FAVORITE COLORS OF HUMMINGBIRDS.

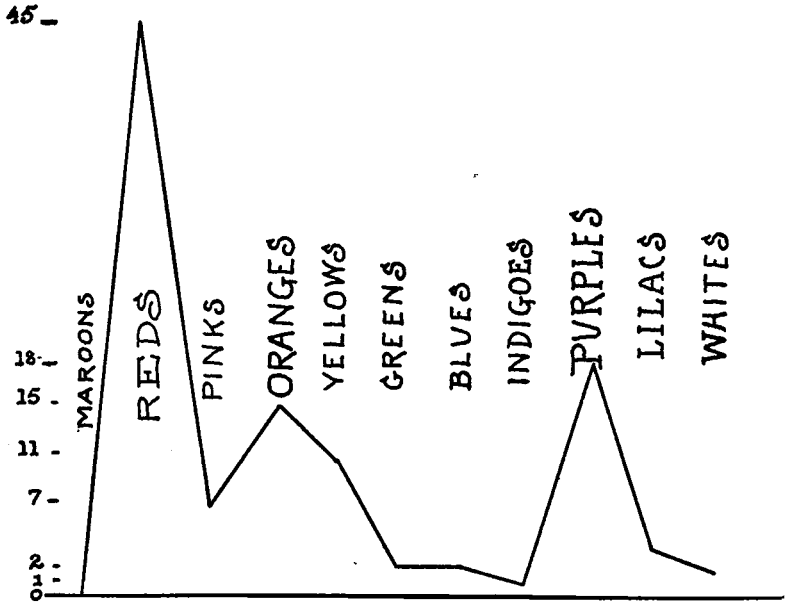
BY A. L. PICKENS.

THAT red is a highly attractive color to Hummingbirds is common knowledge among ornithologists. Any one can easily convince himself of this by experiments with red tissue paper bells, streamers of cloth hung in the bushes, or even wrapped about sticks and placed among the limbs. Coues, in 'Birds of the North-west,' following Holden, tells of Hummingbirds in the Black Hills being attracted to a piece of flesh thrown into a small dead tree from a Hawk's body that was being skinned.

Finding oranges and purples highly attractive to these nectar-seeking birds naturally leads one to further inquiry. Living near the southern Appalachians, where we have the most remarkable mingling of biological zones in the Eastern States, I began cataloguing floral species in the vicinity of my home. About five hundred plants were tabulated of which upwards of one hundred were introductions that had become naturalized. I also ran a floral calendar recording the first appearance of flowers, and was surprised to find the season of first appearances ran from December to September, October and November being well supplied with flowers that had appeared earlier. Classification by color best suited my purpose, and roughly following the spectrum I divided my finds into maroons, reds, pinks, oranges, yellows, greens, blues with indigoes, purples including violets, and whites. Yellows, blues, purples, and whites, all began in December and January. Pinks and maroons came in March, while the high season and first appearance of greens came in April. All these colors except maroon had fresh floral species to show even in the last month, September. Orange and red, however, with the elimination of the highly erythrophyllic red maple, appeared in April and brought fresh species up to July and August respectively. Hummingbirds appear in this vicinity in April and depart in September, lingering only, in my experience, where an abundance of garden flowers is available until October 5, and usually rare in the open country by September 20. Reds opened with the largest

number and declined toward the end of their season as thicker foliage shut off the light. Oranges opened with one or two and increased in number until their last month, which showed most new arrivals. I secured a list of the same colors from the northeast and found a similar graph as to appearances of fresh species and numbers, with some to be expected seasonal delay.

Barring the previously mentioned red maple, and some introductions from abroad, all these red flowers showed an approximate tubular flower, the form preferred by Hummingbirds. This was true of the majority of orange flowers. Nowhere in eastern North



GRAPH by COLORS of 110 SPECIES of FLOWERS VISITED by HUMMING BIRDS

America have I been able to find a true bird flower outside of these two colors, but to bird-insect flowers this does not apply. I decided to make a graph following the spectrum roughly with species of flowers Hummingbirds had been seen to visit both in the open and in gardens. The final list represents 110 species of which 45 are red and 19 purple while oranges, including here those

red and yellowish bicolored flowers which often appear orange at a short distance number 15.[1] My experience had led me to expect this result. But how explain it? In popular nature literature, and in private conversation, both, it has been suggested that it was the admixture of red in the two other colors. The old idea of Brewster which considered red, yellow, and blue as the primary colors lends strength to this, as does the mixing of pigments today. But Maxwell thinks red, green, and blue the primary colors, while Young, and also Abney support red, green and violet. Purple in its broad sense of course includes violet and a portion of the adjacent indigo in the spectrum, as well as combinations of red and blue which approximate these parts of the spectrum. It is not the purpose of this paper to deal with such points as dispute the occurrence of a true blue in the floral kingdom, or the occurrence of a true purple in the spectrum. That a certain shade of purple cannot be produced by any one set of light wave lengths, but only by combining violet or blue with red, does not eliminate the fact that purple as usually understood includes not only mauve and lilac but violet.

That the eye of the bird leaps through the spectrum hitting only in intense spots is unthinkable. The evolutionary scheme of colors with our present knowledge of all involved gives no help. Augustin de Candolle's scheme of dividing flowers into blues or cyanics, and yellows or xanthics, with true red as a neutral, seems to show one thing that we would expect, especially with some of the modern limitations placed on the theory, *i.e.*, the more tropical xanthics appear to supply more Hummingbird flowers. The coloring of vegetation in the tropical regions is much more intense, and Hummingbirds making up what is overwhelmingly a tropical family may naturally be expected to be instinctively on the outlook for intensely colored flowers. At some season of the year nearly every species of these birds is found in the tropics, and in red Hummingbird flowers, my present information points to a choice of the scarlet of the xanthic side rather than the crimson of the cyanic side. The overwhelming number of tropical species of *Trochilidae* can be appreciated only by comparative study. Colom-

[1] A vari-colored, indefinite flower included in the list, could not be assigned strictly to any one color scheme shown on the graph.

bia is their great center, containing almost a third of the known species. As we work out in any direction from this region there is a noticeable decrease in number of new species found, until Argentina on one side, and the United States on the other, probably show no species not encountered nearer the equator, at least at some time of the year.

It is easy to perceive that Hummingbirds prefer the intensity of color shades rather than the paleness of color hues. Take for example the drop from reds to pinks certainly containing red and from purples to lilacs. Once perceiving this I feel we are on the right track to a solution of the problem, which appears to hinge largely on the matter of visibility by day and concealment at night, the same problem that we have between day-flying and night-flying insects. Lovell in 'The Flower and the Bee' considers red, blue and purple favorite colors of the long-tongued species. Plateau, as I find in Kellogg's 'American Insects,' in his experiments contradicted the classic color experiments of Lubbock and apparently showed that smell, or some sense other than sight, leads bees to flowers. Butterflies too seem to prefer the intense shades as for example the rich orange of butterfly weed, *Asclepias tuberosa*, sometimes visited by Hummingbirds. Whether or not insects perceive color need not enter into the question. If they merely see colors as shades of grey, still pink, true yellow, light blue, lilac and white would be highly visible at night expecially by moonlight, while red, orange, deep blue and purple would not be perceived, and the night moths would leave their nectaries more nearly full. Such a fact must eventually impress itself upon the feeding instincts of the Hummingbird.

The question is one that cannot be decided by mere rule of spectrum or pigments. There is so to speak a relativity of colors. A white wall, a snowy mountain, and an icy lake are to the careful observer, watching late in the evening, a soft pink. A white wall seen through a hedge may appear soft blue, as do certain indoor and ice-plain shadows, while an asphalt pavement under certain lights gives a dark blue.

Red being the complement of green is the most conspicuous color that a flower can show. In nature, as in commerce, it has good distinctive value against almost any other background.

Most conspicuous by daylight, it is quite invisible at night and in deep shadows. This makes it a very valuable color for flowers to be pollinated by color-perceiving honey-seekers. Pink while visible at day unless of a deep shade is also highly visible by night.

Orange, while not so brilliant, is more showy in deeply shaded swamps and woods than is red, and where deep enough in shade is also invisible at night. Orange will shine through a series of intervening shadows broken by sunlight shafts where red remains in obscurity. It is a valuable color for *Macranthera* growing on the edge of Mississippi bay swamps so dark that Owls call in the shadows at midday, and for jewel weed (*Impatiens fulva*) frequently found along the edge of shadowy thickets in Atlantic slope swamps, where it is frequented by Ruby-throats. Further west, on the sunny prairies and the less forested Pacific slopes it probably plays less part in the luring of pollinators of the feathered type.

Yellow, while brightest of colors, and popular with insects, some if not all of which probably perceive by shades of gray, is too near green to be highly noticeable to a color-perceiving eye, and it is also too often used in light and foliage trickeries to trust. Next to white, it appears most visible at night in moonlight, unless golden or orange-tinged.

Green flowers are too inconspicuous among foliage. In certain contrasting desert backgrounds, or on sere dry-season prairies it should have value. Thus, while no green Hummingbird flowers are known in the East, *Nicotiana paniculata* one of the greenest large flowers I know, is much frequented in the west during the dry season at least.

Blues when too dark to be visible at night are almost invisible by day. Of all colors blue approaches white nearest in its lighter hues and black in its darkest shades. Prismatically it and yellow produce white, a fact long appreciated by the laundress who whitened yellow linen with bluing. The little African lobelia, *L. erinus* is hard to distinguish despite its massed growth, and at the width of a street away one finds himself wondering if it has not withered even with the sunlight directly on it, and when the shadows of the trees drop on it it is equally obscure. Rood in his 'Textbook of Color,' following Bezold, rejects indigo and inclines to ultramarine as a name for the spectral region next to violet.

Now Saunders in 'With the Flowers and Trees in California' tells of an artist on the desert who insisted that the blooms of the indigo bush (*Dalea spinosa*) were preferably designated as ultramarine. To me one of the biggest surprises of the summer desert has been this intensely blue flower on its dry thorny gray branches, so vivid nearby, and yet so obscure even in bright sunlight when seen at a short distance. Against a certain background it might be fairly conspicuous, but I know of dark blue bird flowers only from the literature.

Purple has, when properly placed, good visibility by day and obscurity at night. It is better fitted for producing bird flowers in the sunnier regions of the west I should think.

Lilac would probably show up better in the Southwest than in the East, being visible at night and Costa's Hummingbird being largely a twilight feeder.

The disadvantages of white are obvious, though the white day lily (*Funkia subcordata*) as I recall is visited by the Ruby-throat, and I think may even sometimes yield to the bird's gently inserted beak in the loose petals of the bud, thus beating the night moths in their own field. By day, however, certain leaves, such as those of mandrakes, give white reflections, at a distance appearing like beds of flowers, and such trickery might have a deterring influence in the development of so symbiotic a relation as that of pollination by animals.

But we must not lose sight of the keen form perception of birds in work of this kind. The Ruby-throat knows well the relation between bees and honey or nectar, and soon finds the sap-flows with their dark back-grounds and swarming hosts of bees, and then peers curiously into the door of the bee-hive evidently taking it for a similar sap-flow because of the presence of the insects. It pauses and examines the floating specks of soot in air perhaps taking them for spiders, and one hovered near a smoker's pipe one day probably taking the blue wisp of smoke for a spider-web. The young Anna, still being fed by the mother may be seen exercising and training the tongue on green pepper-tree leaves, and the older one will rush back and forth through a swarm of gnats or midges as if to take some as Swallows do. In the forest the different species quickly note the gleam of eye or of field-glasses and curiously investigate.

With such perception in use the visits to the neglected colors in garden hybrids of varied colors will be higher than among wild flowers. Dahlias, petunias, snap-dragons, pentstemons, nasturtiums, gladioli, zinnias, pansies, morning-glories, and amaryllis, these ten flowers, so often planted in beds of massed colors, I have preferred to consider in terms of their ancestral colors. The young Anna coming to the antirrhinum bed will try a red flower, feeling around the seeming openings in the calyx, and perhaps finally discover how to get into the mouth locked for sake of the bees. Once in, it is easy to get into the white phase standing near.

Obviously a graph, formed from a series of short notes in different localities, is much nearer the truth than one formed by long observation in a single spot if we merely use species of flowers. The casual visits of a dabbing nature must eventually draw a purely local list of neglected colors very close to, or beyond, the number of red species, which are decidedly limited in any one locality. Such a condition can be fairly tabulated only by recording by color the actual number of visits to the flowers, in a locality fairly representing the various colors.

Complete lists would probably show red, the sharpest contrast to green, a favorite everywhere, with orange in some favor in tree-shaded regions and a neglected color like green rising in sun-browned territory.

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