



BIRDS of a
FEATHER

BY JANA MARAVI

Background

This article will showcase four major feather types: wing (regimes), tail (rectrices), contour, and semiplume. Twelve species, consisting of four pheasants, three macaws, two pigeons, and five miscellaneous species, will be used to illustrate many of the differences and variations that exist across feathers all over the world. Various photographic techniques are used as a means to shed light on both broad and microscopic differences.

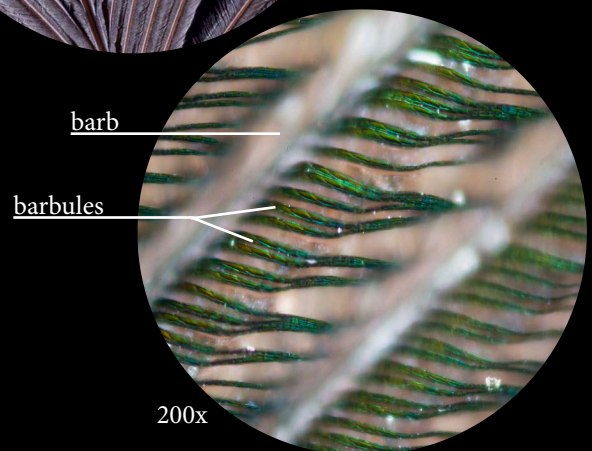
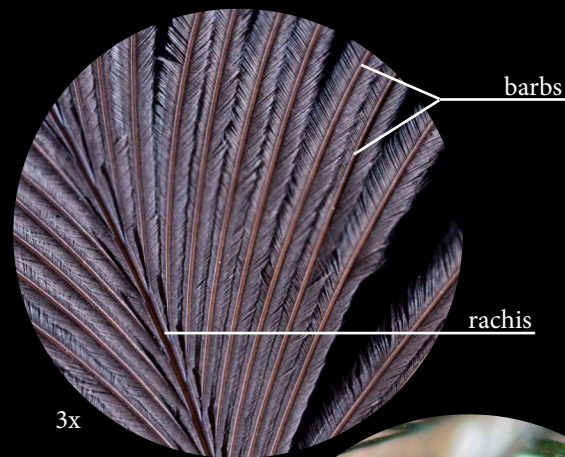
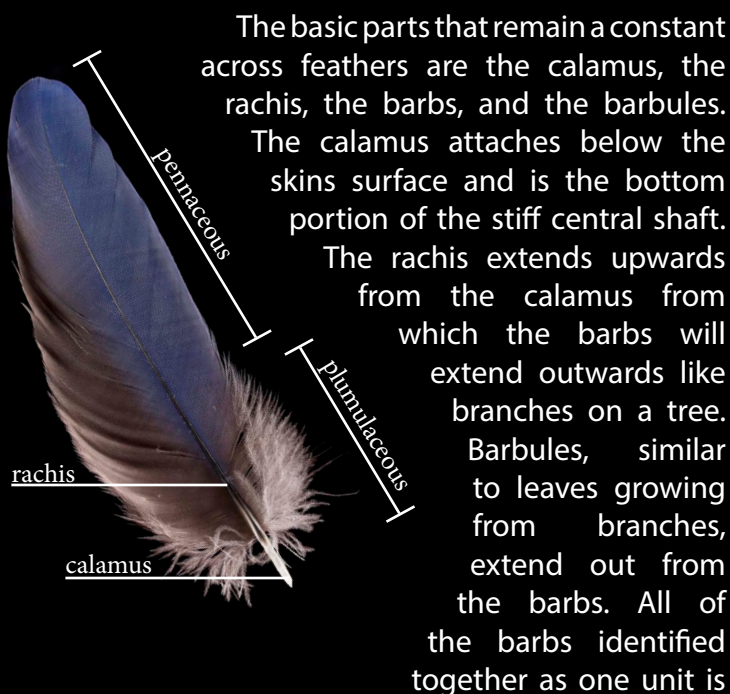
Feathers have been traced as far back as to the age of the dinosaurs. Similar to the hair and nails that humans possess, feathers are made of the protein keratin that works to provide structure and protection. Today, feathers provide a wide variety of services, including insulation, waterproofing, display, camouflage, and the newest but most recognized development - flight. Not only do each of these purposes come with their own unique feather anatomy and microstructure, but also differ between bird species.

Constant upkeep is a necessary task for birds to keep feathers clean, properly aligned, and oiled. This is done through a process known as preening, performed by smoothing their beak over each and every feather, often with the assistance of the uropygial gland that secretes oil at the base of the tail.

known as the vane. The vane can be either pennaceous or plumulaceous, or a combination of the two.

The pennaceous region is located at the top of the feather in which the barbules have small hooks that interlock the barbs together. This creates a smooth surface to block wind and allow lift for flight. In most feathers, a plumulaceous region exists below the pennaceous region where there are no hooks and the barbs do not interlock. Some feathers, like down feathers, are entirely plumulaceous, allowing body heat to be trapped, keeping the bird warm. Down feathers also lack a rachis, making them the loosest of all feathers, opposite to wing feathers which are the most rigid. Contour feathers (shown in the bottom left), covering the majority of the bird's body, have a more even proportion of both the pennaceous and plumulaceous region. This allows them to keep away moisture with the interlocking barbs while, at the same time, holding in heat with the non-interlocking barbules. Falling in between the categories of down and contour, is a feather type known as semiplume (shown in top diagram below). Semiplume is entirely plumulaceous, similar to down feathers, but still contains a rachis, providing more structure. Understanding even just the basic structures of the feather can provide an immense amount of information on the animal itself.

Anatomy



Pheasants

are part of the Phasianidae family, in the subfamily Phasianinae, along with peafowl, junglefowl, tragopans, and other similar birds. They express sexual dimorphism, wherein the two sexes express different physical qualities. For pheasants, this means that the males are highly ornate with unique characteristics such as wattles, fleshy excrescence such as that hanging from a rooster's neck, and long tails. All of the feather's shown here are from male pheasants.



Lady Amherst's Pheasant
Chrysolophus amherstiae

Key Facts

Coloring: Black and white stripes

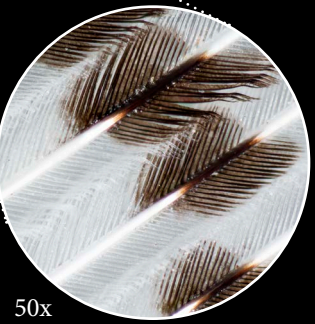
Length: 70 centimeters

Purpose: Display

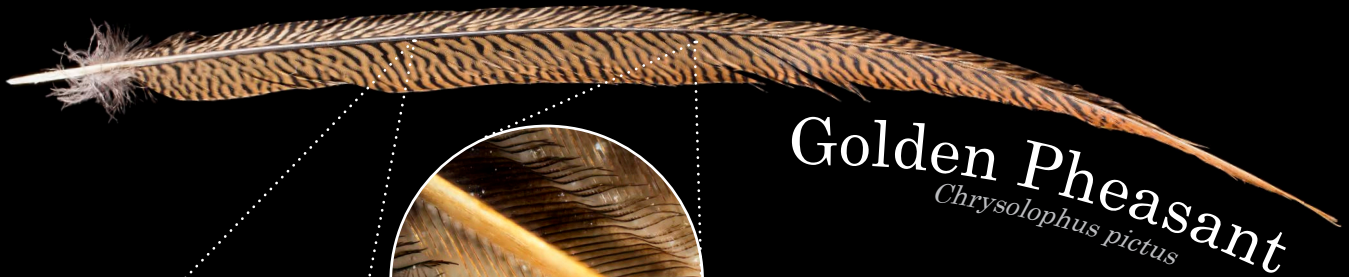
Type: Tail Feather

Native Location: China, Burma

Additional Information: William Pitt Amherst first sent the bird to London in 1828 and named it in honor of his wife, Sarah Countess Amherst.



50x



Golden Pheasant
Chrysolophus pictus

Key Facts

Coloring: Black spots on cinnamon

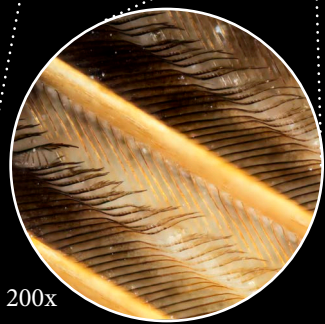
Length: 67 centimeters

Purpose: Display

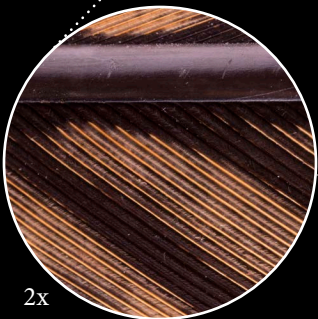
Type: Tail Feather

Native Location: China

Additional Information: They are a rare and endangered species, found in mountainous regions. They prefer running to walking, but will fly upwards when startled.



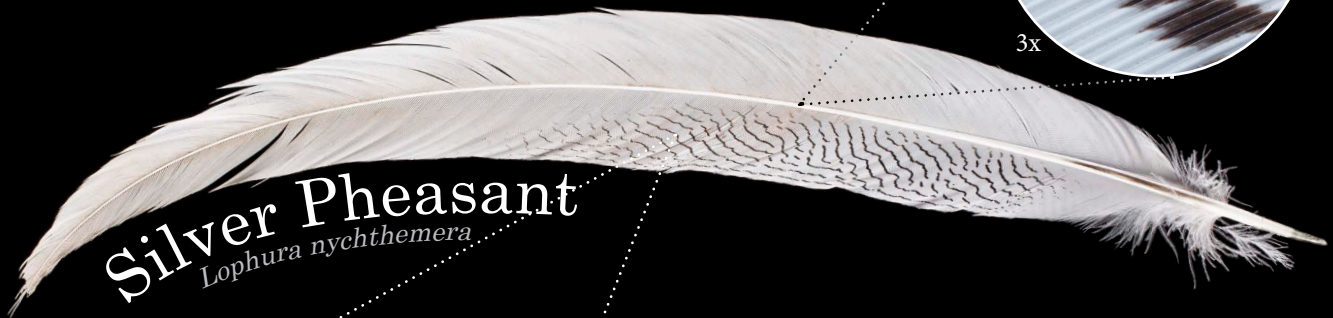
200x



2x

Pheasants

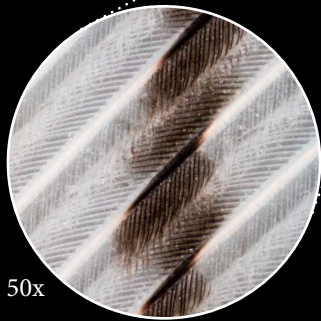
(continued)



Silver Pheasant
Lophura nychthemera

Key Facts

Coloring: White with black markings
Length: 61 centimeters
Purpose: Display / Stability
Type: Tail Feather
Native Location: Southeast Asia, China
Additional Information: These birds are common and easy to care for.



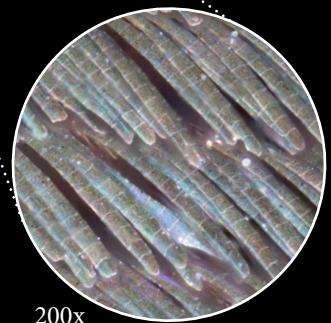
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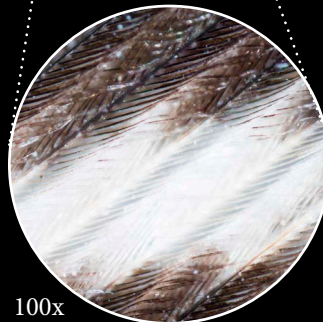
Palawan Peacock Pheasant
Polyplectron napoleonis

Key Facts

Coloring: Iridescent blue ocelli (eye) with white spots on brown
Length: 21 centimeters
Purpose: Display / Camouflage
Type: Tail feather
Native Location: Palawan
Additional Information: An erect tail can also indicate a show of threat, not display and mating.



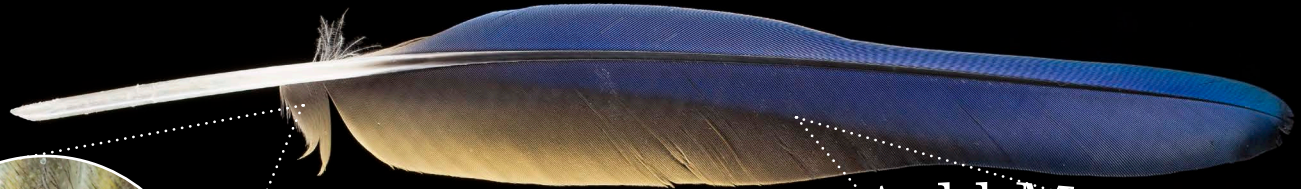
200x



100x

Macaws

are part of the Psittacidae family and are found in the subfamily of "New World Parrots," meaning they have been known to the Western world since Columbus remarked on them in 1492. These famous parrots are known for their coloring, long beaks, long tails, and zygodactyl feet – the first and fourth toes pointing backwards. Only DNA testing can determine the sex of a macaw.



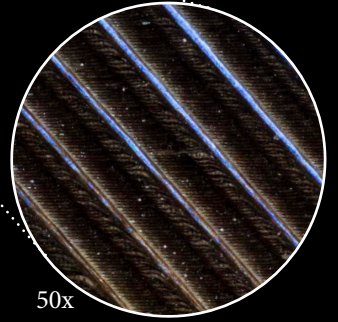
Key Facts Blue and Gold Macaw

Ara ararauna

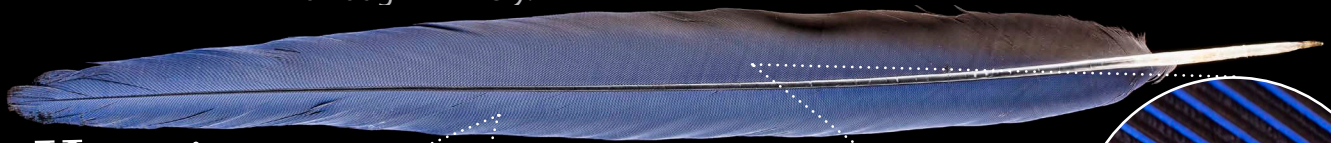
Coloring: Blue and gold
Length: 33 centimeters
Purpose: Flight
Type: Wing Feather
Native Location: South America (Venezuela, Peru, Brazil, Bolivia, Paraguay, Panama)
Additional Information: These birds can talk through mimicry.



50x



50x

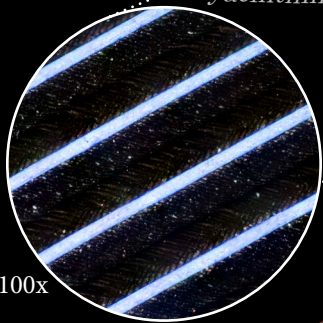


Key Facts Hyacinth Macaw

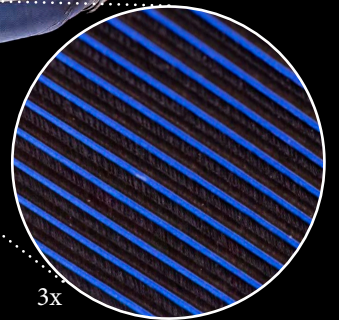
Anodorhynchus hyacinthinus

Key Facts

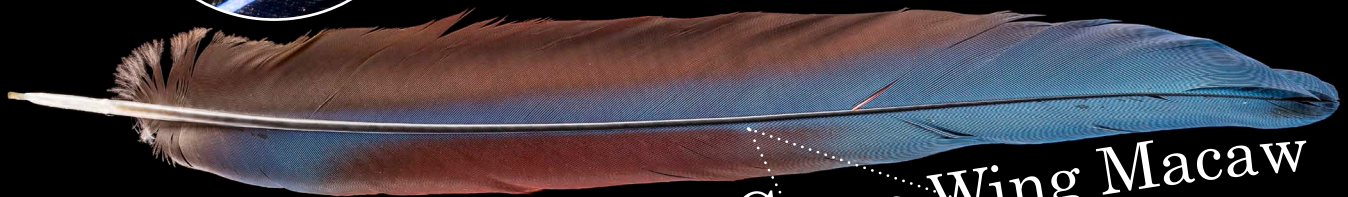
Coloring: Blue with some black
Length: 51 centimeters
Purpose: Stability / Display
Type: Tail feather
Native Location: Central and eastern South America
Additional Information: These are the largest parrot species in the world. They have been observed using tools.



100x



3x

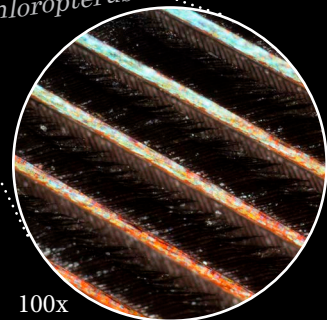


Key Facts

Coloring: Blue and red
Length: 37 centimeters
Purpose: Stability / Display
Type: Tail Feather
Native Location: Northern and central South America
Additional Information: These birds are friendly but can take on the mood of their owners.

Green Wing Macaw

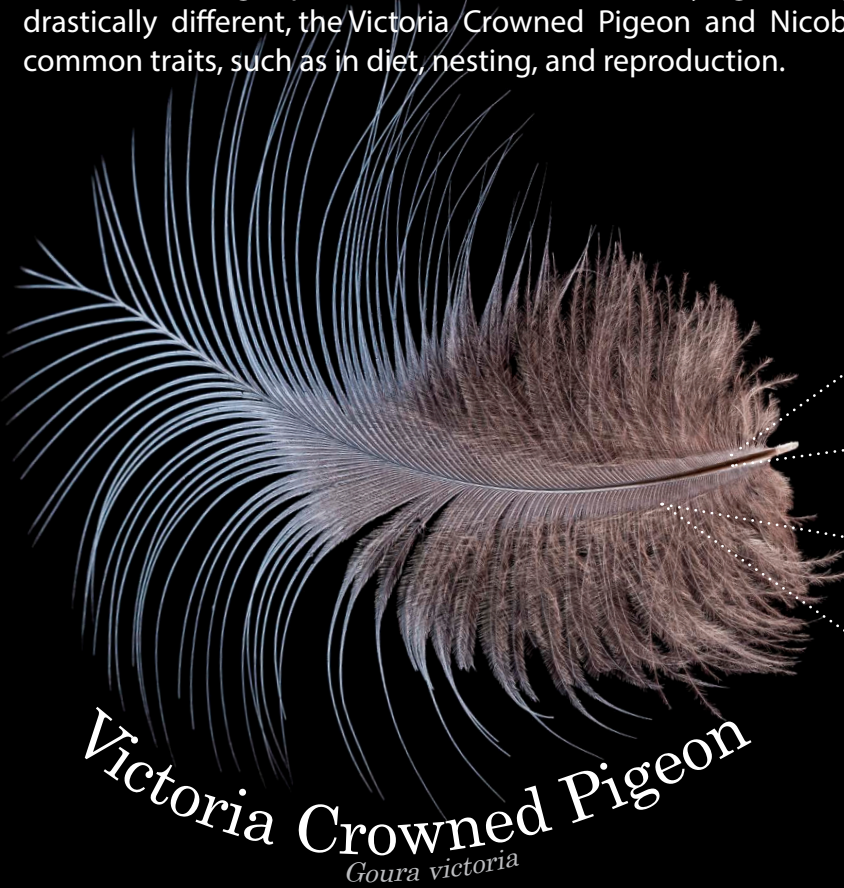
Ara chloropterus



100x

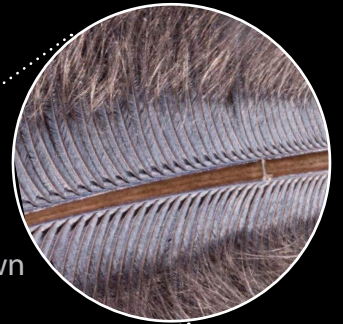
Pigeons

are part of the family Columbidae and typically have a stout body, short neck, and a short slender bill and can be found worldwide. Pigeons are highly intelligent and many have been found to pass self recognition tests. The term carrier pigeon comes from a time when the rock pigeons unique long distance homing capabilities were utilized for carrying messages. While both the birds and the feathers look drastically different, the Victoria Crowned Pigeon and Nicobar Pigeon shown below actually share many common traits, such as in diet, nesting, and reproduction.



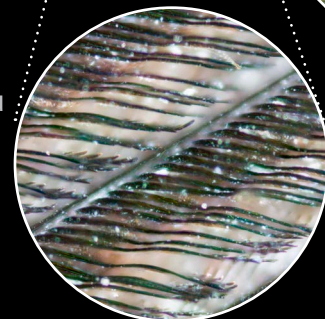
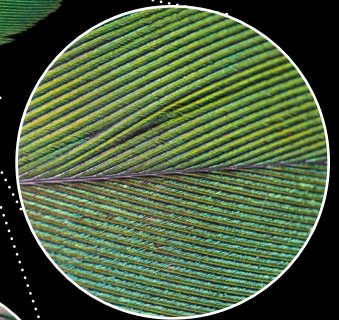
Key Facts

Coloring: Blue and brown
Length: 12 centimeters
Purpose: Shape / Insulation
Type: Semiplume Feather
Native Location: New Guinea
Additional Information: These are the largest pigeons in the world. Aggressive mating displays between males are common.



Key Facts

Coloring: Metallic green and brown
Length: 8 centimeters
Purpose: Shape
Type: Contour feather
Native Location: Nicobar Islands, Malay Archipelago, Solomons, Palau
Additional Information: The iridescence exists due to the refraction of the thin films that cover the barbules. These birds are the closest living relatives to the extinct dodo bird.

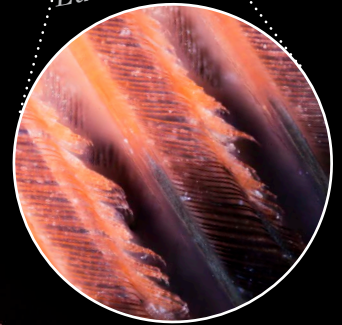


Miscellaneous

Key Facts

Family: Threskiornithidae
Coloring: Pink with black tip
Length: 21 centimeters
Purpose: Flight
Type: Wing Feather
Native Location: South America, Caribbean Islands
Additional Information: The only wing feathers with a black tip are known as "primaries" and are necessary for thrust during flight.

Scarlet Ibis
Eudocimus ruber



Red Crested Turaco
Tauraco erythrolophus



Key Facts

Family: Musophagidae
Coloring: Deep red with black tip
Length: 16 centimeters
Purpose: Flight
Type: Wing Feather
Native Location: Angola

Additional Information: This red feather has been considered a treasure to royalty across Africa. It is also viewed as a symbol of conservation.

Key Facts

Family: Strigidae
Coloring: Brown with white spots
Length: 12 centimeters
Purpose: Camouflage / Insulation / Shape
Type: Contour Feather
Native Location: Australia, New Guinea, Indonesia, Timor, The Sunda Islands
Additional Information: Owls have special serrated wing feathers that allow for silent flight.

Boobook Owl
Ninox boobook



Photography

A variety of photographic and lighting techniques were used for the imagery in this article in order to achieve various magnification levels. First, the feathers were brought into a studio to be photographed in their entirety with strobe lights. Two strobes with medium softboxes were placed on either side of the feather, a few feet away and at about a 45° angle from the front. The 45° allows for even illumination. A Canon 6D and Canon 100mm macro lens was used.

Next, the feathers were brought to a copy stand where the same camera could be mounted from above. Here, the feathers were photographed with both a Canon 65mm macro or a 20mm thimble lens mounted to a bellows extension, depending on the desired magnification. The 65mm lens can achieve a magnification of 5:1, or 5 times the size of real life, but the thimble lens with the bellows fully extended can magnify to an even greater degree. Two continuous fiber optic lights with diffusers were placed again at 45° to keep the lighting consistent with the images from the studio.

Finally, the feathers were brought under a reflected light microscope and photographed at various magnifications, starting at 50x all the way to 500x. These images allowed for the best view of the feather's microstructures. Due to the high magnification and textured surface of feathers, the depth of field was very shallow, meaning that the entire surface could not be photographed in focus all at once. To compensate for this, multiple exposures were taken of the same field at each different focus point. In post production, these exposures were combined in a process called "focus stacking" which results in a final photograph that is sharp throughout.

Author

Jana Maravi, a Rochester Institute of Technology student studying Biomedical Photographic Communications, specializes in scientific imagery of biological subject matters with the most experience in high magnification photography. As of December 2015, she is in her third year of the program with an expectation to graduate in May of 2017. She spent this past summer at the Smithsonian Institution National Museum of Natural History (NMNH) where she did photomicrography of oriental flea beetles for the museums archives. She is also a PADI certified Underwater Photographer and is interested in the marine sciences. Her spare time is spent exploring new places with her camera by her side, always in search of what hasn't yet been seen or photographed.



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Bird Kingdom

All of the feathers were received as a gift from Bird Kingdom, located on the border of Canada in Niagara Falls. Special thank you to Kim Cosby for the collection and identification of feathers, as well as other aviary staff for the delightful and informative tour of the facilities. Along with countless others, all of the birds below can be found inside the aviary and were featured within this article. In order from left to right, they are the Lady Amherst's Pheasant, the Hyacinth Macaw, the Green Wing Macaw, the Scarlet Ibis, the Blue and Gold Macaw, the Nicobar Pigeon, the Victoria Crowned Pigeon, the Golden Pheasant, and the Silver Pheasant. Further information for Bird Kingdom can be found at www.birdkingdom.ca.



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