

A STUDY OF TWO NESTS OF THE
BLACK-THROATED GREEN WARBLER

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PART II: CHRONICLE OF THE AUGUST NEST

It must be confessed that the discovery at 5:05 P. M. on July 26th of another nest of this species a quarter of a mile to the east of the first did not evoke quite the same enthusiasm as had the event of July 9th. This nest was thirty feet up in an ancient hemlock, fifteen feet from the trunk; I climbed the tree and found it was impossible to examine the contents. The female appeared chipping, and soon the male arrived, only to be driven off by his mate. At 5:15 she settled on the eggs, but when her mate came almost to the nest, she left to chase him off. Ten minutes afterwards she approached the nest but darted away, repeating the process two minutes later. The male flew down past her, and she pursued him. Twice again she neared her nest but turned back, and twice again she chased her mate before I left at 5:42.

Incubation. Ten hours were spent in observation during incubation, but the results were far from satisfactory. The nest was so well concealed that usually it was impossible to be sure whether or not the female was on the eggs. She was also much more timid than the other bird, but her distrust showed itself in such an unusual way that I did not at first take the necessary precautions to allay her fears. She did not chip after the first day until after the young were half-grown, but she sometimes, although not always, refused to stay on the nest after returning to it unless I had left my usual seat, in plain sight twenty feet to the north of the nest, and had hidden myself under a distant hemlock. That my presence did not prevent her from leaving the nest was shown on August 2d, when she departed two minutes after my arrival.

On July 27th, 29th, and 30th there was one twenty-minute absence each day, and on the latter date a period on the nest of more than 78 minutes, although the temperature in the woods was 80° F. On August 2d there was one absence of 15 minutes, and on August 5th there were absences of 15 and 13 minutes and one period on of 99 minutes, although again the temperature was around 80°. The incubation periods of this bird were much longer than those of the first female. Again there is evidence of shortened absences the day before hatching.

This male sang in the nearest hemlock grove, but as this was seventy yards from the nest, it was difficult for me to hear more than the two highest notes of his song, and I suppose much of his singing never reached me at all. He was singing on July 30th, but on August 2d and 5th I heard only series of chippings from him, apparently signals to his mate to leave the nest and join him. I have no later evidence of his presence.

Care of the Young. On August 6th the female left at 8:06. I retired as usual, but unwisely left my pillows in full sight, and they proved as disquieting as my own presence would have been. At 8:25 she visited the nest but dashed away; I expected a prompt return, so waited, but finally at 8:58 I concealed the offending objects and went back one more to my hiding place. At 9:03 she alighted within ten inches of the nest, sat there for two minutes apparently listening to the screams of a Red-tailed Hawk (*Buteo borealis borealis*), and then went to the nest. At 10:26 she left, and I did likewise, making my pillows into an inconspicuous pile; in fifteen minutes she returned and went directly on the nest, leaving again fifteen minutes later. At 10:15 she returned with food for the first time since my arrival at 7:40, then brooded quietly till 10:53. This time I stayed, as the female returned with a small green larva; she started to leave at sight of me, but turned back and fed and cleaned and inspected for about four minutes, then left to the south. The young must have hatched before my arrival, for I saw no manipulating of egg-shells.

I watched till 12:26 and again from 1:35 to 5:15; she brought fourteen meals in all, but strangely enough brooded after only eight of them. The explanation of her erratic conduct might have been nervousness (although she did not appear to pay any attention to me) or perhaps inexperience. The temperature was 70° in the morning and 80° in the afternoon, considerably warmer than on any of the subsequent days of nest life.

On August 7th, 8th and the morning of the 9th, the female had settled down into the typical routine of brooding after practically every meal, as will be seen by the chart of her activities. She brooded considerably more than the first female, but this was probably due to cool weather—from 66° to 76°. Her rate of feeding for the first four days ran much the same as at the first nest—once every 30, 31.2, 30, and 25.7 minutes respectively, but on the 10th it was much more rapid, once in 18.6 minutes. Like Female No. 1 (although a day later in the cycle) she suffered a relapse on the following day, feeding once every 30 minutes during three hours on the next afternoon; if observations had been taken also in the morning, the rate might not have

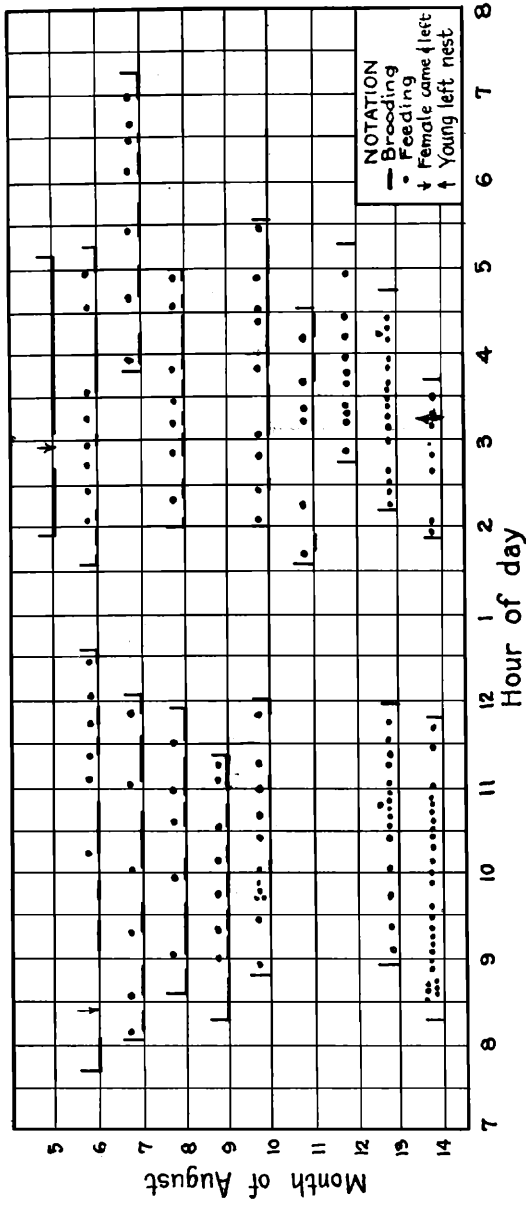


CHART II
INCUBATION, BROODING AND FEEDING OF THE SECOND FEMALE

been quite so slow. The average rate of feeding during the $32\frac{3}{4}$ hours observation of the first six days was once every 26.9 minutes, almost the same as that during the 52 hours of the first six days at the other nest, once in every 25 minutes.

During these first six days the female was heard to chip on only one occasion—two chips at 10:58 on August 8th. On the 9th she chased off a Chickadee (*Penthestes atricapillus atricapillus*), but as soon as she had left, the Chickadee came to the nest and looked in. A red squirrel lived in the vicinity and every day scolded me at length from the nesting tree; but the Warbler showed no concern. On the 10th I first noted a baby's head raised above the nest, and the next day both were occasionally visible. On the whole, the female was silent, never present in the vicinity between the infrequent meals she brought, and only occasionally showed originality in approaching and leaving. But the afternoon of the 12th she showed a greatly increased rate of feeding—once every 13.5 minutes; also before the second feeding at 3:16, the female chipped vigorously for three minutes, although at all other times she was silent. The young for the first time were noisy.

The next day the female seemed like a different bird. She chipped, often with great vigor, at all but four of the 32 feedings; she spent much of the time in the vicinity, gathering food near by instead of far away, she fed on an average of once every 10.3 minutes, and she evinced much originality in her methods of approach and departure. The morning of the 14th she showed the same behavior to an even greater degree, chipping that sometimes became vehement being given in connection with all but two of the 27 meals, which were brought at average intervals of once every 7.7 minutes.

Early in the morning the young reacted to their mother's arrival when she was ten inches from the nest, by mid-morning at a distance of eight feet, and by noon the moment she came into the tree. At 8:43 I noted they were greatly excited, and at 8:45, 10:08, and 10:25 that they nearly left the nest. At 8:45 the female after feeding returned to the nest chipping very loudly as if to stir up the young.

I left at 11:48, and upon my return at 1:55 found that one baby was in the branch two feet below the nest calling constantly, while the nest baby was quiet. The female, giving about one chip a second, carried a tiny larva to the baby, but flew off, returned, and then darted away. A Red-eyed Vireo approached the nest; the Warbler dashed at it but it refused to leave. In the excitement the baby fluttered to the ground, and his mother followed. I went to look at it, and she became perfectly frantic,

flying around and about in a great circle, chipping desperately, fluttering her wings very fast, with her tail spread and drooped, as she dashed about over the ground. I returned to my seat, and the baby, who had kept absolutely quiet, started to climb a stick. His mother came hurrying to him, guarding him and encouraging him away from danger. He progressed by big hops, sometimes aided by his wings, and soon was out of sight.

At 2:38 and 2:49 the nest baby was fed and at 3:17 it clambered out of the nest and stopped two or three inches away. Two minutes later the female came with food, approached the baby with loud chips, but darted away. The baby tried to follow but fell a short distance, while the female flew about; it made another attempt and tumbled to the ground. She flew down and hurried it to the south, so that in a few minutes it was one hundred feet from its birthplace.

My husband climbed the tree to poke the nest down, and the female came flying back protesting. As with the other warbler, the tie with the nest was not immediately broken by the leaving of the young.

The chipping of the female was a matter of excitement, sometimes due to fear, at other times evidently a stimulus to the young to be up and doing. Although to my ears the notes did not differ except in rapidity of utterance and in loudness, the young reacted in directly opposite ways according to whether a warning or encouragement was intended. There were two clear cases of warning, the one already mentioned when I went to look at the first little bird after it had fallen on the ground, and the day before, when the female chipped after each one of the distant screams of a Red-tailed Hawk, the young subsiding into the nest. In the first case the chipping was the most violent I ever heard from this bird; in the second it was rather subdued.

How much of her almost constant chipping during the last two days was incited by distrust of me, and how much was a normal expression of excitement over the imminence of the fledging of the young, it is impossible to say. On the afternoon of the 14th before I came in sight of the nest I heard loud chipping that could have had no connection with myself. It may be that much of her vociferations in my presence expressed a mild degree of disturbance that called forth no response in the young. Her silence during the first six days and her clamor during the last three reflected the normal rise of parental devotion.

TABLE II
ACTIVITIES OF THE FEMALE AT THE AUGUST NEST

AUG. HOURS	BROODING			FEEDING		EXCRETA		
	<i>Per cent of time on nest</i>	<i>Average length brooding</i>	<i>Average time off</i>	<i>Number times fed</i>	<i>Rate of feeding in minutes</i>	<i>Eaten</i>	<i>Carried</i>	
6	7	50.7	21.1	27.1	14	30.0	?	0
7	7¼	59.1	21.3	15.4	13	31.2	1	0
8	6	62.9	19.3	11.2	12	30.0	?	0
9	3	54.2	14.2	13.7	7	25.7	?	0
10	6½	19.3	15.0	18.6	21	18.6	?	2
11	3	20.5	12.3		6	30.0	?	3
12	2½	6.6	10.0		10	13.5	0	8
13	5½				32	10.3	1	11
14	5¾				34	9.3	0	11
Total	36				169	16.3	2	35

Discussion of Brooding and Feeding. The brooding of this female was much less consistent than that of the July bird, partly because of her erratic behavior on the first day resulting in an abnormally small percentage of time spent on the nest (even though I do not start the record until her return at 9:05), partly because of the cool weather that caused her to brood more than usual. She was more erratic than the other bird in the length of periods on and off, almost without exception these being both shorter and longer every day than with female 1. The average lengths of brooding at the August nest during the first three days approximate those of the first two days at the July nest, and the next three days that of the third day at the earlier nest. Her average time off was far longer on the first two days than that of the first female and shorter on the next two. The length in minutes of her periods on and off were as follows:

August 6, A.M. 21 (15) 15 (19) 38 (14, 13) 7 (8) 11 (7, 23);

P.M. (5) 6 (15, 16, 13) 7 (7, 21) 49 (8, 25).

August 7, A.M. 15 (12) 20 (20) 25 (21) 40 (20) 37 (13);

P.M. 24 (22) 27 (19) 23 (21) 12 (5) 4 (6) 10 (10).

August 8, A.M. (13) 12 (21) 15 (2) 9 (10) 13 (8) 40 (2) 8 (12); P.M. (13) 14 (5) 14 (14) 18 (5) 10 (17) 15 (17, 11).

August 9, A.M. 27 (13) 14 (5) 14 (14) 18 (5) 10 (17) 15 (17, 11).

August 10, P.M. (27) 7 (14, 7) 36 (9) 16 (16, 8) 23 (12).

The variation in the length of periods on was noticeable: 7 to 49 minutes, August 6; 4 to 37 minutes, August 7; 8 to 41, August 8; 10 to 18, August 9; 4 to 33, August 10; and 8 to 19, August 11. The same was true of her periods off: 5 to 25,

August 6; 5 to 22, August 7; 2 to 27, August 8; 5 to 13, August 9.

As to feeding, although this bird was as deliberate as the other during the early part of nest life, she showed typical behavior by speeding up from the sixth day on. She did not often bring large objects and almost never carried more than one at a time.

In ninety cases the number of seconds spent at the nest in feeding was measured; in this respect her behavior did not differ much from that of the other bird during the first six days, except that the periods fell into four-day and two-day groups rather than two three-day periods, but during her last three days she worked much more rapidly. (This bird never fed more than one nestling at a time, while the other often did so.) The periods on August 6th to 9th ranged from 21 to 135 seconds, median 47.5; on August 10th and 11th, 12th to 66, median 31 seconds; August 12th to 14th, 2 to 55, median 12. On the 12th and 13th they ranged from 8 to 45 seconds with a median of 13, on the 14th from 2 to 55 with a median of 10.

This female fed regularly from the east rim of her nest and usually faced west when brooding; occasionally she fed from the west or south. During the first six days she left most often to the southwest, and fairly often to the west, south, and north-west, and only rarely in other directions. But during the last three days she left predominantly to the east and south, and seldom in any other direction. During the first six days she left by climbing up the branches three times; during the last three she did this twenty-one times. This marked change in methods of departure was entirely different from female 1, who continued her old habits throughout the nesting period.

THE BEHAVIOR OF THE FEMALES

It was a fortunate chance that enabled us to study the behavior of two females of the same species that had the whole care of their families.

Did they succeed in raising all the young that were hatched? It is probable that the first did so, but problematical as to the second. This species usually lays four eggs, but Harlow ('18) states that "sometimes 3" constitute a full set. Judging from the evident inexperience of the male in the first case and the female in the second, it is improbable that either pair had already raised a brood; the lateness of the dates would indicate that each female had laid two sets previously. If this were so, it would not be surprising that three eggs should comprise the full clutch. The second female may have lost one of three pos-

sible offspring, either through the failure of one egg to hatch, or the death of a nestling when very young. The inaccessibility of the nest was unfortunate from our point of view, but may have saved the brood from the neighboring red squirrel.

In her failure to increase to any great extent her rate of feeding until two young had left the nest, the first female behaved more atypically than the second. But in other respects the latter was much more erratic and original in her ways than the former—in the abnormally small amount of brooding on August 6th, in the greater variability of periods on and off, and in the striking changes in conduct during the last three days both in the matter of chipping and in methods of leaving the nest. Yet on the whole the females were more alike in their behavior than different when we compare them with other Warblers, as may be seen in Table III, where the results are summarized of all published studies on birds of this family that give sufficient data to be representative.

It will be seen that Oven-birds (*Sciurus aurocapillus*) follow a much slower rhythm than the arboreal Warblers of the table; hence they will be disregarded. In the matter of brooding, the 11 females fall into four groups: short periods of 6.2 and 6.6 minutes, the Yellow Warblers (*Dendroica aestiva aestiva*) and one of the Black-throated Blues (*Dendroica caerulescens caerulescens*); medium periods of 9 to 11 minutes, the other Black-throated Blue, the Myrtle Warbler (*Dendroica coronata*), Redstart (*Setophaga ruticilla*), and both Magnolia Warblers (*Dendroica magnolia*); long periods of 14 and 15 minutes, Chestnut-sided Warbler (*Dendroica pensylvanica*) and the first Black-throated Green; and, finally, very long periods of 18 to 20 minutes, the second Black-throated Green and the Northern Parula (*Compsothlypis americana pusilla*). The last named Warbler is the only one of the eleven having a longer average period of brooding than our two birds. It is probable that long periods are not necessarily inherent in this species any more than in the others, but are merely a reflection of the lack of interruption.

In the columns dealing with the rate of feeding, the first Black-throated Blue and the Parula Warbler are not comparable with the others, because they were observed only during the first half of nest life, when feeding is typically slower than during the last half; the other studies cover to a greater or less extent the whole period. If we compare the rate of feeding at our two nests with those of the nine arboreal Warblers where both parents were active, we see that it was very much slower. However, the table gives no indication of the size of the meals brought nor of the number of young fed at each trip. Also it

TABLE III
COMPARISON OF BROODING AND FEEDING AT SIXTEEN WARBLER NESTS.

SPECIES	Average length of brooding	Rate of feeding both female birds	No. of times		No. of Age of young		REFERENCE		
			female fed	male fed	young	young			
Yellow Warbler I	4.5	1560	813	3	0-10	144	Bigglestone, '13	
Yellow Warbler II	3.7	277	112	5	0-9	29	Mousley, '26	
Black-throated Blue I	(15.0)	46	16	2	0-5	15½	Mousley, '24	
Black-throated Blue II	5.6	193	201	4	2-10	36½	Nice, '30b	
Maryland Yellow-throat	4.7	552	682	3	0-8	98	Shaver, '18	
Myrtle Warbler	10.9	48	60	3	3-9	19½	Nice, '30a	
Redstart	13.6	32	12	4	1-9	10	Mousley, '24	
Magnolia I	9.8	58	34	3	1-9	15	Mousley, '24	
Magnolia II	10.9	91	118	3	0-8	26½	Nice, '26	
Chestnut-sided	14.2	40	58	3	1-9	18¾	Mousley, '24	
Black-throated Green I	15.1	19.7	6	3	0-9	73	Nice,	
Black-throated Green II	18.3	16.3	169	0	2	0-9	36	Nice,
Parula Warbler	19.9	(42.9)	21	45	3	0-5	15	Mousley, '24
Oven-bird I	65.0	76.0	38	37	2	0-8	48	Mousley, '26
Oven-bird II	25.7	48.9	38	28	2	1-8	31	Nice, '31
Oven-bird III	27.1	35.5	54	0	3	0-3	32	Nice, '31

must be remembered that there were fewer young in the second Black-throated Green nest than in any other, while three of the nests contained more young than did the first of our 1931 nests.

The feeding rate of the females alone is of especial interest. Both Yellow Warblers fed at very rapid rates, once every 6.3 and 5.5 minutes, but one had five young and the other had to assume the whole task of feeding after the sixth day, when her mate was greatly frightened by a snake that carried off one of the young. The Maryland Yellow-throat (*Geothlypis trichas*) comes next with a feeding every 10.7 minutes; she and her mate raised a Cowbird besides two of their own young, truly a remarkable feat for such small birds. The Black-throated Blue female fed her four young on an average of once every 11.3 minutes. Five birds with much the same rate come next, a Magnolia Warbler (15.5), the second Black-throated Green (16.3), the other Magnolia (17.5), the Redstart (18.8), and the first Black-throated Green (19.7). The Myrtle Warbler and Chestnut-sided lag considerably behind with rates of 24.4 and 28.1 respectively.

The second Black-throated Green female proves to have the median rate of all the eleven Warblers, with the first one not much different. Here apparently lies the explanation for the slow rate at which their young were fed; the females appear to have followed their inherent rhythm, not bestirring themselves to feed any faster to make up for their delinquent mates.

Whether this inability to change caused the death of one little bird in the August nest it is impossible to say. The first female, we believe, adjusted herself successfully to the situation by the large size of the meals brought, even though she persisted abnormally long in a slow rate of delivery.

It is interesting to note in the table that in two of the sixteen pairs, the parents fed almost equally, in five the male outdid the female, but in nine she assumed the larger share.

BEHAVIOR OF THE MALES

We believe that our experiences this summer were atypical, and that as a rule the male of this species feeds his young.

On July 1, 1928, I found a nest at Grey Rocks (Pelham) conspicuously situated, twenty-five feet from the ground and nine feet from the trunk of a hemlock. I could not examine the contents, but the young must have been about half grown, for the female did not brood, yet the nestlings were not developed enough to be noisy or visible above the rim of the nest. From 8:30 to 10:30 the female fed 15 times, the male 6—once in 5.7

minutes for both, once in 8 minutes for the female. Four of the insects offered by the female were large, one was small; once several were brought at one trip. During the first hour the male gave 287 songs. Unfortunately the following morning the nest was empty.

A nest containing four young about six to eight days old was watched for six and one-half hours on two days by Stanwood ('14); the male fed 22 times, the female 25—once in 8.1 minutes for both birds, once in 15 for the female alone.

At a nest in the Berkshires found June 29th by Reading and Hays ('31) the male fed a third as much as his mate, who "invariably brought a heavier load." When both met at the nest, he sometimes passed the food to her. In a letter Mr. Hays tells me that the young were fed during the earlier part of nest life about 10 to 12 times an hour, and later about 12 to 14 times an hour. Two of the four young perished during storms, one of the survivors leaving July 5th, the other July 7th. The female of this pair fed the young when held in people's hands, and Job ('17) describes a male that was equally bold. In no less than nine cases we have seen male Black-throated Green Warblers feeding young out of the nest at Grey Rocks.

What is the explanation of the dereliction of our two males in 1931? The second male may have been killed, or his nesting ardour may have waned so late in the season. (One of my Song Sparrow males, apparently wearying after five months of nesting duties retired to molt, leaving the September brood to be brought up by his indefatigable mate, who succeeded in raising two offspring.)

As for the first Warbler, he appeared to be unaware of the existence of his offspring until he was attracted to the nesting site by the excitement of his mate over the young that had left the nest. The excessive sound and movement on her part appeared to have set his feeding reaction in motion, for he did not examine the nest before returning with a caterpillar eleven minutes after his first appearance. Interestingly enough, he started at the very beginning of the feeding cycle, bringing small insects, trying to put them far down the throat, always endeavoring to feed in the nest and ignoring the young that had left the home tree.

In those species where the male does not help incubate but does feed the young, the female must in some manner, either consciously or unconsciously, inform her mate that the young have hatched. We can find no mention in the literature of how this takes place. Harding ('31) tells of a "low-pitched vibrant call ss-hss-ss-hss" given by the female Black-throated Blue

Warbler to call her mate to the nest; in a letter the author states that this is sometimes used by the male in the same manner. We believe that our first female's chipping in response to her mate's singing might have been meant as a signal to him, but if so, he failed to understand.

DATES OF YOUNG SEEN AT GREY ROCKS

In 1927 we were at Grey Rocks from June 28th to August 23d, in 1928 from June 23d to August 26th, in 1931 from June 11th to August 30th. In these three seasons we have recorded one brood of these Warblers being fed out of the nest in June (June 28, 1928), six in July, and seven in August—viz. two broods August 7, 1928, two August 14, two August 21, 1931, and one August 23, 1928. From the preponderance of late dates it seems probable that two broods are sometimes raised. The unusually long season of song gives additional evidence.

SINGING OF THE BLACK-THROATED GREEN WARBLER

This Warbler is by far the most charming singer of the Grey Rocks *Compsothlypidae* and also probably the most untiring. His energy is almost unbelievable. The season is long, birds remaining in apparently full song till almost the end of July, and singing to some extent through the first week of August, my latest date being August 9, 1927. In the record of Warbler one, as shown in Table I, there is some decline in singing after July 15th, but the hour on the 21st formed an exception.

Distance from the Nest. Our first Warbler sang from 35 to 45 yards from his nest, the second 75 yards away. These distances are far greater for this species than those given by Mousley ('19) for Hatley, Quebec—namely, 12, 14, and 20 yards. Perhaps it is characteristic of Warblers at Grey Rocks to sing at longer distances from the nest than the Quebec birds. Mousley gives 7 and 18 yards for the Magnolia Warbler, while the bird I studied ('24) sang from 20 to 100 yards from his nest. He gives 10 to 18 yards for a Blackburnian Warbler; the one watched in Pelham this past summer ('32) habitually sang 150 yards from his nest. Both in this case and in that of our second Black-throated Green Warbler the deciding factor seemed to be the position of suitable groves; when the males had to choose between singing near their nests in small trees in one case and in hard woods in the other, and singing far away in thick growth of conifers, they both preferred the latter.

Varieties of Song. This species has two main songs—the sweet *trees*, *trees murm'ring trees*, which I call A and the less

distinctive *See see see see wee see*, which I call B. Thayer ('07) states that the latter is "at least as often uttered and in mid-summer is the commoner of the two" around Monadnock Mountain, New Hampshire, but at Grey Rocks it is not heard more than a fourth as often as A. Warbler one was peculiar in his very small indulgence in B. I have not noted any special variations in this song.

As a rule A is not varied markedly by our Grey Rocks birds, but in 1931 two males with adjoining territories gave a peculiar form which consisted in the insertion of four rapidly uttered quavering notes before the final *treees: treees, treees, murmuring twiddle-diddle treees*. One of these birds was heard to give a normal B.

A peculiarity of this species is the utterance of chips in between songs when singing A. I have never heard it with B. This chipping may be double or single, and varies in amount from two or three notes before each song to a practically continuous utterance interrupted at brief intervals by the songs. Curiously enough, the chipping often seems to come from a somewhat different part of the tree from the songs, perhaps ten feet or more away—something I have noted also with Magnolia and Blackburnian Warblers. Different minutes contained the following numbers of chips and songs: 5 songs and 11, 14, and 30 chips; 7 songs and 37 chips; 6 songs and 52 chips; 8 songs and 58 chips; 7 songs and 73 chips. Warbler one introduced chipping into about a third of all his singing, in about one half of the morning singing and about one tenth of the afternoon singing. Perhaps chipping is an expression of excess of energy. From our standpoint it distinctly mars the æsthetic effect of the pretty song.

This Warbler gave three forms of A—the complete song—A-1—lasting 1.1 seconds, and two incomplete versions, one without the first note, A-2, the other without the last, A-3. This third version was not heard except July 16th, 19th, and 20th and amounted to only one per cent of the total number of songs. (I heard it given from two other males July 25th.) A-2, which made up about 29 per cent of all the songs, was characteristically associated with the chipping, only rarely being given by itself, this happening typically just before the beginning of a session of chipping; *i.e.*, he sometimes swung into the shortened form before he started the chips, or he might be chipping with A-1 and then change to the abbreviated form. About 32 per cent of the morning songs belonged to A-2, but only 4 per cent of those given in the afternoon. Chipping occurred with about one fourth of A-1 and six sevenths of A-2.

One reason for the large total of singing reached by this species is the rapid rate at which A is given, from 6 to 9 and occasionally 10 times a minute. The average rate of 1180 minutes of Warbler one in the morning was 7.4 songs a minute; the average rate of 528 minutes in the afternoon was 6.2 songs. As to intervals between the beginnings of songs, 95 measured by stop watch in the mornings varied between 5.1 and 13 seconds, the median being 7. Thirty-one afternoon intervals varied between 6 and 12.5 seconds, the median being 8.

Curiously enough, B was not heard from this bird until July 12th, when 13 of this form were given; the numbers on the following days varied from 0 to 81 until July 20th, when 310 were uttered, a third of the total amount of singing heard that day. We thought it might be characteristic of the very early morning, but this did not prove to be the case, since it was never heard earlier than 5:30 A.M. nor later than 6:16 P.M. Five hundred and eight of the 14,005 songs were B, or 3.6 per cent of all the singing. B is delivered at a more leisurely pace than A. Thirty minutes of this Warbler's singing varied between 3 and 8 songs a minute, both the median and average being 5. Thirty morning intervals recorded with another bird July 16, 1928, varied between 9.5 and 16.5 seconds, the median being 11.2.

Total Amount Sung. The largest number of songs recorded in any one hour was 466 on July 15th from 8:02 to 9:02 A.M. The longest period of uninterrupted singing was 74 minutes from 7:47 to 9:01 on this same day.

Of the 55 morning hours, singing was recorded in all but one; of the 33 afternoon hours, in all but five. The average amount of singing per hour (except for the six silent ones) varied in the mornings from 103 to 317, averaging 194; in the afternoons from 11 to 172, averaging 84.

As to the per cent of time spent in singing, it varied in the mornings from 26.6 (July 16th) to 79.4 (July 14th), and in the afternoons from 8.8 (July 19th) to 45.5 (July 15th). It is unfortunate that the Warbler sometimes sang too far away to be heard, so that these lowest figures are probably not representative.

All the figures point to greater energy in the morning—the rate, the intervals, amount of chipping, the proportion of hours when there was no singing, the average number of songs per hour, and the per cent of time devoted to singing.

SUMMARY

1. The young in the first nest were raised with no assistance from the male until the last two days, when he brought 11

- meals in contrast to his mate's total of more than 245. The young in the second nest were raised entirely by the female.
2. The first female incubated for periods ranging from 34 to 50 minutes, absenting herself for periods ranging from 9 to 26 minutes. The second female once incubated for 99 minutes at a stretch; her absences varied from 13 to 20 minutes.
 3. Both females brooded for longer periods than the majority of arboreal Warblers that have been studied, averaging 15.1 and 18.3 minutes respectively.
 4. Both females fed at slow rates, the average for the first being once in 19.7 minutes, for the second once in 16.3 minutes.
 5. The first female adapted herself successfully in the absence of her mate by often bringing large insects and several at a time; the second female increased her feeding rate markedly during the last three days.
 6. Both females made definite efforts to get their last young out of the nest and to lead them to a distance.
 7. The young in the first nest left at the age of 8 and 9 days; in the second, at the age of 8 days.
 8. The male of the first pair did not seem to know of the existence of his young until two had left the nest.
 9. The male of this species possesses extraordinary energy for singing. The first Warbler gave 466 songs in a single hour and more than 14,000 in the 94 hours of observation.

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