

Exoskeletal structures in birds and Mammals

Exoskeletal structures in mammals:

The exoskeletal structures are well developed in mammals. The exoskeletal structure constitutes of nails, claws, hoofs, horns and antlers, and some times hairs ^{and scales}. The exoskeletal structures are described below: →

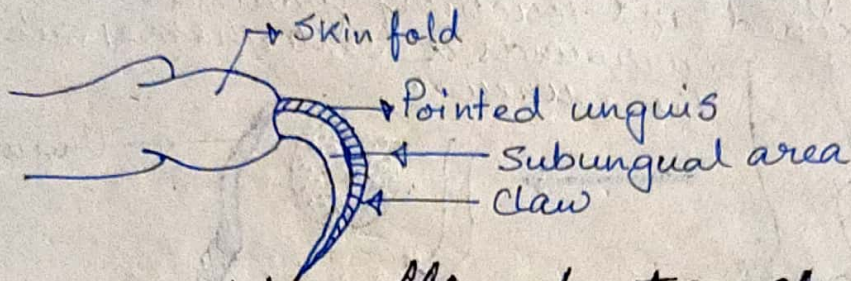
❶ Digital tips:

Digital tips of the mammals are mainly of three type. The description of these types are as follows: →

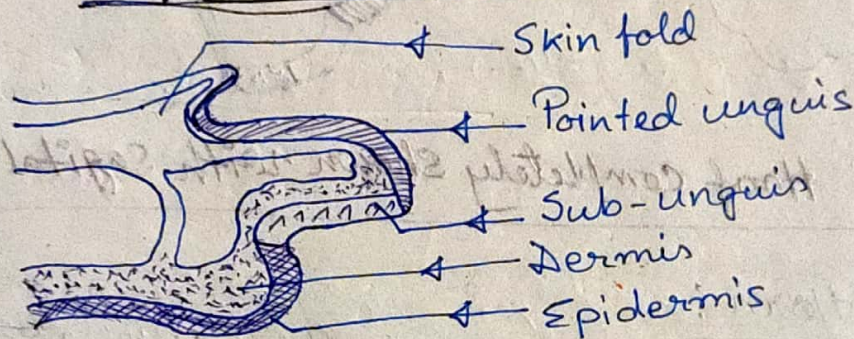
(i) Claw:

Claws of mammals are identical in structure with reptilian and avian claws. Claw is composed of a scale like plate, which takes the dorsal position. It is a hard, pointed, narrow, curved, horny dorsal plate called Unguis. Below the unguis a less-hard ventral plate called sub-unguis lies. In mammalian claws, the sub-unguis is reduced in size and is almost continuous with the pad at the ~~base~~ end of digit. In lemurs

~~Lemings~~ Lemmings the second digit on the hindlimb is provided with claw, while the other digits are ~~not~~ provided with nail.



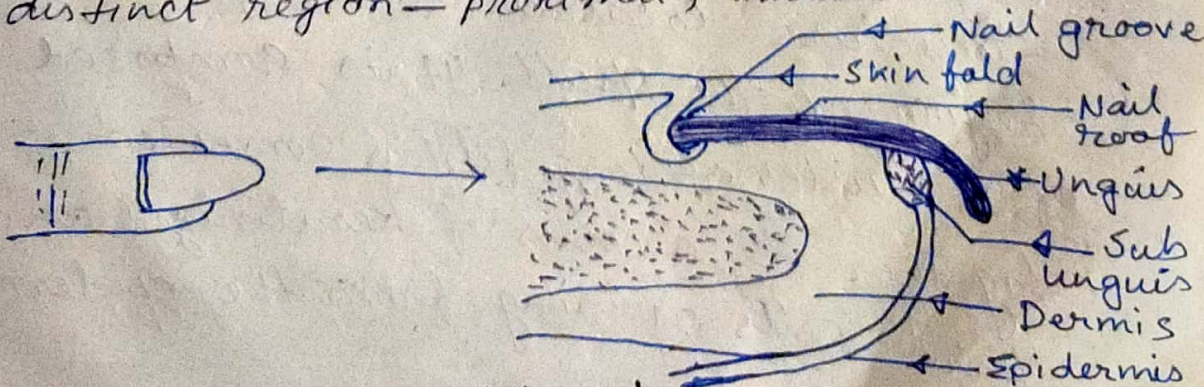
Complete outline structure of claw



Sagittal section of claw

(ii) Nail:

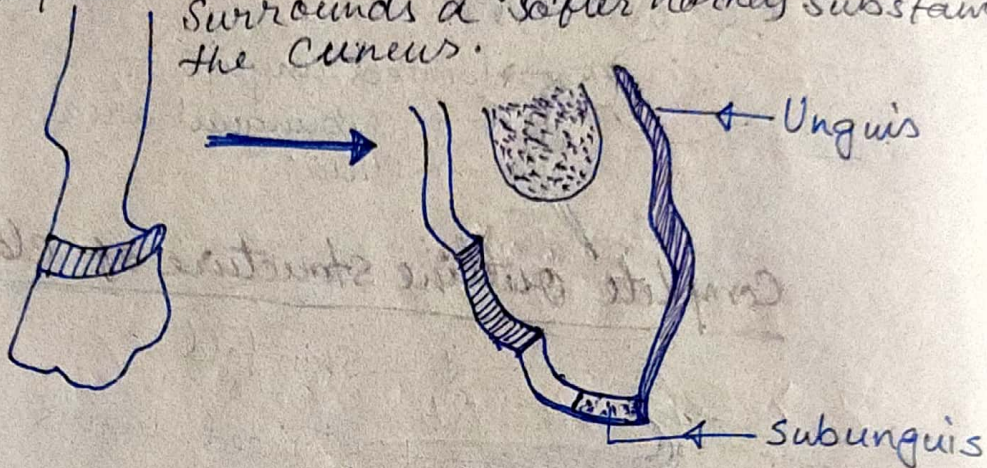
In nails unguis is better developed and broad and flat. Where as subunguis is reduced and its remnant is present under the tip of the nail. The region from which the growth of the unguis generates, it lies embedded in a pocket under the skin. This pocket is called sulcus-unguis or Nail-groove. The nail bed is made up of three distinct region—proximal, middle and distal.



Nail shown complete with sagittal section

(iii) Hoof :

Hoofs are completely characteristic of ungulates. The ~~to~~ horny unguis is neither pointed nor flat, but 'U' or 'V' shaped. Sub-unguis is also 'U' shaped ~~and~~ greatly thickened and touching ground. Subunguis surrounds a softer horny substance, the cuneus.



Hoof completely shown with Sagittal section

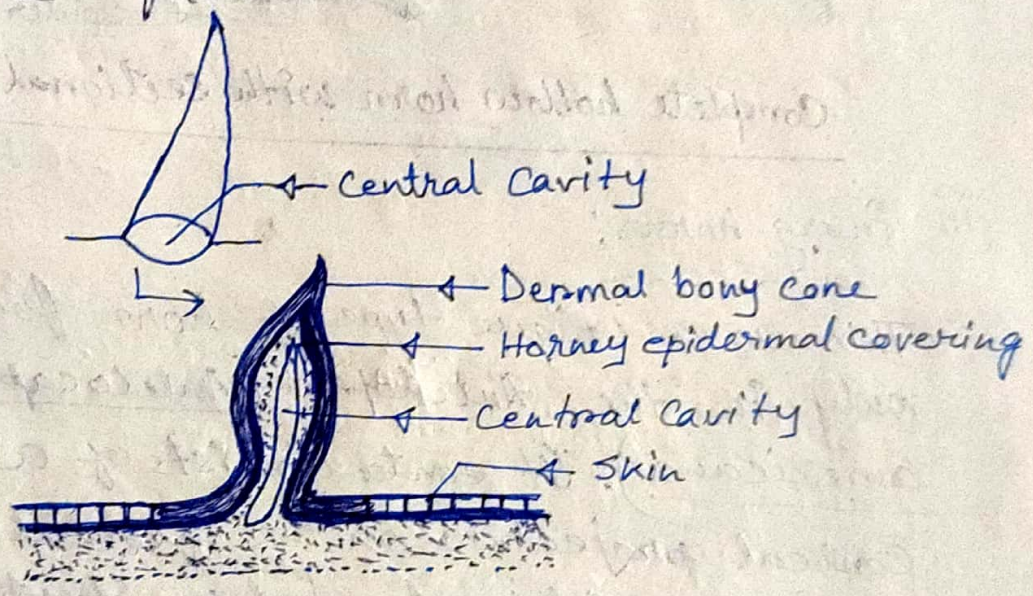
(2) Horn :

Horns are mainly of three type, but ~~a special type of horn i.e, the antlers are also found (in male deer only).~~ These structures are as follows :-

(i) Keratine fibre horns :

keratine fibre horn is found ~~in~~ only in the ~~Rhynoceros~~ Rhinoceros. It's a hard conical structure located on the fronto-nasal region of the skull. It is composed of a cluster of long fibres cemented together by a mass of keratinized and hard cells growing from the epidermis.

Each fibre resembles a very thick hair and emerges from a dermal papilla, the fibres are not true hairs since their bases are follicles. In Indian Rhinoceros there are one horn but in African Rhinoceros there are two horns. The two horns are located in the same median line along the fronto-nasal bone and larger one lies in the front.

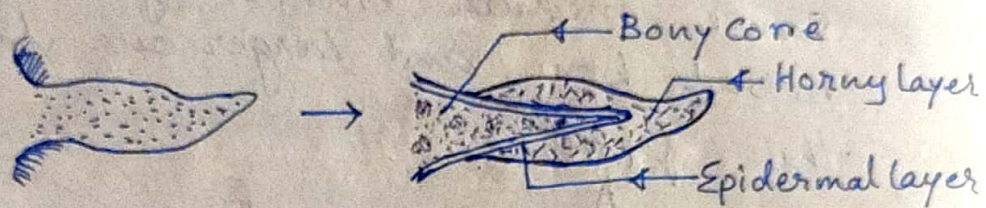


Keratin fibre horns

(ii) Hollow horns:

Cattle, sheep etc possess hollow horns. The horns consist of a bony projection from the frontal bone of the skull. The projection is covered over by a cornified layer of epidermis. A cavity extends into the bony projection in very young animals, the first

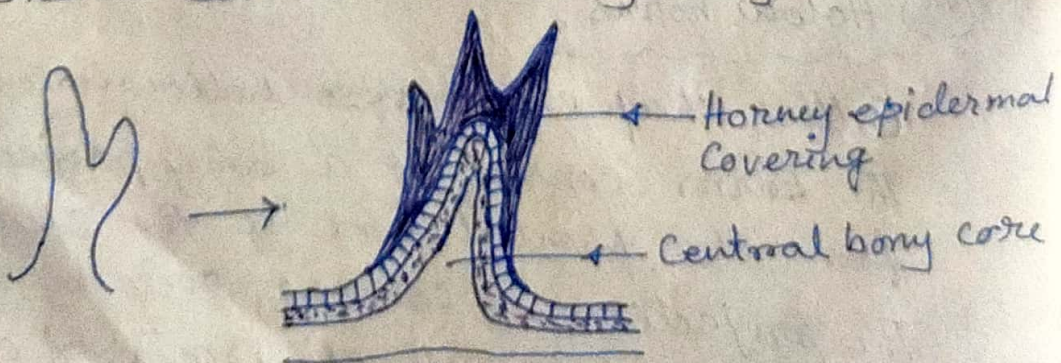
Q. indication of the future development of horn is ~~sa~~ seen with the formation of Os cornu. It is a loose button like mass of bone cells. If Os cornu. is destroyed by applying chemicals the ~~be~~ horn fails to develop.



Complete hollow horn with sectional view

(iii) Prong horns:

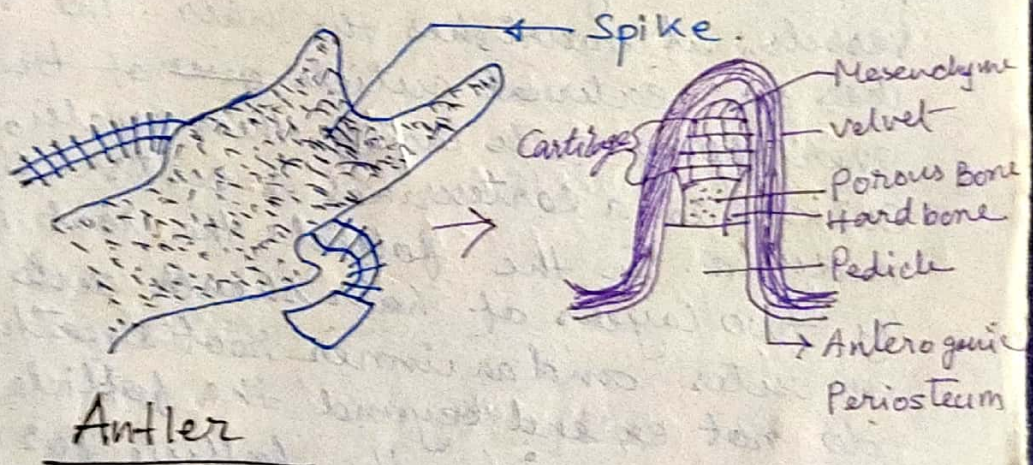
This is a unique type of horn found only in the Antelope* (Antilocapra americana). It ~~consists~~ consists of a conical projection on the frontal bone. A horny epidermal ~~shed~~ sheath is shed with annual periodicity, and a new epidermal sheath covers the bony projection.



Prong horn with sectional view

(15) Antlers:

Antlers are present only in the male members of the deer family. In rein-deer and caribou both the sexes bear antlers. When fully developed the antler is a solid bony structure and as such entirely mesodermal in origin. Though it is better to consider the antlers as parts of the dermal skeleton it is discussed under the integumentary derivatives simply because the antler is formed under the influence of the integument.



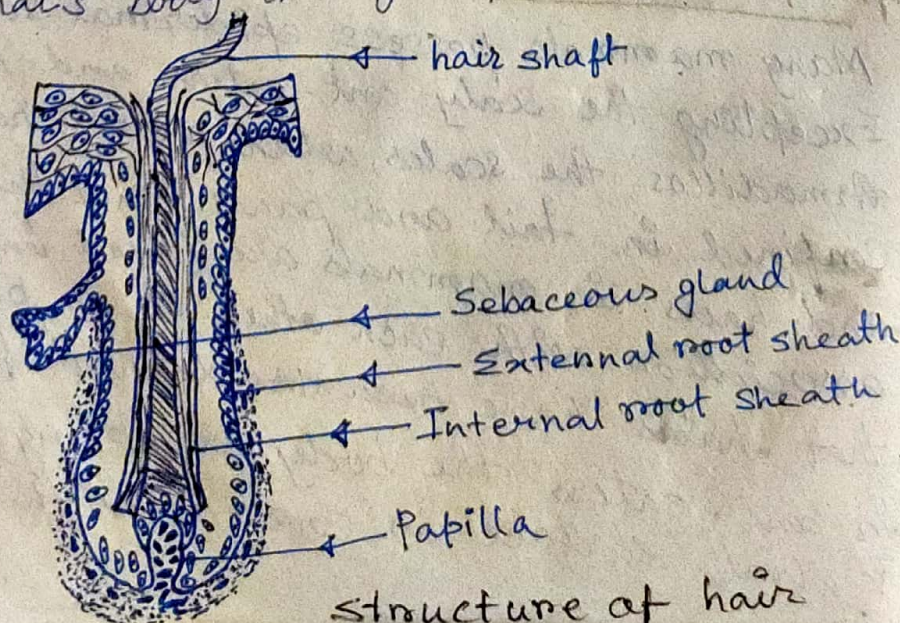
(16) Epidermal Scales:

Many mammals possess epidermal scales. Excepting the scaly ant-eaters and the Armadillos the scales, when present remain confined in tail and paws. Since the scales and hairs in mammals are found in close association with each other. It is believed that hairs have been derived from scales. In ant-eaters the body excepting on the ventral surface is covered with large,

Overlapping and horny scales. The scales are typically reptilian in nature, but ecdysis occurs singly.

5) Hairs :

Hairs are new outgrowths of the epidermis only. A hair has an upper projecting shaft and a lower root lying in a hair follicle which is a sunken pit in the dermis. The shaft is made only of dead keratinized cells. At the base of the follicle the root expands into a bulb. Below the bulb is a dermal papilla having connective tissues and blood vessels, it nourishes the hair. The hair shaft has an external cuticle over of transparent overlapping cells lacking their nuclei, inside the cuticle is a cortex and a central core or medulla. In the follicle the root is surrounded by two layers of hair sheath cells forming an outer and an inner root sheaths, they do not extend beyond the follicle. A sebaceous gland opens into the follicle for oiling the hair. The hair covers most of the mammalian animal's body and give protection.



Exoskeletal structure in birds:

The exoskeleton of birds is derived from epidermis and occurs in the form of claws, beaks, scales and feathers.

These structures are described as follows: →

<1> Claws:

Claws are present in the hindlimbs of the birds and in some birds (e.g. → Chauna) some digits of the modified forelimbs are also provided with claws. Claws are hard, horny, pointed, curved, & sharp-ended structure which mainly helps in perching and some times it helps in prey predation also.

<2> Scales:

In most of the birds scales are confined to the shanks and feet. The scales are cornified derivatives of the stratum germinativum of epidermis which form a protective covering of body parts and are shed and replaced by moulting. The scales of birds resemble with reptilian scales in every respect, which indicate towards the origin of birds from reptiles.

<3> Beak:

The beak is essentially a structure to obtain food, to preen feathers, to collect nest materials to build the nests and also to act as the organ of defence.

Because of the functional diversities, the beak have undergone extensive range of modification in different birds. The modification of beak are essentially adaptive in nature and the form of beak indicates the food habits.

Beak is formed by an elongated upper jaw and comparatively smaller lower jaw. Both jaws of beak lack teeth and externally remain ensheathed by a horny sheath of *Rhamphotheca*. The terminal mouth of a bird is thus guarded by both jaws of beak and has very wide gap.

4) Feathers:

Feathers are found only in birds and are modified reptilian scales. Feathers light, strong, elastic, waterproof and show many colours due to pigments and structural arrangement. They form a protective covering, regulate body temperature, and support the body in flight.

There are three kinds of feathers in birds, they are —

- (i) Contour feathers or penna.
- (ii) Down feathers and
- (iii) Filoplumes.

(i) Contour feathers:

Contour feathers or penna occur all over the body, they are of two types —

a) flight feathers or quills are large in size, those of on the wings are remiges and those on the tail are rectrices.

b) Coverts are smaller in size and cover the body.

The structure of a contour feather of flight is described below: →

Structure of a quill:

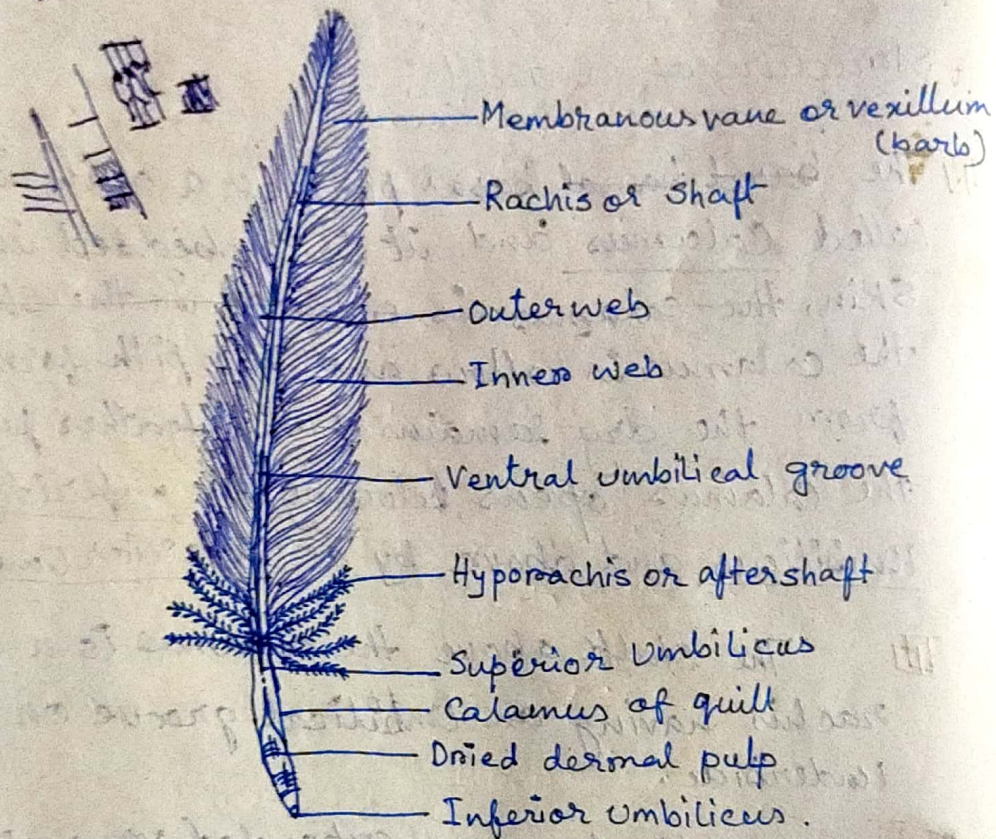
☐ The ~~basal~~ basal part of a quill is called calamus and it is embedded in the skin, ~~the calamus is embedded in the skin,~~ the calamus is hollow and has pith formed from the dry remains of the feather pulp, the calamus opens below by an inferior Umbilicus and above by a superior Umbilicus.

☐ The stalk above the calamus is a solid rachis having an Umbilical groove on its underside.

☐ The rachis bears an expanded vane or vexillum made of many parallel barbs on both sides of the rachis. Each barb is a thin flat plate bearing distal barbules on one side which have many curved hamuli or hooks, on the other side ~~which have many~~ each barb has proximal barbules which have grooved edges. Hamuli of distal barbules hook over the grooved edges of proximal barbules binding the barbs together, so that entire vane acts as one flat piece offering resistance to

air.

Between the Calamus and rachis is an after-shaft, or hyporachis, it is a downy tuft of barbs and barbules, in some birds it is very long. ~~Coverts are smaller than flight feathers and their hamuli are~~



A typical feather (quill) in ventral view

Coverts are smaller than flight feathers and their hamuli are poorly developed, they cover the body, wings, legs and tails.

(ii) Down feather or plumule:

Down feather has a very small quill having barbs with barbules arising from the tip, they have no hamuli. In an

adult the down feathers form powder down feathers from which powdery fragments are dropped ~~from~~ for cleaning the plumage. They are concealed in contour feathers forming a dense layer in which no air movement occurs, so that they do not permit loss of body heat and prevent freezing in cold. ~~upper~~ In a young one the down feathers cover the body and are called nestling down. They have a horny sheath covering the quill and basal portion of barbs, they appear on the tips of developing feathers and are soon worn off after temporary service on the young ones.

⁰⁰⁰ (iii) Filoplumes:

Filoplumes are delicate hair-like feathers with a long slender stalk having a few terminal barbs with no hamuli; they lie among contour feathers.