

# ORIENTATION BEHAVIOR OF NIGHT-MIGRATING BIRDS (EUROPEAN ROBINS) DURING LATE AFTERNOON AND EARLY MORNING HOURS

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IT has been shown previously that European Robins (*Erithacus rubecula*) will orient their nocturnal locomotor activity in Kramer cages in their natural migratory direction when exposed outdoors to the natural night sky; and that these directional preferences can be essentially changed by change of the direction of the magnetic field (Wiltschko, Höck, and Merkel, 1971). During these experiments the birds' activity was recorded also during late afternoon and early morning hours. An analysis of this daytime activity, which differs in several respects from orientation during darkness, will be presented in this report. These data are of interest with respect to questions of variation of directional preference between night and day and with respect to the development and deterioration of directional preference before and after nocturnal migratory activity.

## MATERIAL AND METHODS

We used the methods previously described by Wiltschko (1968). The orientation cage was octagonal, 1 m in diameter and 35 cm high. It contained 8 radially-positioned perches. Every hop of an experimental bird closed a micro-switch, and caused a signal to be punched into a paper tape which was processed later by a computer. Food and water were offered in the center of the cage.

We installed two of these cages in the open air and covered them with plexiglass. With a pair of Helmholtz coils we made a magnetic field in which the north direction deviated from geographic north by  $115^\circ$  to ESE, although the intensity and inclination remained the same as in the earth's magnetic field (0.47 Gauss,  $mN = 115^\circ$ , Incl.  $68^\circ$ ) (Fig. 1). We used the earth's magnetic field (0.47 Gauss,  $mN = 360^\circ$ , Incl.  $68^\circ$ ) as a control.

A grey plastic curtain between the Helmholtz coils and the cage prevented the birds from seeing the coils and the surrounding landmarks. From the center of the cage the birds had a  $53^\circ$  view of the sky, but when the birds moved to the sides of the cage they could actually see a  $102^\circ$  sector of the sky. The test installation was located in the Rhön Mountains, 110 km northeast of Frankfurt a.M.

In both cages the directional preference of European Robins were recorded alternately in the natural magnetic field (Control) and with the direction of the magnetic field artificially turned (Test). We used two different groups of robins, 16 as Test birds and 15 as Controls, in order to avoid the possible transfer of effects from Test to Control conditions.

During the recording period the operator classified sky conditions as "clear" when there was a cloudless sky; as "partly covered" when the sky was partly obscured by clouds or when fog came up during a clear period, and as "overcast" when the sky was completely covered with clouds or when the sun was invisible because of fog during the entire test period.

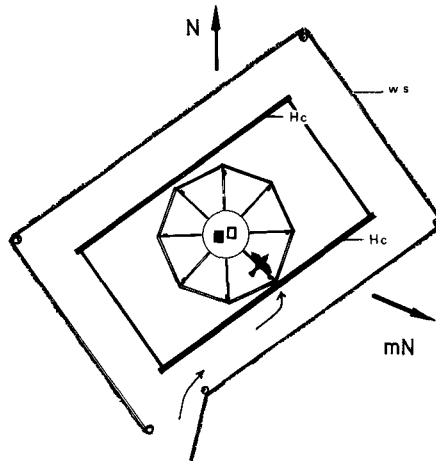


FIG. 1. Ground plan of the test arrangement: N = geographic north; mN = magnetic north when current is switched on; Hc = Helmholtz coils; ws = windscreen.

The tests were made during spring migratory period of 1969, with registration between dusk and 10:00 of the following day, and in autumn 1969 and spring 1970, with registration between 16:00 and 10:00 of the following day. The computer provided for a distinction between evening, night, and morning activity. The directional tendencies (calculated by computer) of the birds in each period are indicated by the mean direction,  $\alpha_m$ , and by the concentration term,  $a_m$ . The statistical significance of  $a_m$  was examined by the Rayleigh Test for directional preference, and differences in mean direction were examined by the Watson and Williams Test (Batschelet, 1965). In the figures the mean directions for single evenings and mornings are represented by triangles on a circle, and the mean direction,  $\alpha_m$ , of the test series is shown as a vector originating from the center. The length of this vector represents the concentration  $a_m$ , and the two inner circles are the 5 per cent (dotted) and the 1 per cent significance borders of the Rayleigh Test.

#### RESULTS

The data for night activity, which are reported in detail by Wiltschko et al. (1971), are summarized here briefly as an essential basis for interpreting the records for morning and afternoon activity in the same birds:

In spring 1969 and 1970 the robins under Control conditions showed a significant directional preference ( $p < 0.01$ ) towards  $26^\circ$ , i.e. NNE, whereas the birds under Test conditions showed a significant preference ( $p < 0.01$ ) towards  $142^\circ$ , which is geographic SE, but experimental NNE. In autumn 1969 the Controls showed a mean direction towards  $175^\circ$ , i.e. S, but this direction is not significant ( $p > 0.05$ ). The birds under Test conditions show a significant directional preference ( $p < 0.01$ ) towards  $321^\circ$ , which is experimental SSW. So in spring as well as in autumn the birds during nighttime selected their migratory direction according to the direction of the magnetic field.

*Activity recorded during late afternoon and evening.*—In spring 1969 and 1970, the mean direction of 16 values under Control conditions (i.e. birds

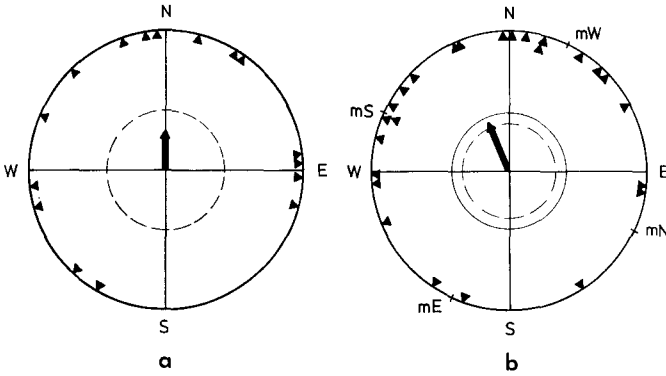


FIG. 2. Mean directions of activity recorded during late afternoon in spring 1969 and 1970: a. Control; b. Test conditions,  $mN = 115^\circ$ .

were tested under the natural sky and the earth's magnetic field) pointed towards  $360^\circ = N$  (Fig. 2a), but this direction was not significant ( $p > 0.05$ ). Under Test conditions (birds were tested under natural sky, but had the magnetic field turned by  $115^\circ$  to ESE) the birds showed in 25 evening periods a significant directional preference ( $0.05 > p > 0.01$ ) at  $337^\circ$  which is geographic NNW, but experimental SW (Fig. 2b).

In autumn 1969 the Control experiments showed again a mean direction of 21 values at NNW at  $347^\circ$  (Fig. 3a), but again this directional tendency was not significant ( $p > 0.05$ ); whereas under Test conditions we found for 33 values a significant directional preference ( $p < 0.01$ ) at  $331^\circ =$  geographic NNW = experimental SW (Fig. 3b).

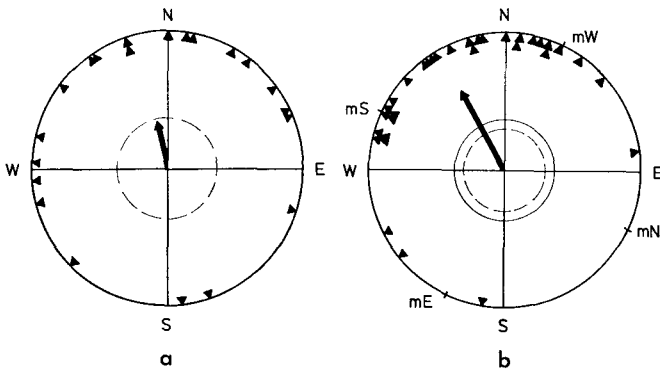


FIG. 3. Mean directions of activity recorded during late afternoon in autumn 1969: a. Control; b. Test conditions,  $mN = 115^\circ$ .

TABLE 1  
THE EFFECT OF WEATHER CONDITIONS ON DIRECTIONS PREFERRED BY ROBINS  
DURING EVENING ACTIVITY

	Control			Test		
	n	$\alpha_m$	$p$	n	$\alpha_m$	$p$
<i>clear:</i>						
spring:	3	29°	—	3	274°	—
autumn:	9	15°	—	16	320°	( $p < 0.01$ )
spring and autumn:	12	18°	( $p > 0.05$ )	19	313°	( $p < 0.01$ )
<i>partly covered:</i>						
spring:	7	320°	—	13	5°	( $0.05 > p > 0.01$ )
autumn:	7	10°	—	10	334°	( $p < 0.01$ )
spring and autumn:	14	360°	( $p > 0.05$ )	23	349°	( $p < 0.01$ )
<i>overcast:</i>						
spring:	6	357°	—	9	298°	—
autumn:	5	265°	—	7	353°	—
spring and autumn:	11	305°	( $p > 0.05$ )	16	330°	( $p > 0.05$ )

The foregoing data show that the mean direction of orientation in robins in evening points towards the geographic NNW sector in both spring and autumn and in either Test or Control conditions. We do not find any statistically significant differences (Watson and Williams Test) in directional preferences between spring and autumn for either Test or Control conditions. We are therefore justified in combining data for spring and autumn, in which case we find a significant directional preference ( $p < 0.01$ ) towards 333° for Test and a significant directional preference ( $0.05 > p > 0.01$ ) towards 352° for Control.

On the other hand the Watson and Williams Test does not allow us to assume that the mean directions of Test and Control experiments originate from different statistical populations; the only difference is that under Test conditions the directional preference is in both seasons more concentrated than under Control conditions.

We may next examine the effect of different weather conditions on directions preferred by the robins, with results summarized in Table 1. Here again we cannot find significant differences between the mean directions for any weather conditions, nor can we, for any weather condition, find a difference between Test and Control.

If we classify the test values of evening activity according to whether the birds showed migratory activity (*Zugunruhe*) during the following night, we obtain the results shown in Table 2. We again cannot find any significant differences.

TABLE 2  
DIRECTIONS PREFERRED BY ROBINS DURING EVENING ACTIVITY

	Control			Test		
	n	$\alpha_m$	p	n	$\alpha_m$	p
<i>followed by migratory activity:</i>						
spring:	13	10°	( $p > 0.05$ )	13	314°	( $0.05 > p > 0.01$ )
autumn:	16	347°	( $p > 0.05$ )	18	319°	( $p < 0.01$ )
spring and autumn:	29	360°	( $p > 0.05$ )	31	317°	( $p < 0.01$ )
<i>not followed by migratory activity:</i>						
spring:	3	323°	—	12	20°	( $p > 0.05$ )
autumn:	5	346°	—	15	348°	( $p < 0.01$ )
spring and autumn:	8	342°	( $0.05 > p > 0.01$ )	27	357°	( $p < 0.01$ )

*Activity recorded during the morning hours.*—In spring we found a mean direction of 44° = NE for 36 Control values and one of 56° = geographic NE = experimental WNW for 42 Test values. The directional preference was significant for Control ( $p < 0.01$ ), but not significant for Test ( $p > 0.05$ ). In autumn the mean direction of 20 Control values pointed towards 307° = NW, the mean direction of 32 Tests towards 311° = geographic NW = experimental SSW. This time the birds' behavior produced a significant directional preference ( $p < 0.01$ ) under Test conditions, whereas for Control we got random movements ( $p > 0.05$ ).

But if we now classify these values according to whether the birds had shown migratory activity during the night before, we obtain the results shown in Table 3. It is obvious that the mean direction of morning activity following

TABLE 3  
DIRECTIONS PREFERRED BY ROBINS DURING MORNING ACTIVITY

	Control			Test		
	n	$\alpha_m$	p	n	$\alpha_m$	p
<i>following migratory activity:</i>						
spring:	30	34°	( $p < 0.01$ )	25	128°	( $p > 0.05$ )
autumn:	15	232°	( $p > 0.05$ )	16	295°	( $0.05 > p > 0.01$ )
spring + (autumn + 180°):	45	34°	( $p < 0.01$ )	41	120°	( $0.05 > p > 0.01$ )
<i>not following migratory activity:</i>						
spring:	6	134°	—	17	22°	( $p < 0.01$ )
autumn:	5	320°	—	16	342°	( $p > 0.05$ )

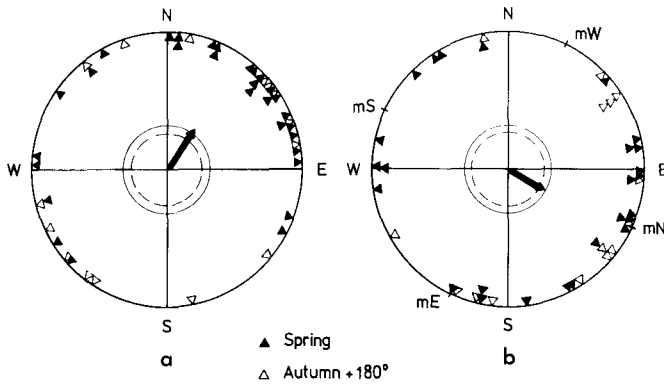


FIG. 4. Mean directions of morning activity when the birds had shown migratory restlessness the night before: dark triangles: data of spring 1969 and 1970; light triangles: data of autumn 1969 turned to the opposite side by adding  $180^\circ$ . a. Control; b. Test conditions,  $mN = 115^\circ$ .

nocturnal activity correspond to the mean directions of this nocturnal activity, although the dispersion of data is larger than at night. The Watson and Williams Test does not show a difference between the direction of night activity and morning activity for any set of values. If we assume that the birds return in spring using about the same route they used in autumn and that therefore the migratory directions in spring and autumn lie opposite, we can combine the data of both seasons by turning the autumn data to the opposite side by adding  $180^\circ$ . We now find significant mean directions at  $34^\circ = \text{NNE}$  for Con-

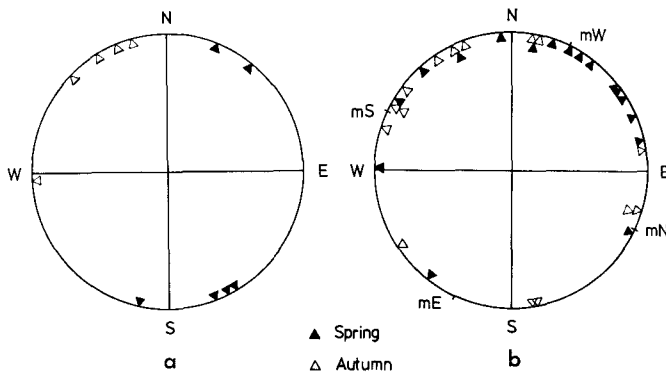


FIG. 5. Mean directions of morning activity not preceded by nocturnal activity: dark triangles: data of spring 1969 and 1970; light triangles: data of autumn 1969. a. Control; b. Test conditions,  $mN = 115^\circ$ .

TABLE 4  
EFFECT OF WEATHER CONDITIONS ON DIRECTIONS PREFERRED BY ROBINS ON  
MORNINGS AFTER NIGHTTIME ZUGUNRUHE

	Control			Test		
	n	$\alpha_m$	p	n	$\alpha_m$	p
<i>clear and partly covered:</i>						
spring:	15	49°	(0.05 > p > 0.01)	8	147°	—
autumn:	7	65°	—	4	239°	—
spring + (autumn + 180°):	22	47°	(p > 0.05)	12	91°	(p > 0.05)
<i>overcast:</i>						
spring:	15	19°	(0.05 > p > 0.01)	17	120°	(p > 0.05)
autumn:	8	238°	—	12	312°	(0.05 > p > 0.01)
spring + (autumn + 180°):	23	24°	(0.05 > p > 0.01)	29	127°	(0.05 > p > 0.01)

trol (Fig. 4a) ( $p < 0.01$ ) and at 120° = geographic ESE = experimental N for Test (Fig. 4b) ( $0.05 > p > 0.01$ ). The fact that these mean directions in Test and Control originate from different statistical populations is significant with  $p < 0.01$ .

On the other hand the data of morning activity not preceded by migratory activity show no relation to the directions the same birds selected when they showed migratory restlessness (Fig. 5).

Different weather conditions did not cause significant differences in birds' directional behavior recorded during mornings after *Zugunruhe* (Table 4).

The mean directions of evening, night, and morning activity of single registration periods are given in Tables in the Appendix.

DISCUSSION

When we started to register daytime activity we wanted to find out whether in the migratory season night-migrating birds have a tendency to move in their migratory direction also during the daytime periods before and after darkness. The direction selected during early morning hours corresponds with the migratory direction, but only when the birds were actually restless the night before. The concentration of these directional preferences is lower than the concentration found during nighttime. This may result from both the shorter registration time (3-5 hours, compared with 9-11 hours during nights) and a weaker motivation to keep the migratory course. These findings correspond with those of Mewaldt et al. (1964), who found that pre-dawn migratory restlessness may persist into the post-dawn period. Mewaldt et al.

found these tendencies with *Zonotrichia* only in autumn, whereas our robins showed this behavior also in spring. This may be merely an interspecific difference.

We cannot state exactly whether the directional preference during morning hours depends on the directional preference during night. The fact that in more than 50 per cent of all experiments the birds selected during morning hours a direction deviating more than  $45^\circ$  from the one they had selected the night before indicates that the birds might select their migratory direction anew. This is also supported by the observation that in most experiments there is a period of low activity or no activity between the night activity and the morning activity peak.

The experiments in our Test arrangement give evidence that the selection of the migratory direction is dependent on the magnetic field also during daylight hours. Most data for Test conditions were obtained during "overcast" morning periods when the sun was not visible; but on "partly covered" mornings the birds' orientation behavior might have been influenced by the sun compass. The robins were unable to see the sun itself because of the plastic curtain that concealed the Helmholtz coils and surrounding landmarks, but they may have got information of the sun's position by lighted clouds or lighter parts of the sky. Unfortunately we have only very few values for "partly covered" Test mornings: the seven values obtained in spring cannot be interpreted as evidence for the use of a sun compass, since their mean direction (statistically nonsignificant) corresponds to the migratory direction according to the magnetic field. In autumn the mean direction points towards SW as expected for sun compass orientation, but it is based on only four values. So we need more data to decide under which conditions the birds use the sun compass, and how they select their migratory direction when sun compass and magnetic compass give conflicting information.

The orientation of morning activity following nights without nocturnal restlessness seems to have no relation to the migratory direction.

The activity recorded during late afternoon and evening shows an orientation towards the NNW sector, which seems similar to the "nonsense" orientation of released non-migrating Mallards, described by Matthews (1961). This orientation in robins does not depend on the direction of the magnetic field, does not alter between spring and autumn, and shows no relation to the migratory direction (except in Test in autumn, where by chance this "nonsense" direction and the migratory direction coincide). But this "nonsense" orientation, unlike the one described by Matthews (1963) is independent of the weather condition and seems to persist under total overcast. We do not think that this direction is caused by phototaxis from the setting sun, since (1) the mean is too far north from the sunset point, (2) it persists under total over-



cast, and (3) the morning activity not preceded by nocturnal activity shows no corresponding eastward direction. A simple explanation could be that the door of the windscreen was in the SE, and so the birds were released from this side into the cage (Fig. 1). NNW is the direction where they try to escape from the operator, and hence may be temporarily fixed in the behavior pattern. In spring as well as in autumn this "nonsense" orientation is much more concentrated under Test conditions. The reason may be that under Test conditions the birds' motivation to prefer this direction is intensified by the fact that it coincides with the axial migratory direction. It is not surprising that the direction opposite to the migratory direction (situation in spring experiments) has a certain prominence for a bird, since we know from the magnetic compass that in the first step the bird perceives only the axial direction of the magnetic field lines (Wiltshcko 1971).

Maybe we can interpret the data of morning activity not preceded by nocturnal activity (except for the four values of Control in spring) as an expression of a similar "nonsense" tendency. This tendency is much weaker than in the evening, as might be expected, since the birds had 13–15 hours to forget the procedure of being caught and brought into the registration cage.

#### SUMMARY

1. The birds' activity during early morning hours is concentrated in migratory direction, but only when the birds showed migratory activity in the night before.
2. When the magnetic field was artificially changed (magnetic north at 115° in ESE), the birds during morning hours selected their migratory direction according to the direction of the magnetic field.
3. The birds' behavior during late afternoon and evening shows a "nonsense orientation" towards the geographic NNW sector in Test (magnetic north in ESE) and Control (earth's magnetic field) in spring as well as in autumn.
4. This "nonsense orientation" seems to persist under clear, partly covered and overcast skies, and might be explained as a temporarily fixed part in the birds' behavior pattern caused by carrying the birds into the cage from the opposite side.

#### ACKNOWLEDGMENTS

The work was supported by the Deutsche Forschungsgemeinschaft. We gratefully acknowledge the help of Dr. W. Schuckmann and Mr. K. D. Klein for the computer program and of Prof. J. R. King for critically reading the manuscript. Special thanks to Mr. and Mrs. Henkel, Ufhausen, Rhön mountains, who permitted us to use their garden for installing our test arrangement, and to Prof. F. W. Merkel for many useful discussions.

#### APPENDIX (TABLES 5–10)

The tables give the mean direction of afternoon and evening-, night-, and morning activity for the single registration periods between 16:00 and 10:00 the following day.

We evaluated every afternoon- and morning activity period in which the bird did more than 50 hops and every night activity period with more than 70 hops.

During spring 1969 afternoon and evening activity was not registered, registration time started at dusk. In a few cases when the entire activity of that night (more than 70 hops) occurred during the first hour, it is considered as evening activity rather than night activity and given as "afternoon" activity in the tables. Also in spring 1969 the morning activity had to be registered separately and could not be registered regularly. The mornings, when no morning activity was registered, are marked as "not reg." in the tables. "Techn. defect" means that the bird showed activity, but this activity could not be evaluated because of a defect in the recording system. The letters refer to weather conditions: cl = clear; pc = partly covered; ov = overcast.

TABLE 5  
SPRING 1969, CONTROL

Date	Bird	Afternoon	Night	Morning
5 April	R 3	—	cl 360°	not reg.
6 April	R 3	—	cl 131°	not reg.
9 April	R 3	—	cl 200°	not reg.
11 April	R 3	—	ov 338°	cl 1°
12 April	R 7	—	pc 18°	—
13 April	R 6	—	—	pc 22°
14 April	R 3	pc 105°	—	pc 160°
17 April	R 12	—	ov 358°	—
18 April	R 3	—	—	ov 154°
19 April	R 9	cl 293°	—	cl 193°
20 April	R 12	—	pc 233°	pc 227°
23 April	R 9	—	ov 348°	—
24 April	R 12	—	ov 139°	—
25 April	R 8	—	pc 125°	pc 42°
26 April	R 4	—	ov 326°	pc 23°
27 April	R 10	—	pc 21°	ov 5°
1 May	R 9	—	ov 66°	not reg.
3 May	R 12	—	pc 234°	ov 5°
4 May	R 9	—	ov 38°	pc 56°
6 May	R 12	—	ov 359°	ov 23°
7 May	R 9	—	ov 17°	ov 305°
9 May	R 12	—	pc 235°	ov 87°
10 May	R 9	—	pc 315°	—
11 May	R 12	—	cl 301°	cl 75°
12 May	R 21	—	cl 26°	pc 40°
14 May	R 12	—	ov 267°	pc 256°
16 May	R 12	—	pc 352°	not reg.
20 May	R 12	—	ov 35°	not reg.
21 May	R 15	—	ov 19°	not reg.

TABLE 6  
SPRING 1969, TEST

Date	Bird	Afternoon	Night	Morning
4 April	R 2	—	—	cl 218°
5 April	R 2	cl 200°	—	cl 117°
8 April	R 4	—	cl 180°	not reg.
10 April	R 4	—	—	ov 301°
12 April	R 8	—	—	pc 57°
13 April	R 4	pc 357°	—	pc 355°
14 April	R 2	—	pc 116°	—
16 April	R 4	—	—	ov 37°
20 April	R 10	—	cl 171°	pc 205°
21 April	R 8	—	ov 159°	ov 172°
22 April	R 2	—	ov 229°	ov 77°
23 April	R 4	—	ov 186°	ov 153°
24 April	R 10	—	ov 166°	not reg.
25 April	R 7	—	pc 215°	—
26 April	R 9	—	ov 359°	—
27 April	R 12	—	ov 153°	ov 130°
28 April	R 8	—	ov 109°	ov 192°
29 April	R 4	—	ov 102°	ov 282°
30 April	R 10	—	ov 70°	ov 110°
3 May	R 10	—	pc 207°	ov 329°
4 May	R 4	—	ov 215°	pc 151°
5 May	R 19	—	pc 239°	—
6 May	R 10	—	ov 41°	ov 112°
7 May	R 4	—	ov 78°	ov 80°
8 May	R 19	—	ov 194°	—
10 May	R 4	—	pc 71°	ov 95°
12 May	R 4	—	pc 252°	pc 261°
13 May	R 13	—	cl 17°	pc 91°
14 May	R 10	—	pc 7°	—
16 May	R 10	—	pc 39°	not reg.
18 May	R 13	—	pc 89°	not reg.
19 May	R 18	pc 248°	—	ov 31°
21 May	R 13	—	pc 155°	not reg.

TABLE 7  
AUTUMN 1969, CONTROL

Date	Bird	Afternoon	Night	Morning
13 September	R 27	cl 64°	cl 181°	pc 75°
14 September	R 22	cl 308°	—	pc 315°
16 September	R 27	ov 265°	ov 218°	ov 249°

TABLE 7

Continued

Date	Bird	Afternoon	Night	Morning
19 September	R 27	cl 53°	pc 20°	pc 349°
20 September	R 22	cl 11°	cl 195°	pc 37°
22 September	R 27	pc 161°	pc 17°	pc 64°
23 September	R 22	cl 225°	techn. defect	techn. defect
24 September	R 27	cl 108°	pc 122°	ov 231°
25 September	R 32	pc 29°	—	ov 335°
27 September	R 22	pc 360°	pc 279°	ov 161°
30 September	R 22	pc 67°	ov 130°	ov 33°
1 October	R 27	pc 273°	pc 347°	ov 310°
2 October	R 32	ov 325°	—	ov 338°
4 October	R 22	cl 327°	pc 194°	ov 49°
7 October	R 22	pc 8°	—	ov 267°
9 October	R 27	cl 37°	pc 30°	ov 259°
11 October	R 32	cl 342°	—	pc 329°
16 October	R 27	ov 284°	ov 118°	pc 235°
23 October	R 27	ov 173°	ov 175°	ov 142°
26 October	R 27	ov 255°	pc 282°	pc 228°
4 November	R 27	pc 342°	ov 186°	pc 190°

TABLE 8

AUTUMN 1969, TEST

Date	Bird	Afternoon	Night	Morning
13 September	R 28	cl 286°	—	pc 108°
15 September	R 26	ov 19°	—	—
16 September	R 28	ov 47°	—	ov 236°
17 September	R 23	—	—	ov 326°
18 September	R 26	cl 34°	—	cl 107°
19 September	R 28	cl 242°	techn. defect	techn. defect
21 September	R 23	—	—	ov 298°
22 September	R 28	pc 19°	pc 257°	pc 237°
23 September	R 26	cl 326°	pc 341°	ov 308°
24 September	R 28	cl 12°	pc 24°	ov 273°
25 September	R 29	pc 328°	ov 328°	ov 311°
28 September	R 28	cl 335°	cl 305°	pc 327°
29 September	R 29	ov 81°	—	ov 81°
30 September	R 26	pc 6°	ov 2°	ov 7°
1 October	R 28	pc 360°	—	ov 12°
2 October	R 29	ov 322°	—	ov 307°
5 October	R 28	cl 5°	pc 16°	ov 23°
6 October	R 29	pc 15°	—	ov 339°

TABLE 8

Continued

Date	Bird	Afternoon	Night	Morning
9 October	R 28	cl 189°	pc 193°	ov 225°
11 October	R 29	cl 230°	—	pc 171°
13 October	R 28	cl 345°	—	ov 9°
15 October	R 34	cl 301°	—	ov 298°
16 October	R 28	ov 350°	—	ov 47°
17 October	R 29	cl 24°	—	ov 169°
19 October	R 28	cl 348°	pc 350°	ov 60°
20 October	R 29	cl 285°	cl 254°	cl 237°
21 October	R 34	cl 283°	pc 343°	ov 275°
22 October	R 28	pc 344°	pc 299°	techn. defect
23 October	R 29	ov 294°	ov 335°	ov 236°
28 October	R 29	pc 283°	pc 240°	pc 169°
29 October	R 28	pc 296°	—	ov 288°
30 October	R 34	pc 297°	ov 278°	ov 294°
1 November	R 28	cl 324°	cl 62°	—
2 November	R 34	—	pc 213°	ov 14°
3 November	R 29	ov 294°	ov 31°	ov 310°
4 November	R 28	pc 312°	—	pc 334°

TABLE 9

SPRING 1970, CONTROL

Date	Bird	Afternoon	Night	Morning
16 April	R 49	—	—	pc 39°
17 April	R 46	pc 263°	pc 47°	pc 237°
18 April	R 43	ov 210°	ov 126°	ov 110°
20 April	R 46	pc 83°	pc 17°	pc 46°
21 April	R 43	pc 14°	ov 46°	ov 69°
22 April	R 49	—	ov 338°	—
23 April	R 46	ov 356°	pc 227°	ov 82°
24 April	R 43	—	pc 100°	ov 21°
26 April	R 46	ov 87°	ov 295°	ov 272°
27 April	R 43	pc 351°	pc 34°	pc 46°
28 April	R 49	—	pc 77°	—
29 April	R 46	pc 254°	pc 332°	ov 331°
30 April	R 43	ov 316°	—	ov 150°
1 May	R 49	—	pc 70°	—
2 May	R 46	—	ov 26°	ov 47°
3 May	R 43	ov 341°	ov 60°	ov 276°
4 May	R 49	—	ov 327°	—
5 May	R 46	pc 222°	pc 71°	pc 71°

TABLE 9

Continued

Date	Bird	Afternoon	Night	Morning
6 May	R 43	—	pc 76°	pc 57°
7 May	R 46	cl 93°	pc 106°	pc 118°
9 May	R 53	cl 35°	pc 183°	pc 53°
10 May	R 43	ov 31°	ov 33°	ov 322°
11 May	R 46	—	pc 116°	ov 66°

TABLE 10

SPRING 1970, TEST

Date	Bird	Afternoon	Night	Morning
17 April	R 44	pc 42°	pc 324°	pc 271°
18 April	R 41	pc 17°	—	ov 26°
19 April	R 40	ov 61°	—	ov 66°
20 April	R 44	pc 1°	pc 101°	pc 113°
21 April	R 41	ov 314°	ov 50°	ov 315°
22 April	R 40	ov 307°	ov 257°	—
23 April	R 44	ov 294°	pc 322°	ov 48°
24 April	R 41	pc 338°	pc 199°	—
25 April	R 40	pc 99°	—	ov 18°
26 April	R 44	ov 214°	ov 176°	ov 326°
27 April	R 41	pc 16°	pc 150°	—
28 April	R 40	pc 7°	—	pc 335°
29 April	R 44	pc 96°	pc 96°	ov 117°
30 April	R 41	ov 293°	—	ov 318°
1 May	R 40	pc 32°	—	pc 53°
2 May	R 44	pc 269°	ov 150°	ov 270°
3 May	R 41	ov 265°	ov 123°	ov 192°
4 May	R 40	cl 336°	—	pc 271°
5 May	R 44	pc 299°	pc 260°	pc 348°
6 May	R 41	—	—	pc 10°
7 May	R 44	—	pc 101°	pc 81°
9 May	R 40	cl 284°	pc 133°	—
11 May	R 44	ov 46°	—	ov 51°
12 May	R 40	ov 148°	—	ov 77°

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ZOOLOGISCHES INSTITUT DER UNIVERSITÄT, 6 FRANKFURT AM MAIN, GERMANY,  
2 JUNE 1971.

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### NEW LIFE MEMBER

A recent addition to the roster of Life Members of the Wilson Society is Robert L. Haines, of Moorestown, New Jersey. Mr. Haines, who has retired from a family paint and glass business, now spends his time in pursuing his ornithological interests, and is active in several organizations concerned with the welfare of the American Indians. He is in fact an adopted member of the Seneca tribe. A graduate of Haverford College, Mr. Haines has carried out serious studies of birds and has published several papers. He has been a member of the Society for 25 years, and is also a member of the AOU, the Cooper Society, The National and New Jersey Audubon Society, and the Delaware Valley Ornithological Club, having served as president of the latter in 1950. He is married and has two children and two grandchildren.

