specialization by the kite for feeding on *Pomacea*, during times of resource scarcity the Limpkin, by taking the smaller snails, may greatly reduce the future availability of the larger snails that the kite selects.

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Abnormal nest building in the Eastern Phoebe.— Several instances of birds abnormally building multiple nests have been reported. Welty (1975) cited instances of the American Robin (*Turdus migratorius*) and the European Blackbird (*Turdus merula*) beginning numerous nests on horizontally hung ladders, girder spaces between roof rafters, stacks of pipes, and pigeon-holes. Herrick (1935) told of an American Robin that began five nests on steps of a fire escape, completed two, and divided the clutch between them. Ashmole (1968) similarly reported an Eastern Phoebe (*Sayornis phoebe*) that built two complete nests and divided the clutch between them; two young were ultimately fledged from one of these nests. The usual explanation for this aberrant behavior revolves around the repetition in man-made structures and the inability of birds to identify the proper site. The observations for this paper were made from 1970 to 1972 on Crane Naval Ammunition Depot, Indiana, in conjunction with a study of Eastern Phoebe and Barn Swallow (*Hirundo rustica*) breeding ecology.

On 21 April 1970 I found Eastern Phoebe nesting material (i.e. fresh moss and mud) forming a continuous thin mat for some 2 m along the west side of a central I-beam under bridge 25, a small wood and steel I-beam bridge that extended north-south over an east-flowing stream (Fig. 1). The date of the beginning of the mat's construction is unknown, but many first nests were begun before 10 April that year. On 27 April the depth of the mat had been substantially increased, but the length was only slightly greater. By 7 May, a typical nest cup had appeared at the south end of the mat. No further construction was noted. At this time the nest mat was 2.2 m long and 2.50–3.75 cm thick for 1.0 m, and 1.25–2.50 cm thick for the remainder of the length. The first egg of a five-egg clutch was laid on 8 May, and five young fledged successfully on 13 June. All aspects of the nesting cycle after nest building appeared normal. This nest was destroyed during the winter, and a normal nest was built and young fledged during the 1971 nesting season. A single visit to the bridge on 1 June 1972 revealed an abnormal nest very similar to the 1970 nest although of smaller dimensions. This nest, which contained five eggs, was on a west-facing I-beam, and the cup was at the north end of the mat.

A second type of aberrant nest was found on 2 June 1972 under bridge 49, also a wood and I-beam bridge, 8 km from the former. This nest, also with greater than normal dimensions, was uniquely composed of 5 separate cups, 2 cups descending as steps in each direction from the complete central cup

Fig. 1. Abnormal nest with extensive base built in 1970 at Crane Naval Ammunition Depot, Indiana.

containing 5 eggs (Fig. 2). The two proximate cups each contained a little lining material, while the two distal cups were very shallow.

Hinde (1973) pointed out that building of even simple nests requires behavior of great complexity, so that explanations of deviations from the norm are difficult. It is clear however that the abnormal building described for the 1970 nest, as well as in the others if the building sequences were similar, is nonadaptive because of the strains placed on the bird's time and energy budgets by such extensive building. For instance, the young fledged from the 1970 nest at about the time many young from second clutches in normal nests were hatching. Although a second nesting was not attempted under this bridge, it is not known whether the bird laid a second clutch elsewhere. Similarly, building multiple nests is nonadaptive not only because of the time and energy expended in the construction of two or more nests, but also because clutches occasionally are divided among nests, and only a partial clutch is hatched at most (Ashmole 1968, Herrick 1935). These two types of building, extensive single nest and multiple nests, are clearly similar, although the multiple-nest case may have extenuating circumstances, such as lack of visual contact between the two nests (Ashmole 1968), but this is not always the case (Welty 1975).

Structural duplication in bridges, culverts, and buildings seems important in multiple-nest cases, but its role as the primary influence is brought to question by the single-nest cases reported here. Both nests under bridge 25 resulted from the failure of an individual bird, perhaps the same bird or an offspring, to respond to orientational cues and place the nest cup in a specific place. Increased estrogen, resulting from courtship, leads to the nest-building behavior, but the female must be stimulated by the nest cup to produce prolactin and progesterone, which brings a decline in nest building and facilitates ovulation and incubation (Beer 1973). As long as no cup resulted from her building activities, the bird continued to build. None of the I-beams held flood deposited mud that might have resembled the mud-footing employed by phoebes for initial nest attachment; hence this factor was discounted as a possible source of confusion. The sequence of events at bridge 49 is not clear from the single observation.

Although repetition of members occurs in all bridges and culverts, this disorientation is the exception. I examined 27 normal Eastern Phoebe nests on bridges identical in construction to those described, as well as more than 250 others on Depot bridges and culverts even more repetitious than these simple wood and I-beam bridges. It also seems likely that selective pressures would have led to development of precise orientation capabilities in a species that is so heavily dependent on repetitive man-made structures for nest sites in many parts of its range (Bent 1942, Graber et al. 1974). In addition, multiple-nest building has been recorded on occasion in natural situations—a Song Thrush (*Turdus ericetorum*) that built 5 nests one year and 6 the next (Welty 1975) and an Acadian Flycatcher (*Empidonax virescens*) that began 5 nests in a single tree (Mumford pers. comm.). It is possible that such instances are as common as occurrences on repetitive structures, but not so easily observed and recorded. Although repetition in structures may play a role in this abnormal nest building, such behavior is more likely shown by an aberrant individual with an overactive nest-building instinct or an abnormal neural response to external stimuli.

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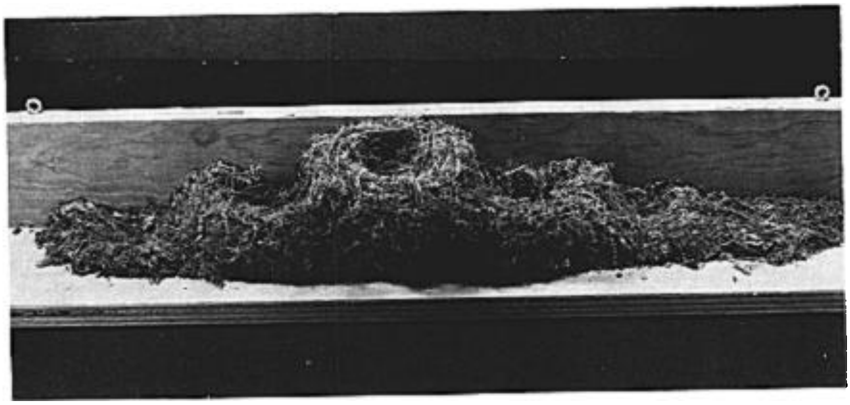

Fig. 2. Multiple-cup abnormal nest built in 1972 at Crane Naval Ammunition Depot, Indiana.

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The effect of tree hardness on woodpecker nest entrance orientation.—Previous work has indicated that woodpeckers in southwestern Virginia orient the entrances to their nest cavities in a slightly downward direction and predominantly toward the east-northeast (Conner 1975). Blume (1961), Lawrence (1966), and Dennis (1969) have suggested that moisture on the underside of a sloping trunk might favor fungus growth that would soften the sapwood and make excavation through that side of the tree easier. As the woodpeckers in southwestern Virginia typically select trees with heart rots for nest sites (Conner et al. 1975), once they have excavated through the sapwood, excavation of the rotted heartwood of the nest tree is usually easy. The present study was designed to determine if the hardness of the sapwood of woodpecker nest trees has an effect on determining woodpecker nest entrance orientation in southwestern Virginia.

During the summers of 1974 and 1975 I measured the hardness of the sapwood portion around the outsides of the nest cavities of Common Flickers (*Colaptes auratus*) (10 nests), Pileated Woodpeckers (*Dryocopus pileatus*) (10 nests), Hairy Woodpeckers (*Picoides villosus*) (8 nests), and Downy Woodpeckers (*P. pubescens*) (9 nests) on the Jefferson National Forest near Blacksburg, Virginia. Three different levels around the outside diameter of the nest cavities were tested: A circle around the nest tree at the level of the nest entrance, a circle 5 cm above the nest entrance, and a circle 5 cm below the nest entrance. Hardness was tested at eight different positions equal distances apart on the circles around the nest trees at each of the three levels. Hardness at each position was measured by the total number of equal force impacts needed to drive a 0.5 cm diameter spike 4 cm into the sapwood of the nest tree. The equal forced impacts were delivered by a hammer with a 30 cm radius arm that was hinged to a 50 cm board. The board was placed on a nest cavity and leveled. The hammer was raised to a position perpendicular to the board and let fall a 90° arc to hit the spike that was positioned vertically in a hole in the board. The number of impacts necessary to drive the spike 4 cm from its starting position were counted.

A one-way analysis of variance was calculated to see if any particular side of the nest trees was softer than the other portions for each species of woodpecker individually and for all species combined. All of the tests failed to detect any significant differences in hardness around the outsides of the nest trees. This indicated that the woodpeckers apparently did not select the softest side of the tree for excavating their nest entrances.

An unavoidable problem in a study of this sort is the impossibility of testing for hardness the sapwood that originally occupied the site of the entrances to the nest cavities. The possibility exists that the entrances were the softest portion of the trees at that height. Other evidence tends to support the view that woodpeckers do not excavate into the softer side of the nest tree. The tests I made above and below each nest entrance were not significantly softer than other sides of the tree. Kilham (1968, 1971) suggested that the strength of the nest tree, especially around the nest entrance, might be of great importance as a deterrent to prevent predators from chewing their way into a nest cavity. Kilham (1971) reported several successful predations by raccoons (*Procyon lotor*) on Yellow-bellied Sapsuckers (*Sphyrapicus varius*). DeWeese and Pillmore (1972) and Franzreb and Higgins (1975) found evidence indicating that black bears (*Ursus americanus*) successfully preyed on Common Flickers and Yellow-bellied Sapsuckers, respectively by chewing into the nest tree at and below the nest entrance.