

VOCAL GYMNASTICS IN WOOD THRUSH SONGS

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The songs of the wood thrush (*Hylocichla mustelina*) have often been described as being among our most beautiful bird songs; they are quite musical, and the notes are sometimes said to have a flute-like quality. In an attempt to learn something of the detailed character of wood thrush songs, and possibly to learn why their quality is so remarkable, we have made audiospectrographs of most of the wood thrush songs in our recordings. The graphs indicate that most of these songs contain some very complex elements, which would seem to call for some rather remarkable vocal gymnastics by the bird.

Most wood thrush songs² consist of three parts. The first part consists of from two to six low weak notes, which are often not heard unless the bird is fairly close. The second part consists of much louder notes which are usually clear, musical, and somewhat flute-like in quality; this is the most distinctly heard portion of the song. The third part consists of notes that are generally uttered too rapidly for the ear to accurately determine their character; they are often relatively low or high in pitch, and are sometimes rather weak. Occasionally the first part of the song, or the first and third parts, may be lacking.

An individual wood thrush usually has two or three different variations of the first part of its song, and several variations of the other two parts. These different part types are variously combined to form a number of different song patterns. The songs are usually sung about every three or four seconds, and successive songs are nearly always different. A bird apparently does not sing its different song patterns in any definite sequence.

We have recordings of 25 different wood thrushes, and no two of these contain identical songs. There are several cases in these recordings where the first parts of the songs of different birds are identical, but no cases of identical second or third parts in the songs of different birds; in many cases the second or third parts of the songs of different birds are very similar, but not identical. It would therefore appear, as Saunders has repeatedly pointed out (1921, 1924, 1935, 1948), that it is possible to recognize an individual wood thrush by its songs.

THE SONGS OF ONE WOOD THRUSH

We can best illustrate "vocal gymnastics" in the wood thrush by a consideration of the songs of one bird, of which we have 55 recorded songs. The recording was made with a Magnemite Model 610-E tape recorder in Blendon Woods, Franklin County, Ohio, July 2, 1954, by the senior author, and is No. 1175 in the library of bird recordings of the Department of Zoology and Entomology, Ohio State University.

Our 55 recorded songs of this bird show two variations of the first part of the song, five of the second part, and nine of the third part. These songs contain 13 principal patterns, or, taking into account the variations of the first part of the song, 18 patterns. The two variations of the first part of the song are extremely similar, and two songs differing only in the first part would be difficult or impossible to distinguish by ear. This number of patterns (18) is nowhere near the

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²We use the term "song" for a group of notes that lasts a second or two; some writers term these note groups "phrases" of the wood thrush's song.

90 that the bird *might* sing, but it is quite likely that had we recorded more songs of this bird we would have found more song patterns. The number of times each pattern is represented in the 55 songs is shown in table 1. The bird did not sing its different songs in any particular sequence, but some (e.g., pattern 1A) were sung more often than others.

Variations in the First Part of the Song.—The first part of the songs of this

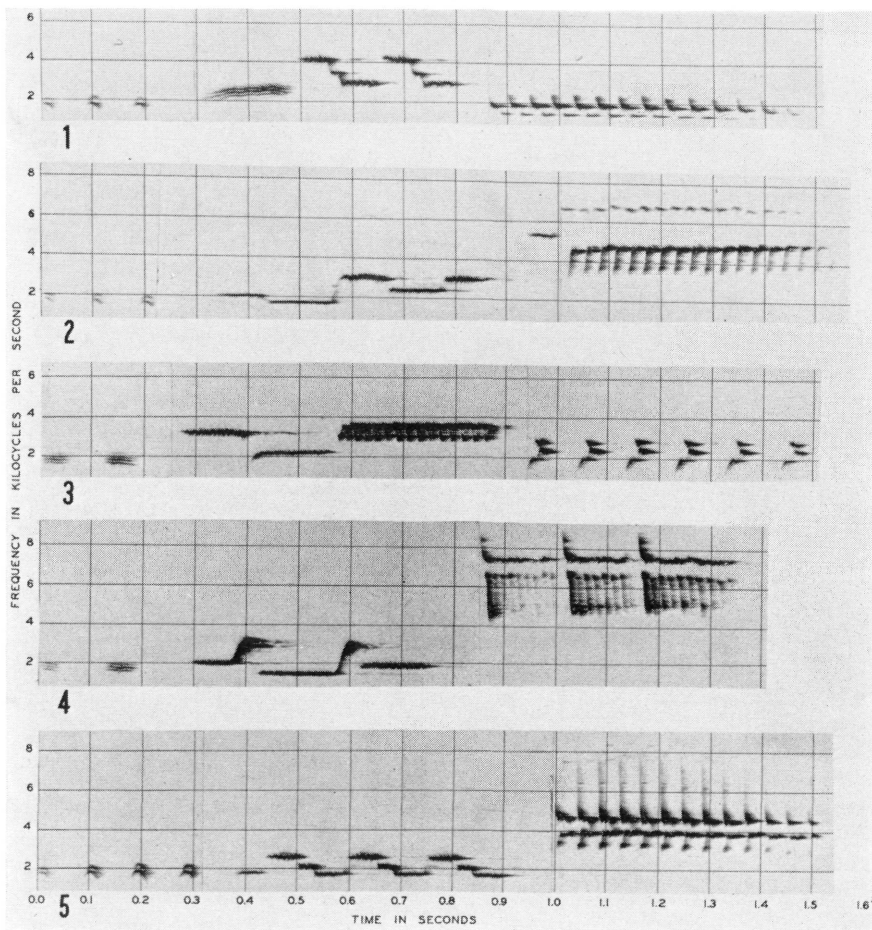


PLATE I. Vibralyzer graphs of wood thrush songs, from recording No. 1175, Franklin Co., Ohio, July 2, 1954. FIGURE 1, the sixth song in the recording, pattern 1A. FIGURE 2, the fourth song in the recording, pattern 3A. FIGURE 3, the eighth song in the recording, pattern 4B. FIGURE 4, the thirty-fifth song in the recording, pattern 5B. FIGURE 5, the second song in the recording, pattern 6A.

bird contain from two to six very weak notes, and the notes are of two types that may be designated as A and B. The notes of type A (e.g., fig. 6, the first 0.2 sec.) are about 0.025 second in length and are uttered at the rate of 14 per second; they are pitched at approximately the third G sharp above middle C. The notes of type B (fig. 3, the first 0.2 sec.) are about 0.05 second in length and are uttered at the rate of about 7 per second; their pitch is about the same as the notes of type A, but actually it fluctuates up and down about 200 times a

second. Type A notes occur in 47 of the 55 songs (13 of the 18 patterns), and type B notes occur in the other 8 songs.

Variations in the Second Part of the Song.—The five variations of the second part of the songs of this bird may be designated by the letters A-E. Type A (fig. 1, 0.3 to 0.8 sec.) consists of a low buzzy note followed by two groups of notes of three notes each. The buzzy quality of the first note is due to the fact that

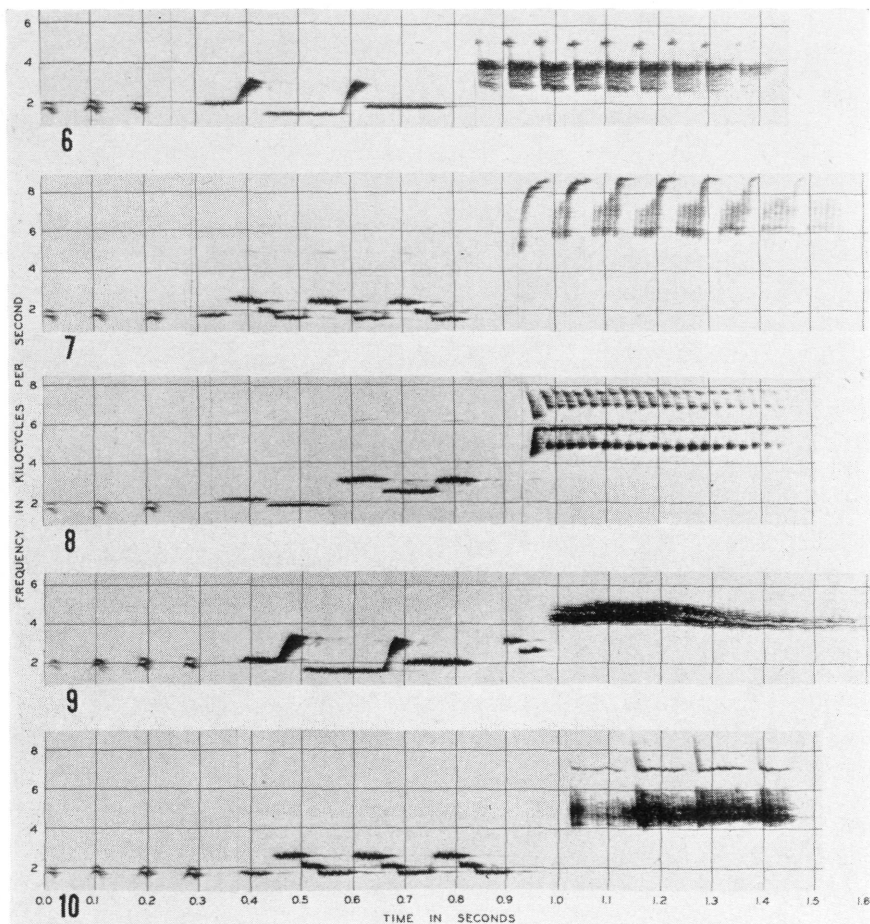


PLATE II. Vibralyzer graphs of wood thrush songs, from recording No. 1175, Franklin Co., Ohio, July 2, 1954. FIGURE 6, the twelfth song in the recording, pattern 7A. FIGURE 7, the fifth song in the recording, pattern 9A. FIGURE 8, the eleventh song in the recording, pattern 10A. FIGURE 9, the seventeenth song in the recording, pattern 11A. FIGURE 10, the nineteenth song in the recording, pattern 12A.

the pitch of this note fluctuates up and down 160 times a second. The notes in the two groups of three are pitched at C, A, and F sharp in the top octave of the piano range. Type B (fig. 2, 0.35 to 0.9 sec., and fig. 8) consists of five loud clear notes, pitched at C sharp, B, G, E, and G; the C sharp is three octaves above middle C. Type C (fig. 3, 0.26 to 0.9 sec.) consists of two loud clear notes followed by a trill; the first two notes are pitched at G sharp and D, the third above middle C; the trill is a single note that fluctuates in pitch 50 times a second, be-

tween the fourth G and A sharp above middle C. Type D (fig. 4, 0.3 to 0.76 sec., and fig. 6 and 8) consists of three loud clear notes, the first two of which are abruptly upslurred at the end. The first note is pitched at the third C above middle C, and at the end slurs up to G sharp; the second note is pitched at the F sharp below this C, and at the end it slurs up to the next G; the third note is pitched at C, the same as the principal part of the first note. Type E (fig. 5, 0.39 to 0.91 sec., and fig. 7 and 10) contains ten loud clear notes, the last nine in three groups of three each; the notes in each group are pitched at E, C, and A, three octaves above middle C.

Saunders (1924, 1935) states that the second part of the song of the wood thrush usually contains two to five notes, but that he has heard one with seven notes. Of the five second-part types in the songs of the Blendon Woods bird,

TABLE 1

Analysis and Summary of the Songs of a Wood Thrush Recorded in Franklin County, July 2, 1954 (Recording No. 1175)

Song Pattern	Analysis of Song Pattern			Number of Songs in Recording	Figure
	Type of Part 1	Type of Part 2	Type of Part 3		
1A	A	A	A	9	1
2A	A	A	B	2	—
3A	A	B	C	4	2
3B	B	B	C	2	—
4A	A	C	D	3	—
4B	B	C	D	2	3
5A	A	D	B	2	—
5B	B	D	B	2	4
6A	A	E	E	5	5
7A	A	D	F	3	6
8A	A	C	G	2	—
9A	A	E	G	4	7
10A	A	B	H	5	8
10B	B	B	H	1	—
11A	A	D	I	3	9
11B	B	D	I	1	—
12A	A	E	B	4	10
13A	A	C	B	1	—

two (C and D) contain three notes, one (B) contains five, one (A) contains seven, and one (E) contains ten. We have recordings of other wood thrushes in which the second part of the song contains more than seven notes.

The frequency with which the five variations of the second part of the song occur in the 55 songs of this bird is shown in table 1.

Variations in the Third Part of the Song.—This is the most variable part of the song, though some of the variations sound very similar to the ear. The nine variations of this part found in the 55 songs may be designated by the letters A-I, and the frequency of their occurrence is shown in table 1. The notes in this part are generally short and are uttered very rapidly; they are usually relatively low-pitched or high-pitched, and are sometimes quite weak. The most remarkable "vocal gymnastics" in wood thrush songs occur in this part of the song.

Type A (fig. 1, 0.9 to 1.5 sec.) contains 13 to 15 pairs of low notes, pitched at the third F and A sharp above middle C; the song shown in figure 1 contains 13 pairs of notes in this part. Type B (fig. 4, from 0.85 sec. to the end of the song,

and fig. 10) is unusual in consisting of two series of notes uttered simultaneously; it contains three to five high-pitched notes that are relatively steady in pitch (at about the first B above the upper limit of the piano range) following an abruptly down-slurred element at the beginning of each note, and at the same time a rapid series of abruptly down-slurred notes uttered at the rate of 65 (fig. 4) to 105 (fig. 10) a second. The lower notes are slurred from about A to D sharp, in the first octave above the piano range, and this slurring takes place in about 0.01 second. Type C (fig. 2, 0.94 sec. to the end of the song) consists of a single steady note followed by 13 to 18 pairs of notes of alternating pitch; the first note is pitched at the first F above the upper limit of the piano, and the notes of the following pairs are pitched at about the A and D sharp above the upper limit of the piano. These note pairs are uttered at the rate of 34 pairs per second. The lower note of each pair begins with a rapidly up-slurred element. Type D (fig. 3, 0.95 sec. to the end of the song) consists of five or six groups of two low notes each, uttered at the rate of 10 groups a second; each group consists of a low note, pitched at the third C above middle C, followed by a note that slurs downward from the F sharp to the D sharp above this C. Type E (fig. 5, 1.0 to 1.5 sec.) consists of 13 to 15 pairs of notes uttered at the rate of 25 pairs per second; the notes of each pair are uttered simultaneously, the upper note beginning with a rapidly down-slurred, element, and the lower note beginning with an up-slurred element. The up-slurring of the lower note begins immediately after the down-slurred part of the higher note. The louder parts of these two notes are pitched at the first D above the upper limit of the piano, and the B below this D. Type F (fig. 6, 0.85 sec. to the end of the song) consists of eight or nine groups of very short, rapidly down-slurred notes; the notes in each group are uttered at the rate of 120 per second, and the groups at the rate of 16 per second. The first note in each group is down-slurred over a greater range than the remaining notes of the group, from the first E above the piano range down to the F nearly an octave below; this slurring takes place in 0.005 second. Type G (fig. 7, 0.93 sec. to the end of the song) consists of eight or nine groups of very short, weak, and rapidly up-slurred notes; the notes in each group uttered at the rate of 90 per second, the groups at the rate of 12 per second. The last note in most of these groups goes up a little higher in pitch than the others, to about the second C sharp above the highest note on the piano. Type H (fig. 8, 0.95 sec. to the end of the song) is rather unusual, and consists of two simultaneously uttered notes, one about five or six half-notes on the musical scale above the other, each fluctuating up and down in pitch 45 times a second. Type I (fig. 9, 0.9 to 1.6 sec.) consists of two short notes followed by a buzz; the two short notes are pitched at G and E in the top octave of the piano range; the buzz is a note that fluctuates up and down in pitch, over about three half-notes on the musical scale, 140 times a second.

Pitch Range.—Brand (1938) gives the range of the songs of the wood thrush as 1825–4025 cycles per second; this is from about the third A sharp above middle C to the fourth C above middle C (the fourth C above middle C, which is the top note on the piano, has a frequency of 4096 cycles per second), or a range of about 14 musical intervals. The pitch range in the Blendon Woods bird varied in different song patterns, from about an octave in pattern 4B (fig. 3) to nearly two and one-half octaves in pattern 9A (fig. 7). The range of this bird, as indicated by our graphs, was from about 1640 to 8900 cycles per second, or from about the third G sharp above middle C to the second C sharp above the upper limit of the piano range (27 musical intervals).

VOCAL GYMNASTICS

What we may call “vocal gymnastics” in the wood thrush includes the following features:

- (1) Many notes, particularly in the second part of the song, are so pitched

that they follow our musical scale very accurately, thus giving a musical character to the song.

(2) There is some overlapping of the notes, with one note beginning before the preceding note ends, which results in the bird uttering more than one note at a time. In one song that we have recorded (another bird in Franklin County, Ohio) there is a moment of about 0.1 second in length when four notes are uttered simultaneously.

(3) The songs frequently contain notes in which the pitch fluctuates up and down very rapidly, as fast as 200 times a second; some songs contain two fluctuating notes uttered simultaneously.

(4) The third part of the song sometimes consists of a series of relatively steady notes, and at the same time a rapid series of abruptly down-slurred notes.

(5) Some notes are slurred over nearly an octave in 0.005 second.

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