ONTOGENY OF SOCIAL BEHAVIOR IN CHICKENS (*GALLUS DOMESTICUS*)

by

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B. A., Sioux Falls College,
Sioux Falls, South Dakota, 1949

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Zoology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1951

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INTRODUCTION

Studies by various workers have shown that nearly all vertebrate animals, except possibly amphibians, have some type of social organization, and that it is decided by fighting, bluffing or some kind of display.

The social organization of chickens was originally described as an absolute peck right; as being firmly fixed and despotic (Schjelderup-Ebbe, 1922, 1935). This avian hierarchy is generally referred to as a peck-order by present day workers, the word peck denoting an expression of aggressiveness.

Chickens peck only those beneath themselves in the social scale and are pecked only by those of higher rank. This social scale is not always straightline from alpha to omega bird as pecking triangles involving three birds may develop within a flock. These triangles may or may not include the alpha bird and a single bird may be a part of one or more separate triangles at the same time. However, the social order tends to be straightline in small flocks and is relatively more stable among hens than among cocks (Guhl, 1945). Cocks usually do not peck the hens and, therefore, have a peck-order which is distinct from that among the hens.

When adult chickens that are strangers to one another are brought together, fights may occur or some birds may submit to others without fighting. In either case, a dominant-

subordinate relationship is established between the two birds involved and thereafter the loser tends to avoid the winner, i.e., its superior. This fighting and/or submission continues until the dominant-subordinate relationships have been established between all the pair combinations in the flock, and a peck-order has been formed. Discussions of the avian hierarchy may be found in the papers of Allee (1936), Allee, Collias, and Lutherman (1939), Collias (1943), Guhl (1945) and others.

Reviews of the factors that may determine the social position of a bird are found in the papers of Collias (1943), Allee, Collias, and Lutherman (1939), and Allee and Collias (1940). Of these factors, the following apply to chickens:

1. The stronger chicken usually wins if other factors are equal.

2. If a chicken is ill, molting severely, or temporarily tired when it meets a newcomer, it will probably lose the initial encounter.

3. Mature chickens dominate immature chickens of the same flock.

4. Chickens fight better in their home pens.

5. Chickens fight better among familiar flockmates.

6. Cocks ordinarily dominate hens.

Maintenance of the social position, after it has been established, is associated with factors which tend to make for social inertia. Memory and habit not only reinforce but may entirely replace the aggressive behavior which is so important in deter-

mining the position of an individual in the social hierarchy of adult chickens, according to Allee, Collias, and Lutherman (1939).

In 1936, Dr. W. C. Allee suggested the use of sex hormones as a method of analyzing some of the underlying bases of aggressiveness. The introduction of male hormone into a hen's body would not be introducing a foreign substance since hens produce this hormone (see Witschi and Miller, 1938 for a summary).

Certain of the endocrine secretions and their effects on behavior have been subjected to tests. Thyroxin had no influence on success in initial pair contacts unless the dosage was large enough to cause severe molting (Allee, Collias, and Beeman, 1940). Low ranking hens injected with a male sex hormone, testosterone propionate, rose to the top of the social organization (Allee, Collias, and Lutherman, 1939). Epinephrine had little or no effect on the social status of an individual (Allee and Collias, 1938). There is a strong indication that heavy dosages of the female sex hormone estradiol lowers aggressiveness and tends to act, probably indirectly, in the opposite direction of testosterone propionate. The above experiments were all done with adult birds and no experiments designed to study the ontogeny of social behavior in chickens were found in the literature.

Domm and Van Dyke (1932), Hamilton and Golden (1939), and Hiestand and Stullken (1943) found that androgenic compounds

caused precocious developments of crowing, comb growth, and "social dominance" in baby chicks.

The foregoing observations suggested an investigation of social behavior in chickens from the time they were hatched until a social organization was formed in the flock. This experiment, then, was set up primarily to attempt to find out at what age pecking appears, how pecking develops, and if pecking is a learned trait. Since androgen increases the relative aggressiveness, and estrogen tends to work in the opposite direction in adult hens, some effects of these hormones on the development of aggressive behavior of an individual and on the formation of a peck-order were also observed. A report on the age of the chicks when other behavior traits appeared is included.

THE BIRDS AND THEIR TREATMENT

Newly hatched chicks were used in all of the experiments except one. This exception was due to the fact that baby chicks could not be obtained by the investigator at that time of the year; consequently four-week old chicks were used.

The first of five series of experiments was conducted with two heterosexual flocks. This procedure was followed in order to determine at what age various behavior traits appeared in each sex in birds that were raised in the presence of the

opposite sex, and to observe at what age there is a discrimination between males and females in their pecking.

Each of the remaining four series, designated as B, C, D, and E, was composed of three groups - one control group, one group treated with a sex hormone, and the remaining birds raised in isolation by which each bird was separated by a wire screen from its fellow isolates.

In order to check on the influence of male sex hormone on the behavior of both sexes of chicks, and to likewise evaluate the influence of the female sex hormone on both sexes, it was necessary to run a series of four experiments. This brought the total number of experiments to five. In each series, after the first one, the birds were placed at random into three groups.

The behavior pattern of the control flock was considered to be a standard for that series. The behavior exemplar of each of the two experimental groups (of each series) was compared to the standard set by the controls.

In adult chickens, the female sex hormone appears to lower aggressiveness and the male sex hormone has been persistently associated with aggressiveness. With this in mind, one flock of each series was injected with either male or female sex hormone in an attempt to evaluate the effects of these particular endocrine secretions on the development of aggressive behavior when the hormones were made available before they would have been present in any great amount from natural

sources, i.e., the gonads. The injections were begun by the first or second day after hatching (excepting Series C) and continued until a peck-order was formed in the flock being treated. The birds of Series C were four weeks old when received.

The chicks in the isolation pens could see and hear one another but there could be no physical contact between the birds, hence, there could be no social interactions formed as a result of physical contacts. After the birds raised in isolation pens were past the age at which a peck-order was established in the controls of the same series, they were combined in a single flock. This offered one means of determining how long it took chickens of this age to start aggressive pecking and how long it took for a peck-order to form.

All five experiments were performed in a basement laboratory of Fairchild Hall. The temperature was fairly uniform at all times and forced ventilation was provided by an exhaust fan that operated continuously. Artificial light was provided from 7:00 a.m. to 7:00 p.m. daily, and was regulated by an electric clock. The dates of observation were as follows: Series A, from February 2, 1950 through April 13, 1950, a total of 70 days. Series B, from March 2, 1950 through May 19, 1950, a total of 78 days. Series C, from June 20, 1950 through July 25, 1950, a total of 35 days. Series D, from October 11, 1950 through January 8, 1951, a total of 89 days. Series E, from February 6, 1951 through April 25, 1951. The control

flocks of Series B and E were used to obtain data relative to staged initial pair contacts.

A portion of the laboratory was divided into two adjoining pens, each with a floor area 92" x 36", and designated as pen I and pen II. The walls of these pens were constructed of chicken wire. In addition, 10 isolation pens were constructed of ½" mesh wire screen and placed on the floor of the laboratory. Each of the isolation pens measured 24" x 11", which was the unit of area per bird in the larger pens. Ground corn cob litter was kept on the floor of all the pens to absorb droppings and to facilitate cleaning.

An electric brooder 72" x 36" was divided into two pens of equal size and used to house the chicks of the first experiment (Series A) until they were about three weeks old. At this age it was necessary to provide more area per bird so they were moved to pens I and II.

For the second experiment (Series B), the brooder was divided into separate pens for the controls, for the injected birds, and individual pens for the isolated birds, allowing an equal amount of floor space per bird. These pens were so arranged that heat from the brooder was available to the control and isolated birds. Heat for the injected flock was provided by suspending a continuously lighted 100 watt electric light bulb about two inches from the floor of their portion of the brooder. Again, more floor space per bird was needed at three weeks of age so the birds were moved to the pens on the

floor of the laboratory.

The birds of the third experiment (Series C) were four weeks old when they were received. These birds were deposited at random into the isolation pens on the floor, and into pens I and II.

The shifting of the birds from brooder to floor pens in Series A and B could have had some effect on the behavior of the chicks as indicated by the manner of walking and the unusual amount of running and flying by the birds when they were transferred to the floor pens from the wire brooder. These were reactions to the changed substratum and to greater freedom of movement. To avoid this shift in the later experiments, the chicks were put immediately into the floor pens when they were received. Excluding the birds of Series C, this presented a problem of providing ample heat for the newly hatched chicks so an infra-red lamp was suspended 18" from the floor of both pen I and pen II. This arrangement was satisfactory. To provide heat for the isolated birds of Series D, two infra-red lamps were placed about 48" from the floor of the pens, arranged in an attempt to diffuse an equal amount of heat to each pen. This was unsatisfactory as the amount of heat per bird could not be readily controlled. A further change was made for the isolated birds of the final experiment. Here, a 25 watt electric light bulb was suspended about 3 inches from the floor in each individual pen and kept lighted 24 hours per day. Each bird could huddle directly beneath, or move away

from, the source of heat.

The chicks used for both Series A and Series B were obtained from the Department of Poultry Husbandry. They were newly hatched White Leghorns of the same strain. As it was not possible to obtain newly hatched chicks of any breed for Series C, White Rocks about four weeks old were used. These were obtained from a commercial source. The birds used in the last two series were newly hatched White Leghorns of the same strain, obtained from a commercial source.

In all instances where male sex hormone was used, it was testosterone propionate (Oreton).[1] The dosage was 0.05 mg (0.02 cc) injected daily into the breast muscle. The female sex hormone used was diethyl stilbesterol (Stilbesterol)[2] and the dosage was 1.5 mg (0.10 cc) injected into the breast muscles. Because of the slower rate of absorption of stilbesterol, it was administered every other day. The amount of hormone used per injection was decided after a consideration was made of the dosage used by Allee, Collias, and Lutherman (1939), Hamilton and Golden (1939), Allee and Collias (1940) and others. All hormone injections were started by the time the chicks were two days old, except Series C, and were continued until after a peck-order was formed in the flock being treated. The birds of Series C were four weeks old when received.

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[1] Schering Corporation, New Jersey.

[2] Jensen-Salsbery Laboratories, Inc., Kansas City, Missouri.

The chicks were fed only mash from a commercial source until they were four weeks of age when cracked mixed grain was added to this diet and crushed oyster shells were made available. Abundant fresh water was accessible to the chicks at all times.

The birds that had received either of the sex hormones were autopsied, and a macroscopic examination of the gonads was made, at the close of each series to establish the sex of these birds.

EXPLANATION OF TERMS USED

An explanation of the meaning of certain terms used in this paper is given below.

Fear Reaction

Fear reaction was the movement of the birds away from the observer's hand even though the bird was not touched, i.e., an escape reaction.

Frolic

The seemingly involuntary running and wing flapping of the birds with no discernable external stimuli to evoke these actions is termed a frolic.

Sparring

Sparring occurred when two birds came face to face, often when frolicking. Both assumed a fighting posture and aggressive pecking was usually attempted in a feeble manner, but no decision was reached as to which bird was dominant.

Peck

An aggressive peck, usually in the head region, delivered as an attack on another bird is referred to as a peck. This is not to be confused with pecking of food, feather picking, nor taking food from another bird's beak.

Avoidance

Avoidance was recorded when one bird actively avoided another even though no peck was delivered immediately preceding this action.

Recognition

Recognition was the ability of the birds to discern a difference between flockmates and a stranger. Recognition was recorded if the birds being tested attacked or avoided the stranger.

RESULTS

Series A was composed of two heterosexual flocks of baby chicks. As the chicks matured, aggressiveness appeared two weeks earlier in males than in females and the males were relatively more aggressive. Heterosexual pecking occurred in both flocks as late as the fifth week of age. Later the females tended to confine their pecking to other females but the males continued to peck both sexes. This sex differential in behavior kept the females so busy avoiding the males of the flock that the formation of a peck-order among the females was interfered with to such an extent that unisexual flocks were used for the balance of the experiments.

Apparently heterosexual dominance was established by the end of the fifth week of age.

In four of the five experiments in which newly hatched chicks were used, the chicks were three days old when fear reactions were first observed. This was true of both the control and hormone treated flocks. Frolicking was first observed in both the control and experimental flocks of Series A, D, and E during the first week of age, and in both flocks of Series B during the second week of age. Sparring was first observed in the control and experimental birds of Series A and E during the first week, and during the second week of Series B and D. No data were obtained for the first four weeks of age of the chicks of Series C as they were four weeks old when

received.

Among the control flocks and hormonally treated flocks (excepting Series B), frolicking was observed before sparring, and sparring was observed before pecking.

The ages of the chicks at which aggressive pecking was first observed are shown in Table 1. The androgen treated males and females started pecking one week earlier than their control flocks of the same sex. The estrogen treated males started pecking at the same age as did their controls, but the estrogen injected females were observed pecking one week earlier than their controls. There was one male in the estrogen treated female flock, as revealed by gonad examinations at the end of the experiment.

Pecking appeared during the fourth week of age in the male control flocks of Series B and C and among the male members of both flocks of Series A. The female control flock of Series D started pecking during the eighth week of age and the female controls of Series E began pecking in the sixth week. The normal male chicks, then, started pecking two to four weeks earlier than the normal female chicks. This suggests inherent constitutional differences in pecking development in male and female chicks.

Androgen obviously augmented the development of pecking in both males and females. Apparently estrogen did not retard the development of pecking, nor did it definitely enhance it, at least in the males.

The age of the chicks (in weeks) when the various dominant-subordinate relationships in each flock were formed is shown in Table 2. The hormone used on the injected birds and the sex of each flock are also given.

The majority of dominant-subordinate relationships were established one week earlier in both male and female androgen treated flocks than in their respective control flocks. Relative to the age when the majority of dominant-subordinate relationships were formed in the estrogen treated birds, there was very little, if any, effect of estrogen on the males, but more of the females tended to form these relationships one week earlier than their controls. Using the intensity and frequency of pecking as criteria of aggressiveness, the estrogen treated males and females were less aggressive than their respective controls.

The dominant bird of the estrogen treated females of Series D was found (at the end of the experiment) to be a male. Gonadal examinations revealed one bird in the androgen treated male flock to be a female. She was fourth from the top in the peck-order of this flock of ten birds.

Androgen injections caused dominant-subordinate relationships to form about one week earlier, in both sexes, than in the controls. Estrogen apparently had little effect on the age at which the dominant-subordinate relationships were formed in males. The most dominant bird of the estrogen treated females, VV, was a male, hence, more aggressive. Nine of the 25 pair

dominant-subordinate relationships formed during the ninth week of age involved this male bird. This seems to account for the trend of estrogen treated females to form a peck-order earlier than their control flock, Table 2.

All of the birds of Series D and E were weighed once a week (to the nearest 0.10 g) from the time they were received at the laboratory until they were past the age when a peck-order was formed in their group. The data thus obtained enabled one to determine the relative importance of weight to the position attained in the social scale and the average rate of gain was used as an indication of rate of physical development.

The coefficient of correlation between the number of birds pecked in the ontogenetic peck order and the weight of the birds at nine or ten weeks of age was found to be not statistically significant in any of the six groups of Series D and E so tested. However, the heaviest bird was dominant in four of the six flocks. The exceptions were in the control flock of Series E, where the heaviest bird was dominated by five birds in a flock of ten, and in the flock resulting from the combining of the birds of Series E that were raised in isolation. In the latter flock, the heaviest bird was dominated by five of the seven flock members.

In Series E, after the initial weighing, the average weight per bird of the estrogen treated females was greater each week than the average weekly weight of the controls. The average

weight per bird of the control flock was greater than the average weekly weight of the birds that were raised in isolation. In Series E, the average weekly weight of the control birds was greater each week than the average weekly weight of either the injected or isolated birds. The isolated birds were heavier each week than the androgen treated birds.

The greater body weight in estrogen treated birds as compared with controls is in agreement with the results obtained by Jaap and Thompson (1945). The corresponding lighter weight of androgen treated chicks conforms with the results reported by Allee, Collias, and Lutherman (1939). The birds raised in isolation weighed less than the controls raised in a flock in each Series. These differences between flocks do not appear to be concerned with the processes under investigation here, as body weight showed no high correlation with position in the peck-order.

The data obtained from the weekly weighings of the chicks do not give any definite evidence that body weight as a measure of physical development is correlated with the development of aggressive behavior. The heaviest bird in a flock was not necessarily the first to initiate pecking, nor was the lightest bird the last to peck.

Ten birds were placed in isolation pens at the beginning of Series B and kept separated until they were past the age at which a peck-order had formed in the control flock. At this time they were assembled simultaneously in one of the large

pens. For the first few moments there was much frolicking and the birds seemed to investigate their new surroundings, then several fights occurred. Fighting was frequent for about two hours but gradually diminished and gave way to unidirectional pecking. Observations were ceased after five hours and were resumed the following morning. By mid-afternoon, 24 hours after the birds were assembled, enough pecks had been recorded to enable the observer to ascertain a peck-order. The social positions of the birds in the peck-order had not changed when the experiment was terminated two weeks later.

This same procedure was repeated for Series C, D, and E with similar results. It should be noted that the age of the birds when isolated was two days in Series B, D, and E, and four weeks in Series C. Aggressive pecking had been observed in the birds used in Series C prior to their isolation.

In each Series, the controls started to peck when four to six weeks old. The birds raised in isolation started pecking soon after they were assembled. If the initial pecks resulted from a learning process only, one would have expected the pecking among newly assembled "isolated" birds to develop more slowly than it did. Although one cannot exclude some learning, the indications are that physiological maturation exerted a greater influence on the development of aggressive behavior than did experience.

According to Allee and Collias (1940), the relative aggressiveness of chickens in a flock can be determined by

staged initial pair contacts. To determine the relative aggressiveness of each individual of the control flock of Series B, staged pair contacts were conducted among seven of the nine members of this group (Two were removed due to slipped tendons which hampered their movements).

Chickens of this age (about 12 weeks) forget previous social relationships during an absence of 14 days (Schjelderup-Ebbe, 1935) so the birds were isolated in a laying battery for two weeks. When the two weeks had elapsed, initial pair contacts were staged in pen II. Each bird had two encounters per day, one in the morning and one late in the afternoon. When a complete round robin was finished the birds were left in isolation in the laying battery for another two weeks, after which time they were reassembled in pen II and the re-established peck-order was ascertained.

The coefficients of correlation (r) between (1) the number of birds dominated in the ontogenetic peck-order and the number dominated in the re-established peck-order (2) between the number dominated in the ontogenetic peck-order and the number of encounters won in the initial pair-contacts (3) between the number dominated in the re-established peck-order and the number of encounters won in the initial pair contacts are shown in the scatter diagrams of Plate I. Also shown are the probabilities (P) or the statistical significance of each correlation coefficient.

The above procedure of staged initial pair contacts was

also followed with eight of the original ten chicks of the control flock of Series D beginning when they were twelve weeks old (Two birds had died early in the experiment). However, one additional round robin of pair contacts was conducted with an isolation period of 14 days between the first and second rounds. The coefficients of correlations were determined and treated statistically in the same manner as in Series B. These results of pair contacts and social positions are also given in Plate I.

It has been previously mentioned that the most accurate method of determining the relative aggressiveness of chickens is by staged initial pair encounters. The high correlation of Figs. 1, 4, 5, and 7 of Plate I indicates that relative aggressiveness tends to remain at about the same level. However, the same birds were combined after an isolation period, and the position in the re-established peck-order had a low correlation when compared with the position as determined by initial encounters (Figs. 2, 3, and 9, Plate I). This is due to the many other factors present when birds are assembled and encounters follow a more or less random order. The positions attained in the social scale of the re-established peck-order are not true pictures of the relative aggressiveness of the individuals in a flock.

Figures 1, 4, and 5 (Plate I) show a high correlation between the positions in the ontogenetic peck-order and the

number of contests won in the initial pair contacts. The above is cited as evidence that the positions in the social scale of the ontogenetic peck-order are a more reliable expression of the relative aggressiveness of the birds of a flock than are the positions in a flock assembled as a group of strangers.

DISCUSSION

There is a general agreement that the male sex hormone tends to increase aggressive behavior in vertebrates (Collias, 1944). In adult chickens, Allee, Collias, and Lutherman (1939) raised the position of a hen in the social scale by injections of androgen. It would seem, then, that the ontogenetic attainment of some certain concentration of androgen might account for the initial appearance of pecking behavior in chicks. If androgen were the only factor required to induce pecking, one would expect that one- or two-day old chicks would begin to peck soon after androgen injections were made. However, this was found not to be true. Male chicks which received daily injections of androgen (beginning when they were two days old) did not begin pecking until they were three weeks of age. Females which received daily injections of androgen (beginning when they were two days old) did not begin pecking until they were five weeks old. The age at which pecking began, in both male and female androgen treated chicks, was only one week

earlier than in their controls.

The amount of androgen required to influence pecking behavior may be quite small. Breneman (1950) found the beginning of a marked growth of the testes to be at about 40 days of age (post hatching). We observed pecking among our birds before this age was reached, i.e., before the testes elaborated any significant amount of male hormone as may be indicated by comb growth. Apparently there is a threshold of pecking response which must be developed before the androgen can produce an effect. This pecking threshold might be associated with physiological maturation. There was a non-significant correlation between body weight and position in the ontogenetic peck-order, and the heaviest bird was not necessarily the first bird to begin pecking. Benoit (1929) noted that changes which involve the intervention of the nervous system have a higher threshold than morphological changes such as in plumage or comb growth.

Estrogen had little effect on initial pecking and on the establishment of a peck-order in male chicks. Table 1 showed the age at which pecks appeared in estrogen treated females as having occurred one week earlier than in the controls. Actually, the difference between injected and control females was only two to three days. There was a slight trend in the estrogen treated females to form a peck-order earlier than their controls (Table 3). It was noted that the estrogen treated males and females pecked less frequently and with less intensity

than did their control flocks. This observation suggests, as did estrogenic treatment of adults by Allee and Collias (1940), that estrogen acts in the opposite direction from androgen, in aggressive behavior.

Aggressive pecking, and the formation of a peck-order, appeared at an earlier age in normal male chicks than in normal females. If these differences were due entirely to the concentration of androgen present in the blood, then the androgen injected females would have pecked, and formed a peck-order, as soon as or earlier than in the control males. This did not occur in these experiments, which indicated that there were inherent constitutional differences related to sex differences. Guhl (1949) postulated the existence of sex differences in inherent neural patterns related to heterosexual dominance.

Not all male chickens, nor all female chickens, are equally aggressive, i.e., the relative aggressiveness varies from individual to individual. A stable social organization based on dominant-subordinate relationships might not exist if this were not true. The results of the initial encounters gave evidence of relatively consistent levels of aggressiveness in individuals. The data obtained in these experiments indicate that the position attained by an individual in the ontogenetic peck-order may be an index of its relative aggressiveness.

SUMMARY

1. Fear reactions were observed as early as three days of age; frolicking was first observed at one week of age and sparring was first observed during the first or second week.

2. Aggressive pecking appeared during the fourth week of age in male chicks and during the sixth to eighth week in females.

3. Heterosexual pecking occurred as late as the fifth week of age.

4. There was a non-significant correlation between gross body weight and position in the ontogenetic peck-order; the heaviest bird of a flock did not necessarily initiate pecking in its group.

5. Normal males formed a peck-order by the end of the eighth week of age; females by the end of the tenth week.

6. Androgen injections lowered the age at which pecking appeared by one week in both males and females.

7. Chicks kept in isolation until their corresponding control group developed a peck-order, when placed together in a pen, pecked almost immediately and formed a peck-order within 24 hours. It was concluded that initial pecking was more dependent on maturation processes than upon learning.

8. Not all chicks were equally aggressive. Position in the ontogenetic peck-order was an index of the relative aggressiveness of the flock members.

9. The level of aggressiveness in individuals tended to remain constant.

ACKNOWLEDGMENT

Appreciation is expressed to Dr. A. M. Guhl, major instructor, for suggesting the problem and for his counsel and criticism during the course of this experiment.

Sincere thanks are hereby extended to the entire staff of the Department of Zoology for their interest and help.

Deep appreciation is expressed to my wife, Maryellen, for her patience, sacrifice, and forbearance during this research study.

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APPENDIX

EXPLANATION OF PLATE I

Scatter diagrams of the coefficients of correlation (r) and their statistical significance (P)

Series B

Fig. 1. The number of birds pecked in the ontogenetic peck-order and the initial pair encounters won.

Fig. 2. Number of birds pecked in the ontogenetic peck-order and the birds pecked in the re-established peck-order.

Fig. 3. Initial pair encounters won and number of birds pecked in the re-established peck-order.

Series D

Fig. 4. Number of birds pecked in the ontogenetic peck-order and the first round initial pair encounters won.

Fig. 5. Number of birds pecked in the ontogenetic peck-order and the second round initial pair encounters won.

Fig. 6. Number of birds pecked in the ontogenetic peck-order and birds pecked in the re-established peck-order.

Fig. 7. First round initial pair encounters won and second round initial pair encounters won.

Fig. 8. First round initial pair encounters won and number of birds pecked in the re-established peck-order.

Fig. 9. Second round initial pair encounters won and number of birds pecked in the re-established peck-order.

P 0.05 doubtful significance
P 0.02 statistically significant
P 0.01 statistically significant

PLATE I

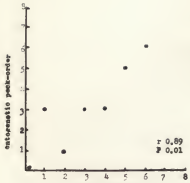


Fig. 1

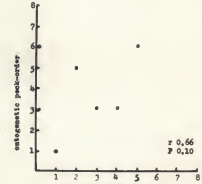


Fig. 2

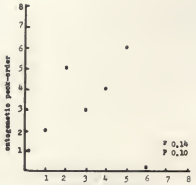


Fig. 3

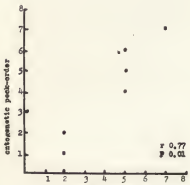
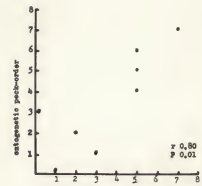


Fig. 4



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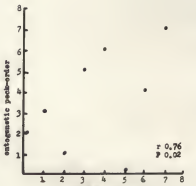

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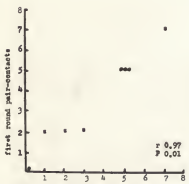

Fig. 7

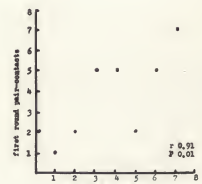

Fig. 8

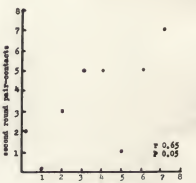

Fig. 9

Table 1. Age of chicks when aggressive pecking was first observed.

Sex	Series	Flocks	Age of chicks by weeks						
			3	4	5	6	7	8	9
Hetero-sexual	A	Pen I*		x					
		Pen II*		x					
Males	B	Controls		x					
		Androgen-treated	x						
Males	C	Controls		x					
		Estrogen-treated		x					
Females	D	Controls						x	
		Estrogen-treated					x		
Females	E	Controls				x			
		Androgen-treated			x				

* These data for the male members only.

Table 2. Number of pair dominant-subordinate relationships formed each week of age.

Sex	Series	Flocks	No.	Age of chicks by weeks					
				5	6	7	8	9	10
Hetero-sexual	A	A_1*	36	4	20	10	2		
		A_2*	45	9	26	7	3		
Males	B	Controls	36			15	21		
		Androgen-treated	45			40	5		
Males	C	Controls	45	2	36	7			
		Estrogen-treated	45	3	37	5			
Females	D	Controls	28					14	14
		Estrogen-treated	28					25	3
Females	E	Controls	45			11	12	14	8
		Androgen-treated	45		7	18	20		

* These data for male flock members only.

Table 3. Mean weights of chicks of Series D and E by weeks.

Age by weeks	Series D (females)			Series E (females)		
	Controls	Estrogen treated	Isolated	Controls	Androgen treated	Isolated
1	*	*	*	43.6	44.1	46.0
2	76.1	79.8	68.7	81.9	68.7	70.0
3	119.7	123.8	114.6	133.8	109.8	113.3
4	185.3	195.4	153.4	208.8	166.9	164.7
5	245.0	274.2	204.2	295.8	224.3	240.5
6	322.0	369.3	282.0	397.0	286.9	333.9
7	402.7	462.6	351.2	511.9	372.3	442.2
8	503.6	576.2	446.3	620.3	449.5	541.6
9	604.9	688.6	557.9	688.7	492.3	650.3
10	732.2	840.6	689.9	812.7		709.5
11	800.4	887.3	746.8	909.4		783.6

* No weighings were made during the first week.

ONTOGENY OF SOCIAL BEHAVIOR IN CHICKENS (*GALLUS DOMESTICUS*)

by

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Sioux Falls, South Dakota, 1949

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Zoology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1951

Most behavior studies of chickens have been done with adult birds, so these experiments were an investigation from the time the chicks were hatched until a social organization was formed in the flocks. Since androgen increases the relative aggressiveness in adult chickens, and estrogen tends to work in the opposite direction in adult hens, some effects of these hormones on the development of aggressive behavior of an individual, and on the formation of a peck-order were observed.

A series of five experiments were conducted with baby chicks to study the development of social behavior. Two heterosexual flocks were used in the first series and each of the remaining series consisted of control birds, androgen or estrogen treated birds, and birds raised in isolation. Injections were begun when the chicks were 1-2 days old and continued past the age when a peck-order was formed. The birds raised in isolation were assembled simultaneously after they were past the age at which a peck-order had formed in the control flock.

Male chicks pecked 2-4 weeks earlier than females and heterosexual dominance was established by the males by the end of the fifth week of age. In normal unisexual flocks, males pecked when four weeks of age and females pecked when six weeks of age. The peck-order was formed in normal male flocks by the end of the eighth week, and in normal female flocks by the end of the tenth week. Androgen augmented the development of

pecking, and the formation of a peck-order. Estrogen did not retard, nor definitely enhance, the development of pecking, and the formation of a peck-order.

Not all chicks were equally aggressive and the level of aggressiveness in individuals tended to remain constant. The position in the ontogenetic peck-order was an index of the relative aggressiveness of flock members.

There was no significant correlation between gross body weight and position in the ontogenetic peck-order, although the heaviest bird was dominant in four of six flocks so tested.

It was found that initial pecking was more dependent on maturation processes than on learning, and that the presence of androgen is not the only factor required to induce pecking.