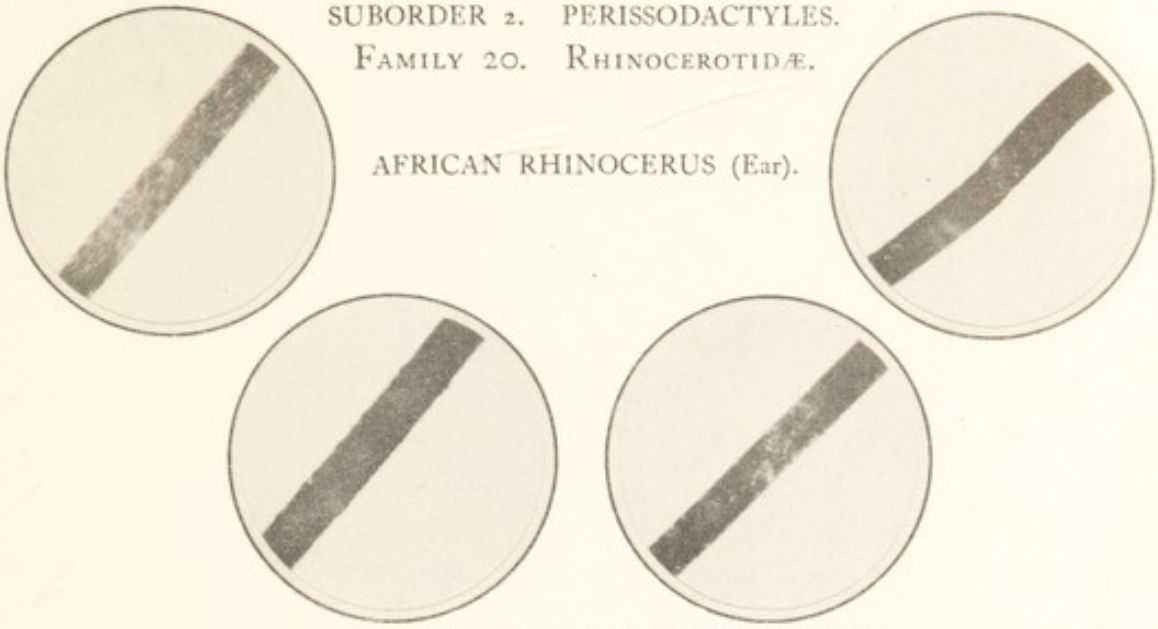
ZEBRA.

ORDER VI. HOOFED MAMMALS.

SUBORDER 2. PERISSODACTYLES.

FAMILY 20. RHINOCEROTIDÆ.

AFRICAN RHINOCERUS (Ear).

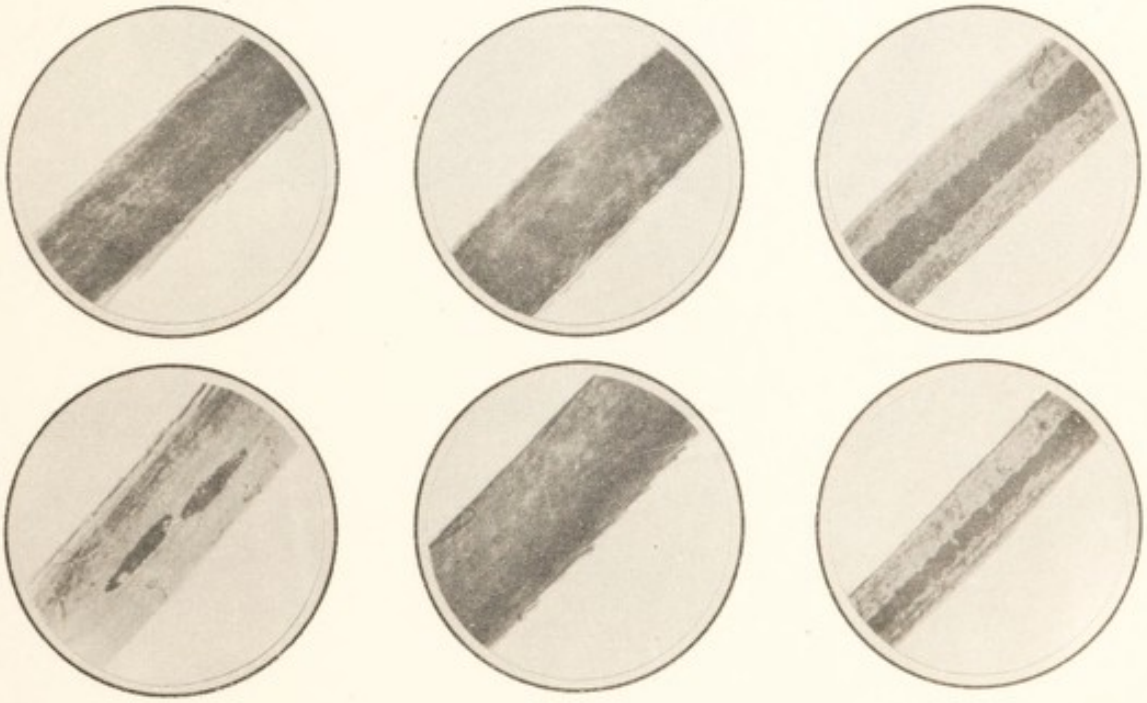


ORDER VI. HOOFED MAMMALS.

SUBORDER 5. HYRACES.

FAMILY 30. HYRACIDÆ.

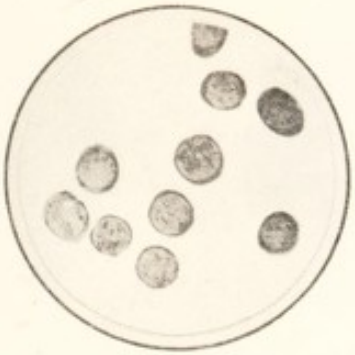
HYRAX.



Family 20. Rhinocerotidæ (continued).

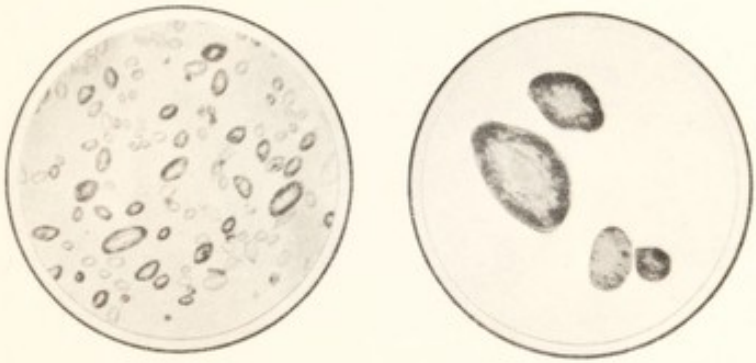
TRANSVERSE SECTIONS.

RHINOCERUS (Ear).



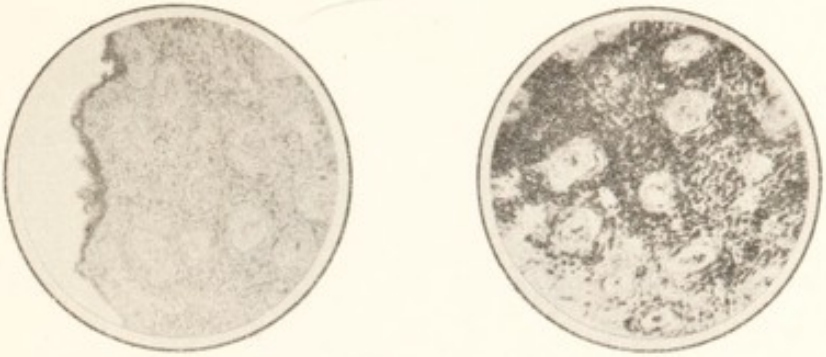
Family 30. Hyracidæ (continued).

HYRAX.

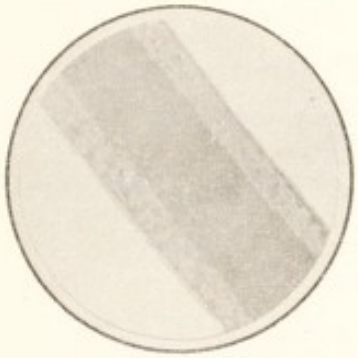


ORDER VI. HOOFED MAMMALS.
SUBORDER 7. PROBOSCIDIANS
FAMILY 35. ELEPHANTS.

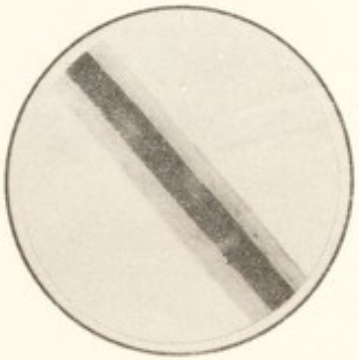
SECTION OF TAIL HAIR.



ORDER VI. HOOFED MAMMALS.
SUBORDER 2. PERISSODACTYLES.
FAMILY 16. TAPIRS.



ORDER VIII. CARNIVORES.
SUBORDER 1. FISSIPEDES.
FAMILY 2. HYÆNAS.



ORDER VI. HOOFED MAMMALS.

Family 16. Tapirs (continued).

TRANSVERSE SECTIONS.

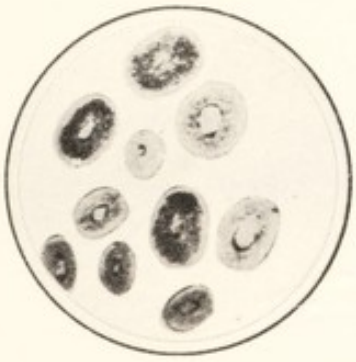
TAPIR.

ORDER VIII. CARNIVORES.

Family 2. Hyænas (continued).

TRANSVERSE SECTIONS.

HYÆNA.



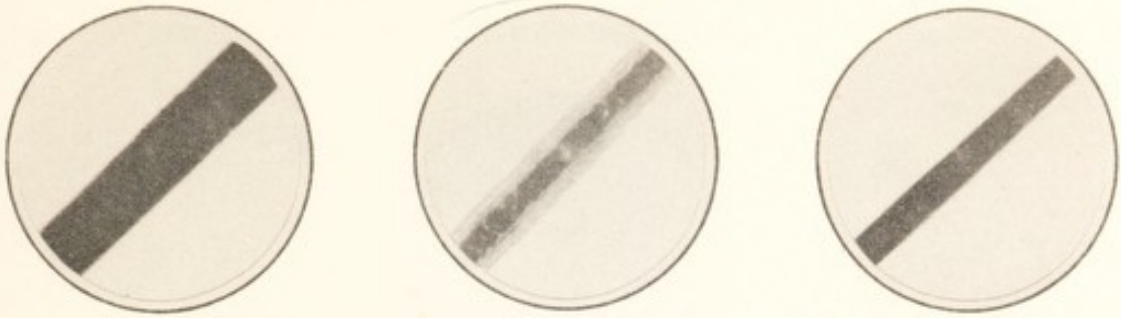
ORDER VII. RODENTS.

SUBORDER 1. SIMPLICIDENDATA.

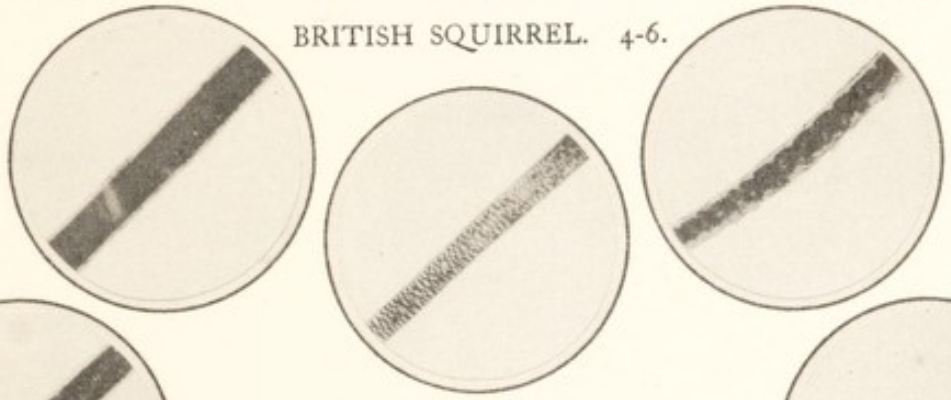
FAMILY 2. SCIURIDÆ.

MARMOT. 1-2.

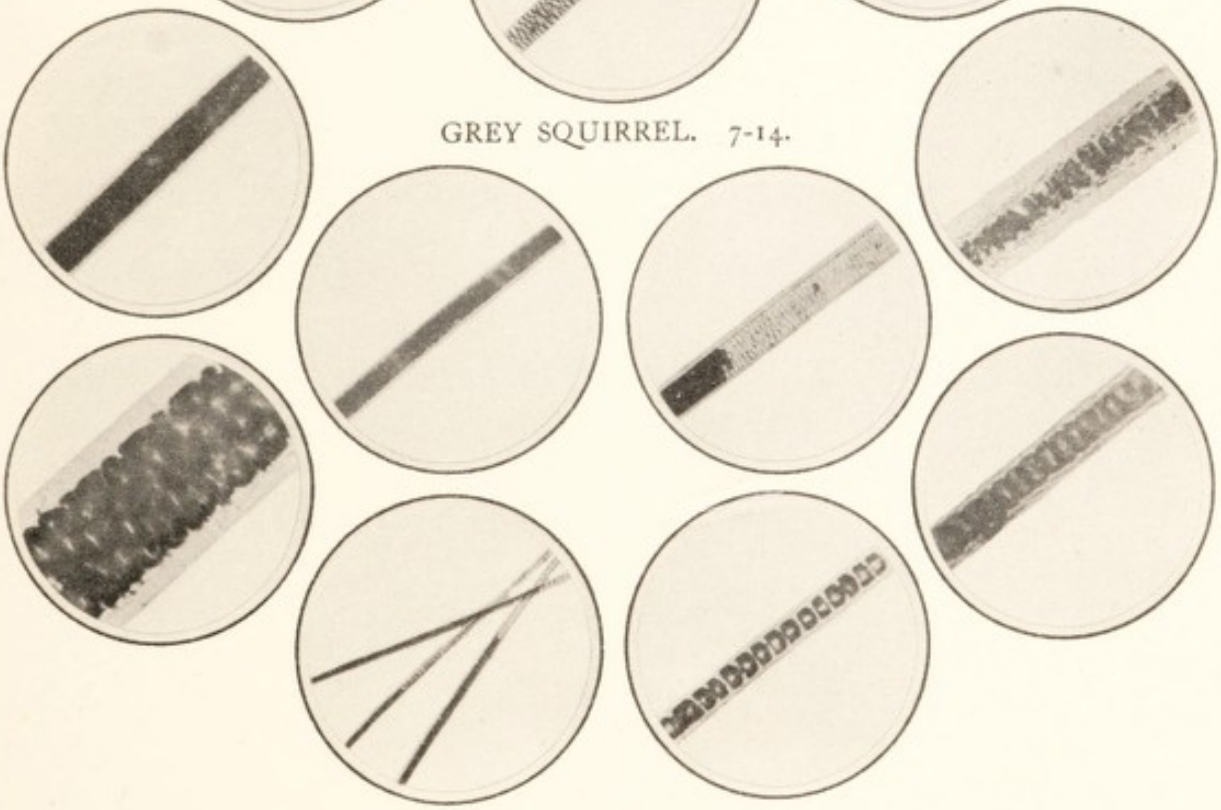
VIATKA SQUIRREL.



BRITISH SQUIRREL. 4-6.



GREY SQUIRREL. 7-14.



ORDER VII. RODENTS.

FAMILY 2. SCIURIDÆ (continued).

TRANSVERSE SECTIONS.

BRITISH RED SQUIRREL.

ORDER VII. RODENTS.

Family 2. Sciuridæ (continued).

TRANSVERSE SECTIONS.

MARMOT.

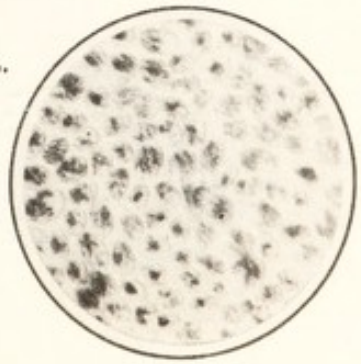
GREY SQUIRREL.

ORDER VII. RODENTS.

Family 5. Castoridæ.

TRANSVERSE SECTIONS.

BEAVER WOOL.

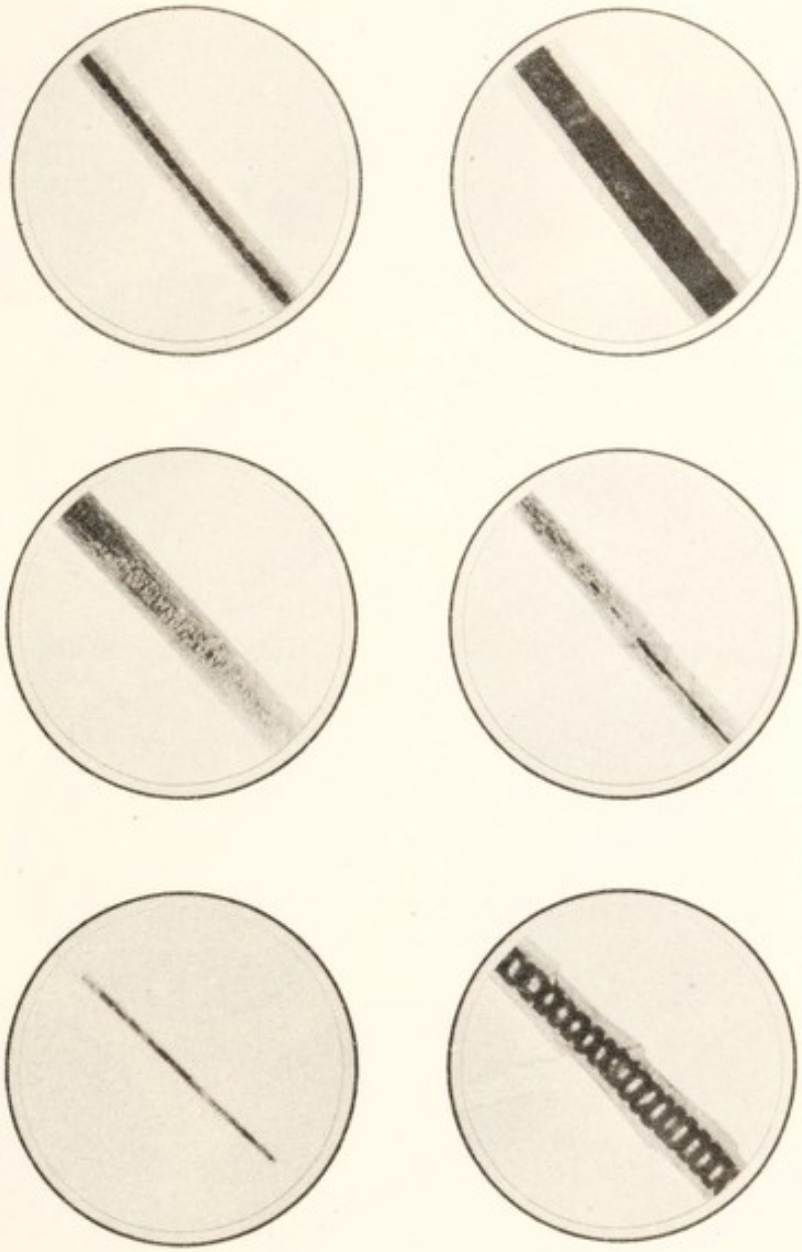


ORDER VII. RODENTS.

SUBORDER 1. SIMPLICIDENDATA.

FAMILY 5. CASTORIDÆ.

BEAVER.

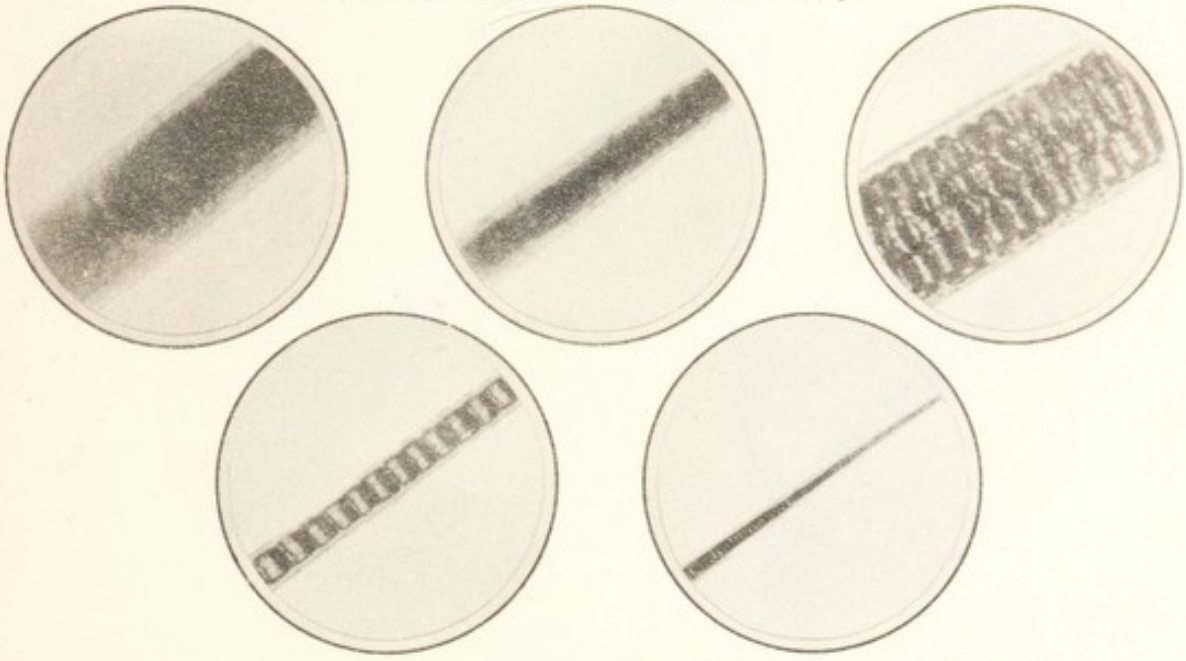


ORDER VII. RODENTS.

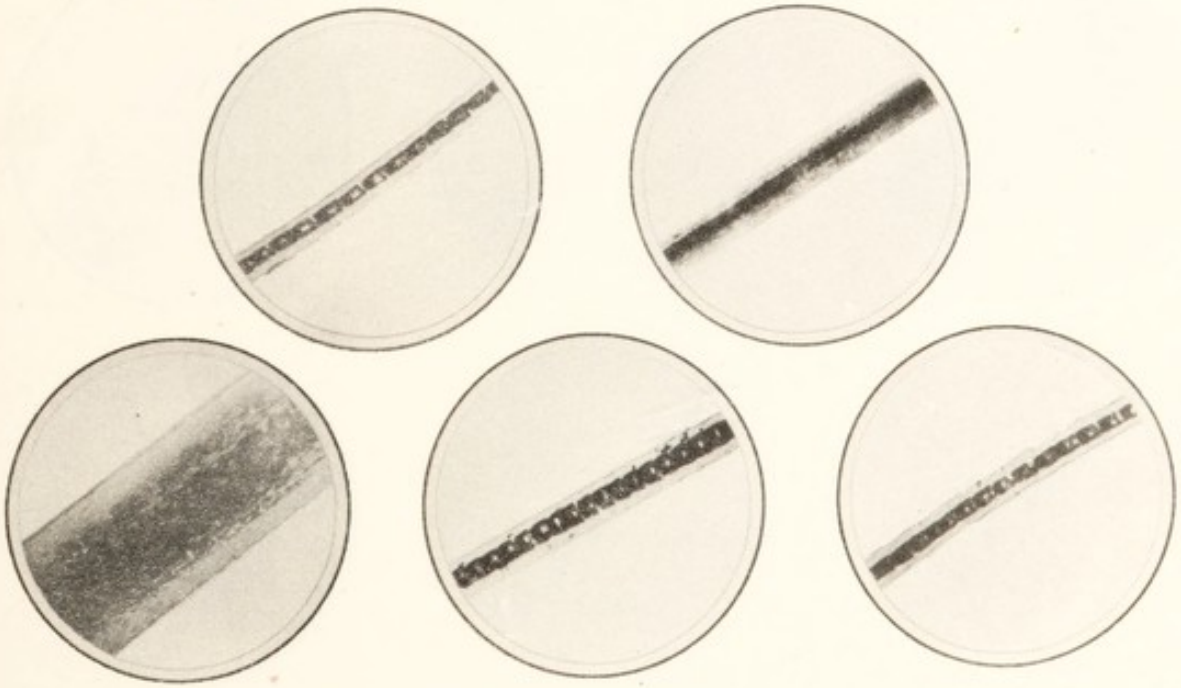
SUBORDER 1. SIMPLICIDENDATA.

FAMILY 8. MURIDÆ.

SHORT-TAILED FIELD VOLE. 1-5.

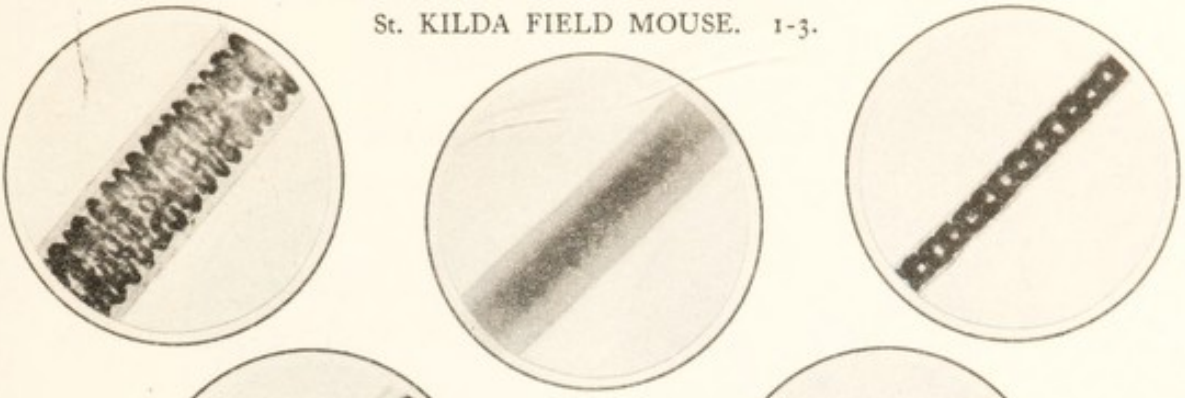


LUSTERED MUSQUASH. NATURAL BLACK MUSQUASH. 7-10.

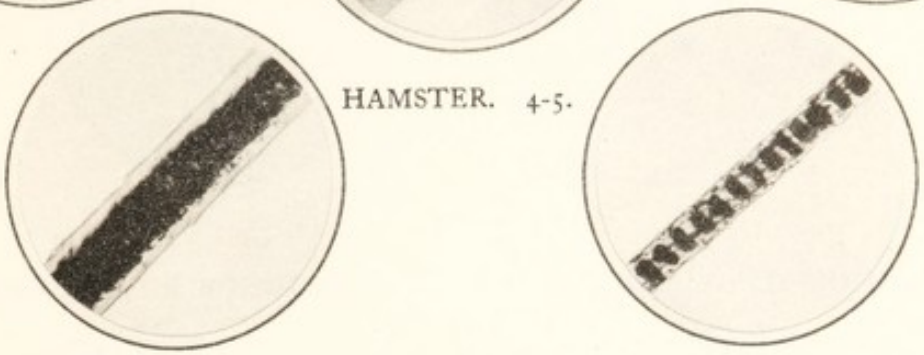


Family 8. Muridæ (continued).

St. KILDA FIELD MOUSE. 1-3.

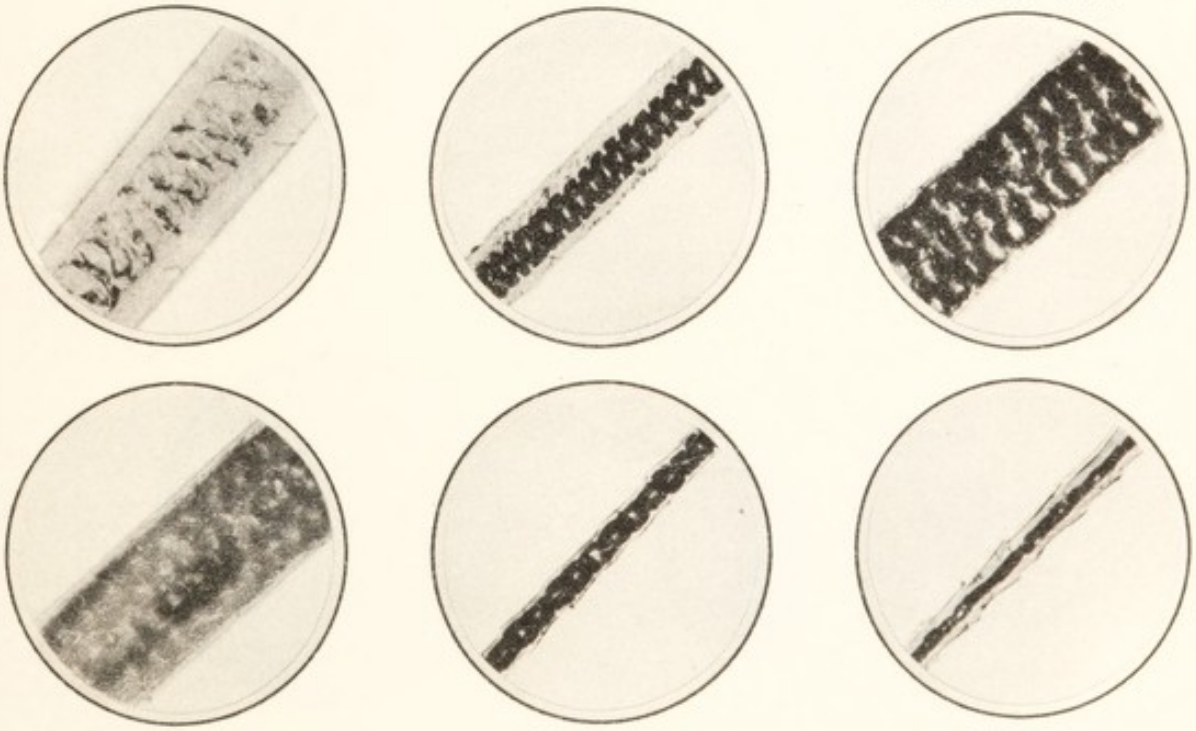


HAMSTER. 4-5.



BROWN RAT. 6-7.

St. KILDA HOUSE MOUSE. 8-11.



ORDER VII. RODENTS.

Family 8. Muridæ (continued).

TRANSVERSE SECTIONS.

SHORT TAILED FIELD VOLE.

NATURAL BLACK MUSQUASH.

St. KILDA FIELD MOUSE.

HAMSTER.

Family 8. Muridæ (continued).

TRANSVERSE SECTIONS.

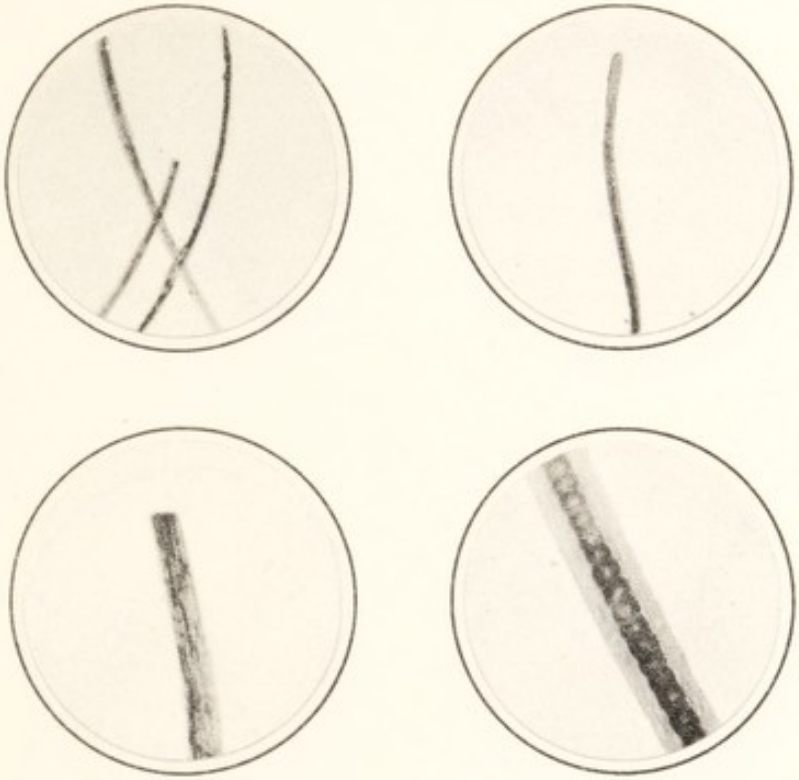
BROWN RAT.

ORDER VII. RODENTS.

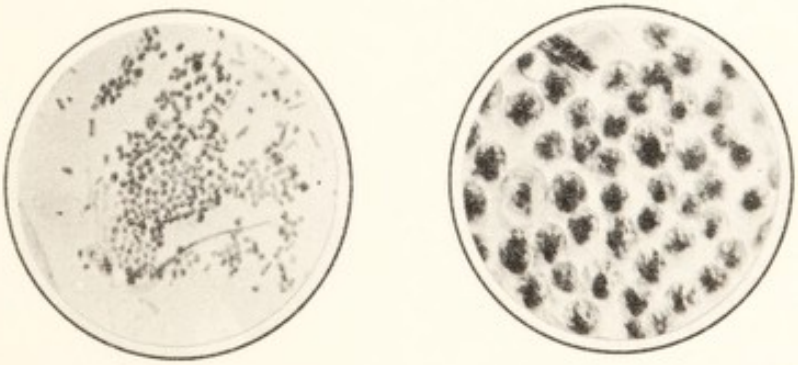
SUBORDER 1. SIMPLICIDENDATA.

FAMILY 13. OCTODONTIDÆ.

COYPU RAT.



TRANSVERSE SECTIONS.

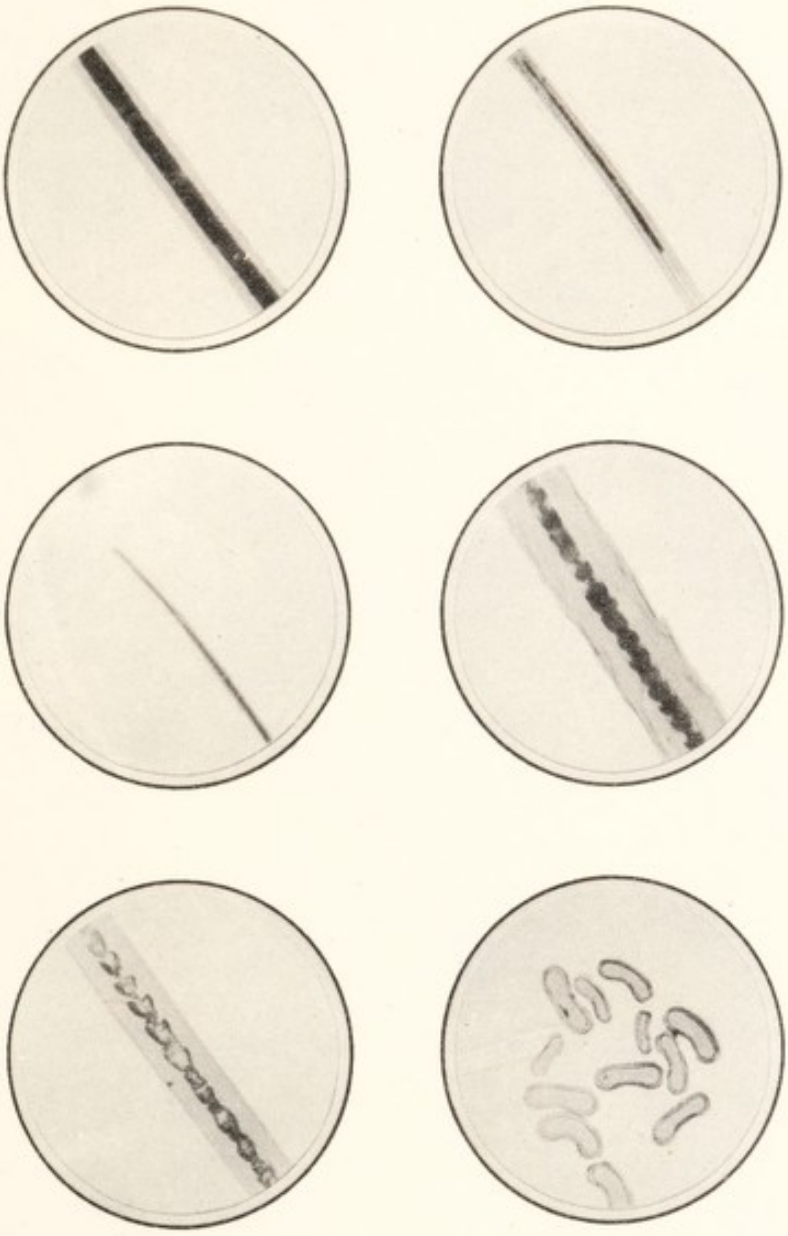


ORDER VII. RODENTS.

SUBORDER 2. DUPLICIDENTATA.

FAMILY 20. LAGOMYIDÆ.

GUINEA PIG.



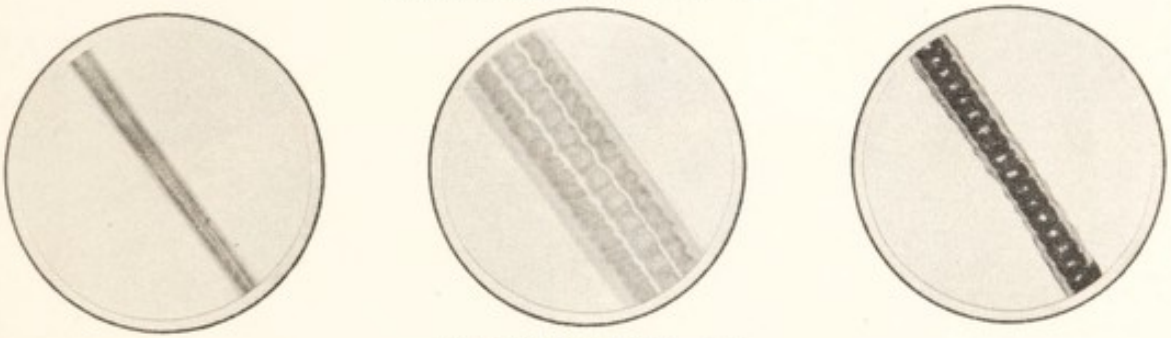
ORDER VII. RODENTS.

SUBORDER 2. DUPLICIDENTATA.

FAMILY 21. LEPORIDÆ.

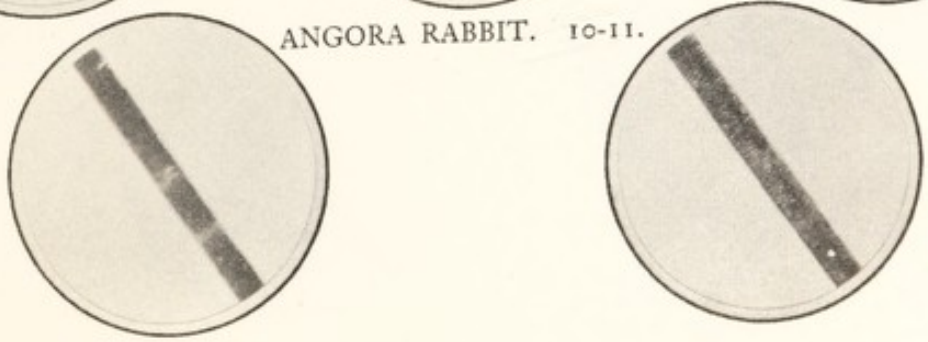
WHITE RABBIT. 1-3.

CHINCHILLA RABBIT. 4-6.



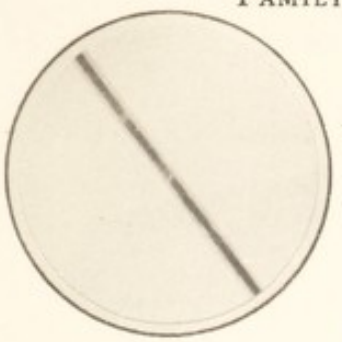
CONEY RABBIT. 7-9.

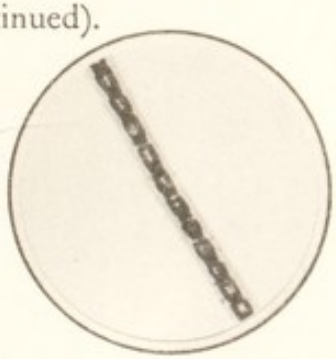
ANGORA RABBIT. 10-11.



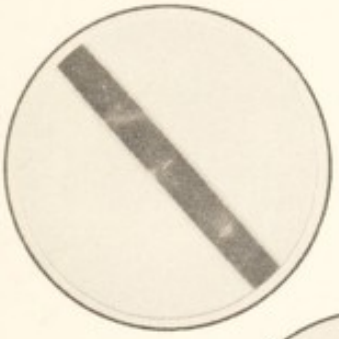
FAMILY 21. LEPORIDÆ (continued).

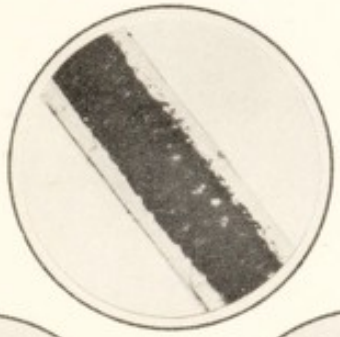
ANGORA RABBIT. 1-2.

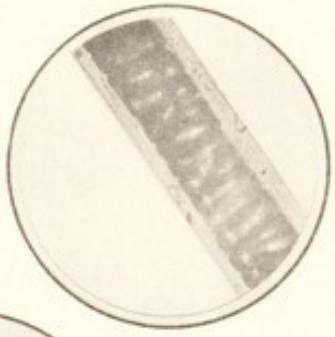


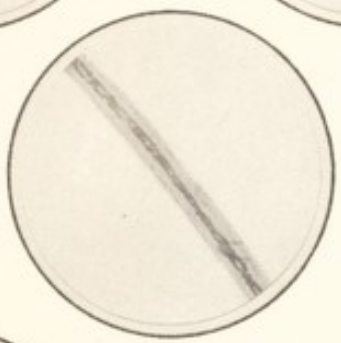


COMMON HARE. 3-7.

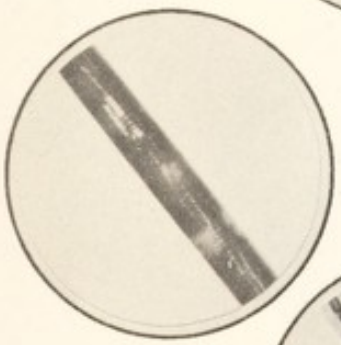


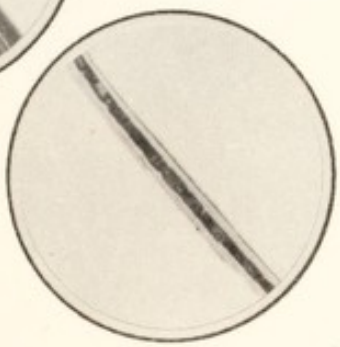


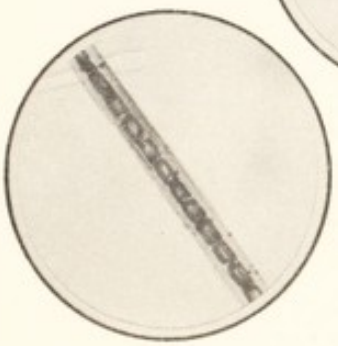




SCOTCH MOUNTAIN HARE.
8-11.







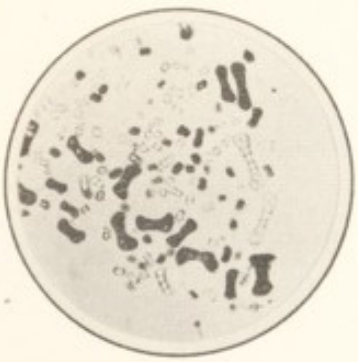
ORDER VII. RODENTS.

FAMILY 21. LEPORIDÆ (continued).

TRANSVERSE SECTIONS.

COMMON HARE.

SCOTCH MOUNTAIN HARE.

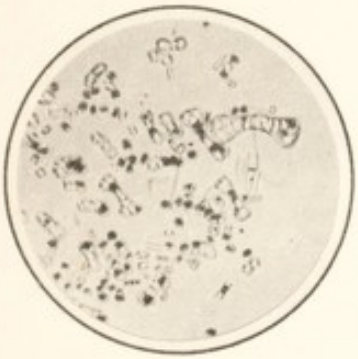


ORDER VII. RODENTS.

FAMILY 21. LEPORIDÆ (continued).

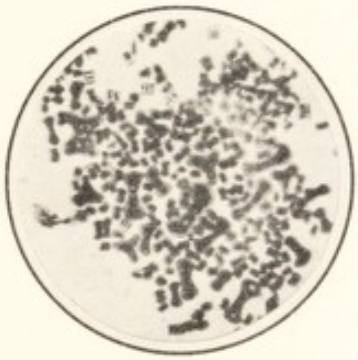
TRANSVERSE SECTIONS.

WHITE RABBIT.



CHINCHILLA RABBIT.

CONEY RABBIT.



ANGORA RABBIT.

Family 21. Leporidæ (continued).

TRANSVERSE SECTIONS.

AUSTRALIAN RABBIT.

ORDER VIII. CARNIVORES.

SUBORDER 1. FISSIPEDES.

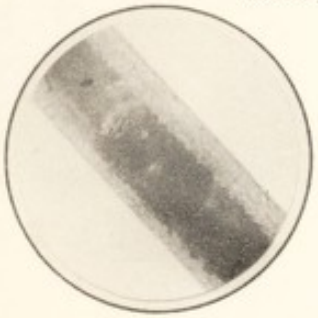
FAMILY 1. FELIDÆ.

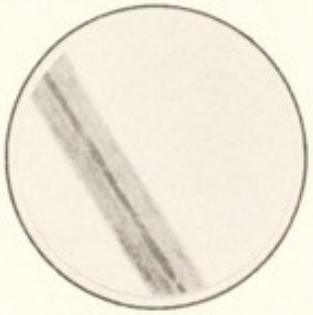
BRITISH WILD CAT. 1-3.



OCELOT. 4-5.

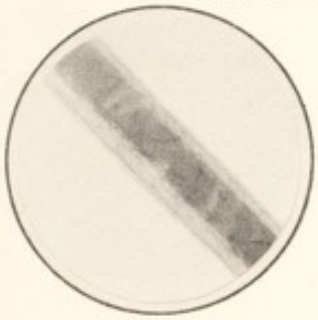
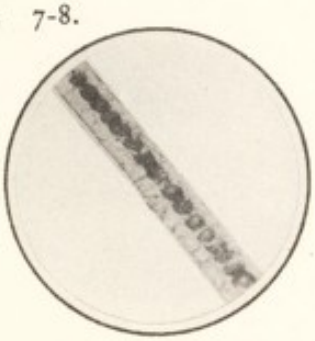
HOUSEHOLD CAT. 6.



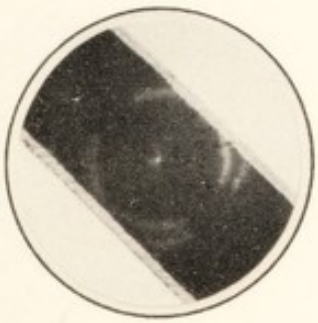
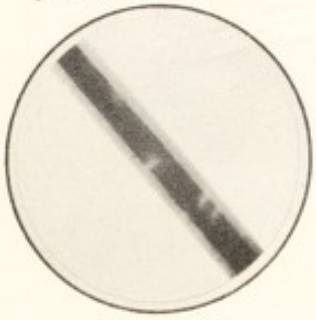
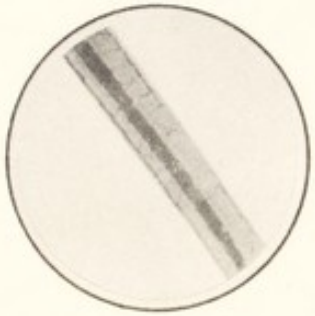


PERSIAN CAT. 7-8.

AFRICAN LION. 9.

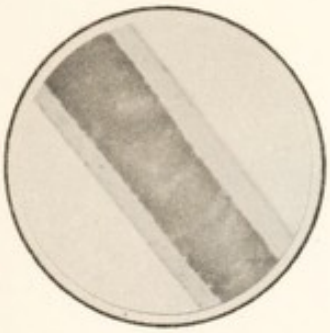



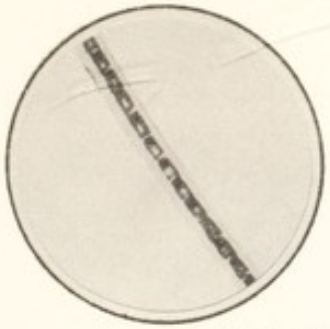

JAGUAR. 10-12.

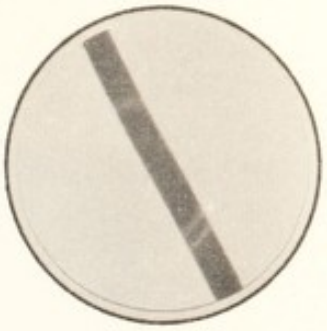
Family 1. Felidæ (continued).

LYNX (Undyed). 1-2.

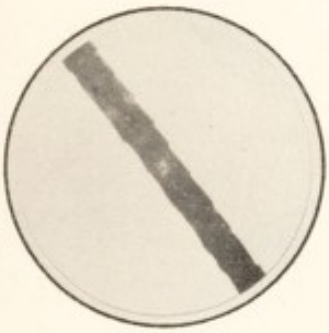


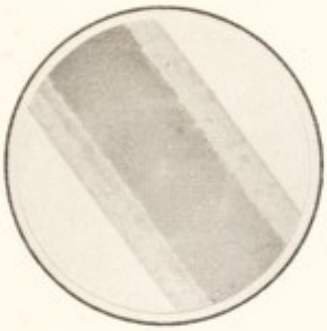


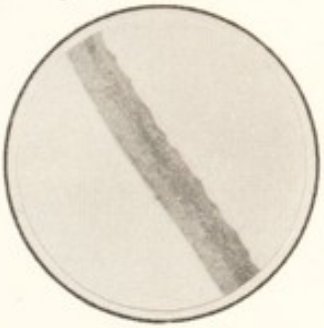
LYNX (Dyed). 3-4.



SNOW LEOPARD. 5-6.

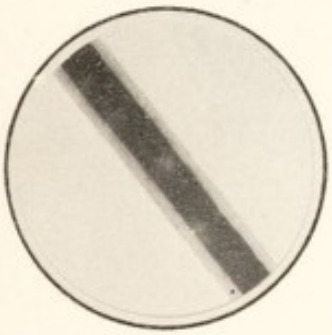


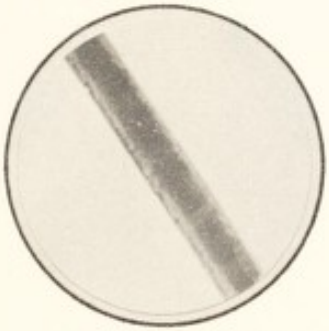


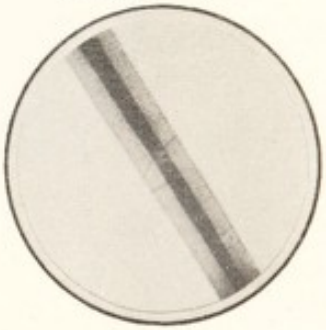


AFRICAN LEOPARD. 7-8.

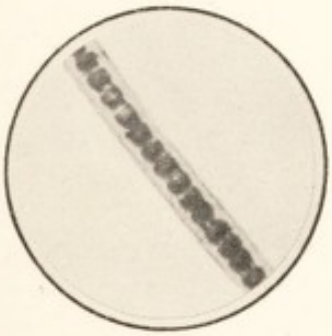
TIGER. 9-10.

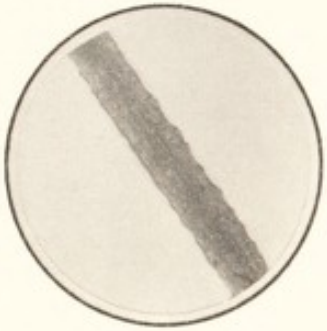






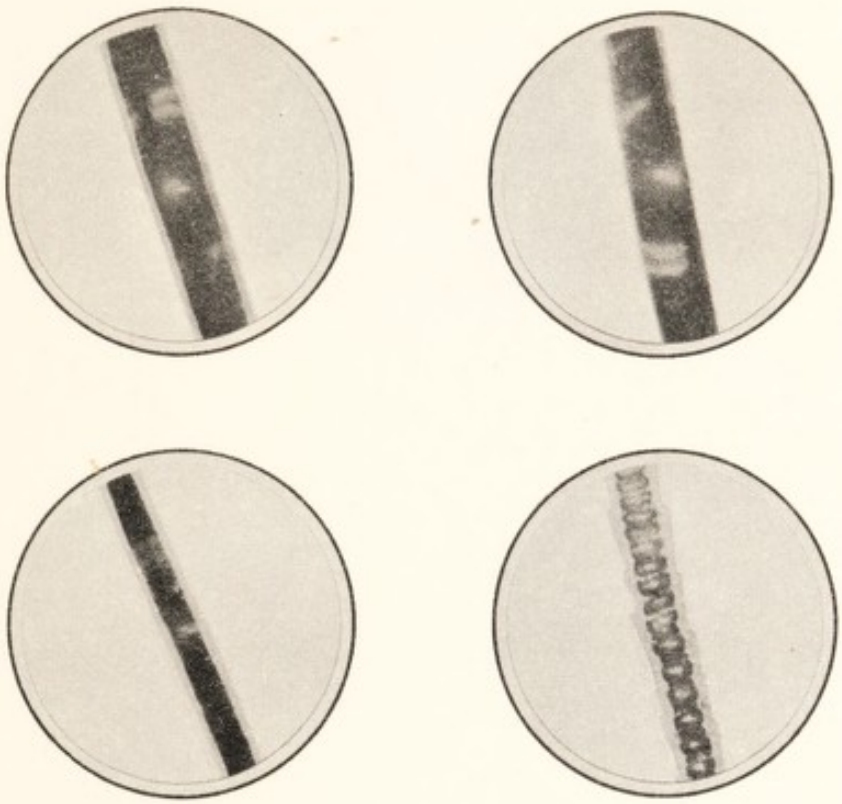
BLACK PANTHER. 11-12.





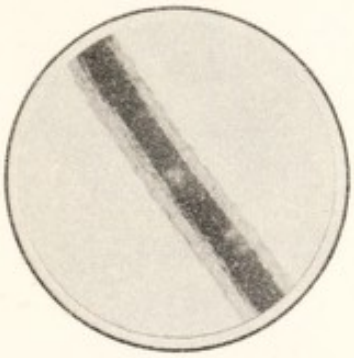
Family 1. Felidæ (continued).

AFRICAN LYNX.



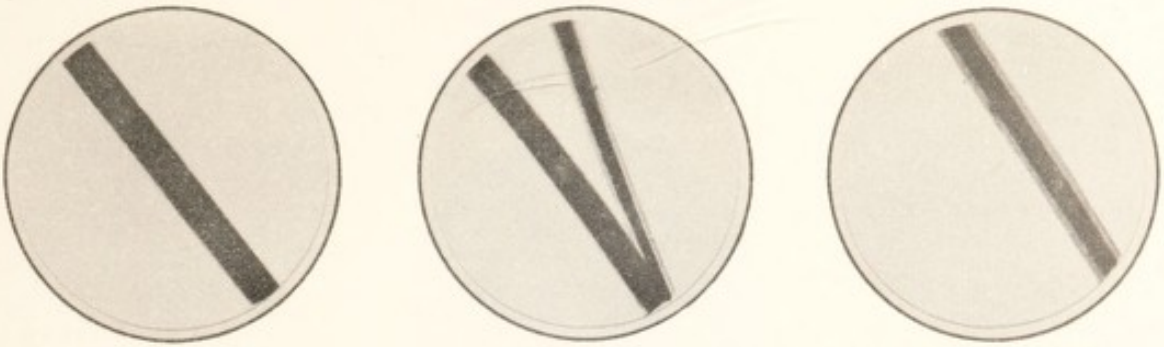
Family 1. Felidæ (continued).

CHEETA.

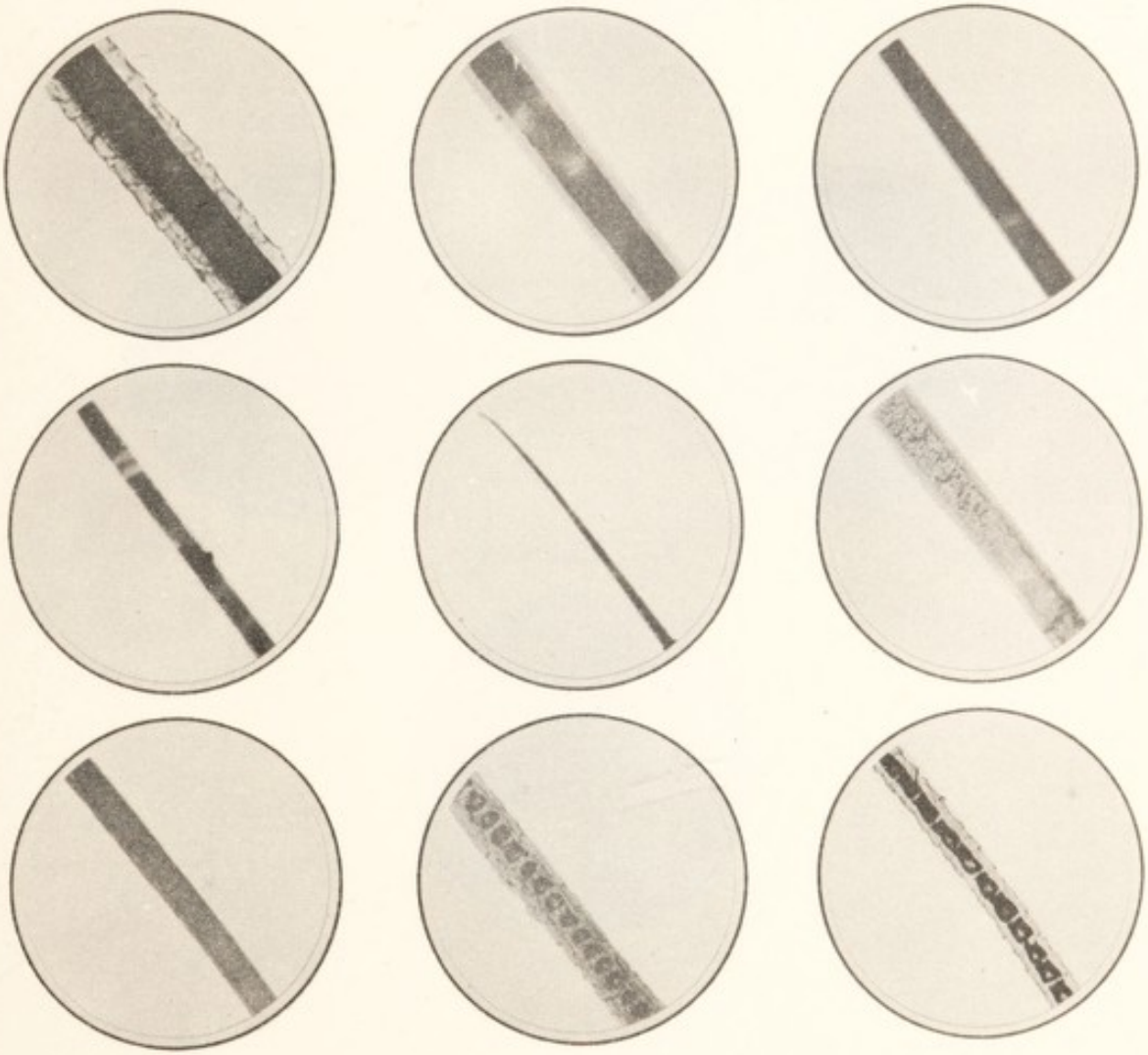


Family 1. Felidæ (continued).

CHEETA. 1-4.



AFRICAN SERVAL CAT. 5-12.



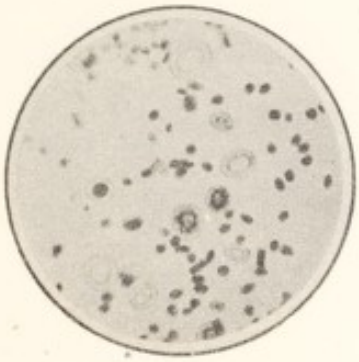
ORDER VIII. CARNIVORES.

Family I. Felidæ (continued).

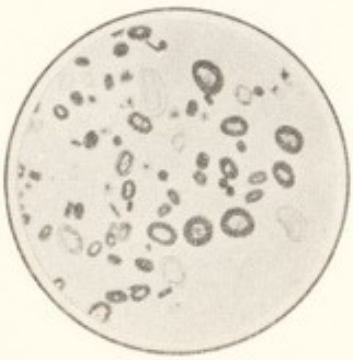
TRANSVERSE SECTIONS.

BRITISH WILD CAT.

OCELET.



HOUSEHOLD CAT.

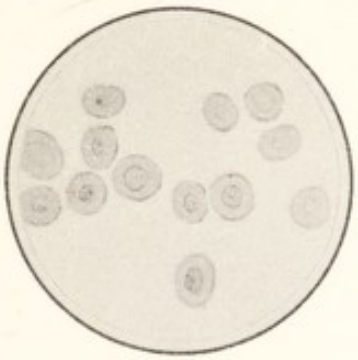


PERSIAN CAT.

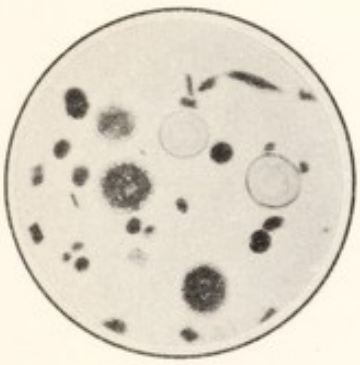
Family 1. Felidæ (continued).

TRANSVERSE SECTIONS.

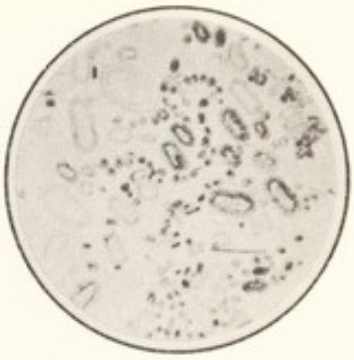
AFRICAN LION.



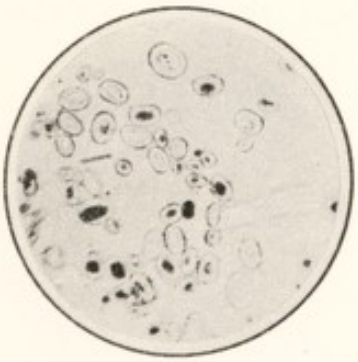
JAGUAR.



LYNX (Undyed).



SNOW LEOPARD.



Family 1. Felidæ (continued).

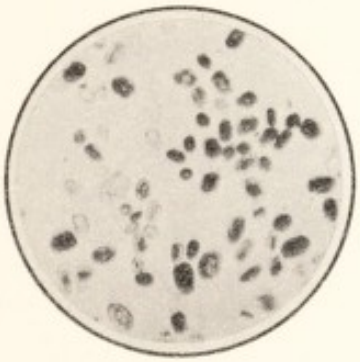
TRANSVERSE SECTIONS.

AFRICAN LEOPARD.

TIGER.

BLACK PANTHER.

CHEETA.



AFRICAN SERVAL CAT.

Family 1. Felidæ (continued).

TRANSVERSE SECTIONS.

OF

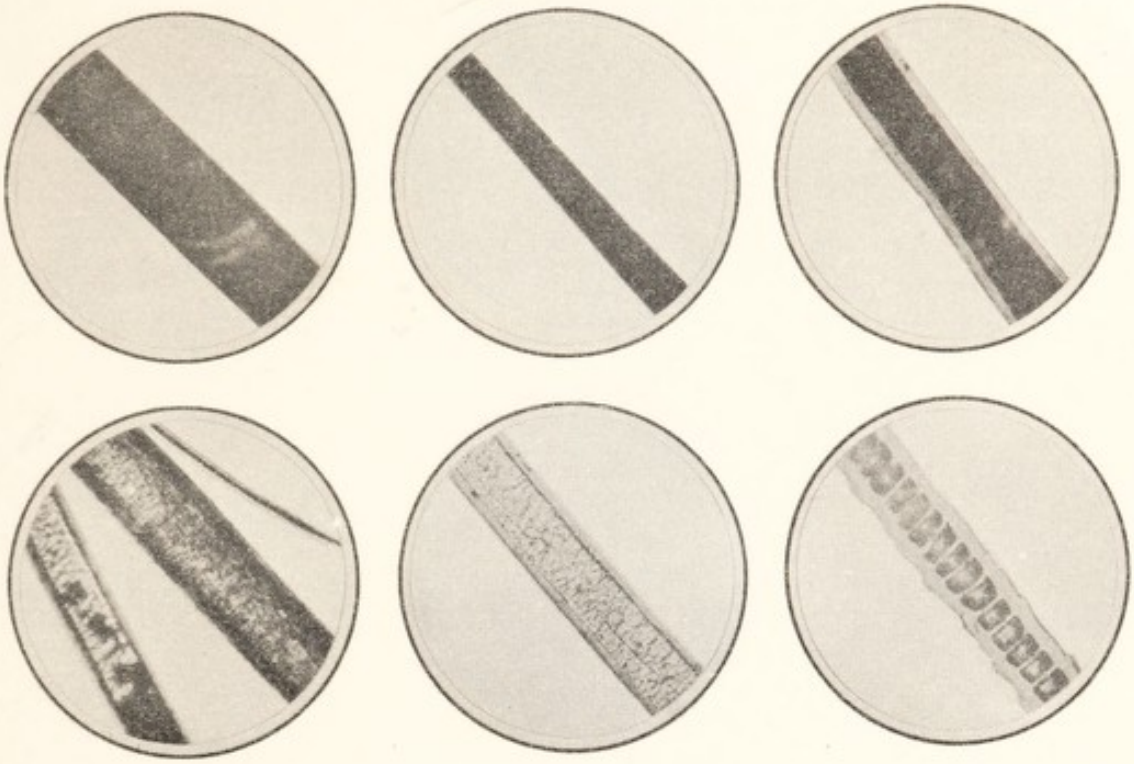
HAIRS OF AFRICAN LYNX.

ORDER VIII. CARNIVORES.

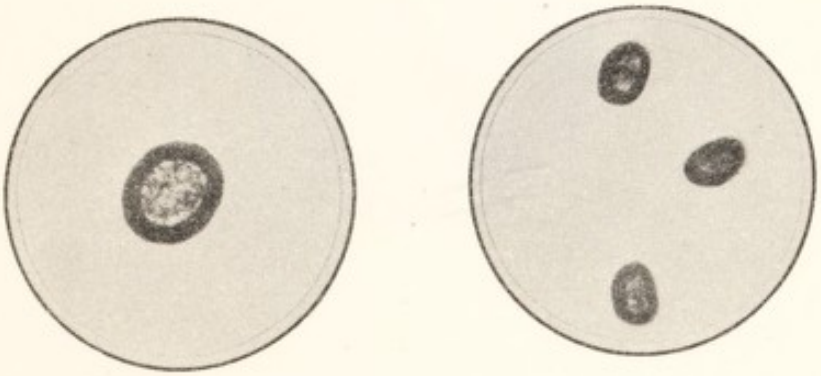
SUBORDER 1. FISSIPEDES.

FAMILY 4. VIVERRIDÆ.

AFRICAN CIVET CAT. 1-7.



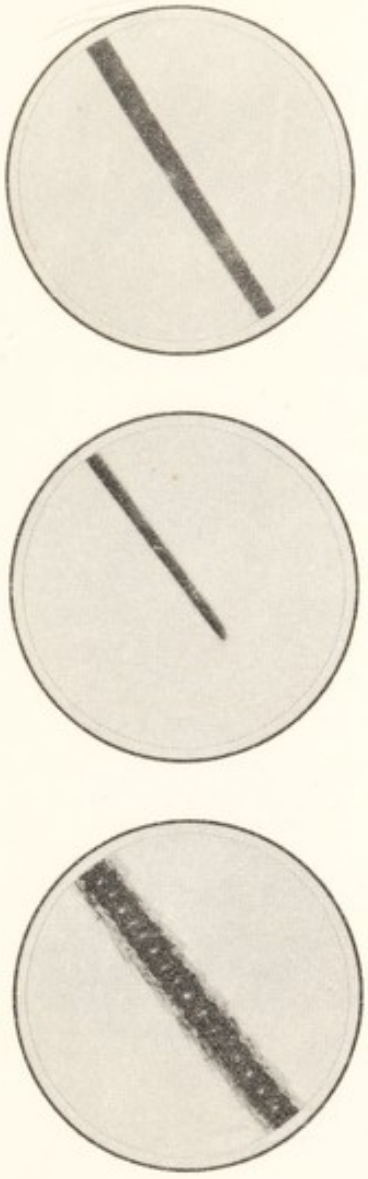
GENET CAT.



ORDER VIII. CARNIVORES.

FAMILY 4. VIVERRIDÆ (continued).

GENET CAT.

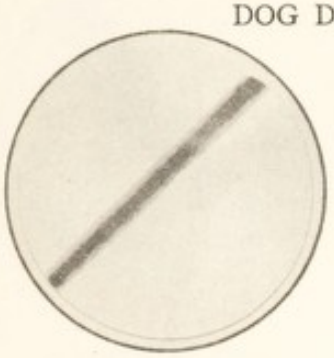


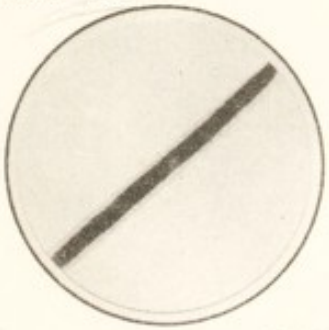
ORDER VIII. CARNIVORES.

SUBORDER 1. FISSIPEDES.

FAMILY 5. CANIDÆ.

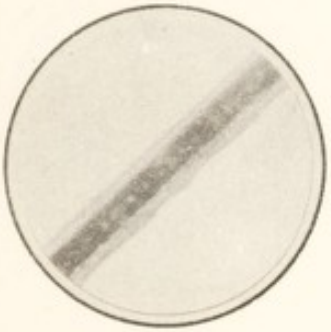
DOG DOMESTIC. 1-2.

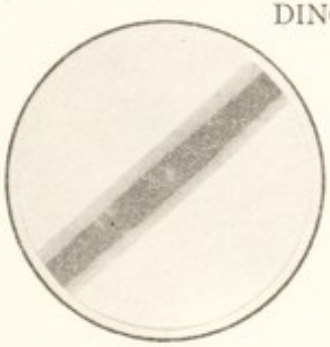


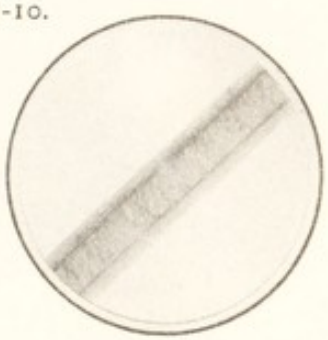


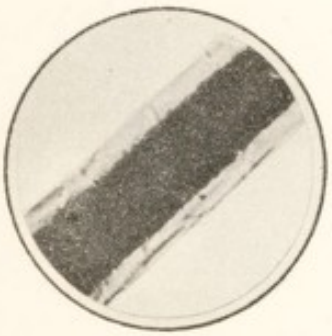
RED FOX. 3-4.

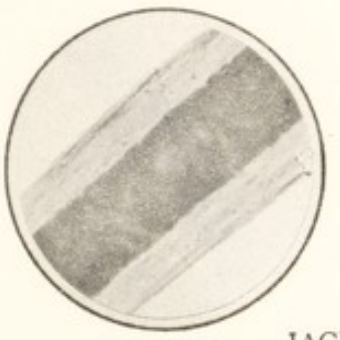
DINGO. 5-10.

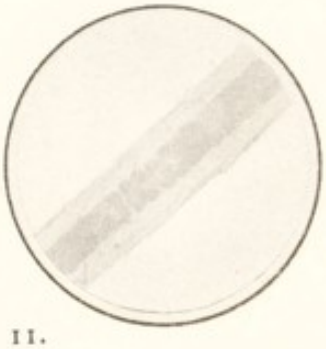








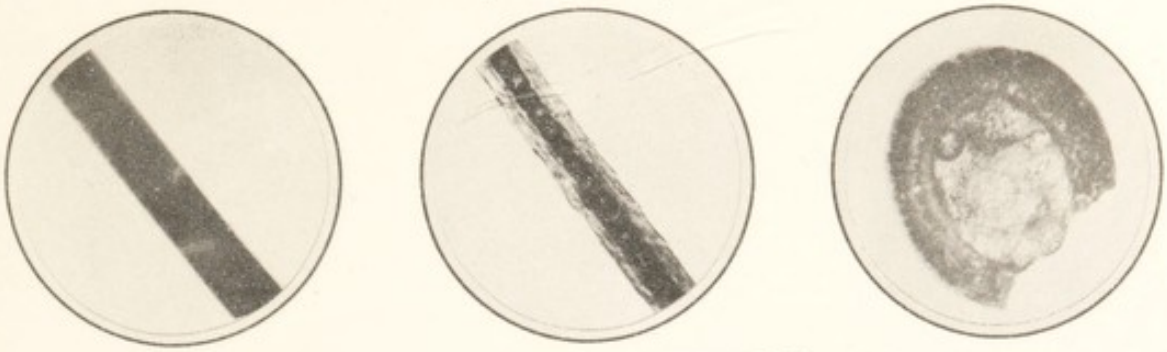




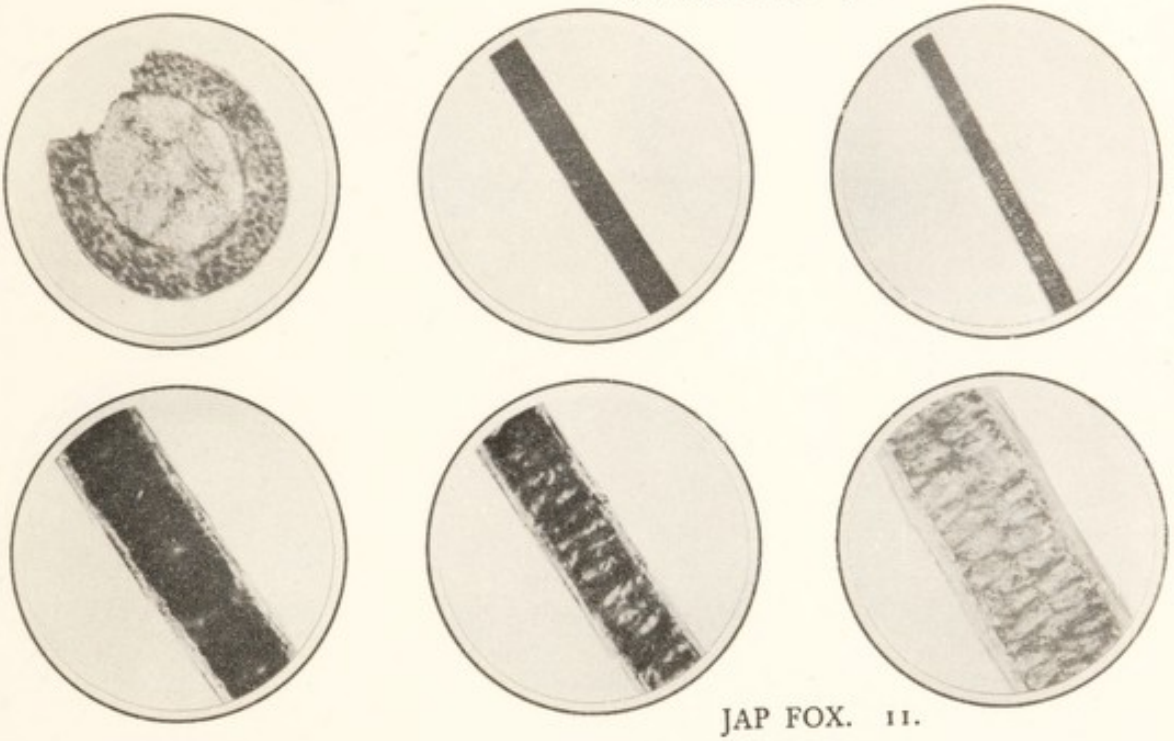
JACKAL. 11.

Family 5. Canidæ (continued).

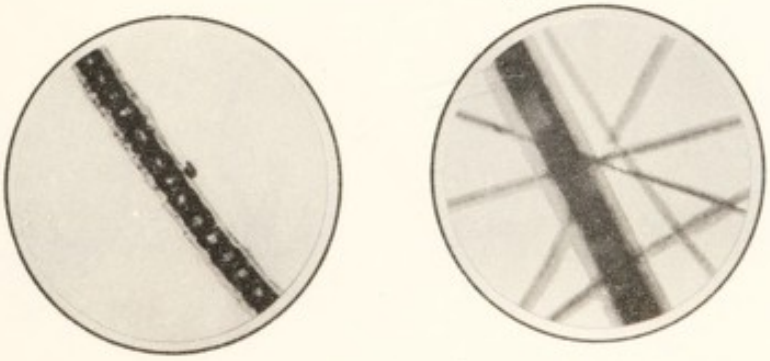
JACKAL. 1-4.



SILVER FOX. 5-10.

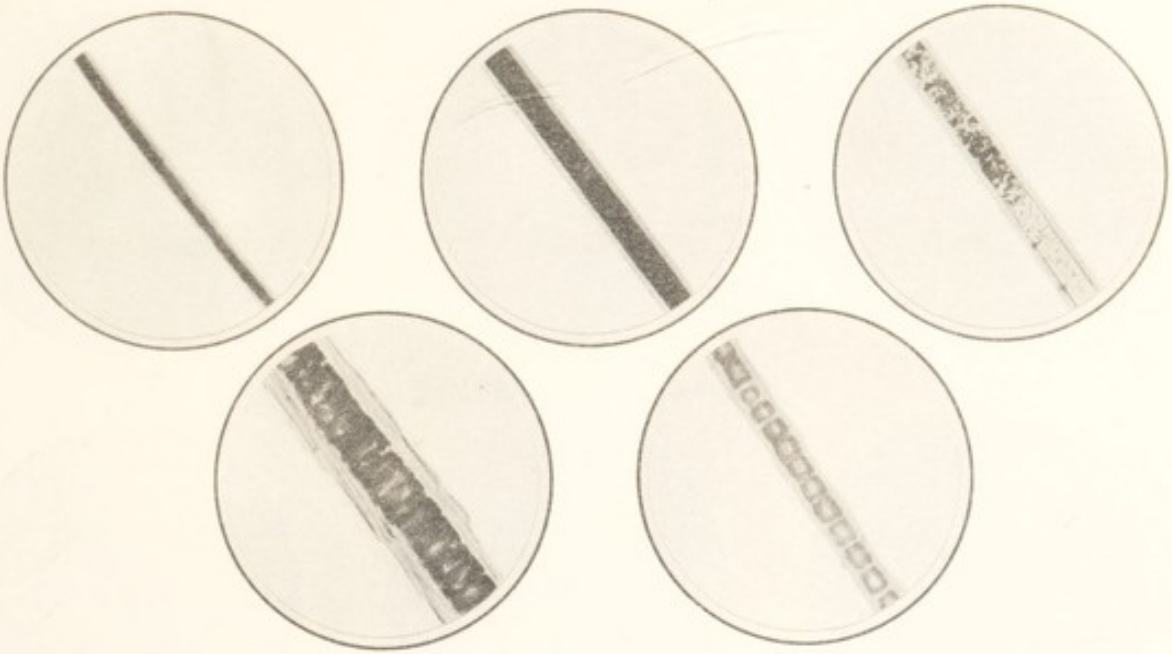


JAP FOX. 11.



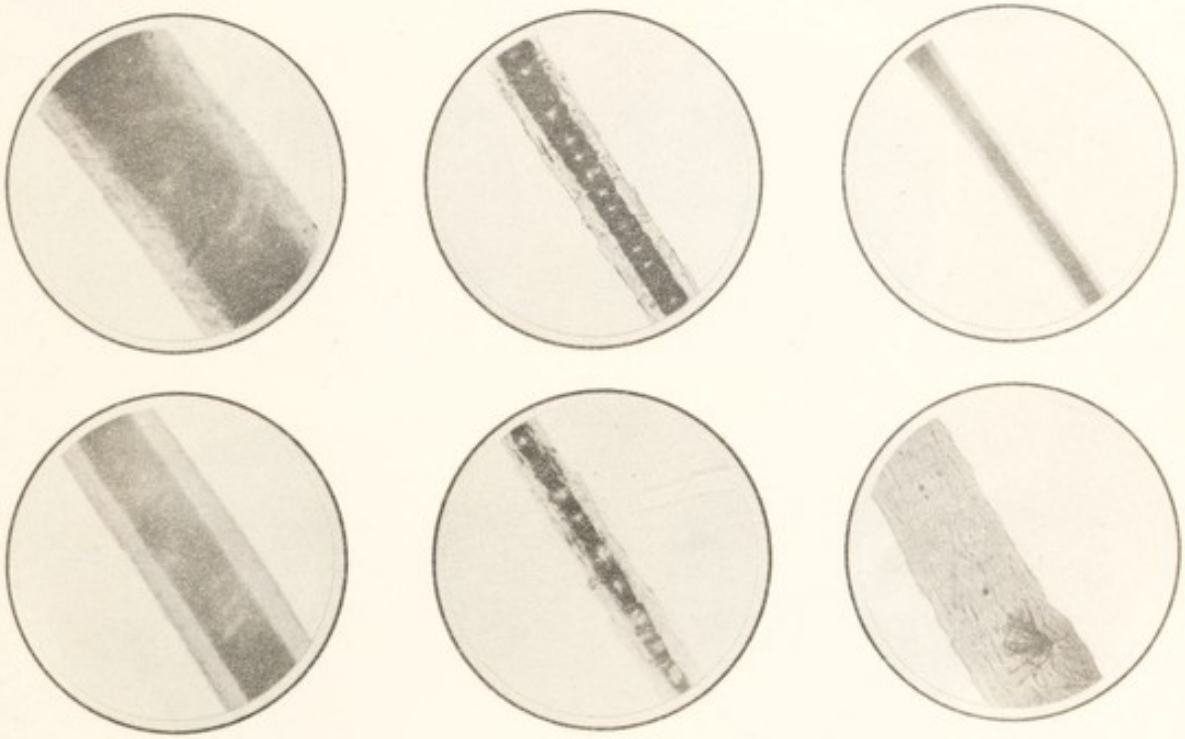
Family 5. Canidæ (continued).

ARCTIC FOX. 1-5.



ARCTIC FOX (Cub). 6-7.

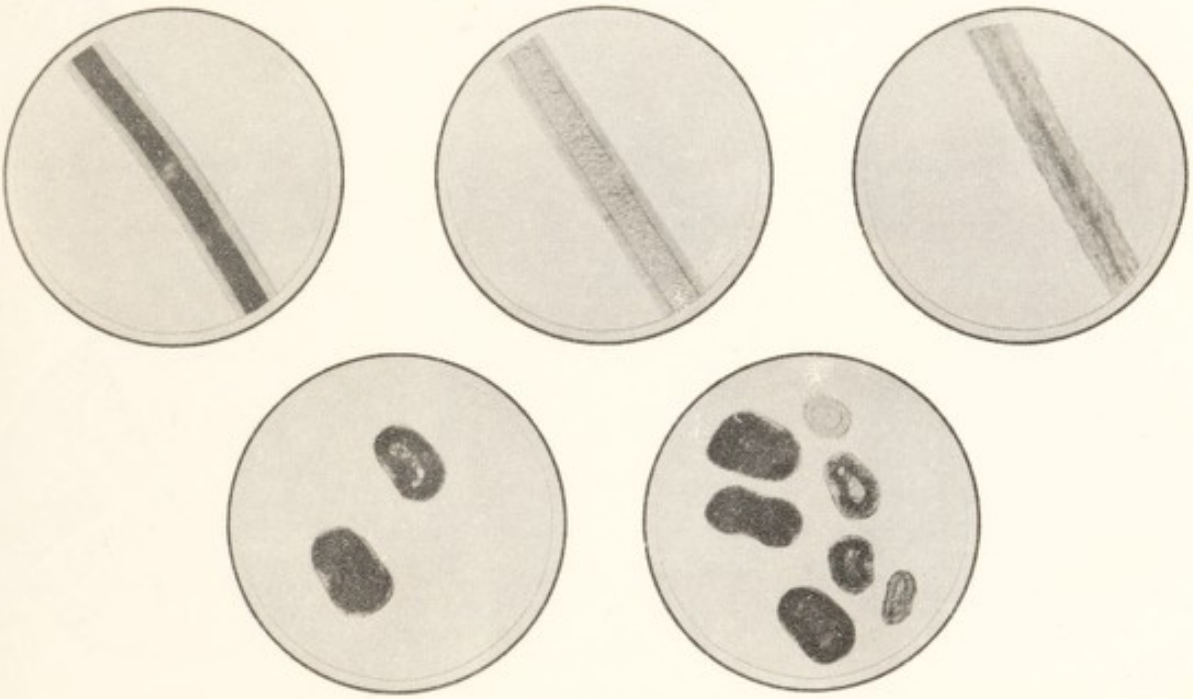
KITT FOX. 8-11.



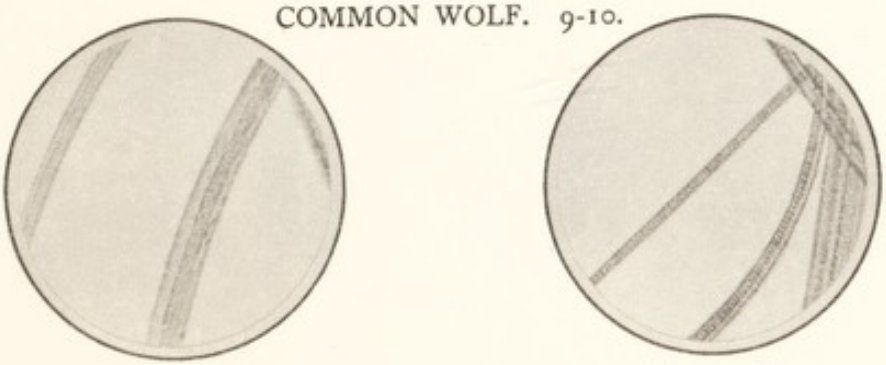
Family 5. Canidæ (continued).

SAHARA DESERT FOX. 1-3.

TIMBER WOLF. 4-8.

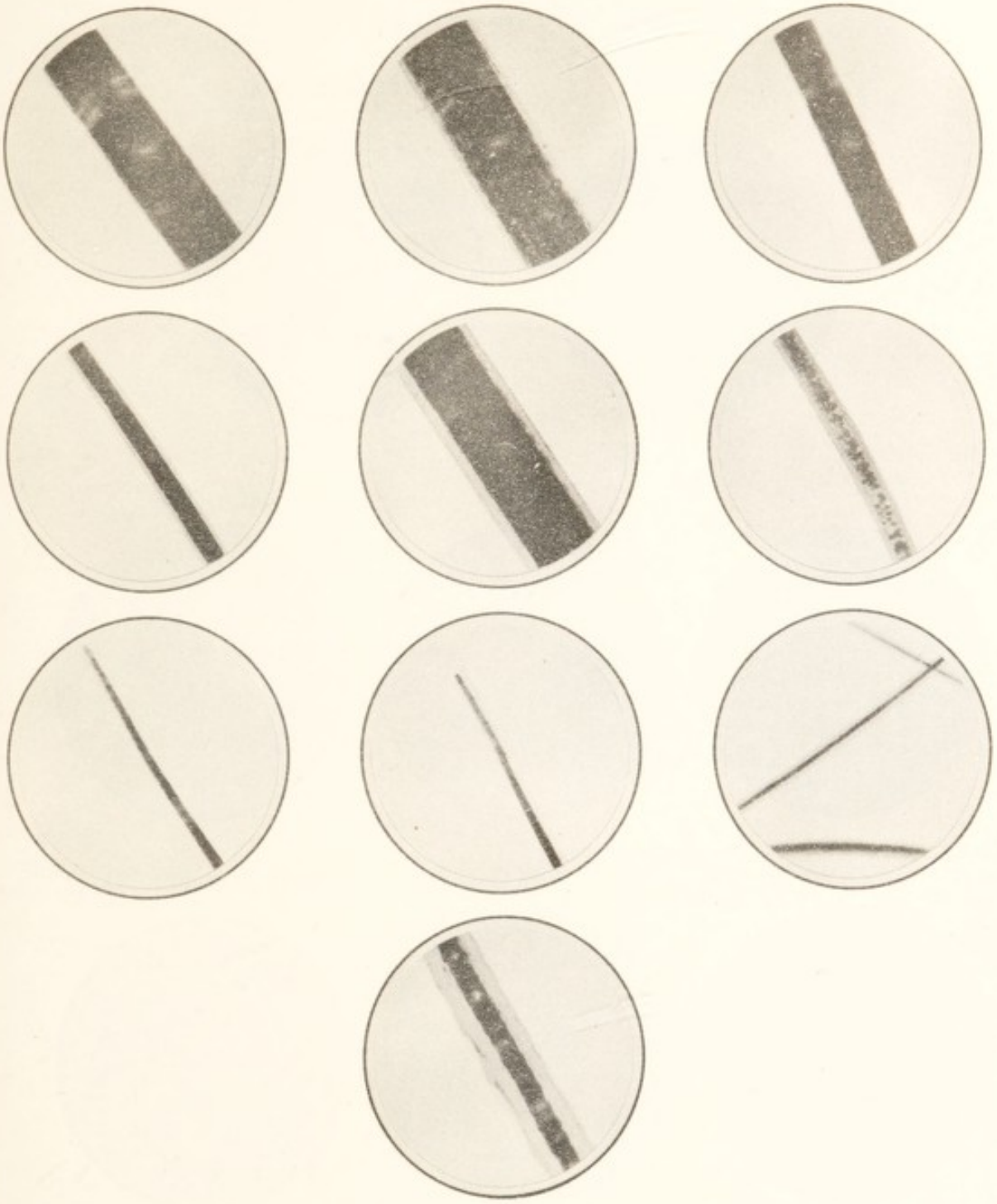


COMMON WOLF. 9-10.



Family 5. Canidæ (continued).

INDIAN WOLF.



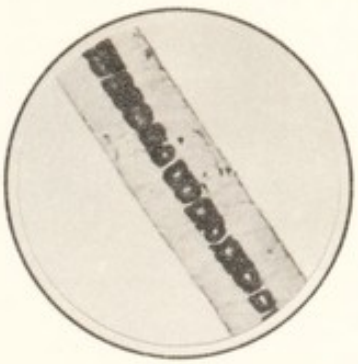
ORDER VIII. CARNIVORES.

Family 5. Canidæ (continued).

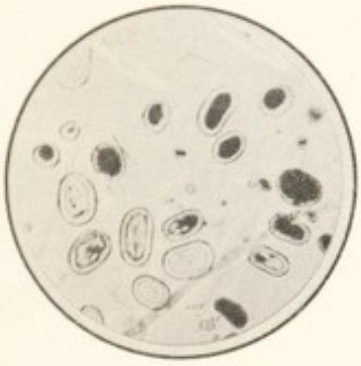
TRANSVERSE SECTIONS.

DOG DOMESTIC.
(WIRE HAIRED TERRIER).

WOOL (Dog)



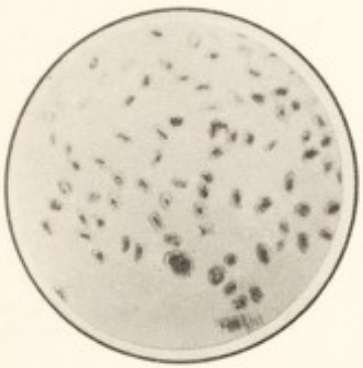
RED FOX.



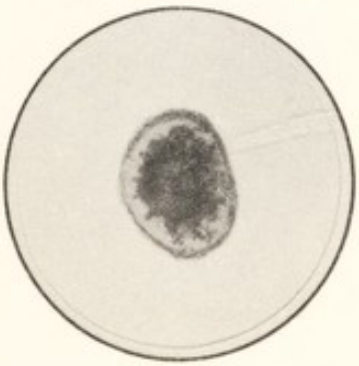
DINGO.

ARCTIC FOX.

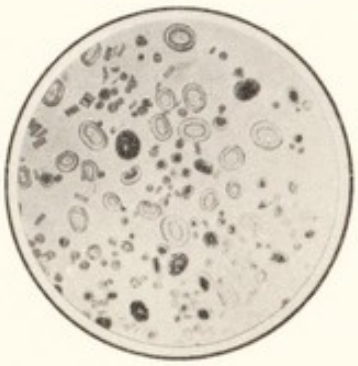
ARCTIC FOX (Cub).



ARCTIC FOX (Cub).



KITT FOX.



Family 5. Canidæ (continued).

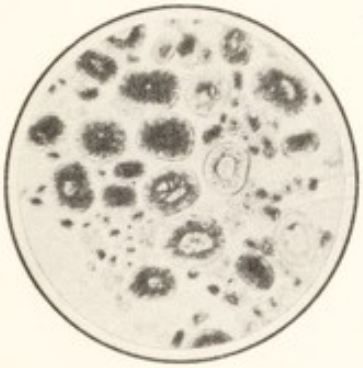
TRANSVERSE SECTIONS.

INDIAN WOLF.

SAHARA DESERT FOX.

SILVER FOX.

JAP FOX.

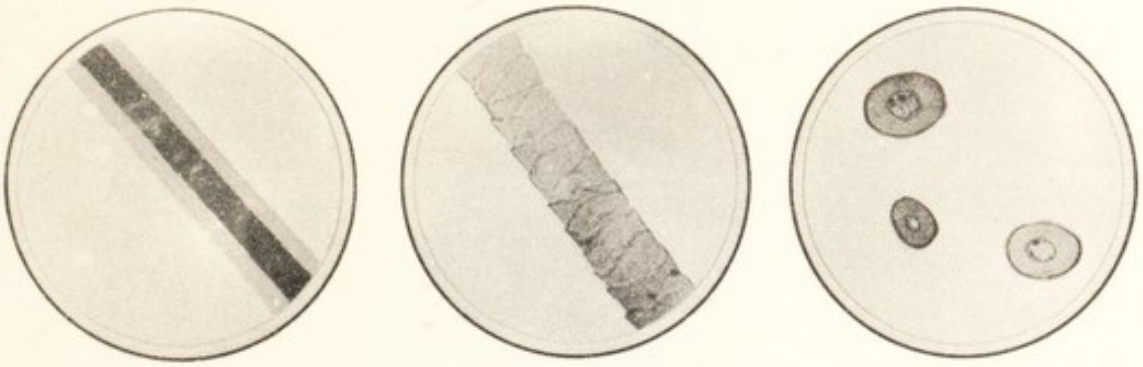


ORDER VIII. CARNIVORES.

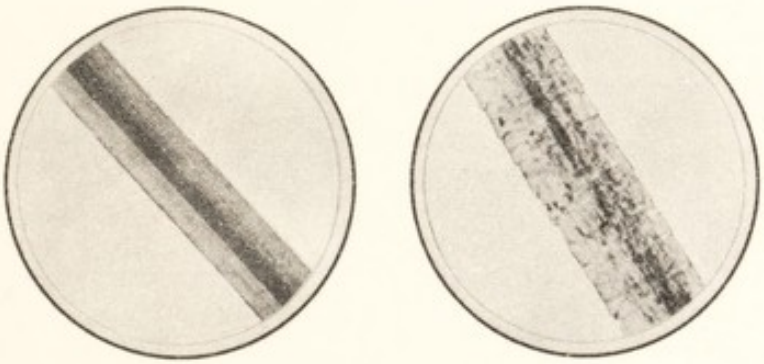
SUBORDER 1. FISSIPEDES.

FAMILY 6. URSIDÆ.

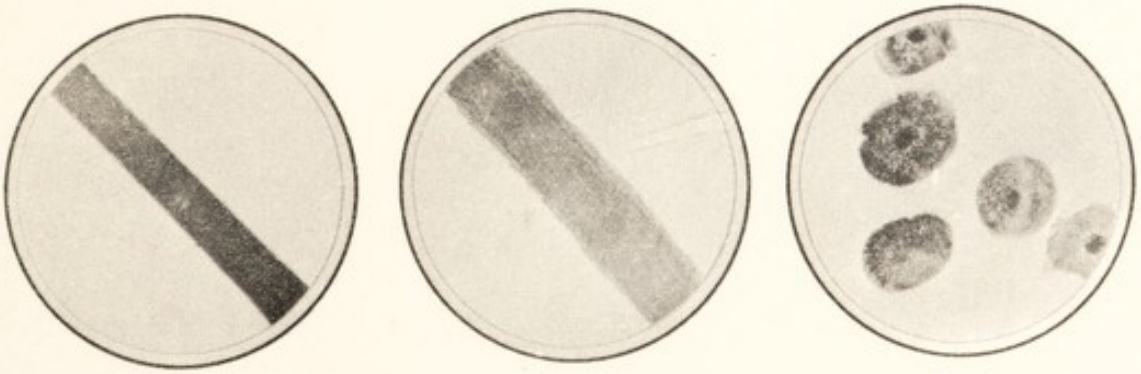
POLAR BEAR. 1-3.



BROWN BEAR. 4-5.



AMERICAN BLACK BEAR. 6-8.



ORDER VIII. CARNIVORES.

FAMILY 6. URSIDÆ (continued).

TRANSVERSE SECTIONS.

OF

HAIRS OF BROWN BEAR.

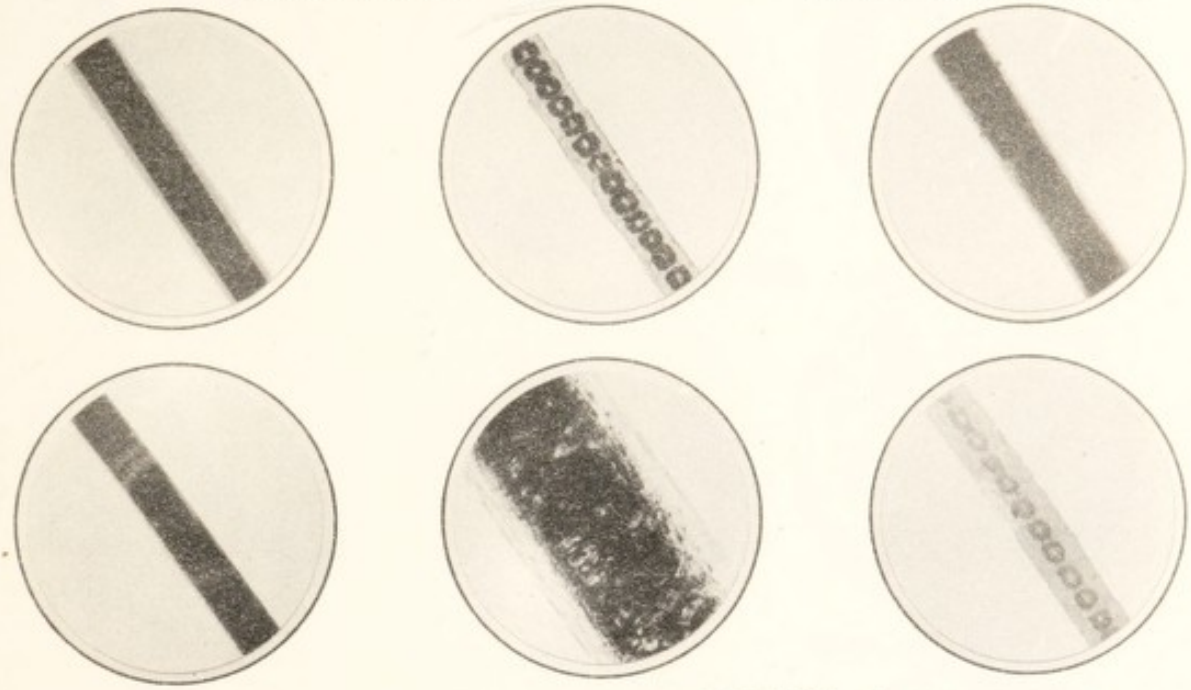
ORDER VIII. CARNIVORES.

SUBORDER 1. FISSIPEDES.

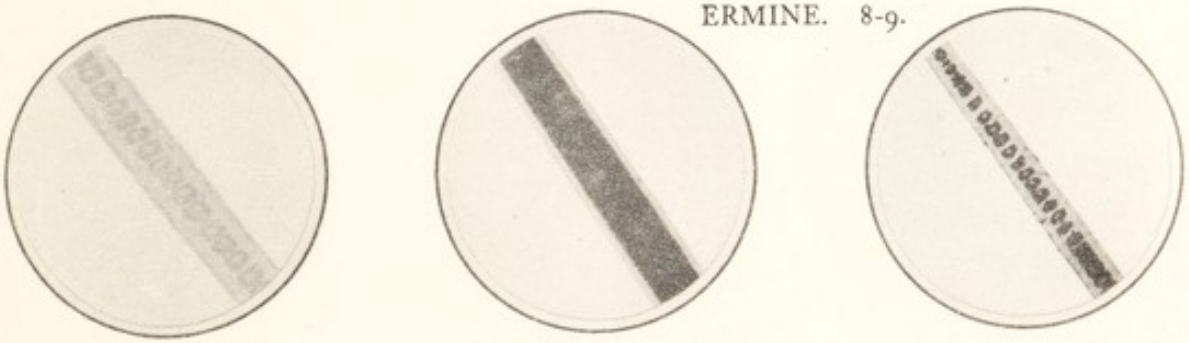
FAMILY 7. MUSTELIDÆ.

BAUM MARTEN. 1-2.

STONE MARTEN. 3-7.



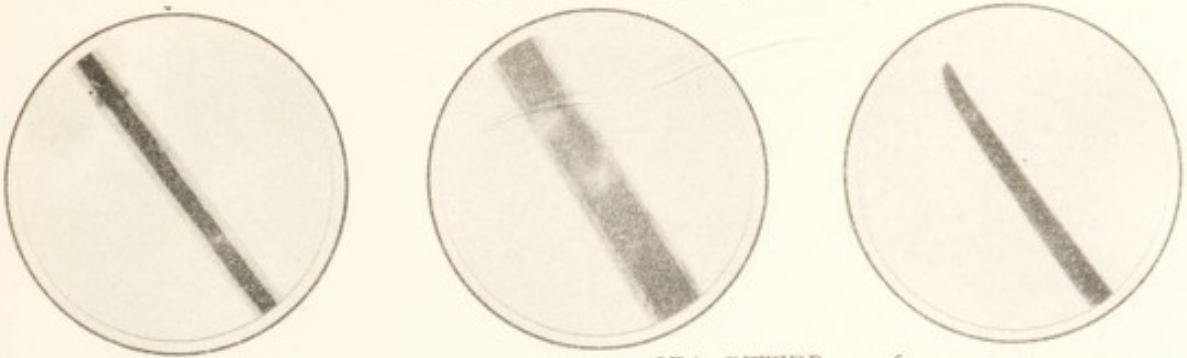
ERMINE. 8-9.



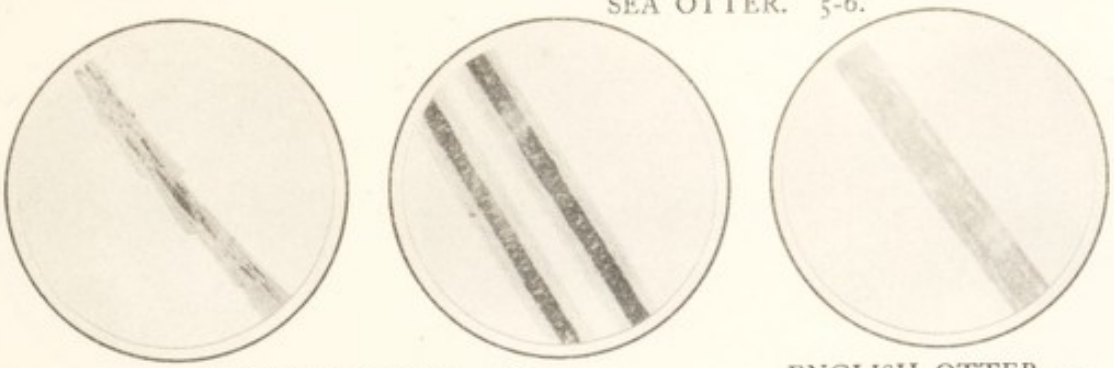
FERRET. 10-12.

Family 7. Mustelidæ (continued).

BRITISH OTTER. 1-4.

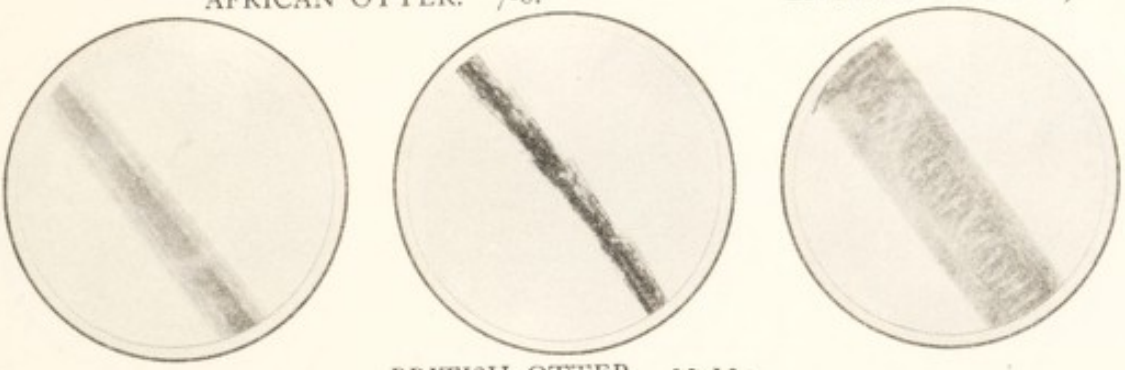


SEA OTTER. 5-6.

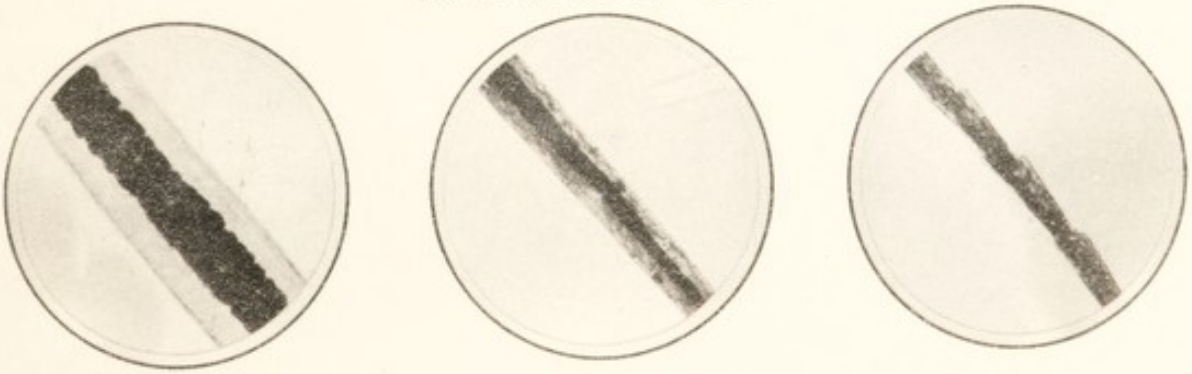


AFRICAN OTTER. 7-8.

ENGLISH OTTER. 9.

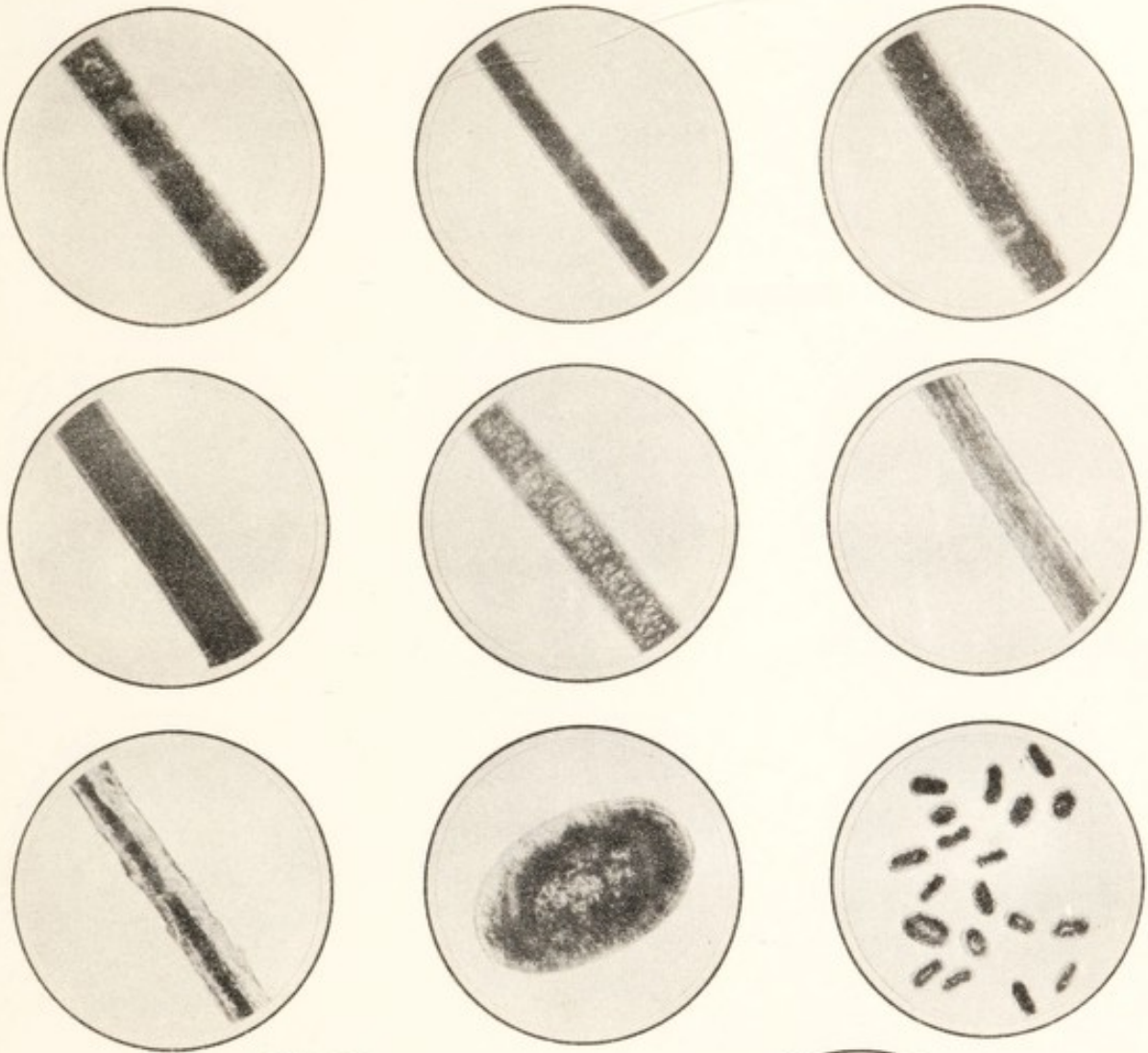


BRITISH OTTER. 10-12.

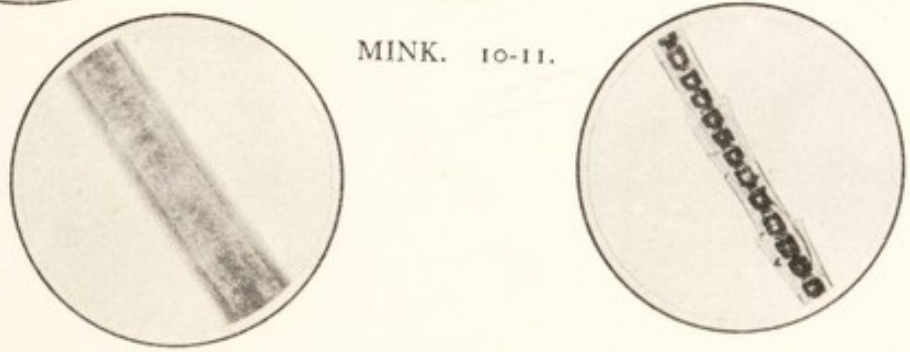


Family 7. Mustelidæ (continued).

SKUNK. 1-9

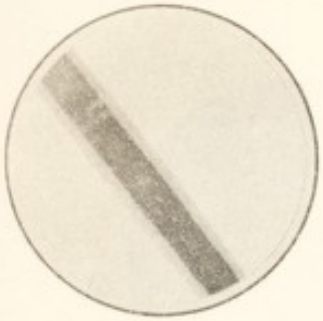


MINK. 10-11.



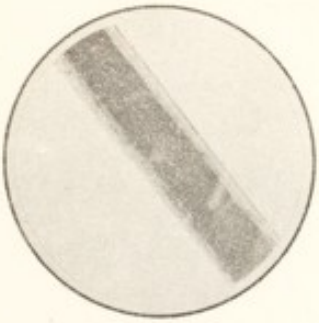
Family 7. Mustelidæ (continued).

POLECAT. 1-2.

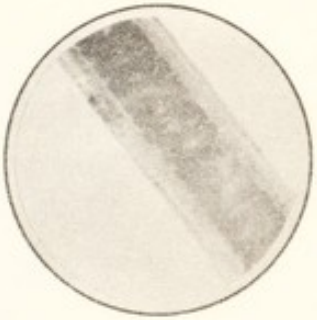


STOAT (Winter Coat). 3-4.

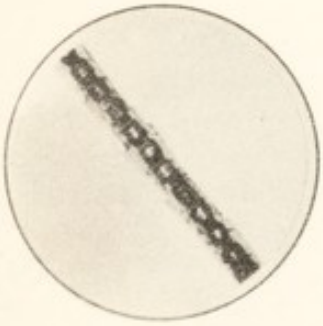
BRITISH BADGER. 5-8.

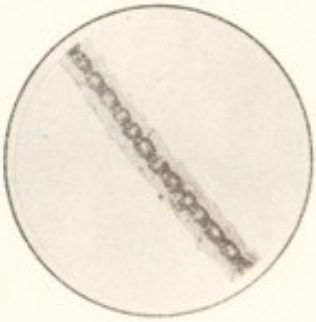


AMERICAN NATURAL SABLE. 9-10.



RUSSIAN SABLE. 11-12.



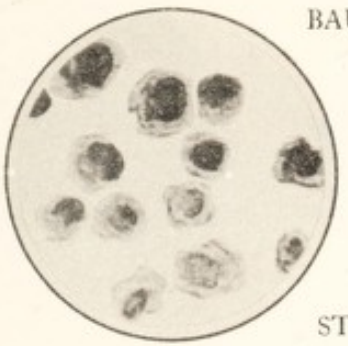


ORDER VIII. CARNIVORES.

Family 7. Mustelidæ (continued).

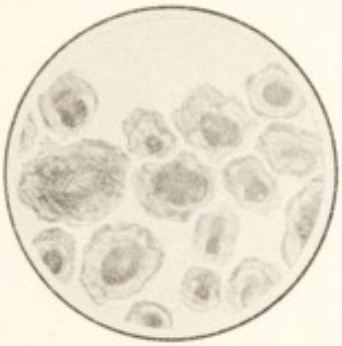
TRANSVERSE SECTIONS.

BAUM MARTEN.

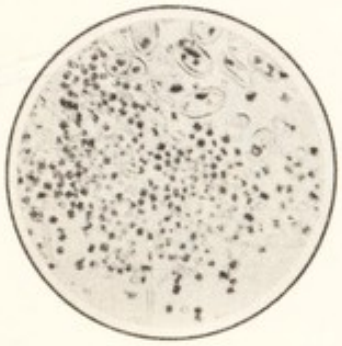


STONE MARTEN.

(Tail).



ERMINE.



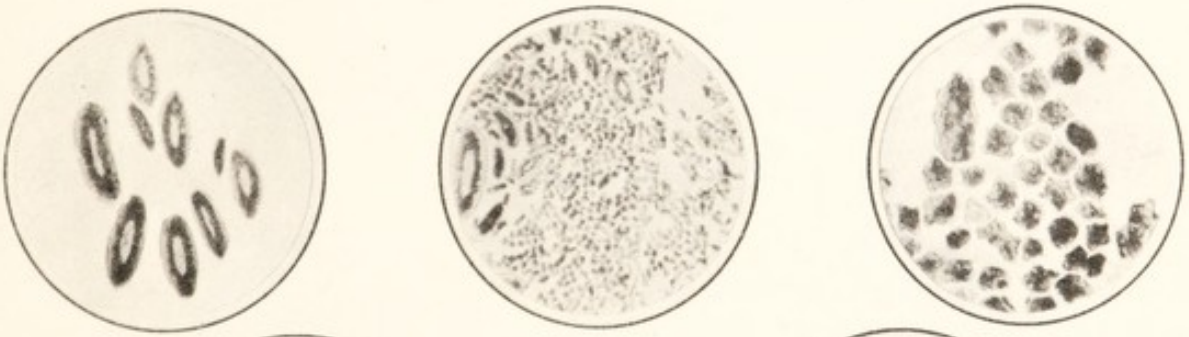
Family 7. Mustelidæ (continued).

TRANSVERSE SECTIONS.

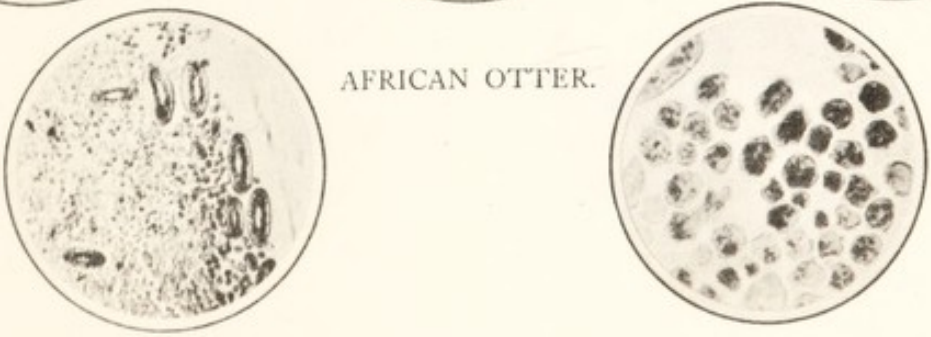
FERRET.

BRITISH OTTER.

SEA OTTER.



AFRICAN OTTER.



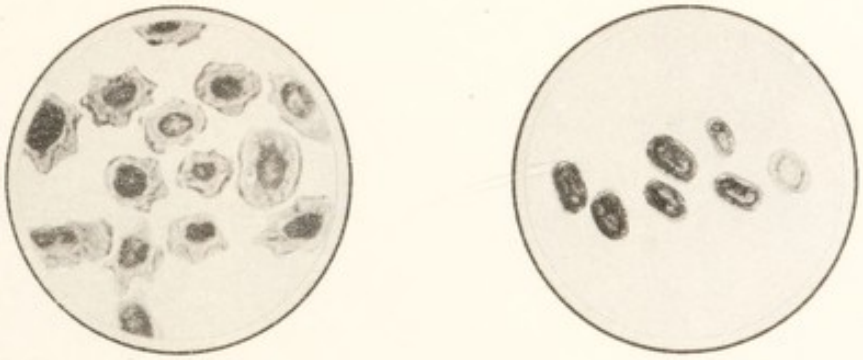
Family 7. Mustelidæ (continued).

TRANSVERSE SECTIONS.

STOAT (Winter Coat).

AMERICAN SABLE.

RUSSIAN SABLE.



Family 7. Mustelidæ (continued).

TRANSVERSE SECTIONS.

SOUTH AMERICAN SKUNK.

MINK.

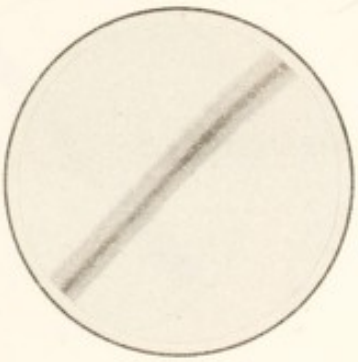
POLECAT.

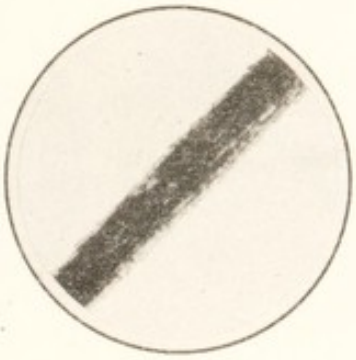
ORDER VIII. CARNIVORES.

SUBORDER 1. CARNIVORA VERA.

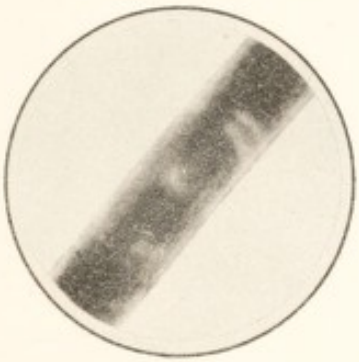
FAMILY 8. PROCYONIDÆ. RACCOONS.

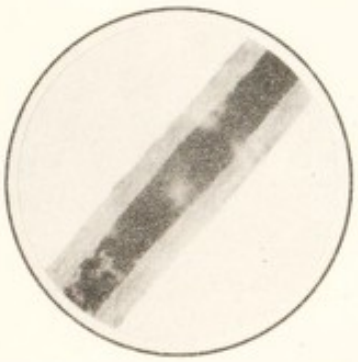
RACCOON. 1-2.

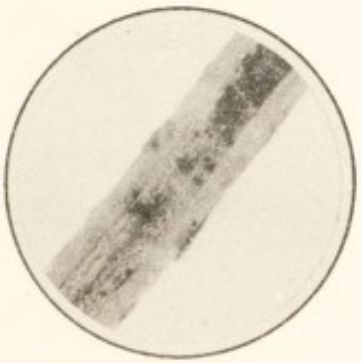


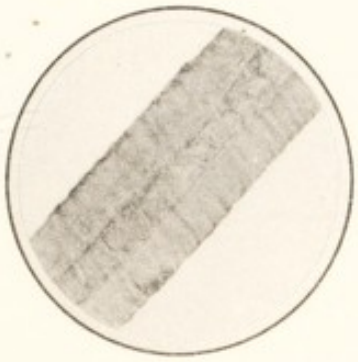


WHITE-NOSED COATI. 3-6.



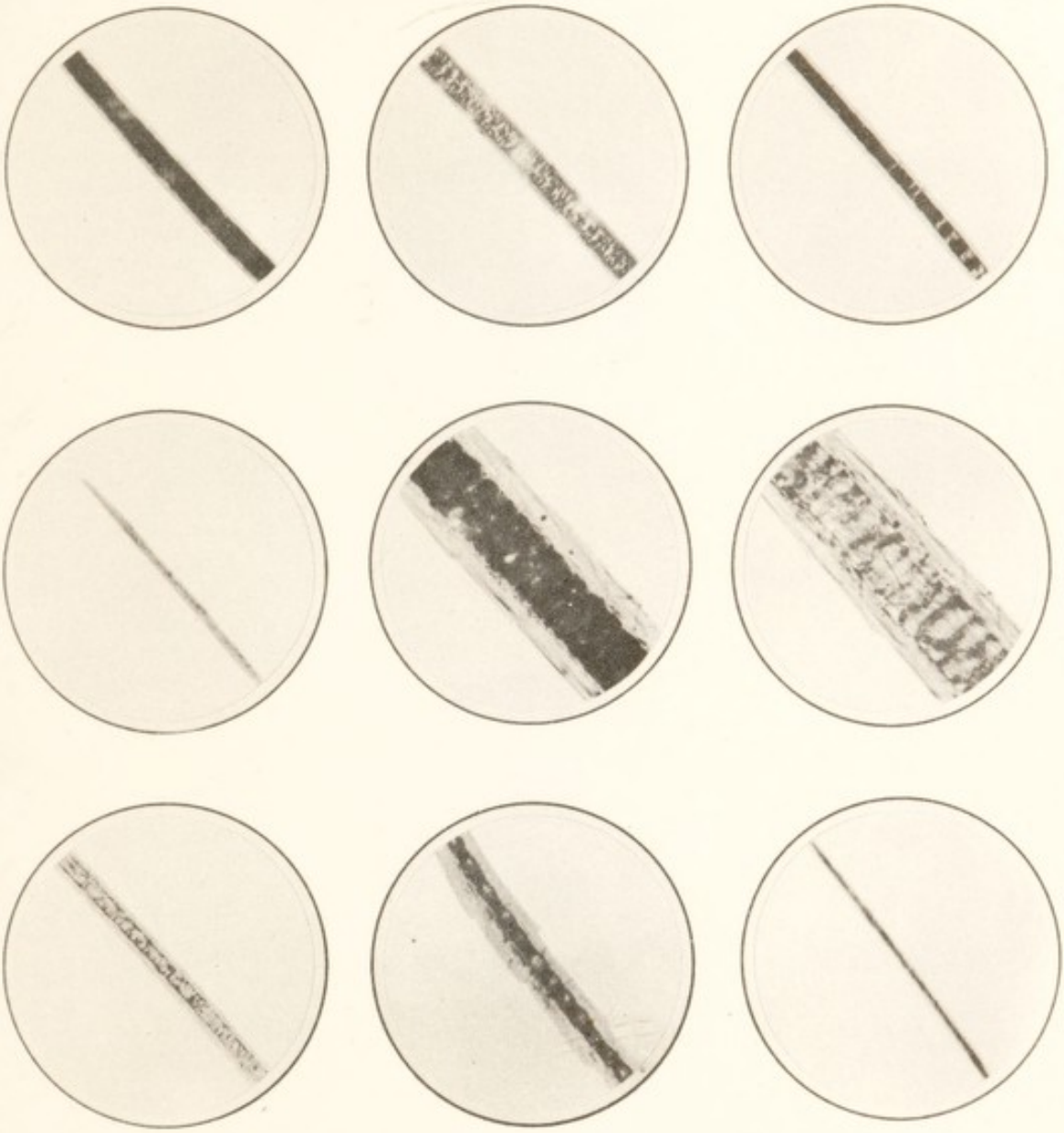






Family 8. Procyonidæ (continued).

PANDA.

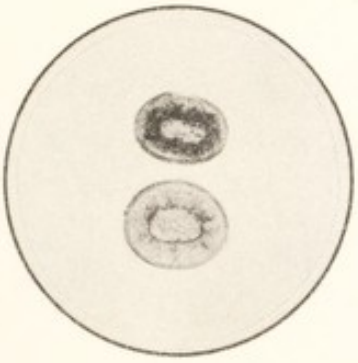


ORDER VIII. CARNIVORES.

Family 8. Procyonidæ (continued).

TRANSVERSE SECTIONS.

HAIR OF WHITE-NOSED COATI.



Family 8. Procyonidæ (continued).

TRANSVERSE SECTIONS.

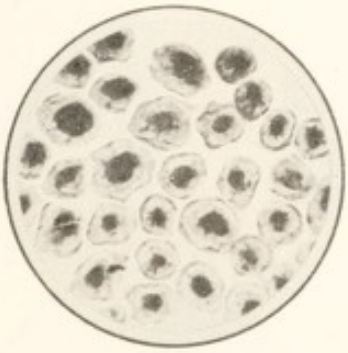
RACCOON.

Upper Half of Hair.

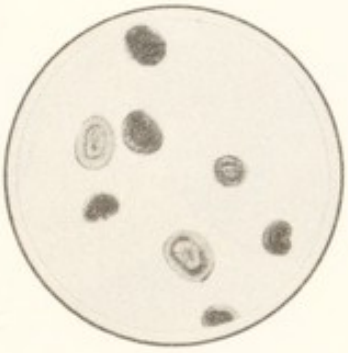
Lower Half of Hair.

PANDA.

Wool.



Hair.

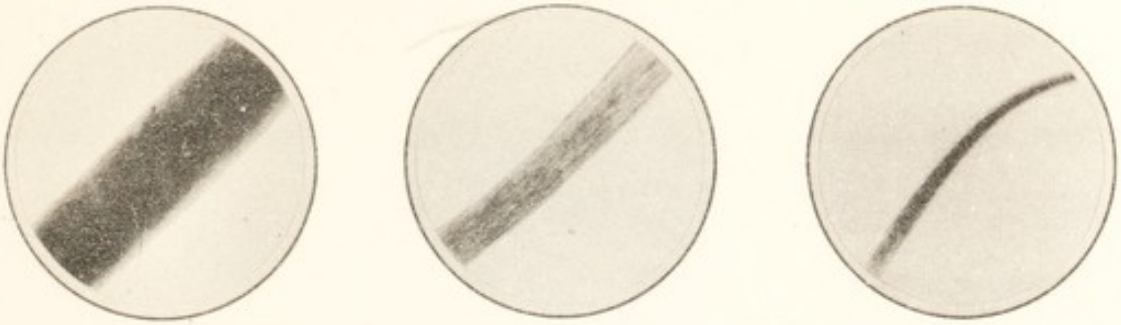


ORDER VIII. CARNIVORES.

SUBORDER 2. PINNIPEDES.

FAMILY 11. PHOCIDÆ. SEALS.

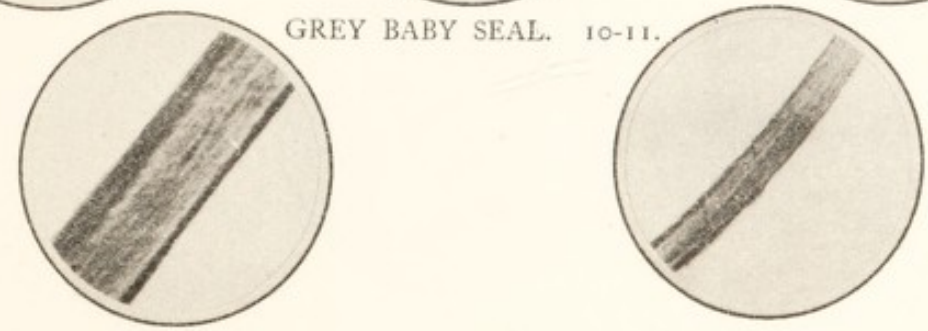
COMMON SEAL. 1-3.



ALASKA FUR SEAL. 4-6. (FAMILY 9. OTARIIDÆ.)

GREENLAND SEAL (Dyed). 7-8. COMMON SEAL (Dyed). 9.

GREY BABY SEAL. 10-11.



ORDER VIII. CARNIVORES.

Families 9 & 11. Seals (continued).

TRANSVERSE SECTIONS.

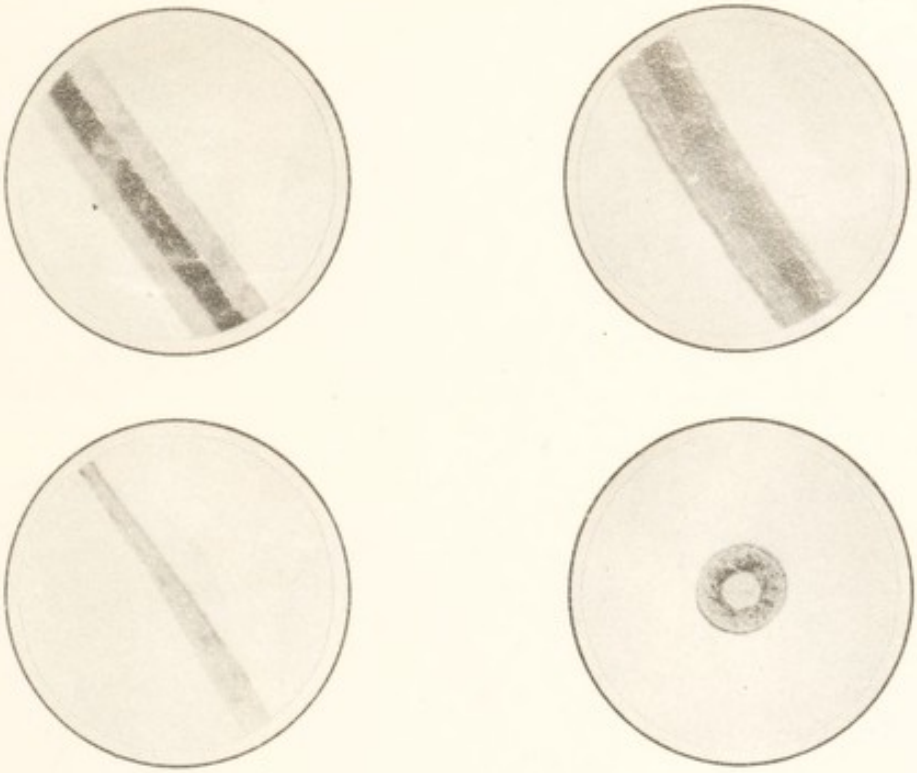
COMMON SEAL (Phocidæ).

ALASKA FUR SEAL (Otariidæ).

GREY BABY SEAL (Phocidæ).

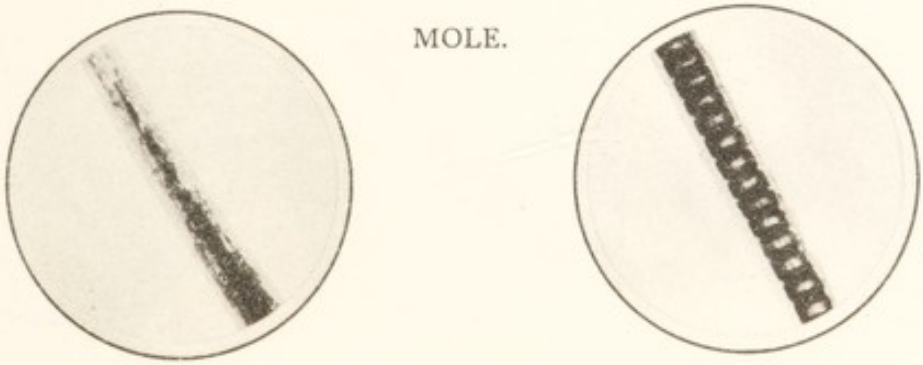
ORDER IX. INSECTIVORES.
SUBORDER 1. INSECTIVORA VERA.
FAMILY 3. ERINACEIDÆ.

HEDGEHOG.



ORDER IX. INSECTIVORES.
SUBORDER 1. INSECTIVORA VERA.
FAMILY 5. TALPIDÆ.

MOLE.

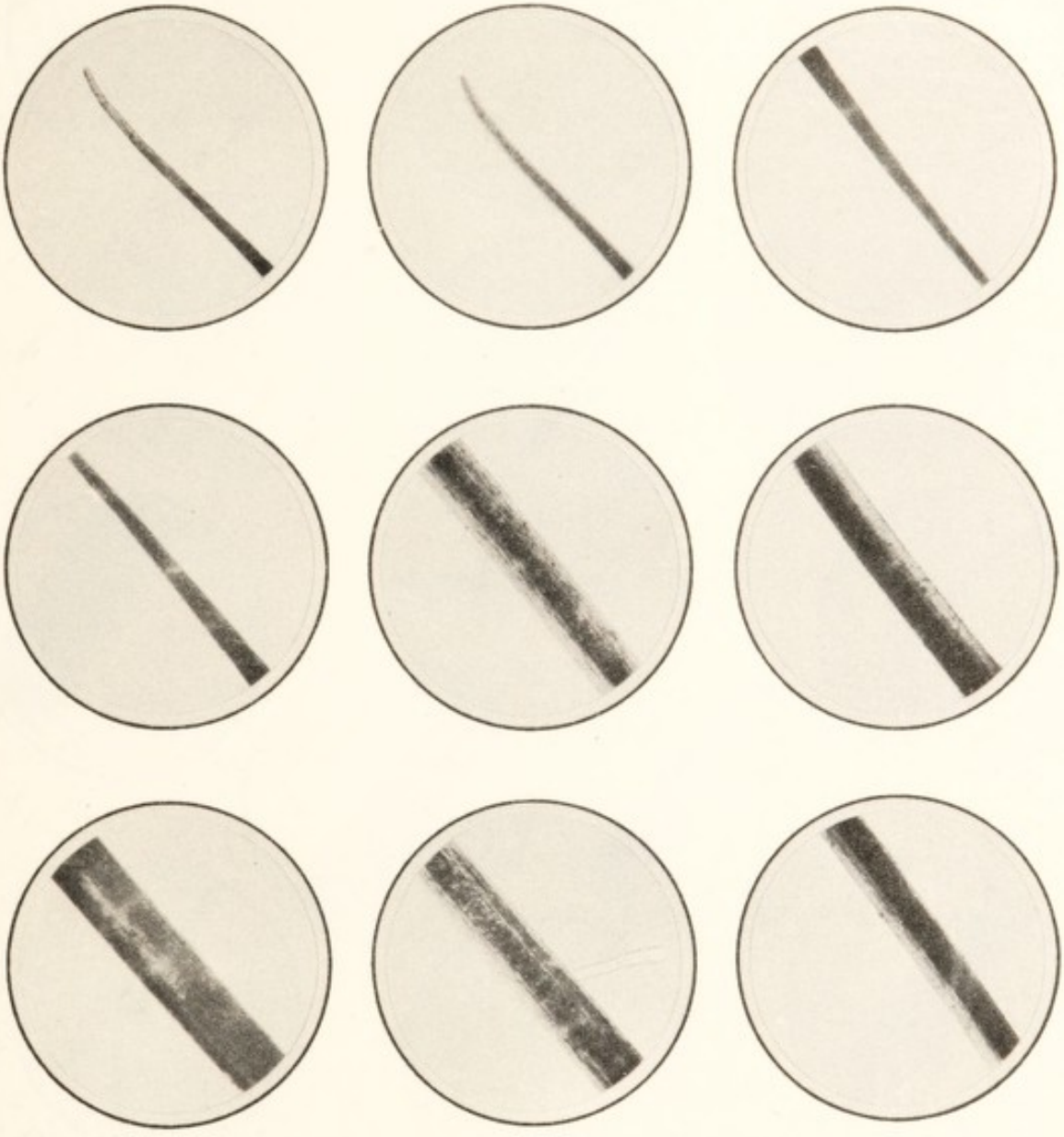


ORDER IX. INSECTIVORES.

SUBORDER 1. INSECTIVORA VERA.

FAMILY 1. TUPAIAS.

TREE SHREW (HEAD).

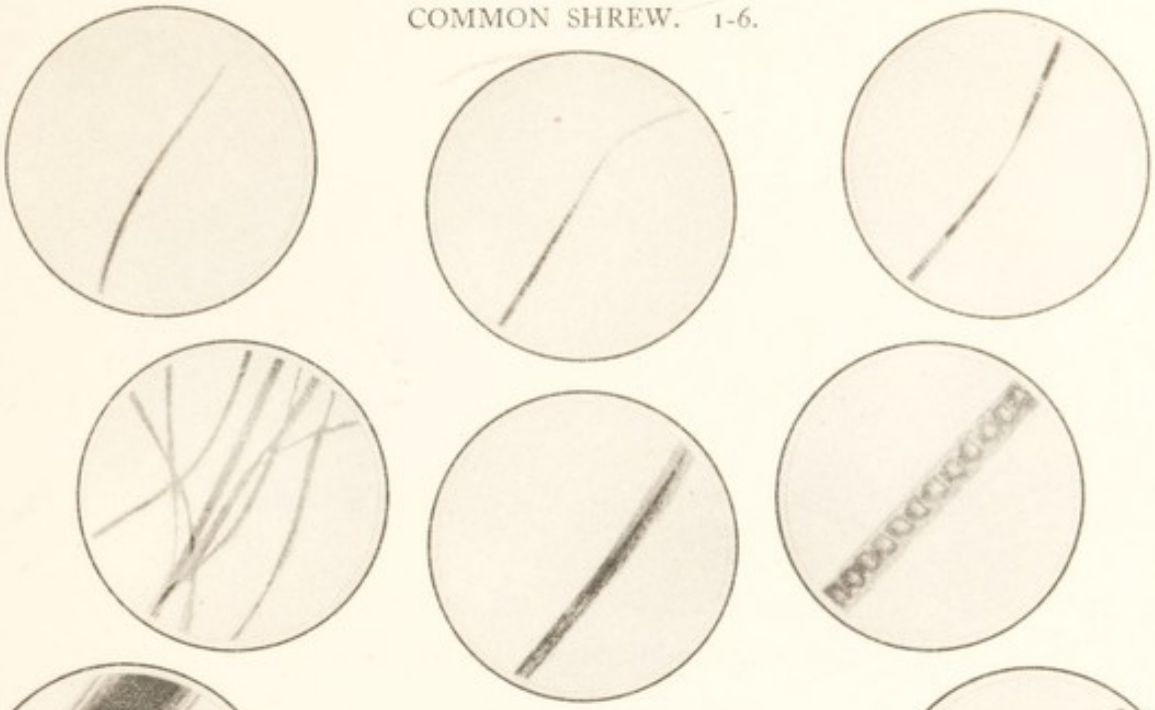


ORDER IX. INSECTIVORES.

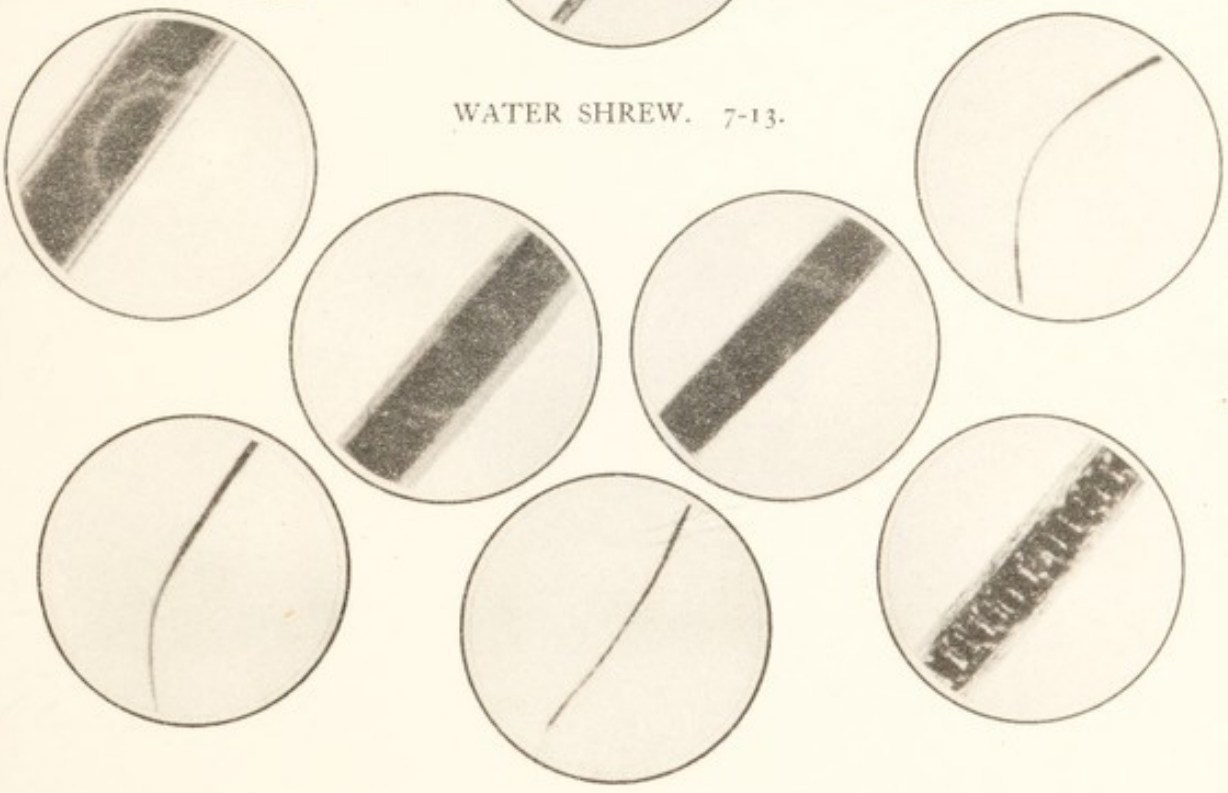
SUBORDER 1. INSECTIVORA VERA.

FAMILY 4. SORICIDÆ - SHREWS.

COMMON SHREW. 1-6.



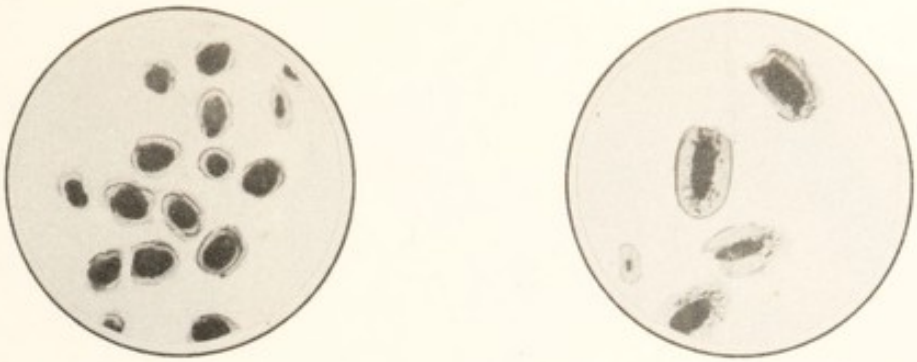
WATER SHREW. 7-13.



ORDER IX. INSECTIVORES.
Family 5. Talpidæ (continued).

TRANSVERSE SECTIONS.

MOLE.



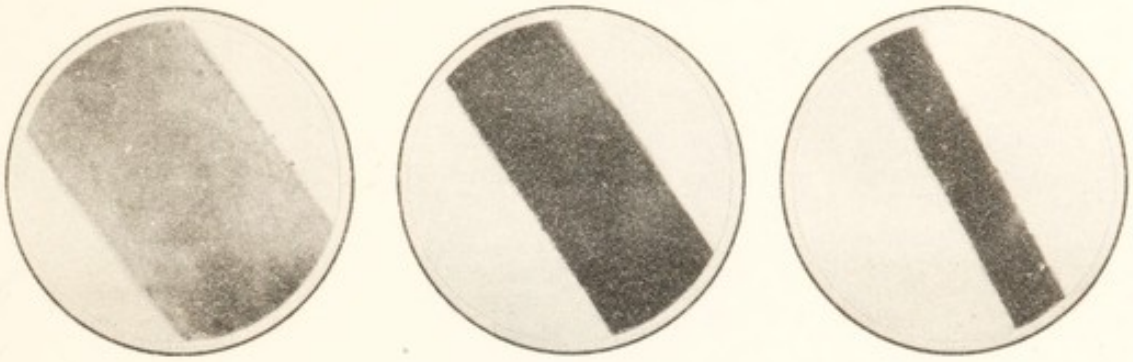
ORDER IX. INSECTIVORES.
Family 4. Soricidæ (continued).

TRANSVERSE SECTIONS.

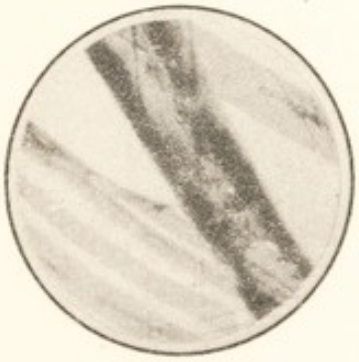
COMMON SHREW.

ORDER X. CHIROPTERA—BATS.
SUBORDER 1. FRUGIVOROUS BATS.

LARGE FRUIT BAT.



ORDER X. CHIROPTERA—BATS.
SUBORDER 1. FAMILY 1. FLYING FOXES.

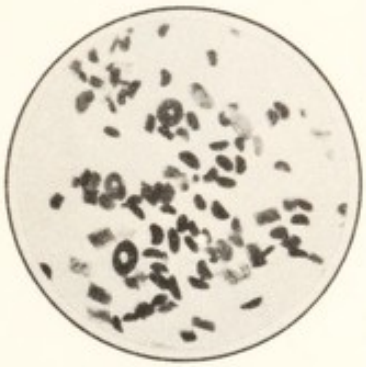


ORDER X. CHIROPTERA — BATS.

FRUGIVORUS BATS (continued).

TRANSVERSE SECTIONS.

LARGE FRUIT BAT.

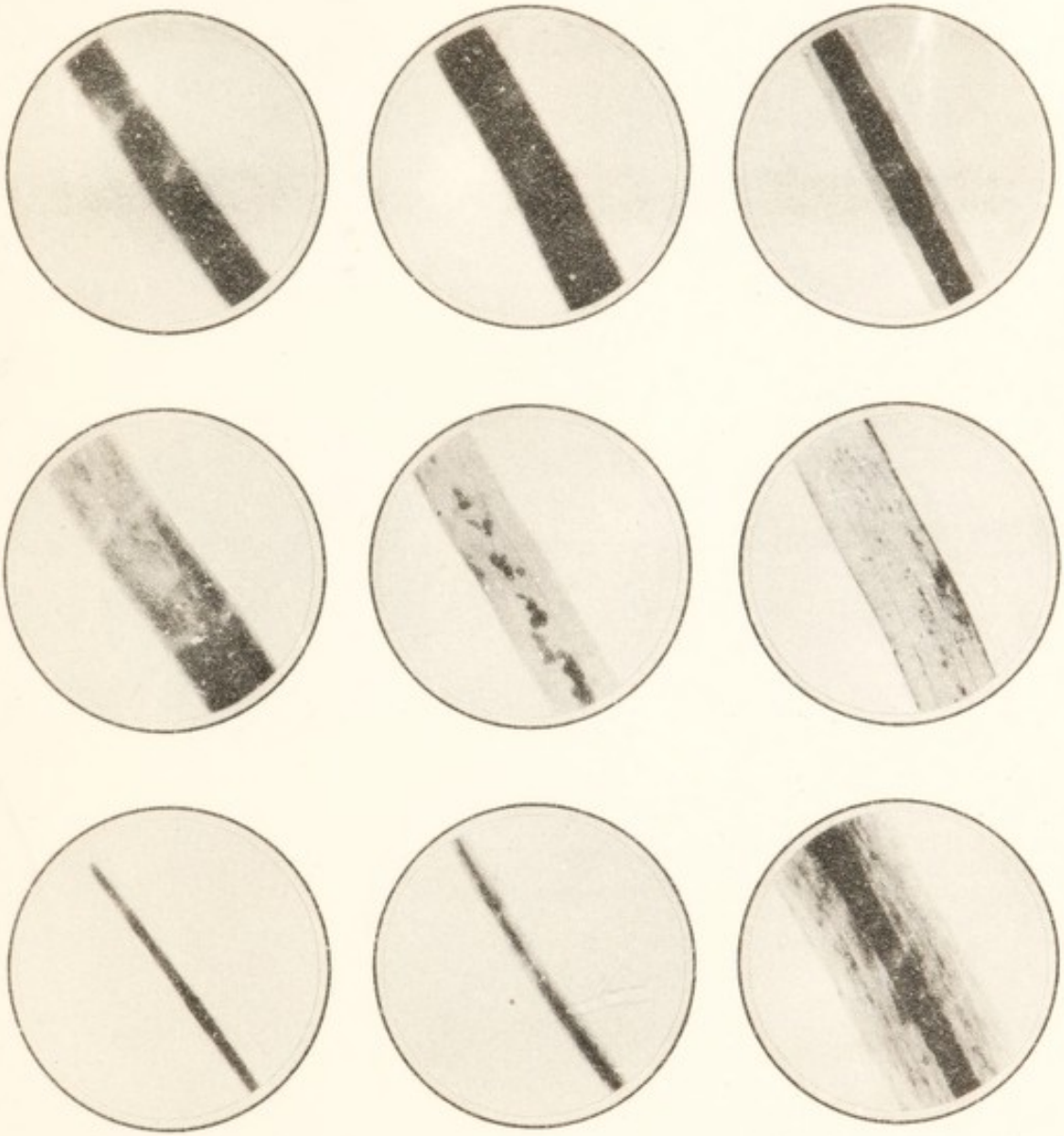


ORDER XI. PRIMATES.

SUBORDER 1. LEMUROIDEA.

FAMILY 2. CHIROMYIDÆ.

AYE-AYE.

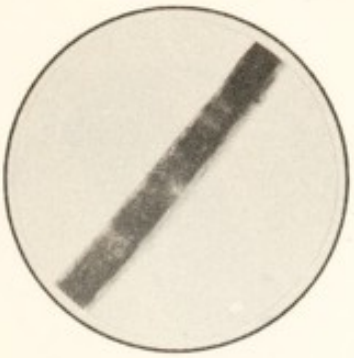


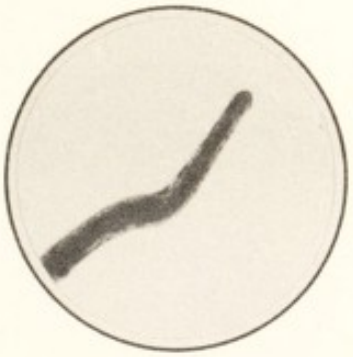
ORDER XI. PRIMATES.

SUBORDER 1. LEMUROIDS.

FAMILY 3. TARSIIDÆ.

TARSIER.



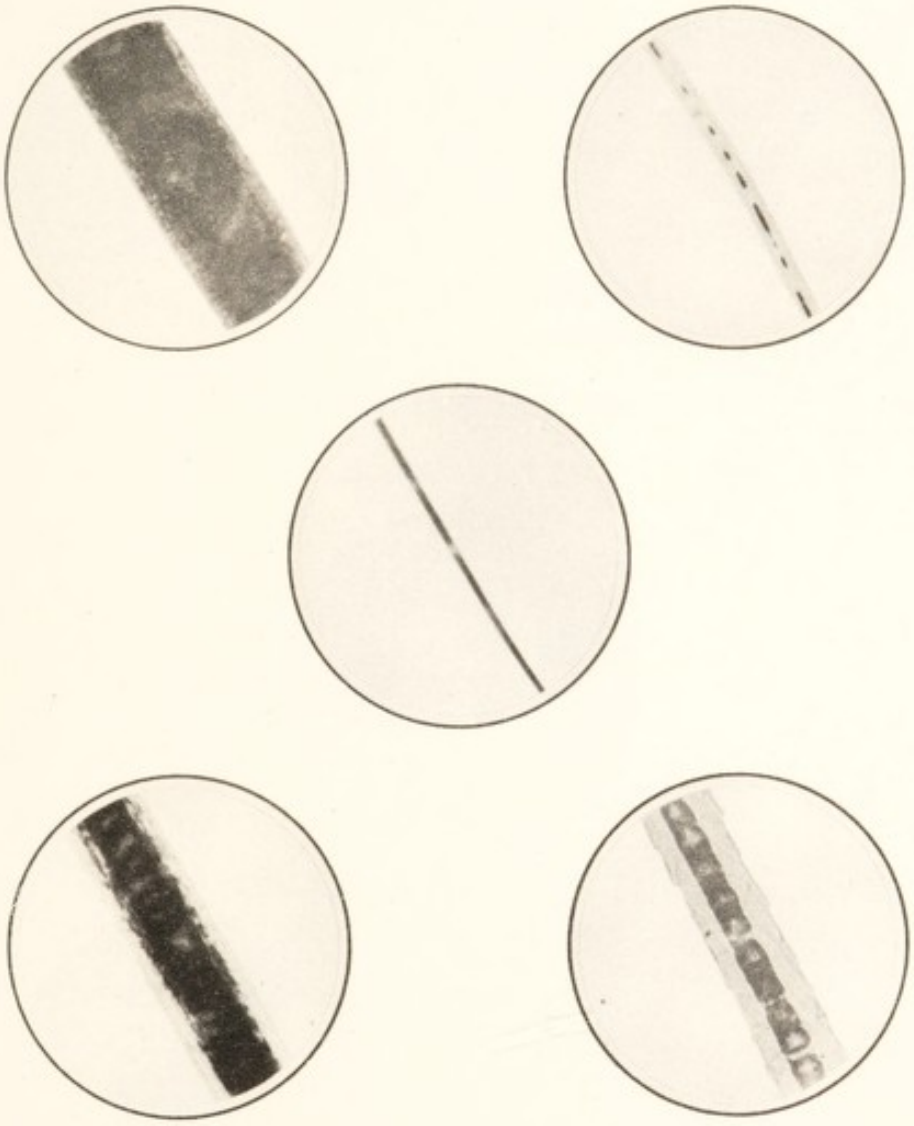


ORDER XI. PRIMATES.

SUBORDER 1. LEMUROIDS.

FAMILY 4. LEMURIDÆ.

RUFFED LEMUR.



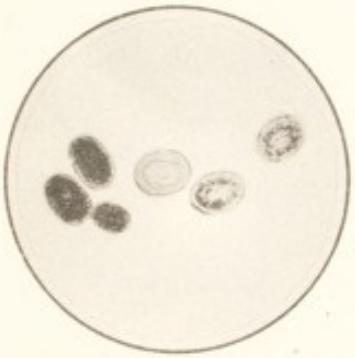
ORDER XI. PRIMATES.
SUBORDER 2. ANTHROPOIDS.
FAMILY 5. HAPALIDÆ.

MARMOSETS.

ORDER XI. PRIMATES.
FAMILY 7. CERCOPITHECIDÆ.

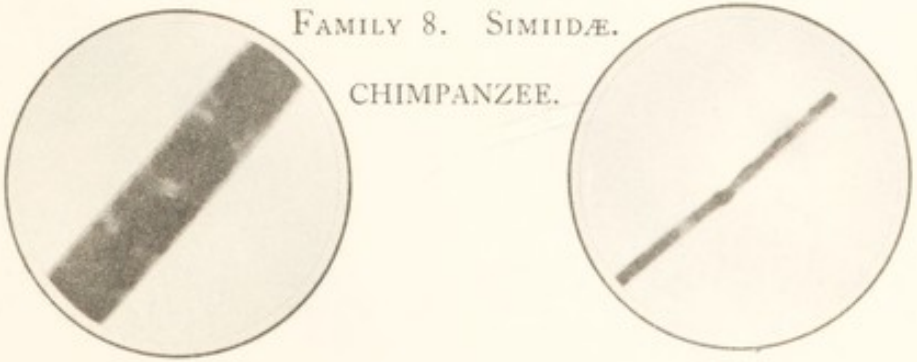
TRANSVERSE SECTIONS.

DIANA MONKEY.



ORDER XI. PRIMATES.
FAMILY 8. SIMIIDÆ.

CHIMPANZEE.



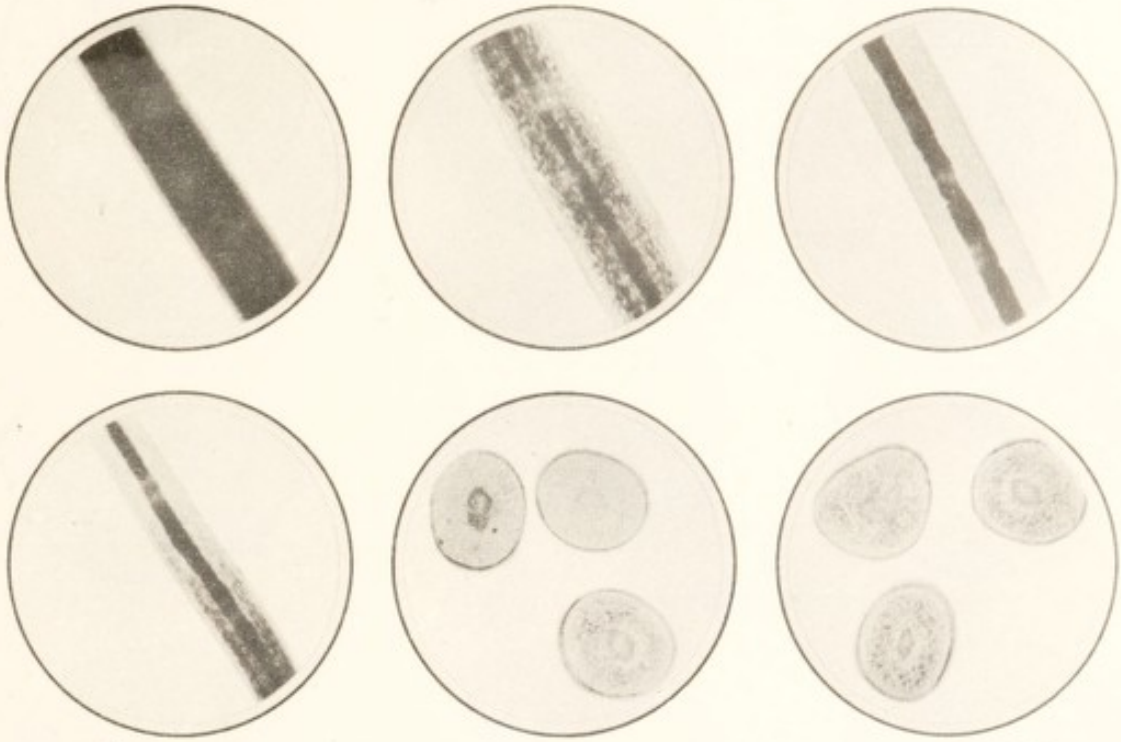
ORDER XI. PRIMATES.

SUBORDER 2. ANTHROPOIDS.

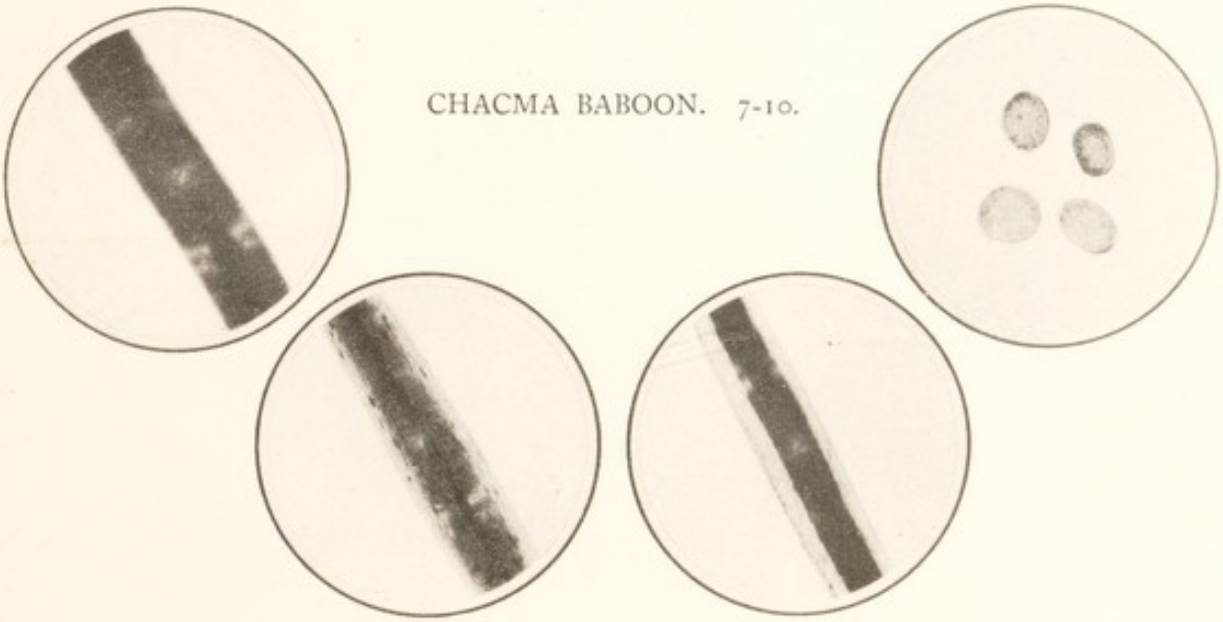
FAMILY 7. CERCOPITHECIDÆ.

(OLD WORLD MONKEYS).

ARABIAN BABOON. 1-6.



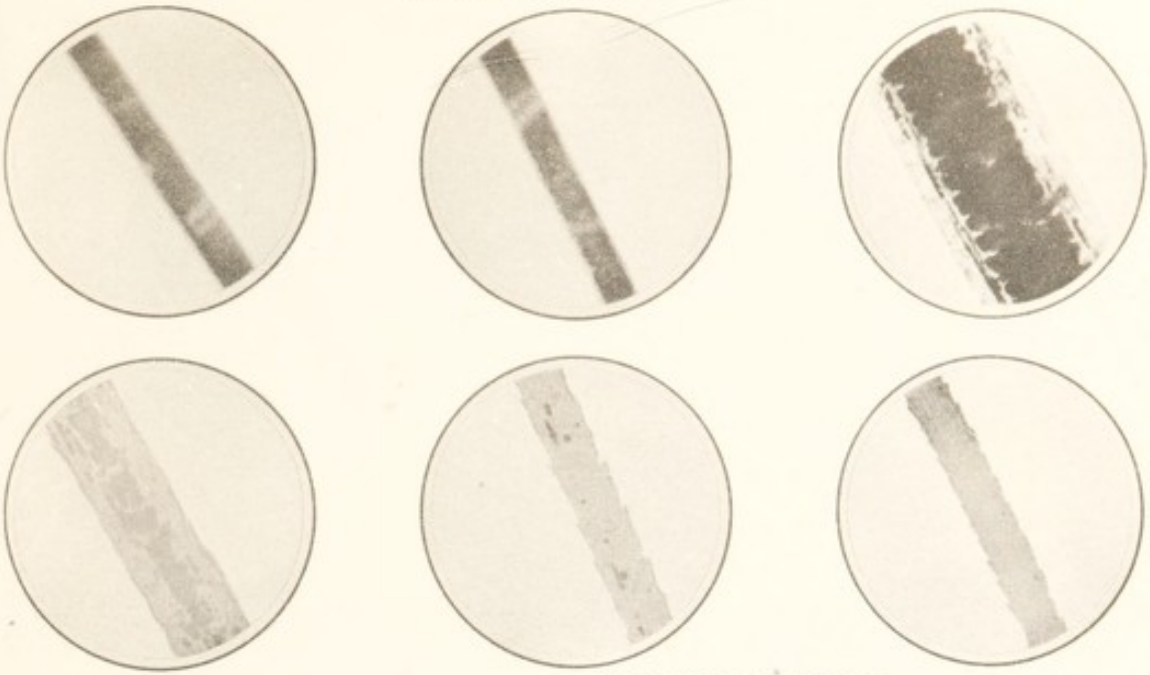
CHACMA BABOON. 7-10.



ORDER XI. PRIMATES.

Family 7. Cercopithecidæ (continued).

DIANA MONKEY. 1-7.



COLOBUS MONKEY. 8-11.

Fam. 8. Simiidæ (cont.).

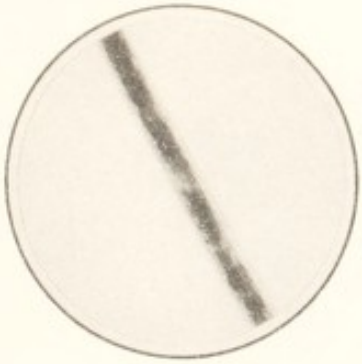
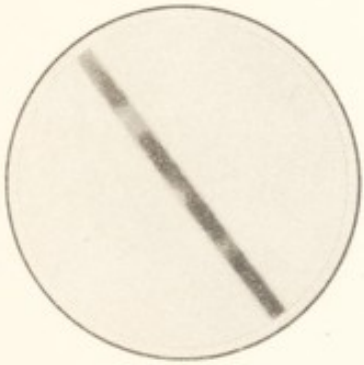
GORILLA, ADULT. 12.

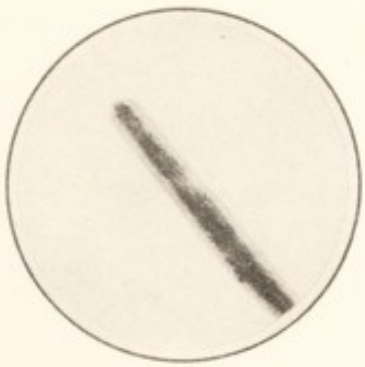
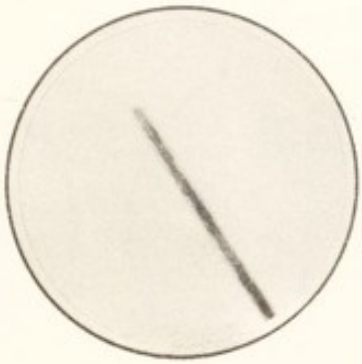
ORDER XI. PRIMATES.

SUBORDER 2. ANTHROPOIDS.

FAMILY 8. SIMIIDÆ.

GORILLA, FEMALE (Young).

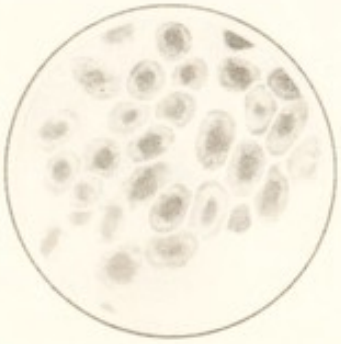
ORDER XI. PRIMATES.
(continued).

TRANSVERSE SECTIONS.

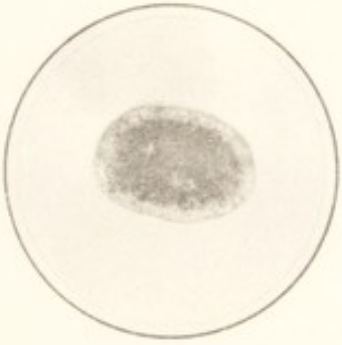
SUBORDER 1. LEMUROIDS.

FAMILY 2.
AYE-AYE

FAMILY 3.
TARSIER.

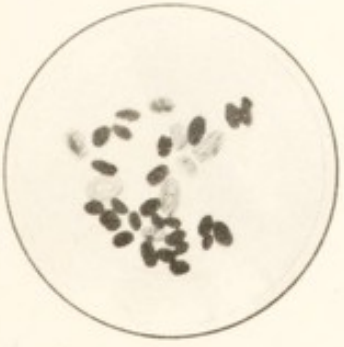


FAMILY 4.
LEMUR.

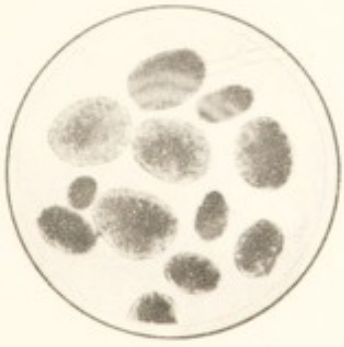


SUBORDER 2. ANTHROPOIDS.

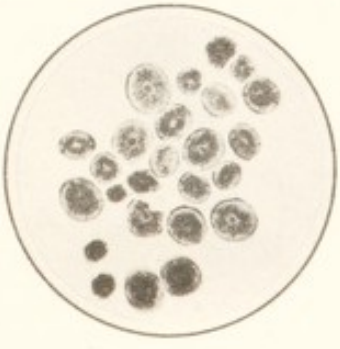
FAMILY 5.
COMMON MARMOSET.



FAMILY 8.
CHIMPANZEE.



FAMILY 8.
GORILLA, FEMALE (Young).

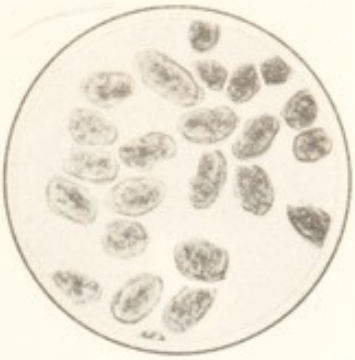


DYED HAIRS & WOOLS.

RACCOON (Sections).

HAIR

WOOL



OPOSSUM (Sections).

HAIR

LYNX (Sections).

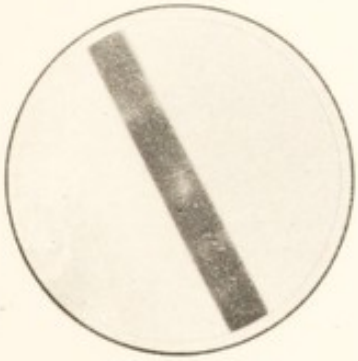
HAIR

GREENLAND SEAL (Sections).

HAIR

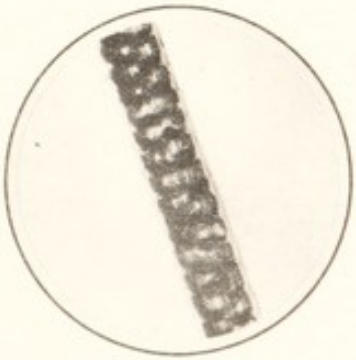
VIATKA SQUIRREL.

HAIR



HAIR

WOOL

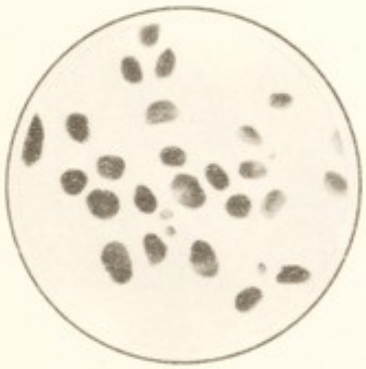


DYED HAIRS (continued).

TRANSVERSE SECTIONS.

GOAT.

PERSIAN LAMB.



SECTION II.

HUMAN HAIRS.

ORDER XI. PRIMATES.
SUBORDER 2. ANTHROPOIDS.
FAMILY 9. HOMINIDÆ.

MAN.

RED HAIR.

HAIR IN OLD AGE.

HEALTHY HAIR BULB.

DISEASED BULB.

TRANSVERSE SECTIONS.

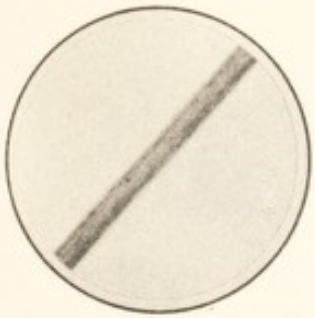
TRANSVERSE SECTIONS.

CUT HAIR.

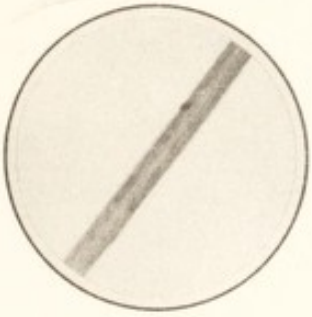
Family 9. Hominidæ (continued).

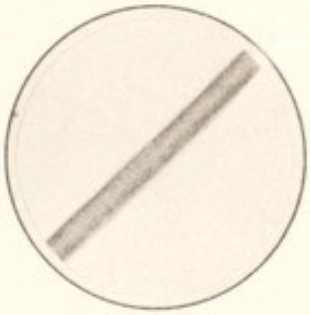
FEMALE. HAIR FROM HEAD.

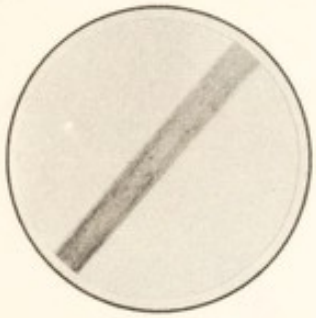
Aged 11 Months. 1.
Light Brown



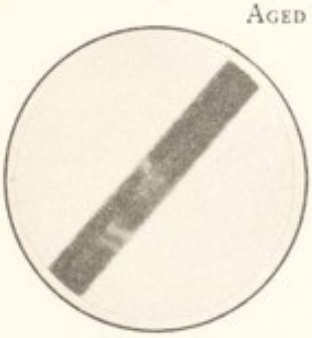
Aged 2½ Years. 2-4
Reddish Fair



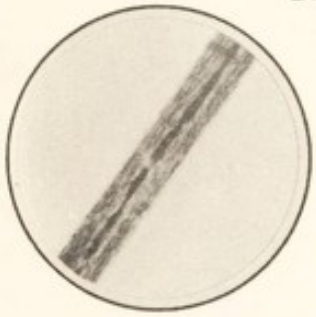




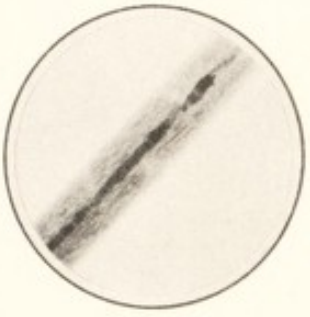
Aged 6 Years. 5-6.
Black

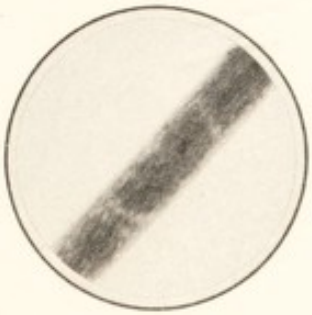


Aged 14 Years. 7-8.
Dark Brown



Aged 15 Years. 9-10.
Red

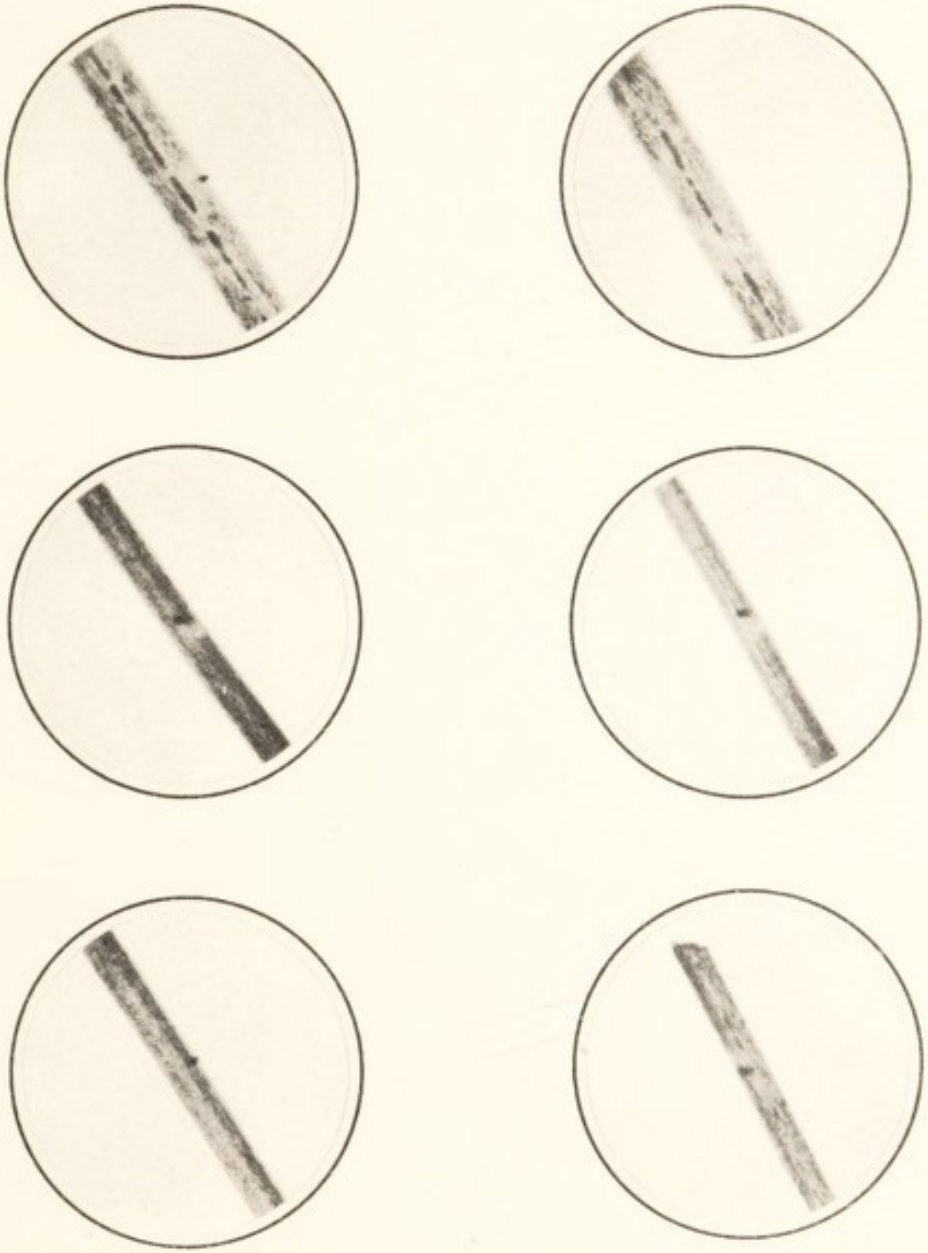




Family 9. Hominidæ (continued).

FEMALE. HAIR FROM HEAD.

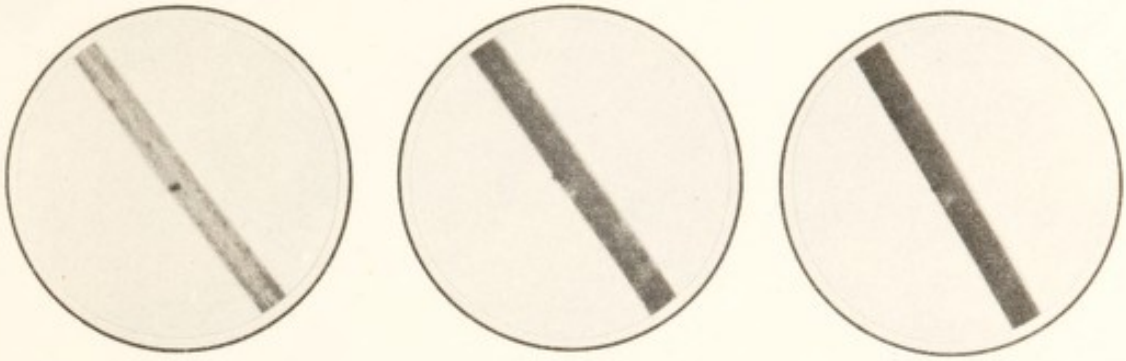
Aged 5 Years. Brunette.



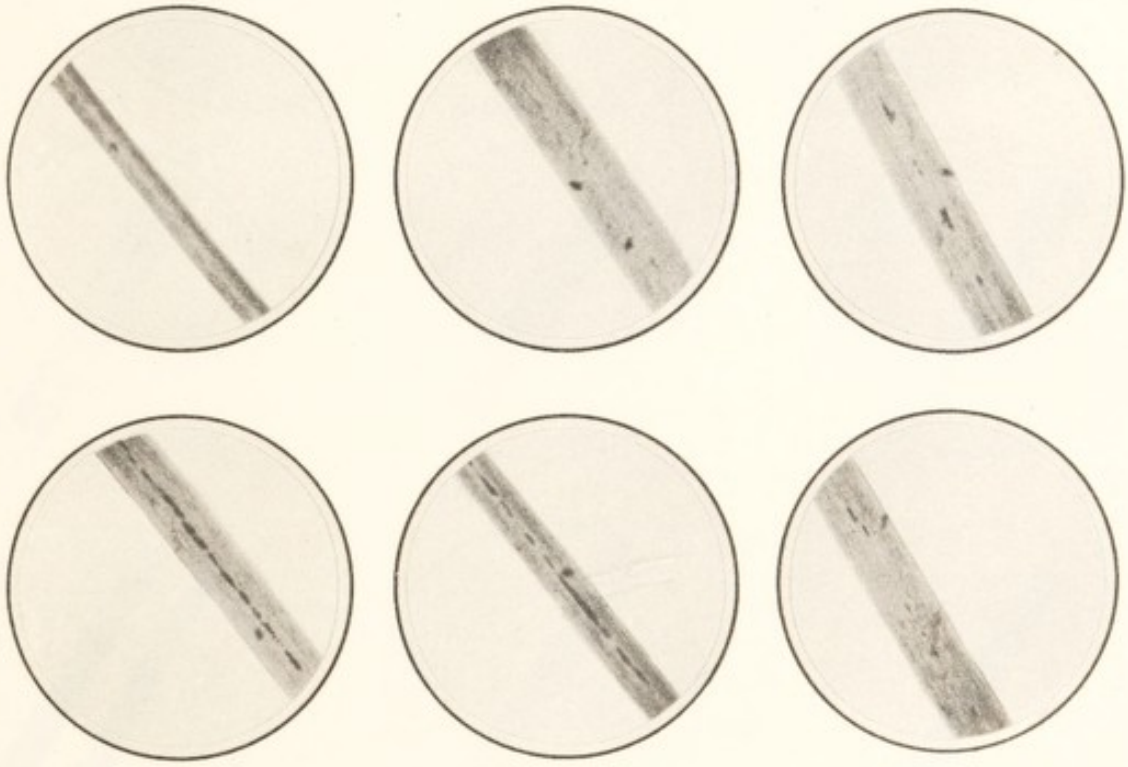
Family 9. Hominidæ (continued).

FEMALE. HAIR FROM HEAD.

Aged 9 Years. 1-4.
Brunette



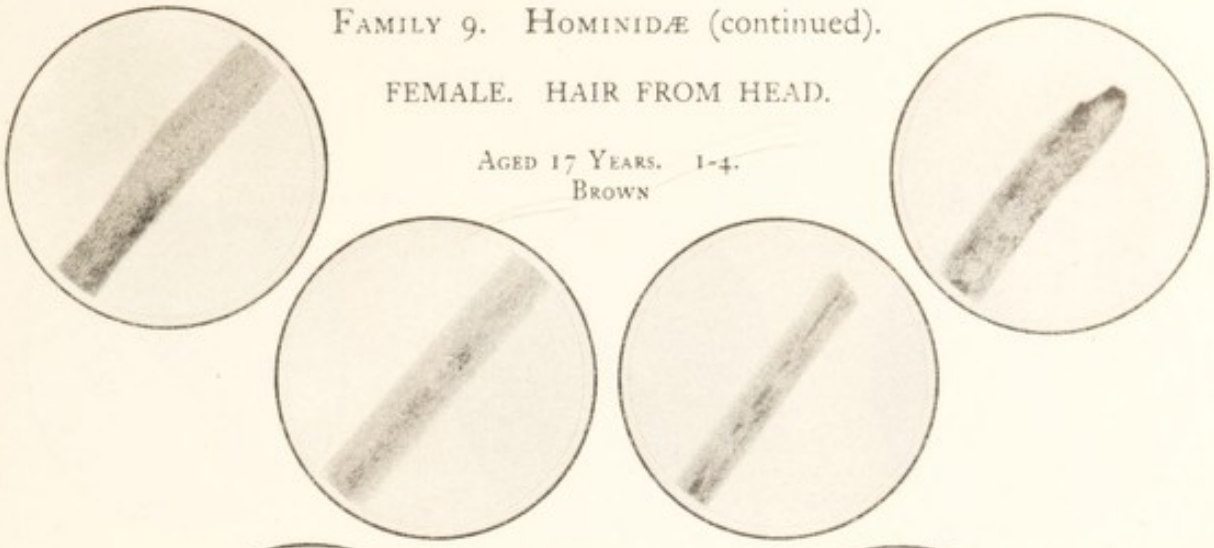
Aged 11 Years. 5-9.
Light Brown



Family 9. Hominidæ (continued).

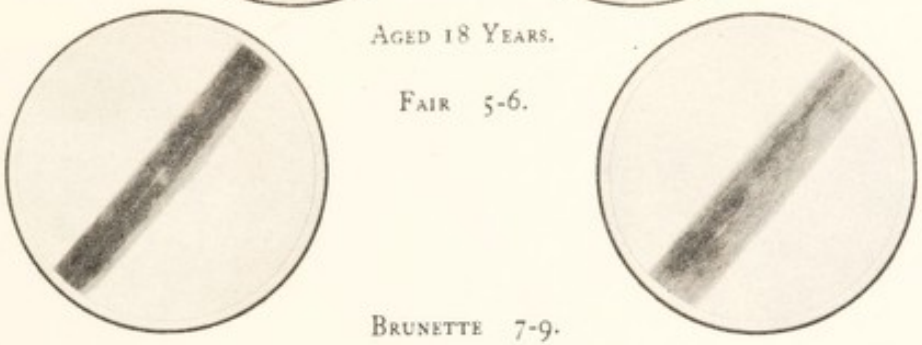
FEMALE. HAIR FROM HEAD.

Aged 17 Years. 1-4.
Brown



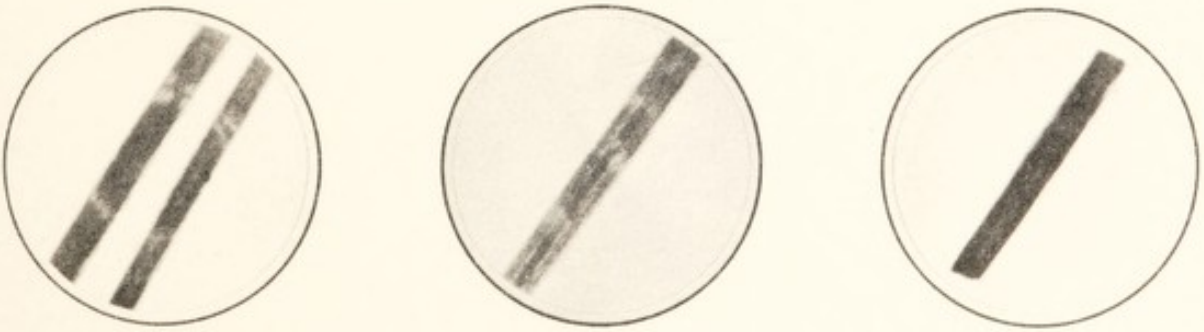
Aged 18 Years.

Fair 5-6.



Brunette 7-9.

Black 10-12.

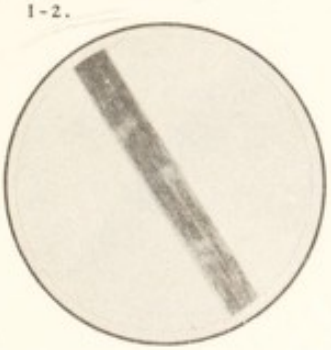


Family 9. Hominidæ (continued).

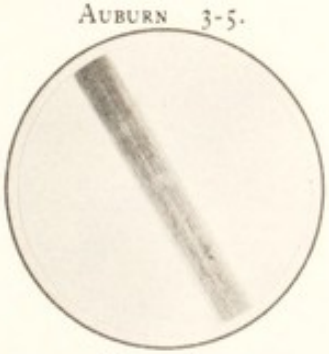
FEMALE. HAIR FROM HEAD.

Aged 19 Years.

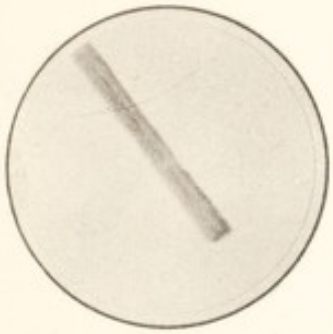
Dark Brown 1-2.

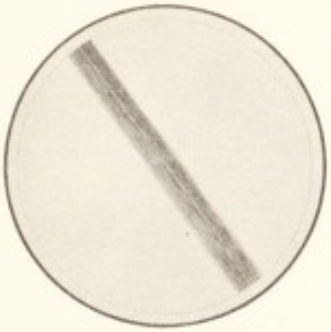


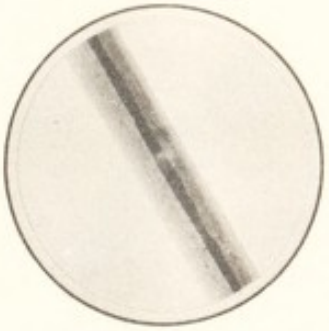
Auburn 3-5.

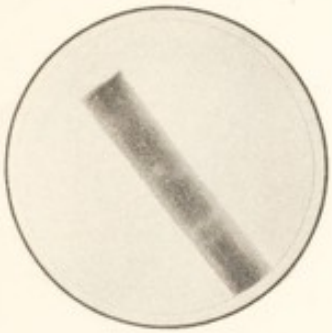


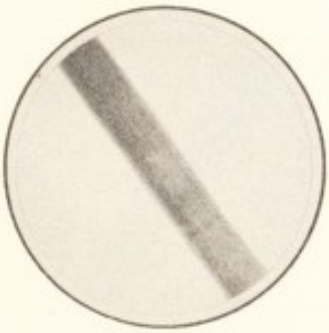
Red 6-10.

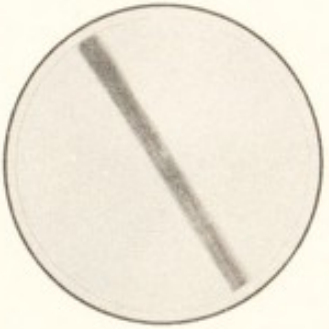


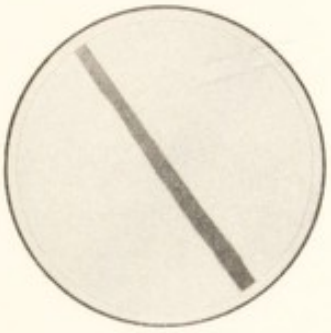












Family 9. Hominidæ (continued).

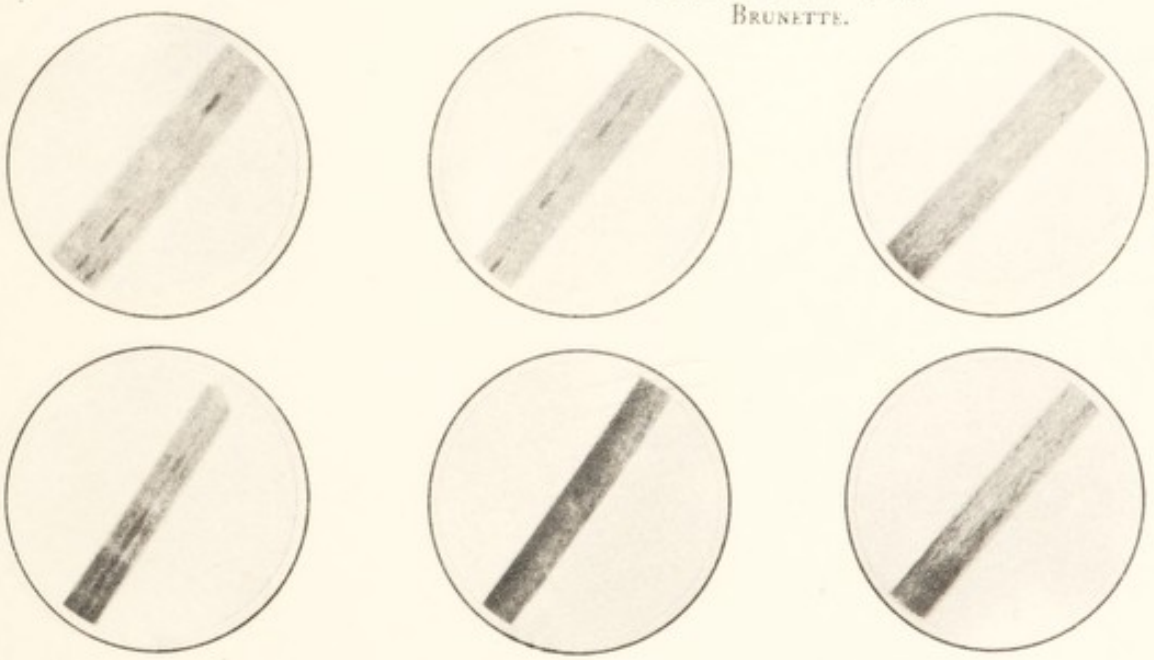
FEMALE. HAIR FROM HEAD.

Aged 17 Years. 1-3.
Dark Brown

Aged 20 Years. 4-5.
Dark Brown

Aged 21 Years. 6-7.
Dark Brown

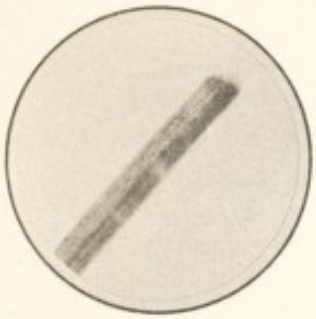
Aged 21 Years. 8-12.
Brunette.

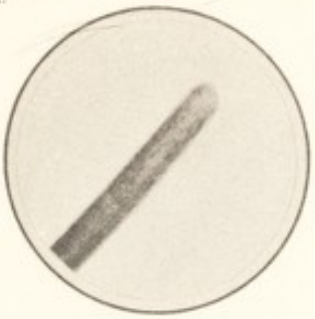


Family 9. Hominidæ (continued).

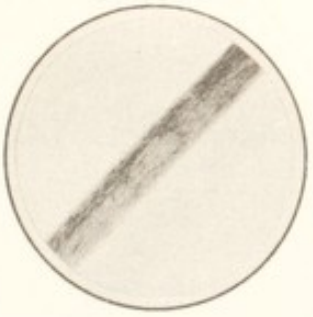
FEMALE. HAIR FROM HEAD.

Aged 21 Years. 1-2.
Brunette

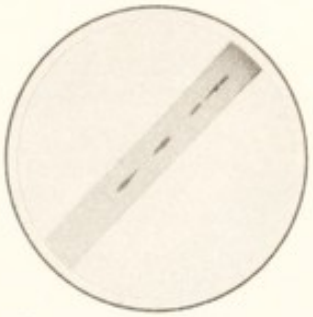




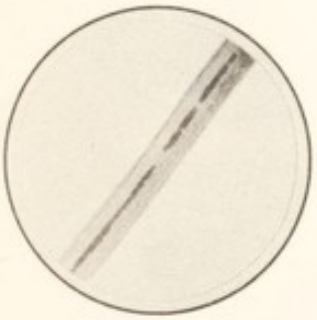
Aged 22 Years. 3.
Brunette

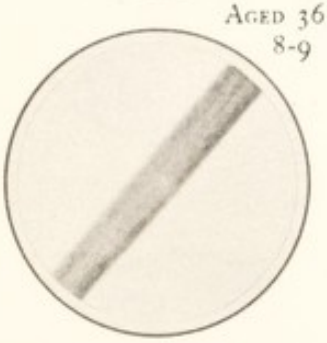


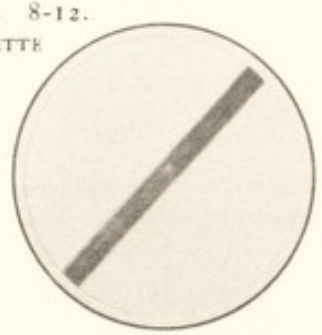
Aged 27 Years. 4-7.
Brunette



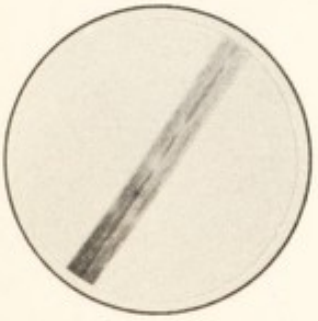
Aged 36 Years. 8-12.
8-9 Brunette

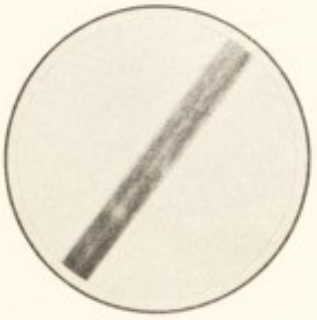


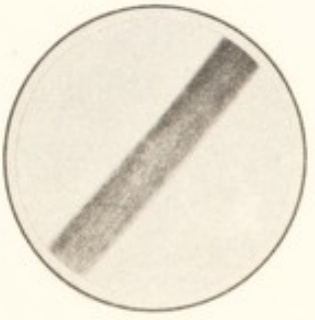




10-12 Auburn



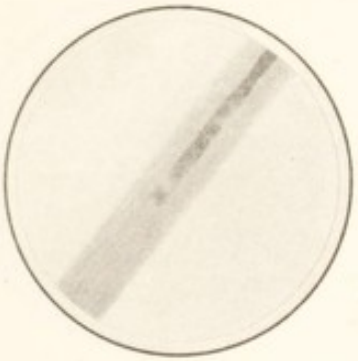


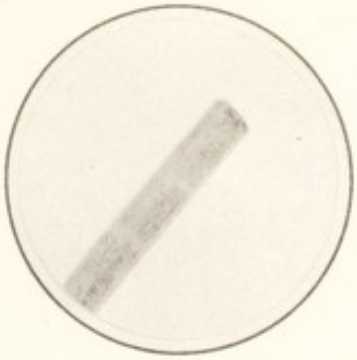


Family 9. Hominidæ (continued).

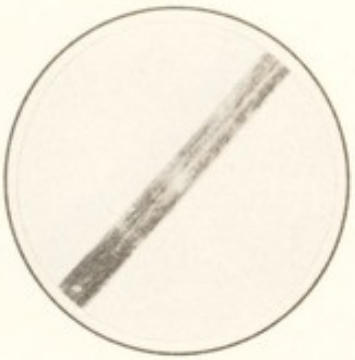
FEMALE. HAIR FROM HEAD.

Aged 36 Years. 1-2.
Dark Brown

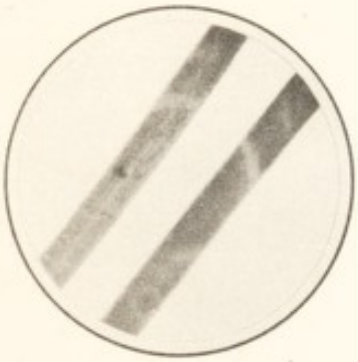


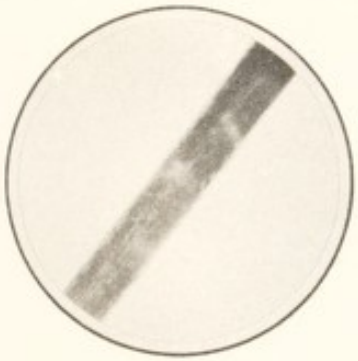


Aged 40 Years. 3.
Brown



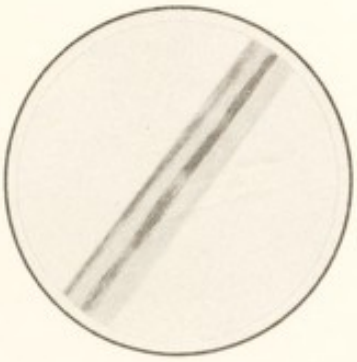
Aged 40 Years. 4-5.
Black





Aged 43 Years. 6-8.
Reddish turning Grey

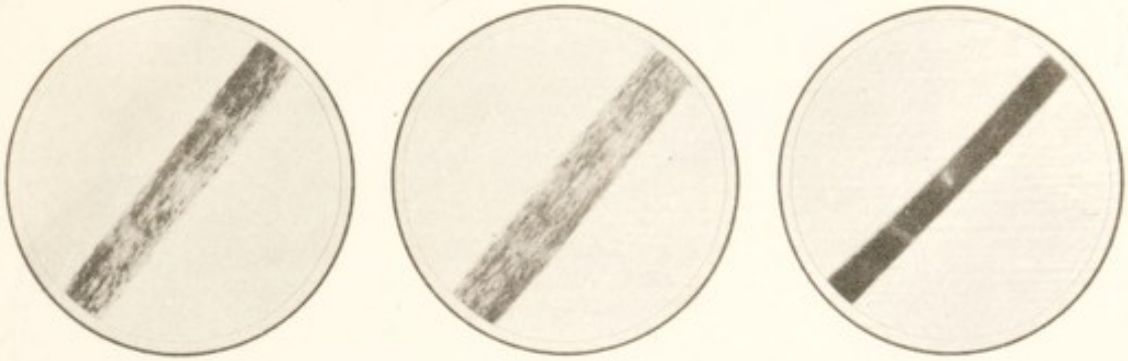
Aged 44 Years. 9.
Black turning Grey



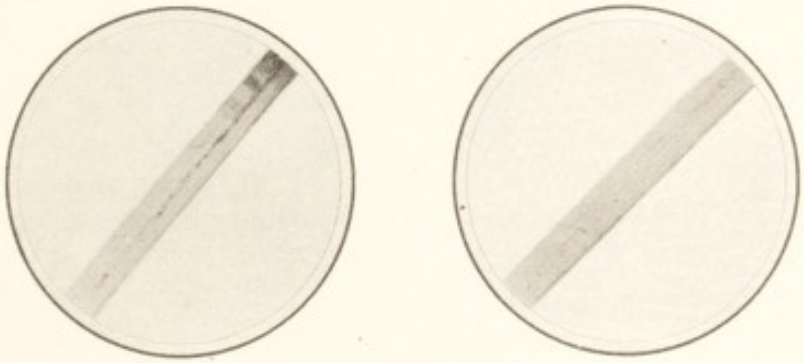
Family 9. Hominidæ (continued).

FEMALE. HAIR FROM HEAD.

Aged 44 Years. 1-2.
Black and Grey

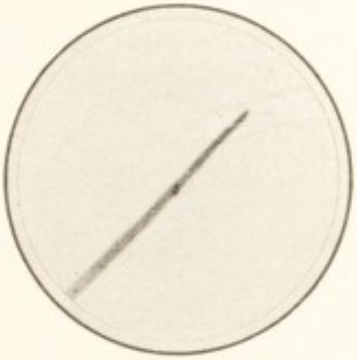


Ages varying from 40-50 Years. 3-5.
Grey



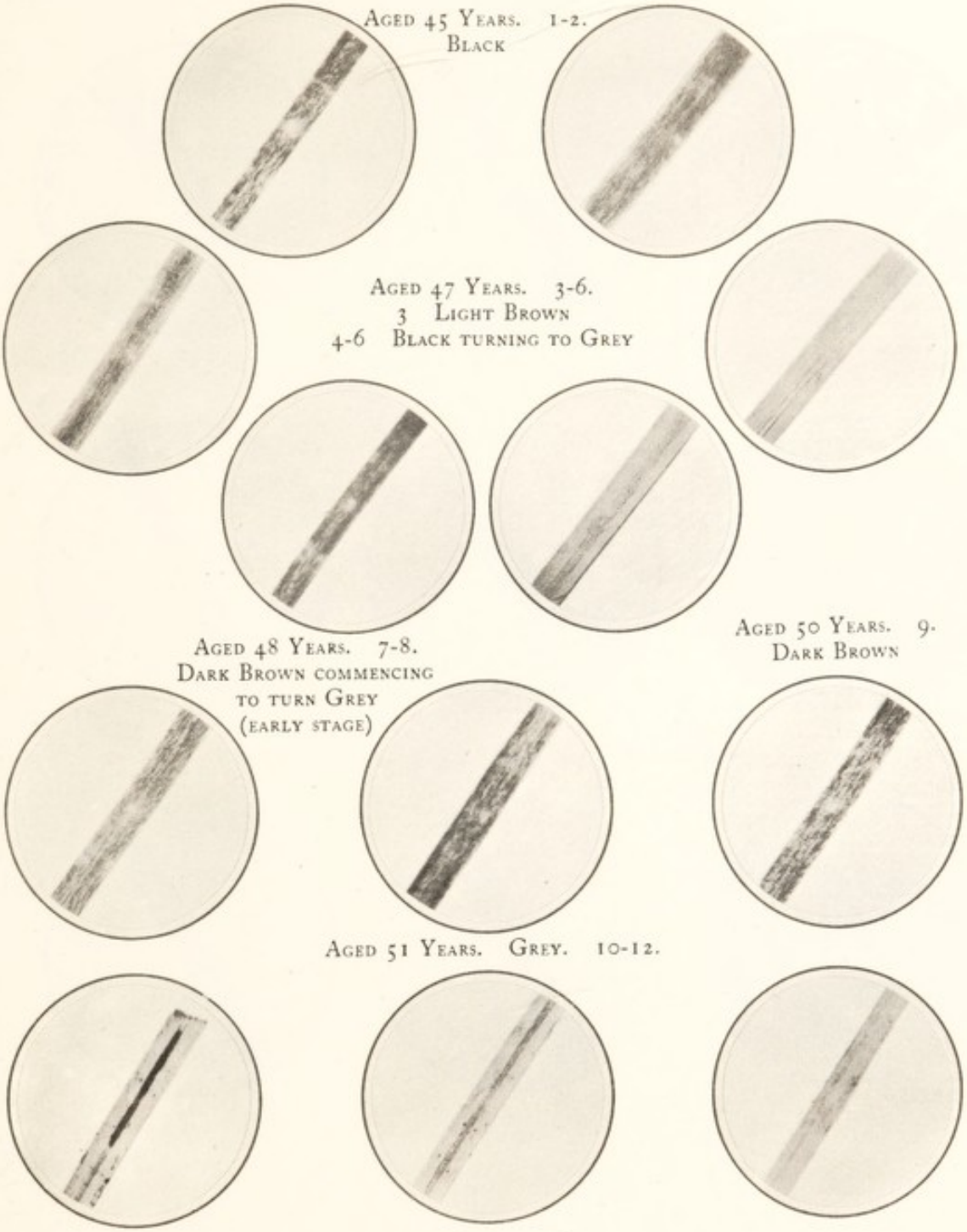
HAIR FROM UPPER LIP.

Aged 26 Years.
Brunette



Family 9. Hominidæ (continued).

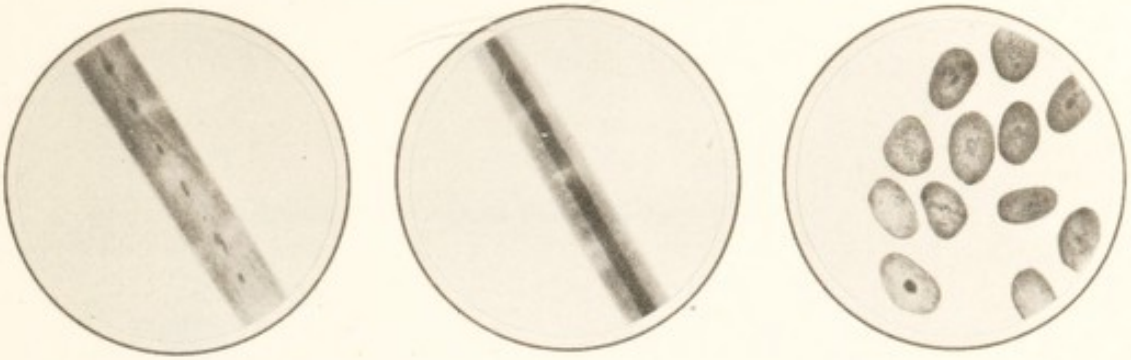
FEMALE. HAIR FROM HEAD.



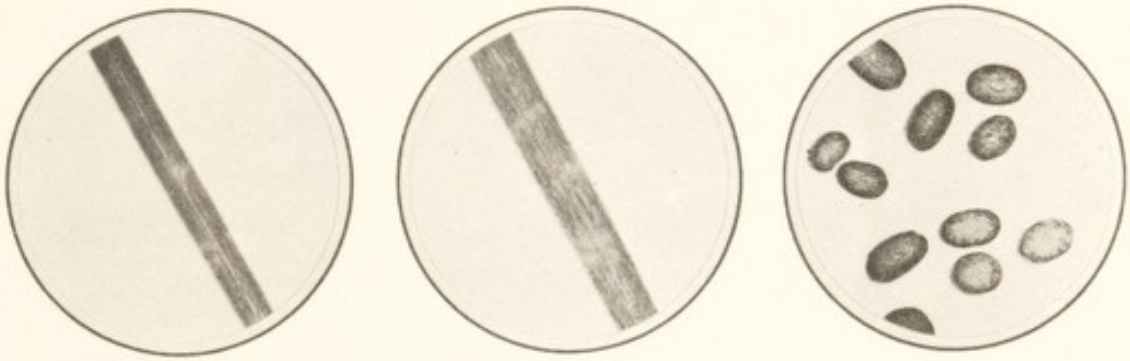
Family 9. Hominidæ (continued).

FEMALE. HAIR FROM HEAD (DYED).

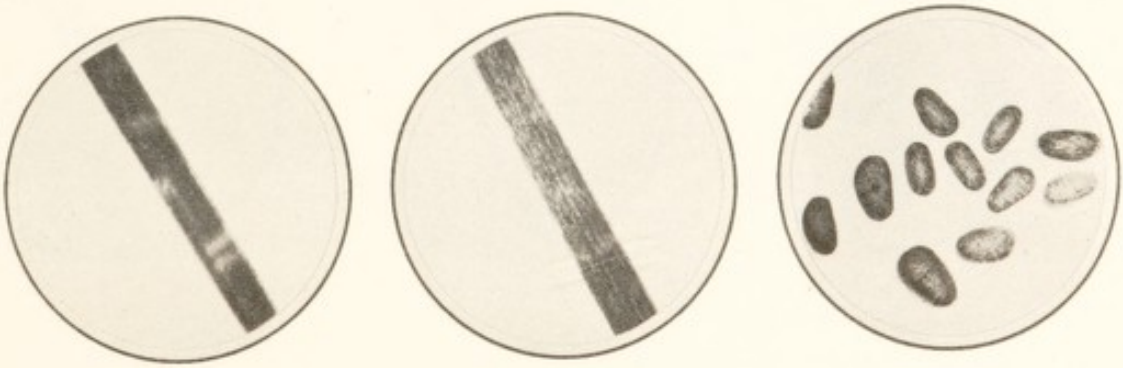
PEROXIDE. (Henna applied previously). 1-3.



PEROXIDE. 10 Minutes. Brown Hair. 4-6.



PEROXIDE. 20 Vols. 12 Hours. Black Hair. 7-9.

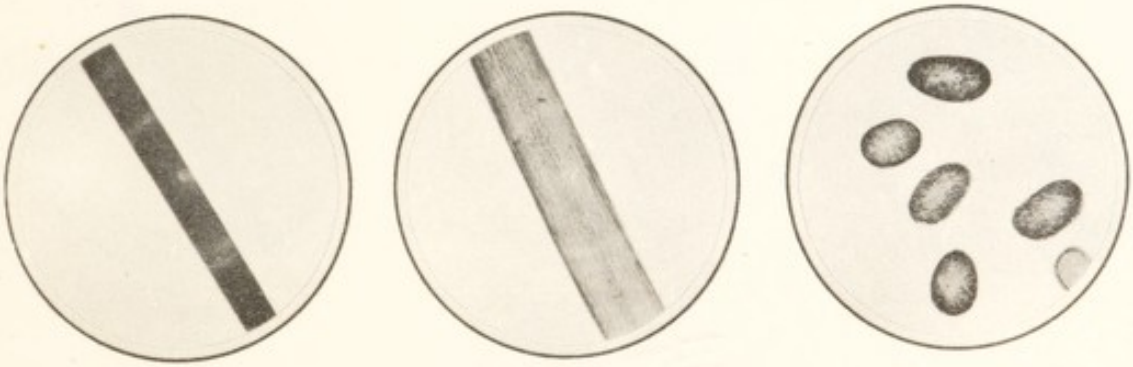


Family 9. Hominidæ (continued).

FEMALE. HAIR FROM HEAD (DYED). (continued).

HENNA. Very Dark Brown Hair. 10-11.

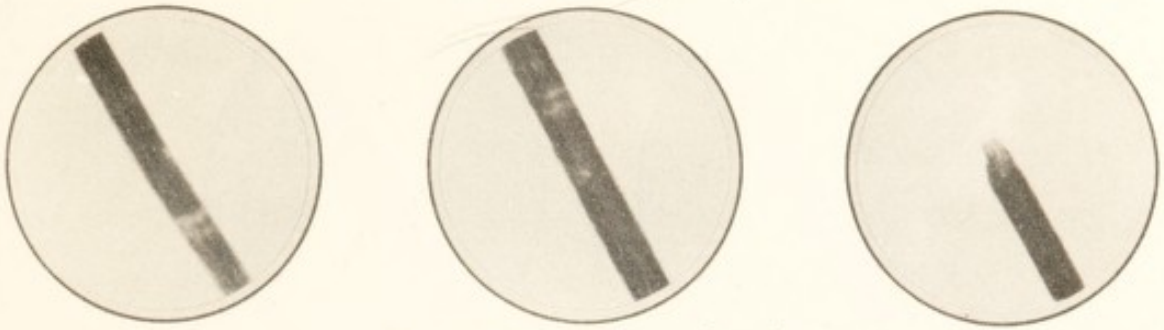
LIQUID DYE WITH PARA BASE. 15 Minutes. 12-14.



Family 9. Hominidæ (continued).

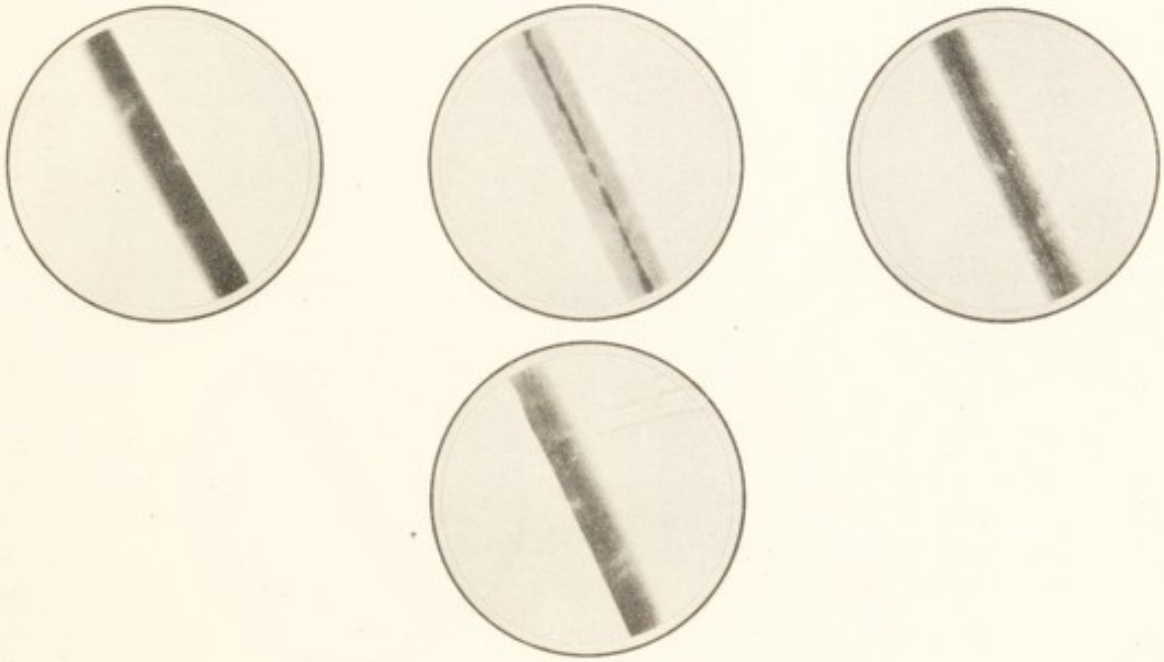
MALE. HAIR FROM HEAD.

Aged 16 Years. (Black).



Aged 19 Years. (Fair - Brown).

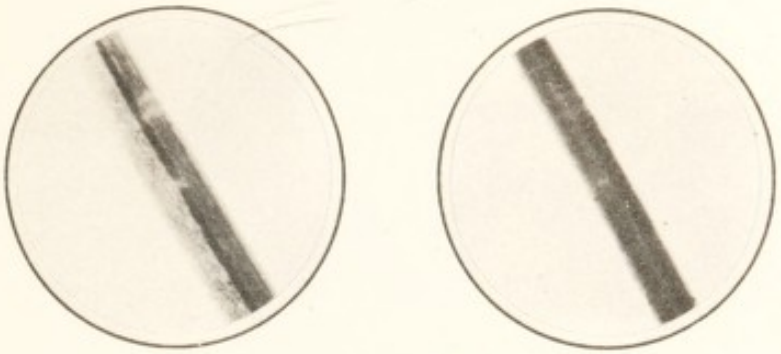
Aged 21 Years. (Reddish Fair).



Family 9. Hominidæ (continued).

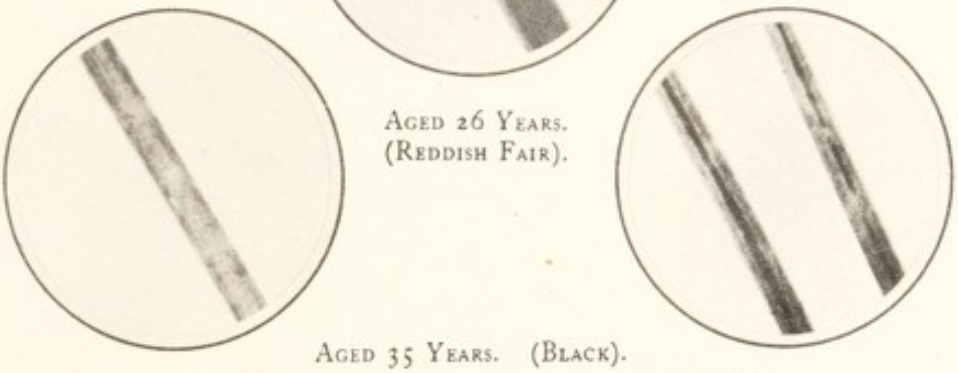
MALE. HAIR FROM HEAD.

Aged 23 Years. (Brown).

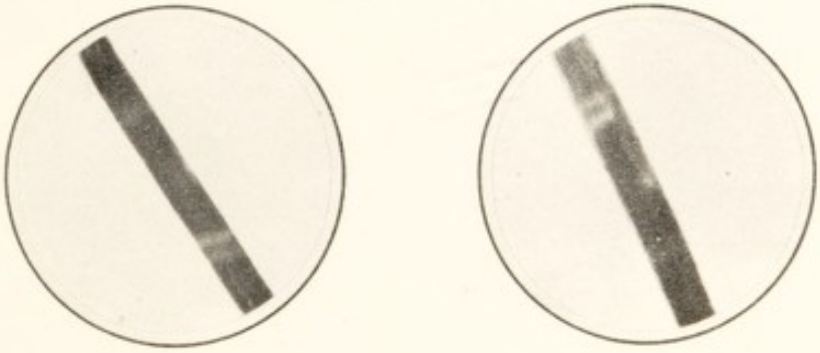


Aged 27 Years. (Dark Brown).

Aged 26 Years.
(Reddish Fair).



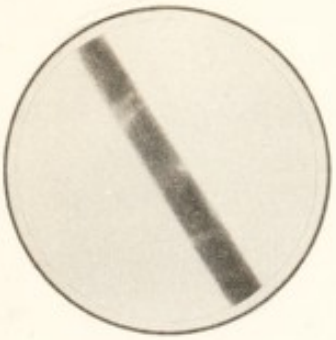
Aged 35 Years. (Black).



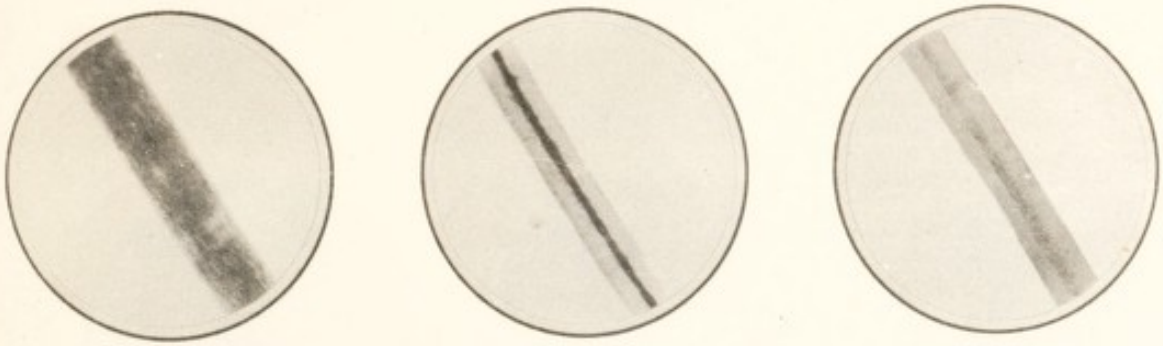
Family 9. Hominidæ (continued).

MALE. HAIR FROM HEAD.

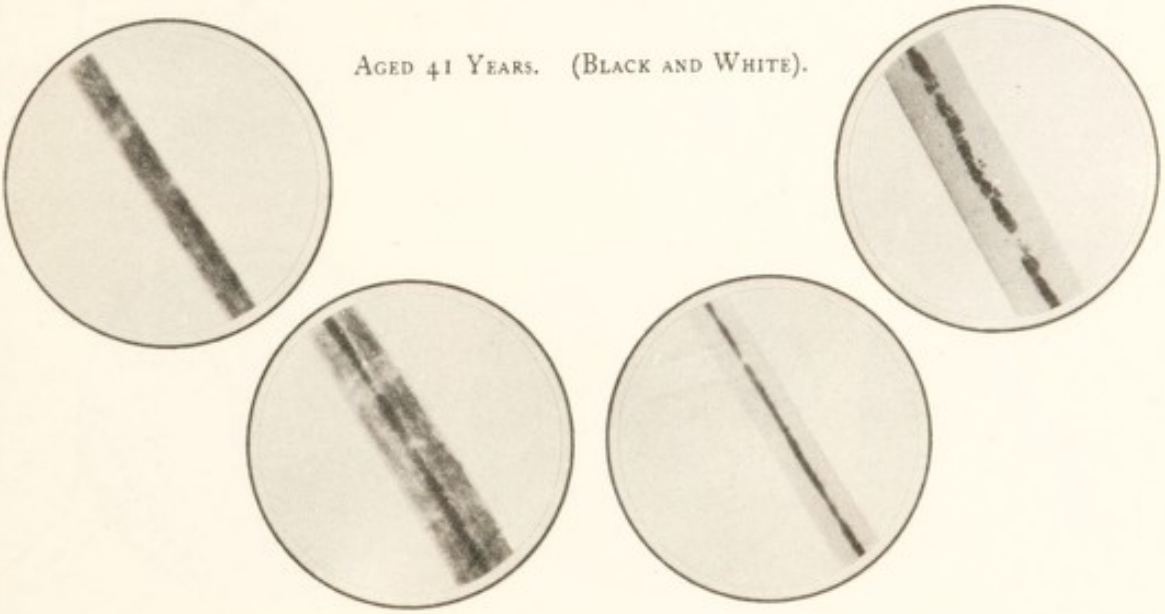
Aged 36 Years. (Reddish Fair).



Aged 40 Years. (Brown and Grey).



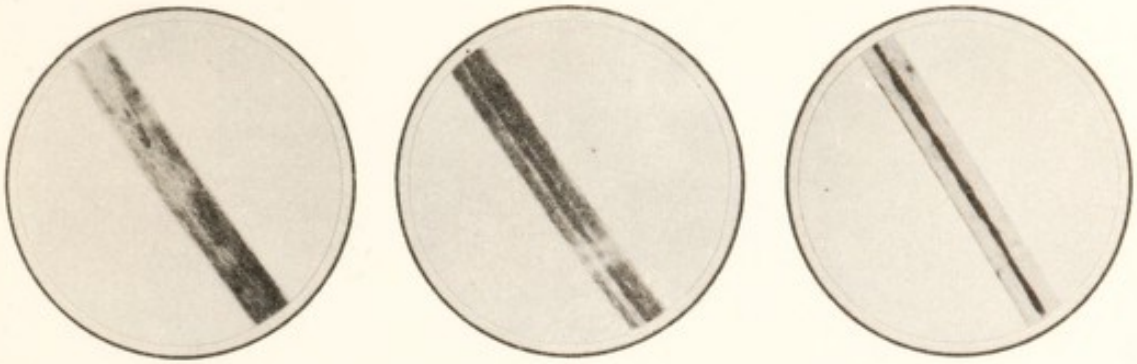
Aged 41 Years. (Black and White).



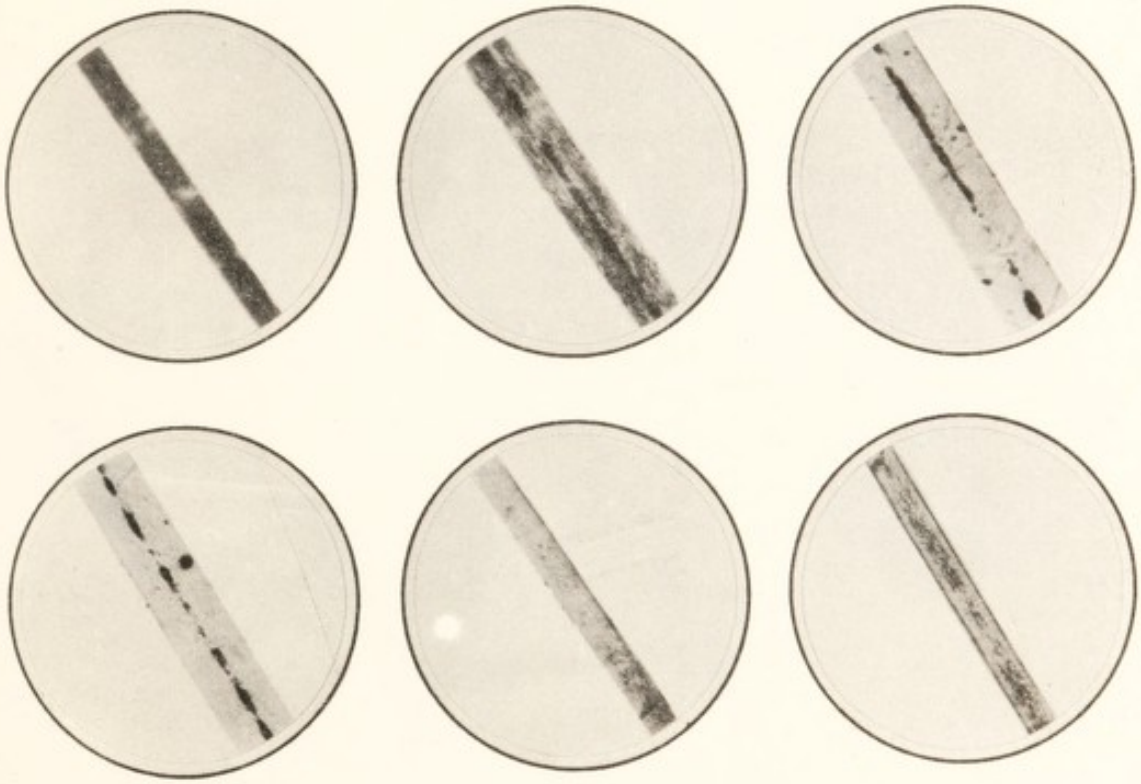
Family 9. Hominidæ (continued).

MALE. HAIR FROM HEAD.

Aged 50-Years. (Brown and Grey).



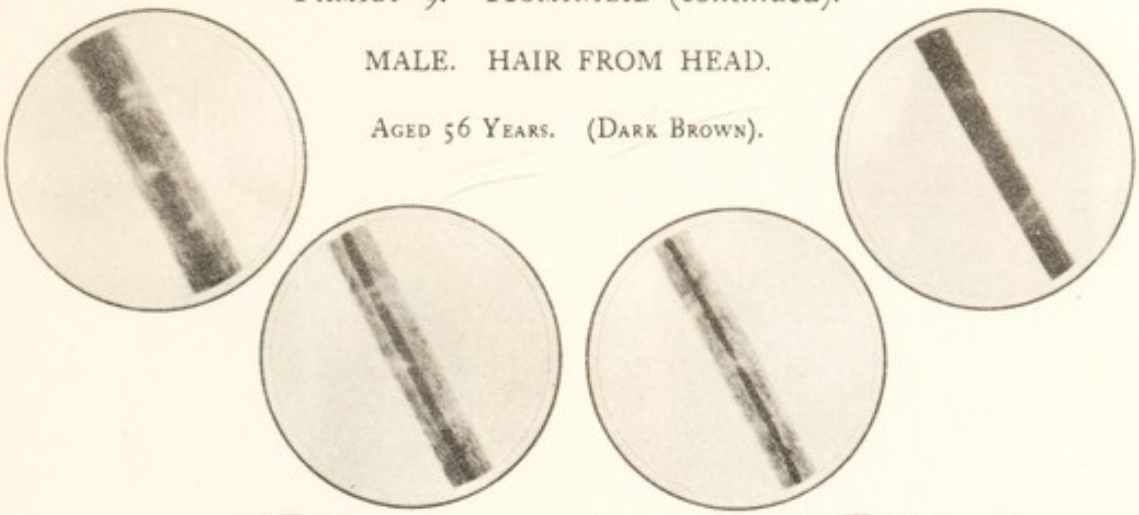
Aged 56 Years. (Grey).



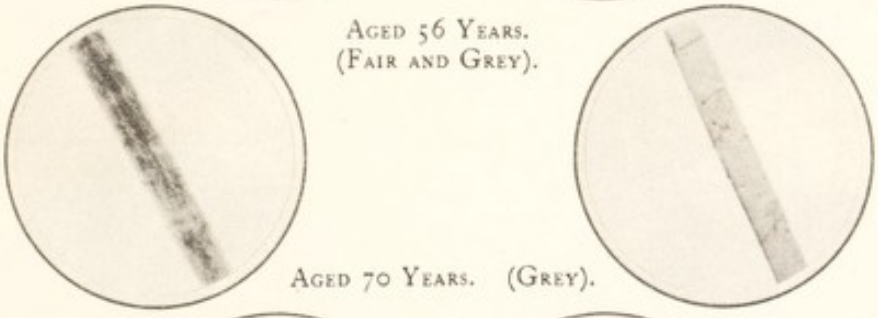
Family 9. Hominidæ (continued).

MALE. HAIR FROM HEAD.

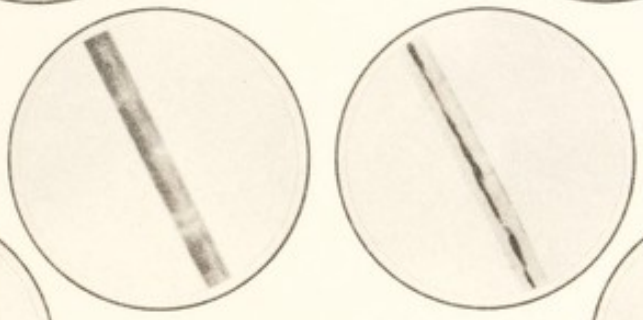
Aged 56 Years. (Dark Brown).



Aged 56 Years.
(Fair and Grey).



Aged 70 Years. (Grey).

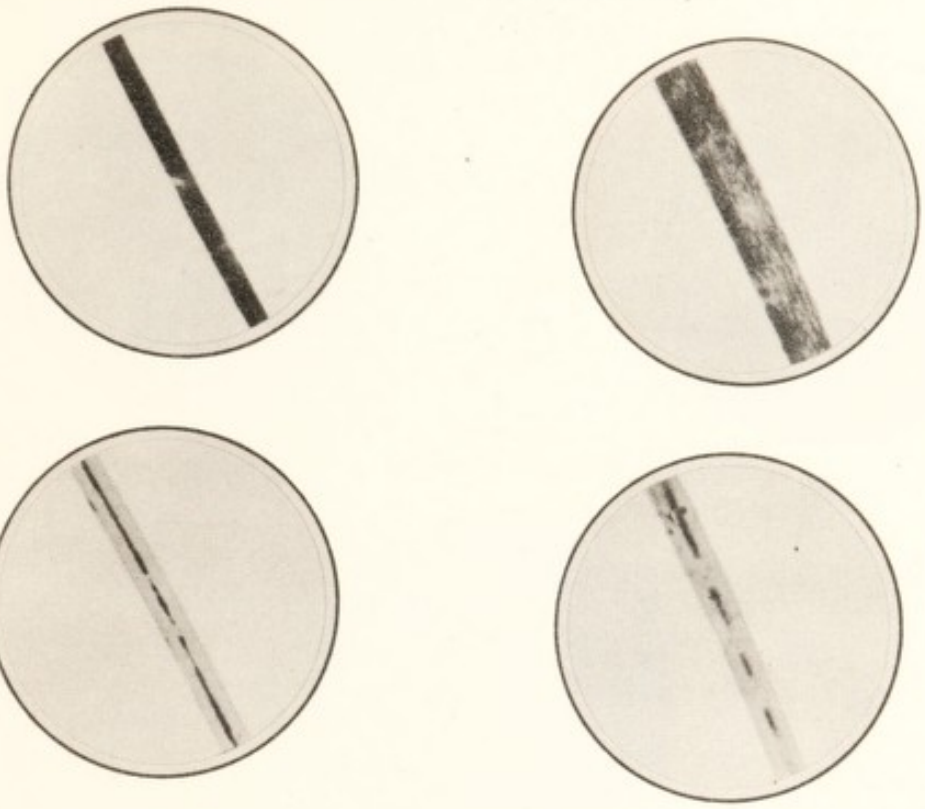


Aged 72 Years. (Brown and Grey).

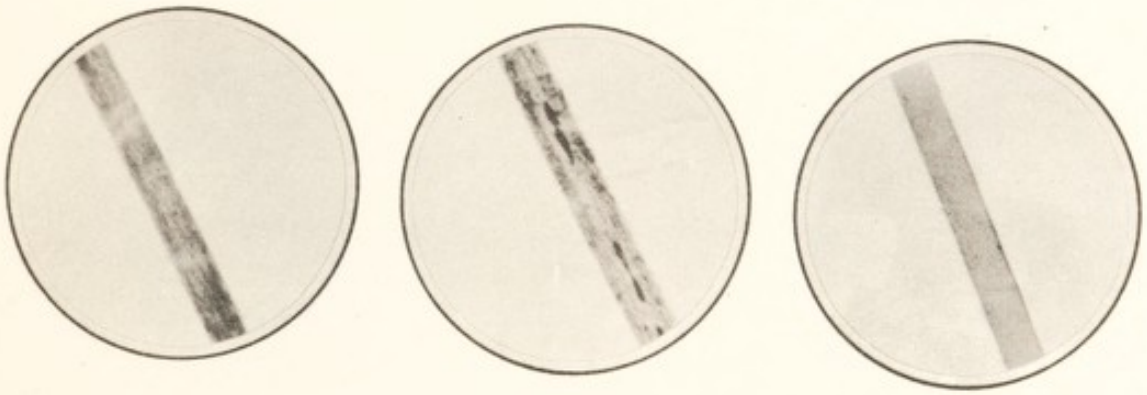
Family 9. Hominidæ (continued).

MALE. HAIR FROM HEAD.

Aged 75 Years. (Black and White).



Aged 80 Years. (White).



ORDER XI. PRIMATES.

Family 9. Hominidæ (continued).

TRANSVERSE SECTIONS.

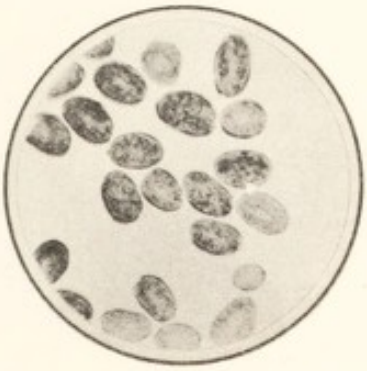
FEMALE. HAIR FROM HEAD.

Reddish Fair.
Aged 2½ Years.

Black.
Aged 6 Years.

Brunette.
Aged 9 Years.

Light Brown.
Aged 11 Years.



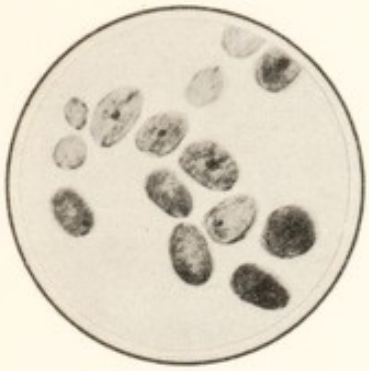
Dark Brown.
Aged 14 Years.

Family 9. Hominidæ (continued).

TRANSVERSE SECTIONS.

FEMALE. HAIR FROM HEAD.

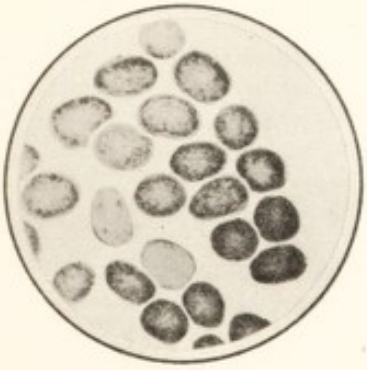
Red.
Aged 15 Years.



Black.
Aged 18 Years.

Fair.
Aged 18 Years.

Brunette.
Aged 18 Years.



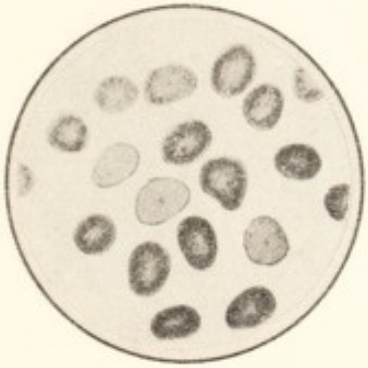
Red.
Aged 19 Years.

Family 9. Hominidæ (continued).

TRANSVERSE SECTIONS.

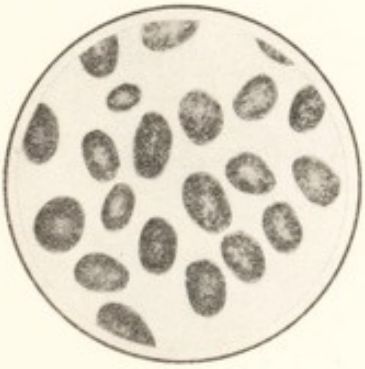
FEMALE. HAIR FROM HEAD.

Brunette.
Aged 27 Years.



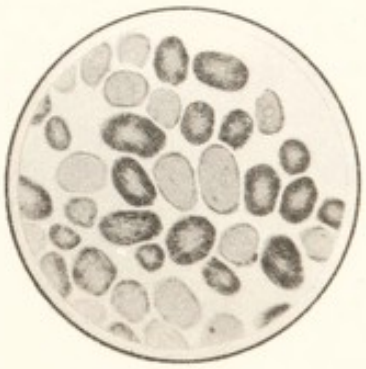
Auburn.
Aged 36 Years.

Black.
Aged 40 Years.



Grey.
Ages varying from 40-50 Years.

Grey.
Aged 56 Years.

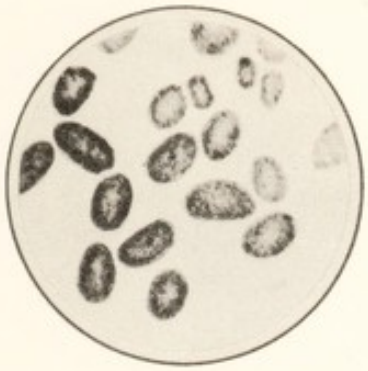


Family 9. Hominidæ (continued).

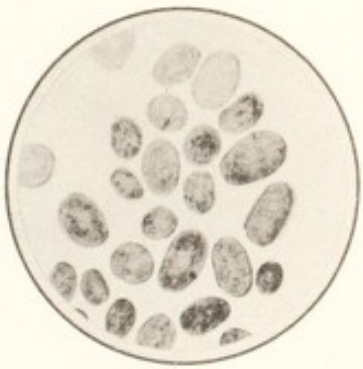
TRANSVERSE SECTIONS.

MALE. HAIR FROM HEAD.

Black. Aged 16 Years.



Brownish Fair. Aged 19 Years.



Red. Aged 21 Years.

Brown. Aged 23 Years.

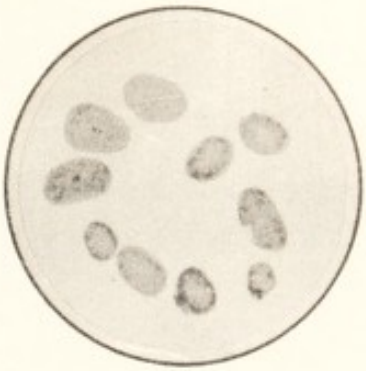
Black. Aged 35 Years.

Family 9. Hominidæ (continued).

TRANSVERSE SECTIONS.

MALE. HAIR FROM HEAD.

Reddish Fair. Aged 36 Years.



Black and White. Aged 41 Years.

Brownish Grey. Aged 50 Years.

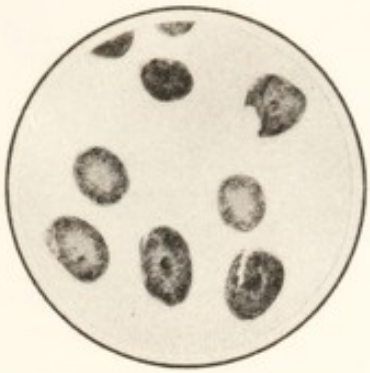
Grey. Aged 56 Years.

Family 9. Hominidæ (continued).

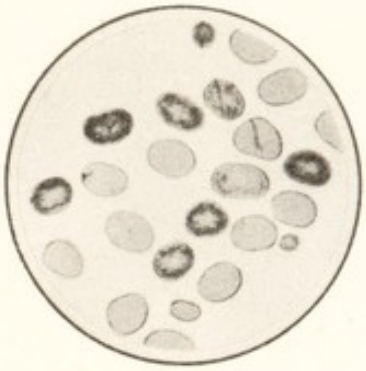
TRANSVERSE SECTIONS.

MALE. HAIR FROM HEAD.

Dark Brown. Aged 56 Years.



Grey. Aged 70 Years.



White. Aged 75 Years.

White. Aged 80 Years.

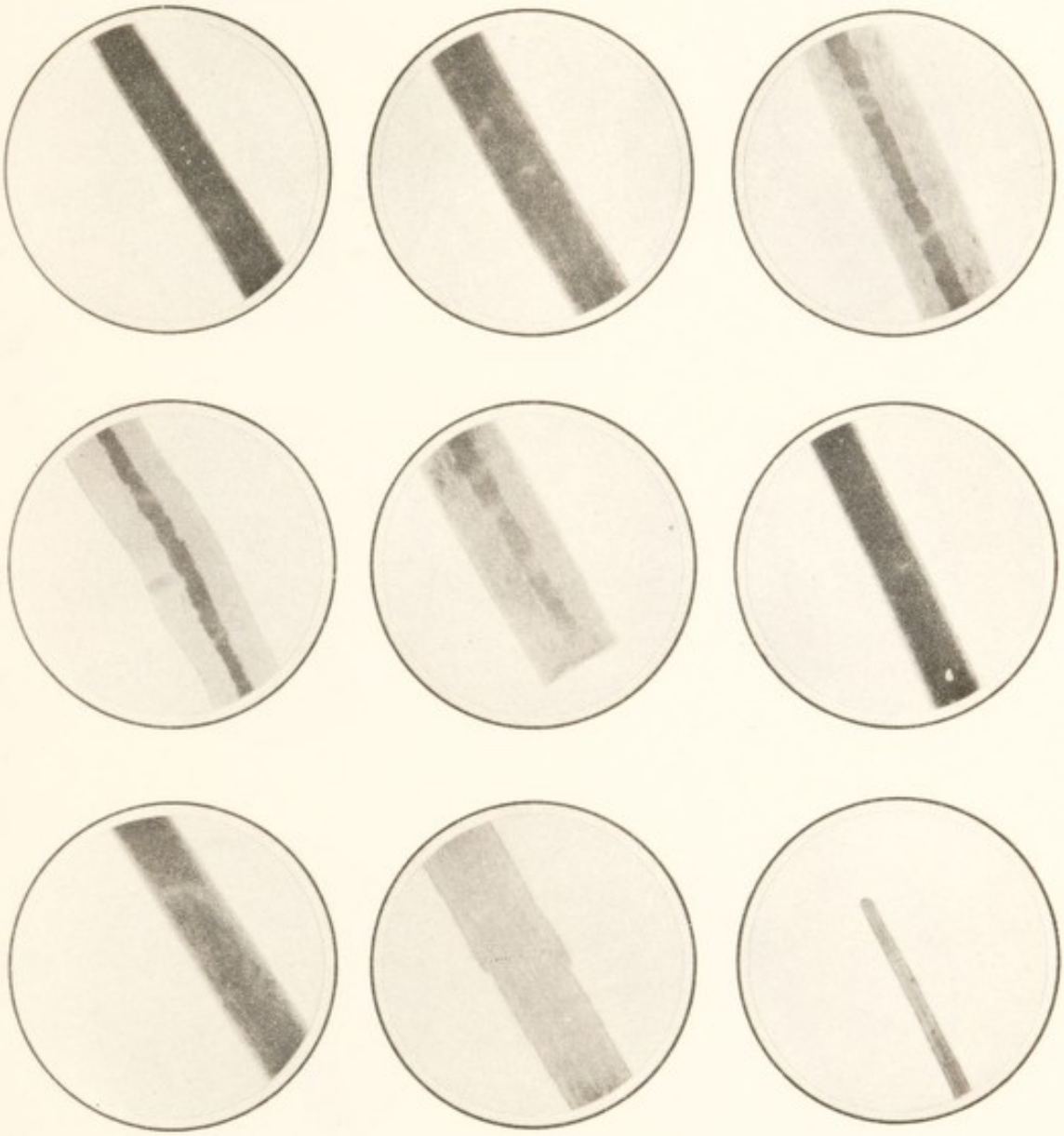
ORDER XI. PRIMATES.

SUBORDER 2. ANTHROPOIDS.

FAMILY 9. HOMINIDÆ (continued).

FEMALE. AGED 26 YEARS. (BRUNETTE).

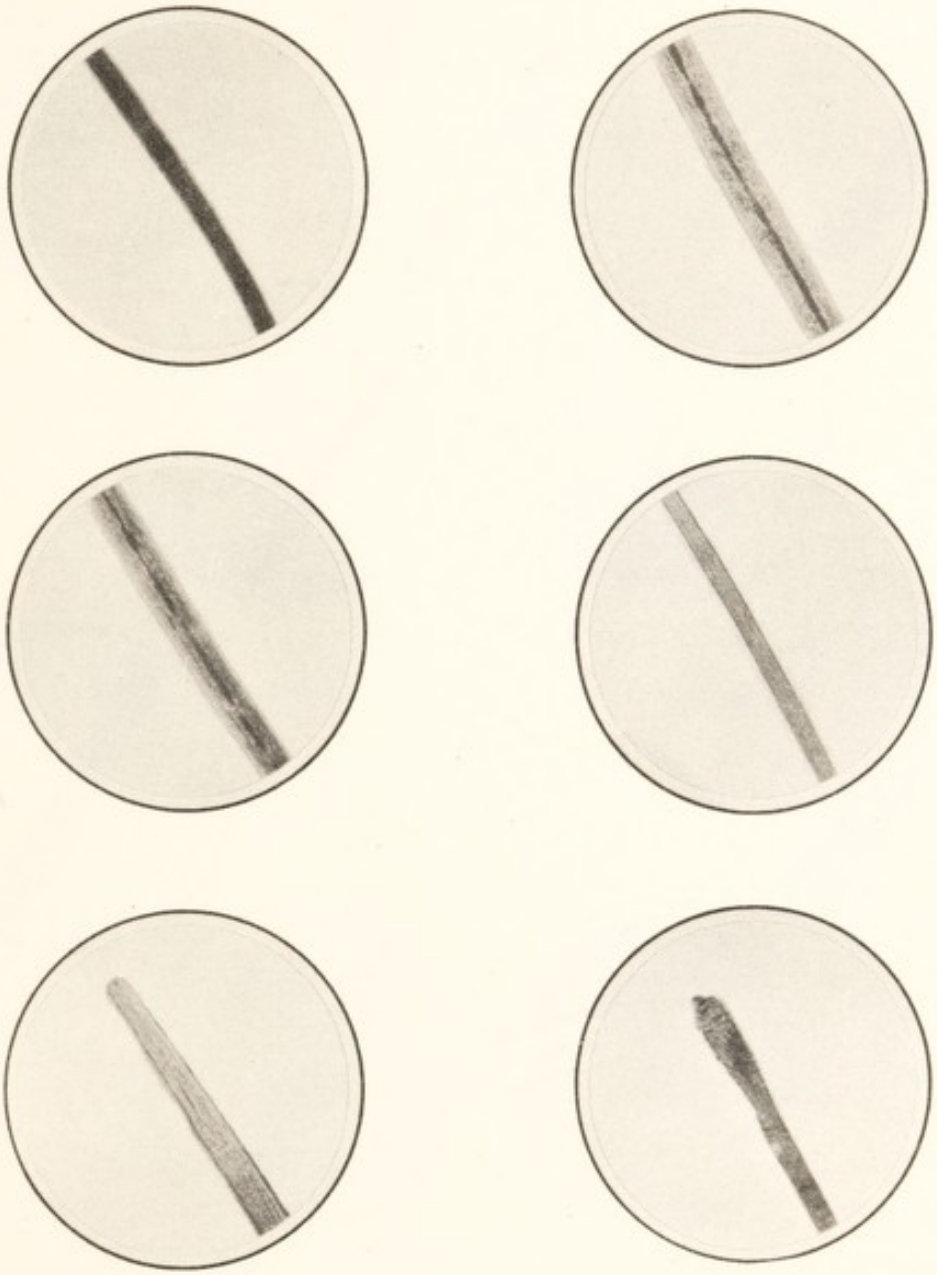
PUBIC HAIR.



Family 9. Hominidæ (continued).

FEMALE. Aged 26 Years. (Brunette).

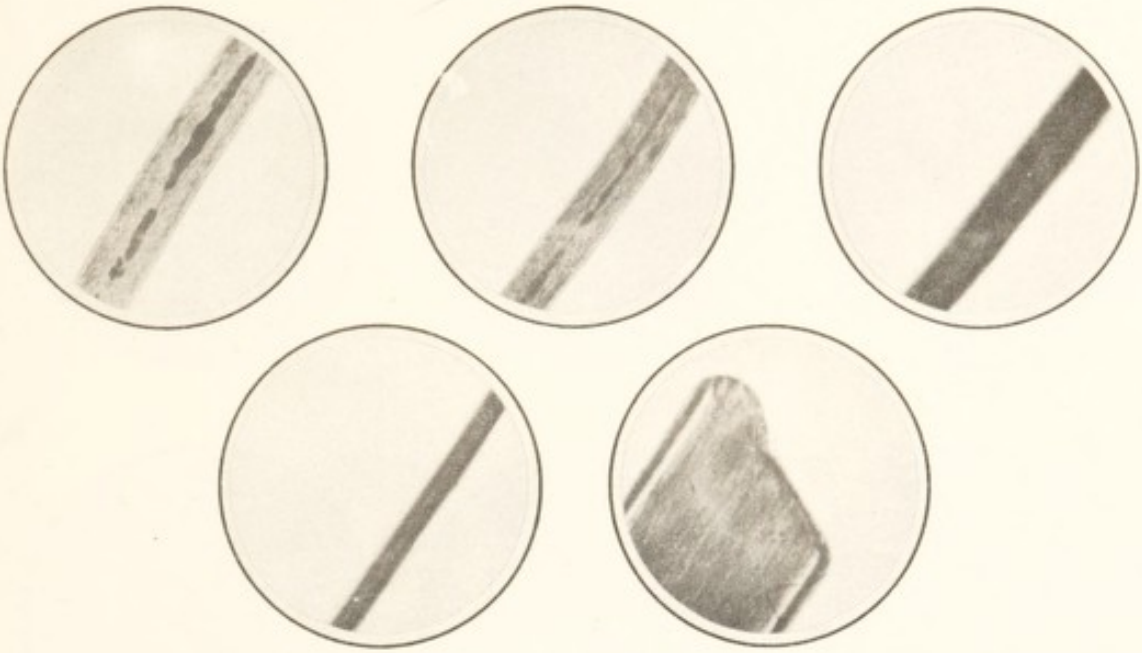
HAIR FROM ABDOMEN.



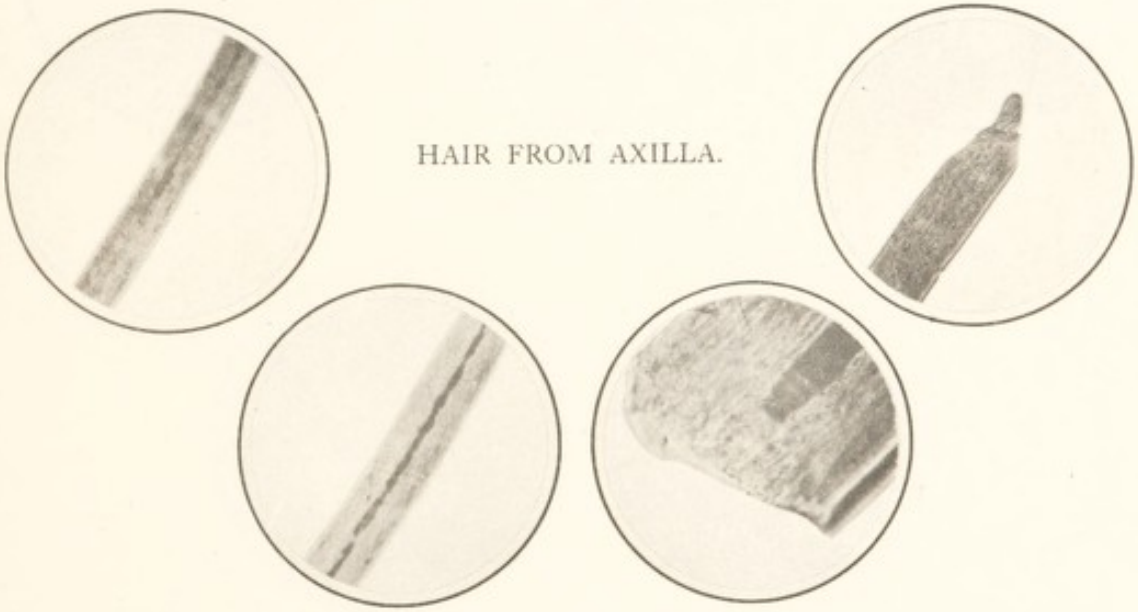
Family 9. Hominidæ (continued).

FEMALE. Aged 26 Years. (Brunette).

HAIR FROM HEAD.



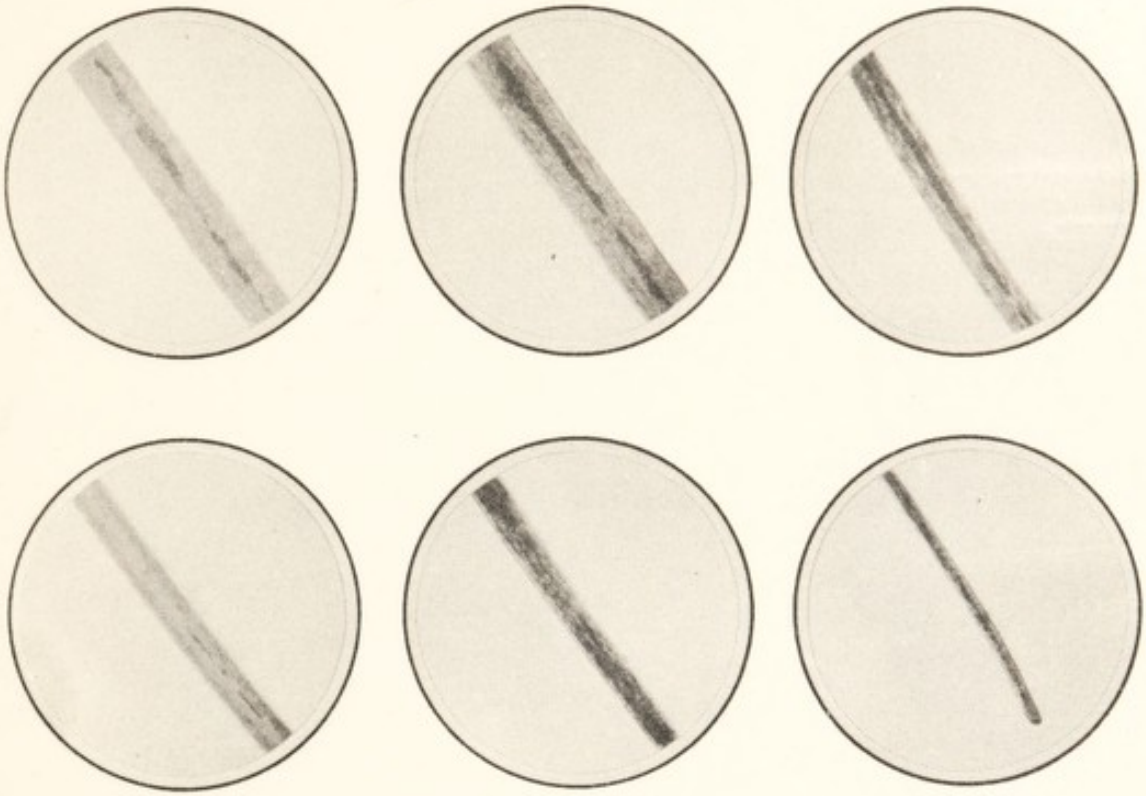
HAIR FROM AXILLA.



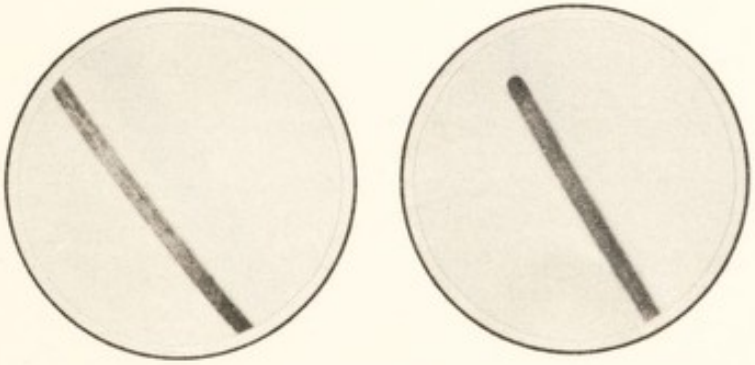
Family 9. Hominidæ (continued).

FEMALE. Aged 26 Years. (Brunette).

HAIR FROM LOWER LEG. 1-6.



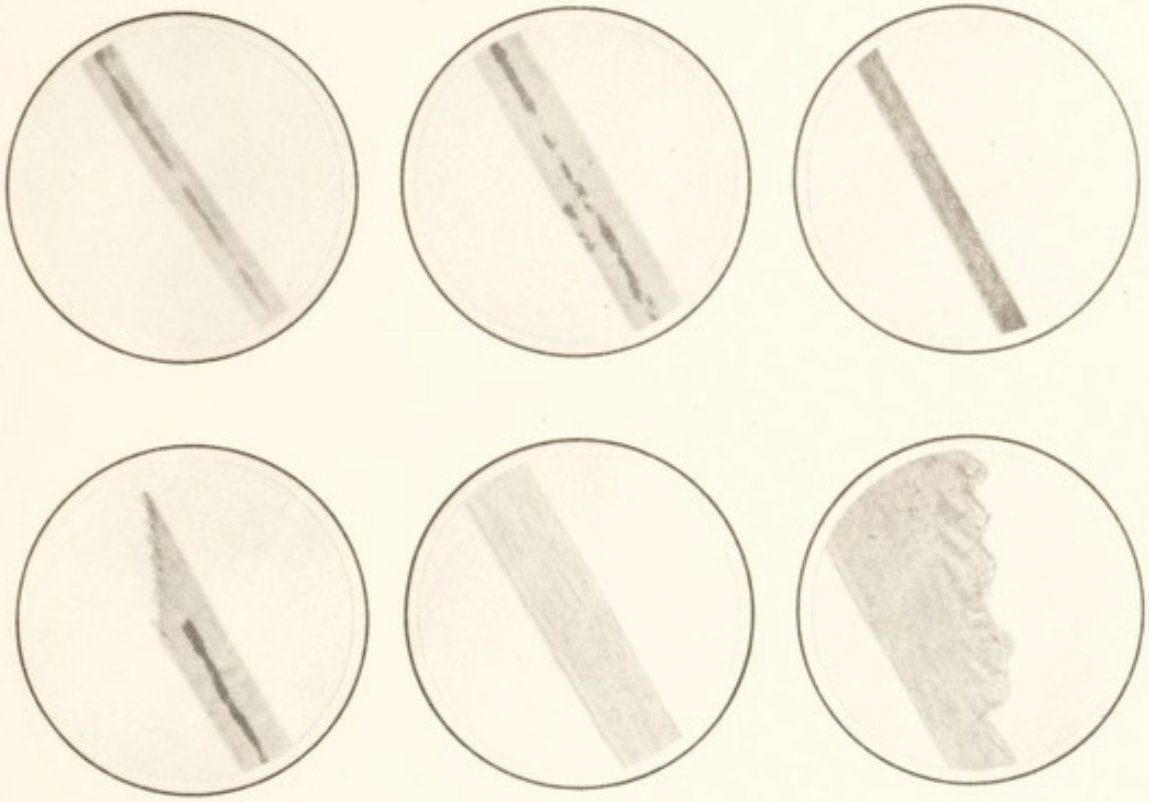
HAIR FROM FOREARM. 7-8.



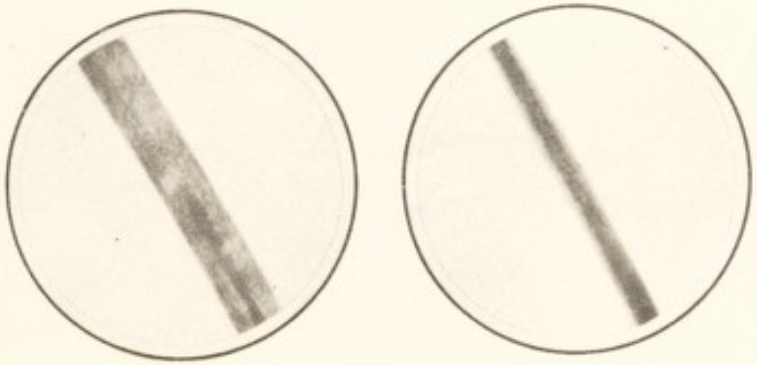
Family 9. Hominidæ (continued).

FEMALE. Aged 26 Years. (Brunette).

ANAL HAIR. 1-7.



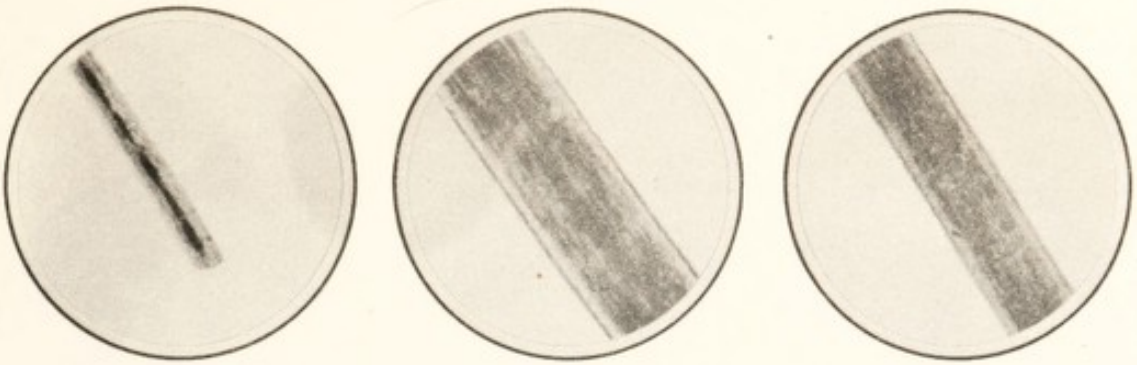
EYELASH. 8.



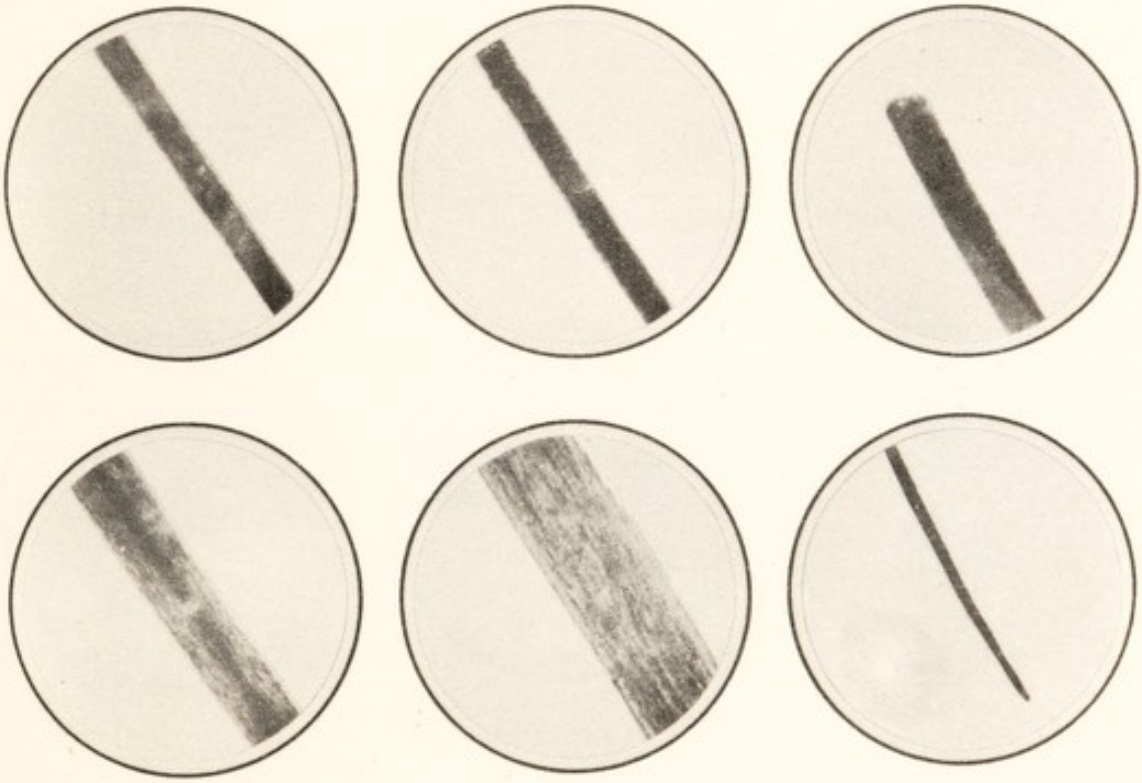
Family 9. Hominidæ (continued).

FEMALE. Aged 26 Years. (Brunette).

HAIR FROM UPPER LIP. 1-3.



HAIR FROM EYEBROW. 4-9.



Family 9. Hominidæ (continued).

TRANSVERSE SECTIONS.

BODY HAIR.

FEMALE. Aged 26 Years. (Brunette).

LEG.
L.

AXILLA.
L.

EYEBROW.
L.

PERINEUM.
L.

PUBIC.
L.

VAGINAL or LABIAL.
L.

ORDER XI. PRIMATES.

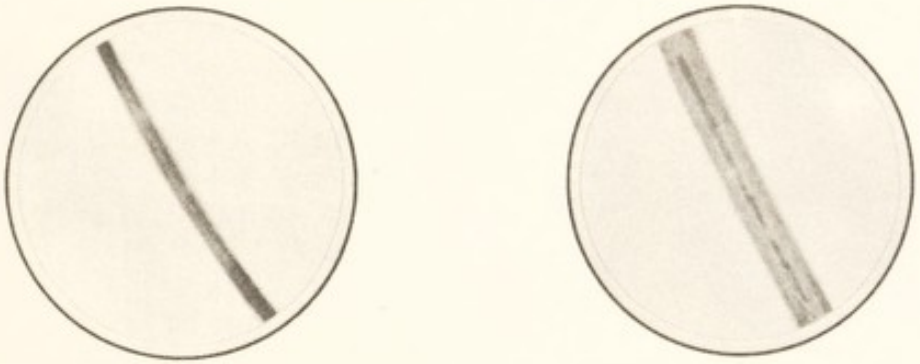
SUBORDER 2. ANTHROPOIDS.

FAMILY 9. HOMINIDÆ (continued).

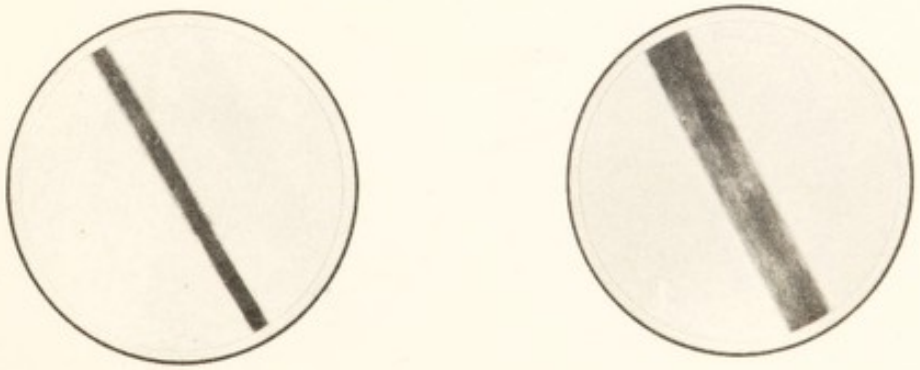
MALE. AGED 33 YEARS. (DARK BROWN).

EYEBROW. 1-3.

CIRCUM-ANAL HAIR. 4-5.



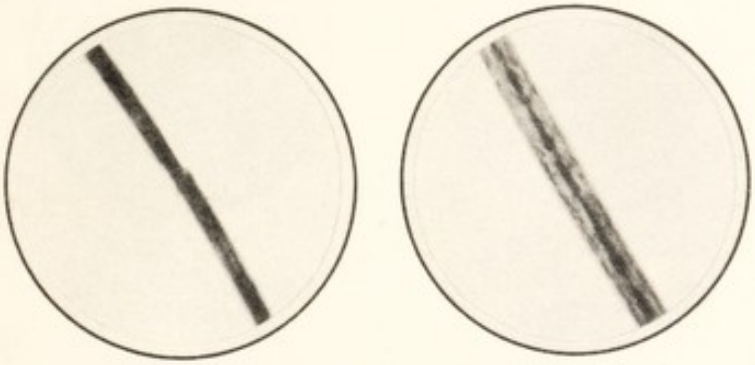
FOREARM HAIR. 6-7.



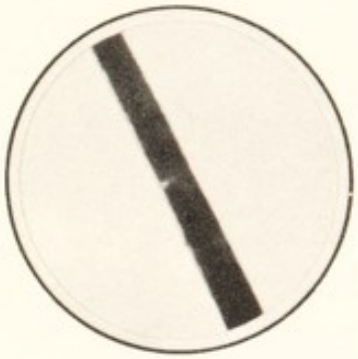
Family 9. Hominidæ (continued).

MALE. Aged 33 Years. (Dark Brown).

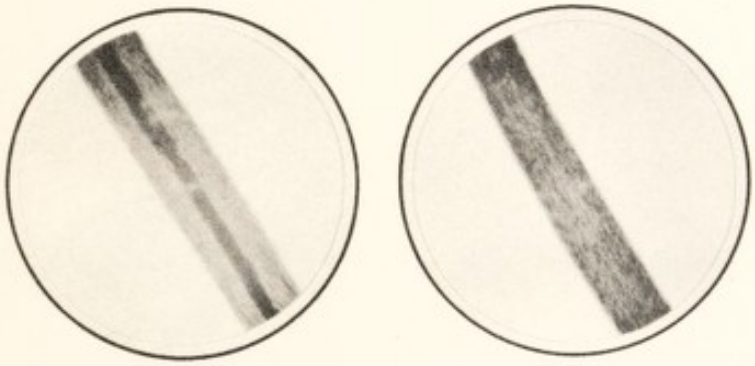
THIGH. 1-2.



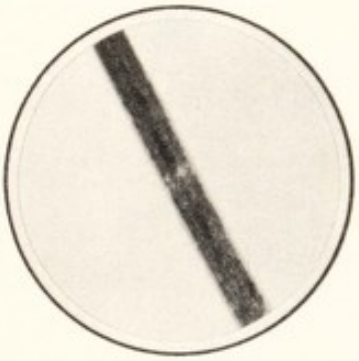
HEAD. 3.



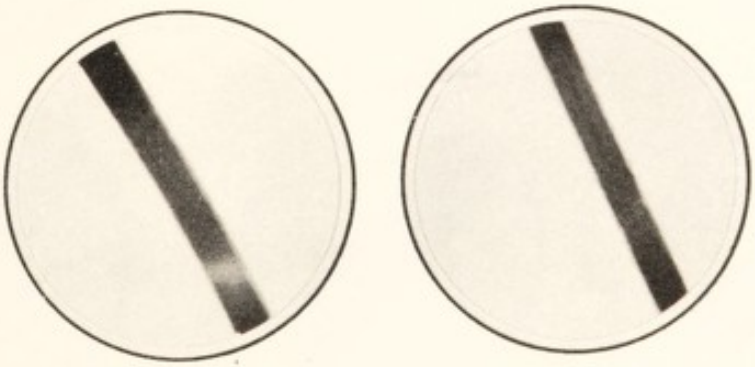
PUBIC. 4-5.



LEG. 6.



BACK OF HAND. 7-8.



Family 9. Hominidæ (continued).

HAIR FROM MALE.

EYEBROW.
Cut End.

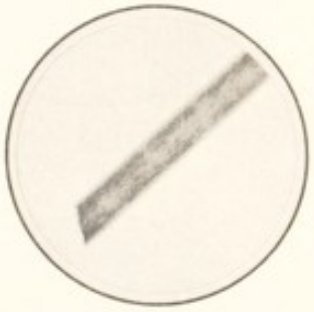
FOREARM.
Cut End.

THIGH.
Cut End.

HAIR TIP.
Back of Hand.

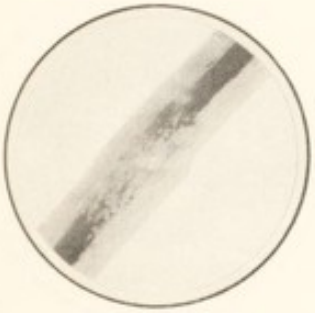
CIRCUM-ANAL.
Cut End.

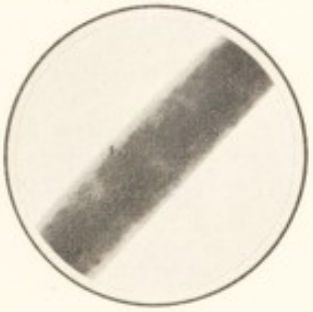
THIGH.
Cut End.



ABDOMEN.

MOUSTACHE.





ORDER XI. PRIMATES.

FAMILY 9. HOMINIDÆ (continued).

TRANSVERSE SECTIONS.

BODY HAIR.

MALE. AGED 33 YEARS. (BRUN).

CANAL OF EAR.
L.

EYEBROW.
L.

EYELASH.
L.

AXILLA.
L.

ARM.
L.

LEG.
L.

PUBIC.
L.

PERINEUM.
L.

SCROTAL.
L.

ORDER XI. PRIMATES.

Family 9. Hominidæ (continued).

TRANSVERSE SECTIONS.

BODY HAIR.

(MALE).

MOUSTACHE. Aged 45 Years.

(Brown).

L. L. L.

BEARD. Aged 75 Years.

(Grey).

ERRATA ET CORRIGENDA.

Page 9. 4th. line from foot of page, "clasess" to read "classes".
Page 10. 21st. line from top of page, "constitued" to read "constituted".
Page 18. 2nd. and 3rd. lines from top of page, "4" and "3" to read "3" and "4".
Page 30. 2nd. line from foot of page, "sight" to read "slightly".
Page 51. 8th. line from foot of page, "caracteristics" to read "characteristics".
Page 54. 16th. line from top of page, "7" to read "4".
Page 57. 9th. line from top of page, "Photographs" to read "Photograph"
10th. line from top of page, "3" to read "2".
Page 61. 5th. line from top of page, "3" to read "4".
Page 67. 15th. line from top of page, "3" to read "2".
Page 73. 10th. line from top of page, "on" should be deleted.
Page 75. 7th. line from foot of page, "proportionatelly" to read "proportionately".
Page 95. 2nd. line from top of page, insert "Plate 56".
Page 105. 4th. line from top of page, "apearances" to read "appearances".
Page 107. 13th. line from top of page, "accasionally" to read "occasionally".
Page 108. 16th. line from top of page, "occassionally" to read occasionally".
Page 109. 3rd. line from foot of page, "14" to read "15".
Page 112. 16th. line from top of page, "veniform" to read "reniform".
Page 114. 7th. line from top of page, "Photograph" to read "Photographs".
Page 120. 7th. line from foot of page, "later" to read "latter".
Page 128. 8th. line from foot of page, "encoutered" to read "encountered".
Page 131. 15th. line from top of page, "hars" to read "hairs".
Page 141. 2nd. line from top of page, "perpherally" to read "peripherally".
Page 146. 1st. line from top of page, "ran" to read "man".
Page 150. 2nd. line from top of page, "oevr" to read "over".
Page 152. 11th. line from top of page, "sheat" to read "sheath".
Page 160. 14th. line from top of page, "D" to read "O".
Page 167. 8th. line from foot of page, "appearanc" to read "appearance".