Feather Structure, Types, and Distribution

General Feather Structure

A typical contour feather consist of a main shaft and a broad flexible vane on each side (Figure 9). The main shaft is divided into two parts: the solid upper part that gives rise to the vanes is called the rachis; the hollow lower end below the vane is called the calamus. At the base of the calamus is an opening called the inferior umbilicus, through which blood and nutrients flowed to the feather during its development. When the feather is fully developed, this opening is closed by a horny plate.

Each vane consists of hundreds of tiny barbs that branch off of either side of the rachis (Figure 10). Each barb itself gives rise to a series of lateral projections, the barbules, on either side. The barbules on the distal side (the barbules on the side of the barb that faces the feather tip) have tiny hooklets (barbicels) that project distally to hook over a flange on the proximal barbules (the barbules on the inner side of each barb) of the next higher barb. Thus the barbs of the vane "zip" together to form a strong, flat surface. Feathers that lack interlocking barbicels are soft and downy. Examine this mechanism under the demonstration microscope. Pull gently downward on the vane to separate the barbs, then pull the feather between two fingers to rehook the barbules: this is the same movement a bird does with its bill when preening.

The contour feathers of some species (notably the pheasants and grouse, family Phasianidae) have an auxiliary structure called an aftershaft or afterfeather that emerges from the central shaft just below the vanes. The aftershaft consists of a rachis and a series of barbs without barbicels, and thus is downy.

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Figure 9

http://cm27personal.fal.buffalo.edu/birds/anatomy/external/feather.html

Figure 10
Feather Types

There are six principal types of feathers, each serving one or several unique services (Figure 11). Examine samples of each macroscopically and microscopically.

**Figure 11**

**Contour or vaned feathers.** Contour feathers include both the vaned feathers that cover the body and the flight feathers of the wings and tail. The contour feathers distributed over the body vary in shape, size and texture, but tend to be symmetrical and provide an aerodynamic yet protective surface. The flight feathers tend to be asymmetrical and provide the lift and propulsive force necessary for powered flight.

**Down feathers.** Down feathers are small with poorly developed rachis and no interlocking barbules (and hence are downy). Down feathers cover hatchling birds and provide insulation in most adults. They lie under the contour feathers. Powder down or powder feathers. The barbs of powder feathers disintegrate, providing a fine powder that is thought to aid in preening and waterproofing the other feathers. They are the only feathers that grow continuously and are never molted. While many species have powder feathers scattered within patches of normal down, they are most prominent in the herons and bitterns (family Ardeidae), and are located on the breast and belly.

**Semiplumes.** Semiplumes are intermediate in structure between the vaned contour feathers and the vaneless down feathers. Semiplumes have a short rachis but are softly webbed and downy. They lie under the contour feathers and provide insulation and contribute to smooth body contours.

**Filoplumes.** Filoplumes are long hair-like feathers with small barbs at the tip and a sensory corpuscle at the base, and are scattered throughout the plumage. Filoplumes monitor the position of other feathers, especially those on the wings and tail, and provide a sense of touch within the plumage.
**Bristles.** Bristles are stiff and hairlike, consisting of a central rachis without vanes, and provide both protective and sensory functions. Bristles occur most prominently around the eyes ("eyelashes"), the lores, the nostrils, and around the rictus (corners) of the mouth. Not all birds have bristles. Rictal bristles are prominent in many aerial insectivores (i.e. nightjars, order Caprimulgiformes, and flycatchers, family Tyrannidae), and are used as sensory organs to help locate and capture prey, much like mammals use whiskers.

**Feather Tracts**

In most birds contour feathers are not evenly distributed over the body, but are concentrated in tracts called pterylae (singular pteryla) which are separated by featherless spaces called apteria (singular apterium). While the apteria lack contour feathers they usually show some down feathers and filoplumes. The distribution of pteryla over the body depends on the taxonomic group in question; you don't need to bother with their names.

Highly aquatic birds like loons (family Gaviidae) and ducks (family Anatidae) tend to have reduced apteria that are densely feathered with down to insulate the body. Some groups, notably the penguins (family Spheniscidae) and some flightless birds like the Ostrich and rheas (order Struthioniformes), have feathers that are uniformly distributed over the skin's surface and not organized into tracts.

**Feather Color**

The coloration of a feather may due to the presence of pigments (chemical coloration) or due to physical properties of the feather (structural coloration), or both. There are three principle pigments found in birds: melanins (blacks, grays, and browns), carotenoids (reds and yellows), and porphyrins (reds, browns, and some greens). Melanin granules tend to strengthen feathers and can reduce feather wear: in many large species the tips of the primaries are infused with melanin and thus tend to be black.

Blues, most greens, whites, and iridescent colors are structural in nature. They are produced by complex patterns of selective light reflection and refraction determined by the microstructure of the cell wall surfaces of the barbs and barbules. Such feathers are not really colored, and only appear so as long as the integrity of the feather remains intact. A blue feather ground up (or worn out) appears brown. The color of some feathers (especially green, yellow-green, blue-green, and iridescent feathers) are due to both structural features and underlying pigments.

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![Feather photos](http://www.nativetech.org/feather/feather.html)

1. Golden Eagle
2 & 3. Red Tailed Hawk
4 Great Horned Owl
5. Turkey Vulture
6 to 9 Turkey

*feather photos from [http://www.nativetech.org/feather/feather.html](http://www.nativetech.org/feather/feather.html)*

[http://cm27personal.fal.buffalo.edu/birds/anatomy/external/feather.html](http://cm27personal.fal.buffalo.edu/birds/anatomy/external/feather.html)