

of breast and head were often smeared with pitch. I have examined several specimens taken at this time in which the feathers were very dirty from this cause.

In Pinery Canyon according to the best information available about seventy-five or possibly one hundred parrots were killed. Probably half of these found their way into collections of bird skins while the remainder were sent to Chandler Brothers, in El Paso, and Colburn, Los Angeles (taxidermists). In Rucker Canyon where the birds were most numerous not more than half a dozen were destroyed: these were killed by hunters through curiosity.

Though parrots apparently remained through the summer in the Galiuro Range, whether they bred there is uncertain. From available accounts the birds in Mexico nest usually in abandoned nesting holes of the Imperial Woodpecker (*Campephilus imperialis*). Suitable nesting cavities for these parrots could be found in large pines in our mountains but are not common. The date of arrival of the Thick-billed Parrot in 1917 seems remarkably early as Thayer (Auk, 23, 1906, pp. 223-224), records nests containing eggs or small young near Colonia Pachacho and Colonia Garcia, Chihuahua, from August 11 to August 28, 1905, and Bergtold (Aug, 23, 1906, pp. 428), secured partly fledged young near Parral on October 5, 1904. From these dates it would seem that there is some variation in the time of nesting, as the parrots arrived in the Chiricahuas at a time when they had been breeding during other years.

United States National Museum, Washington, D. C., October 3, 1934.

GEOGRAPHICAL DISTRIBUTION AND DISPLAY COLORS OF TROCHILIDAE

By A. L. PICKENS

Students of botany are familiar with De Candolle's law by which xanthic flowers group themselves toward the tropics and cyanic flowers toward the circum-polar regions. When, several years ago, I began a close study of our southwestern hummingbirds I found in the geographical arrangements of the gorget and other display colors an elusive orderliness nothing short of surprising. Experimenters have so emphasized the spectrum in their color tests that the color wheel of the worker in pigments has been almost neglected.

In this color wheel, with some necessary distortion of proportions, the pigmented approximation of the spectrum may be imagined as wrapped about the dial of a clock with red at twelve, and the purplish hues joining the red through a series of crimsons between eleven and twelve. The scarlets will shade away on the other side and the counter-color of red will stand at six. The six major colors, red, orange, yellow, green, blue, and purple, will stand by the even numbers on the dial in their natural order, the intermediate shades, red-orange, orange-yellow, and the others, will stand in order by the odd numbers. Thus we travel from red to its counter-color, green, on one side through a xanthic series and on the other through a cyanic. Now, with a map of North America and our color dial we start at about 61° of latitude in Alaska and southern Yukon, and at about twelve on our dial, dropping continuously to the lower numbers in each case, though of course not proportionally, to find a surprising orderliness in the first appearances of the luminous display colors of the various species of hummingbirds.

Reds.—The most northerly ranging species, the Rufous Hummingbird (*Selas-*

phorus rufus) has the luminous display color scarlet, with orange-inclined or coppery hues, a decided inclination to the xanthic side. However, the purest red pigment that man can produce is inclined to retain this trace of yellowish impurity.

The next highest ranging species, the Ruby-throated Hummingbird (*Archilochus colubris*), if isothermally as far north is not latitudinally so, and its ruby gorget shows an inclination toward the purples of the cyanic side of the color dial. With the Allen Hummingbird (*Selasphorus alleni*), the two preceding species make up a great territorial arch about the dryer regions of the western part of the continent. The scarlet of the two western forms is better suited to contrast with the deep blues of the coniferous forests of the northwest; the ruby of the eastern species is better fitted for contrasting on the more yellowish background of certain eastern broad-leaved forests.

Within this arch comes another of entirely crimson hues, much lighter on the average, and better fitted for contrasting against a region largely covered with chaparral and grass. The most northern ranging species in this second rough arch is the Calliope Hummingbird (*Stellula calliope*), with rose-purplish display, and reaching as far north as British Columbia; next, into southern Idaho, the Broad-tailed Hummingbird (*Selasphorus platycercus*) ranges; while farther south and west we find the crimson pink gorget of the Anna Hummingbird (*Calypte anna*).

Purples.—A third northward-pointing arch, with the purple display band of the Black-chinned Hummingbird (*Archilochus alexandri*) reaches its highest in southern British Columbia. In the same color-group, the Costa Hummingbird (*Calypte costae*) reaches as far north as southwestern Utah, but the Rivoli Hummingbird (*Eugenes fulgens*), with its violet-blue or purplish, barely gets over our southwestern boundary, while the violet-purple of the Lucifer Hummingbird (*Calothorax lucifer*) seems to exceed it somewhat in territory occupied in the United States. The purple of the first, the amethystine of the second, and the violet-purple of Lucifer, leading to the violet-blue of Rivoli, indicates an approximately regular descent, not merely in colors but in hues! This we have clearly seen in the alignment of reds. The elusive pink that may flash at times from the gorget of the Costa makes one wonder if nature has been adapting it to contrast with the greener leaves of *Covillea tridentata*, the ranges of the two in the west being similar, both adding a wealth of color to the desert not found in the more northern reaches of the sober-hued sagebrush. Contrast evolution, if it has taken place, in such an environment might well be expected to interrupt an orderly appearance of hues, granting that our law of color can apply to such minute details.

Blues.—A metallic azure display color is found in the Blue-throated Hummingbird (*Lampornis clemenciae*), found in its subspecific forms in Arizona, New Mexico, and western Texas. Still restricting our arch, in an east and west direction more than a northward one, we have the Broad-billed Hummingbird (*Cyananthus latirostris*), in adjacent corners of Arizona and New Mexico. Elliot lists its display color as sapphire, and Bailey as peacock-blue, a hue reaching forward from the blue in the direction of green.

Greens.—We have noticed Rivoli already as occupying a position barely within the range of our United States species, the very last of the purples. But it also has a display gorget of metallic green. Now blue is our color midway between purple and green and this species with both thrusts itself northward in range into a region occupied by our most northerly blues. To meet a merely metallic green display alone we must push on farther south in the valley of the lower Rio Grande, to find it in the metallic green throat and breast of the Buff-bellied Hummingbird (*Amazilia yucatanensis chalconota*). Sufficient information is lacking to pass on the align-

ment of the hues of blue-green, green, and yellow-green, and as it is the most common color of hummingbird plumage with which we are now dealing there would be the risk of having passed, unnoticed, displays of green on the body of some other casually noted species. With green we reach the complementary or counter-color of red with which we started. Our Mexican boundary is a sort of dividing line between the cyanic displays at their farthest north, and the yellows at theirs. Elliot finds metallic greens of yellowish and golden tones in the next considered species.

Yellows.—Yellow in its purest form is probably best seen in lemon. And it is hard to imagine a metallic lemon or yellow. Our golds, coppers, and brasses, and our tinted tinfoils, will lean toward orange or toward green. In northwestern Mexico we encounter our first truly metallic golden display plumage in *Chlorostilbon auriceps*. Increased difficulties arise in the obtaining of workable descriptions of color displays and ecological backgrounds. Seeking intensification of our golden hues we pass farther south on the map, and farther toward orange on the color dial. Rivoli's purple-green display is soft indeed compared with the ruby-red crest and glittering topaz-yellow chin, throat and breast of the Ruby-topaz Hummingbird (*Chrysolampis moschitus*) of Venezuela and Colombia, even ranging according to Porsch and Sassi as far northward as the Lesser Antilles.

Oranges.—In the equatorial regions of Brazil, along the Rio Negro, we find *Topaza pyra*. Elliot described some individuals as showing orange-yellow displays while others showed orange-red.

How do these rules apply in the hemisphere to the south? As in the north, a yellow-tinged red reaches farthest from the equator in the display of *Eustephanus galeritus*. But as North America recedes from the equator it widens, while South America below that line narrows rapidly. At that place, where a sudden inward shrinkage appears on both coasts, we strike a narrow band, largely steppe and desert land, running from the La Plata valley, through Bolivia and Chile to southern Peru, from southeast to northwest. Here purples, blues, and greens all attain their most southerly reaches, and so telescoped and jumbled they seem until more detailed information is available, that we must wait, remembering, however, that the purple gorget of the Bolivian plateau may be isothermally farther from the equator than the green one at the mouth of the La Plata. Altitudes here run to as much as twenty thousand feet and more, dwarfing anything along our Mexican border. Yellow appears to attain limits rather behind this general boundary, but orange again loiters nearest the equator in the same genus already noted. From Colombia, through Ecuador and Peru into Bolivia we find species with the most variable color repertoires: Topaz, to flame or to emerald in *Iolaema luminosa* of Ecuador and Peru; in *Diphlogaena iris* of Bolivia, golden-green to orange scarlet and metallic blue with velvety black; in *Helianthea bonapartii* of Colombia, dark green, coppery red and purplish blue; and in *Bourcieria assimilis*, black with iridescence merging into metallic red to golden, the throat purple.

In contrast to these are the mere green forms, with no display colors, ranging well across the tropics, and probably the most primitive of the family, certainly ancient enough to have given us the two extremes of size in the family in the giant *Patagona gigas* of Ecuador, Bolivia, Peru, and Chile, and the diminutive *Mellisuga minima* of Jamaica and Santo Domingo. Perhaps the nearest approach to metallic white or metallic black is a silky or glossy for one and a jet or velvet for the other, unless for the first we wish to emphasize some of the silvery displays sometimes seen in the tropics. Black and white are probably as a rule merely contrast or framing colors. *Aglactis pamela* of Bolivia, largely jet black, shows a tuft of pure white feathers on the jet black breast. White with gold spots, and white tipped by glossy

green, are seen in Mexico and Brazil, both in *Lophornis*; and in *Oxygogon* of Venezuela the black of head and crest shows a white line in the center and a bounding band of white, with a lengthened tuft or beard of white hanging from the throat.

In *Lophornis adorabilis* of Chiriqui in Central America a ruby-red forehead passes into a pure white crown, but in *Anthocephala floriceps* of Colombia a buffy white on the forehead yields to a peach blossom on the crown, while in *Microchera albocoronata* of Veragua both front and crown are of a silky white. The last is almost as small as the sole occupant of the genus *Mellisuga* with which it was once grouped. Silvery greens, and greens yielding silvery sheens, are shown by *Heliangelus spencei* and by *Heliotrypha barrali* of Venezuela and northern Colombia. These whites and silvery sheens it will be noted are found in countries at the southwestern corner of the Caribbean Sea. Perhaps albinism is involved in some forms now leaning toward the silky whites.

Cinnamon, buff and rufous evidently make contrasting and harmonizing settings, and are found ranging far along the Pacific side of the Americas. In *Lophornis* of Venezuela various species show crests of rust red, of rufous, of deep chestnut, or of chestnut red as if to contrast the metallic green, in some on the forehead, in some on the throat, or perhaps spotting or tipping the feathers that spring, racquet-shaped, in tiny tufts from the side of the neck. But we must not carry the idea of contrasts too far as to plumage, and far less as to landscape. The Rufous Hummingbird appears to seek color harmony in its plumage rather than color contrast, but thereby it attains even greater contrast with its environment of bluish-green conifers when among such.

To summarize: Any and all colors of display plumage are to be found among hummingbirds in the deeper tropics. In their northward ranges, possessors of these colors tend to drop out in the following order: Oranges, yellows, greens, blues, purples, and reds, a similar arrangement to that found on the pigment wheel of the colorist. A similar order is indicated in the southern hemisphere.

As De Candolle found the xanthic flowers more tropically inclined and the cyanic more nearly circumpolar, the xanthic or yellowish hues of display plumage tend to drop out in the tropics, while the bluish hues extend farther into the temperate zones. In each hemisphere, however, the species reaching farthest from the equator shows a yellowish or xanthic red in its display plumage, rather than a bluish or cyanic.

Greenville, South Carolina, August 7, 1934.

A HISTORY OF THE BIRD COLONIES OF GREAT SALT LAKE

WITH MAP

By WILLIAM H. BEHLE

There are four breeding colonies of water birds on the islands of Great Salt Lake, each situated on a different island. The four islands vary considerably as to size and the number of avian inhabitants. The colony which is most widely known, though not the largest, is located on Bird Island (local name, Hat Island on most maps). This island is roughly circular in form and about 150 yards in diameter except for a sand bar extending southward for several hundred yards. Back from the beach the surface of the island is fairly level for several yards and then rises gradually to the rugged rocks which form the summit of the island, some 75 feet above the water. Scattered about are greasewood bushes (*Sarcobatus vermiculatus*) and other desert shrubs. These bushes are largest near the beach where they are five to seven feet tall. Much of the open space on the island is rocky, but a large