ANALYTICAL STUDIES OF HENSLOW'S SPARROW SONGS

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THE song of the Henslow's Sparrow (*Passerherbulus henslowii*) is usually described as consisting of two short buzzy notes. Peterson (1947:231) describes it as "one of the poorest vocal efforts of any bird . . . a hiccoughing *tsi-lick*"; it has been paraphrased *tee-wick* (Jouy, 1881), *flee-sic* (Faxon, 1889), *se-lick* (Hathaway, 1913), and *teesick* (Saunders, 1935, who states that the second note is higher than the first). All these phrases fit fairly well what one hears, but the song is uttered so rapidly that the human ear cannot detect many parts of it. When one listens to a recording played at a reduced speed it is immediately evident that the song contains several notes and is not as simple as it sounds at normal speed. Audio-spectrographic analysis of the song shows that it contains many notes, and it would seem unduly belittling to call such a song the poorest vocal effort of any bird.

Our study of Henslow's Sparrow songs is based on three recordings containing a total of 73 songs: No. 412, recorded in the northern part of Franklin Co., Ohio, April 18, 1953, by Robert A. Lewis; No. 416, recorded in the northern part of Franklin Co., Ohio (about one-fourth mile from where No. 412 was recorded), April 26, 1953, by Carl R. Reese; and No. 492, recorded in the northern part of Delaware Co., Ohio (about 30 miles from the locality of Nos. 412 and 416), May 16, 1953, by the writers. These recordings, now in the writers' collection, were made with a Magnemite recorder, using a tape speed of 15 inches per second.

Vibralyzer graphs (Borror and Reese, 1953) were made of 22 of the 73 songs in our collection. Time measurements were made on graphs prepared using the wide band filter (Figs. 2, 3, 5, 6, 8, and 9); the range of error in these measurements is about 0.001 or 0.002 second (greater in the weaker notes). Frequency measurements were made on graphs prepared using the narrow band filter (Figs. 1, 4, and 7); the range of error in these measurements is about 2 per cent of the range covered by the graph. However, the frequency-wise spread of a note on the graph depends to a considerable extent on the settings on the control panel of the instrument when the graph is made; settings giving a heavy mark result in an apparently greater spread in the frequency, and settings giving a lighter mark result in what appears to

[1]This study has been aided by a grant from the Ohio State University Research Foundation. The authors wish to express their appreciation to Miss Mary Jane Boyle for her assistance in the preparation of the graphs, and to Mr. William M. Protheroe, Dr. Charles A. Shaw, Dr. Robert A. Oetjen, and Dr. Wave H. Shaffer, all of the Department of Physics and Astronomy, Ohio State University, for advice and criticisms during the course of the study.

be a more nearly pure note. In making these graphs we have used a setting which will bring out all or nearly all of the fundamental frequencies present; as a result, the frequency spread in the louder notes may be somewhat exaggerated. The lines that appear at about 2800, 7200, or 7800 cps on some of the graphs are artifacts, due to something in the graphing mechanism and not something in the songs.

Some measure of the relative intensity of different notes or frequencies in a song is given by the darkness of the mark on the graph. Some notes appear to have one frequency of greatest intensity, while in others many frequencies appear equally intense. Another measure of the relative intensity of different notes is given by the readings on the VU meter of the recorder when the song is played (at a reduced tape speed). Loudness in Tables 2–4 is indicated only in general terms, as we cannot at present assign definite decibel values to the different notes. The range from "very weak" to "loud" represents a decibel range of at least 25 db; with a gain setting on the recorder that gives a maximum reading on the VU meter for the "loud" note, the needle does not register the "very weak" note; "fairly loud" is about 5 db below "loud," and with a setting that gives a maximum reading on the VU meter for the "fairly loud" note the needle just barely registers the "very weak" note.

Data on the interval between successive songs are given in Table 1.

TABLE 1

INTERVAL BETWEEN SUCCESSIVE SONGS

Recording	Date Recorded	Time of Day	Total No. of Songs Recorded	No. of Intervals	Range of Intervals (seconds)	Average Interval (seconds)
412	4/18/53	0830	49	42	1.9–5.9	3.04
416	4/26/53	0930	14	12	0.8–1.8	1.21
492	5/16/53	0740	10	8	3.5–7.5	5.22

This interval varied from 0.8 to 7.5 seconds. The different average length of the interval in the three recordings may indicate an individual difference in different birds, or it may indicate—as Hyde (1939) has shown—that the interval later in the season is longer.

CHARACTER OF THE NOTES

A bird's note may consist of a steady output of sound, or of a series of rapid pulses that may be either isolated or connected. Since the silent interval between successive outputs of sound is variable, it is difficult to draw a line between a "note" consisting of a series of isolated pulses and a series of

"notes" each consisting of an isolated pulse or group of pulses. The audiospectrograph is capable of a high degree of time resolution, and can show that what often appears to the ear as a single note actually consists of two or more well isolated sounds. In general, we have used the term "note" for a series of pulses which appear connected when graphed using the narrow band filter, and the term "note group" for a well defined group of such "notes."

A note consisting of a rapid series of connected up-and-down slurred pulses, as in most of the notes of the Henslow's Sparrow songs, is described as a *vibrato* note; a note consisting of a series of individual pulses that are nearly or quite isolated, as in **A** and **F** of Figure 2, is described as a *staccato* note.

Recording No. 492 (Plate I).—Graphs were made of 8 of the 10 songs in this recording, and all are remarkably similar; graphs of two of these songs are shown in Plate I. The song consists of six note groups, which may be designated by the letters **A**–**F** (see Fig. 2). These songs vary in length from 0.300 to 0.305 sec. (average, 0.302 sec.). A summary of the songs graphed is given in Table 2.

TABLE 2

SUMMARY OF SONGS IN RECORDING NO. 492

Note Group	Length (sec.)	Note	Length (sec.)	No. of Pulses	Type of Note	Frequency in cps	Loudness
A	.005–.008	1	.005–.008	2	staccato	9300–10200	very weak
B	.025–.027	1	.011–.014	5–6	vibrato or staccato	8300–9900	not very loud
		2	.004–.005	1	down-slurred	8800–10000	weak
C	.033–.039	1	.014–.019	5–6	vibrato	7000–9000	fairly loud
		2	.005–.007	1–2	staccato	8200–9000	weak
		3	.006	1	up-slurred	8000–8700	weak
D	.041–.044	1	.020–.025	5–6	vibrato	4200–5800	loud
		2	.017–.020	3–5	vibrato	4200–6000	loud
E	.029–.030	1	.014–.017	5–6	vibrato, down-slurred	6500–7800 to 5800–5900	fairly loud
		2	.010–.013	2–3	vibrato, down-slurred	7500–7800 to 5900–6200	fairly loud
F	.032–.038	1	.032–.038	4	staccato, down-slurred at end	5000–5700 to 4800–5800	almost as loud as D

A is an extremely weak note. **B** follows **A** after a silent interval of about 0.040 sec., and is lower in pitch and considerably louder than **A**; it consists of two separate notes, designated in the table as *1* and *2*. In six of the eight songs graphed *1* is a vibrato note (Fig. 2), and in the other two is a staccato note (Fig. 3). **C** follows **B** after a silent interval of about 0.002 or 0.003 sec.; it is somewhat lower in pitch and louder than **B**. It contains three notes, designated in the table as *1*, *2*, and *3*; *2* and *3* are quite weak.

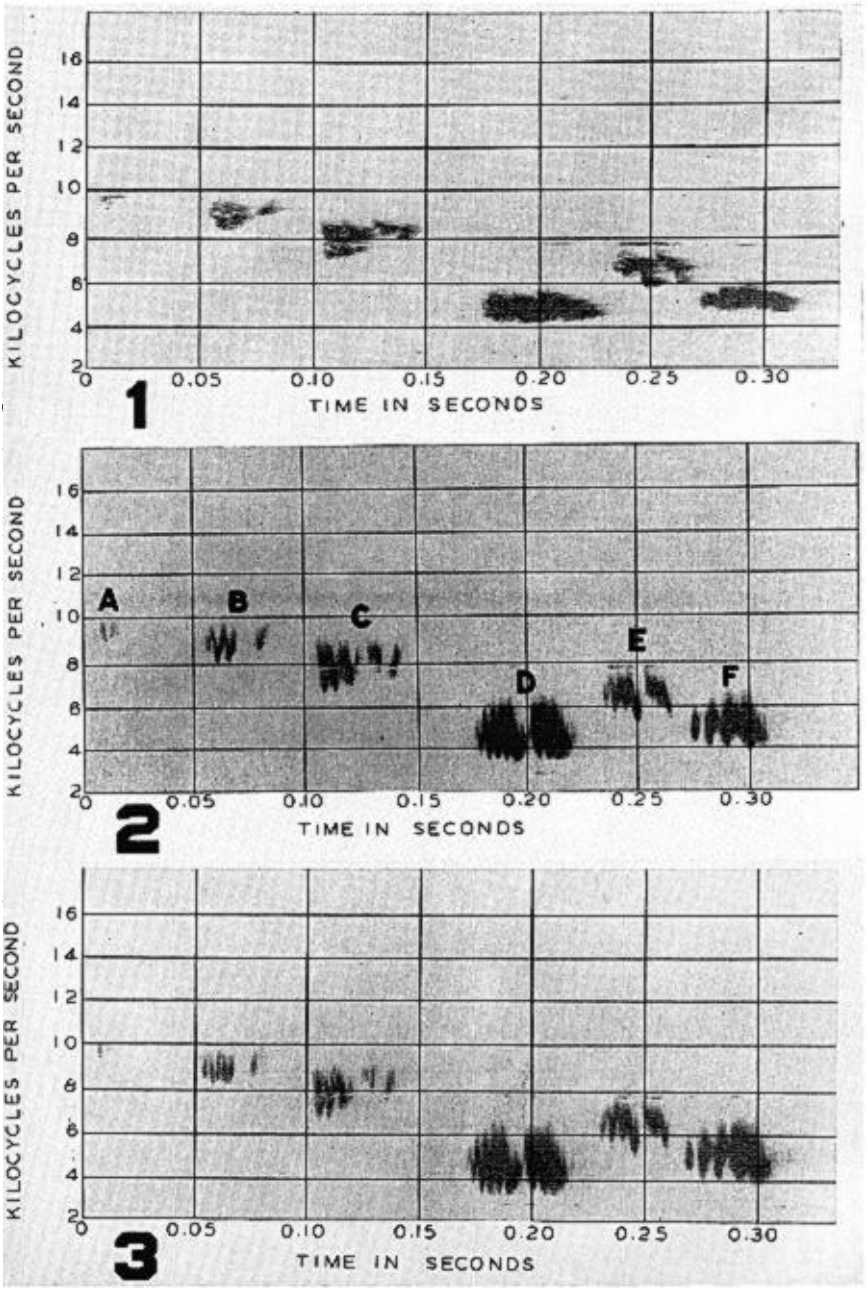

PLATE I. Songs of Henslow's Sparrow No. 492, recorded in Delaware Co., Ohio, May 16, 1953. Fig. 1, the second song in this series, graphed using the narrow band filter; Fig. 2, the same song, graphed using the wide band filter; Fig. 3, the sixth song in this series, graphed using the wide band filter. **A–F**, the six note groups (see text).

D, which follows **C** after a silent interval of about 0.003 sec., is the loudest and lowest in pitch of all the notes in the song; it contains two notes, the first a little longer than the second. **E**, which follows **D** after a silent interval of about 0.015 to 0.020 sec., is a little higher in pitch than **D** but not as loud; it consists of two notes, the first a little longer than the second, and each terminates in a downward slur. **F**, which follows **E** after a silent interval of about 0.010 sec., is almost as low in pitch and as loud as **D**.

By starting a recording at normal speed and gradually decreasing its speed, it is possible to determine what parts of the song the ear detects. The first three note groups (**A**–**C**) are heard as a faint lisp, but only if one listens very carefully. **D** is the first part of the song that is usually heard. **E** and **F**, which come in very rapid succession, are heard as a single, somewhat buzzy note, the *sic* or *lick* of most descriptions; since the frequencies in these notes are for the most part higher than those in **D**, this apparent note (**E** and **F**) appears higher in pitch than **D**, as Saunders (1935) has stated. The songs in this recording sound typical for this species.

Recording No. 412 (Plate II).—Graphs were made of 8 of these songs, and they are very similar to one another and to those for No. 492. The songs in No. 412 contain only five note groups, and some of these groups differ slightly from the corresponding note groups in No. 492. The first note is very much like **A** and the remaining notes resemble **C**–**F** of No. 492; **B** of No. 492 is missing in these songs (Fig. 5). The songs in No. 412 vary in length from 0.223 to 0.230 sec. (average, 0.227 sec.). A summary of the songs graphed is given in Table 3.

TABLE 3

SUMMARY OF SONGS IN RECORDING NO. 412

Note Group	Length (sec.)	Note	Length (sec.)	No. of Pulses	Type of Note	Frequency in cps	Loudness
A	.006–.010	1	.006–.010	2–4	staccato	9000–10000	weak
C	.034–.038	1	.014–.017	5–6	vibrato	7000–9000	fairly loud
		2	.002–.004	1	down-slurred	8600–9600	very weak
		3	.001–.003	1	up-slurred	8000–8800	very weak
D	.040–.050	1	.027–.032	13–15	vibrato	4200–6000	loud
		2	.005–.015	1	staccato	4500–6000	loud
E	.024–.027	1	.012–.017	5–7	up-slurred, vibrato	7000–9000	fairly loud
		2	.002–.004	1	down-slurred	8500–9000	very weak
F	.020–.024	1	.007–.008	1	somewhat down-slurred	5800–7000	fairly loud
		2	.010–.013	3	vibrato	5400–7800	fairly loud

A is rather weak, but is a little stronger than in No. 492. **C** follows **A** after a silent interval of about 0.040 sec., and consists of three notes (*1*, *2*, and *3* in the table); it is lower in pitch and louder than **A**. **D**, which follows **C** after a silent interval of about 0.025 sec., is the loudest in the song and the lowest in pitch; it consists of two notes, the first about twice as long as the second. In one of the eight songs graphed the second note in **D** followed the first after a silent interval of about 0.010 sec., and was only 0.005 sec. in length; in the other seven songs (Figs. 5–6) this second note was

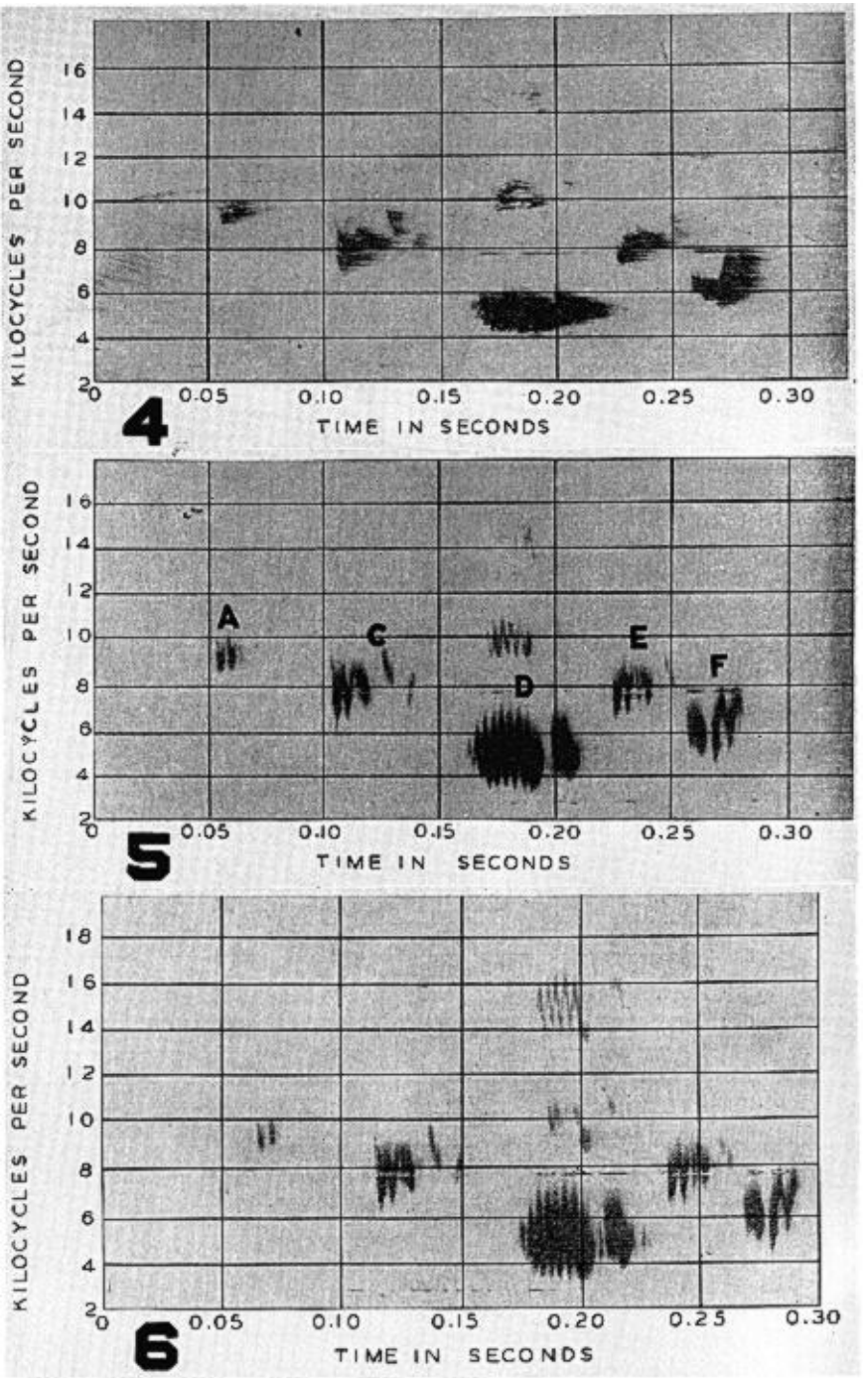

PLATE II. Songs of Henslow's Sparrow No. 412, recorded in Franklin Co., Ohio, April 18, 1953. Fig. 4, the twenty-fourth song in this series, graphed using the narrow band filter; Fig. 5, the same song, graphed using the wide band filter; Fig. 6, the twentieth song in this series, graphed using the wide band filter. **A, C–F**, the five note groups (see text).

0.010 to 0.015 sec. in length and followed the first almost immediately. **E**, which follows **D** after a silent interval of about 0.015 sec., is very similar to **C** but lacks the third very short and up-slurred note (*3* in **C**); it has about the same pitch and loudness as **C**. **F** follows **E** after a silent interval of about 0.007 to 0.008 sec., and is the second loudest and lowest in pitch in the song; it contains two short notes.

These songs sound to the ear almost exactly like those in No. 492. The first two note groups are heard as a faint lisp, but only if one listens very carefully. **D** is the first distinct note of the song, and **E** and **F** are heard as a single buzzy note slightly higher in pitch than **D**.

Recording No. 416 (Plate III).—These songs sound a little different to the ear than the songs of the other two birds, and when graphed differ considerably from those of Nos. 492 and 412. These songs consist of four groups of notes, which progressively increase in loudness and decrease in pitch. The first two may be designated **B** and **C**, since they are very similar to the **B** and **C** of Nos. 492 and 412; the third may be designated as **F**, as it is somewhat similar to the **F** in the other two songs; the fourth may be termed **D**, as it is similar to the **D** of the other songs. Graphs were made of six songs of this bird; these songs vary in length from 0.259 to 0.268 sec. (average. 0.262 sec.).

TABLE 4

SUMMARY OF SONGS IN RECORDING NO. 416

Note Group	Length (sec.)	Note	Length (sec.)	No. of Pulses	Type of Note	Frequency in cps	Loudness
B	.021–.029	1	.009–.018	3–4	vibrato	8800–9800	weak
		2	.005–.006	1	down-slurred	9000–9800	very weak
C	.030	1	.016–.020	3–5	vibrato (?)	8000–9500	not very loud
		2	.006–.008	1	down-slurred	8400–9800	not very loud
F	.071–.072	1	.030–.032	3	vibrato and staccato	5800–8500	fairly loud
		2	.015–.019	2	staccato (?)	8100–9000	weak
						8000–8600	
		3	.013–.017	2	vibrato	6400–7600	weak
					staccato	6900–7600	
D	.066–.076	1	.027–.030	10–12	vibrato, up-slurred and down-slurred	3100 to 5800 to 3100	loud
		2	.038–.042	12–15	vibrato, slightly down-slurred	4200–5500 to 3500–4600	loud

B is very similar in its general character to **B** in No. 492. **C**, which follows **B** after a silent interval of about 0.025 sec., is a little louder and lower in pitch than **B**, and contains two notes. **F** is a composite group of notes consisting of a fairly loud principal note (F_1) followed by two very weak notes (F_2 and F_3); **F** follows **C** after a silent interval of about 0.020 sec. F_1 contains three principal pulses; the first pulse contains two groups of frequencies, one of about 6,000–6,800 cps and the other 7,700–8,500 cps (Fig. 7); the second pulse contains frequencies between about 5,800 and 7,100 cps, and

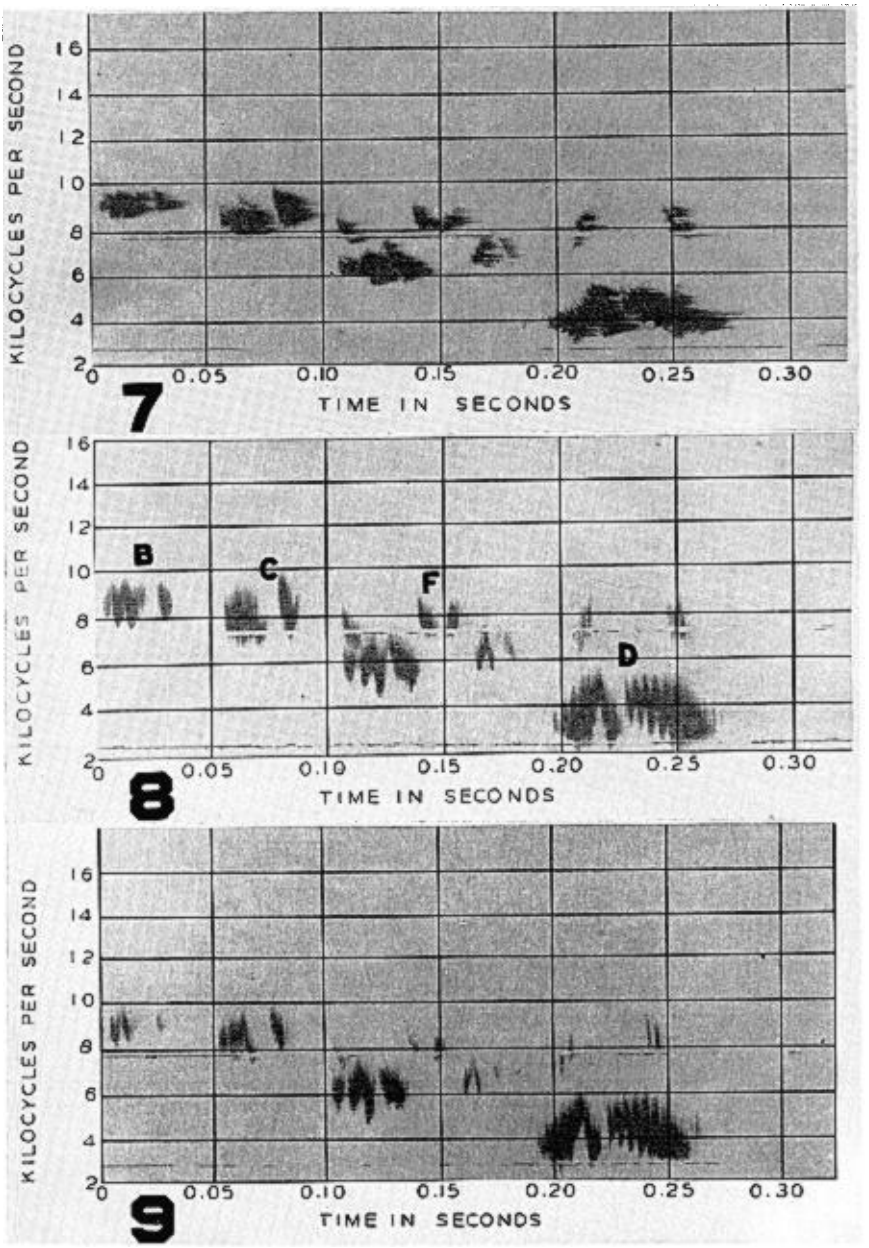

PLATE III. Songs of Henslow's Sparrow No. 416, recorded in Franklin Co., Ohio, April 26, 1953. Fig. 7, the fifth song in this series, graphed using the narrow band filter; Fig. 8, the same song, graphed using the wide band filter; Fig. 9, the second song in this series, graphed using the wide band filter. **B–D, F**, the four note groups (see text).

the third, frequencies between about 5,800 and 7,500 cps. $\mathbf{F}_2$ contains two pulses, the first a little higher in pitch than the second. $\mathbf{F}_3$ contains two pulses. **D** follows **F** after a silent interval of about 0.020 sec., and is the loudest in the song and the lowest in pitch; it consists of two notes, the first a little shorter than the second. The first note in **D** rises in pitch and then falls back rather abruptly; the second note is slightly down-slurred in pitch.

To the ear this song seems to consist of two notes, the first somewhat lisping and the second loud and emphatic; the first appears higher in pitch than the second. The first three note groups (**B**, **C**, and **F**) are heard as a single lisping or buzzy note; **D** is heard as the last emphatic note of the song.

Harmonics

Some of our graphs show what appear to be harmonics; others do not. We believe that all these notes would show a few harmonics if proper instrument settings were used in making the graphs, but a graph designed to show them would distort the fundamental. We have found a weak single harmonic in groups **C** and **E** (not shown in the figures) and weak double harmonics in **D** (Fig. 5) and **F** (not shown in the figures).

Summary

Audio-spectrographs of the songs of three individual Henslow's Sparrows show that the songs are much more complex than they appear to the ear. The song usually consists of a series of two or three note groups of decreasing pitch and increasing loudness, beginning with frequencies around 9,000 or 10,000 cps, and with the lowest frequencies in the lowest note about 3,100 cps. The lowest (and loudest) note in this sequence is usually followed by two fairly loud notes, the first a little higher in pitch than the second, and the second a little higher than the loud note preceding them. The ear seldom detects the first two or three note groups in the song, and the first note usually heard is the loud low note; the last two note groups appear to the ear as the "second" buzzy note of the song. Some of the graphs show what appear to be harmonics for the louder notes. The range in loudness between the weakest and the loudest note of a song represents a decibel range of at least 25 db.

The songs of a given individual are extremely similar, while those of the three individuals are different. The songs of two of the three birds here reported were fairly similar; the third bird had a somewhat different song.

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NEW LIFE MEMBER

Horace H. Jeter, a native of Shreveport, Louisiana, and now a practicing Certified Public Accountant in that city, has had a life-long interest in birds and, currently, bird photography. His memberships in ornithological societies include the American Ornithologists' Union, National Audubon Society, Cooper Ornithological Club, and Louisiana Ornithological Society. He is now president of the latter organization and a regular contributor to *Aububon Field Notes*. He is now working on a checklist of the birds of the Shreveport vicinity and is gathering data on song periods of birds.