(*Molothrus ater*) eggs. The first clutch was the earliest ever recorded for this population (Tompa, Ann. Zool. Fenn. 3:3–73, 1964; Smith et al., Oecologia 47:164, 1980).

A simple model of the temporal spacing of Song Sparrow broods (Smith and Roff, Can. J. Zool. 58:1007, 1980) shows that a brood-size of one is the only one that will allow Song Sparrows sufficient time to raise four broods, except in an unusually long breeding season. This was precisely the situation for this pair. Only a single sparrow-young reached banding age in each of the first three broods. Because the parents had previously bred together this may have allowed broods to be more closely spaced in time (Smith and Roff, 1980). The final nesting attempt of the pair raised both cowbirds and two of the Song Sparrows to banding age. In all, the four nests fledged at least five Song Sparrows and one cowbird (as judged from begging calls of fledged young), and at least two of the young sparrows reached independence from parental feeding. Thus, the pair were able to compensate for the extreme brood reduction in their first three nests and still have a moderately successful breeding season.

No other pair raised four broods of young in a single year during 6 years of intensive study. Nice (Trans. Linn. Soc. New York 4:93, 1937) cited a report of a single case where a pair of Song Sparrows raised four broods in Ohio. This pair also began the four broods at intervals of about 4 weeks, but began to breed almost 6 weeks later than the case reported here. I doubt if attempting to raise four broods constitutes a breeding "strategy" in the Song Sparrow or other temperate zone passerines. Rather, it is a consequence of having three small broods at the start of the breeding season.

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Post-copulatory display in the Lark Bunting and other species.—In the summer of 1964, Lark Buntings (*Calamospiza melanocorys*) unexpectedly nested in large numbers in southern Saskatchewan and other regions remote from their usual range (e.g., southwestern Minnesota; Anderson and Getman, Loon 37:63–69, 1965). (For a good description of the habitat used by buntings in the Regina area see Smith and Smith, Blue Jay 24:129–131, 1966.)

Having been intrigued by a post-copulatory display in the male Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) in response to a female dummy of the same species in precopulatory pose (Nero, Wilson Bull. 75:391–394, 1963) I set out to test for this behavior in the Lark Bunting. Tests involving the use of a dummy female Lark Bunting placed on the ground in precopulatory or soliciting pose were carried out at several sites from 24–26 June, and 1 and 8 July 1964. The female dummy was arranged in typical passerine soliciting posture, i.e., head drawn back with bill up and open, tail closed and raised, wings partly out, and body low on the tarsi (see Fig. 1).

No attempt was made to quantify the results: I simply wanted to observe and photograph the results of the tests. The most striking response consisted of a post-copulatory display by the male during which it assumed a static exaggerated version of female passerine precopulatory posture (Figs. 1, 2). Nearly identical displays were given by approximately 20 individual males in response to the same dummy.

The dummy female was first placed in the territory of a male, about 4 m from a nest which

FIG. 1. Male Lark Bunting responding to female Lark Bunting dummy (mounted bird) in typical passerine sexual solicitation posture. Male is in post-copulatory static pose. (Photos reproduced from color transparencies by the author.)

contained four eggs. Two types of response to the dummy were observed: that of the nesting female, and those of her mate and several other males attracted to the scene. Interactions between males were also observed. The female's response gave some indication of conflicting motivations: with feathers sleeked, head held high and legs extended, she approached and attacked the dummy, then suddenly gave an extreme tail-lifting display in what I assumed was appeasement. When the incubating female left the nest to approach the dummy, her mate flew to her with wings raised and tail spread, an aggressive response. In turn she bit him on the head and/or the wing, and briefly held onto him.

At least six other males appeared sexually aroused by the dummy, as indicated by prominent cloacal protuberances. They bill-tilted (indicating threat) and tail-raised (indicating appeasement) to each other, but did not approach the dummy. On the other hand, the response of the territorial male to the dummy was startling. He rushed in, bit at her wing feathers, copulated, then hopped off and demonstrated extreme tail-lifting as he turned away. He disappeared in the grass in silence, but a moment later he emerged, began picking up grass stems until he had a beakful, dropped them and again rushed to the dummy and repeated the performance. After copulating with the dummy three times, however, the male went away with tail lowered and spread. At some time during this sequence semen was deposited on the back of the dummy.

The post-copulatory behavior of males in several other tests with the dummy was variable, showing various degrees of conflict between aggression and appeasement, but exhibiting strong, exaggerated resemblances to the female precopulatory display. The most surprising aspect was the absolute stillness of the bird. Although I had previously seen this in the male Yellow-headed Blackbird it was even more striking here. In extreme display the tail was

FIG. 2. Male Lark Bunting in extreme post-copulatory posture. White eye-ring is anomalous.

straight up (Fig. 1) or even directed forward (Fig. 2), the head withdrawn and the beak up and open (but with no apparent vocalization). At times the nictitating membrane closed and opened. The bird rested on its tarsi, breast to the ground (Fig. 2) and the closed wings were held out. Occasionally, the breast was lowered to the ground even when the male was only half-crouched (i.e., tarsi not resting on the ground). At times the display was so extreme the male appeared to be trying to touch the back of its head with its tail. Similar displays were even given when the dummy was fastened to fence wire, the responding male displaying despite the awkward perch (Fig. 3). Also, there was often a lateral display, the male leaning to one side away from the dummy, keeping the leg on that side partly extended while resting on the opposite tarsus (Figs. 2, 4). During lateral display the wing on the side facing the dummy sometimes was partly spread, and the flank feathers on that side were fanned out (Fig. 2). With its raised bill open, the male's pink-colored palate was conspicuous.

Generally, the more frenzied or hurried the movements of a male approaching the dummy and the more "complete" the copulation effort, the more extreme the post-copulatory display. Often the male approached the dummy in a low run, body and head parallel and low, plumage loose and full, raising the crown feathers (denoting apprehension) as it neared the dummy, then, during copulation, lowering the crown and compressing the head and neck plumage. Occasionally, an approaching male hopped by dropping onto its tarsi, bobbing up and down. The hopping part of the approach sequence was once briefly given by a male responding to a live female. A few times males gathered nesting material prior to approaching the dummy, and once a male copulated while holding long grass stems in its bill. On one occasion a male ran towards the dummy with a weed stalk four times the length of its body held sideways in its bill. Once I saw a live female in precopulatory display holding grass stems in her bill.

FIG. 3. Male in post-copulatory display on fence wire; female dummy to right.

In the summer of 1964, I set up a dummy female Chestnut-collared Longspur (*Calcarus ornatus*) near Moose Jaw, Saskatchewan (G. M. Fairfield's study area), in precopulatory position on the territory of a male of this species which elicited extreme post-copulatory display from the male. Fairfield notes (pp. 1638–1639 *in* Life Histories of North American Cardinals, Grosbeaks, Buntings, Towhees, Finches, Sparrows, and Allies, Austin, ed., Dover, New York, New York, 1968): "Approaching the dummy female in a zigzag course, he erected his chestnut collar, stretched his head high, and looked down at her over his lowered bill from directly in front. He then fluttered to her back and attempted to copulate. Dismounting, he ran away from her holding his body level with the ground, wings and wide-fanned tail almost dragging. He then circled back and tried once more to copulate, and circled to the front. There he assumed an exaggerated 'female precopulatory posture', in which he raised his closed tail as high as possible until his chest almost touched the ground, bent his head back on his shoulders with bill pointing straight up, and the wings projecting back and down."

On 8 May 1966, a display resembling that of the Lark Bunting and the Chestnut-collared Longspur was observed in McCown's Longspur (*C. mccownii*) which occurred briefly but distinctly in post-copulatory response to a dummy male of the latter species (I had been unable to obtain a female). The dummy, in head-up, tail-up posture, was propped up on a McCown's Longspur territory near Regina. As with the Lark Bunting and the Chestnut-collared Longspur, cycles of behavior were observed in which the responding bird several times approached frenziedly, displayed with head held high and crest raised, uttering a high-pitched trill, copulated, went into post-copulatory display close beside and parallel to the dummy, then ran off to "rest." The approach display was given at some distance, gradually

FIG. 4. Male in lateral post-copulatory display (in part); female to right.

building up in intensity, whereupon the male would make his approach, etc. On nearly all of approximately six occasions, the approach was performed with one wing raised straight up, a posture previously noted by DuBois in 1937 (pp. 1576 *in* Austin, ed., 1968). While resting, a double note *chip-peet* was given repeatedly. Usually, post-copulatory display was given to the dummy with the male in a parallel position, lying on its opposite side while maintaining the head-up, tail-up aspect. Often the male ended the rigid post-copulatory display with a spring into the air (from resting on its tarsi) coming down to land on its toes with its wings out. Then the male would walk away with the tail spread (especially on the side nearest the dummy) and the wing on the dummy side highest, at times with a peculiar "scooter-gait," one foot pushing along ahead of the other. Then it would circle in front of the dummy and re-mount, or go away with tail display and wing (or wings) elevated. In these instances what appeared to be annoyance-pecking at the dummy was noted. This has been seen in nearly all my experiments with female dummies (including those involving the Red-winged Blackbird [*Agelaius phoeniceus*] in which no post-copulatory display was ever elicited). Once the McCown's Longspur pulled at rump feathers, and thus dragged the dummy backwards.

Post-copulatory display in the Yellow-headed Blackbird (Nero 1963) included elevated tail, an exposed cloacal area (enhanced by a circlet of yellow feathers), wings held out sideways, and static posture, although head-up display was not given. Tail raising in this species is also given to other males where it is considered an appeasement display. Similar display occurs in several other icterids.

In all likelihood, the head-up, tail-up post-copulatory display by male birds is used in agonistic situations relating to the constant solicitation display of the dummy female. Aspects of the display, especially tail-up, while facing away from an opponent, suggest a high degree of appeasement function in agonistic circumstances.

Performance of head-up, tail-up display in flight by a male Indigo Bunting (*Passerina cyanea*) towards a human supports the suggestion of the use of female solicitation behavior by males under stress in agonistic situations. On 10 July 1971, near East Braintree, Manitoba, both members of a pair of Indigo Buntings appeared and reacted to me as if they had fledglings in the vicinity. Several times when I "pished," the male flew toward me in stilted flight, head and tail up, wings held partly open at the sides and fluttering.

Marler (Behaviour Suppl. 5, 1956:118) described use of the female precopulatory or soliciting posture by male Chaffinches (*Fringilla coelebs*) when confronted by dominant males. The postures of the submissive birds were "identical with the high intensity soliciting posture of the female." Judging from the photos of the latter display, Marler's (1956) submissive males had postures nearly identical to that of Lark Buntings in post-copulatory display. The use of female soliciting posture by male Chaffinches was "associated with a strong escape tendency that is prevented from expression" (Marler 1956:119). Marler (1956:121) notes further that in male-male confrontations "the most elaborate display is associated with the highest intensity of conflict." The post-copulatory display of the Lark Bunting, Chestnut-collared and McCown's longspurs appears to be of this nature. Although elicited by an artificial stimulus source (the dummy bird) these displays must be regarded as a genuine part of the behavioral repertoire of the species, significant in terms of motivation, latent with meaning, and beautiful.

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Responses of Black-capped Chickadees to mirrors.—The use of mirrors is of interest in studying agonistic and social behavior (Svendson and Armitage, Ecology 54:623–627, 1973). Several species of birds have been tested in the laboratory (e.g., Zebra Finch [*Poephila guttata*], Ryan, Wilson Bull. 90:295–297, 1978; House Sparrow [*Passer domesticus*] and Budregriar [*Melopsittacus undulatus*], Gallup and Capper, Anim. Behav. 18:621–624, 1970). The only species of free-living birds that have been presented with mirrors are Glaucous-winged Gulls (*Larus glaucescens*) (Stout et al., Behaviour 34:29–41, 1969) and Blue Grouse (*Dendragapus obscurus*) (Stirling, Can. J. Zool. 46:405–408, 1968).

Here we examine reactions to mirrors of free-living Black-capped Chickadees (*Parus atricapillus*) in winter flocks. We asked the following questions: (1) How do chickadees respond to mirrors? (2) Do responses reflect differences in dominance rank?

In winter Black-capped Chickadees live in small flocks and exhibit a linear dominance hierarchy (e.g., Glase, Living Bird 12:235–267, 1973). Displays associated with aggressive interactions include various postures, gaping, and a vocalization termed the "gargle" (Ficken et al., Auk 95:34–48, 1978). In natural encounters only the more dominant males give this vocalization frequently.

Experiments were conducted at the University of Wisconsin–Milwaukee Field Station, Saukville, Ozaukee Co., Wisconsin, from January to March 1979. Observations were made from blinds located 10 m from two feeders, D7 and F9. The two feeders were identical in