quiet my mother sitting in the drawing room can say quite softly, 'I believe he is coming,' when the dog, two or three rooms distant and apparently asleep, will start up and run from window to window, looking up and down the street. He will do the same on any other day and for any individual, but with some variation in the rapidity of his response. I record these acts merely to show that while they might superficially appear to be the result of reasoning processes, they are doubtless only instances of memory and the association of spoken words with the objects or acts.

ARTHUR W. WEYSSE.

BOSTON, MASSACHUSETTS.

SPECIAL ARTICLES.

THE INHERITANCE OF SONG IN PASSERINE BIRDS. REMARKS ON THE DEVELOPMENT OF SONG IN THE ROSE-BREASTED GROSBEAK, ZAMELODIA LUDOVICIANA (LINNÆUS), AND THE MEADOWLARK, STURNELLA MAGNA (LINNÆUS).

I AM tempted to elaborate at some length the life history of two broods of young birds that were raised in May and June, 1903, that definite data may be before the reader and student, as to exactly what has occurred for the past year with the individuals under observation.

On the 7th of June, 1903, I found a nest of rose-breasted grosbeaks in a swamp on the Millstone River, near Princeton. At the time of discovery the female was sitting, and presumably brooding new-laid eggs. She was not disturbed, but as I did not know when incubation had commenced, the locality was visited and observations were made at intervals of every other day, until on the 14th of the month I was assured that the young had been hatched. I was not then aware of the number of fledglings composing the brood. It seems worthy of record here that both parents took part in incubation, though the male only assumed such duty for brief periods, when the hen bird went away, probably for exercise and bathing, but not in quest of food. The male constantly fed the female and was solicitous in his care for her.

On the 14th of the month the young were hatched, and the parents shared the duties of brooding as they had shared the period of incubation. On the 19th of the month, concluding that the young were old enough for the experiment in view, I secured the nest, in which were a brood of three fledglings, and at once had a water-color sketch made of the young in the nest, as a record of their absolute condition, so far as feathering and appearance were concerned. While not able to discriminate with certainty the differentiation in sex, I was reasonably sure from the first that the brood contained two young male birds and one female.

On the 20th another accurate water-color sketch was made to record how these birds had grown and developed, and on the 21st a sketch of one of the birds, a male, for by this time the sexes were easily distinguishable, records his appearance from both a front and a back view.

These birds were carefully hand reared in the nest, which they left on the twenty-first inst., when about seven days old. Grosbeaks of this kind are very precocious, and being admirable climbers, they clamber about long before they are able to fly, on the limbs and tangle of vines which generally surround the nest.

It seems improbable that during the first four days of their lives these birds acquired much appreciation of the song of the male parent, though he was constantly singing close at hand.

The three young birds were successfully reared, and are alive at the present writing. The brood consisted, as I had anticipated from the first, of two males and one female. The birds were kept together for the first six or seven months of their lives, in a large cage, and as I had no other male grosbeak in my laboratory, it was, of course, quite impossible that they should have learned anything of the method of song of their ancestors, except such impression as may have been gathered during the first four days of their lives. All of them went through the regular moult, and assumed by September the characteristic dress of rose-breasted grosbeaks at that season of the year. In October the two young males both developed a change in appearance which progressed slowly

until near Christmas-time, when they began to appear like adult male grosbeaks in full spring plumage. I was not a little chagrined that during September and October they showed a disposition to quarrel and harass one another, so that many of the feathers of the tail were broken and ragged, and the birds presented a rather worn and torn plumage. My experience has been that with most passerine birds, the primary quills and the feathers of the tail are retained for the entire first year without change. I had, however, discovered that young Baltimore orioles moulted the rectrices during the months of January and February, and was, therefore, prepared for a similar moult in these grosbeaks, for I find that in very highly colored birds, while the primaries are not moulted during the first year, but attain their brilliancy either by wear or *by direct change in the color of the feather,* the tail feathers of such birds, at least in a number of species, are moulted. Any one who is familiar with the color pattern of the rectrices of adult Baltimore orioles and rose-breasted grosbeaks must be aware that there is a very strongly contrasted area of either black and yellow or black and white on most of the feathers. To emphasize the matter let me say again that Baltimore orioles and rose-breasted grosbeaks both moult their entire set of tail feathers during January and February, and acquire by this moult the distinctive color pattern which is characteristic of the adult bird.

In the case of my grosbeaks, with this moult of the rectrices they recovered rapidly their fine appearance, and are indistinguishable at the time I am writing from wild representatives of their kind out of doors. Therefore, my apprehension that they might not present a fine appearance was unwarranted, for the reason that I have fully explained.

With the primaries the change seems to be effected, so far as I have observed, in a different way, which I ascribe, as I have said before, partly to wear of the surface of each feather, but, besides this, *I am strongly inclined to the opinion that there is a physical change in the feather itself, which alters its appearance so far as color is concerned.*

The moult was about completed by the 10th of February, but previous to that time I had detected a slight motion of the throat and body, indicating that the two males were beginning to sing. At first it was hardly possible to detect anything but the faintest sounds, but in a week or ten days I could discriminate the song, which I shall describe as nearly as is possible, in words. The tone, on the whole, is extremely musical, and has the soft plaintive quality characteristic of the rose-breasted grosbeak. It is very melodious, and while the birds have continued to sing daily to the time of this writing, no one would refer the *method* of song to the bird in question. While it is fully as prolonged as the song of the rose-breasted grosbeak, as we know the bird out of doors, it has not nearly the volume, and is not so abruptly broken. The notes are low and flute-like and resemble strongly the kind of song one associates with robins and thrushes in the autumn or late summer for a short period, after they have completed the moult. I have had a number of competent observers listen to the performances of these birds on many occasions, and all agree with me that the song could not be referred to the rose-breasted grosbeak. It is true and entirely possible that later the birds may develop a more characteristic song, but inasmuch as the time approaches when wild rose-breasted grosbeaks make their advent in this vicinity, coming from their winter homes, I am inclined to believe that these birds have now acquired the song that will characterize them throughout the period of breeding. I may say that I have mated two of the birds, one of the young males and the female, and have secured an older female from another source, with which I have mated the other male bird. I trust that I may be able to report, later, successful efforts in breeding these birds in captivity, and further data concerning the method of song which may obtain amongst them. This finishes my remarks in regard to the rose-breasted grosbeaks, and I now propose to give some data in regard to meadowlarks, obtained about May 25, 1903.

I shall speak of the meadowlarks in a much more general way than of the grosbeaks, as

I have been unable to watch them as closely, for they have not been caged, but have been at large, first in a room by themselves until February, and later associated in another room with a number of meadowlarks that had been reared in previous years. I particularly wish to refer to one of the birds, a male which has arrested the attention of all observers.

In the same room with these larks there are three blackbirds, *Merula merula* (Linnæus), which I procured from Germany. All of these birds are males, and they sing chiefly late in the afternoon, but much more frequently during the night, especially when there is moonlight. Early in February I heard constantly what I supposed was the song of one of these blackbirds. The curious part of it was that only one measure of the song was produced, a silvery whistling sequence of five or six notes rather longer drawn out, and given with much precision. For several weeks I ascribed this to one of the blackbirds, and believed that because of the shelter afforded them by many evergreen trees in my bird room that it could only be this bird, though I was unable to see the singer while hearing the song. My friend, Mr. Horsfall, who was with me during all the time, checked my observations, but we neither of us were able to *locate* the songster.

One of my meadowlarks of the brood mentioned attracted our attenion by his behavior and deportment during the early part of April. In addition to his song, which was quite dissimilar to that of a wild meadowlark, he accompanied the performance by what I should call a parade or dance, analogous to the strut of the turkey-cock. It is so marked a characteristic of this and other individuals of the same species that I determined to have it recorded in a color sketch, and for two or three days Mr. Horsfall and I spent much time in getting the position and manner of the bird while occupied in this kind of behavior. The bird sang frequently while going through the manœuvre described, and both of us finally saw and heard him many times sing, preparatory to or after his own song, the cadence described, which I had referred, before I saw the meadowlark do it, to the European blackbird.

While I am fully aware that under the artificial conditions of confinement birds are extremely likely to acquire abnormal songs, I can not but feel that the knowledge of the methods of song which has come to me while watching birds under these conditions, indicate a receptivity which to some extent undoubtedly obtains in their lives out of doors. My conclusion is that birds are influenced in their early lives very strongly by any noise that arrests their attention, even in a wild state, and that this propensity to imitate and differentiate their normal methods of song is greatly exaggerated under the artificial state wherein they live when in confinement.

WILLIAM E. D. SCOTT.
DEPARTMENT OF ORNITHOLOGY,
PRINCETON UNIVERSITY,
April 30, 1904.

STANDARD TESTS OF AUDITION.*

IN a recent publication from this laboratory,† tests for acuteness of hearing were divided into two classes: speech-tests, which employ letters, words or sentences, spoken aloud or whispered, and mechanical tests, which employ such apparatus as the watch, the tuning fork and the acoumeter. The existence and the common use of these two methods, for similar purposes, seem to be explained by the fact that each method possesses peculiar advantages, while neither is sufficiently free from serious defects to give it the whole field. The method that employs the voice measures directly the most important function of audition, the hearing of human speech, and it may, at the same time, be made sufficiently complex to cover a wide range of tone and noise; but, to offset this advantage, the method suffers from the great variability of the vocal stimulus. Mechanical tests, on the other hand, are simpler and are more easily standardized; but they do not—just because of their simplicity—furnish an adequate and reliable expression of general

* From the Psychological Laboratory of Cornell University.

† See 'Auditory Tests,' B. R. Andrews, *Amer. Journal of Psych.*, XV., 14.