Summary.—A study of the family relations of the Plain Titmouse (*Baeolophus inornatus*), a non-migratory bird, was made at Stanford University, California, from 1928 to 1933. The birds were captured and banded in nest-boxes. The number of eggs laid ranged from 3 to 9 with an average of 6.75. One titmouse was found to be at least seven years old.

Forty-five per cent of all titmouses banded as adults were recaptured in following years and all except one were nesting either in the same nest-box or in one less than 100 yards distant. Of those juvenile birds banded in the nest only two, 1.3 per cent, were recaptured nesting the following year, and both were more than a quarter of a mile distant from the box where hatched.

A titmouse usually keeps the same mate from year to year and there was only one known case of "divorce." Of a total of 14 pairs recaptured, 11 were mated together for at least two years and only 3 were not. No sex difference was found in the retention of territory from year to year. If a bird lost its mate the survivor, whether male or female, remained in the nesting territory and secured a new mate. In one case the new mate was known to be a juvenile of the year before.

Stanford University, California, July 26, 1935.

AN OBJECTIVE METHOD FOR MEASURING IRRITABILITY IN BIRDS

By SHERBURNE F. COOK and HELEN C. FREDRICKSON

The purpose of the experiments herein described was to work out an objective method for measuring the irritability of a bird. In this sense we take irritability to signify the degree of responsiveness of the bird to the sum of environmental stimuli, whether or not all the stimuli are recognized as such by the observer. Thus one bird may give the impression of extreme activity, another may be relatively quiet. If we conceive of the observed actions as representing motor responses to external stimulation, then under field conditions we have no quantitative reproducible method for determining whether the differences lie in variation of the external stimuli, internal stimuli, or the nervous system of the bird. Some of these variables may be ruled out, partly at least, if we study an individual under controlled conditions.

Method.—In these experiments a canary was used which had been kept in a cage in the laboratory for some weeks. The particular factor studied was light intensity and the reactions of the bird were recorded by the kymographic method.

The bird cage was placed in a photographic dark room for half an hour prior to a run with the light at a reduced but constant intensity. A kymograph was set up to revolve at a slow speed, at a considerable distance from the bird. A signal magnet with writing point was arranged for recording and wires run to a switch key near the observer. The latter was seated close to the bird, and made a contact with the key whenever the bird made any motion, thus getting a record of all motions. A time clock recorded 5-second intervals on the drum. Each run consisted of 30 to 60 minutes of continuous observation. After each experiment the bird was brought for at least 30 minutes into a normal light intensity to feed and drink. Then it was replaced in the room at the light intensity to be used in the following experiment. In all-day testing the period from the beginning of one experiment to that of the next was 3 hours.

The light intensity was determined in a purely arbitrary fashion. A 10-watt bulb was placed in front of a camera at a constant distance and side leakage prevented. The light passed through a ground glass plate at the back of the camera and illuminated the bird and its surroundings. By closing or opening the diaphragm the intensity could be varied—reproducibly—because the bird was always placed at a constant distance from the camera (3.85 meters). The lowest intensity used was that which just rendered the bird visible to the observer.

Results.—The reactions of the canary, as observed by us, showed a typical, recurring form. Beginning with a period of complete quiescence the bird suddenly made a series of several quick, jerky motions in rapid succession, and then became motionless. At a variable time thereafter it began a new group of motions, and so on. An analysis of these motions (individually and in groups) was made with respect to (1) light intensity, and (2) time of day. Undoubtedly the influence of a host of other factors could be determined in the same way, but we restricted ourselves to these two.

The data may be analyzed in various ways. We have used the following criteria:

1. The number of groups of motions per minute.
2. The average time between groups.
3. The mean number of motions per group.
4. The average time between motions within a group.

The data are presented in the following tables. The latter are arranged with respect to the two light intensities used (as indicated by the stop number of the camera) and the time of day. In each case the average figure for several different determinations is given.

TABLE I

Number of Groups per Minute

Time of day	f.22	f.8
9 a. m.	0.55	0.80
12 m.	0.95	1.80
3 p. m.	1.22	2.67
6 p. m.	0.95	1.08
9 p. m.	0.27	.062

TABLE II

Average Time between Groups in Seconds

Time of day	f.22	f.8
9 a. m.	48	62
12 m.	40	27
3 p. m.	39	20
6 p. m.	55	34
9 p. m.	106	66

TABLE III

Mean Number of Motions per Group

Time of day	f.22	f.8
9 a. m.	0.82	0.93
12 m.	1.20	1.04
3 p. m.	1.09	1.11
6 p. m.	0.90	1.08
9 p. m.	1.05	0.92

TABLE IV

Average Time in Seconds between Motions within a Group

Time of day	f.22	f.8
9 a. m.	0.82	0.93
12 m.	1.20	1.04
3 p. m.	1.09	1.11
6 p. m.	0.90	1.08
9 p. m.	1.05	0.92

From the tables the following conclusions may be drawn:

1. With respect to the effect of light intensity there is no doubt that the frequency of occurrence of motion groups is greater at the higher light intensity (that is, f. 8). However, the mean number of motions per group seems to be rather constant and there is no consistent and material difference in the average time between individual motions within the group. This might be taken to mean that once a train of motions is started, its duration is conditioned by some other factor, internal or external, than the light intensity.

2. There is a clear diurnal rhythm of irritability which reaches its maximum in the early or mid afternoon. The minimum (if the experiment had been possible) would probably have been found to be during the early morning hours. The rhythm is most clearly indicated in the frequency of group occurrence, although it is also suggested in the frequency of the individual motions within each group.

3. It is suggested that a method of observation and analysis such as is here described might be utilized in order to secure comparative quantitative data concerning the activity of many birds under both laboratory and field conditions.

Department of Physiology, University of California, October 1, 1935.