

nesting, the fossil evidence of these species tells little about contemporary conditions. There is nothing in this avifauna to contradict the nature of the landscape, vegetation, and climate as postulated by Hibbard (1955. *Univ. Mich., Contrib. Mus. Paleo.*, 12: 203-204). The abundance of duck remains is further indication of marshes and marsh-edged streams and pools. Even as a migrant the presence of a Wood Duck suggests that there were probably at least patches of woods along the lowland streams. The records of pelican and goose point to the existence of fairly large, shallow lakes. Hibbard's suggestion of mixed grasses on some valley walls and on some uplands is supported by the owl remains.—PETER STETTENHEIM, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan, December 3, 1957.*

**New records of the Nashville Warbler in Colorado.**—The Nashville Warbler (*Vermivora ruficapilla*) is comparatively rare in Colorado. According to Dr. Alfred M. Bailey (pers. comm., November 7, 1957), "There are three specimens taken in the state, including one from Mesa Verde, and several sight records, the most recent being from Colorado Springs, May 19, this year."

To these records we wish to add the following: In August, 1954 (exact date not available), a single bird was observed by a biology class under the direction of Daniel, in a shrubby area near the mouth of the Conejos River Canyon, Conejos County, about 20 miles north of the New Mexico border. On November 1, 1957, an individual flew into the window at the home of Mr. and Mrs. Robert Armagast of Alamosa, Alamosa County, Colorado. It was released on November 2, apparently unharmed.

Both of these locations are in the San Luis Valley which is a high (7500 feet), large, flat, intermontane basin on the eastern slope of the Rocky Mountains.—JOSEPH C. DANIEL, JR., ROBERT M. ARMAGAST, AND JULIA W. ARMAGAST, *Adams State College, Alamosa, Colorado, January 21, 1958.*

**Notes on pre-copulatory display in the Starling.**—In a recent paper on the breeding biology of the Starling (*Sturnus vulgaris*), Kessel (1957. *Amer. Midl. Nat.*, 58:257-331) brings together some of the European literature on the sexual displays concerned with pair formation and copulation. The following two observations from the field, however, are presented to point out elements of pre-copulatory display which are not included in Kessel's paper. The first observation was made on April 22, 1956, on the grounds of Harvard University, Cambridge, Massachusetts. A Starling, hereafter called "A," was perched in a tree when first seen, but immediately flew down to Starling "B," perched on a lower limb in the same tree. Bird A alighted on the right side of B, and mutual bill rubbing took place. Both birds assumed a sitting position with the axes of their bodies at about a 45° angle with the limb, and rubbed their bills together in a motion resembling bill wiping on a limb, with the exception that it was slightly slower. Then A mounted B for a brief interval, flying up to a higher limb immediately afterwards. Shortly after, B flew to a limb about six feet lower, and both birds began to preen vigorously. Bill wiping against the limb was prominent in the comfort movements. Then A flew down to the side of B again, and mutual billing took place. A mounted B in the same manner as before, after which both birds sat quietly side by side. The entire sequence lasted about two minutes, and was performed in complete silence, as far as I was able to detect.

This observation points to two exceptions and an addition to Kessel's descriptions. She notes that the female "always" pecks the male in the neck just prior to his mounting, and that a second mating never follows the original one (although she acknowledges that it may happen rarely). Moreover, "courtship-billing" as described here is not mentioned

in her paper. In a brief examination of recent literature on the Starling (about two dozen papers in English and German) no reference to this display could be found, although one note (Nethersole-Thompson and Musselwhite, 1940. *Brit. Birds*, 34:44) mentions a somewhat similar movement, which is discussed below.

The origin of behavior patterns of birds is now receiving increased attention (e.g. Daanje, 1950. *Behaviour*, 3:48-98; and Tinbergen, 1952. *Quart. Rev. Biol.*, 27:1-32), and it is thought that most instinctive movements are derived or "ritualized" from more basic patterns, such as locomotion. Moynihan (1955. *Auk*, 72:240-246) has pointed out that many parts of complex displays which were once considered to be of "extraneous" origin, can be shown to be derived from intention movements of more basic actions. Therefore, if courtship-billing is truly "autochthonous" (that is, derived from a motion actually in the context of courtship), it could have one of several sources. Lack (1940. *Auk*, 57:169-178) gives several examples of mutual billing in bird courtship which are derived from courtship-feeding, although he had no reports of either in the Sturnidae. Recently, however, courtship-feeding has been reported in the Starling as a prelude to coition (Chappell, 1949. *Brit. Birds*, 42:118-119) or coition attempts (Owens, 1949. *Brit. Birds*, 42:181-182), and since billing has now been observed to occur in a similar context, it may be that the latter is derived from an intention movement of the former. Lack also mentions a second origin of courtship-billing in birds which might apply to the Starling. In the courtship, especially of species in which the nest site is very important in maintaining the pair bond (as it seems to be in the Starling *vide* Kessel, *op. cit.*), often nesting material is passed from one bird to its mate. Marples (1936. *Brit. Birds*, 30:14-20) and Beven (1946. *Brit. Birds*, 39:116) have described behavior similar to this in the Starling, so that billing might have been derived from this source, instead of from courtship-feeding. A third possible autochthonous origin of courtship-billing is incipient aggression. Courtship in birds often involves an interplay of three tendencies: attack, escape, and sexuality, the components of the first two decreasing, the third increasing as courtship progresses. It is not difficult to visualize the selective advantage of reducing an aggressive peck-thrust to an intention movement resembling billing. However, a fourth, "extraneous" or out-of-context, origin is also possible. It was noted that vigorous comfort movements, especially bill wiping, were characteristic of both birds at the time of courtship. It is conceivable that this comfort motion has been incorporated into the courtship display in a manner similar to the supposed origin of "courtship-preening" in ducks (Moynihan, *op. cit.*). By association with the rest of courtship display, the extraneous movement may acquire by conditioning a "courtship valence" to the female, which can then be acted upon in the males by natural selection. The proposed explanation is well set forth by Moynihan, and will not be labored here. It is interesting that Nethersole-Thompson and Musselwhite (*op. cit.*) describe a courtship motion similar to ordinary bill wiping by the male Starling, except that the beak does not touch the limb and it is performed conspicuously before the female. They also make note of a "false preening" by the female which functions in the display. The above sources are presented only as suggestions, of course. Before the origin of courtship-billing can be traced, the forms of courtship-feeding, nest material handling, aggression, and comfort movements of bill wiping, as well as the billing itself, must be studied in greater detail.

The second field observation was noted on December 28, 1957, when two Starlings were observed in a small fruit tree near Cabin John, Maryland. Bird "D" mounted "C" very quickly, after which both sat quietly together for a few seconds. Then C mounted D, although no differences could be distinguished in the reverse mounting. Characteristic

wing-fluttering was noted, but no other specific motions were seen in either "mating." Both birds were frightened by approaching people, and took wing during the second mounting. Starling C was unusual in that it was in spring-like plumage, with yellow bill and noticeable spots, although D was in usual winter plumage.

Kessel gives a list of references which record sexual behavior in the Starling throughout the year, and they need not be repeated here. However, the observation raises the problem of winter sexuality in general. Although many of the "ultimate" causes (e.g., increasing day length) affecting sexual behavior have been investigated, published observations on immediate environmental conditions eliciting winter display and copulation seem to be scarce. An investigation of weather maps for the week prior to the second observation here reported showed no unusually warm or changing temperatures. Any conclusive correlation with weather would involve watching marked birds over a considerable period of time.

Kessel does not mention reverse mounting in Starlings, although it has been reported in a brief note by Glick (1954. *Auk*, 71:204). There seems to be no other mention of this in the literature, but it is well known in other species of birds. The second observation also contradicts Kessel's belief that pecking of the female directed at the male's neck or shoulder is a necessary "releaser" for mounting.

In addition to the questions of the origin of courtship-billing and the cause of winter sexuality, it is apparent that there are still many problems concerned with the sexual behavior of the Starling. Although other components of sexual display have been reported (see Kessel's paper with references), we still lack a coherent ethological description of the frequency of display components in the Starling.

Drs. Ernst Mayr and Lawrence Kilham helpfully led me to references and made suggestions about the subject matter, and Andrew Meyerriecks critically read the note and supplied several pertinent references.—JACK P. HAILMAN, *Harvard University, Cambridge, Massachusetts, February 7, 1958*. (Present address: 4401 Gladwyne Drive, Bethesda, Maryland.)

**Black-crowned Night Herons using bill motion to lure prey.**—The late Witmer Stone, in writing about the Black-crowned Night Herons, *Nycticorax nycticorax* (1937. "Bird Studies at Old Cape May" Vol. 1, p. 148), relates how the birds would stand along the shores of a shallow pond, with the neck deflected and the point of the bill just touching or slightly submerged in the water. On July 14, 1956, while observing a number of those herons feeding along a tidal channel in the Tuckerton Meadows in Ocean County, New Jersey, I had the opportunity to observe three of them at close range and discovered what I believe to be the reason for their odd behavior.

The birds I had under observation were not more than 100 feet from my parked car, from which I watched them through a 20× Balscope held rigid in a window mount. The channel along which they slowly stalked, or stood with bill tip submerged for a few seconds at a time, was partially covered with a green algae that thickened along the shoreline, screening any underwater activity. But the bill tips were not held motionless in that medium. Rather they were opened and closed so rapidly that the motion may best be described as a vibration, the distance between the upper and lower mandibles during the action being very slight but clearly discernible through the glass. This motion would continue for a few seconds; then with a quick thrust of the entire bill into the water, a small fish would be withdrawn and swallowed.

During the hour or more that I kept the birds under observation this maneuver was