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EXPERIMENTS IN FEEDING HUMMINGBIRDS DURING SEVEN SUMMERS.¹

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The experiments herein described were begun without intending them to bear upon the question of the food naturally sought by the Ruby-throated Hummingbird (*Archilochus colubris*); the original aim of the feeding was to attract the Hummingbirds about the yard in the hope that sometime they would remain to nest there. The experiments have been conducted on independent lines without knowledge of any similar work that was being done by others until the autumn of 1912, except in one instance, where special acknowledgments are due Miss Caroline G. Soule of Brookline, Mass., who in Bird-Lore for October, 1900, described her success in feeding Hummingbirds from a vial, which she had placed in the heart of an artificial trumpet-flower made from Whatman paper and painted with water-colors. This suggestion of using artificial flowers was taken, but more durable ones were made from white oil-cloth, their edges were stiffened with one strand of wire taken from picture cord, and they

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were carefully painted with oil colors, the first to represent a nasturtium, and the second a tiger-lily.

In August of 1907 upon the appearance of a Hummingbird about our flowers the artificial nasturtium, tacked to a stick, was placed near a clump of blooming phlox, and its bottle was filled with a syrup made of granulated sugar dissolved in water. The next day a female Ruby-throat was seen searching the depths of tiger-lilies that grew north of the house; as she flew to the east of the house she was instantly followed, and was seen drinking from the artificial flower for the space of about a minute, after which she flew to a rose-bush, wiped her bill and rested a brief time before flying away. This was about noon. She returned at intervals of about a half hour for the next three hours, then at 3:10 o'clock she came back to search quite thoroughly the phlox blossoms, this being the first time she had paid any attention to them after finding the syrup. Ten minutes later she drank deeply from the bottle, and was seen no more that day.

In this way began the feeding of the Ruby-throated Hummingbirds, which has been continued each summer since 1907 with a varying number of birds. The first season it appeared that but a single bird found the bottled sweets. Perhaps it was the same bird that came the following summer, and was not joined by a second Hummingbird until the latter part of August. In 1909 the number was gradually augmented until seven of these birds were present together. The following year there were days when again seven came at one time; since then four have been the largest number seen together.

The days and weeks are calm and quiet ones when a single bird has the bottles to herself. More or less fighting ensues as soon as another bird comes on the scene, and the tumult of battle increases with each new arrival until the presence of six or seven of these tiny belligerents makes the front yard appear like the staging of a ballet. With clashing sounds and continuous squeaking cries they chase each other about, often swinging back and forth in

an arc of a circle with a sort of pendulum-like motion. Sometimes they clinch and fall to the earth where the struggle is continued for many seconds. So jealous are they lest others share the syrup that they seem more anxious to fight than to drink. When seven are present they are very difficult to count, and appear to be three-fold that number. We have read accounts of forty or a hundred Hummingbirds hovering about a tree or bush. Clearly these numbers must have been estimates, probably large ones, too, any one must believe, who has made sure that only seven birds have created the maze of wonderful and beautiful motion in which there seemed to be a dozen or a score of participants.

The number of bottles in use has been sufficient on most days to satisfy the needs of all the Hummingbirds present. Each new bottle has been added by way of an experiment. The first one was placed in an artificial flower painted to imitate a nasturtium, mainly yellow in color; the second flower in form and color closely resembled a tiger-lily. The experiment with the yellow and the red flowers was to test a supposedly erroneous theory which had been published to the effect that Hummingbirds show a preference for red flowers. In further proof of the fallacy of this statement the third flower, shaped like the nasturtium, was painted green, and was placed in a bed of green plants which at that time bore no blossoms. It was pronounced by other people to be "exactly the color of the surrounding foliage." It was staked out and filled on August 5, 1909, when no Hummingbird was in sight, but in about ten minutes some of the species had come, and fifteen minutes later one was drinking from the bottle in this green flower.

It was then suggested by my sister, Dr. E. Amelia Sherman, that I try a bottle without an encircling flower. The problem of supporting a bottle without an artificial flower was solved in this way: The bottle was encased in a piece of unbleached muslin, enough of the cloth extending beyond the bottom of the bottle to allow the tacking of it to a stick. The support of the bottle in a position slightly up from the

horizontal was furnished by a piece of leather with a hole in it through which the bottle was thrust, and the leather was then nailed to the stick. In this arrangement the most vivid imagination can find no suggestion of a flower. It was put out on August 8, and in forty-three minutes a Hummingbird was drinking from it. The bottle was then moved from proximity to the artificial nasturtium and tiger-lily, and a Hummingbird found it in its new location in thirty-two minutes. This place about eight feet from the artificial flowers has been its position in the four succeeding summers. In July, 1911, two more flowerless bottles were added to the group, making six in all. For convenience in referring to them the flowerless bottles will be called by numbers 4, 5 and 6.

Bottle No. 4 had not been long in use before it was noted that the Hummingbirds showed preference for it, while the nasturtium was sought least of all. This seemed due to the deep insetting of the bottle in the flower, which caused the birds to brush against its lower leaves, an unpleasant experience when sticky syrup adhered to it. For this reason the filling of the nasturtium was sometimes omitted for several days whereupon the Hummingbirds soon ceased to visit it, although drinking regularly from the tiger-lily a few inches away. When the filling was resumed the birds returned to it as they had been accustomed.

In the fourth season of experiments the bottle held by the green flower was put out when the others were, but was not filled for six weeks. During that time Hummingbirds were present and drinking on twenty-three days. It is safe to say that they were seen drinking fully four hundred times from the other bottles, but never once were they seen to approach the green flower. The first morning it was filled four of them were about the yard and one drank from this flower two minutes after the filling. The following year (1911) after dark on July 14 the green-flower bottle was set in its bed of green and was left empty for a few days. About noon on the 17th one of the Ruby-throats visited it, thrust-

ing in her bill; the bottle was then filled for the first time that year, and in a half minute a bird was drinking from it. To this is added a transcript from my journal bearing date of July 17, 1912; "About 9 A. M. before I had put out any syrup a Hummingbird was dashing from bottle to bottle and tried the green-flower one. It was bent over in the green foliage, and certainly has had no syrup in it for six weeks or longer. I filled it after I saw the bird visit it, and she came again to drink."

The new bottles No. 5 and No. 6 covered like No. 4 with white muslin and nailed to a weather-beaten fence picket were put out after dark on July 23, 1911, but neither was filled for one week. The next morning about eight o'clock a Hummingbird was searching one of these bottles for suspected sweets; four such visits were noted in one day and on several other occasions. At the end of the week the filling of No. 5 began but no syrup was put in No. 6 for two years. During these years a record was kept of each time a Hummingbird was seen to visit and search this unfilled bottle, and the total number was fifteen in addition to those visits already mentioned.

Thus far this writing has been confined to a description of the things seen; no theories have been advanced, no deductions have been made, no hypotheses have been carried to their logical conclusion. The first deduction offered is, that at the beginning of the experiments in 1907 the artificial nectarium may have led the Hummingbird to explore its depths, and finding its contents to her taste she returned to it. Other birds may have found the syrup there in the same way, yet it seems more likely that most of them were led to the bottles by seeing another drinking. This probably was the case with the Catbirds that have drunk from the bottles on several occasions, although they have found it an inconvenient performance. The same may be true of a pair of Chickadees that drank as long as they remained with us. They clung to the stiff leaves of the tiger-lily and found no difficulty in the way of drinking. Only one Hummingbird

learned to perch on this flower and drink from it while standing. From the earlier experiments it was suspected that the Hummingbirds found the syrup through some sense, rather than stumbling upon it by chance or through imitation, but several things disprove such a supposition. The principal one is that migrants passing through the yard in the spring, but more especially in the fall, fail to find the syrup. That these migrants can be recognized as such by their behavior will be shown farther on.

The twenty-five or more visits paid to bottles No. 5 and No. 6 before they were filled for the first time show that the birds recognized them as receptacles for their food, though they were new bottles occupying new locations. To make sure that the birds should not be attracted to them by seeing me stake the pickets out this work was done after dark. The first summer that No. 6 was out frequent pretenses of filling it were made in sight of the birds, but no response followed. The next summer no such pretenses were made yet a Hummingbird was seen to search this unfilled bottle on May 12 and 31, twice on June 1, on July 21 and 26, on August 4, 7, 12, 23 and 26.

One is led to wonder if the Homeric gods on high Olympus were more deeply stirred by the appearance among them of the youthful Ganymedes bearing cups of nectar, than are the Hummingbirds at sight of their cup-bearer. When several of them are present the wildest confusion reigns. Possibly not one of them is in sight when the door is passed, yet instantly the air seems filled with them: some swinging back and forth in the air, squeaking and fighting, or darting from bottle to bottle thrusting in their bills as they pass, while an over-bold one will buzz about my head, sometimes coming under the porch in her zeal for the meeting; but the timorous ones fly from their perches into sight over the bottles then back into a bush. Some one of these types of behavior marks the bird boarder from the migrant. The latter pays no attention to cup-bearer or bottle but diligently searches each bunch of blossoms. For two or three weeks

after the drinking birds have left there is occasionally a migrant among the natural flowers. The bottles are full of syrup but it passes them unheedfully.

Habits seem to change when steady drinking is practiced, but in the case of the birds the habit does not appear to be a harmful one. At once she ceases to search the flowers and, like the typical summer boarder, she sits and waits for the food to be served. Each bird appears to have her favorite perch, a dead twig of syringa or lilac bushes on the north, or on the south in one of the snow-ball bushes; the telephone wires on either side of the street offer acceptable waiting-places at times. Not infrequently I have been intent upon other duties about the yard and looking up have found a Ruby-throat perched directly over-head, her bright eyes seeming to say "I want to be fed." So complete appears the cessation of the search for other food that it led to the keeping of a full record for the past three years of every time one of these birds has been seen catching insects or searching the natural flowers for food. Most of these instances noted were, if the whole truth could be learned, probably, cases of strangers just arrived within our gates, that had not yet acquired the drinking habit.

In 1911 the drinking birds were about our place on forty-three days. During that time on only four occasions was a Hummingbird seen catching insects or probing the flowers. A large number of plants called "Star of Bethlehem" had been raised, these flowers in previous summers having proved a great attraction to the Ruby-throat in the yard of a friend living two miles distant; but our drinking birds were never seen to visit these flowers. After their departure strange Hummingbirds searched them thoroughly as well as the phlox, tiger-lilies, sweet peas, nasturtiums and clover. These strangers were present on twelve days. In 1912 the drinkers were with us on seventy-seven days, and were seen but ten times seeking other food than syrup. In 1913 for forty-nine days the drinking birds imbibed, and on nine occasions a Hummingbird was seen gathering food elsewhere. In the

169 days that make the grand total for the three summers the Ruby-throats were seen drinking syrup between one and two thousand times, they were seen collecting food away from the bottles twenty-three times, but one cannot be positive that insect food was always taken then. Never for an instant was one of these birds in captivity, and there was the utmost freedom for it in choice of food.

This choice of a sugar diet together with the large amount consumed caused surprise and soon called forth the estimate that a Hummingbird would eat a tea-spoonful of sugar in one day. Some method of testing this estimate was sought, resulting in a plan for putting the bottles beyond the reach of the ants that swarmed about them: The stick that supported the artificial nasturtium and tiger-lily was nailed to a block of wood which was submerged in a flower-pot filled with water. For a short time this arrangement served very well until leaves and flower petals fell in forming rafts upon which the ants were able to cross. No myrmecologist was at hand to suggest a remedy, but at last ants' aversion to kerosene was recalled and the water was covered with a film of kerosene, which effectually debarred them. Nevertheless one day the ants were found taking the syrup as of old; an examination of existing conditions showed that a grass stem had lodged against the supporting stick, forming a bridge over which these wise little creatures were busily passing to and fro. Except when the bottles were isolated in this manner ants of various sizes and different colors fed constantly on the syrup often crowding a bottle to its very mouth, but this did not prevent the birds from drinking. I am not prepared to say that they never took an ant as food, but I have stood as closely as is possible to a bottle while a Hummingbird was drinking from it, and none was taken at such times. When a new bottle was placed, or the old ones were set out in the spring and filled it took from one to two days for the ants to find the syrup. A small red species generally, if not always, was the ant to make the discovery, the fruits of which it enjoyed

for a very brief season, a large black ant soon taking possession and holding the spoils for the rest of the summer.

The bottles, having been removed from the encroachments of the ants, were ready for the first test. One bird being the sole boarder at that time a level tea-spoonful of sugar dissolved in water was consumed by her daily. In time two, three, four and five Hummingbirds having joined her the quantity of sugar was increased accordingly, a spoonful or two being added to offset any possible waste. In this way more than a pound of sugar was eaten in twenty days, or to be more exact three cupfuls, weighing 9252 grains; which made an average of 462 grains per day. This for the six birds frequently counted as present confirmed the first rough estimate of a tea-spoonful of sugar daily for each bird.

Another method of estimating the amount eaten was devised. On several days the sugar and the water were carefully measured and weighed, then weighed and measured again, after which the syrup resulting from their combination was also measured and weighed, until I felt confident that in a dram of the thinnest syrup served there were forty grains of sugar, or two-thirds of a gram to every drop. But the syrup usually used was considerably richer than this, easily containing a grain of sugar in every drop; but it seems best in giving the estimates to keep them to the weakest grade of syrup ever served.

In making the test a dram of syrup was measured in a glass graduate, and bottle No. 4 was filled. This was always done in the morning when the bottle had been emptied by ants. A waiting Hummingbird came and took her breakfast after which the residue of syrup was poured back into the graduate, the bottle being thoroughly drained. Possibly a drop still adhered to the bottle, but the number of minims now in the graduate subtracted from sixty must have given very nearly the amount drunk by the Hummingbird. In two summers a number of these tests were made. A bird took for her breakfast from eight to twenty minims, the average being fifteen. Using the low estimate of two-thirds of a

grain of sugar to each drop the average breakfast held ten grains of sugar. A better comprehension of the size of that meal may be gained by remembering that two large navy beans, or one medium-sized lima bean also weigh ten grains. Breakfast and supper were the Ruby-throats' heaviest meals, but there were many luncheons between them. By reckoning eight to nine such meals daily, (and beyond doubt there were that number), we reach again the first estimate of seventy to ninety grains of sugar as the daily ration. About this amount of sugar is held by a common tea-spoon when level full; such a spoon will hold from 110 to 120 minims of water, whereas one of those heir-looms, a grandmother's tea-spoon, is the measure of the standard tea-spoonful of sixty minims. Referring then to the standard measure the bird would be said to eat two tea-spoonfuls of sugar daily. An ordinary cube of loaf sugar contains the equivalent of this amount.

Reflecting upon the bulk consumed by so small a creature one naturally desires to know the weight of a Hummingbird. A little boy brought to us the body of a male, that had been shut into a machine shed, where its death may have resulted from starvation. Its weight was thirty-three grains. Naturalists in early days were vexed by the same question as is shown by a quotation given by Mr. Ridgway in his book on Hummingbirds. It is from "Philosophical Transactions," 1693, by Nehemiah Grew, who wrote: "I did weigh one (in those parts) as soon as ever it was kill'd whose weight was the tenth part of an Ounce *Avoirdupoise*." From these weights one makes the deduction that our Hummingbirds are accustomed to eat of sugar twice their own weight daily. If human adults ate of sugar proportional amounts there would be required nearly three hundred pounds of this saccharine food daily for the average person.

No attempt has been made to tame the birds that came to drink, yet one, perhaps two of them, became bold enough to drink when a bottle was being filled; while she thrust her bill into the empty receptacle a spoonful of syrup was fre-

quently held touching the mouth of the bottle, but she did not learn to drink from the spoon. While drinking the tongue was extended about a quarter of an inch beyond the tip of the bill, and two or three drops were sipped before the bill was withdrawn. Once fifteen drops were taken with three insertions of the bill, and at another time the bird drank without the withdrawal of her bill for about the duration of a minute. At such times the bottle was free from ants, probably they were present when the drinking was done with numerous sips. Often a bird preferred to take her breakfast in courses, perching on a nearby dead twig for a minute or two between drinks.

During two of the seasons it was thought that some of the birds roosted on our place appearing as they did very early, and making a long day for feasting and fighting. In other years the birds were seen to fly eastward at night and their morning arrivals were not so early. One June morning a bird was ready for her breakfast at four o'clock, and took her last drink at night just before the clock struck eight. On some August days there are records of their presence at break of day, in one case it was thirty-eight minutes before sunrise. They usually lingered a short time after sundown, drinking long and deeply before taking their evening departure.

The conviction that the same birds were returning to us summer after summer began to be felt at the beginning of the fourth season. On May 26 of that year the first Hummingbird appeared on the place. The next day the flowerless bottle No. 4 was put out, and in a few hours a bird was drinking from it. For the next three weeks she was seen drinking from this bottle on every day except two, but not in the middle of the day; then for two weeks she was missed, returning again on the first of July.

The history of the fifth season was similar, Hummingbirds having been seen on May 22 bottle No. 4 was staked out and filled for a few days. No bird coming to drink, the bottle-filling had been discontinued, when on June 6 a Hum-

mingbird on suspending wings was seen searching this bottle, not finding syrup in it she flew to the spot always occupied by the flower-pot holding the artificial flowers, when they were in place. Over this vacant spot she hovered an instant before flying away. On a few other June days a bird of this species was present, and on the 17th one was seen drinking, but her steady summer boarding did not begin until July 9. In the sixth spring the species arrived earlier than usual. No bottles were out on May 7 when a Hummingbird was seen hovering over the customary place for the artificial flowers. As quickly as possible these flowers were put out, but before they could be filled the bird was thrusting her bill into the tiger-lily. She came to drink on most of the days thereafter until June 9, also June 14, 15 and 24, and on July 1 and 2; but it was not until July 16 that she came for constant drinking.

These dry and dull details have been given in full because two theories were based on them. That the birds of former years have returned to be fed seems unquestionable from their searching at once flowerless bottle No. 4, and from the other evidences offered. Because the birds came in May and at intervals in June and July, before becoming steady boarders about the middle of July, seems to indicate that they nested two or three miles away, too far for daily trips after incubation began. The supposition that these nestings were in the woods is founded on the fact that in leaving the birds flew in that direction, also because they were never found about the trees of the four farm-yards that intervene between our place and the woods. That in two summers a mother Ruby-throat returned with her daughter was suggested by seeing on several occasions two birds drinking together from one bottle, a phenomenon that needs explanation when we consider the pugnacious disposition usually exhibited by one drinker toward another.

In further confirmation of the foregoing is the history of the feeding in 1913. Bottles No. 4 and No. 6 were set out on April 30. For two months and a half no Hummingbird

visited them. It chanced on July 14 that the stick support of No. 4 was lying on the ground, leaving only No. 6 in position, when my sister saw a Hummingbird thrusting her bill into it. She hastened to fill this bottle, which was the first time it had ever been filled, and it lacked but eight days of two full years since it was first set out. Six days later I was in the orchard a hundred feet or more distant from the bottles, when a Hummingbird flew toward me and buzzed about my head as do no other birds except those that are fed. With greatly accelerated pulse I hurried to the house and filled the bottles. In exactly two minutes the Hummingbird was drinking from one of them; this was the first drinking witnessed in that year. It was one of my most thrilling experiences in bird study. Two marvelously long journeys of from one to two thousand miles each had this small sprite taken since last she had drunk from the bottles, yet she had not forgotten them, nor the one that fed her. She was quite prone to remind either of us when the bottles were empty by flying about our heads, wherever she chanced to find us, whether in the yard or in the street. Once having been long neglected she nearly flew into my face as I opened the barn door to step out.

The last experiment made was that of flavoring one of the bottles of syrup with vanilla, and later with extract of lemon, to see if the birds showed preference for the plain syrup or for the flavored. Both kinds were served at the same time, and of both the birds drank, showing no choice that could be detected.

It may already have been surmised from the gender of the pronoun used that it is the female only of this species that has the "sweet tooth." Never once in the seven summers has a male Ruby-throat been seen near a bottle. The drinking birds have been examined long and critically, with binocular and without, in order to detect on some of the birds the identification marks of the young males, but without success; moreover, had young males been present they, too, would have been apt to return in later years. This absence of the

males led to noting their scarcity in general, and to recording in note-book when and where a male at any time was seen. The entire number seen in the past five years has been six on our place and six elsewhere. It is impossible to do more than estimate the number of females that have been seen; but when it is remembered that on several days in two summers seven have been in sight at one time, it does not appear to be an over-estimate to place their number at twelve or fifteen for each year, or six times more of them than of the males.

The simple experiments herein described are such that they may be tried by any one having a yard frequented by the Ruby-throat. If any one doubts that the female of this species will choose a saccharine diet, when it is available, let him continue the tests until convinced beyond cavil or a doubt. It is especially desirable that the experiments be made in proximity to the nesting birds in order to see if the mother will feed syrup to her nestlings. Sometimes our Catbirds and Brown Thrashers have come into the porch to the cat's plate and taken his bread and milk for their nestlings. Upon this hint for needed aid I have put bread soaked in milk on the fence railing for them, and they have taken it also. It is reasonable to believe that in like manner sweet benefactions proffered to a hard-working Humming-bird mother might be acceptable to her, and shared by her with her nestlings.

NEST LIFE OF THE CATBIRD.

Dumetella carolinensis Linn.

BY IRA N. GABRIELSON.

The data, on which this paper is based, was obtained from partial studies of three nests of this species during the summer of 1913. One of these was watched at Sioux City during the last two days of the nestling period. This nest will be referred to as nest A in the paper. The other two nests were located at Lake Okoboji, Iowa. One was observed by Mr.