

A STUDY OF THE EASTERN SONG SPARROW,
MELOSPIZA MELODIA MELODIA.

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THIS paper presents the results of rather extensive observations at the nests of *Melospiza melodia melodia* during a period of six weeks in the summers of 1928 and 1929, with more casual observations during the rest of the time.

Habits.—The Song Sparrow is a conscientious mother. The bird which I observed during the summer of 1928 began the construction of a fourth nest of the season on the fourth day after the young of her third brood were destroyed. This was surely evidence of adherence to the maternal instinct, since two broods are the usual number.

What fighters they are at times! One Song Sparrow, feeding in the yard, sometimes drives away five or six House Sparrows or White-throated Sparrows, both larger than she, and then enjoys the food in peace. This is the more remarkable since the House Sparrow is usually more belligerent than the Song Sparrow.

The Song Sparrow is usually very active when trapped, but occasionally quite docile. Even though a bird may seem wild when trapped it returns again to the same trap, learning very quickly the source of a full meal. I trapped Number 24947 seven times between April 8 and May 28, 1928, after having banded it on April 8. Number 24948, banded April 8, returned to the same trap six times between that date and May 24.

Territory.—The two birds I observed during the summer of 1928 offered an excellent opportunity for a study of territory. During the period in which the fledglings were in the nest, the birds occupied a very limited area. This was especially true of the female. She obtained all of the food she gave from the bush in which the nest was located, and the mulberry tree which was about ten feet away. The male was seldom out of sight of the nest, staying always in the upper part of the garden.

After the young birds had left the nest, the parents were seen and heard in a much larger territory—in the lower garden and in the woods opposite the garden. Only one of the young birds was

seen. I had banded it with a pink and a white celluloid band similar to those used by W. K. Butts in his work, so the bird could be easily recognized. The banded parents were found in the vicinity of this young bird.

Six days later the female was busy with her next nest. During the incubating period the nest was deserted so frequently that I feared the eggs would not hatch. This was the third brood of the season. The territory at this time was quite large. This nest was about one hundred feet from the former one. The territory included all of the former area and the space around the new nest, being about twice the size of the former territory. Often the female arrived from out of sight, incubated for a short period of time, and then flew away, sometimes to a distance of twenty-five feet, to feed on the ground. Occasionally she flew out of sight. As the days passed the time spent away from the nest decreased—and she remained in a very limited territory.

The male, in the meantime, enjoyed a large territory. He was to be found with the young bird of the former brood, and in the old territory, and in the area near the new nest.

Toward the end of the incubating period the female confined herself to a very small area, indeed, never being more than ten feet from the nest. After the birds had hatched, the female was constantly at the nest, leaving it only long enough to get food from the immediate vicinity for the young birds.

On the third day of the life of these birds the young bird of the former brood and the adult male were frisking about very near the nest. The male was now usually in a territory near the new nest.

This nest was destroyed when the young birds were five days old. For a time the female was not in evidence. The male sang from various perches—again wandering about with the young bird.

After three days, the female was discovered building a new nest about one hundred feet from each of her former nests, so that the three nests formed an almost perfect equilateral triangle. While actually employed in nest building, the bird remained in a very small area, but much of the time she spent elsewhere, returning to the site of the new nest, usually accompanied by her mate, from considerable distances. Unfortunately, I was able to make observations for only a few days longer, so that the extent of the

territory of the fourth brood was not learned. The first nest, Dr. Allen said, had been broken up early in the season. I had observed the second and the third broods.

To summarize my findings, I might say:

1. That the territory occupied by the male is larger than that occupied by the female during nesting season.
2. That the adults are found in the vicinity of the young when there are young on the wing.
3. That the territory occupied by both birds is much larger when there are neither eggs nor young.
4. That the territory of a subsequent brood includes the original one.

Since these observations have to do with but one pair of birds no definite conclusions as to the territory habits of Song Sparrows can be given. The summary, however, is quite in accord with Howard's¹ theory of the part played by territory.

Song.—One of the first things I noticed about the male Song Sparrow which I observed for six weeks was his fondness for two perches, one in a plum tree to the right of the nest, and the other in a dead cherry tree a little to the left and behind the blind from which I made my observations. The cherry tree perch was the favorite one. He seldom sang from any other spot.

When his territory was enlarged during the next nesting period he selected two new perches. The dead cherry tree had been removed, and the plum tree was, seemingly, too far from the new nest. He sang at times from a position on the telephone wire as near as possible to where the dead tree had stood. At other times he burst into song from the wire along the road on the woods side, nearer the new nest. He now had young on the wing in the lower garden and in the woods, and he sang occasionally from each of these localities. Here he sang from a number of different perches, not revisiting the same one with any great regularity. A few days before the eggs hatched in this third nest the male added a new perch to the other two usual ones, and from that time on he sang frequently from the maple tree near which the dead tree had stood. After the eggs had hatched the proud father sang not infrequently from a fence post quite near the nest. After this nest had been

¹Howard, H. Elliot—Territory in *Bird Life*, 1920.

destroyed the bird sang from various perches, in the lower garden, in the woods, near the nest. During the days when the female was not seen, the male continued to sing and call in a territory constantly increasing in size. When she returned and began to construct a new nest his song came from the old, frequented perches, although his territory remained large for several days.

I began to make daily observations of the pair of Song Sparrows already mentioned on July 2. The male sang frequently and with a great deal of spirit during most of the month of July. On the 27th, the day the second set of eggs hatched, he sang frequently, but his song was subdued. On July 30 he sang his usual song but with no volume, the end being scarcely audible. His singing was constant. Later, on the same day, he sang with a volume that was only slightly less than at the beginning of the month. This was soon followed, however, by the subdued song.

On August 4, the day the female began the building of the fourth nest, the song of the male was quite short. On August 8 there was one egg in the nest. The proud father sang frequently, with full volume and much variation from all of his various perches, near the new nest, near the former nest, in the lower garden where he had been seen and heard with one of the young birds of the second brood, singing as though proclaiming to all the world the glad tidings of promise of a fourth brood.

On the twenty-seventh day after hatching I heard a young Song Sparrow make an attempt at song. It was short and weak, and had I not seen the bird, and identified it as one recently banded with colored celluloid bands, I could not have recognized the song as that of the Song Sparrow.

I have noted a midday relaxation in July. Singing is most constant early in the morning and early in the evening, but the bird sings at all hours of the day. When one is in the territory of a Song Sparrow it seldom takes many minutes to locate the male. His song soon calls attention to his presence.

On July 5, 1928 the moon was fading and a few stars were still shining when, at 3:50 A.M., I heard the first bird note—a Robin's call. The day was damp and cold, and rain came before 8 o'clock so all the birds were late that morning.

3:52 Pewee called and continued to do so.

- 3:55 Wood Thrush sang a number of times. Other Wood Thrushes answered.
4:01 Crested Flycatcher and Veery sang.
4:05 Concert of all these birds.
4:07 Catbird called and then sang.
4:08 Crow flew over head and called.
4:11 Wren sang.
4:13 Song Sparrow sang.
4:18 Full chorus of bird voices.

At 6:45 P.M. the evening concert began. The Robins' voices were conspicuous at first, the Flycatchers' later and those of the Veery and Wood Thrush still later. Between 6 and 6:45 the Song Sparrow sang nine times. At 6:46 he repeated his song seven times. Between 7:35 and 7:40, after the other birds had become comparatively quiet, the Song Sparrow sang five times, and from 7:40 to 7:45 he sang constantly. At 7:50 he sang twice and at 7:55, once. Then all was quiet. These figures, although interesting, do not carry the weight of those given by H. W. Wright, 1912, '13, '15¹ and F. H. Allen 1913, 15² on the subject, since they are based on one day's observation, and not on a study covering a long period of time.

Call.—After I became somewhat acquainted with the habits of my pair of Song Sparrows, I was able to interpret some of their calls. One morning when a crow was flying low, calling, the male gave a sharp, "Dick, dick!" evidently his note of alarm to the female who remained on the nest and gave an answering chirp. Shortly afterward a baby Robin flew into the bush with the Song Sparrow nest and moved around quite a little. This seemed to greatly alarm the mother bird. She left the nest only infrequently, and, when she did leave she returned immediately and without food, keeping up constantly a chirp of alarm.

On the sixth day, in the afternoon, I heard the young birds for

¹ Wright, H. W. 1912. Morning Awakening and Even Song. *Auk*, vol. 29, p. 307.
1913. Second Paper. *Auk*, vol. 30, p. 512.
1915. Morning Awakening Notes at Jefferson Highland. *Auk*, vol. 32, p. 240.
² Allen, F. H. 1913. More Notes on Morning Awakening. *Auk*, vol. 30, p. 229.
1915. Notes—The Status of the Song Sparrow and Chipping Sparrows as Early Birds. *Auk*, vol. 32, p. 110.

the first time. Their first food cries were feeble, but they soon became very decided and were given with great frequency. On the seventh day, when one of the young birds had left the nest, it kept up a continual crying. The parents paid more attention to it than to the two still in the nest, probably because its voice was stronger, more persistent, and more continuous, and because they had the new experience of having an off-spring out in the world. The parents were very attentive, but did not offer food as frequently as they had on the preceding day.

After the young birds had left the nest, the adults were frequently found near each other on the ground, moving about, constantly chirping. The chirp was, probably, a means of keeping together, and of keeping the young birds near them. Occasionally a faint chirp came in answer from the undergrowth. This was so similar to the chirp I heard one of the young birds giving while he was in view that I feel certain it came from one of them.

During the incubation period of the third brood, the adult birds were frequently in evidence hopping around on the ground on opposite sides of the road, calling to each other, "chimp," in alarm. The female seemed much more nervous with this nest than with the former one. Perhaps this was because the nest was along the road, and was therefore not so quiet; and yet, since the children were not near it frequently as they had been near the former nest, the female did not become accustomed to having someone near the nest. For days she made no sound when near the nest, and left quickly whenever she was alarmed.

A young bird from the former brood was occasionally heard "tzip"—almost like the call of the White-throated Sparrow.

On the day the third brood hatched the female frequently, on the least provocation, gave her alarm cry "chimp." While I examined the young birds, both adults were greatly concerned and kept up a constant "chimp." As they saw no harm coming to the young the cries became less persistent and more subdued until finally fear seemed to go. The male soon began to sing, and the female brooded constantly even though she knew I was near.

When the male had finished his song he gave a sharp, metallic "chip," flew to the ground in search of food, and became busy with family cares. That "chip" seemed very expressive. While the

female was brooding she said, "pip, pip" very softly, and then purred loudly in a most contented manner. The next morning the brooding female said, "Bura-Bura-bura-brrrr." These two calls seemed to express contentment, satisfaction.

After this nest was destroyed and the female disappeared for three days, the male called very frequently from all parts of his territory, as though he were searching for his mate. After her return, the birds were frequently seen together calling to each other. From these observations it seems that the call notes correspond to conversation, and that the vocabulary of the Song Sparrow is rather extensive.

Nest.—It is probable that no two nests are exactly alike. Each nest is made of materials most easily obtained, and this factor will of course necessitate variation. I was fortunate in being able to make observations at three successive nests of my pair of Song Sparrows in 1928.

Nest 1.—The foundation was of grapevine bark and coarse grass stems, some of which were $3/16''$ in diameter, many of which had the roots attached. The stems varied in length from less than three inches to very long pieces which were twined in and out. The outside of the nest was much more loosely constructed than the inside. The stems toward the middle of the nest were much finer, and on the whole longer than those in the outside. The nest was lined with a horsehair and many short pieces of grass—the average length $3''$. The nest was not perfectly round on the outside, outside measurements $5\frac{1}{2}'' \times 4\frac{3}{4}''$. The inside of the nest, having been shaped by the mother's breast, was round with a diameter of $2''$. The depth was $3''$, inside depth, $1\frac{1}{2}''$.

Nest 2.—The foundation was made entirely of coarse stems most of which had the roots attached. The nest had a very thin middle layer made of finer stems. The lining was, again, made of fine grasses. This time there were a few grass stems and a very few hairs in the lining. At the very bottom of the outside of the nest there was a piece of moss about $1\frac{3}{4}''$ long. Attached to a root of one piece of coarse grass was a hard bit of soil in which there was a very short piece of moss. The nest was much looser and thinner walled than Nest 1. The outside measurements were $5\frac{1}{2}'' \times 4\frac{1}{2}''$, inside diameter, $2''$; outside depth, $2\frac{1}{2}''$; inside depth, $1\frac{1}{4}''$.

Nest 3.—The foundation contained one piece of grapevine bark, and coarse grass stems many of which have roots and fruits attached. As in the preceding nest, there was a thin middle layer of fine stems. The nest was lined with fine grass, and two black horsehairs, and two human hairs 4" long. This nest was much more untidy than the preceding ones, much less compact. The outside measurements were $7\frac{3}{4}$ " x $5\frac{3}{4}$ ". Loose grass stems extended on all sides of the nest. If they are considered, the outside measurements would be 15" x 12". The inside diameter was $2\frac{1}{4}$ ", outside depth $3\frac{3}{4}$ "; inside depth 2".

Nest 4 and Nest 5 are nests of the same pair of birds in 1929 both built on the ground and about 150 feet down the hill to the westward of those of 1928.

A comparison of these nests seems to indicate that the early nests, which are quite likely to be built on the ground are more neatly and compactly built than succeeding ones. The variation in materials is due to a difference in availability—when horsehair is obtainable it is used. Grapevine bark makes a more compact foundation. Its presence in abundance in the earliest nest probably made a warmer home early in the spring than grass stems would have made. The early nest, being made of comparatively short pieces of dry grass of the preceding year, can readily be made neater than the later nests made of growing, non-brittle grass, many pieces of which are $1\frac{1}{2}$ feet long.

On August 4, 1928, I watched this Song Sparrow begin her fourth nest of the season, the third one I described. She began at 7:30 A.M., putting down a foundation of strips of grapevine bark and stems of coarse grass, loosely arranged. She worked very fast, carrying pieces of dry grass 8" or 9" long. Some of this she pulled out by the roots, some she broke off from above the ground. Much she discarded without any apparent cause. Sometimes she carried two pieces at once. Once she tried to carry a piece about 15" long with fruit at the end. The grass was so heavy that the bird could not rise from the ground on the first attempt. After frequent attempts she managed to fly a short distance, and after a short rest flew on to the nest.

When she returned to the roadside, from which she was obtaining most of the nesting material after she had finished [the] grapevine

bark foundation, she pulled at a fresh, growing plant, placing her bill on the stem down near the ground. The stem did not break. The persistent little bird tried three times, and then flew away, returning soon with a piece 15" long. She pulled at two more green plants unsuccessfully before she succeeded in finding a plant dry enough to snap off readily.

In the meantime, the male sang occasional short snatches of song. The female frequently pumped her tail up and down. After a time she almost never flew to the nest without two pieces of grass. Holding one long piece in her mouth she pulled a second piece out by the roots. So she continued flying back and forth to the developing nest for over an hour. Then she changed her path of approach to the nest, probably for more careful arrangement of the materials. Some of the grasses she attempted to pull out gave her such difficulty that, although she pulled apparently with all of her strength, so that she almost fell, it was necessary for her to walk away with the grass in her mouth, and even then there were unsuccessful attempts.

I watched the process for almost two hours and returned again at 1 P.M. to find the busy little bird carrying a piece of grass $2\frac{1}{2}$ feet long. The nest was well under way, carefully hidden in the spruce tree. After about half an hour, during which the female worked industriously, the male flew to one of his favorite perches near by and sang. The female flew away with him and had not yet returned at the end of another half hour.

In the morning the mass of stems had not resembled a nest, but now it was carefully shaped, and the grasses were woven together instead of being, as in the morning, merely placed in position. The grass was not yet dry and the whole nest felt withered.

The next morning I found the nest finished—deep and perfectly formed. The female was hovering near in the hedge. There were many long pieces of grass on that, and on near-by spruces.

Of the five nests which I have described the first was in a barberry bush, the next two in a spruce hedge, and the fourth and fifth on the ground. The first three were all about three feet from the ground. Of the nests which I have seen in Philadelphia, Phoenixville, and Center Bridge, Pennsylvania; and Ithaca, New York, those which have been at least two feet above the ground

have raised more families than those lower, either in bushes or on the ground. The Song Sparrow is so tame that it builds its nest quite near houses, in flower beds, and even in a rose bush (Condor, Volume 19, page 34). The bird's fondness for water explains the fact that not a few nests are found in bushes overhanging a stream, sometimes a few inches above the water, sometimes several feet above it.

Eggs.—The pair of Song Sparrows I observed during the summer of 1928 returned to the same garden in the spring of 1929, and were recognized by their bands. The male was first noticed on March 12, the female, some days later. On April 26, they had three eggs in a nest on the ground. Early in July they were busy with the third family, having successfully raised two broods.

The bird does not begin to incubate until the last egg to be laid is in the nest. There were four eggs in a nest which I observed. The female did all of the incubating, but left the nest frequently—for food, for a visit with the male, or because she was scared away by some disturbance near the nest. On the morning I began my observations, the adults were hopping around on opposite sides of the road, calling to each other. The female made frequent visits to the nest, fed in the spruce hedge near it, but did not begin to incubate for half an hour. Then she was soon frightened away by children who passed near the nest. She stayed away for six minutes, incubated for fifteen minutes, and deserted once more.

On another day, toward the end of incubation, her behavior was much the same. I arrived at the nest at 8:25 A.M. The male was singing, but the female was not in evidence. At 8:40 she appeared. She stood perched on the wire of the fence near the nest and carefully preened her feathers over and under the wings, the breast and neck, and shook all her feathers once more. Then she fed on the ground and in the hedge within twenty-five feet of the nest. At 9 o'clock she began to incubate. After five minutes she again flew off. At 9:20 she returned. She seemed nervous and left the nest at my least move, returned at once, moved around near the nest for three minutes, then settled down for seventeen minutes. Then the presence of a House Sparrow near the nest alarmed her, and she left quickly. When she returned she again preened her feathers before settling on the nest. For the rest of the morning she was

never away from the nest long, but she did not incubate constantly.

On another day, at 1:50 P.M., the bird was not at her nest; the eggs were cold. Ten minutes later she returned from the lower garden. She was not so nervous as on previous days. My presence did not annoy her at all, and she was not frightened by passing cars. Again her periods away were almost as long as the periods when she incubated.

On the day before the eggs hatched the bird's behavior was much as it had been before, except that she was unusually alert to all bird sounds.

Each day during the incubation period the female turned the eggs with her feet and bill so that each egg was evenly heated.

Usually the bird sat very low in her nest so that only her tail, or sometimes only the very end of her tail, was visible at a short distance from the nest. Two days before the eggs hatched her position was not so low as it had been. Her head, as well as her tail, was visible. At all times she was perfectly quiet when at her nest. Her approach and departure were also quick and quiet.

During most of the incubation period the male sang from his various perches. I never saw him at the nest. Toward the end of the incubation period he became more quiet than was his custom, when he was in the territory near the nest. He spent most of his time not far from the nest.

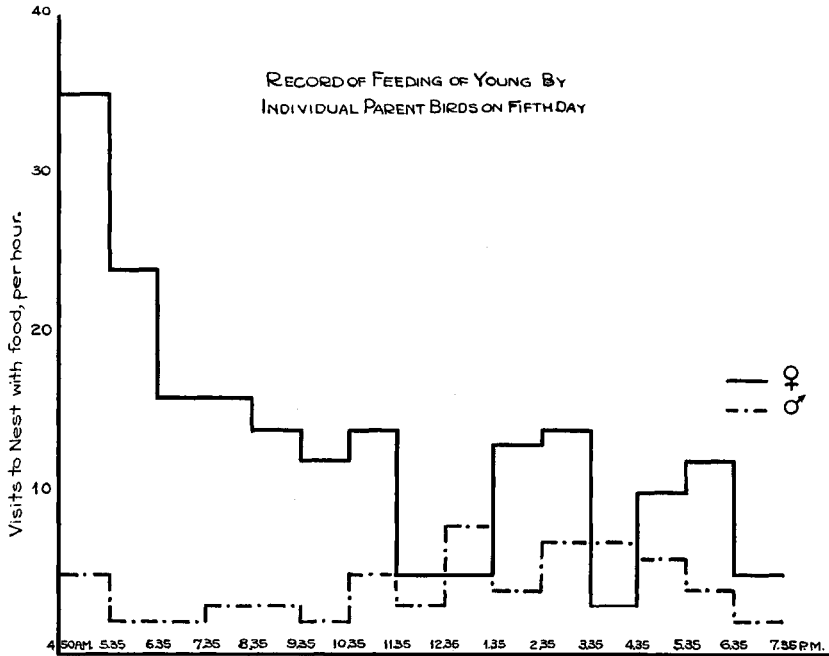
Care of young.—After the eggs had hatched, both parents became very much absorbed in the care of the young birds. The pieces of empty egg shell were carefully removed by the mother bird, carried away one piece at a time in her bill, and dropped some distance from the nest.

I marked the four young birds which I studied by tying threads of different colors around the right legs. The increase in total length of the birds from day to day is shown in the following figures:

| | Rose | White | Black | Green |
|--------------|---------|---------|---------|-------------|
| July 27..... | 1 5/16" | 1 5/16" | 1 8/16" | not hatched |
| 28..... | 1 6/16 | 1 5/16 | 1 14/16 | 1 3/16 |
| 29..... | 1 14/16 | 1 12/16 | 1 15/16 | 1 8/16 |
| 30..... | 2 2/16 | 2 2/16 | 2 4/16 | 1 10/16 |
| 31..... | 2 4/16 | 2 4/16 | 2 6/16 | 1 12/16 |

On August 1, the young birds were destroyed, probably by a cat which had been seen in the vicinity of the nest.

It is interesting to note that the two birds which hatched the same length were equal in length at the end of five days, although on the 2nd and 3rd days the "rose" bird grew more than the "white" one. The bird which began life the largest of the brood was still the largest of the brood on the fifth day. The runt was still the runt, and had not increased in size as rapidly as the other three birds.



During the first three days of the life of my four young Song Sparrows they were fed nothing but regurgitated food by the female when I was observing. Since my visits were made at different times of the day, and lasted for 30 to 65 minutes each, it is perhaps safe to imply that the young were fed little undigested food during this time. On the fourth day, I again found the female brooding almost constantly. Occasionally she cleaned the nest,

picking for lice which she fed to the young birds. Seven times during the hour from 7:30 to 8:30 A.M. she fed regurgitated food. Once she ate a piece of straw from the nest, regurgitated, and fed. When she fed regurgitated food a number of young were fed at the feeding. On this day feeding was infrequent and consisted entirely of lice from the nest and regurgitated food.

On the next day, when the young birds were five days old they were fed more frequently than on previous days, and were fed insect food,—caterpillars and grasshoppers, by both male and female. Since these young birds were destroyed no further data can be given for them.

I had, however, observed a previous brood of the same pair from the day when they were, according to Dr. A. A. Allen, probably three days old. On the fourth day the female fed regurgitated food, small flying insects which she caught as they flew by the nest, and lice from the nest. The male occasionally fed a small insect. On the next day I observed all the happenings at the nest from 3:50 A.M. until 8:10 P.M. The adults were very busy. For 10 hours, during which I kept record of the kind of food given, of the 171 pieces of food given, 74 pieces were of animal origin, 56 of plant origin and 41 unknown.

| <i>Animal</i> | | <i>Plant</i> | <i>Unknown</i> | |
|-------------------------|----|-----------------|----------------|----|
| Unrecognized insects... | 32 | Mulberries..... | 47 | 41 |
| Caterpillars..... | 19 | Barberries..... | 8 | |
| Grasshoppers..... | 17 | Straw..... | 1 | |
| Lice..... | 4 | | | |
| Butterflies..... | 2 | | | |

The male fed only insect food; in the morning the female fed mulberries, barberries, lice from the nest, and a few insects caught at the nest. In the afternoon she spent more time searching for food, and fed more insect food.

On July 5, 1928, when my observations began at 3:50 A.M., I recorded the number of feedings given each hour.

The young birds, hungry after long hours of the night without food, were fed more frequently during the first two hours than during any other hours of the day. It rained from 8:20 A.M. until 3:50 P.M. The rain seems to have had no effect on the frequency

of feeding. The decrease in the number of feedings at noon seemed to indicate a mid-day rest period. The decrease between 3:35 and 4:35 was occasioned by the female's dislike of an experiment I tried. In order to study the frequency with which each of the young birds was fed I marked them in a certain way which will be discussed later. The female spent her time trying to remove my identification marks instead of feeding the young birds.

The faithfulness of the male and of the female during the course of the day is shown by the following graph.

A glance shows that the female did most of the feeding. During the second hour of the female's mid-day rest period, the male exerted himself a little more than at any other time during the day. During that hour, and during the hour, already referred to, during which the female's attention was distracted, the male fed the young more frequently than the female did. Of the total 261 feedings during the day, the female gave 198, the male, 63.

For the first three days after hatching, feeding seems not to be a very important item. The young birds are frequently left alone; and when the female is at the nest she spends most of her time brooding. On the fourth day, the parents become a little more devoted, bringing food three or four times an hour. On the fifth day, in the three hours time during which observations were made, the birds were fed 10, 20, and 15 times respectively. During the same three hours on the next day, the day for which the figures have already been given, the birds were fed 19, 17, 14 times. The variation in these two days, is not great but there is an increase in frequency as the birds grow older rather than a decrease. The figures given for the earlier days seem to indicate an increase as the bird grows older. This problem could not be definitely answered, however, without constant observation at a nest from the time the eggs hatch until the birds leave it. The problem presents obvious obstacles, but perhaps it will be solved at some future time.

The parent, on visiting the nest with food, usually feeds one bird; frequently two are fed; occasionally three. All previous figures have referred to a parent's visit, the actual number of feeding is therefore somewhat larger than the numbers given.

| Number of Nestlings Fed | 11.35 | 12.35 | 1.35 | 2.35 | 3.35 | 4.35 | 5.35 | 6.35 |
|----------------------------|-------|-------|------|------|------|------|------|------|
| One..... | 4 | 9 | 11 | 14 | 7 | 11 | 8 | 4 |
| Two..... | 2 | 4 | 6 | 6 | 3 | 3 | 7 | 3 |
| Three..... | 2 | 0 | 0 | 1 | 0 | 1 | 2 | 0 |

The preceding table shows that in 108 visits made, the birds were fed 154 times. That is, each bird was fed on the average of 6.4 times an hour, or once in 9.3 minutes.

This is assuming that each occupant of the nest receives the same amount of food. This cannot be taken for granted. I frequently saw one of the adults give one bird a second mouthful while the other two birds held their mouths open for food, in vain. This led to an attempt to study the subject. I tied a brown cord, made by twisting threads from the blind, about the neck of one young bird, a piece of grass about the neck of a second, and left the third unmarked.

After the male had fed twice, and the experiment seemed to promise interesting results, the female returned to the nest. She carried food but dropped it on seeing such foreign matter as brown threads and grass in the nest. She removed both the threads and the grass. I again marked the birds in the same way. Again the female removed the identification marks, and seemed so disturbed that I gave up the attempt to solve the problem.

Judging from the development of the birds, however, the food was not equally divided. On the next day one of the birds left the nest in the morning. It was markedly larger than the other two. By afternoon one of them began to show signs of action, travelling to the edge of the nest and back. The third bird was decidedly smaller—decidedly the runt of the brood. It was easy to see that the large bird, being more active, and reaching higher for food, was likely to get a large share of what was offered by the parents.

After the hatching of the eggs, the female spends most of her waking hours searching for food for the young birds, feeding them, cleaning the nest, or brooding. Brooding, sitting on the nest with feathers puffed out and sometimes with wings partly spread, is a means of protecting the young helpless birds from the heat, cold, rain, and from enemies. As has already been stated, the female broods most of the time during the first three days. When the bird

is about to brood she pushes the young aside with her feet, in order to have them distributed in the nest to her liking, spreads out her feathers, especially those on her breast, spreads her wings and gently settles. Sometimes she pulls her head down into her feathers so that there is a straight line from her bill to the base of her tail. At such times, the tail, instead of being held at a jaunty angle, is flattened almost on a line with her body.

For two consecutive hours during my day's observation I kept a record of the time spent away from the nest, action on return, and time spent brooding. During this time the female was away from the nest 54½ minutes and brooded for 61½ minutes. In the entire period the male brooded for only one minute. That was the only time during the observation at two nests that I saw him brooding at all. It was during a heavy shower. As soon as the female returned to the nest he left. The female spent more time brooding during those two hours than she did in hunting for food for herself and the three young birds. This gives a good idea of the importance of brooding.

During the heaviest downpour, the female brooded constantly for thirty-five minutes. After that, although it was still raining, she spent her time hunting food, feeding the young birds, and cleaning the nest, for one and one-half hours, during which time she did not settle down once.

Cleaning the nest was a very important item. Both male and female participated. Nest cleaning consisted of removing the little white sacs of excreta, eating lice, eating bits of straw, and removing the identification marks already referred to. The female frequently seemed to stand on her head in the nest and to pick around vigorously with her bill, removing the lice. At first these were always fed to the young birds, but as the birds grew older, from the sixth day on, this was not done. The female ate them herself. I never saw the male searching for lice. Occasionally, the female ate a few pieces of straw from the nest. At first I interpreted this to be a sign of hunger, but since she picked a piece here, and one there, on one occasion five pieces altogether, I decided that the movement of the birds in the nest had made the nest appear untidy to the mother's eye, and that she ate the offending objects as a quick means of disposing of them. Just once I saw the male eat a piece of straw from the nest.

The female was much more sensitive to disorder in the nest than was the male. He returned and fed the young birds twice, apparently without even noticing my identification marks.

The following table shows the attention given by the male and female to the disposal of the sacs of waste matter.

*Number of Sacs of Excrement Removed Per Hour by Each Parent from
4:35 A. M. to 7:35 P. M.*

| | to 4.35 | 6.35 | 8.35 | 10.35 | 12.35 | 2.35 | 4.35 | 7.35 |
|--------|---------|------|------|-------|-------|------|------|------|
| Male | 2 0 | 0 0 | 0 4 | 3 1 | 1 1 | 5 4 | 3 3 | 2 0 |
| Female | 0 3 | 3 1 | 5 0 | 0 3 | 5 2 | 4 1 | 3 4 | 9 3 |

In the course of the day, 74 sacs were disposed of, 33 by the male, 41 by the female. This work seems to be more evenly shared than is feeding. Most of the sacs were carried away. Seven sacs were eaten by the female, three by the male. Once the female swallowed four sacs, carried a fifth one away, and returned immediately for a sixth.

Each of my birds had a definite method of approach and of leaving the nest, so that even if the birds had not been marked with the colored celluloid bands I could have known which bird visited the nest on most of the visits.

Nest Behavior of Young.—The young birds, while in the nest, showed many interesting phases of growth. During the first three days after hatching they huddled together in the nest, and when disturbed reached open mouths up for food for a few seconds, then settled down again. By the end of the third day the larger ones reached for food when the bush was touched. There seemed to be, during these early days, no attempt at exercising; the only movement was an instinctive one, for food.

On the fourth day, the young birds made certain movements which could be interpreted only as stretching, a kind of exercise. One of the occupants of the nest, evidently tired of keeping still, stretched his neck. Neither parent was present with food, no movement had disturbed the nest from the outside, but the stretching of one bird caused the others to stretch their little necks upward and to open their mouths for food. When no food was given they settled down again. Since the parents were very faithful, and visited the nest with food very frequently, there were few move-

ments that could be considered as being made just for the sake of exercise.

On the next and on the succeeding days, the young birds became so active that the mother bird seemed to be squirming around in the nest whenever she brooded. Frequently, she rearranged her wings, while brooding for as short a period as four minutes, to keep the moving young ones covered.

When the birds were six days old, they stretched sleepily at 4:35 A.M. They were soon wide awake. The activities of the day have been described elsewhere. On this day, the young birds were very active, stretching their necks and little wings, and keeping the female constantly moving when she brooded. The largest bird preened its feathers early in the morning. All three birds showed considerable growth by the end of the day. After the rain, all of the young birds preened their feathers.

On the seventh day, the largest bird left the nest. Each time it was put back it hopped out again immediately and moved around in the bush. The middle sized bird was very active, moving about the nest, and stretching frequently.

The young birds, in the two nests which I observed, reached silently for food during the early days of their lives. I heard no food call, no sound of any kind from the young birds until the sixth day. Early in the afternoon faint cries were given whenever the young birds reached for food. These cries increased in volume as the afternoon advanced, so that by evening they were lusty chirps.

On the seventh day, the birds cried continually for food. The bird out of the nest, especially, kept up a continuous sharp chirp.

The young birds apparently did not develop the fear instinct while in the nest. I handled the occupants of the nest, and measured them each day for five days without any sound of protest or any show of fear. When each bird was returned to the nest it huddled down with the others, and then immediately stretched or reached for food.

On the seventh day, the day the largest bird left the nest, it showed some fear, hopping away whenever I approached it. The two birds in the nest crouched down when I approached the nest, but as soon as I withdrew, they stretched upward again. This seems to indicate the beginning of the fear instinct.

During the first three days, any sound near the nest and any movement of the nest or bush in which the nest was located caused the young birds to reach upward with mouths open. On the fourth and succeeding days any *slight* sound near the nest, any *gentle* movement of the bush near the nest caused the stretching of necks with wide open mouths; but any loud noise near the nest was ignored. There seemed to be no fear, but the growing birds were better able to classify stimuli so that they no longer looked for food whenever any disturbance occurred in the vicinity of the nest. During the entire time in the nest, however, a sound or movement like those made by the parent birds was responded to by the opening of mouths.

On the last day in the nest, the two smaller birds were removed and perched on a twig. The runt was so small and weak that it was unable to hold on and had to be returned to the nest. The middle sized bird held on to the branch, showed no fear, and after a time cried for food. The parents, however, were more interested in the largest bird, who had left the nest earlier in the day, and did not respond to the cries.

While the young birds were in the nest, there was no attempt on the part of the parents to train them. On the day before the first young bird left the nest, I observed every movement at the nest from before sunrise until after sunset, and I noted that the parents were very devoted, but made no effort whatever at training.

Behavior of Adults and Young after the Young Leave Nest.—After the young birds had left the nest, I heard occasional faint chirps in the garden but did not see the young birds for nearly a week. The adults were usually together near the old nest, or flying together into the lower garden or to the woods. On the sixth day after the first young bird left the nest, I saw the male and this young bird (both recognized by the colored bands) fly into a hemlock tree near the nest. From there they both flew to the dead tree, a favorite perching place of the male's. Here the young bird gave several weak chirps and then flew to the woods. The male followed it, sang from the telegraph wire at the edge of the woods, and then flew to the lower garden. In a few minutes the young bird followed him to the lower garden.

Frequently weak chirps were heard in the undergrowth in the

lower garden during all the rest of the summer session. Several times, when the male was heard singing in the lower garden and in the woods the young bird was seen with him. The female was frequently seen with the male until she was engaged in raising her next family, the details of which have already been recorded.

Number of Broods.—As I have already stated, the pair of Song Sparrows I observed had four broods in 1928. The nest and young were destroyed the first and third times. No observations were made after the laying of the eggs the fourth time. Even an attempt to raise a fourth brood in one season seems rather unusual. I have found no such record in any of the ornithological journals. In 1929 at the beginning of July this same pair of Sparrows was busy raising a third brood, having successfully sent the first two out into the world.

Much more devotion was showered on the young of the second brood than on those of the third brood. Both parents were at the nest frequently in the first case. If the nest was deserted for half an hour the fact was remarkable. But even during incubation the third nest was frequently unattended. After the young had hatched, I, more often than not, found neither parent at the nest on my visits. Seldom were both parents there at one time, although in the case of the former nest, this was a frequent occurrence. When this nest was destroyed, however, the female took no rest before beginning her fourth. Seeming to realize the shortness of the season, she built this nest in two days, instead of taking, as usual, a week for the operation.

Raising Other Young.—In the third brood, in 1929, there were three Song Sparrows and one Cowbird. This is evidence of the industry of this pair of birds—the raising of even two of the legitimate young with a Cowbird is rather unusual.

Winter Behavior and Food.—In winter, I have seen, and occasionally heard Song Sparrows, usually alone or with one or two companions near dense shrubbery, or in piles of branches, sheltered from the wind. They seem to be somewhat exclusive, not associating much with other birds, but picking a scanty living in the fields and woods where there are weed seeds to be found, and finding shelter at night, so that they can stand even our occasional zero weather in Philadelphia.

Enemies.—The Song Sparrow has numerous enemies. Among the most serious are egg hunting boys, cats, and those who cut down trees and shrubs. The removal of many shrubs leads to the nests being built on the ground. Of the nests which I have observed, those built on or very near the ground raised fewer families than those at an elevation of four or five feet. Of the seven nests I observed between May and the end of July, 1928, only one raised a family to the nest-leaving stage. That nest has already been discussed. Of the others, one seen on the ground in Phoenixville, Pennsylvania, contained three eggs and the incubating female on May 10; on May 17, the nest was empty and deserted. A nest containing four eggs, found on the ground near the Cornell University campus on July 10, contained no eggs two days later. A nest found very low in a bush near campus on July 16 contained four eggs. On July 19 two birds had hatched, on July 20 the two birds were gone, the eggs were still there but the nest was deserted. A nest found about a foot from the ground against a fence post near Dwyer's Pond, Ithaca, New York, on July 20 contained two naked birds, just hatched, and two eggs. On the next day a third egg had hatched. The fourth egg was removed and its contents examined. Incubation was almost complete. The next day the nest was empty. Probably the young birds had been destroyed by a weasel, since an animal resembling a weasel in size and behavior had been seen in the field near the nest. The other nest in which the young birds were observed for five days, although four feet from the ground, was destroyed, probably by a cat which had been seen near the nest.

Economic Importance.—The Song Sparrow is of considerable economic importance both in its relation to man's interest, and in its relation to nature. During the nesting season I have seen the parent birds eating, and feeding the young, chiefly insect food. They eat many grasshoppers, their stout mandibles being well adapted for killing them. I have watched them bringing numerous caterpillars, butterflies, and beetles. During the rest of the year I have observed them eating weed seeds chiefly, occasionally berries and wild, small fruits.

From a purely practical point of view, therefore, the Song Sparrow is directly associated with the welfare of mankind, as a

destroyer literally of tons of weed seeds, thus reducing next year's crop of worse than useless plants, and as a destroyer of a number of harmful insects. In addition to this, the esthetic value of the bird is great. Its beautiful song and cheerful disposition are important contributions, and add much to our happiness.

Mt. Airy, Philadelphia, Pa.