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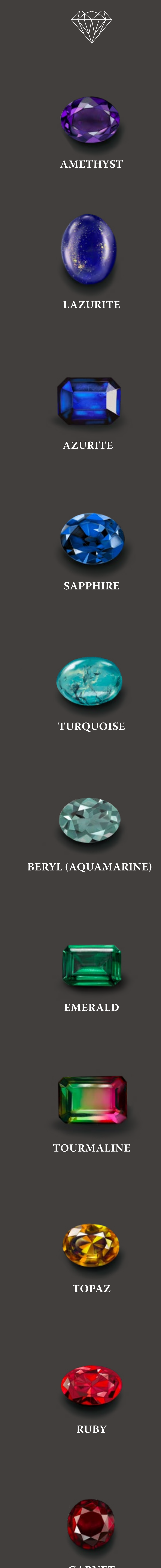
Gems of the Western Hemisphere

By Jillian Ditner

Of the 363 species of hummingbirds in the world, more than 50 are named after gemstones. The sparkling qualities of hummingbirds and gemstones are created by the degree to which they bend the path of light. Diamonds curve and refract light as it enters and bounces around the gem's interior. The red gorget of a Ruby-throated Hummingbird gets its shininess from the interplay of light and intricate nanoscopic structures inside the feathers. By bending light in extreme ways, many hummingbirds literally look like flying jewels—hence the references to sapphire, emerald, and other gemstones in their common names.



FEMALE CHOICE DRIVES MALE SHININESS

Gemstones are a product of huge amounts of pressure exerted by the shifting of Earth's tectonic plates over millions of years. Similarly, the amazing ornamentation of hummingbirds results primarily from the intense evolutionary pressures of sexual selection—the pressure on males to attract females. For certain hummingbird species, the shiniest males are the most fit.

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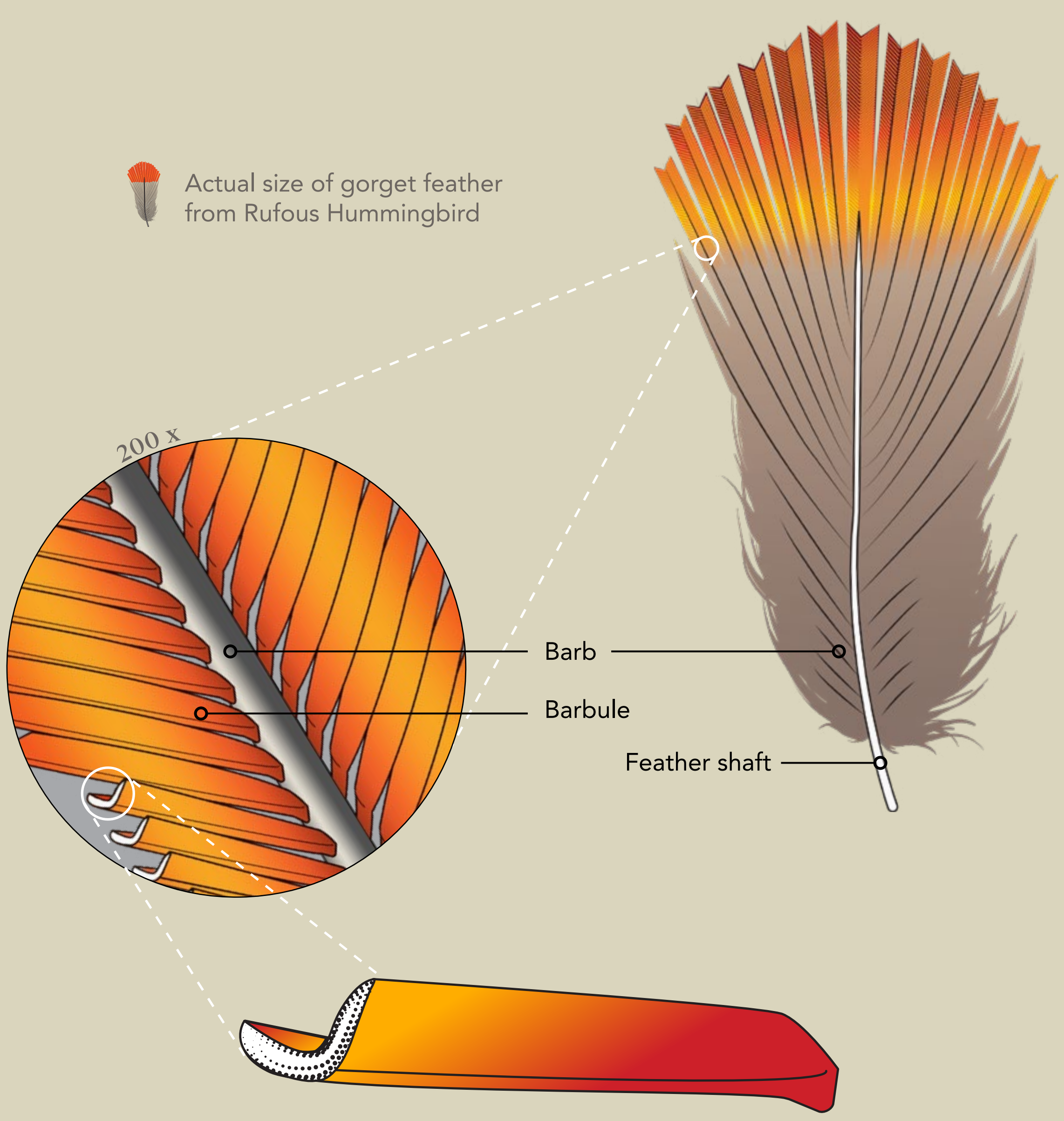
FEATHERS THAT SHIMMER AND CHANGE COLOR

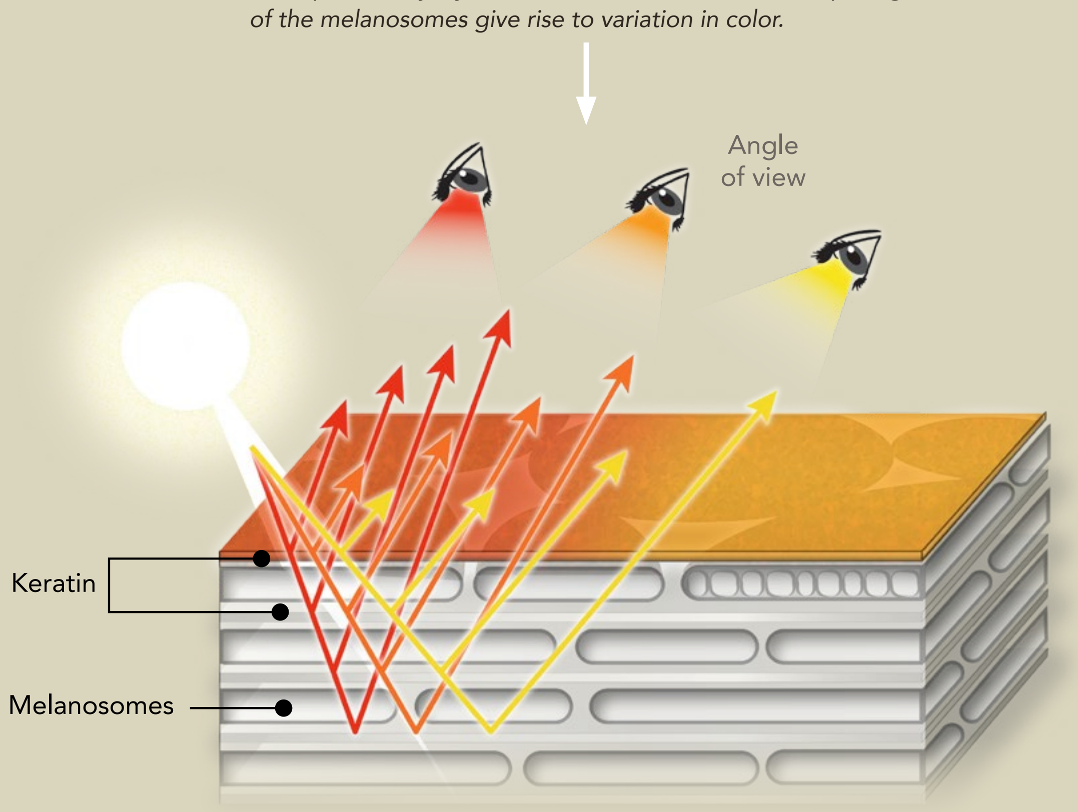
The brilliant range of iridescent colors seen in hummingbird feathers is created at the nanoscopic level. Whereas many birds create colors through pigments in their feathers, hummingbirds produce iridescence through the structure of their feathers—by scattering light in their feather tips. Inside the nanostructure of hummingbird feathers, stacks of pancake-shaped structures called melanosomes function as multilayer mirrors, with highly precise spacing that results in bright flashes of color that can only be seen at specific angles.

SHINY FEATHER TIPS

All feathers are made of keratin and consist of a main shaft with barbs. Each barb has filaments called barbules attached to it. Hummingbird feather barbules have evolved to act as a reflective surface that appears to change color depending on the angle of view. The flattened barbules overlap like Venetian blinds to create a surface perfect for reflecting brilliant colors.



The cross-section of a hummingbird barbule reveals repeating layers of hollow, air-filled structures called melanosomes that are separated by layers of keratin. The thickness and spacing of the melanosomes give rise to variation in color.



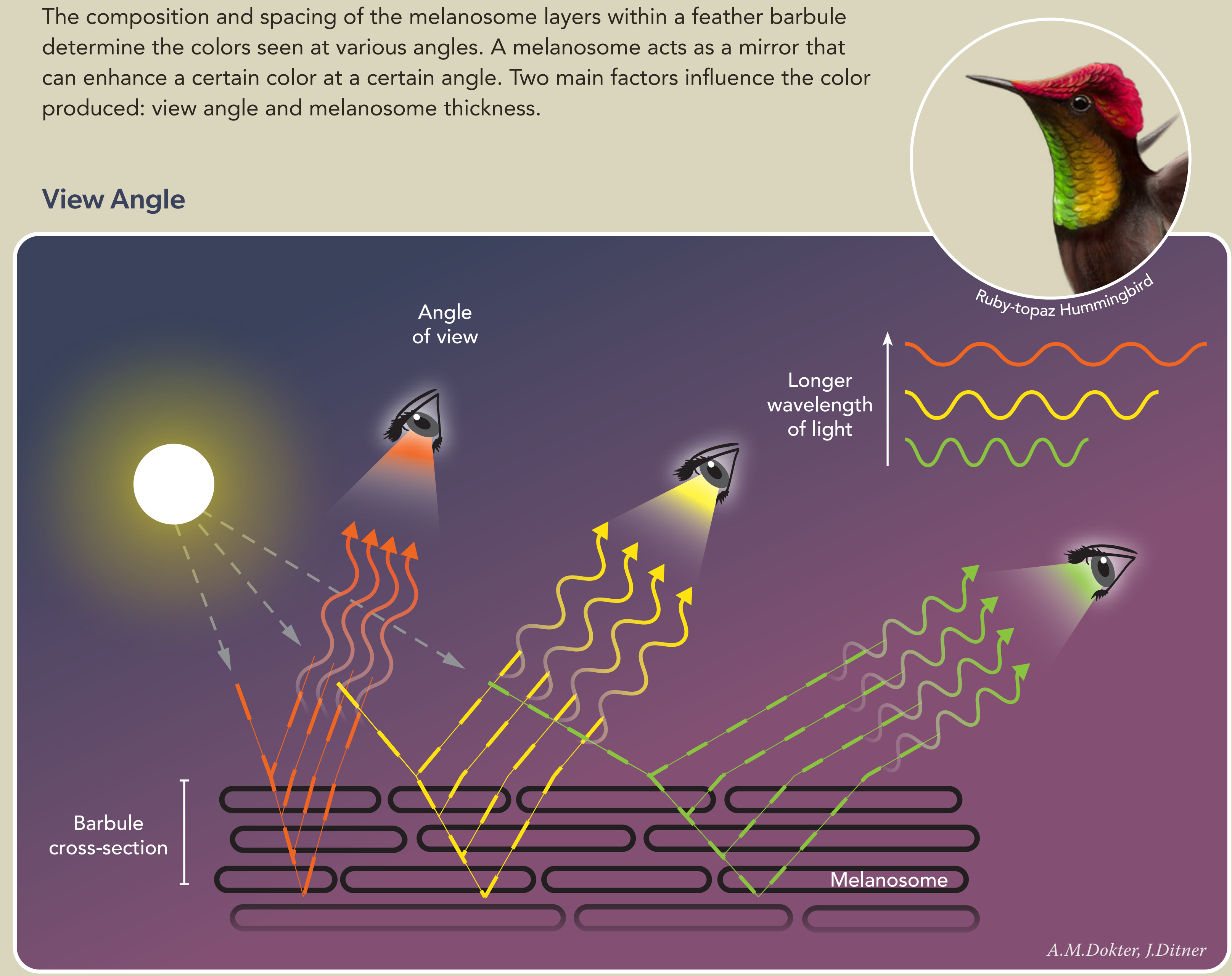
Barbule Cross-section

As light hits the top layer of the barbule, it refracts through a thin layer of transparent keratin and hits the top layer of melanosomes. Some light gets reflected, some light passes through to the next layer—and so on, and so on; the light gets increasingly refracted (or bent) through as many as 15 melanosome layers per barbule.

COLOR–SHIFTING FEATHERS

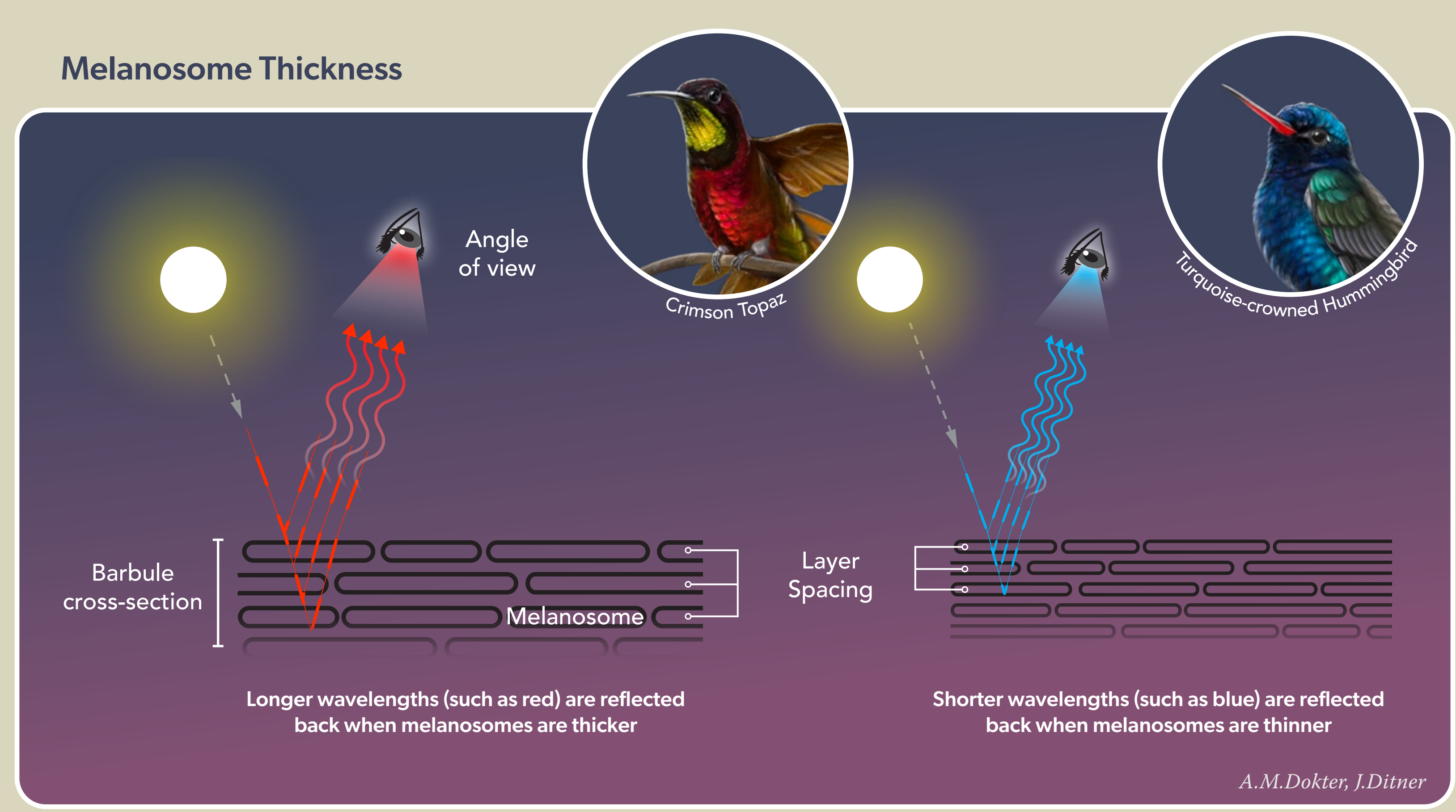
The composition and spacing of the melanosome layers within a feather barbule determine the colors seen at various angles. A melanosome acts as a mirror that can enhance a certain color at a certain angle. Two main factors influence the color produced: view angle and melanosome thickness.

View Angle



Iridescence is the gradual changing of color as the angle of view or the angle of illumination changes. In a hummingbird feather barbule, incoming light from the sun reflects off melanosome layers. These reflections can add up and amplify each other—with wavelengths of light in perfect synchrony—to create bright flashes of color or even appear to change color altogether.

Melanosome Thickness



Colors produced by longer wavelengths of light—such as red, orange, and yellow—are produced when the underlying barbule structure contains thicker melanosome layers. In contrast, cooler colors—like cyan, blue, and violet—have shorter wavelengths and are produced by thinner, more densely stacked melanosome layers.

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