By the end of January 1971, the Blue Jay had gone, and it was not noticed in my yard again that winter nor during the next two. However, I had speculated incorrectly that its chance for survival was small; it appeared at the feeder again on 14 December 1974. There is no doubt that it was the same individual owing to the uniqueness of the malformation. As before, it stayed around for several weeks. It was not seen during the winter of 1975–1976.

In his compilation of longevity records, Dr. J. H. Kennard (1975, Bird-Banding 46 : 55) listed the longest lived banded Blue Jay to be 14½ yr. Privately he communicated that his own banding experience with 960 Blue Jays indicates their mortality to be considerably higher during the first 2 yr than in the 3–10-year-old period. Thus, the present individual had managed to survive well beyond the most precarious time of its life.

This particular Blue Jay's ability to survive for at least 4 yr with a gross malformation of its bill might be attributed to the fortuitous sideways curvature of the upper mandible. The right edge crossed over the trough of the lower mandible (Fig. 1C) enabling the bird to pick up seeds readily and hold them securely in its bill.

K. C. Parkes pointed out to me that abnormal mandibles that do not fit together well tend to grow longer than normal when they cannot be "honed" regularly. This individual's method of feeding may have served to keep the growing tips of the horny bill sheath honed down so that no perceptible changes in the shape of either mandible occurred during 4 years.—V. P. WYSTRACH, *20 Westfield Road, Wilton, Connecticut 06897*. Accepted 21 July 76.

A Slaughter of Mice by Common Crows.—On 13 February 1976 at 0755, the authors dumped 100 living adult and subadult laboratory white mice (*Mus musculus*) onto a barren knoll in a field of grass at Crab Orchard Lake Wildlife Refuge, Williamson County, southern Illinois. Red-tailed Hawks (*Buteo jamaicensis*), Red-shouldered Hawks (*B. lineatus*), and American Kestrels (*Falco sparverius*) were known to be frequenting the area, and from vantage points about 200 m north and west of the knoll, we and two associates (Gary Nunn and Kenneth Vail) waited for these predators to appear and detect the mice. Our hope, indeed our purpose, was to observe and film raptors capitalizing on a dense population of vulnerable prey.

Several mice soon separated themselves from their fellows and began to quest about, moving generally downslope, but throughout the observation period most of the mice huddled together or ran about on or near the summit of the knoll. At 0843, a Common Crow (*Corvus brachyrhynchos*) suddenly alighted amid the main concentration of prey. It stood motionless for a few moments and seemed to examine the mice very intently; then it took a few cautious steps toward a mouse and pecked at it, at the same time jumping back a bit; next it strode forward and with its bill seized, shook, tossed about, and nibbled on the mouse, which the crow then carried away, flying close to the ground. A second crow, and then a third, alighted on the knoll at about this time, and each of them more or less repeated the activities of the first crow, killing and flying off with a mouse. None of the crows emitted a sound, then or later.

The first crow cached its prey in grass about 100 m from the knoll. It soon returned and quickly caught, killed, and set out to cache another mouse, while the second and third crows, having cached their victims in the grass at various points some distance away, began to return, and soon they, too, obtained fresh victims and took them away and cached them. In this systematic fashion, the three crows killed and cached 79 mice in 127 min.

All morning a storm had been threatening, and at 1027 it broke, interrupting the slaughter. Wind, and hailstones up to 20 mm in diameter, flattened the grass in the prey-caching sites so completely that we failed, during several pauses in the storm, to locate even one of the cached specimens. We were compelled finally to leave the area before the storm ended.

One needs only read the accounts of genus *Corvus* in Bent (1946, Bull. U.S. Natl. Mus. 191: 183–302) to find reports of heavy predation on mice (*C. corax*), food caching (*C. corax*, *C. cryptoleucus*), and, of course, resourceful food gathering of striking kinds. There is even a description that to our mind can be interpreted as indicating a case of "surplus" killing of juvenile gulls by Common Crows in Maine. The case we report combines shades of all these elements in a singular way and may be instructive in showing the potential capacity of a widely distributed, common nonraptorial bird to help control mouse cycles of abundance.

The fact that in our experiment large numbers of mice were killed in a brief period does not seem to us, however, to represent what Kruuk (1972, J. Zool., Lond., 166: 233–244) termed "surplus killing": "the killing by a predator of prey, without the killing individual or its offspring or members of the same social unit eating anything from the kill, although there is free access to the carcass, and usually the particular prey species would be eaten by that predator." The crows, in caching every one of their victims, exhibited a pattern of behavior that seems consistent with an intention to eat the mice sooner or later.

We wish to thank Terry Anthoney for having provided Nunn with a Beauliere R-16 16-mm movie camera, by which a useful record of the slaughter was obtained.—WILLIAM G. GEORGE AND TIMOTHY KIMMEL, *Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901.* Accepted 2 Aug. 76.

Vocal virtuosity in the Brown Thrasher.—Ethograms, or catalogues of behavioral acts, in a variety of animal species have typically revealed a relatively limited and finite number of behaviors (e.g. Kaufman and Rosenblum 1966, Wilson and Fagen 1974). This is also true for vocal behaviors in songbirds: some species may have only a single song (Marler and Tamura 1964), several wren species may sing approximately 100 songs (Verner 1975), and 'type-token' analyses for Mockingbirds (*Mimus polyglottos*) have yielded estimates of 66–244 song types for four males (Wildenthal 1965). Our recent studies reveal a vocal behavior in the Brown Thrasher (*Toxostoma rufum*) where song types of an individual number in the thousands and may even be improvised during display.

On 14 May 1973 we recorded 113 minutes of singing from an adult male Brown Thrasher in full song at the Rockefeller University Field Research Center near Millbrook, New York. The bird sang nearly continuously from a single perch, but pauses of up to 11 min in length became more frequent during the last half of the recording session. Tapes were analyzed on a continuous spectrum analyzer (Hopkins, Rossetto, and Lutjen 1974). Although Brown Thrashers sing in a "continuous" fashion, the field biologist recognizes temporally distinct song units that often (approximately one-third of the time) consist of twice-repeated syllables (see Fig. 1). These song units were considered distinct units in this study if separated from other units by at least one-fourth sec (same method used by Borror 1964), though occasional exceptions were made when it was obvious that the same pattern of notes was continued after a longer pause. Using this method a total of 4,654 song units was distinguished in the 113 min of recordings from the one male.

In order to estimate the number of different song units occurring in this sample of 4,654, every hundredth song unit was examined for its occurrence elsewhere in the sample. Two song units were considered the same if they consisted of the same sequence of notes, although the number of repetitions of the specific note sequence (syllable) might vary. Song units 1,800 and 3,600 were considered to be the same, leaving a total of 45 song units that were studied systematically.

Many of the song units (20 of 45) did not recur in the entire singing record, but two occurred as many as seven times (Fig. 2). While some song units were distributed throughout the sample (e.g. unit 200 recurred at 3,269 and 4,416), others seemed to recur several times within a few minutes time (see Fig. 1).

These 45 song units accounted for 116 of the 4,654 song units. The average number of occurrences (116/45 = 2.6) divided into 4,654 yields an estimate of 1,805 different song units in the sample (95% confidence limits of 1,483 and 2,307; median number of occurrences was 2, yielding an estimate of 2,327 different song units, with confidence limits of 1,722 and 3,585).

Estimating the zero class, i.e. the number of song units the male was capable of singing but did not actually sing in the sample of 4,654, cannot be done with much statistical confidence from the distribution of Fig. 2. Preparing the customary 'type-token' curves would require literally millions of sonogram comparisons (5.4 million if each song type occurs twice in the sample), but would allow no more sophisticated a

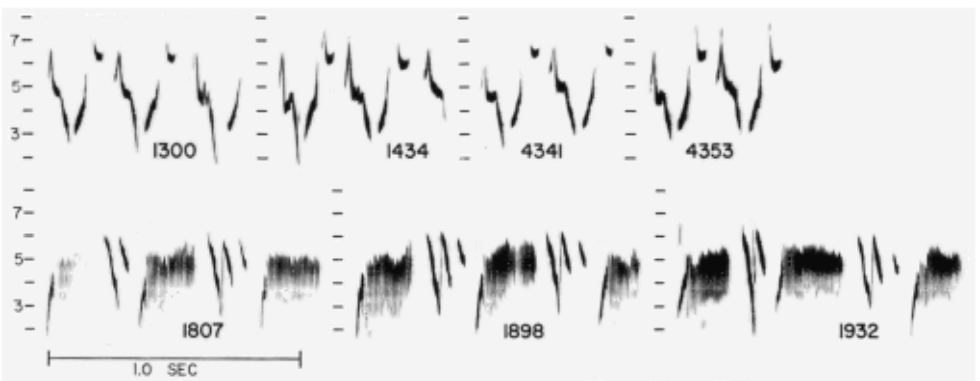

Fig. 1. Examples of recurrences of song units 1300 and 1807 in the sample of 4654. Timing mark is 1.0 sec, while vertical axis is kHz. (See reference (4) for additional sonograms.)