

# Introduction to Feathers

Feathers are unique to Birds. They are a defining characteristic of the group, meaning simply that if an animal has feathers, then it is a bird. Feathers serve many functions in birds but most notable is the critical role feathers play in enabling birds to fly. Unlike feathers, flight is not a characteristic restricted to birds - bats fly with great agility and insects fluttered through the air several million years before birds joined them. But feathers have enabled birds to refine flight to an art form matched by no other organism alive today.

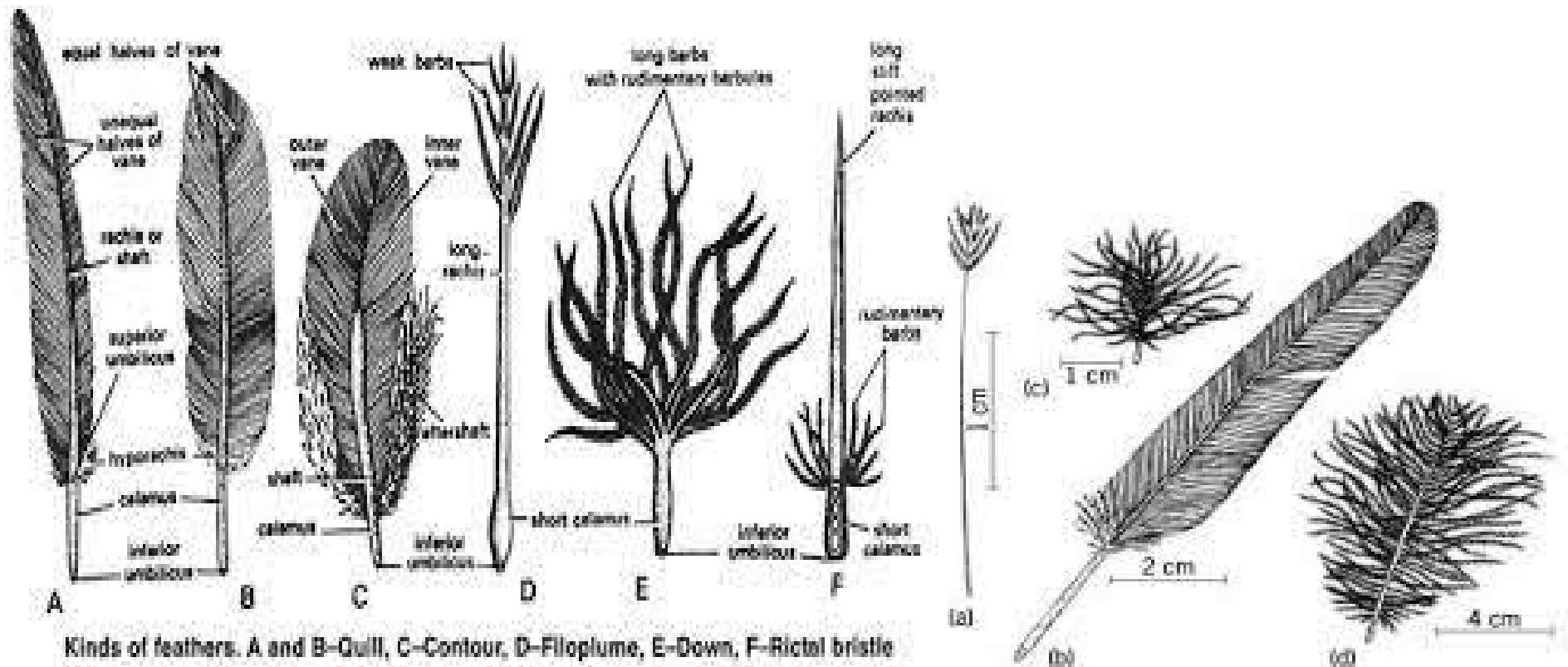
In addition to helping to enable flight, feathers also provide protection from the elements. Feathers provide birds with waterproofing and insulation and even block harmful UV rays from reaching birds' skin.

# Feathers: marvelous creation of Evolution



Feathers are among the most complex integumentary appendages found in vertebrates and are formed in tiny follicles in the epidermis, or outer skin layer, that produce keratin proteins. Here the protein is of  $\beta$ -keratin type as found in feathers, beaks and claws.  $\beta$ -keratin is very much stronger in structure than  $\alpha$ -keratins of mammalian hair, horns and hoof.

# Feather types & its growth



## Feather growth

Like hair, feathers develop in a specialized area in the skin called a **follicle**. As a new feather develops, it has an artery and vein that extends up through the shaft and nourishes the feather. A feather at this stage is called a **blood feather**. Due to the color of the blood supply, the shaft of a blood feather will appear dark, whereas the shaft of an older, mature feather will be white. A blood feather has a larger quill (calamus) than a mature feather. A blood feather starts out with a waxy keratin sheath that protects it while it grows. When the feather is mature, the blood supply will

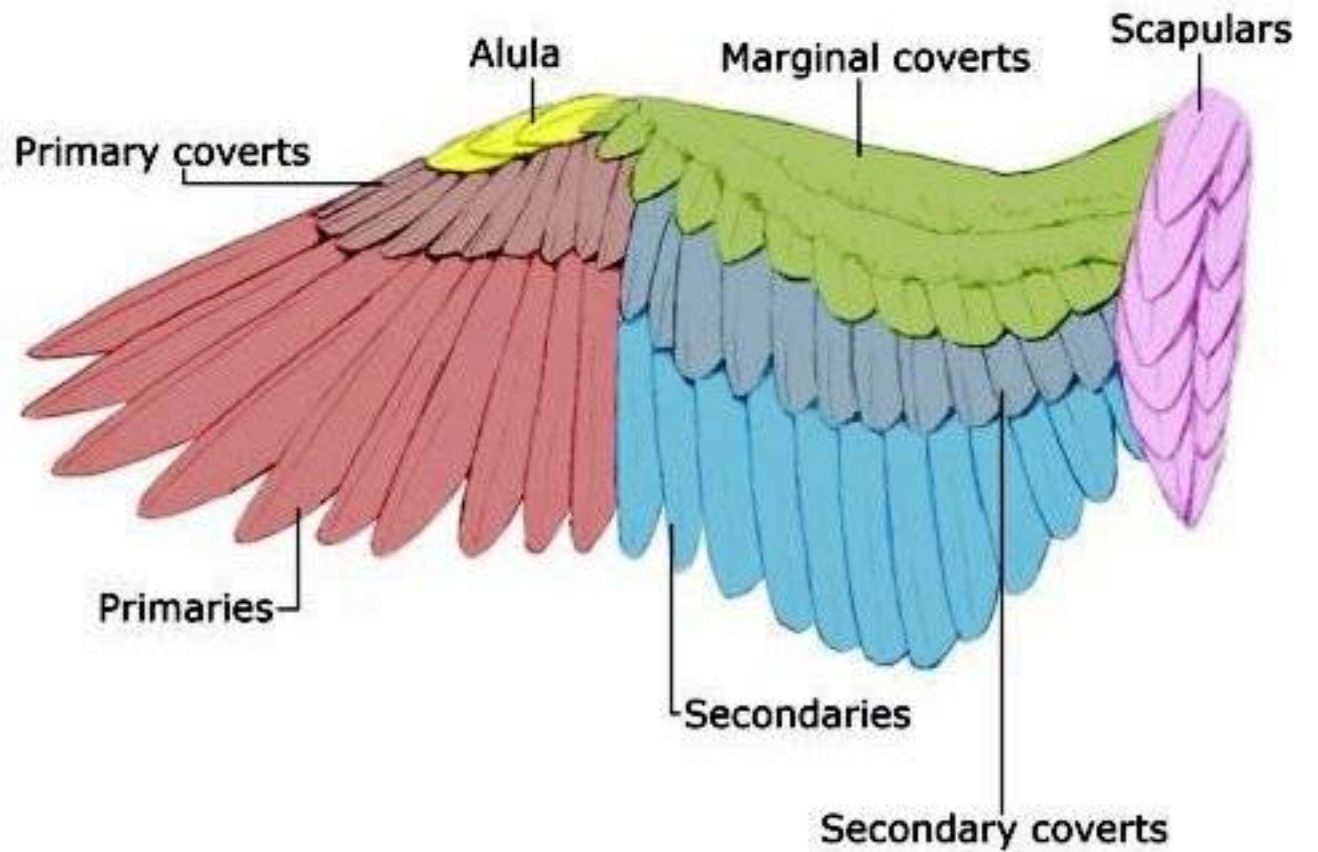
# STRUCTURE

Feathers are made up of Keratin, an insoluble protein that is also found in mammalian hair and reptilian scales. In general, feathers consist of the following structures:

- **Calamus (quill)** - the hollow shaft of the feather that attaches it to the bird's skin
- **rachis** - the central shaft of the feather to which the vanes are attached
- **vane** - the flattened part of the feather that is attached on either side of the rachis (each feather has two vanes)
- **barbs** - the numerous branches off the rachis that form the vanes
- **barbules** - tiny extensions from barbs that are held together by barbicels
- **barbicels** - tiny hooks that interlock to hold the barbules together



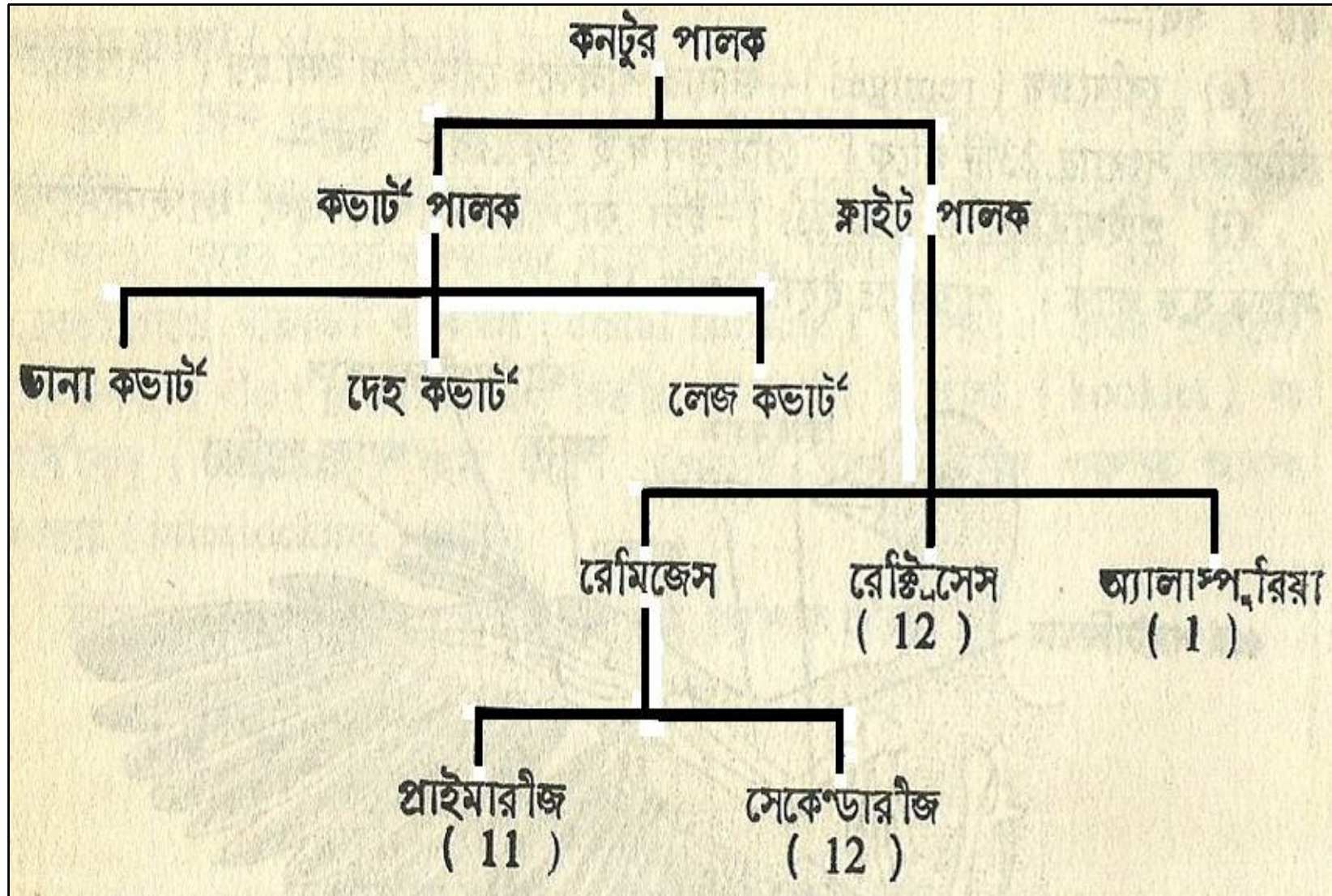
**Wing feathers:  
Remiges**



**Tail feathers:  
Rectrices**

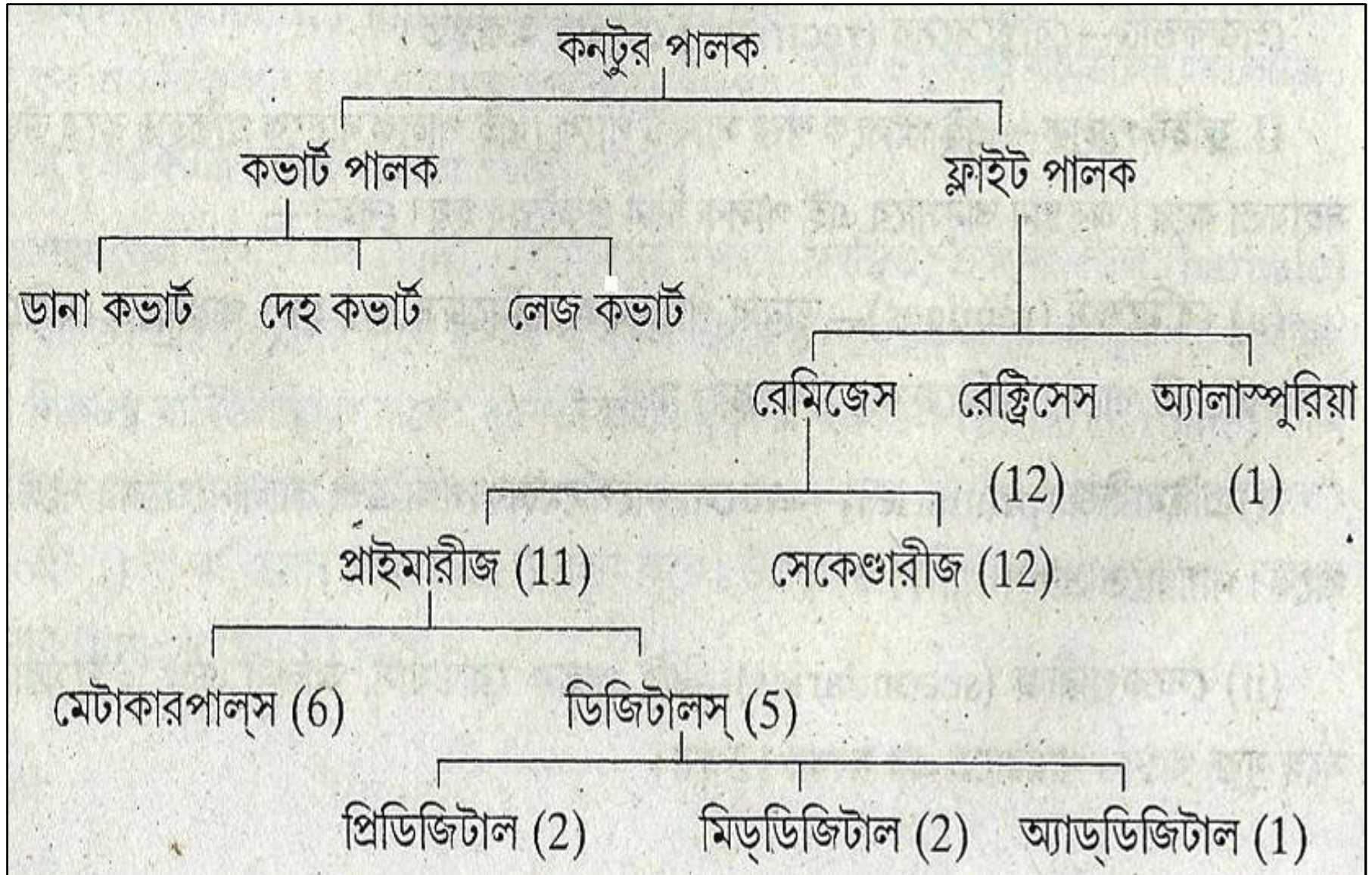


# Classification of feathers





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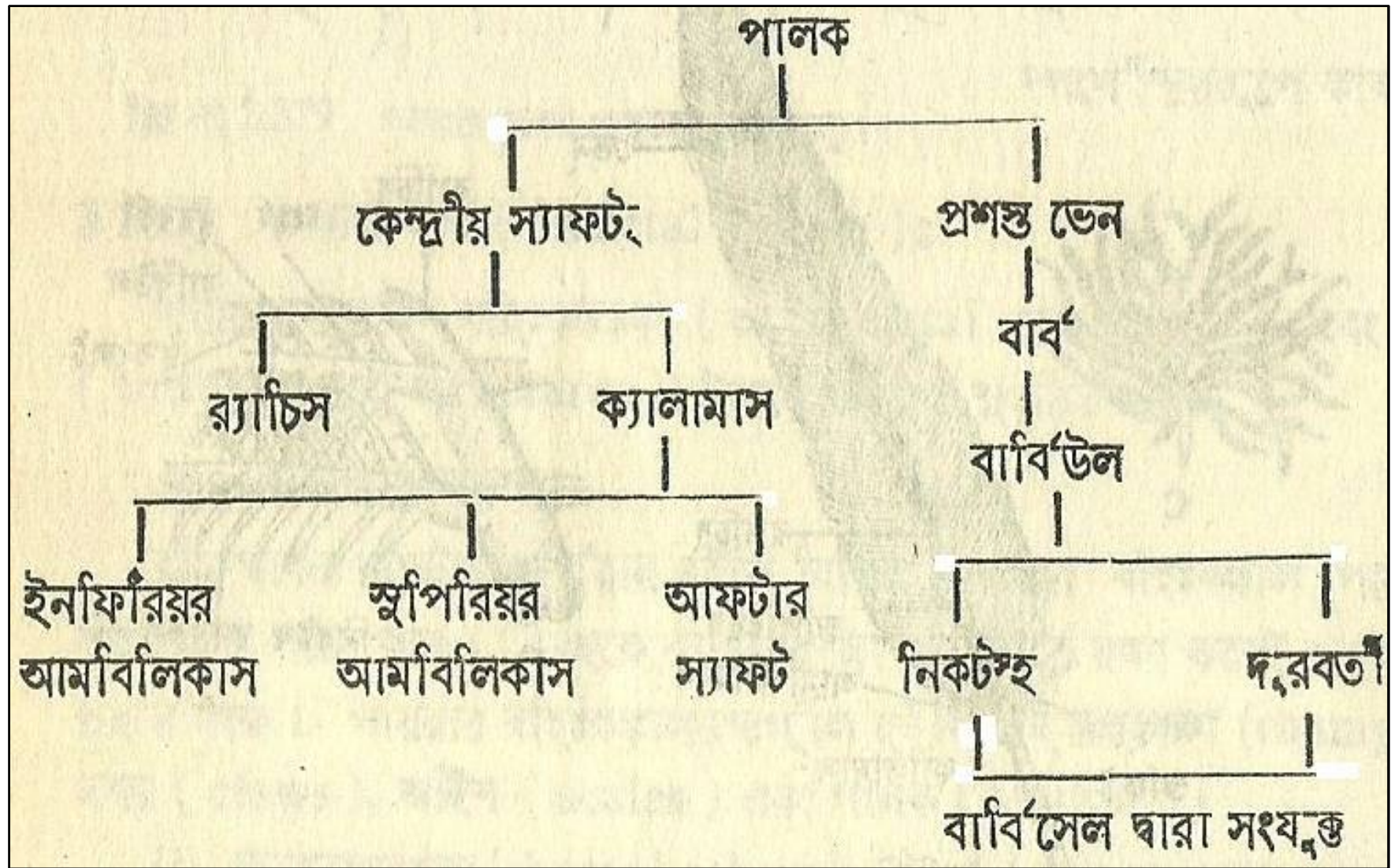
# TYPES

Birds have several different types of feathers and each type is specialized to serve a different function. In general, feather types include:

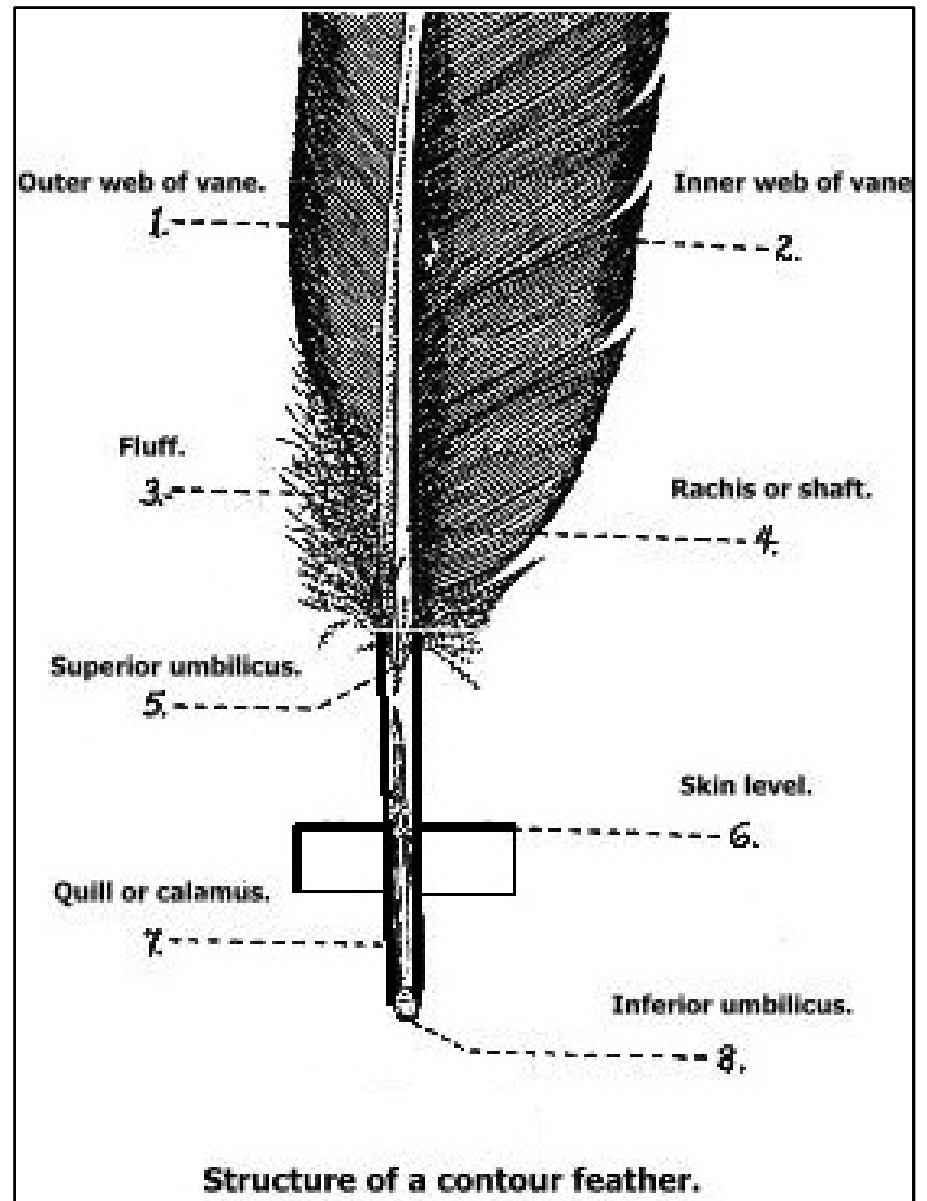
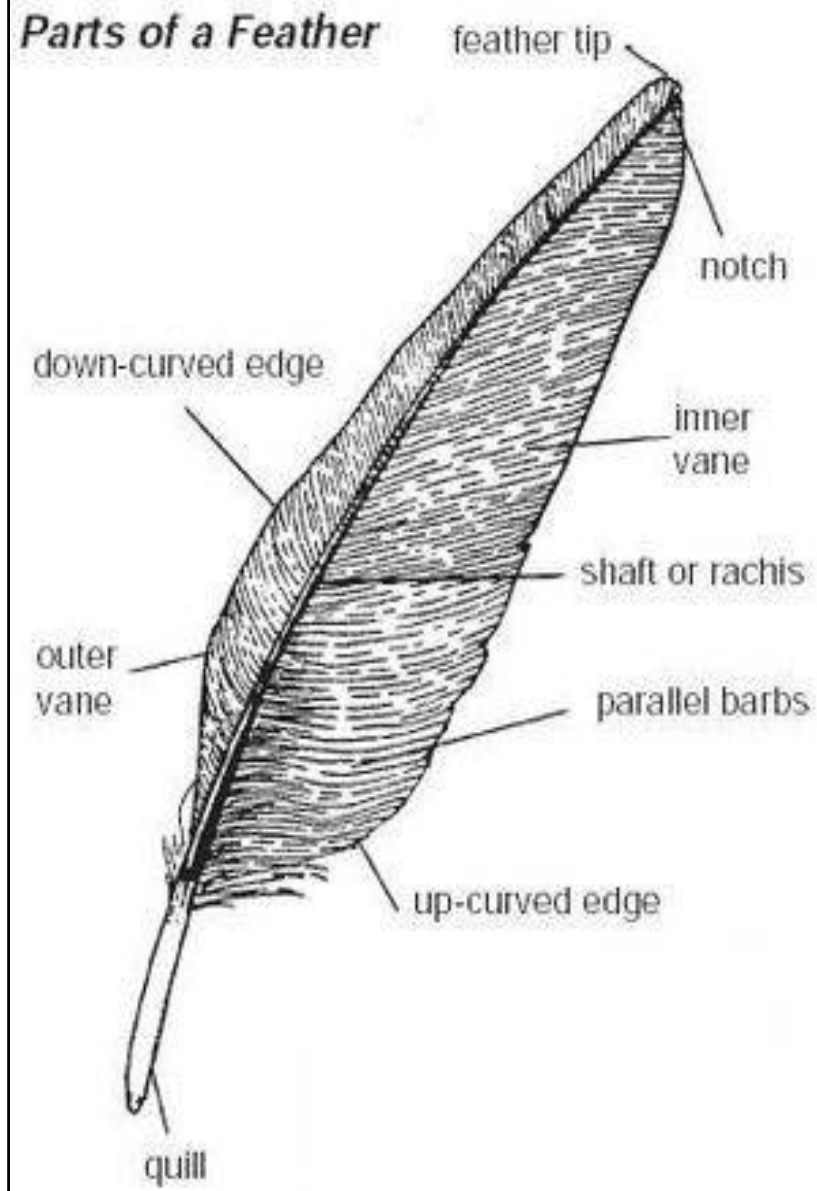
- **primary** - long feathers located at the tip of the wing
- **secondary** - shorter feathers located along the trailing edge of the inner wing
- **tail** - feathers attached to the bird's pygostyle
- **contour (body)** - feathers that line the bird's body and provide streamlining, insulation, and waterproofing
- **down** - fluffy feathers located under the contour feathers that serve as insulation
- **semiplume** - feathers located under the contour feathers that serve as insulation (slightly larger than down feathers)
- **bristle** - long, stiff feathers around the bird's mouth or eyes (the function of bristle feathers is not known)



# Anatomy OF a model FEATHER



# Different parts of a feather

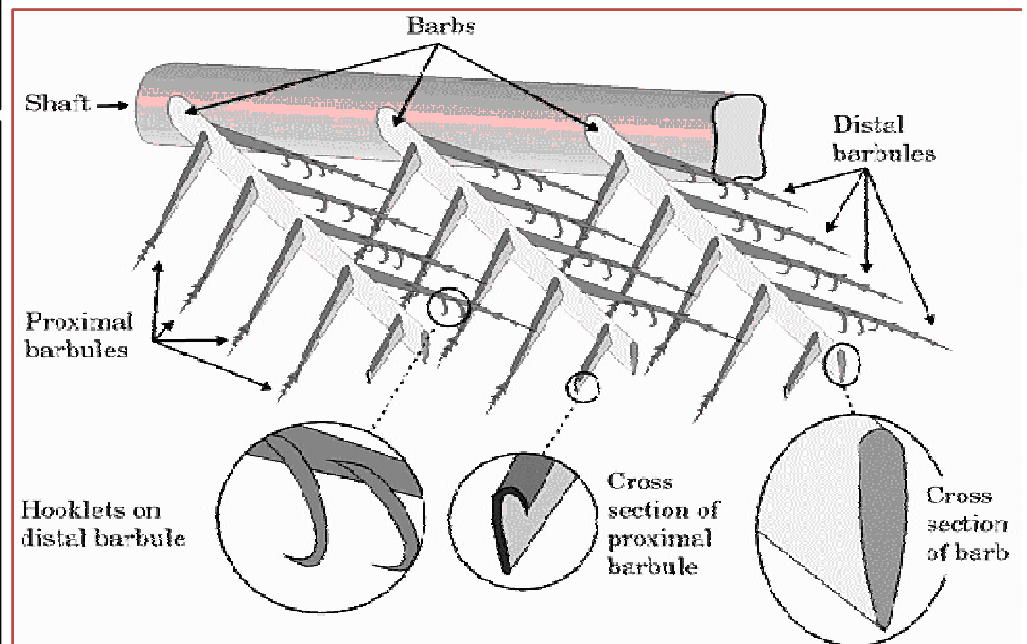
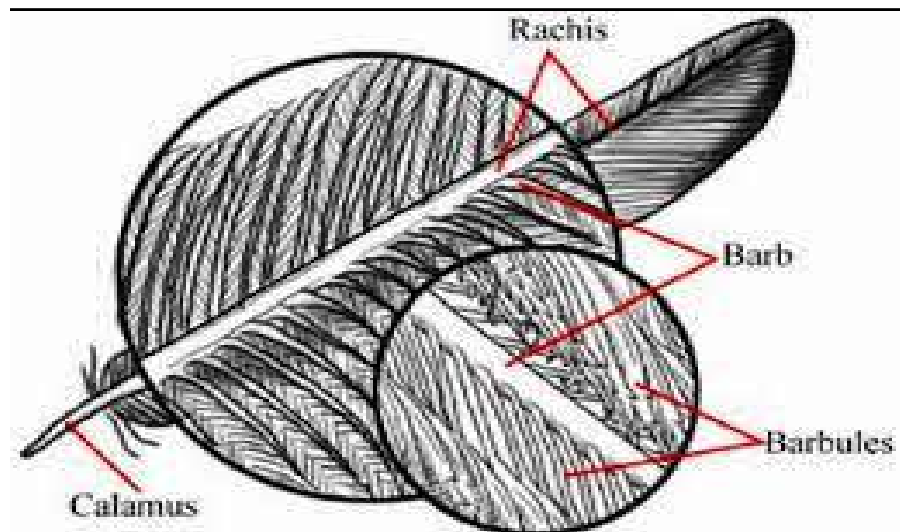
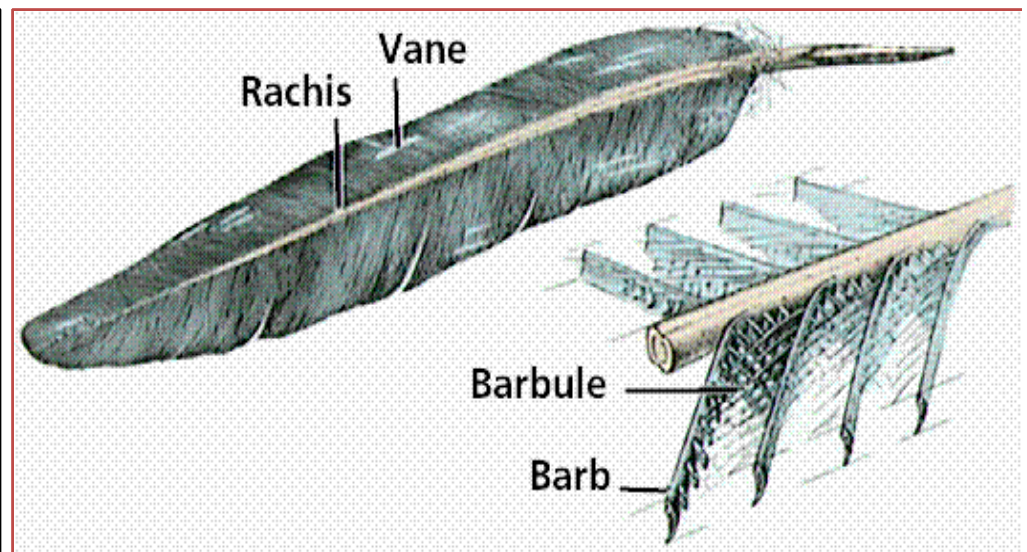
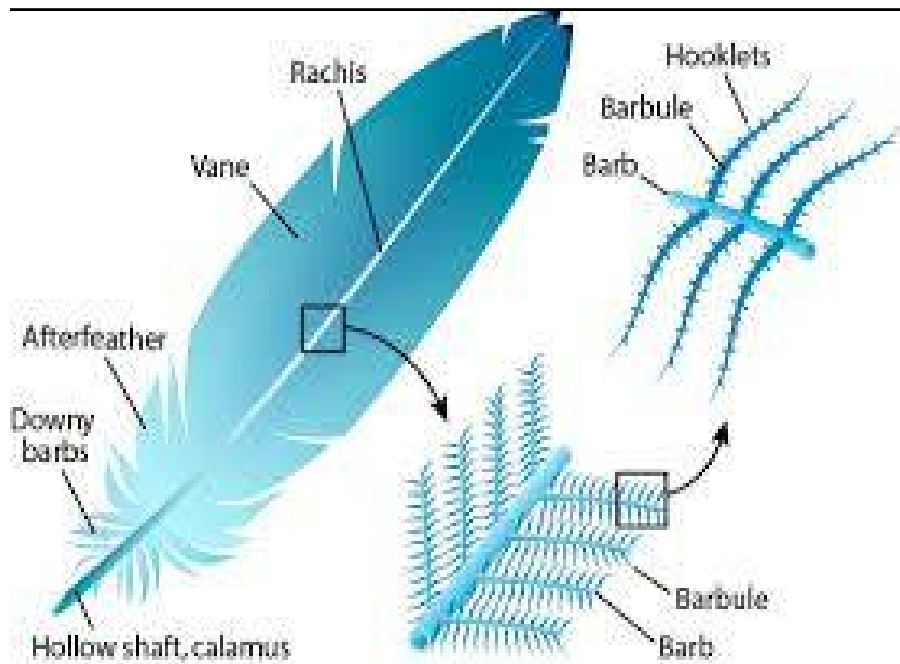


The **remiges** or flight feathers of the wing, and **rectrices**, the flight feathers of the tail are the most important feathers for flight. A typical feather features a main shaft, called the rachis contains on either side the vanes. Fused to the rachis are a series of branches, or **barbs**; the barbs themselves are also branched and form the **barbules**. These barbules have minute hooks called **barbicels** for cross-attachment.

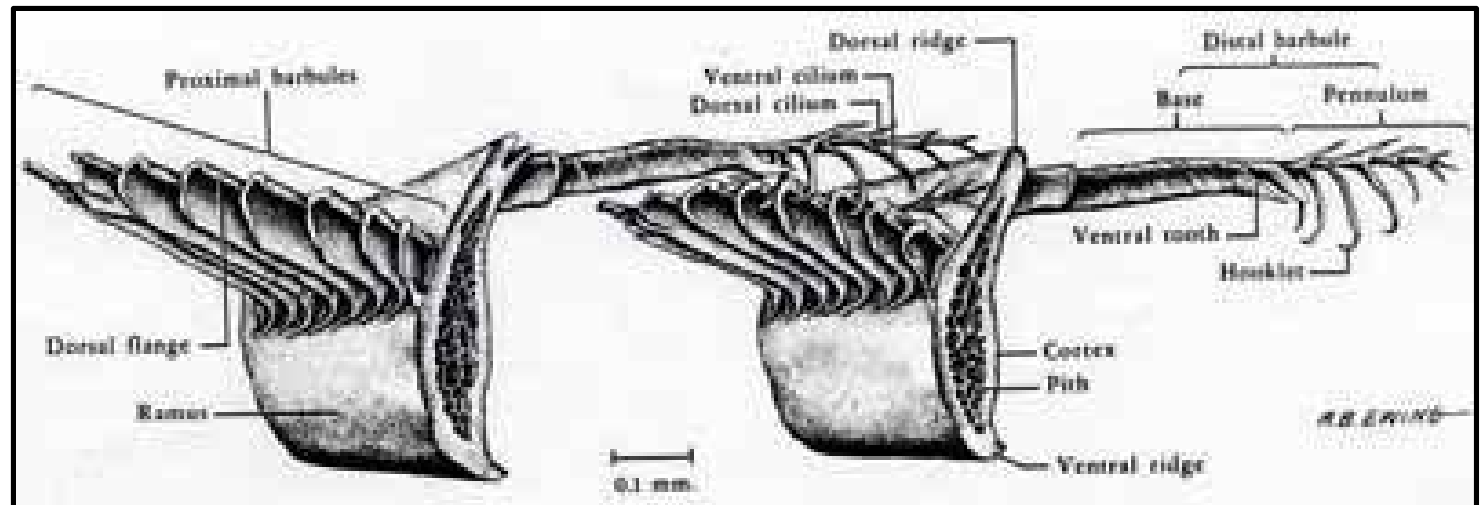
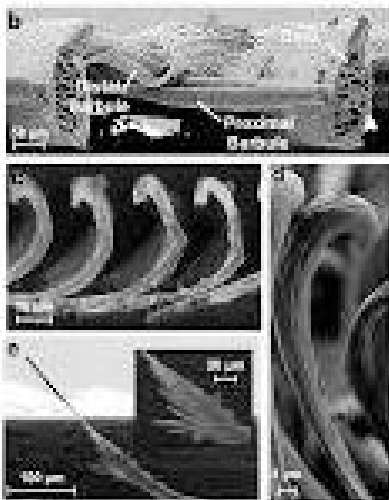
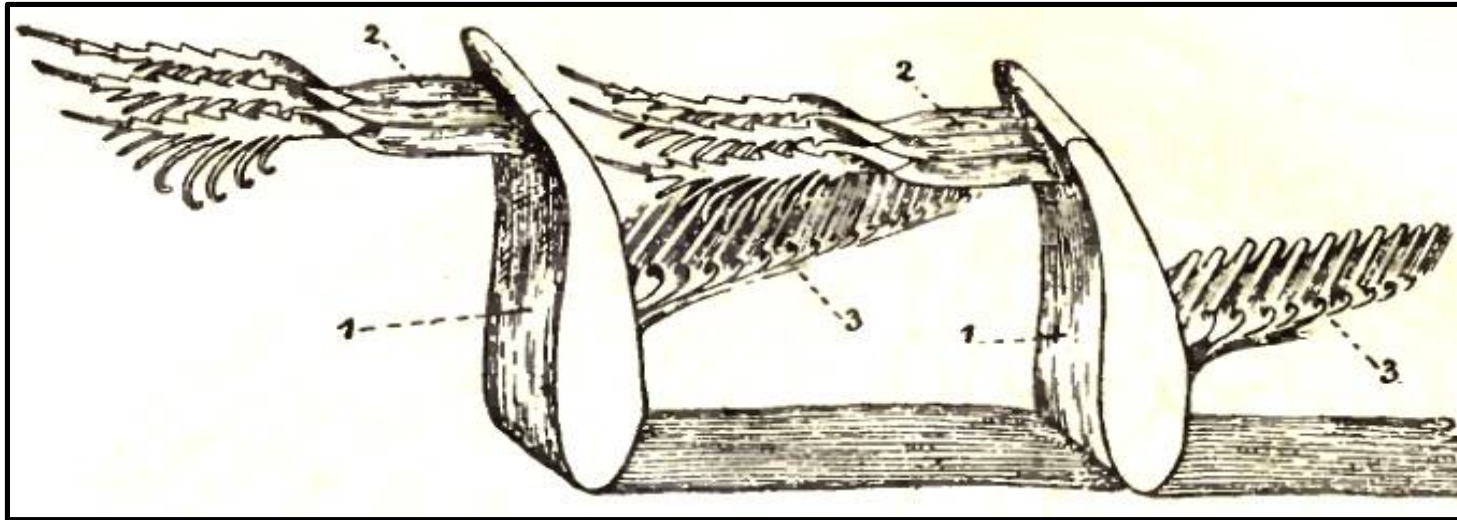
Down feathers are fluffy because they lack barbicels, so the barbules float free of each other, allowing the down to trap air and provide excellent thermal insulation. At the base of the feather, the rachis expands to form the hollow tubular **calamus** (or quill) which inserts into a follicle in the skin. The basal part of the calamus is without vanes. This part is embedded within the skin follicle and has an opening at the base (*proximal umbilicus*) and a small opening on the side (*distal umbilicus*).

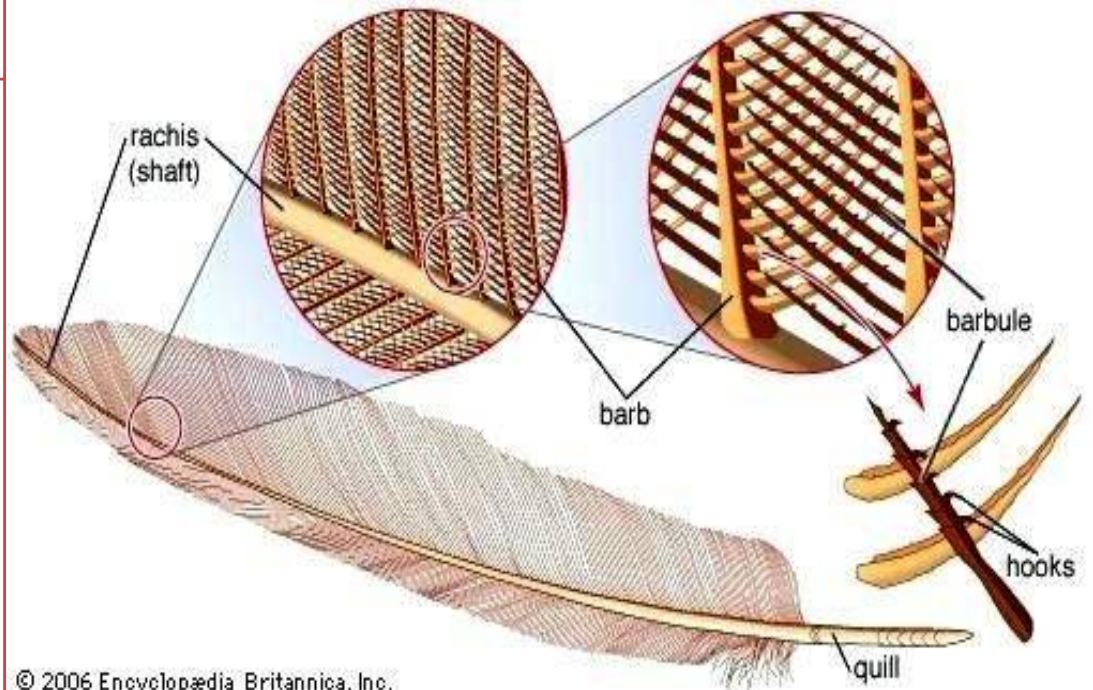
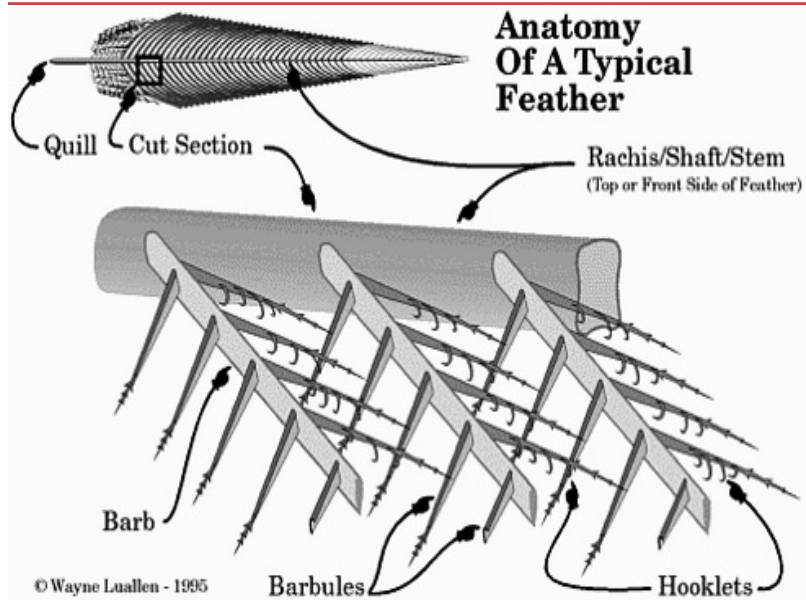
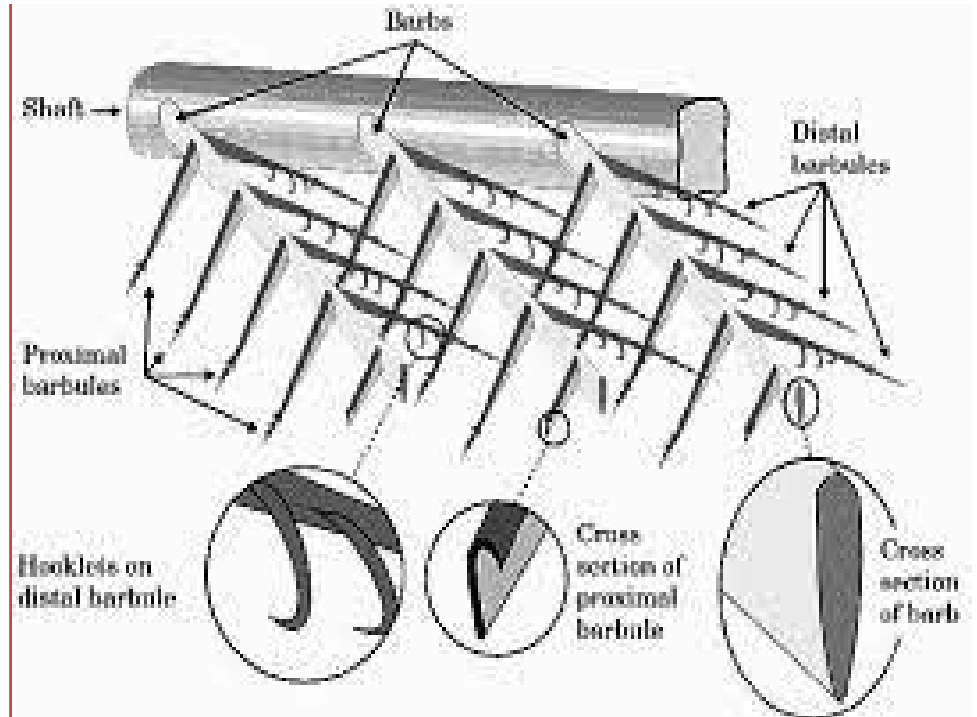
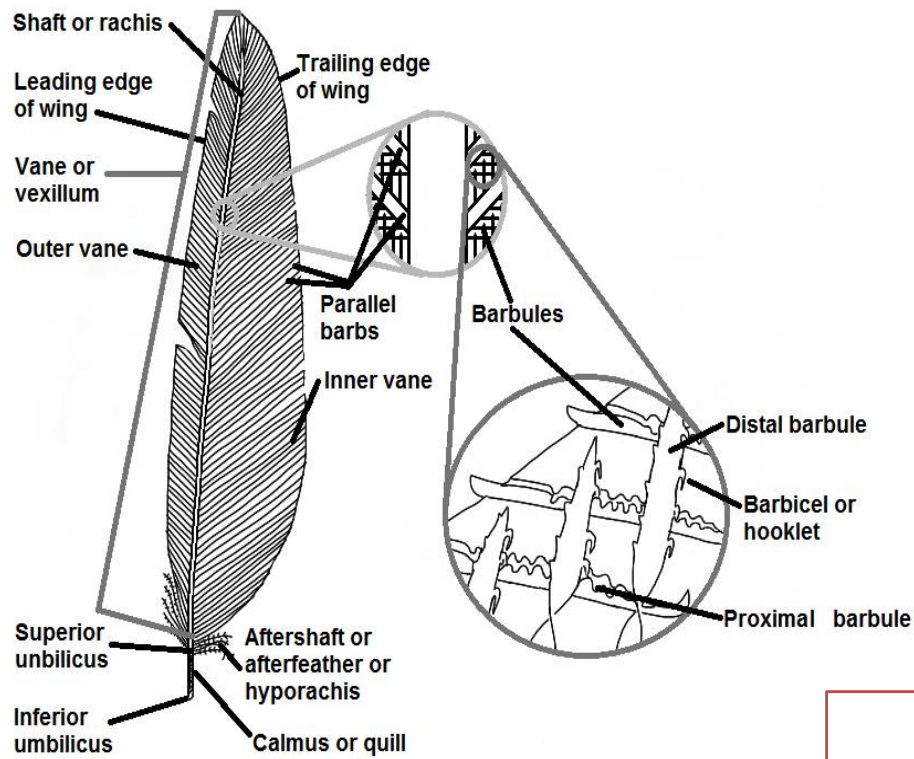


# Details of a model feather



# Microanatomy







# Varieties ON FEATHERS



# EVOLUTION OF FEATHERS

The first sign of feather [evolution](#) goes back as far as 325 million years in dinosaur fossils. These primitive feathers, however, are not believed to be associated with flight as they are simple in structure and must have been beneficial for another purpose, such as protection or warmth. Fossil records of the first complex feather useful for flying date back to around 160 million years in the Late Jurassic from fossils of **Coelurosaur** dinosaurs. Missing link, ***Archaeopteryx*** also had feathers....

# FUNCTIONS

**Feathers evolved from the scales of reptiles, and set birds apart from all other animals.**

**Feathers are necessary for..... all kinds of flight, insulation (thermoregulation), courtship displays, resistance from mechanical injury, camouflage.....etc.**

**Feather colors and shapes help us distinguish between different species of birds and, in some cases, between males and females.**

**THANKS, dated, 18/03/2019**