27 nests I found. Eighty-five percent of these were also in conifers, but 65% of the conifers used were in small groves in the midst of a deciduous stand, not in predominantly coniferous stands. Of the four nests in deciduous trees, only one was situated in a tree of the predominant species around the nest site.

I found no nests in lone trees or even in open stands. Nest sites were characteristically in dense stands with a well-developed canopy, but below the top of the canopy. Nest trees consistently had dense foliage; conifers are evidently selected for this reason. Two of the deciduous trees used were diseased, with abnormally dense growth. Two trees growing with their trunks nearly touching were used in three instances. The most common nesting site I found consisted of grouped or scattered conifers in a stand of taller deciduous trees.

Adult Sharp-shinned Hawks appeared at the nest sites up to four weeks before eggs were laid. On the southern border of Utah (Washington County), the hawks began nesting 15–20 days earlier (second week of May) than those 350 miles north (Cache County). In central Utah (Beaver and Utah counties), eggs were laid during the fourth week in May, while in northern Utah (Cache and Box Elder counties) eggs were laid during the first week of June. Laying dates for the same territory in consecutive years have been known to vary as much as seven days. In only one case was the same nest used in consecutive years. However, groves are commonly re-used and may contain as many as five old nests.

In the 34 nests reported before my studies, average clutch size was 4.3 (range 3–5) eggs. Eggs are laid on alternate days, but hatching of five eggs may occur within a period of 36 hours, indicating that incubation does not begin until the clutch is complete. At two nests that were examined before the clutch was complete, hatching occurred 30 days after the last egg was laid (K. Tuttle, pers. comm.). This is six days longer than the maximum period suggested by Bent (1937, Life histories of North American birds of prey, Pt. 1, U. S. Nat. Mus. Bull. 167, p. 99).

Young males fledged when 24 days old while females required 27 days.

I thank J. R. Murphy, C. M. White, and the late E. M. Christensen for help in this project and my more extensive research efforts on accipiters.

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THE INFLUENCE OF EARLY LEARNING ON NEST SITE SELECTION IN THE HOUSE SPARROW

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The use of open tree sites for nesting in the House Sparrow (*Passer domesticus*) appears to be related to the availability of other more protected sites, although it is also more common in the warmer portions of the species' range (Summers-Smith, The House Sparrow, Collins, London, 1963). Building of tree nests in the absence of suitable nesting cavities is not always the case, however. Tree nests have been built when holes were readily available (Greve, Ornithol. Mitt. 10:176, 1968). One testable hypothesis that might help to explain this exception is that fledgling sparrows become imprinted on, or learn the characteristics of, the nest they are reared in, or the type of structure supporting the nest, and they in turn tend to build that type of nest as breeding adults. To test this hypothesis, I conducted the following experiment.

A colony of 40 nest boxes was erected on out-buildings on a farm about five miles NNE of Lawrence, Kansas, in Jefferson County during the spring of 1973. House Sparrows had already been nesting there in cedar trees and in cracks and crevices of out-buildings. A similar colony of nest boxes was already in place on a farm about one-half mile south of this location on the University of Kansas Nelson Environmental Studies Area. Nestlings banded here served as controls.

I categorized nests on the study area as box, tree or crevice. I considered crevice nests distinct from box nests because often they were not totally enclosed on four sides and could be either domed over or not. They were sufficiently different from either tree or box nests in construction and placement that they might provide nestlings with different learning cues. Nestlings of the same age (usually less than one week) were transferred from one type of nest to another. Different colored markings were applied to the tarsi of nestlings with felt-tipped pens so that they could be distinguished from one another. Colored plastic leg bands were applied as the nestlings became large enough. Brood size was not altered in any of the nests. Notes were kept on brood size, desertions, rejections of transferred nestlings, survival of young and dispersal of juveniles in late summer and fall. I observed the banded individuals in the following breeding season to determine the type of nest they occupied.

One hundred fifty nestlings (50 from each nest type) were transferred and banded. An equal number from each nest type were banded in the control area. Fledging success was surprisingly high (70.7% for experimentals and 76.7% for controls) but the number of juveniles returning to breed on the two areas was small (24.7% and 30.7%). Mortality and a high emigration rate appear to be the primary sources of loss for the two areas. There was only one desertion and only two nestlings were known to have been thrown out of the nest of a foster mother. Table 1 summarizes the outcome of the experiment.

Fledging success of sparrows in tree nests was slightly lower than from either box or crevice nests (66% vs 74% and 72% in the experimentals; 72% vs 80% and 78% in the controls). Hence, fewer sparrows that might have learned the characteristics of the tree nest were contributed to the population. This difference is not significant however (chi square test, $P > 0.05$), and approximately the same number of House Sparrows from each nest type were found in the breeding population the next spring.

The difference in numbers between sparrows choosing the natal type of nest site over other types in the experimental population appears to be negligible. Considering the males and females together the differences for all nest types were not statistically significant ($\chi^2 = 0.887$, $df = 2$). Similarly, there were no significant differences between nest types chosen

TABLE 1. Nest types selected by experimental and control populations of House Sparrows.

	Nestlings		Nest-building by surviving ♂♂ and ♀♀		Nest-building by surviving ♂♂ only		Nest-building by surviving ♀♀ only	
	Number marked	Number fledged	Natal Nest type	Other Nest type	Natal Nest type	Other Nest type	Natal Nest type	Other Nest type
Experimentals (transferred)								
Hole type nests	100	73	14	9	8	7	3	5
Box	50	37	6	5	5	4	1	1
Crevice	50	36	8	4	3	3	2	4
Tree nests	50	33	5	9	3	5	2	4
Controls								
Hole type nests	100	79	19	10	8	6	11	4
Box	50	40	10	4	5	2	5	2
Crevice	50	39	9	6	3	4	6	2
Tree nests	50	36	7	10	4	4	3	6

in the control population ($\chi^2 = 2.837$, df $= 2$). Experimental and control populations were not significantly different in the number of sparrows choosing natal nest types over other nest types ($\chi^2 = 0.066$, df $= 1$).

It is possible that one sex might influence the selection of the nest site more than the other. A male selects the nest site, from which he advertises his presence to females; a female selects not only her mate but also the site associated with him.

Considering males alone, I still found no significant differences between the three types of nest sites selected in either the experimental population (Fisher's exact test, $P = 0.888$, 0.769, and 0.529) or the control population ($P = 0.881$, 0.897, and 0.785). Females also show no significant differences ($P = 0.411$, 0.121, and 0.464 in the experimentals; $P = 0.157$, 0.769, and 0.109 in the controls).

Although the three nest types appear distinctly different, sparrows may discriminate only between tree nests and hole type nests (either box or crevice). Pooling the data for box and crevice nests, I still found no significant preference for hole nests over tree nests in either the experimental population (Fisher $P = 0.156$) or the control population ($\chi^2 = 3.56$, $P > 0.05$), although a slight preference was shown for hole type nests and it approached significance. No difference was evident between the two populations ($\chi^2 = 0.023$).

Considering males alone, there were still no significant preferences for one nest type over the other ($\chi^2 = 0.348$ for experimentals, 0.825 for controls). Females, however, did show a significant preference for hole nests (Fisher $P = 0.054$) in the experimental population and the preference approached significance in the control population ($\chi^2 = 3.425$, $P > 0.05$). Differences between populations for males alone and females alone were not significant ($P > 0.05$).

Although my data are limited, two conclusions can be drawn from this experiment. First, in answer to the original hypothesis, there seems to be no early learning or imprinting involved in nest site selection in the House Sparrow. Second, females clearly seem to choose hole type nests over tree nests. Such nonrandom nest site choice regardless of natal nest type indicates that females possess a possible innate preference for hole type nests. If so, then males advertising from tree nests would seem to be at a distinct selective disadvantage in terms of securing a mate, unless the number of holes is limited. Other data suggest that the number of tree nests is influenced not only by the availability of holes, but also by the density of sparrows in a given area, the food supply, and the percentage of first-year breeding birds in the population.

I thank Mary H. Clench, Richard F. Johnston, Peter E. Lowther, Norman A. Slade and Edward C. Murphy for their helpful suggestions on the manuscript. Field work was funded by the National Science Foundation, Grant BMS72-02374-A02 to Richard F. Johnston.

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ON THE TONGUES OF SUNBIRDS

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The successful existence of any animal depends to a large extent on its ability to satisfy the energetic demands of everyday life. Although an animal can live temporarily on a negative energy budget, eventually it must account for its energy expenditures in order to carry on its activities and to reproduce. The efficiency with which an animal can exploit food resources will influence its ability to survive and reproduce. This foraging efficiency (caloric value of food relative to the caloric costs for obtaining food) should be optimized through natural selection (Emlen 1968, Royama 1970, Tullock 1971, Wolf et al., unpubl. data). This optimization should reflect characteristics of the food resource, such as availability and quality, as well as the mechanisms for ingesting food.