Double-scratching and terrestrial locomotion in emberizines: some complications.—Harrison's (Wilson Bull., 79:22–27, 1967) review shows that some species of emberizine sparrows perform a "double-scratch" foraging movement in which the two feet are moved synchronously, and proposes that this behavioral trait is a useful taxonomic characteristic. He suggests that the possession of double-scratching behavior is correlated with hopping locomotion, as opposed to terrestrial locomotion in which the legs are moved separately (e.g., walking and running). In this contribution I add new data and discuss several aspects of Harrison's hypothesis.

Harrison "expected" that certain genera would show the double-scratch/hopping combination, and further contributions stimulated by his paper have already been published. For instance, Taylor (Wilson Bull., 82:465, 1970) reported that the Vesper Sparrow (*Pooecetes gramineus*) double-scratches, as expected by Harrison. However, Enders (Wilson Bull., 82:225, 1970) reported that the Seaside Sparrow (*Ammospiza maritima*) double-scratches, and described its locomotion on land as "walking"—contrary to the hopping expected by Harrison. I here add some further data of my own on double-scratching and locomotory behavior from 15 species of American emberizines. These data show that a strict interpretation of Harrison's hypothesis of correlation is inconsistent with the facts, and also reveal a number of complications about the behavioral patterns and attempts to correlate them.

During the period 1957–58 I made extensive observations on the behavior of emberizines, only some of which were published. In one report (Hailman, Bird-Banding, 29:241–244, 1958) I noted that the Ipswich Sparrow (*Passerculus princeps*) was always seen to run, never to hop. This is a genus that Harrison expected to hop rather than run. I have

TABLE 1

DOUBLE-SCRATCHING AND TERRESTRIAL LOCOMOTION OBSERVED IN SOME AMERICAN EMBERIZINES

Species	Double-scratch	Locomotion	
		undisturbed movement	hostile chasing
Pipilo erythrophthalmus	X	H	—
Passerculus sandwichensis	X	W,R	R
P. princeps	—	W,R	R
Pooecetes gramineus	—	H/W	—
Amphispiza belli	X	—	—
Junco hyemalis	X	H/S,R	H/R
J. oreganus	—	—	R
Spizella arborea	—	H/R	R
S. passerina	—	H	—
Zonotrichia albicollis	X	H/W,R	H/R
Z. leucrophys	X	H	—
Z. capensis	—	H	—
Passerella iliaca	X	H	—
Melospiza georgiana	X	—	—
M. melodia	X	H/S,W,R	—

Key: H, hop; R, run; S, "skip"; W, walk; X, observed; synchronous leg movements separated from asynchronous ones by a slash (see text).

TABLE 2

DOUBLE-SCRATCHING OF EMBERIZINES REPORTED BY NICE (1937)

Pipilo erythrophthalmus
Passerculus sandwichensis
*Spizella arborea**
Zonotrichia querula
Z. leucophrys
Z. albicollis
Passerella iliaca
Melospiza lincolnii
M. melodia

* Double-scratching apparently absent in the congener *S. pusilla*.

summarized in Table 1 previously unpublished observations from my notebooks, which include not only data from my study in the late 50's, but incidental observations made in the intervening years.

The first data column of Table 1 indicates nine species I have seen double-scratching. Harrison laments that information on emberizine double-scratching is not available in the literature. Yet, in a well-known study not cited by Harrison, Margaret Nice (Trans. Linnaean Soc. New York, 4:42, 1937) reported nine species of American emberizines that double-scratch (see Table 2), adding that the behavior "does not seem to occur in the Field Sparrow" (*Spizella pusilla*). My list (Table 1) is remarkably similar to Nice's (Table 2).

The second data column of Table 1 summarizes notes made on locomotion in undisturbed birds moving over the ground, and includes the South American *Zonotrichia capensis*, observed in Ecuador. Emberizines use at least four discernable means of moving over the ground: *hopping* (denoted H), in which the two legs are moved synchronously; "*skipping*" (S), in which the legs are moved asynchronously, but not truly alternately; *walking* (W), in which the alternation is slow; and *running* (R), in which the alternation is rapid. Some species, such as the Song Sparrow (*Melospiza melodia*) can use any of the four methods. Nice (op. cit.:49) also reports hopping, walking, and running in the Song Sparrow.

The frequency of use of these different modes of terrestrial locomotion is not known quantitatively for any species, nor are the conditions that govern the type of locomotion employed clear. Nice (op. cit.: 49) states that "although adult Song Sparrows progress over the ground chiefly by hopping, they also walk to some extent, especially where the going is rough." On 24 July 1958 I noted that a Song Sparrow hopped on uneven surfaces and ran across even surfaces, which seems to be the opposite of Nice's experiences. On 25 April 1959 I noted that a White-throated Sparrow (*Zonotrichia albicollis*) ended a bout of fast hopping with a few single walking steps. It may thus be that both the substrate and speed of locomotion help to determine the gait employed.

The data in Table 1 on undisturbed locomotion do not bear out Harrison's correlation between double-scratching and hopping. Among the species seen as double-scratchers, four were seen to use the limbs asynchronously during undisturbed locomotion. The Tree Sparrow (*Spizella arborea*) runs, and is cited by Nice (Table 2) and Harrison (op. cit.) as double-scratching. Furthermore, the Vesper Sparrow, reported to double-scratch by

Taylor (op. cit.), walks as well as hops (Table 1). If we also add to this list Ender's (op. cit.) notes quoted above, at least seven species of double-scratchers are known to move over land by some means in which the legs are not moved together.

A point overlooked by Harrison when he described species as having "hopping locomotion" is that in hostile chasing emberizines appear often to run. This behavior was noted in my study of *Passerculus princeps* (Hailman, op. cit.), and previously unpublished observations of other species are shown here in the last column of Table 1. Harrison noted that "*Junco* spp." double-scratch, and this column adds evidence that *J. oreganus* moves its legs alternatively in at least one type of terrestrial locomotion.

There are, then, at least eight known species that do not fit a strict interpretation of Harrison's hypothesis. The hypothesis might be rephrased to state that double-scratchers hop, even if they use other terrestrial locomotory patterns as well. While I have not seen *Passerculus sandwichensis* hopping, Robbins et al. (Birds of North America, p. 308, 1966) state that it "runs and hops, rarely walks." Perhaps then all emberizines that double-scratch also hop as well as run or walk. However, Harrison notes that the Old World emberizines do *not* double-scratch, yet possess hopping *as well as* running and walking. The double-scratchers hop, run and walk and the "non-double-scratchers" also hop, run and walk.

Finally, a few further complications exist. A fifth form of terrestrial locomotion in emberizines is "*side-stepping*," which was described more than a decade ago (Hailman, Auk, 77:349–350, 1960) in a foraging Song Sparrow. I have only one other such observation in my notebooks: a Slate-colored Junco (*Junco hyemalis*) side-stepping along a tree-branch, which is not, of course, truly terrestrial locomotion. Another point to be reckoned with in attempting to correlate scratching and locomotion is raised by my field notes of 11 January 1959, in which the leg movements of a "double-scratching" Song Sparrow were noted as being somewhat asynchronous.

On the basis of this relatively scanty evidence it would be unwise to reject the notion of *any* correlation between scratching and locomotory patterns. We require evidence on more species, more detailed observations on the synchrony of leg movements in scratching of various species, an understanding of what contexts determine locomotory gaits, and special attention to kinds of behavior that *appear* to be lacking in certain species. Furthermore, there may already exist much more published evidence than cited by Harrison, as suggested by publications of Nice and me quoted above. The importance of the subject matter, however, transcends the taxonomic usefulness of these characters. This is an example of functional relationships among physical movements that may help to clarify anatomical substrates of as well as evolutionary processes in behavior, and is thus worthy of continued attention.

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The Purple Finch nests in central Ohio.—Male Purple Finches (*Carpodacus purpureus*) were seen and heard regularly between early April and the middle of July of 1972 on the Ohio State University Golf Courses in Franklin County, Columbus, Ohio. At least four territories were held throughout the season in groves of scotch pine and spruce, which also contained honey locust, tulip poplar, ash, oak, and maple. The appearance of three young and an attendant female on 8 July and a similar family group on 18 July in two of these territories justify the inference that they nested.