BEHAVIORAL DEVELOPMENT, SOCIAL ORGANIZATION, AND CONDITIONING OF COURTING BEHAVIOR IN THE JAPANESE QUAIL COTURNIX COTURNIX JAPONICA

Thesis for the Degree of Ph. D.

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THESIS

This is to certify that the

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BEHAVIORAL DEVELOPMENT, SOCIAL ORGANIZATION, AND CONDITIONING OF COUNTING BEHAVIOR IN THE BOBWHITE QUAIL COLINUS VIRGINIANUS

presented by

Howard Hazel Farris

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ABSTRACT

BEHAVIORAL DEVELOPMENT, SOCIAL ORGANIZATION, AND CONDITIONING OF COURTING BEHAVIOR IN THE JAPANESE QUAIL COTURNIX COTURNIX JAPONICA

by Howard E. Farris

This study investigated the behavioral development and social organization of the Japanese quail (Coturnix coturnix japonica). Observations were made three times a day and records kept of all behavior observed from day 1 post-hatch through day 42. Behavior Classes and the response patterns under each class were defined and listed in table form.

The subjects were raised in heterosexual groups and in isolation during the period of observation. The total number of birds in the social group was 54 and the total number of isolates was 36, this included Ss in the original study and two replications.

Emphasis was placed on the sequence in which the behavior patterns appeared and the age at which they first appeared (day of onset). Attention was also given to the duration of the behavior or how long the response pattern remained in the bird's repertoire, the per cent of birds showing the behavior, and to the integration of the behavior patterns.

The data were compared for the social and isolate groups and related to finding obtained in similar studies using domestic fowl.

The birds raised in isolation were further tested by placing them in new and varied environments. The major reactions observed were those associated with extreme fear, such as immobility and injury feigning. After three weeks in a group environment the behavior of the birds raised in isolation was not distinguishably different from those raised in groups.

EXPERIMENT II

In this study the quail were tested for spontaneous alternation of response. One group of 20 birds, 50 days old, was run in a single unit T-maze without deprivation or reinforcement. A second group of 28 birds was run to a water reward in the same apparatus under 12 hours of water deprivation. One arm of the maze was black, the other white. For one-half of the Ss the black was on the right and the white on the left, the cues were reversed for the remaining Ss.

No evidence for spontaneous alternation was found in either group. Instead, there was a significant tendency for response repetition (.01 level of confidence). This finding supported that which has been found in a similar study with chickens.

EXPERIMENT III

This study investigated the extent to which courting behavior in the Japanese quail, an innate response pattern, could be classically conditioned. Four male birds (3, 75 days old; 1, 42 days old) were conditioned so that their courting pattern

was elicited by the sound of a buzzer (CS). The unconditioned stimulus (US) was the female bird and the CS-US interval was 10 seconds with the CS overlapping the (US) 5 seconds.

The birds conditioned rapidly at 4 trials per day, showing some conditioning as early as the 5th trial and complete response patterns as early as the 14th trial (mean 27.6). Cumulative records of the conditioned responses of acquisition, extinction, and spontaneous recovery revealed a sequential pattern for response onset and a separation of the individual components, indicating differential conditioning for the respective component responses.

The discussion centered about the relationships between innate and learned response patterns and the effects of learning on innate behavior patterns of birds in capitivity, especially appetitive behavior.

Approved: M. Ray Denny

Date: Aug 7, 1964

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By

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CHAPTER I

INTRODUCTION

The Japanese quail (Coturnix coturnix japonica) is a cinnamon-colored terrestrial galliform somewhat smaller than the American bobwhite. The bird was introduced into North America by the Missouri Conservation Commission in the late 1950's as a possible supplement to the decreasing population of upland game birds (Stanford, 1957). Since that time other conservationists have shown increasing interest in this quail (Wetherbee, 1961). Several researchers have recently suggested using the bird as a laboratory animal for various kinds of research (Abplanalp, 1960, 1962; Padgett and Ivey, 1959; Reese and Reese; 1962; Wilson et al., 1961). Because of its short incubation period and rapid development, the bird has been of particular interest to avian embryologists and physiologists (Padgett and Ivey, 1960).

Two general sources of information are available on this species of quail. Stanford (1957) reported the results of several years of research conducted by the Missouri State Game Commission where the birds were hatched, reared, and released in large numbers for hunting purposes. Wetherbee (1961) reviewed the literature on the life history of the Coturnix quail and conducted a field study of its habits. Both Stanford and Wetherbee

include excellent physical descriptions, ecological information, discussions of reproductive behavior, and data on migration.

However, only a very limited amount of behavioral research on the bird has been reported. Bartlett and Lieberman (1960) used the bird in a pilot study on visual imitation learning and Reese and Reese (1962) reported the results of an exploratory study in operant conditioning. Wilson et al. (1961) explored the possibility of using the Coturnix as a pilot animal for subsequent research on poultry.

The lack of work with this animal is surprising since this particular species has many attributes that make it desirable for use in behavioral research. Padgett and Ivey (1959) described the bird as being hardy, easy to handle, precocious, and prolific. Other authors concurred (Wetherbee, 1962; Stanford, 1957).

Maintenance

Maintenance presents no particular problem for this bird. It readily adapts to a variety of laboratory conditions (Reese and Reese, 1962), and needs little daily care. Since the adult bird is small, space requirements are minimal. Wilson et al. (1961) reported that the bird consumes about one-fifth as much food as the domestic chicken, and for every pound of food consumed, the female produces about 18 eggs. The birds thrive well on a good commercial poultry feed, with a minimum of dietary supplementation (Stanford, 1957; Ernst, 1963). For a special food formula developed for the birds by the Poultry Science Department at Michigan State University, see appendix.

In captivity the birds eat periodically throughout the 24 hour day and consume great quantities of water when commercial feed is substituted for their regular diet of insects and vegatable matter. Consequently, the animal works well in experimental situations with as little as 12 hours of initial deprivation. Reese and Reese (1962) reported successful operant conditioning after 17 hours of deprivation. In contrast, more traditional experimental animals such as the pigeon and rat require several days or weeks of deprivation.

All available sources described the bird as being very hardy and resistent to diseases common to similar game birds. Stanford (1957) reported that they raised about 35,000 of the quail under "normal brooding conditions" and not one of the birds died of any "traceable disease." The only losses encountered were due to mechanical reasons such as accidents and over-crowding.

Reproduction

Wetherbee (1961) and Stanford (1957) both reported that the male Coturnix quail reached sexual maturity in 28 days and the female about 36 days. The first eggs were produced about the 36th day with a range of 31 to 42 days. Wilson et al. (1962) who studied the egg production of the bird reported that if the eggs were set within the first week after production, the percentage of eggs hatching was most impressive, ranging from 70 to 100 per cent. It was further suggested that because

of the Coturnix's rapid sexual maturation and short incubation period, under ideal conditions one might obtain four or more generations in one year. This rapid reproduction could help to alleviate the problem typically encountered with experimental animals, that of meeting the demands for adult populations.

One of the most remarkable attributes of the male quail is the fervor and persistence of its mating behavior. Wetherbee (1962) described the male as "actively promiscuous throughout the year in captivity." Reese and Reese (1962) stated that the female often looses her spinal and cervical feathers due to the male's persistent copulation efforts. Stanford said, "The male Coturnix is the most avid suitor of any bird that has ever been observed, at times pushing the female off the nest to copulate" (Stanford, 1957, p. 335). He speculated that in many cases the female had to hide from the male to brood the eggs of the clutch. Pfeifer (1954) entitled a descriptive article on the male's sexual behavior, "The Rape of a Wounded Female Coturnix by the Male." Psychologists and physiologists would undoubtedly find the sexual behavior of this species interesting and deserving of study.

Social Behavior

In their natural habitat the birds do not covey or form into groups as do other quail. They are territorial and tend to remain in small family units or single pairs. In the spring migration,

the birds arrive on location and the males set up territories about 100 yards apart (Wetherbee, 1961) and call persistently to the females until mated. The males tend to be monogomous unless there is an over abundance of females. They are extremely pugnatious toward their mates and competitors, attacking either with little or no provocation.

In captivity the birds display a rich repertoire of behavior, making them ideal for systematic studies of development and social behavior. According to Collias (1952), the need for such studies is great since the knowledge of social behavior of the class Aves is still very sketchy and uneven. He suggested that much of what we know comes from studies with domestic fowl which leave many questions unanswered.

Undesirable qualities

The birds have few if any undesirable qualities. Reese and Reese (1962) reported that on solid floors, feces tend to cling to the feet of the young bird forming large balls on the toes. The feces harden cutting off circulation which results in the loss of toes. This does not happen if the birds are raised on wire floors.

The birds startle easily and have a tendency to jump straight upward striking their heads against the top of the cage. This often results in scalping or damage to the head. The former can be greatly reduced by housing the quail in cages with smooth surfaced sheet metal, canvas, or plastic roofs.

Conclusion

The general characteristics of the Coturnix quail suggest that this animal would be ideal for behavioral research. Reese and Reese (1962) have pointed this out earlier by suggesting that it is suitable for work in learning, motivation, and social behavior and might be especially valuable as a representative of Class Aves. It should also be excellent for demonstrations and experimentation in laboratory courses.

Since little behavioral information is available on this species, initially we must systematically observe and describe the animal's behavior patterns. Too often experiments are designed and carried out with little consideration for the animal used or for its natural behavior. Ethologists have frequently pointed this out to researchers, particularly American psychologists. It is the contention of many animal behaviorists that without a fairly comprehensive knowledge of the organism's characteristic behavior (species-specific), one is deprived of a baseline from which to work. Scott said, "Before we attempt the modification of behavior through learning, we need basic descriptive information about the behavior to be modified" (Scott, 1958, p. 93).

CHAPTER II

EXPERIMENT I

The purpose of this study was to obtain complete records of behavioral development of the Japanese quail (Coturnix coturnix japonica) as observed under specific laboratory conditions. Systematic records of the observations were kept of all behavior observed from day 1 post-hatch through day 42. From these data analyses of specific behavior patterns were made based on definitions derived from pilot work with the animal. Emphasis was placed on the sequence in which the patterns appeared and the age at which they first appeared. Efforts were made to note the "dropping out" of any behavior as the birds matured and as patterns became less flexible. Every effort was made to minimize subjective interpretations in the recording and classifying of the behavior.

Development was studied for birds raised in heterosexual groups of various sizes and for birds hatched and raised in isolation. The original study was replicated twice with the inter-observer reliability being checked at different stages in the replications. Observations were made at different times throughout the 24 hour day.

Group I Method--Birds Raised in Groups

Subjects

The subjects were 36 Japanese quail of both sexes obtained from Poultry Science at Michigan State University on the day of hatch. The birds were taken from the incubators and transported directly to the experimental room in partitioned cardboard boxes. They were divided into two equal groups and immediately transferred to brooders. The quail were maintained on MSU turkey starter which served as a complete diet for the first month, at which time a special formula quail breeder was introduced (see appendix for formula). Food and water were available at all times.

Replication 1

The subjects for first replication were 12 Japanese quail obtained from the same place as those in the original study and treated exactly the same in all respects. The birds were divided into two groups of 6 each and marked for individual identification.

Replication 2

The subjects for second replication were 6 Japanese quail obtained and treated as those in the previous studies. The 6 birds were marked for individual identification and raised under same conditions as all other group birds.

The total number of birds used in social groups for the original study and the replications was 54.

Apparatus

The brooders were 23x36x10 inches, commercial stock with sheet metal tops and sides. The sides were partially open to allow room for detachable feeders. The floor was 1/2 inch hardware cloth which was covered with paper during the first week. Heat was furnished by a thermostatically controlled electric unit and temperatures ranged from a maximum of 105 degrees directly under the unit to a minimum of 80 degrees at the front of the brooder. Room temperature was 75 degrees and the brooders were lighted 24 hours a day with one 60 watt bulb. Gravity flow water dispensers were placed in the middle of the brooders.

Procedure

Observations were made three times daily; mid-morning, mid-afternoon, and mid-evening on the first group. The time of day was varied for the replications to include early morning and late evening. Observations were made in a dark room with the brooders lighted as usual. The time spent at each group cage was a function of the number of birds in the cage (Nx3 minutes). All behavior observed was recorded on forms which were designed to facilitate speed and accuracy of recording. The sheets from each observation were summarized for complete pictures of daily behavior and the daily records were in turn placed on weekly summary sheets. The data from each group were kept separate.

Group 2 Method--Birds Hatched and Raised in Isolation

Subjects

Subjects were 12 Japanese quail of both sexes obtained from Poultry Science at Michigan State University. The birds were hatched in individual racks to prevent them from seeing or having bodily contact with other birds. They were removed from the incubators on the day of hatch, placed in individual compartments of a cardboard box, and transferred to the experimental room. There they were immediately placed in the apparatus.

Replications

This part of the study was replicated twice with 12 birds on each replication. All birds were hatched, transported and treated the same way in every respect.

The total number of birds raised in isolation was 36.

Apparatus

The inside dimensions of the isolation boxes were 9 x 9 1/2 x 11 inches. The sides and top were white pine and 1/4 inch plywood respectively, with a 1/4 inch hardware cloth floor. The box was heated and lighted by one 25 watt bulb. The temperatures ranged from a maximum of 105 degrees under the bulb to a minimum of 85 degrees in the far corners of the box. Both light intensity and temperature were controlled by a varying line current with a variac. Food and water containers were near the light source and could be cleaned and refilled from the outside (see appendix). A 1/2 inch

hole was cut in the top of the box for observation. All the floor area was visible from that point.

Procedure 1

Observations were made three times daily at the same time as the group birds. Observations were begun alternately on the group and isolates with at least 3 minutes being spent at any one box on each observation. Recording procedure was the same as for the group-raised birds.

Procedure 2

At the end of 42 days tests were made of the isolate birds by removing them from the boxes and introducing them into a variety of environments. Some were simply placed in an empty brooder, others were put in with social birds, some were introduced to other isolates in a brooder. Each group of isolates from each replication was similarly tested. Six isolates of both sexes from the original study were placed in a brooder and observed for 21 days.

Comparisons of behavior records were made between the group-raised birds and the isolates. Particular attention was given the following aspects, using the group-raised birds' behavior as a norm: (a) absence of behavior, (b) incomplete patterns, (c) retardation of development, and (d) abnormal or different behavior.

Results

The definition of behavior classes represents behavior patterns observed and categorized in the course of the behavioral development of the quail. Where applicable, definitions were used that coincided with similar work done with other species, i.e., Guhl (1958) with chickens, Ratner (1964) with chickens, and Miller and Miller (1958) with ring doves.

Table 1 shows the behavior development for both social and isolate animals. First considered was the day of behavior onset with median, range, and per cent of the animals showing the behavior. The second variable considered was the duration of the behavior or the length of time after onset that the behavior remained in the animals' repertoire; median and range are given. The general frequency was derived by considering the frequency at which the different behaviors were observed to occur across observations; i.e. very high; behavior was observed more than once on each observation, high; the behavior was observed at least once on each observation, medium; observed at least once every 3 observations, low; observed at least once every 6 observations, and very low; once every 15 observations (5 daily sessions).

The data in Table 1 were summarized from observations made by the author during the first replication and by the author and 6 other observers during the second replication. Inter-observer agreement was excellent.

TABLE 1

BEHAVIOR CLASSES WITH RESPECTIVE RESPONSE PATTERNS SHOWING DAY OF BEHAVIOR ONSET, RANGE, DURATION, AND GENERAL FREQUENCY

Behavior Class	Day of Onset						Duration				General Frequency	
	Social			Isolate			Social		Isolate		Social	Isolate
	Mdn	Range	% Ss	Mdn	Range	% Ss	Mdn	Range	Mdn	Range		
RESTING												
Lying	1	-	100	1	(1-2)	100	6	(1-7)	6	(1-8)	M	M
Squatting	1	-	100	1	-	100	A	(1-A)	A	(1-A)	M	M
Standing	1	-	100	1	-	100	A	(1-A)	A	(1-A)	H	H
Huddling	1	(1-2)	100	-	-	-	11	(10-14)	-	-	H	-
VOCALIZATION												
Soft Peeping	1	-	100	3	(2-5)	100	A	(1-A)	7	(2-8)	M	L
Distress cry	1	-	100	1	-	100	14	(1-18)	19	(1-21)	L	H
Cricket call**	40	(38-42)	50	38	(38-40)	16	A	(38-A)	A	(38-A)	L	VL
Crowing (males)	28	(27-32)	100	28	(27-32)	100	A	(27-A)	A	(27-A)	M	H
Vocal threat	40	(38-42)	10	-	-	-	A	(39-A)	-	-	VL	-
LOCOMOTION												
Walking	1	-	100	1	-	100	A	(1-A)	A	(1-A)	H	H
Running	1	-	100	1	-	100	A	(1-A)	A	(1-A)	M	M
Dash (short burst)***	2	(1-3)	100	4	(3-6)	37.5	10	(1-14)	8	(3-14)	M	L
Hopping**	4	(2-6)	100	19	(18-19)	12.5	13	(2-14)	19	(18-21)	L	VL
Jumping*	12	(10-20)	100	4	(3-5)	100	A	(10-A)	A	(3-A)	L	L
NUTRITION												
Feeding	1	-	100	1	-	100	A	(1-A)	A	(1-A)	VH	VH
Drinking	1	-	100	1	-	100	A	(1-A)	A	(1-A)	H	H
Swallow/gaping	1	-	100	1	-	100	A	(1-A)	A	(1-A)	L	L

TABLE 1.--Continued

Behavior Class	Day of Onset						Duration				General Frequency	
	Social			Isolate			Social		Isolate		Social	Isolate
	Mdn	Range	% Ss	Mdn	Range	% Ss	Mdn	Range	Mdn	Range		
DEFECATION	1	-	100	1	-	100	A	(1-A)	A	(1-A)	M	M
BODY CARE												
Feather ruffling*	6	(4-8)	100	8	(7-9)	100	A	(4-A)	A	(7-A)	M	M
Bill Wiping*	2	(1-3)	100	5	(4-5)	100	A	(1-A)	A	(4-A)	L	L
Preening												
Breast	2	(1-3)	100	2	(2-3)	100	A	(1-A)	A	(2-A)	M	L
Wing	2	(2-5)	100	2	(2-3)	91.6	A	(2-A)	A	(2-A)	M	M
Back	2	(2-5)	100	2	(2-3)	83	A	(2-A)	A	(2-A)	M	M
Leg	2	(2-5)	100	2	(2-3)	95.8	A	(2-A)	A	(2-A)	M	M
Mutual	4	(1-6)	61.1	-	-	-	A	(1-A)	-	-	L	-
Scratching	1	-	100	2	(2-4)	100	A	(1-A)	A	(2-A)	L	L
Stretching												
double wing-neck	2	(2-4)	100	2	(2-8)	100	A	(2-A)	A	(2-A)	L	L
Leg-wing	2	(2-4)	100	2	(2-8)	100	A	(2-A)	A	(2-A)	L	L
Wing flutter/flap	3	(2-5)	100	3	(2-5)	100	A	(2-A)	A	(2-A)	M	L
Dusting**	8	(1-12)	83	13	(12-14)	29	A	(1-A)	A	(12-A)	L	VL
DEFENSIVE REACTIONS												
Freezing	1	-	100	1	-	100	14	(1-19)	19	(1-21)	M	M
Alert stance	14	(12-18)	100	14	(12-19)	100	A	(12-A)	A	(12-A)	M	M
Escape reaction	1	-	100	1	-	100	A	(1-A)	A	(1-A)	H	H
Popping*	16	(12-20)	100	10	(3-11)	100	A	(12-A)	A	(3-A)	M	H
Brief flight**	12	(10-14)	100	23	-	8	A	(10-A)	A	(23-A)	L	VL
Backward running	4	(3-6)	100	-	-	-	A	(3-A)	-	-	L	-
AGGRESSIVE-SUBMISSIVE												
Generalized pecking	1	-	100	1	-	100	8	(1-10)	14	(1-16)	M	H
Competitive pecking	4	(3-5)	61.1	-	-	-	7	(3-10)	-	-	L	-
Threat posture	38	(35-40)	33.3	-	-	-	A	(35-A)	-	-	L	-

TABLE 1.--Continued

Behavior Class	Day of Onset						Duration				General Frequency	
	Social			Isolate			Social		Isolate		Social	Isolate
	Mdn	Range	% Ss	Mdn	Range	% Ss	Mdn	Range	Mdn	Range		
Frolic**	3	(2-4)	100	6	(3-11)	4.1	7	(2-7)	11	(3-11)	L	VL
Frolic w/object	5	(3-7)	22	-	-	-	7	(3-7)	-	-	VL	-
Rapid approach	12	(4-14)	2	-	-	-	21	(4-23)	-	-	L	-
Avoidance run	10	(8-12)	82	-	-	-	A	(8-A)	-	-	M	-
Body peck	12	(8-13)	22	-	-	-	A	(8-A)	-	-	L	-
Head peck	17	(17-26)	11	-	-	-	A	(17-A)	-	-	L	-
Fight	42+										VL	
SEXUAL BEHAVIOR												
Courting (male)												
Neck and body tonus	36	(33-38)	100	-	-	-	A	(33-A)	-	-	M	-
Leg action	36	(33-38)	100	-	-	-	A	(33-A)	-	-	M	-
Toe walking	36	(33-38)	100	-	-	-	A	(33-A)	-	-	M	-
Vocalization	36	(30-42)	100	-	-	-	A	(30-A)	-	-	L	-
Feather puffing	38	(37-42)	100	-	-	-	A	(37-A)	-	-	L	-
Circling	40	(38-42)	100	-	-	-	A	(38-A)	-	-	M	-
Jumping	42+	-	5.5	-	-	-	A	-	-	-	VL	-
Tidbitting	42+	-	22.2	-	-	-	A	-	-	-	VL	-
Preening	42+	-	11	-	-	-	A	-	-	-	VL	-
Mounting (males)	36	(34-38)	100	-	-	-	A	(34-A)	-	-	M	-
Post copulatory response (males)	36	(34-38)	100	-	-	-	A	(34-A)	-	-	M	-
Crouch (female)	38	(37-42+)	44	-	-	-	A	(37-A)	-	-	VL	-
Pecking (female)	42		11	-	-	-	A	-	-	-	VL	-
Feather ruffling	36	(34-38)	100	-	-	-	A	(34-A)	-	-	M	-
Egg laying	37	(36-42+)	100	40	(36-42)	100	A	(36-A)	A	(36-A)	H	H

*Significant difference between Social and Isolates for day of onset
**Significant difference between Social and Isolates for per cent of birds showing behavior
***Both differences significant
A = Adult, VH = very high, H = high, M = medium, 1 = low, VL = Very low
42+ = occurs after 42 days

Definition of Behavior Classes

Resting

Lying.--lying on side with head and feet stretched out, appears lifeless, common in young birds the first week.

Squatting.--squatting position, underside may or may not touch floor, legs folded, head withdrawn, eyes closed.

Standing.--standing upright, sometimes on one foot, eyes closed, head withdrawn.

Huddling.--a standing or squatting position, 3 or more birds in close proximity, move as a group.

Vocalization

Soft peeping.--a soft medium-pitched, one syllable sound given while feeding or moving about the brooder undisturbed.

Distress cry.--a high pitched, loud, one syllable call beginning on a high note and progressing downward during the call. Given in series of 3 or more. Bird stands upright, head erect and remains in one position while calling.

Alarm cry.--a rapid, high-pitched call given when picked up or gently restrained, accompanied by struggling movements of the head and feet, mouth is held open.

Cricket call.--a soft cricket-like call of varying pitch and intensity, given in a variety of situations such as feeding or moving about pecking, heard only from adults (Stanford, 1957).

Vocal threat (adult males).--a rapid, low pitched, throaty cackle of medium intensity given in a long series of 8 to 10 accompanied by one of two different body positions. (1) a threat posture as defined below, (2) bird standing at full height with his head cocked to one side facing other male, mouth open wide, rapid throat movement.

Courting call.--part of male's courting pattern and a subdued, hoarse, vibrating call given by the male when courting. A two syllable brr-p sound several seconds long.

Vocal response to male's crowing (female).--a two syllable, medium pitched call in response to male's crowing, described by Wetherbee (1961) as a "peu, peu", notes are clearly separate and calls are spaced by short pauses.

Crowing (males).--a loud rapid, harsh, rattle (castanet-like) of medium pitch with 3 to 4 syllables. It begins low, increasing in intensity. The accent is dropped on the second syllable and the third is accented and drawn out and rapidly decreases toward the end. The notes are very close but discriminable. The bird stands at full height, feet spread for balance, chest out, and head thrown back as the call is begun. As the call is given the head shakes rapidly with the bill opening and closing with each castanet sound. The body sinks down during the act. The call is given mostly in absences of the female in a series of 3 or 4. Mated males will usually "counter-call" to the calls of the unmated males.

Locomotion

Walking.--advancing the feet alternately, body upright, with the tail slightly lowered, head partially withdrawn. Legs are flexed forward forming about a 30 degree angle with the body.

Running.--body position similar to walking, head a little more extended for birds 12 to 24 hours old and slightly withdrawn for adult birds.

Dash.--(short burst of running), spontaneous short run with the neck slightly extended and wings loose at the sides. Probably related to the frolic.

Hopping.--pusing off with both feet simultaneously, traveling only a short distance.

Jumping.--beginning from slightly crouched position, bird springs up and forward, may use wings, travels greater distance than hop (see popping behavior).

Nutrition

Feeding.--pecking food from feeder or the floor, similar to other birds, front of body and head are lowered close to floor, head is cocked and peck delivered. Birds may also feed from squatting position as seen in dusting behavior. They are capable of very rapid pecks in a series.

Drinking.--bill lowered into the water, head raised. Newly hatched birds tend to submerge greater portion of bill.

Swallowing or gaping.--neck stretched up and forward with mouth open side, accompanied by movement of neck muscles and swallowing movements.

Defecation

Elimination.--preceded by a short backward movement lowering the posterior and fluffing the vent and tail feathers during the move. After expelling the feces the vent muscles are rhythmically contracted a few times.

Body Care

Feather ruffling.--practically all the feathers of the body and neck raised or fluffed. Wings and body shaken. This often occurs during and after preening, after copulation, and in the male, during courting.

Bill wiping.--head lowered to the floor and both sides of the bill wiped by turning the head back and forth, little or no body swing.

Preening

Breast.--bird stands upright, tail pointed toward the floor, neck stretched upward and then bill is "tucked" close to neck. A picking movement is used with some side to side movement at the base of the feathers. There is a rapid opening and closing of the bill with the feathers being passed between the mandibles.

Wings, Back, and Legs.--preened in much the same manner as described above. Almost without exception preening is done from a standing position.

Mutual preening.--pieces of food frequently picked from feathers and bill of other birds. This is done with little force and seldom elicits reaction from the "preened" bird.

Scratching.--underside of the neck and back of head scratched with toes. This is a very rapid leg movement and is often accompanied by vigorous head shaking.

Stretching

Double wing-neck stretch.--wings raised simultaneously and neck stretched forward.

Leg-wing stretch.--leg raised and extended backward, at the same time the wing on the same side lowered and feathers are "fanned" out.

Wing flutter or flapping.--fluttering of the wings observed in young quail and later evolving into a less rapid flapping movement. The birds raise to full height, chest out, head back, wings moved up and down rapidly. Often follows preening or resting.

Dusting.--lies flat on its stomach with wings slightly extended. The body is tilted or "rolled" to one side and the opposite leg and foot rapidly scratch the floor with simultaneous feather puffing. Birds often move several inches about the floor in the process. This is often accompanied by a rapid series of pecks at the floor around the bird.

Defensive Reactions

Freezing.--birds momentarily stop all on-going behavior.

Alert stance.--body held erect with legs straight, tail low, neck and head stretched high, with head oriented toward or at approximately 90 degree angle to stimulus source.

Escape reaction.--a rapid scattering in all directions, running wildly about the brooder giving high-pitched calls. If elicited from birds in a group, a "cart wheel effect" is observed, with each bird running in a different direction. In the isolates a rapid, undirected running is observed accompanied by vocalization as above.

Popping.--similar to jumping behavior and may be an extention of the same response with more vigor. The birds spring from a crouched position directly upward, if generally excited, it may be repeated several times or more. This is also part of a startle reaction and may be elicited with almost any loud stimulus.

Brief flight.--appears late in the first week in some birds and may be part of the escape reaction, with added wing activity. In captivity, flight attempts are seldom seen at any other time.

Backward running.--breast lowered close to floor, posterior elevated and a few rapid steps are made backwards. This is terminated by either stopping and remaining still or a whirl and running away. Often appears subsequent to threats or direct confrontation by another bird, noise, or human observer.

Aggressive Submissive Behavior

Generalized pecking.--pecking at objects other than food, shiny objects such as thumb tacks, corners of the wire floor, toes and eyes of other birds. Observed frequently during the first week, decreases over time.

Competitive pecking.--two or more birds pecking at the same object, food or non-food. Both may grasp the object and pull away from the other. May be terminated by one bird getting the object and dashing around the cage with it (frolic with an object).

Threat posture.--two positions: (1) bird crouches low to floor, head slightly extended low and forward and may be cocked to one side, (2) bird approaches another and raises itself to full height, extends its neck and head over the back of the other bird. Usually sounds challenging note or vocal threat at this time.

Frolic.--after Guhl (1958) and Ratner (1964). A short, spontaneous burst of running about the cage with wings raised and often fluttering.

Frolic with an object.--same as above except bird grasps an object in its bill (feather, paper, etc.) and is frequently pursued by other birds. This may follow competitive pecking for an object.

Rapid approach.--charges directly at another, sometimes colliding with the other bird but most of the time stopping short of contact. In older birds this may occur prior to threats.

Avoidance run.--(retreat) moving rapidly away from the charging bird or retreating from a threatening bird.

Body peck.--delivers peck to body of another bird with more vigor than seen in mutual preening, many times eliciting avoidance on the part of the pecked bird.

Head peck.--delivers peck to head of another bird, usually elicits avoidance.

Fight.--a series of postures, attacks, and vocalizations. Both birds rapidly approach each other and peck vigorously at each other. Body pecks are most common but some head pecks do occur. Jumping at the opponent is not uncommon. Fighting is often accompanied by vocal threats and occurs mostly in males in the presence of females. Fights are sometimes initiated without any prior displays.

Sexual Behavior

Courting behavior (male)

Neck and body tonus.--posterior elevated, neck thrust forward and slightly downward. From a side view the

back is parallel with the floor and the head is cocked to one side (toward the hen) and the neck is slightly humped just behind the head (see appendix).

Leg action.--body brought up and forward on the legs, hips are swivelled so that the legs are straight down, the strut is stiff legged.

Toe walking.--raises itself on toes and struts about in this raised position. Some toe movement is observed.

Vocalization.--(described above)

Feather puffing.--all feathers of the body from the neck downward fluffed, accenting the neck, breast, and wings. The wings are spread in "fan fashion" so that the large primaries are close to, or touching the floor. The rump feathers are simultaneously raised.

Circling.--male circles female strutting in full display. This is done 1 or 2 times with his head cocked inward toward the female.

Jumping.--male springs straight upward during the courting strut (uncommon in captive birds).

Tidbitting.--male scratches floor and calls several times in rapid succession (uncommon in captive birds).

Preening.--male rapidly and vigorously preens feathers (mostly breast and wings). This was not observed to be present in most courting and may be displacement preening (see discussion).

Mounting.--male cranes neck above female and grasps her by back of head or neck. Both feet are placed on female's back and the male lowers his posterior at the same time pulling backwards on the neck of the female. The wings are spread for balance but frequently both birds fall to one side during the act. The tail and vent feathers are raised.

Post copulatory response (males).--releases the female and steps off her back. A response very similar to the pre-copulatory courting is then given. It lasts for varying periods of time but usually about 1 minute long. Repeated mountings are uncommon in other than deprived birds.

Crouching (female).--often responds to male's courting by running a short distance and squatting or it may take place on the spot. If she runs, the male will usually give chase sometimes courting as he goes. A receptive female lowers herself to the floor, feet wide apart and legs folded under her.

Chase.--females often run away from the courting male and are pursued. It is not uncommon to see a female "dragging" a male around the cage with him holding on to her neck. Females occasionly initiate the chase.

Pecking.--female may approach male and peck at head or back and move away quickly and squat.

Feather fluffing (male and female).--after copulation all feathers raised and fluffed. The body is shaken vigorously.

Results and Discussion

In general, there were few differences found between the social and isolate birds in the course of behavioral development, except for sexual behavior. Those behaviors showing significant differences for the day of behavior onset were dashing (short bursts) .05, feather ruffling .005, bill wiping .05, jumping .05, and popping .01 (median tests). Significant differences between the social and isolates for the per cent of animals showing the behavior were found for cricket call .05, dash (short burst) .001, brief flight .001, hopping .01, and dusting .01 (2x2 chi square tests).

The differences found were predominately for behavior patterns for which the frequency was very likely to have been affected by the size of the home environment. Even though the amount of floor space per bird differed little between the social and isolate birds (about 1 cubic ft.), the overall size of the brooders was undoubtedly more conducive for some behavior, i.e., brief flight.

At no time was any sexual behavior observed for the isolate group until after changing them to a group environment. This would suggest that for at least early expression of overt sexual behavior, i.e., male's courting, the proper releasers must be present.

There are few studies which provide the necessary data for making direct comparisons between other birds and the Japanese quail's behavior development. Those available are studies using domestic fowl as subjects (Guhl, 1958; Ratner, 1964). Although these researchers were primarily interested in aggressive behavior and dominance relationships, they approached the problem from a developmental standpoint and their results provide some basis for looking at our data as part of a larger scheme.

Locomotion and Resting

Some of the developmental trends are similar for the quail and chicken. They both showed a predominance of sequential behavior patterns which approximated each other in the early stages and in both species some behavior patterns appeared and dropped out rather abruptly. The most pronounced differences were found in the aggressive behavior and structure of the social organization.

Like the chicken, a few hours after hatching, the quail is an active, highly mobile bird. About one third of the behaviors listed in Table 1 are functional on the first day of life and the quail's motor capacities compare favorably with chickens and other nidifugous birds.

Upon being placed in the brooders the quail chicks moved about emitting soft peeping sounds and pecking frequently at objects in the environment. At first this behavior, called generalized pecking (Guhl, 1958; Ratner, 1964), seemed rather indiscriminate but closer observation revealed that shiny objects were the best elicitors.

Generalized pecking persisted strongly for the first several days, followed by a pronounced reduction in frequency after 8 days for the social group and 14 days for the isolates. An increase in feeding behavior coincided with the reduction of generalized pecking. It was suggested by Ratner (1964) that this change might be a function of the birds learning to discriminate food and non-food objects, or it could be simply a need for greater food intake due to the rapid physical maturation. The former explanation appeared particularly relevant for the first two groups of isolates since they never had food on paper in their boxes and had to take all their food from the feeders. It is possible that this forced them to learn a more difficult food-non-food discrimination and prolonged generalized pecking.

The birds walked or ran about the cages continuously, and during the first few days there was a tendency for them to move about in groups. If one bird moved a short distance, the others tended to follow staying in close proximity. In a living cage of 18 birds, there were often as many as 12 birds in one group and perhaps several smaller groups moving about the brooder at one time. This behavior is similar to that found in newly hatched chickens. According to Collias (1950d), young chickens after having experienced bodily contact, come together in a group when separated.

The birds rested for short periods of time throughout the day, often lying on their sides with their heads and feet stretched out, giving the appearance of being lifeless. This particular

resting position was not observed after the first week. Other birds rested by standing upright in one spot with their eyes closed, occasionally falling over. Some crouched in a squatting position with their undersides resting on the floor. Resting behavior also tended to be carried out in groups with the birds huddled together near the source of heat. Huddling decreased in frequency after 4 or 5 days and was seldom seen after the second week.

Vocalization

Distress cries were not frequently heard from the social groups as long as the brooders were warm (100 to 105 degrees). But occasionally a bird would stand in the middle of a group and give distress calls for several minutes. This often occurred without the group as a whole being disturbed or excited. If one of the birds was isolated from the group however, it immediately began to cry out and continued to do so periodically for the next several hours. There was some tendency for particular birds to call more than others.

The frequency of distress calling was much higher in the isolate group than in the social group, and persisted about six days longer or to about the end of the third week. However, in the third study, newspaper was placed on the floor of the isolation boxes as it had been in the group cages and the frequency of distress calls dropped immediately. It is speculated that the decrease in calling may have been a function of increased temperature, even though the over-all temperature in the isolation boxes did not change. But since paper will absorb and hold heat, this would give the birds a warm surface on which to rest.

Unfortunately, this explanation does not seem entirely adequate since the calls dropped off immediately, hardly allowing the paper time to get warm.

If the young quail were picked up and gently restrained, they would give a high-pitched cry similar to that heard in chickens. We called this an alarm cry since it elicited "freezing" behavior generally terminated by escape reactions from the other birds in the area. The call was accompanied by strenuous struggling movements which were frequently followed by the bird "going limp". This may be related to injury feigning or the immobility reponse observed in chickens and other animals, which is thought to be a reaction to extreme fear (Ratner and Thompson, 1960).

Body Care

Preening was first recorded on the first day post-hatch for the social birds and the second day for the isolates. This behavior appeared to be spontaneous and spread rapidly to other birds in the group. No consistent pattern could be found to the preening activity although the frequency did increase slightly after the birds had eaten. It seemed that the isolates preened less frequently than the social birds but the data gave little objective support to this conjecture.

Dusting behavior was observed early in the first week for the social birds and in the second week for the isolates. There was no significant difference between the two groups for the day of onset but there was a significant difference for the per cent of birds showing the behavior (Social 83%, isolates 29%).

Dusting was accompanied by a rapid series of pecks at the floor and if paper were placed on the floor with food on it, the frequency of dusting greatly increased. Typically, the birds squatted until their undersides were touching the floor with their legs folded underneath the body. The wings were slightly extended and the feathers were puffed. The body was "rolled" to one side and the bird scratched the floor vigorously. This resulted in a "thumping" sound from either the body or foot striking the floor.

Bill wiping appeared significantly earlier in the social animals. It was observed as early as the first day in the latter group and not until the fourth day for the isolates. If this response is primarily a grooming response, it would be reasonable to expect the isolates of the first two groups to show the behavior as early as , if not before, the social birds. For these isolates were forced to take all their food from feeders and the mash tended to cake to their bill. However, the data do not support this expectation.

Defensive Reactions

Guhl (1958) and Ratner (1964) have studied behavior development of chickens and have described in detail the sequence of behavior patterns occurring in these birds. Guhl (1958) pointed out that the behavior patterns, especially agonistic behavior, appeared in the following sequence: escape reaction (fear), frolicking, sparring, aggressive pecking, avoidance behavior, and fighting. Ratner's work (1964) supported these findings differing only in age of behavior onset.

We see a striking similarity in the behavior development of the quail and chicken for the first 3 to 5 days of life. The escape reaction for quail is much the same as Guhl described for the chicken but it occurs at an earlier age in the quail. It was easily elicited from the quail early in the first day by over-head movement or a loud noise near the cage. The reaction was characterized by a scattering of the birds racing wildly about the cage. It was accompanied by a rapid, high-pitched call similar to the alarm cry. Similar escape behavior continued to be displayed by adult birds though decreasing in frequency.

Beginning on day 1 post-hatch, the quail chicks would "freeze" to a slight disturbance. The pause varied in length but was usually only a few seconds long and was terminated by an escape reaction or the resumption of normal activity. Later freezing behavior evolved into or combined with the "alert stance" which was first observed about the 12th day. The bird stood highly erect with the neck stretched upward and the head oriented toward, or at right angle to, the stimulus source.

If directly confronted by another bird or human observer, the quail would frequently run backwards. The retreating bird lowered its breast almost to the floor, elevated its posterior, and ran rapidly backward for a few steps where it would stop or whirl and run away. This behavior was observed to follow threats and facilitated a quick separation of the two birds. It was not observed in the isolates.

The only other backward movement observed occurred just prior to defecation. However, this was slower, the posture differed, and the distance covered was shorter than the backward run.

Competitive pecking was observed regularly on the 4th day. Usually two or more birds would peck at the same object for a short period of time (feather, paper, etc.). The object was often grasped by the two birds at the same time and a tug-of-war took place. If one of the birds succeeded in getting the object, it would frequently run about the brooder pursued by the other bird(s). Ratner (1964) has referred to this behavior as "frolicking with an object", and observed it in chickens during the second and third week. It was first observed on day 3 in the quail and was not observed after day 7.

Both Guhl (1958) and Ratner (1964) reported "frolicking without an object" on day 3 in young chickens. They described it as a spontaneous run across the cage with the wings up or fluttering. Once initiated by one bird, others in the cage frequently began to frolic. The activity usually ended as abruptly as it began. The quail in the social groups were observed to frolic early in the first week (mdn. 3 days). Several instances of the behavior were reported in the isolates during the first week but it was not a strong behavior pattern for this group.

According to Guhl (1958) and Ratner (1964), sparring often followed the frolic. It was described as two chicks facing each other, jumping up and down, much as adult chickens do when fighting. However, no pecks were delivered by either bird. This behavior was not observed in the quail.

Jumping was defined for the quail as an upward and forward movement initiated from a crouched position. It was a spontaneous activity shown by all of the birds but it appeared significantly earlier in the

isolate group (isolate, mdn. day 4; social, mdn. day 12). Toward the end of the second week the frequency of this behavior was greatly reduced and, although it did not drop out completely, it was rarely observed in the adult birds.

Popping is somewhat similar to jumping but in the former, the movement was straight upward with little or no forward motion. The birds first crouched and then sprang upward, often striking the top of the cage. Popping could be elicited by almost any loud stimulus and appeared to be a startle reaction. But it was also observed to occur when the birds were in a general state of excitement. Once popping behavior began, jumping sharply declined. This may indicate that the distinction made between the two responses is a superficial one, reflecting only a difference in physical maturation.

Popping occurred significantly earlier in the isolates and may be related to the overall tendency for the isolates to have a lower threshold for startle. It may also be related to the size of the physical environment. Birds in the group brooders were observed to display escape reactions or brief flight to loud stimuli. However, if they were "trapped" in a corner of the brooder, they tended to pop or spring straight upward.

Aggressive-Submissive Behavior

Ratner (1964) mentioned frequent observations of juvenile fighting in chickens during the fourth week of life. No fighting behavior was observed between the quail prior to 42 days and after this, fighting was rather infrequent. However, it could be readily elicited by introducing a strange male into a cage with another male

and his mate. The resident male invariably attacked the newcomer with a series of head and body pecks, giving loud vocal threats. Usually the decision was in favor of the resident male.

General aggressive behavior varied greatly from group to group. Instances of body pecks were noted as early as the 8th day post-hatch in one of the groups containing 18 birds. The pecking bird was identified (female) and proved to be the only bird pecking. On the 10th day the brooder mates began to avoid this bird and by the 17th day, she was delivering severe head pecks. By the end of the third week she had to be removed from the group because her attacks on the birds had become so vicious and persistent. Upon removal of this "despot", the activity level of the group sharply dropped and no other bird assumed the absent tyrant's dominant role.

In another group of 18 birds, body pecking was noted on the 12th day. Again the pecking bird was identified (male) and closely observed. The frequency and intensity of pecking gradually increased and by the 14th day, pen mates avoided his approach. At this time, it was noted that another male was pecking some of the other birds but was in turn pecked by the first male. Severe head pecking began on the 22nd day and by the 26th day the first male had to be removed. When this bird was removed, the other male bird took over its role and was also removed several days later. All pecking observed was unilateral with the tyrant dominating the entire group. Very few additional cases of inter-bird pecking were observed with these showing no consistent pattern.

One instance of dominance was noted in one of the smaller groups of 6 birds. The pattern of the dominance was the same as before; the

entire group being dominated by one bird, pecking all and being pecked by none. When the tyrant was removed, inter-bird pecking was slight and showed no consistent pattern.

Stanford (1957) reported similar behavior which he called "picking" beginning in the first week. He suggested, "Removal of the birds addicted to picking goes far in keeping this problem at a minimum" (Stanford, 1957, p. 354). He further pointed out that the incidence of "picking" increased greatly in over-crowded pens. Although 18 birds in one of our brooders was not considered "overcrowding", pecking behavior was observed more frequently in the larger groups than in the ones containing only 6 birds.

The role of aggressive behavior in the structure of the social organization of this species is conjectural, but one function may be related to the dispersion of these quail in their natural habitat. They are territorial and do not live in groups as do other wild game birds. Guhl (1953) has pointed out that Pugnacity and flocking are antithetical tendencies and based on his work with chickens, he suggested that pugnacity should act to disperse the individuals and lead to the disintegration of the group. But this does not happen with chickens, instead, they establish well defined dominance-submissive relationships and thrive well in group situations. On the other hand, quail do not normally live in groups and when forced into close proximity in captivity, extreme forms of despotism developed. In all cases the dominant birds had to be removed from the living cages because of their persistent and vicious attacks on their pen mates. If this type of social dominance persisted in the wild, it might serve to disperse the individuals of the groups and explain the tendency for this species

to live in small family units. However, more information is needed to clarify the exact nature of the social organization of this species before such speculation can be substantiated.

Sexual Behavior

The male Coturnix is sexually mature in 28 days and on the 28th day, the first crowing occurred. Strong overt sexual behavior in most males was not observed until the 36th day, although some birds did begin to display as early as the 33rd day. Crowing by the male was most pronounced in absence of the female but males with females will crow as a "counter call" to another calling male. This supports Wetherbee's (1961) earlier findings. The onset of crowing occurred first in the isolate birds but it preceeded the social birds only a small margin (6 to 18 hours). In one instance, one of the isolates was observed to crow during the morning observation and on the evening observation other isolates and social males were crowing.

Courting Behavior (male)

Nine different components of the quail's courting pattern were identified and are described in detail in Table 1. They vary greatly in frequency and intensity from bird to bird but the first five components listed in Table 1 appear most frequently in all birds. Developmentally, the first component to appear was vocalization. The next three were the neck and body action, leg action, and toe walking. All of these appeared rather abruptly about the same time. The last and most evident component to be observed consistently was feather puffing or ruffling. This pattern appeared as the overall vigor of the male's courting pattern began to increase.

The male's courting displays were observed several days prior to any noticeable reaction from the female. Successful mountings were observed on the 36th day but these were carried out without the cooperation of the female. The first squatting by the female to the male's display occurred on the 38th day but only a few of the females reacted this soon, most did not respond until after 42 days.

Courting behavior began by the male "craning" his neck over the back of the female, followed by a full display. The displaying male approached the female obliquely or circled her with his head cocked toward her. The initial courting pattern varied in length from bird to bird depending upon the female's behavior. If receptive, the female would squat immediately to the male's display, or run a short distance away and then squat. The male usually grasped the back of the female's neck, placed both feet on her back, lowered his posterior and at the same time slightly raised the vent feathers. The female's tail feathers were raised and her feet were slightly spread with the legs touching the floor as in a regular crouched position. Occasionally the pair fell over on their sides during copulation but in most cases, this did not affect its completion.

After copulation, both birds ruffled their feathers and shook their necks and bodies vigorously. The male then began a post-copulatory response very similar to the display observed in courting prior to copulation. A similar type of post coitus display was mentioned by Wood-Gush (1954) and Tinbergen (1952). It

was suggested that these displays might be a continuation of the courting behavior. In the quail, the frequency of the post-copulatory response is as consistent and regular as the pre-copulatory courting.

Occasionally the female initiated the mating by approaching the male, pecking him, and then running a short distance and squatting. The female would usually continue this pecking until the male gave chase. The frequency of this behavior was very low, probably due to the persistence of the male's high sex drive.

Wood-Gush (1956) indicated that research with the chicken showed that parts of the male's courting pattern was also given to other cocks. He suggested that these patterns might have value as threat displays and detailed closely the similarities between aggressive and sexual displays in the Brown Leghorn chicken.

Only in a few instances were the males observed displaying to another male quail. These occurred after long periods of sexual deprivation with the males being confined together. There were some instances of homosexual mountings in these situations.

The maintenance of the courting pattern of birds in captivity and its decline with age will be discussed in Experiment III.

Displacement

Displacement preening was observed several times in the male quail. This occurred when the male was isolated from the female and later placed in the presence of a female accompanied by conditions likely to initiate conflict.

One instance of displacement preening was observed when a very aggressive female was introduced into a cage with a deprived male. The male began to court and the female attacked him. He continued to display and attempted to mount the female but she continued to fight. Rather abruptly, the male stopped his pursuit and began to preen vigorously.

Very few instances of preening were observed to occur in the usual courting display.

Test of Isolate Birds

The isolate birds were taken from their boxes on day 42 and placed in different environments. The brooders used to raise the group birds, a large living cage, and the open floor of the experimental room were used as test environments. The following specific tests were made: Isolate male to new environment (empty brooder), Isolate female to empy brooder, Isolate male to isolate female in the brooder, Isolate male and female to various size groups of social birds, Social male to isolate female in brooder, Isolate male to social female in brooder. Six of the isolate birds were placed into a brooder and observed for 21 days (3 males and 3 females).

The first two hours after transfer the behavior was observed constantly. After the first hour the birds were checked periodically but never less than several times a day throughout the 21 days.

The displays during the first hour were mostly defensive reactions. Some of the behaviors observed to occur most frequently

were: (1) immobility (freezing for long periods of time), (2) popping continuously for several minutes at a time, (3) hugging the walls of the brooder, (4) vocal threats, (5) assuming and holding a submissive posture, (6) marked increased respiration (breathing with mouth open), (7) feather puffing, with the feathers remaining up for long periods of time, (8) injury feigning, particularly in females. In general, the above behaviors lasted at least one hour with a gradual decline in the extreme reactions during the second hour. Injury feigning was very pronounced (broken wing acts), even prompting the observers on one occasion to remove the "injured" bird. Many of the birds crowded near the light bulb in the back of the brooder and remained there. All physical contact with the other birds was avoided and if contact was made, "freezing" or popping quickly followed.

The birds remained in a high state of excitement for the next several hours and showed no interest in food or water. Some of them began to eat by the end of the first day and by the third day the only immediate difference between these and the social birds was the physical separation of the individuals in the group. By the 7th day, the first signs of sexual behavior appeared, as two of the males began to show remnants of courting behavior. The first successful copulation was observed on the 10th day after the change in environment. However, the females were not observed to squat to the displaying males until after the 17th day.

When changed to the group situation, all the female isolates were laying. This behavior stopped immediately (premature eggs

were expelled) and laying did not begin again until the 11th day for one group and the 17th day for another.

After 21 days of observation, no noticeable differences could be further observed, but the groups as a whole startled easily and continued to be highly active for long periods of time after being disturbed.

CHAPTER III

EXPERIMENT II

Spontaneous alternation has been studied rather extensively in the last decade but there are still aspects of the phenomenon that need clarification, one being its phyletic generality. In a review of the literature on alternation behavior, Dember and Fowler (1958) discussed many of the implications of the behavior and related it to different theoretical positions in psychology.

There has been some tendency for spontaneous alternation to be considered as a general phenomenon, occurring rather reliably across phyla (Dember, 1961). A close look at the area reveals that the bulk of the experimental data has been obtained from rat studies. However, there have been some studies that have demonstrated the behavior in other animals; earthworms (Wayner and Zellner, 1958), cockroaches (Iwahara and Soeda, 1957), and in human subjects (Wingfield, 1943; Bakan, 1960).

On the other hand, Hayes and Warren (1963) failed to find evidence of spontaneous alternation with chicks in a Y or T maze. In light of the recent emphasis on bird research, it would be of interest to test for the phenomenon in another member of the bird species.

The purpose of this study was to test for alternation behavior in the Japanese quail (Coturnix coturnix japonica).

Method

Subjects

The subjects were 20 Japanese quail 50 days old. Ten of the Ss were from the group-raised population in Experiment I, and the remaining ten were from those raised in isolation.

Apparatus

A single unit T maze was used with guillotine doors at the startbox and stem, and at the entrance of each arm. The floor was medium grey wood covered with 1/2 inch hardware cloth to prevent the Ss from slipping. The walls were dull white cellotex 12 inches high. The start box and stem were 8 and 16 inches long respectively and the arms were 16 inches long including an 8 inch goal box. The maze was 6 inches wide and uncovered. A black removable insert made of poster board was constructed to fit inside the arms and goal boxes and was used to alternate the black/white position cues.

Procedure

Two groups of birds (10 social, 10 isolates) were marked for identification and taken from their living cages one at a time just prior to running. Each bird was placed in the start box by E and 5 seconds later the start box door was raised. If the subject did not leave the start box in 2 minutes he was returned to the living cage and tried again at a later time (no bird failed to run). Subjects were given 10 free choice trials with an ITI of 5 seconds. The black insert was on the right for half of the birds and on the

left for the other half. The Ss were not deprived and ran to no reinforcement.

Results

Table 2 shows the individual Ss and the respective number of alternations for each S in a block of ten massed trials. There was no difference between the social and isolates so the two groups were combined.

In a block of ten trials the maximum number of times an S may alternate is nine and 4.5 alternations may be expected by chance. Therefore each S must alternate significantly more than 4.5 times in ten trials in order to show a systematic tendency of alteration.

The observed median number of alternations was 2.00, with a range of (0 to 6), and a chi square ($X^2 = 37.54$, df = 19, p = .01). The results indicate a strong tendency toward response repetition or perseveration. There was also some tendency for the birds to turn predominately to the left in the maze (average 7.55 out of 10 trials).

TABLE 2

NUMBER OF ALTERNATIONS PER BIRD IN A BLOCK OF 10 TRIALS

SOCIAL		ISOLATES	
S	Number Alternations	S	Number Alternations
1	3	1	2
2	0	2	4
3	2	3	6
4	0	4	1
5	2	5	2
6	2	6	0
7	3	7	2
8	0	8	0
9	4	9	2
10	3	10	6

CHAPTER IV

EXPERIMENT IIb

Method

Subjects

The subjects were 28 Japanese quail 50 days old, 20 social and 8 isolates. Ss were deprived of water for 12 hours prior to running and were run to a water reward. Food was always present in the home cage.

Apparatus

The same as used in Experiment IIa.

Procedure

On day 1, all Ss had two free choice trials in the maze to determine a "preference". Following these free trials each S had 10 forced trials to a water reward. One half of the Ss was forced with their preference and one half against. The Ss were randomly assigned to running positions 1-10, ITI was 5 seconds. On the trial following the 10 forced trials each S was given one free choice trial.

Results

The proportion of birds alternating on the free trial was .214 or 6 out of 28 birds. The .01 confidence interval for this

proportion was (.054-.443). The upper limit was below the chance level of .50 indicating a strong tendency of response repetition rather than alternation.

Discussion

The data obtained from the quail agree closely with that found by Hayes and Warren (1963) with chickens, even though there was a fairly large age difference between the subjects of the two studies. There was no evidence to indicate that quail tend to alternate responses in a two choice maze, either in a free choice situation or with forced choice procedure. Instead, there was a significant trend toward response stereotype in both groups. This is quite different from the general findings with rats. Denny and Leckart (1964) using forced procedure found that rats show about 75 per cent alternation on the free trial 24 hours following the last forced trial and of free choice is given immediately, almost 100% of the Ss go to the non-forced side. This is clearly different than our findings with the quail.

Typically the birds ran the maze very well with or without reward. There was little hesitation at the choice point after the first trial in the free choice situation and none in the forced procedure. There was, as was previously mentiond, a tendency for a predominance of left turns in the maze. To test for the possible influence of extra-maze cues, the maze was rotated 180 degrees for 1/2 of the group's trials. E also changed his position periodically when starting the birds and in some cases, this allowed the birds to approach E who was standing at the choice point end of the maze.

Hayes and Warren (1963) suggested that the possibility of alternation behavior might exist in older birds since they used 2-6 day old chicks. They further speculated that shorter arms on the maze might make a difference by reducing latencies.

In the present experiments, both of these suggestions were adopted without altering the outcome of that found by Hayes and Warren (1963). Thus, of the two avian species tested, neither alternated. Perhaps this response tendency does not occur in birds.

CHAPTER V

EXPERIMENT III

Classical Conditioning of Courting Behavior in the Japanese Quail

Certain behaviors in animals have traditionally been looked upon as being species-specific and occurring only in very specific situations. The stimuli that elicit these behaviors are referred to as "releasers" (Thorpe, 1963) or "sign stimuli" (Lorenz, 1957; Tinbergen, 1951) and are said to be mediated by inborn mechanisms which are susceptable to very fixed stimulus patterns. For years people interested in animal behavior have watched with amazement elaborate response patterns unfold in the presence of these sign stimuli. Since these key stimuli will elicit the behavior in most, if not all of the inexperienced members of the same species, there can be little doubt that these behaviors are essentially species-specific or innate.

The problem of the modification of these behaviors through learning, or more specifically, eliciting the behavior patterns with stimuli other than those know to be effective, has often been suggested (Thorpe, 1963), but as yet, has not been fully explored. There is some experimental evidence to suggest that modification of a sort is possible (Adler and Hogan, 1963) but no evidence

has been obtained to indicate the extent to which such stimulus modifications may occur. It would be of interest if one could demonstrate the extent to which such behavior could be elicited in absence of the effective releasing stimuli.

In studying the behavioral development of the Japanese quail, it was observed that most males began to court the females shortly after the males became sexually mature (Table 1). It was discovered that if a male bird was isolated from the female for a few hours and then a female placed in his cage, courting pattern was displayed immediately. The latency to the onset of the courting (UR) after introducing the female (US) was about 5 seconds (range 3 to 10). Copulation usually followed within a few seconds. The consistency of occurence of the courting response was very high in most males if several hours were allowed between trials.

The purpose of this study was to investigate the extent to which courting behavior could be classically conditioned.

Method

Subjects

The Ss were 6 male Japanese quail. Three, (S-1, S-2, S-3) were from the social group in Experiment I and three, (I-1, I-2, I-3) were from the isolate group. All of the birds except S-2 were about 75 days old, S-2 was 42 days old. All were sexually mature. Five Ss (S-1, S-3, I-1, I-2, I-3) had extensive copulatory experience, S-2 had shown courting behavior but was never observed

to copulate. The 6 Ss were selected on the basis of having regular and strong courting patterns.

Apparatus

A brooder, identical to the one described in Experiment I, was used to house the males and as a conditioning apparatus. The conditioned stimulus (CS) was a 6 volt low intensity buzzer, approximately 50 db, attached to the top of the brooder. The unconditioned stimulus (US) was a female bird. The brooder temperature was maintained at 75 degrees and was lighted 24 hours a day with one 10 watt bulb. Food (quail breeder) and water were available at all times.

Procedure

Four Ss (S-1, S-2, I-1, I-2) were used in the classical conditioning group. The Ss were conditioned one at a time. For this, S was placed in the brooder two days prior to the experiment. This served both as an habituation and deprivation period. On the third day conditioning trials were begun (4 trials per day). A 10 second CS-US interval was used with the CS overlapping the presentation of the female (US) 5 seconds.

The CS was turned on by E seated in front of the brooder. After 10 seconds the female (US) was placed by hand into the brooder with the male. Responses were recorded on forms designed to facilitate speed and accuracy of recording. The female was removed immediately after copulation or after one minute, if the male failed to copulate.

After the CR was well established (all components were being regularly elicited) extinction was begun. The CS was presented alone and responses recorded. Extinction was continued to a criterion of no CR for 3 consecutive trials.

One day after reaching extinction criterion, the CS was again presented alone until the criterion of no CR in 3 consecutive trials was met. This was the measure of spontaneous recovery.

Two Ss (S-3, I-3) were run as pseudo-conditioning controls. These Ss were treated the same as the conditioned birds except the CS and US were never paired. A 20 unit Gellerman Series was used for random presentation of the CS and US.

Results

Figures 1 and 2 show cumulative CR's for both social and isolate birds respectively. The components of the courting pattern conditioned were: (a) neck and body tonus, (b) leg action, (c) toe walking, (d) vocalization, (3) feather puffing. For definition and illustration of components see Table 1 and appendix.

The solid bar line extending from the ordinate at zero on each graph in Figures 1 and 2 indicates the trial on which the respective component was first elicited by the CS. The cumulative record indicates no response occurred when the lines for acquisition, extinction, and spontaneous recovery are parallel with the abscissa (level off), i.e., extinction would be indicated by no upward movement of the line.

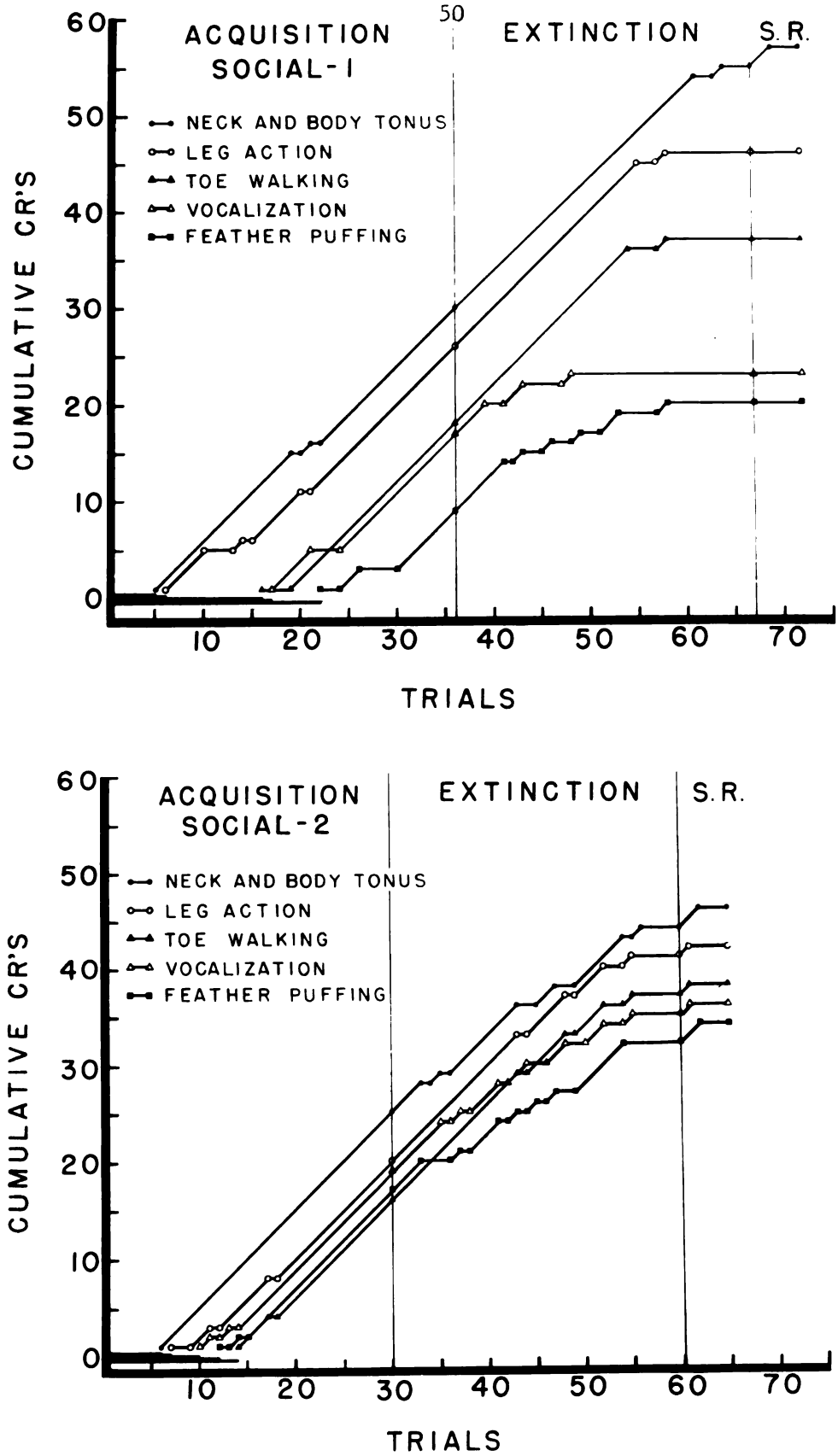
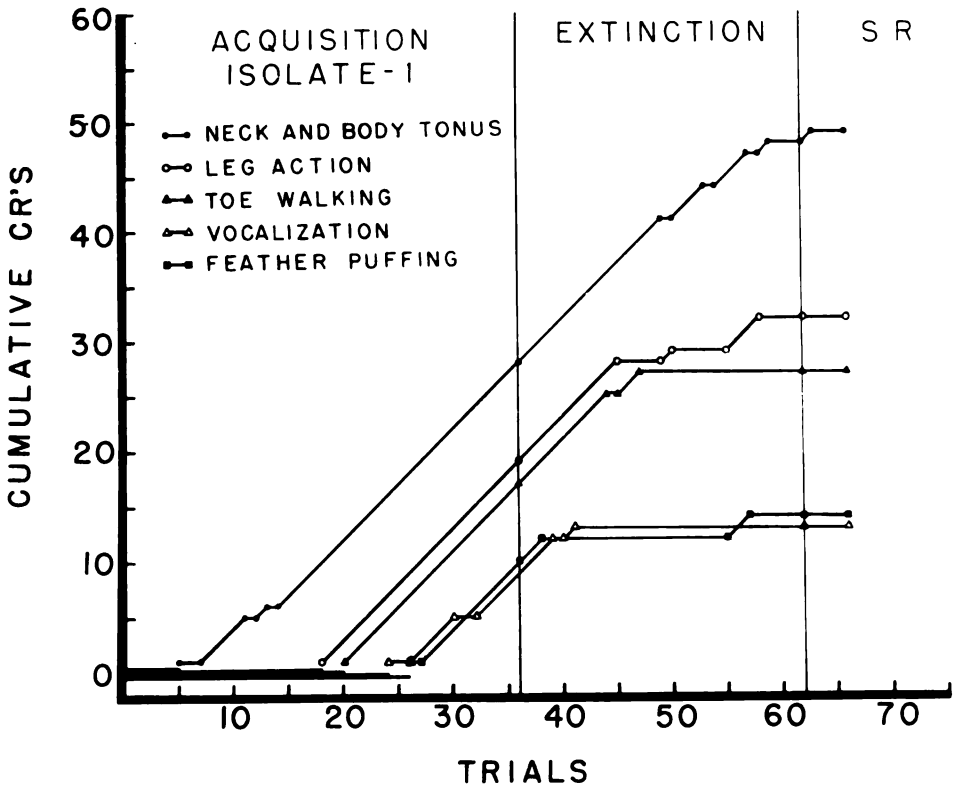


Figure 1.--Acquisition, extinction, and spontaneous recovery of conditioned courting behavior in the Japanese quail raised in heterosexual groups.



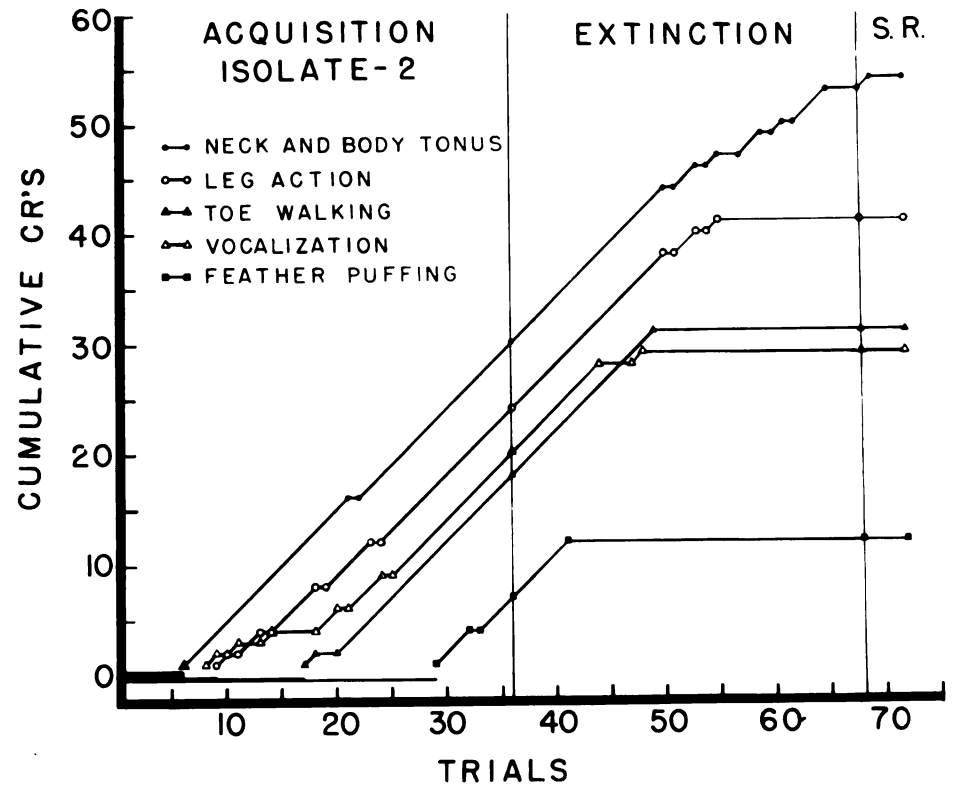


Figure 2.--Acquisition, extinction, and spontaneous recovery of conditioned courting behavior in the Japanese quail raised in isolation.

The courting pattern was readily conditioned in all Ss and, with the exception of S-2, the cumulative records of CR's were very similar. The sequence in which the responses conditioned varied little from bird to bird, and it tended to remain constant in extinction. For the most part, the CRs appeared in the following order: (1) neck and body tonus, (2) leg action, (3) toe walking, (4) vocalization, (5) feather puffing. However, there were several exceptions such as the onset of vocalization early for Ss I-2 and S-2. Neck and body tonus always appeared first (average, 5.2 trials) and for Ss S-1, I-1, and I-2, feather puffing was the last to be conditioned.

The variable of isolation tended to have little noticeable effect on the conditioning. Most differences found were between S-2 and the other birds, with age of the S being the dominant factor. Subject S-2 conditioned more readily than the other birds, with the different components being elicited much earlier in conditioning and much closer together in terms of the number of trials to the first CR. Subject S-2 showed more resistance to extinction and more spontaneous recovery. The mean number of trials on which all of the components first elicited was 27.6 for Ss S-1, I-1, and I-2, and 14 for S-2.

The latencies were recorded in acquisition and showed a decline over conditioning trials becoming asymptotic about the 18th trial. Subjects S-1, I-1, and I-2 began to court only the buzzer on about the 18th trial and when the female was introduced, mounting took place immediately. This behavior occurred on the 14th trial for S-2.

The pseudo-conditioning results gave clear evidence that the CS alone, (the buzzer) did not elicit the components of the courting behavior. It did elicit a slight startle and some activity in the early trials but these reactions quickly habituated. However, the female (US) reliably elicited courting behavior from both of the birds on each trial it was presented.

Discussion

Though exploratory in scope, the study has demonstrated that classical conditioning of innate responses is possible and, that under certain circumstances the conditioning occurs quite rapidly. This experiement lends further evidence to the position that conditioning is capable of modifying innate behavior patterns and the stimuli that elicit these behaviors, especially appetitive behavior.

Another recent example of classical conditioning of innate responses was reported by Adler and Hogan (1963). They were able to condition the innate response of gill extension in fish (Betta splendens) using weak shock as a (CS). Normally this response is elicited only by the male of the same species.

Two of the most salient aspects of the conditioned courting behavior in the quail were the sequential orderliness with which the behavior conditioned (see Figures 1 and 2) and the consistency with which the components were elicited after first conditioned.

The orderliness and abrupt onset of the behavior in conditioning parallels that found in the ontogeny. For example, feather

puffing was consistently the last component to appear in development; it was also the last to be elicited in conditioning, and the first to be extinguished. This sequence occrred reliably for all Ss except S-2, and the ordering effect held roughly for all components of the courting pattern.

The greatest differences between the Ss in acquisition, extinction, and spontaneous recovery were found between S, S-2 and other birds. It is likely that these differences are related to the difference in age or to the copulatory experience of the birds. For example, Wood-Gush reported that, "Younger cocks, particularly in the summer, were very much more forceful in their courting than the older cocks. They chased the hens more and displayed more by waltzing and strutting than the older cocks . . . ." (Wood-Gush, 1954, p. 102). Wood-Gush also noted that in some of the small groups living in pens, that "The frequencies of the cock's display are much reduced. Possibly due to the birds familiarity with one another" (Wood-Gush, 1956, p. 139). He suggested that perhaps because there was a "ready outlet" for the cock's sex drive, courting and aggressive displays were reduced.

Subjects S-1, I-1, and I-2 had lived in heterosexual groups for over a month prior to the experiment which might have affected the speed with which conditioning took place. On the other hand, S-2 was younger and had not been confined with females after 42 days.

Failure to Get Conditioning

In one instance conditioning of the courting pattern could not be obtained. In this case, the males were placed in a "conditioning box" that was built for this purpose. The male's chamber had plywood walls, a plastic top, and 1/2 inch hardware cloth floor. The female was placed in a compartment adjoining the male's but was separated by an insulated guillotine door. The conditioned stimulus (CS) used in this attempt was a pulsing light consisting of two 7 1/2 watt bulbs on either side of the cage near the door to the female's box.

The birds were treated in every other way exactly the same as the pilot birds which conditioned readily in the brooders. The male was placed in the box two days prior to the first conditioning trial and on the third day the (CS-US) pairing was begun. The males failed to copulate with the females in the box and instead showed signs of fear behavior. Four different males were used, allowing two days for deprivation and habituation. One of the males was kept in the apparatus for seven days. The usual response elicited by the introduction of the female (US) was popping or freezing. The bird kept in the box for seven days was beginning to show avoidance and defensive behaviors to the onset of the (CS) when the conditioning attempt was terminated.

Presumably the failure to get conditioning was due to the failure of the males to habituate to the apparatus, allowing for the presence of strong competing responses.

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APPENDICES

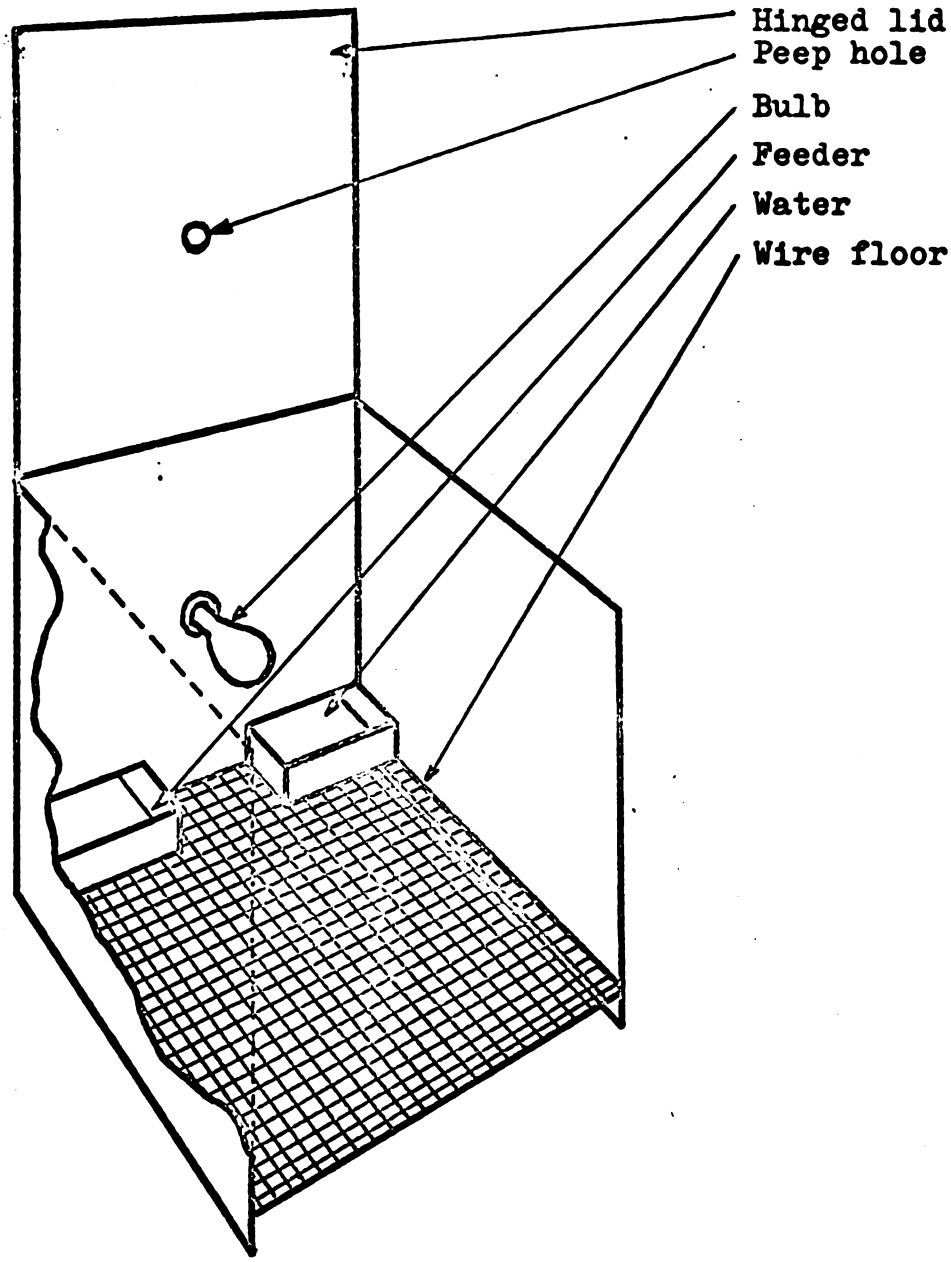
APPENDIX A

FORMULA FOR "QUAIL BREEDER", A COMPLETE DIET DEVELOPED BY POULTRY SCIENCE AT MICHIGAN STATE UNIVERSITY-- QUAIL BREEDER 25%

	Per cent
Ground yellow corn	.41
Soybean meal dehul'd	.37
Alfalfa meal 17% protein	.05
Dried Whey	.02
Meat and bone scraps 50% protein	.02
Fishmeal menhaden 60% protein	.02
Ground Limestone ($CaCO_3$)	.05
Dical Phos. 18% pro., 24% Ca	.01
Salt, Iodized	.005
Vitamin Premix 1 (Napco M-4)	.002
Fat	.02

Manufactured by: King Milling Company

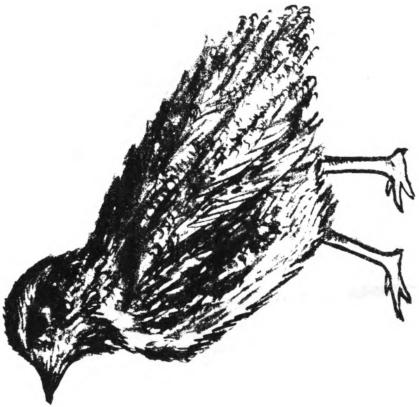
Lowell, Michigan



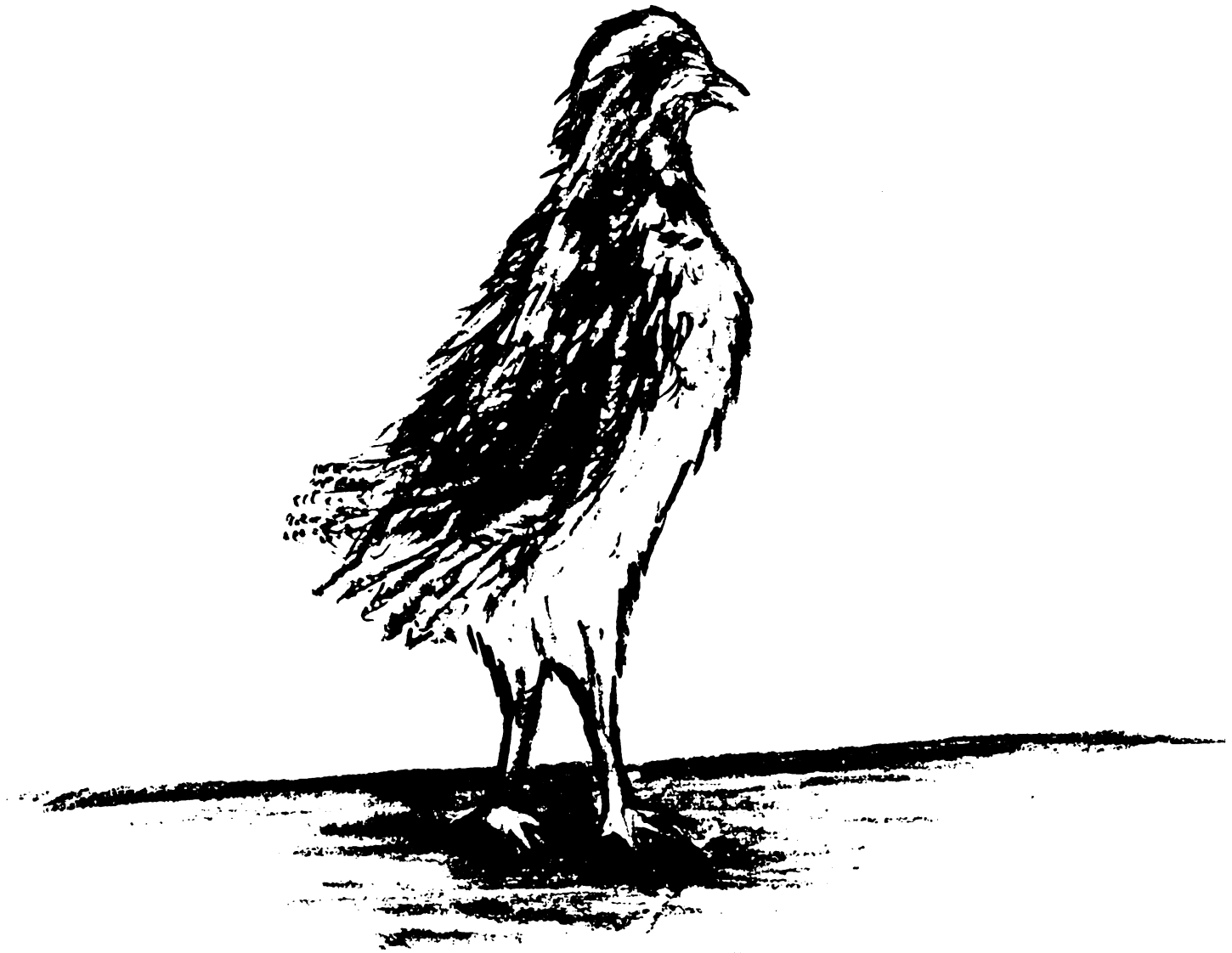
Isolation chamber used in Experiment I. The inside dimensions of the box are 9 inches wide, 9½ inches high, and 11 inches long. The chamber is shown without the guillotine door.

APPENDIX C

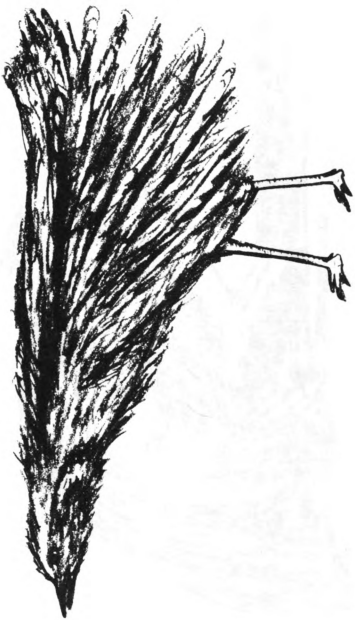
POSTURE SKETCHES



Normal Stance



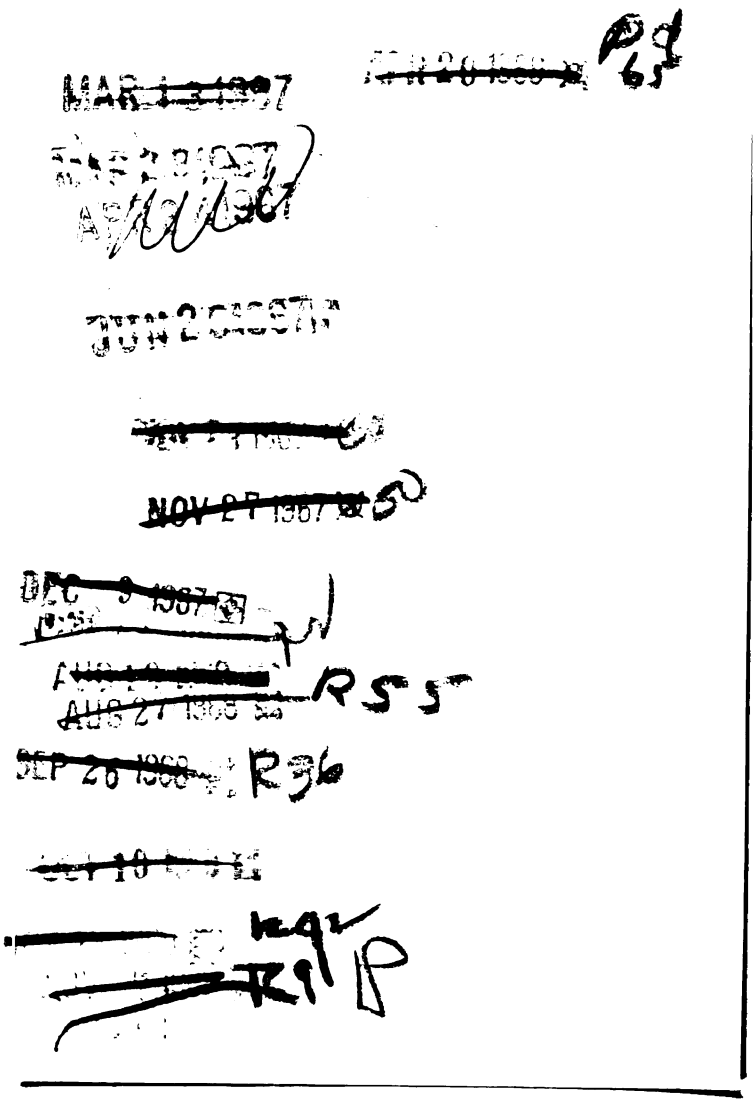
Male Crowing



Male Courting

Copulation

ROOM USE ONLY



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