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TIME AND MOTION STUDY OF AGONISTIC POSTURES DURING
INITIAL PAIR CONTESTS IN THE DOMESTIC FOWL

by

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INTRODUCTION

Interest in social behavior of animals has increased over the years, partly due to the realization that man is himself a social animal. As such he may obey general laws which can be discovered through a study of animal behavior. In addition, social behavior is a factor contributing to the usefulness of domestic animals. For example, the social organization of a flock of chickens may have an effect on egg production and the organization of a herd of dairy cattle may influence milk production.

Much of the basic work on sequences of behavior patterns and the evolution of behavior has involved the study of postures as signals in social interactions. Little of this work has been performed with chickens and that which has, has been inconclusive. The aim of this study was to employ a new approach--the time and motion study of motion pictures--to determine the configuration of "standard" stances assumed during agonistic behavior in the chicken.

REVIEW OF LITERATURE

Since the study involved posture stances in aggressive and submissive behavior in the domestic fowl, the literature reviewed includes work on social orders, initial encounters, measurement of levels of aggressiveness, genetic influences on levels of aggressiveness and postures as signals in social behavior.

Social Orders

The social dominance order was first noted in the domestic fowl by Schjelderup-Ebbe (1935) and has been investigated in the fowl and in many

other wild and domestic animals. Several additional social relationships have been shown to exist. Scott (1956) recognizes eight relationships including simple aggregations, dominance-subordination, leader-follower, sexual, care-dependency, maternal care, tropholaxis and mutual defense.

Dominance and grouping patterns in small groups of mammals and birds kept in large enclosures were studied by Collias (1950) at the New York Zoological Park. Dominance hierarchies were observed in colonies of White-tailed deer and several varieties of geese. While a group of five female Nyala antelope normally showed no aggressive interactions, restricting them to short rations for two days caused an unstable dominance hierarchy to become evident or develop.

Interspecies dominance orders were found to exist among various water birds, as well as among certain species of birds and mammals from the African veldt. Rank in these orders varied with size of species, age, sex, territorial relations and other aspects of individuality (Collias, 1950).

The dominance order in the domestic chicken is an expression of the relative aggressiveness and/or submissiveness of the members of the flock and is a social means of controlling aggressiveness. Dominance relationships between individual birds is shown by pecking behavior. Pecking between any two individuals is unilateral--the inferior bird makes no attempt to defend itself and avoids the superior bird. This dominance-subordination relationship is maintained by threatening postures or vocalizations (Schjelderup-Ebbe, 1935).

Two peck orders are usually present in bisexual flocks of chickens; one for each sex. Males are more aggressive than females, but the cocks normally do not peck hens. Within each order one animal usually dominates

every other animal, while another pecks all but the most dominant one; the most submissive is pecked by all and pecks none. Pecking triangles may occur at any level in the order (Schjelderup-Ebbe, 1935).

Initial Encounters

Dominance relationships within a group of birds are worked out by means of a series of individual initial pair encounters. When a number of strange birds are introduced into a pen they fight by twos until each bird has fought all the others. The winner of each of these encounters then has the right to peck the loser. At later meetings, one member of each pair pecks or threatens the other, reinforcing the avoidance of the inferior bird and the peck order becomes established (Guhl, 1953).

Many studies have been performed to determine factors relating to success or failure in individual initial encounters and consequent high or low rank in the peck order. While much of this work has been done with birds, particularly with chickens, Scott and Frederickson's work (1951) on the causes of fighting in mice and rats is interesting. They found that in non-competitive situations both the male hormone and pain are important factors affecting the initial appearance of fights. In competitive situations the important causal factors seemed to be states of hunger and possibly thirst, and the degree to which fighting is an effective response to a given situation. They suggest that frustration tends to bring about aggression only in situations in which aggression provides a satisfactory solution to a problem.

Factors contributing to success in initial encounters between hens have been found to include male hormone output as indicated by comb size, and

thyroxin secretion as indicated by the complex of changes which accompany moulting (Collias, 1943). He also found that social rank in the home flock had much less influence and that body weight was of very little importance.

Marks et al. (1960) investigated the effects of comb and wattle removal on the social organization of flocks of hens. Although the study did not involve the observation of birds both before and after dubbing, they found that dubbed birds, when intermingled with undubbed chickens in large flocks, were subordinate to the normal hens. The dubbed birds ranked in the lower positions in the peck order.

It is still open to question whether the removal of the comb directly caused the dubbed birds to lose contests, or whether it only affected the ability of the undubbed birds to recognize the others as individuals. Guhl and Ortman (1953) have shown that the features of the head and neck, including comb size, are very important in individual recognition. If the dubbed birds are not recognized as individuals, birds that they have dominated would not be able to avoid them on the basis of visual recognition--resulting in an increased number of fights and more turmoil in the flock. As a result of this increased fighting, the dubbed birds, since they would be involved in more fights, would become fatigued and tend to rank toward the bottom of the peck order.

The effects of testosterone propionate on success in initial paired encounters, as well as its effectiveness in bringing about successful revolts in the peck order of White Leghorn hens, were studied by Allee et al. (1939). They injected testosterone propionate into low-ranking individuals of several flocks and produced a rise in social status in most of the treated birds. A treated bird eventually occupied the top position

in each flock. One group of injected pullets was tested in initial paired encounters with strange birds and was found to be more successful than before the injections.

Measurement of Levels of Aggressiveness

Various methods have been devised to measure aggressiveness in the domestic chicken. Guhl (1962) lists the two primary methods as the determination of rank in the peck order and initial pair encounters. There are several useful variations of initial pair encounters, such as inter-pen contests, caged contestants, random sampling and panels or teams.

Rank in the Peck Order. Rank in the peck order can be determined by recording the pecks and threats between all pairs in a flock. Each bird must be marked for identification, either with colored dyes or numbered wing badges. The agonistic reactions in the flock are then recorded in code and later tabulated to determine the social status of each bird. Either rank in the peck order or the number of birds pecked by an individual may be used as a measurement of relative aggressiveness.

Initial Pair Encounters. The staging of initial pair encounters allows the experimenter to control some of the factors which make for winning contests, such as the advantage of "home ground" and the amount of handling. In this procedure, two strange birds are placed together in a neutral pen or cage to establish their dominance relation. A bird's relative level of aggressiveness is determined by counting the number of contests won or lost.

When one bird from each of two flocks is used in initial pair encounters, the encounter is called an inter-pen contest. The birds can also be isolated in a laying battery for two or three weeks before the contest, as in the

caged contestants method. This time interval is required to extinguish any previous dominance relationships.

If a large number of birds are to be evaluated for levels of aggressiveness, random sampling may be employed, using either birds from two or more flocks or from isolation batteries. Developed by Siegel (1960), this method is useful in comparing aggressiveness between lines of selection or breeds. A given number of paired contests are conducted per day, with the contestants matched at random. The number of contests won would serve as a relative measure of the lines or strains compared.

A method of measuring aggressiveness by testing individual birds in initial pair encounters against members of a standard panel has been devised by McBride (1958). The scores obtained were highly repeatable, but a time interval must be provided between encounters to prevent panel members from increasing in aggressiveness as a result of training. Birds measured against the panel may come from organized flocks or from isolation.

Guhl (1962) pointed out that decisions in any of the conventional methods of measuring aggressiveness may result from fighting, pecking, threatening or avoidance alone. Repeated avoidance or escape behavior by one of the pair usually indicates that subordination has been established.

Evidences of Genetic Influences on Levels of Aggressiveness

Breed Differences. Several workers have reported differences in relative aggressiveness between different breeds of domestic chickens. Potter (1949) used rank in the peck order and initial paired encounters to evaluate the dominance relations of seven breeds of hens in 12 flocks. Of the breeds studied, White Leghorns were the most dominant, and White Cochins Bantams, the least. Dominance scores of the intermediate breeds overlapped.

Although no significant differences existed between Brown Red Game and Rhode Island Red hens, the Game were more dominant than the White Wyandottes or Brown Leghorns, and the Rhode Island Reds were less. The Rhode Island Reds were in turn, more dominant than Light Brahmas, whereas White Wyandottes, Brown Leghorns and Light Brahmas were essentially equivalent in dominance.

Complete dominance of one breed by the other was observed in 13 out of 15 small multibreed flocks by Hale (1956). Strangers of the dominant breed were accepted as dominant individuals without challenge by individuals of the subordinate breed. Morphological modifications, including coloring and dubbing of the dominant-breed penmates did not modify recognition by the subordinate-breed birds even though similar modifications led to loss of individual recognition within a breed. In this case breed recognition may actually interfere with the operation of the dominance order.

Within-Breed Differences. An attempt to selectively breed for high and low aggressiveness in the White Leghorn was reported by Guhl and Eaton (1948). Flocks of male and female leghorns were allowed to establish stable peck orders and high-ranking males were mated with high-ranking females and vice-versa. The offspring were tested for levels of aggressiveness on the basis of peck order rank. No agreement was found between relative aggressiveness of parent and offspring in the first generation, but Guhl et al. (1960), after further work on the same breed, noted that beginning with the F_2 through the F_4 generation the two lines showed significantly different percentages of initial encounters won or lost as well as high or low ranks in the peck orders. Heritability estimates of 0.22 and 0.18 were obtained when based on the percentages of contests won and individuals dominated, respectively.

A genetic basis for both aggressiveness and mating ability was indicated to Siegel (1959) by significant differences among lines of White Plymouth Rock cocks for these traits. No heterotic effect was exhibited when crossline cocks were compared with cocks from the inbred lines from which they originated.

Komai et al. (1959) estimated the heritability for social aggressiveness within six strains of four breeds. They found aggressiveness to be genetically variable enough within strains (mean heritability estimate 0.30 and 0.34) to allow effective selection. The social standing of the six strains studied had a high repeatability (0.857) indicating that differences in aggressiveness among the strains were largely determined by hereditary differences.

Since differences in relative aggressiveness between breeds have been found, and since lines for high and low aggressiveness have been predicted by heritability estimates and actually obtained by selective breeding, it is reasonable to assume that genetic factors play an important part in the aggressive behavior of the fowl.

Postures as Signals for Social Responses

The role of posture as a signal for social behavior has been studied extensively by many investigators, particularly the European ethologists, including Tinbergen (1953) and Lorenz (1958). Much of this work has been done with mating behavior and territorial defense, and little on paired encounters.

Tinbergen (1953) has done extensive research on the sexual behavior of a fish, the Three-spined Stickleback, and has contributed to the concept

of the "releaser." The releaser idea states that various stimuli including postures, vocalizations and movements serve to "release" the appearance of specific innate behavior patterns in another animal. The behaviors in a complex action such as courtship are arranged in sequences and are expressed when the proper signal is given by the animal's partner. The action of the second animal then serves as a releaser to the first, and the sequence progresses to the end.

For example, Tinbergen (1953) diagrams the complete mating behavior of the stickleback as shown in Fig. 1.

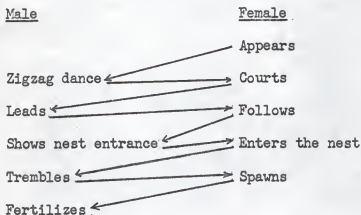


Fig. 1. Diagram of mating behavior of the stickleback.

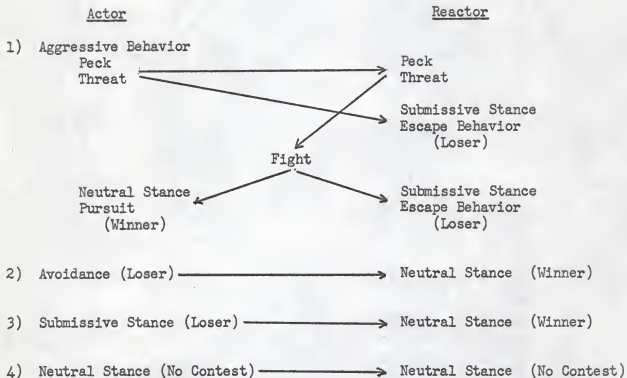
The appearance of the female elicits the movements of the zigzag dance by the male, which in turn causes the female to court, and so on. It should be emphasized that such sequences have been described for many types of behavior and with many different animals.

Plate I shows the relationship between stimulus and response in agonistic behavior of the chicken during initial pair encounters. Aggressive behavior such as a peck or a threat by one bird may elicit either aggressive or submissive behavior from the other. A fight usually results if the second

EXPLANATION OF PLATE I

Stimulus-response diagram for agonistic behavior
during initial encounters in the domestic fowl.

PLATE I



bird reacts aggressively. The loser of the fight either adopts a submissive stance (crouch) or tries to escape from the winner, while the winner takes a neutral stance or pursues the loser. If one bird avoids the other or adopts a crouch without receiving any stimulus from the other, it automatically loses the contest. A "no contest" results from both birds taking neutral stances.

The original work on postures in agonistic behavior of the chicken was done by Foreman and Allee in 1959. They reported that postures termed "tall," "low" and "sex crouch" were associated with the loss of initial pair encounters and may be given by submissive individuals in newly organized flocks. Postures called "semi-crouch," "crouch" and "deep crouch" were associated with winning in pair contests. It should be noted that the terms "crouch," "semi-crouch" and so on were adapted from boxing terms and as such are primarily concerned with the degree to which the legs are flexed. The term "crouch" when applied to chickens usually implies a submissive stance, or sexual receptivity in response to males.

PROCEDURE

Birds and Pens

Two strains of White Leghorn hens were used in this study. The birds were fifth generation descendents of lines bred at Kansas State University for high and low levels of aggressiveness. The parental generation was obtained from eight sire families of the Cornell random-bred control population of White Leghorns (Tindell and Craig, 1960). Two strains were used to allow greater diversity in social interactions than would have been possible if only one line had been used.

Ten hens of each line were housed in separate large pens and were allowed to form stable dominance orders. The peck order for each flock was determined in the pens and pecks were recorded throughout the study to note any probable changes in status of individual birds. The birds had been marked with bars of colors to allow individual recognition by the experimenter. The high-aggressiveness line was marked on the wings and the low line on the back to indicate flock membership.

Initial Pair Contests

Initial pair encounters were staged between individuals of each line in a neutral area. A large exhibition cage set up in an insulated "quiet room" served as the site for the contests. The cage had an opaque partition to enable each bird to be placed in a separate compartment and become accustomed to its surroundings before encountering the other. The partition was raised from a distance by a pulley arrangement to begin the contest (Plate II).

No food was provided in the first contests in order that the hens would react only to the other individual. Later a small bowl of food pellets was introduced in an attempt to bring the two birds together and facilitate interaction.

The contests were considered as terminated when a decision was reached, whether by threatening, pecking, fighting or avoidance. Consistent submissive behavior by one of the birds was the criterion for decisions. If no social interaction was noted over a period of at least five minutes, the contest was ended and recorded as a "no contest."

EXPLANATION OF PLATE II

Fig. 1. Exhibition cage with separated birds prior to initial pair encounter. Note contest number, clock and opaque partition.

Fig. 2. Apprehensive stance is shown by bird on left.

PLATE II



Fig. 1



Fig. 2

Photography

Motion pictures were taken with a Kodak magazine-type 16mm camera equipped with a 13mm wide-angle lens. The film used was Kodachrome II Type A, and light was provided by two No. 2 floodlamps in 11 inch reflectors. A speed of 16 frames per second was employed with a lens opening of f:8. The distance from the camera to the contest cage was four feet. The left light was positioned 66 inches from the floor and five feet from the cage, and the right one was 24 inches from the floor and three and one-half feet from the cage.

The contest number for each pairing appeared on a card on the upper left corner of the cage and a clock was attached to the upper right corner. Both were visible in the motion pictures (Plate II).

The camera was started as the partition between the contestants was lifted and was run whenever the birds interacted with each other. All pecks, threats, fights and crouches were recorded on film, as well as frozen or apprehensive stances.

Recording at Time of Contest

Data recorded at the time of the contests included the date and hour of day, contest number, code of individuals in right and left compartments of cage, sequence of agonistic behavior, type of decision and code of winning and losing birds.

Time and Motion Study of Film

The motion pictures of the encounters were analyzed with the use of a Bell and Howell Model 173BDA projector. This projector permitted the film to be run at a wide range of speeds and allowed detailed study of single frames of the film. In addition, a frame counter permitted individual frames to be numbered and coded for future reference. Throughout the study the films were kept on the 50-foot reels on which they were returned from the processor. This made relocating single frames easier, since only one small reel needed to be handled at one time.

The film was first analyzed for sequences of behavior patterns, with the reel and frame numbers for each type of behavior being noted. Behavior patterns recorded included apprehensive stance, threat, peck, fight, crouch, escape and pursuit. In addition, cases in which no social interaction occurred, as well as the time elapsed from the beginning of the contest until the first threat, peck, fight and decision were noted.

Finally, a detailed study of posture during the various behavior patterns was made, in order to determine "average" or "normal" stances for each behavior. Posture of the body, neck, tail and wings was noted for the apprehensive, threatening, pecking, fighting and crouching stances. The angles of the back with the floor, neck with floor, neck with back, tail with floor and tail with back were determined, as well as whether or not the neck was extended, the condition of the hackle (raised or smooth) and the spread of the wings and tail (Forms 1-6, Appendix).

Measurements. The angle of the neck with the floor was measured as the angle from a line parallel with the floor passing through the junction of the neck with the body, to the back of the neck (Fig. 2). An angle of 0°

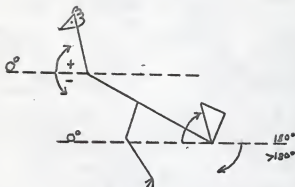


Fig. 2. Diagram showing measurement of angles

was defined as parallel to the baseline and a dip below the baseline was recorded as a minus angle.

Both the angle of the tail with the floor and the body with the floor were measured from a line parallel with the floor and passing through the point of junction of the tail and body. An angle of 0° , once again, was defined as parallel to the baseline, in the case of the body-to-floor angle. If the body dipped below the baseline, a minus angle was recorded.

The angle of the tail with the floor was measured from the same baseline as the angle of the body with the floor. All angles were measured to the leading edge of the tail. When the tail was extended parallel to the baseline posterior to the bird, the angle was noted as 180° . Dips below the baseline in this direction were recorded as angles greater than 180° .

RESULTS

The aim of the study was to determine numerical norms for stances involved in the various components of aggressive and submissive behavior in the domestic chicken. Birds were photographed during initial pair encounters in a large exhibition cage (Plate II). Five behavior patterns were considered for time and motion analysis of the film. They were apprehensive stance, threatening, pecking, fighting and crouching. Although five measurements of angles were made during the analysis (back with floor, neck with floor, neck with back, tail with floor and tail with back), it was decided to consider only those measured from the floor, since this was a fixed reference point. The angles of the neck or tail with the back can be derived from the other three measurements.

Apprehensive Stance

Nineteen measurements of the apprehensive stance were made, with several made on the same bird on different days. A bird was considered to be apprehensive if it "froze" in the pen and remained immobile for an appreciable period of time (Plate II), or if it defecated while in the pen. Since only three measurements were made of defecating birds, this stance may be considered primarily as that adopted by immobile birds.

Angle of Body with Floor. The angle of the hen's body with the floor varied from 0 to 60° , with a mean of 8.33° . Most of the 18 measurements were between 0 and 30° . Thirteen were 0° and four were between 15 and 30° . Only one bird measured 60° (Table 1, Plate III).

Angle of Neck with Floor. The range of this measurement was the same as that of the angle of body and floor, but the mean was considerably higher,

TABLE 1. Apprehensive Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
1	GVl	I 180	--	--	--
2	VVh	I 684	0	40	180
12	Rh	III 828	0	30	90
13	VVh	III 1215	0	30	60
14	YYh	III 1412	0	20	210
20	Yh	IV 1107	15	60	165
20	YYl	IV 1238	0	60	165
23	YYh	V 112	0	15	210
25	GGh	V 885	60	60	240
26	RRl	V 1119	30	30	90
29	Vl	V 1807	0	50	60
31	Yl	VI 317	0	0	180
32	YYh	VI 518	0	15	180
36	Vl	VI 1686	15	50	--
50	YYh	VIII 889	0	30	225
54	Yh	IX 430	30	30	120
55	Rh	IX 551	0	30	90
56	YYh	IX 647	0	0	210
59	YYl	IX 1144	0	45	180
		Mean	8.33	33.06	156.17
		Range	0 to 60	0 to 60	60 to 240

^a Capitals color

h high line

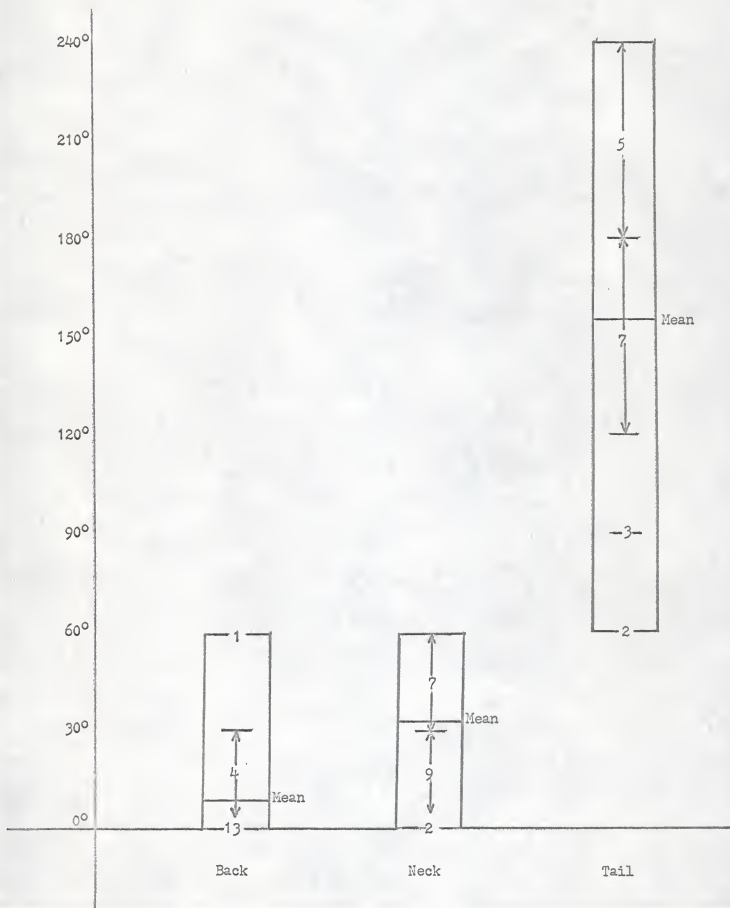
l low line

-- not measurable

EXPLANATION OF PLATE III

Graph of apprehensive stance, including angles of back, neck and tail.

PLATE III



at 33.06° . Only two of the 18 birds measured 0° , while nine ranked between 0 and 30° , and seven between 30 and 60° .

Angle of Tail with Floor. This angle seemed to be indicative of the general level of excitement of the hen. In this stance, with very little excitement and in fact general immobility, 12 out of 17 birds measured exhibited angles of greater than 120° , or only slightly elevated. These 12 measurements consisted of seven between 120 and 180° , and five between 180 and 240° . Only five hens possessed what could be termed an "erect" tail. Two of these measured 60° and three, 90° . The mean of all measurements was 156.17° . Thus, an apprehensive bird usually showed a lowered tail.

It was noted that apprehensive birds generally assumed a definite posture. The body was parallel or very slightly elevated from the floor (mean angle of 8.33°), the neck was raised slightly, about 30° above a line parallel with the floor. The tail in the apprehensive stance was characteristically lowered; this was indicated by a mean measurement of 156.17° .

Threatening Stance

The threatening stance may consist of an undelivered peck in the direction of the bird being threatened or the threatening bird may "stand tall," raise its hackles and make intimidating gestures toward the other bird (Plate IV). This behavior may be accompanied by vocalizations. As in all stances studied, several individuals were measured more than once, on different days.

Angle of Body with Floor. A mean of 23.75° was obtained for the angle of the body with the floor. The measurements ranged from 0 to 60° , distributed with three at 0° , seven between 0 and 30° , and two between 30 and 60° (Table 2, Plate V). This angle was characteristically near 30° .

EXPLANATION OF PLATE IV

Fig. 1. Threatening posture is shown by rear bird, while front bird avoids.

Fig. 2. Bird on left is shown pecking bird on right.



Fig. 1



Fig. 2

TABLE 2. Threatening Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
3	Yh	I 1012	--	--	--
4	GGh	I 1462	40	60	90
6	Rh	II 285	20	50	110
11	Yh	III 586	0	60	90
15	RRh	III 1644	0	40	80
17	VVl	IV 293	0	-10	90
21	Rh	IV 1556	30	60	90
24	RRh	V 648	15	45	60
30	Gl	VI 239	30	60	90
48	Yh	VIII 455	30	90	60
53	Vh	IX 248	30	90	30
55	GVl	IX 565	60	60	120
63	Yh	X 437	--	60	90
65	Rh	X 751	30	90	60
		Mean	23.75	58.07	81.54
		Range	0 to 60	-10 to 90	30 to 120

^a Capitals color

h high line

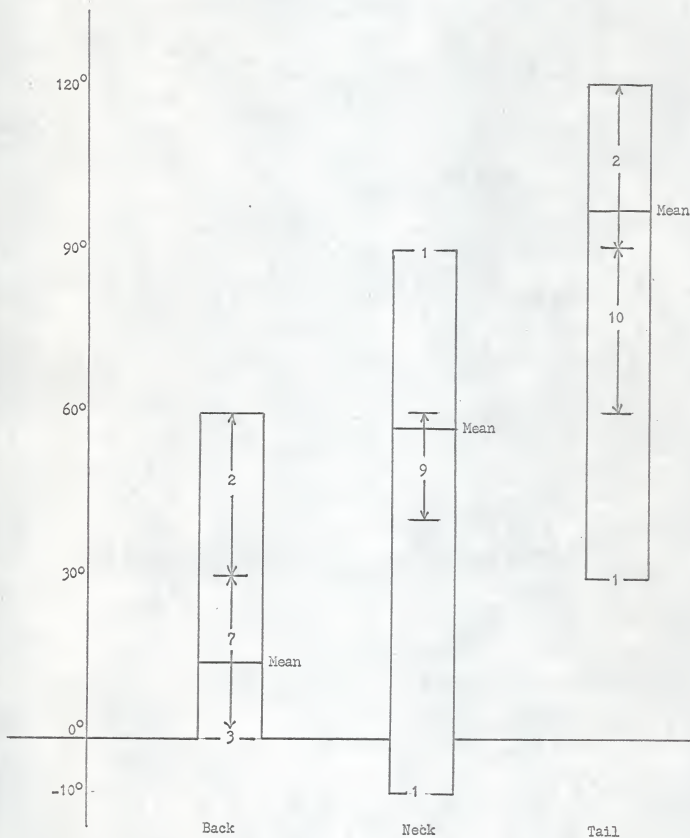
l low line

-- not measurable

EXPLANATION OF PLATE V

Graph of threatening stance, including angles of back, neck and tail.

PLATE V



Angle of Neck with Floor. These angles varied from -10° to 90° with only one measured at each end of this range. Six birds registered angles of 60° and three were between 40 and 50° . The mean was 58.07° , indicating a pronounced elevation of the neck.

Angle of Tail with Floor. This angle again seems to indicate level of excitement, since in the threatening stance six out of the 13 measurements were 90° and four were between 60 and 90° . Only one angle observed was as low as 30° and only two were between 90 and 120° . A mean of 81.54° was obtained. It should be noted that a vertically erect tail is often spread horizontally, and that a lowered tail is usually not spread, but folded compactly.

In review, birds in a threatening stance exhibited a slightly raised body-to-floor angle, with a mean of 23.75° . Neck and head were also raised with a mean angle of 58.07° from the floor. The tail in a threatening bird was nearly erect, averaging 81.54° from the floor.

Pecking Stance

Measurements of the pecking stance were made on birds while actually in the act of delivering a peck to the body of the other bird (Plate IV). The bird being pecked was not studied. Several individuals were measured more than once.

Angle of Body with Floor. Measurable angles of the back with the floor were observed in only 17 out of 23 contests. The measurements varied from -30 to 60° (Table 3, Plate VI). Two birds measured -30° ; five, 0° ; eight between 0 and 30° ; and two between 30 and 60° . The angle observed depended to some extent at least on the position of the other bird, since the

TABLE 3. Pecking Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
3	Yh	I 1012	15	60	--
4	GGh	I 1463	15	50	90
6	Rh	II 877	-30	0	90
11	Yh	III 587	0	45	90
11	GRL	III 629	30	--	120
15	RRh	III 1674	0	-10	110
18	GRh	IV 509	35	45	60
21	Yl	IV 1605	45	45	60
23	YYh	V 262	25	60	240
24	RRh	V 652	15	15	75
30	G1	VI 242	30	30	90
31	VVh	VI 420	0	0	120
34	GGh	VI 945	--	-60	90
39	Yh	VII 213	-30	-30	60
40	Rh	VII 453	--	90	90
41	VVh	VII 941	0	-60	90
42	RRh	VII 1169	15	-15	90
45	GRh	VII 2021	--	0	--
47	Vh	VIII 260	60	60	45
48	Yh	VIII 467	--	-30	--
53	Vh	IX 263	--	90	--
57	RRh	IX 844	--	--	--

TABLE 3. (cont.) Pecking Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
63	Yh	X 453	0	0	60
64	Rh	X 758	--	--	90
		Mean	13.24	18.33	92.63
		Range	-30 to 60	-60 to 90	45 to 240

^a Capitals color

h high line

l low line

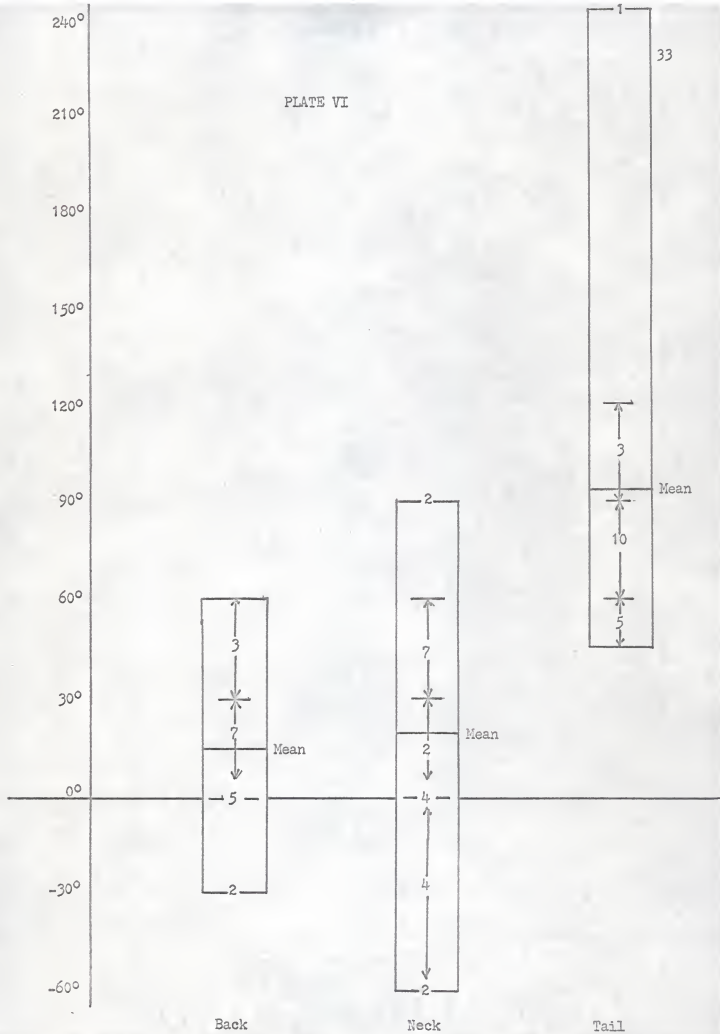
-- not measurable

EXPLANATION OF PLATE VI

Graph of pecking stance, including angles of body, neck and tail.

PLATE VI

33



pecking individual had to reach the other in order to deliver the peck. The mean of the 17 measurements was 13.24° , or slightly raised.

Angle of Neck with Floor. These measurements ranged from -60 to 90° . Here again, the angle was dependent on the position of the bird being pecked. Six measurements out of 21 were obtained between -60 and 0° , four at 0° , two between 0 and 30° , seven between 30 and 60° , and two at 90° . The mean for this angle was 18.33° . This was slightly higher than that for the body-to-floor angle.

Angle of Tail with Floor. The mean angle of the tail with the floor was 92.63° . The measurements varied from 45 to 240° , with 10 of the 18 angles in the 60 to 90° range. Four birds measured between 45 and 60° , and four between 90 and 240° . Once again in an "exciting" situation, the tail was held erect while pecking.

Generally, the pecking stance involved a slightly raised body in relation to the floor (mean angle of 13.24°) and a slightly raised neck and head (mean angle of 18.33°). The tail was erect in this posture with an angle of 92.63° with the floor.

Fighting Stance

Angles were measured for both birds of a pair during a fight. A fight was considered to be an exchange of pecks, but some involved the use of feet and wings (Plate VII). Both birds were measured in the same frame of the motion picture, and the choice of frame was highly subjective. The experimenter attempted to select a frame in which both birds were fighting freely, and where one had not begun to dominate the other. It would be possible to obtain almost any angle for any pair of birds during the course of a fight, due to their constant changing of positions and rapid movements.

EXPLANATION OF PLATE VII

- Fig. 1. Fighting birds exhibited nearly all stances, as evidenced by the differences between these fighting birds.
- Fig. 2. Front bird shows submissive crouch while rear bird assumes neutral posture.



Fig. 1



Fig. 2

Angle of Body with Floor. Twenty-two measurements of the angle of body with floor were made, ranging from 0° to 60° (Table 4, Plate VIII). One bird measured 0° , nine from 0 to 30° and 12 between 30 and 60° . The mean for the measurements was 40.33° .

Angle of Neck with Floor. Of 23 angles measured, only one was as low as 30° . Eleven measured between 30 and 60° and 11 between 60 and 90° . A mean of 71.73° was obtained, signifying an erect posture of the neck and head.

Angle of Tail with Floor. These angles varied from 45 to 240° . Eight measurements were recorded between 45 and 60° , eight at 90° , one at 120° , three between 150 and 180° , and two between 180 and 240° . The mean was 102.95° . The tails were relatively erect during a fight. It must be remembered that on a bird with its body inclined to the floor at an angle of 40° , as was the average for fighting birds, an average tail-to-floor angle of 103° represents a very erect back-to-tail angle of 60° .

It was noted that practically every possible angle was assumed by fighting birds during the course of an encounter, hence no particular measurement was indicative of a fighting bird. The averages presented in this study were made while the birds were fighting freely. The mean angle for the body with the floor was 40.33° ; for the neck with the floor, 71.73° ; and for the tail with the floor, 102.95° . The range of the values was large.

Crouching Stance

The crouching stance was adopted by submissive birds without any aggressive behavior on the part of the other, as a result of a threat or peck by the dominant bird, or following a fight (Plate VII). More crouches

TABLE 4. Fighting Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
3	Yh	I 1026	60	60	150
3	RL	I 1026	30	--	90
4	GRl	I 1468	45	60	60
4	GGh	I 1468	30	60	90
11	GRl	III 598	60	60	--
11	Yh	III 598	45	45	225
18	RRl	IV 520	--	90	90
18	GRh	IV 520	45	75	60
23	YYh	V 272	45	90	240
23	RL	V 272	--	90	--
24	VVl	V 659	45	90	60
24	RRh	V 659	15	60	90
34	RRl	VI 976	30	60	90
34	GGh	VI 976	30	90	120
40	RL	VII 526	60	90	180
40	Rh	VII 526	30	90	180
42	RRl	VII 1121	15	90	45
42	RRh	VII 1121	30	60	45
53	Vh	IX 322	60	90	90
53	RRl	IX 322	0	90	60
57	RRh	IX 862	60	60	90
57	RL	IX 862	60	60	90

TABLE 4 (cont.) Fighting Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
60	G1	IX 1488	30	30	60
60	GRh	IX 1488	60	60	60
64	YY1	X 842	--	--	--
64	Rh	X 842	--	--	--
		Mean	40.33	71.73	102.95
		Range	0 to 60	30 to 90	45 to 240

^a Capitals color

h high line

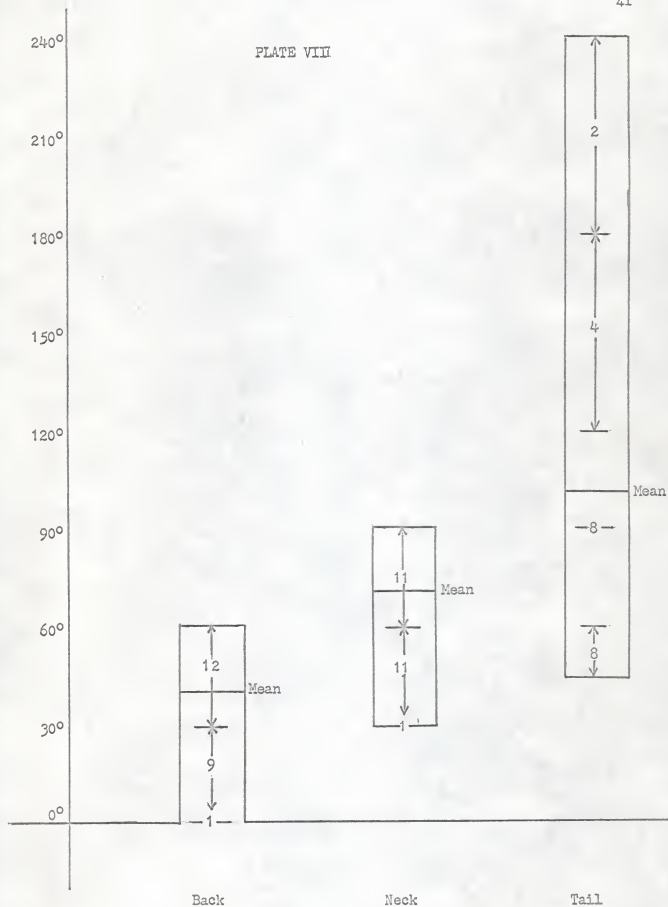
l low line

-- not measurable

EXPLANATION OF PLATE VIII

Graph of fighting posture including angles of back, neck and tail.

PLATE VIII



were noted than any other behavior pattern studied, and the crouch was also the most uniform of the stances.

Angle of Body with Floor. Twenty-eight of the 33 measurements obtained were 0° (Table 5, Plate IX). The angles ranged from -45 to 15° , with four between -45 and 0° and only one at 15° . The mean obtained was -2.27° . For all practical purposes the back may be considered parallel to the floor in the crouch.

Angle of Neck with Floor. Nineteen of these angles (total = 32) were 0° . The measurements varied from -60 to 90° . Nine angles were between -60 and 0° , three were between 0 and 30° , and one measured 90° . The mean was -4.22° . The neck appears to be characteristically parallel to the floor, or slightly dipped in the crouch.

Angle of Tail with Floor. The mean obtained for the angle of the tail with the floor was 174.31° . The range of measurements was 60 to 210° , with three between 60 and 90° , and 22 between 180 and 210° . In nearly all cases the tail was parallel to the floor or dipped slightly below the horizontal.

Crouching behavior was the most uniform behavior pattern observed in this study. The body was usually parallel with the floor as were the neck and head. The tail was very low, in fact, practically parallel with the floor with a mean angle of 174.31° .

DISCUSSION

In order to further define the postures involved in the apprehensive stance, threatening, pecking, fighting and crouching of the chicken, it is necessary to consider the variation between the various behavior patterns within each angle studied.

TABLE 5. Crouching Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
3	Yh	I 1052	-15	--	210
6	VV1	II 895	0	0	--
7	RRh	II 1256	0	0	60
11	Yh	III 605	0	0	180
11	Yh	III 635	-45	-45	210
15	Y1	III 1691	-20	-30	180
17	GVh	IV 293	0	0	60
18	RR1	IV 637	-10	0	180
19	Gh	IV 964	0	-15	195
21	Y1	IV 1730	0	0	210
23	R1	V 451	0	0	90
24	RRh	V 750	0	0	180
27	GRh	V 1438	0	0	180
30	Rh	VI 251	0	-15	195
31	Y1	VI 432	0	0	195
34	GGh	VI 988	0	-30	--
38	Vh	VII 98	0	15	180
39	Y1	VII 227	0	-60	210
40	Rh	VII 693	0	0	180
41	VV1	VII 953	0	0	180
42	RRh	VII 1319	0	0	180
44	GVh	VII 1720	0	0	165
46	Gh	VIII 119	0	30	150
48	Yh	VIII 531	0	0	180

TABLE 5 (cont.) Crouching Stance

Contest Number	Contestant Code ^a	Reel and Frame No.	Angles		
			Back with Floor °	Neck with Floor °	Tail with Floor °
52	Gh	IX 110	15	15	195
53	Vh	IX 336	0	-30	210
55	Rh	IX 579	0	0	180
57	RRh	IX 889	0	0	180
60	G1	IX 1554	0	90	120
62	Vh	X 311	0	0	210
63	VV1	X 597	0	-30	--
64	Rh	X 861	0	-30	210
65	GR1	X 1107	0	0	--
		Mean	-2.27	-4.22	174.31
		Range	-45 to 15	-45 to 90	60 to 210

^a Capitals color

h high line

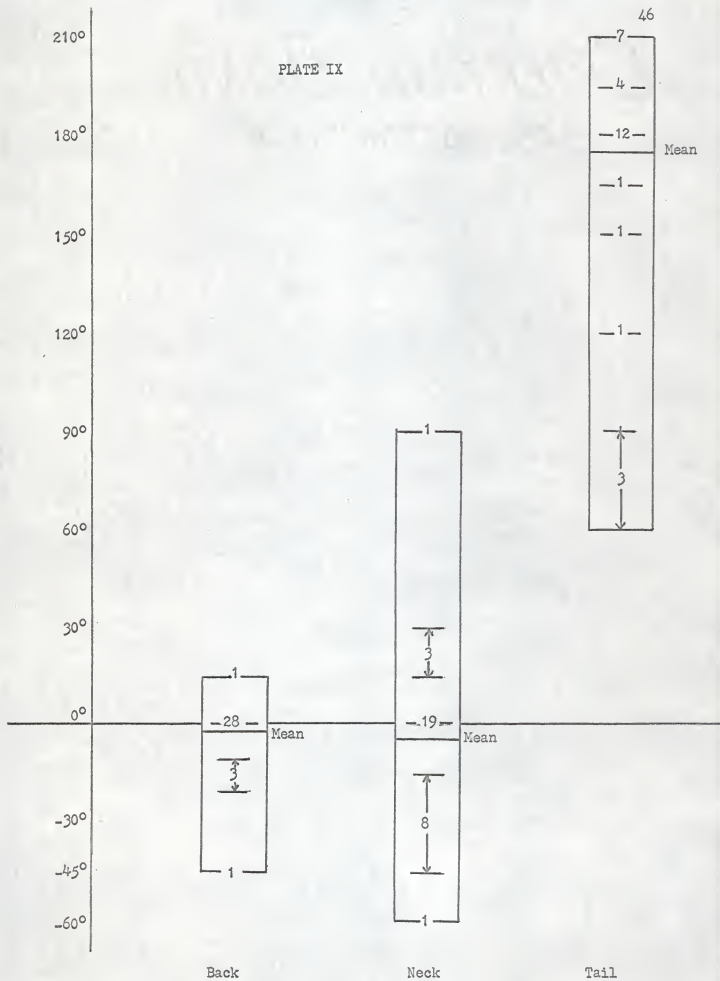
l low line

-- not measurable

EXPLANATION OF PLATE IX

Graph of crouching stance including angles of back, neck and tail.

PLATE IX



Angle of Body with Floor

The crouching posture exhibited the lowest mean angle of the body with the floor, -2.27° . Apprehensive birds had a slightly more inclined back, with a mean angle of 8.33° . The pecking stance showed a mean angle of 13.24° . The moderate mean inclination here is probably due to the fact that the pecking bird often had to stretch itself out and lower its body in order to land the peck on the other bird. The main angle of threatening birds was relatively high, 23.75° . The largest mean angle, 40.33° , was shown by fighting birds.

Generally as the level of aggressiveness increased, the angle of the back with the floor also increased. This was not true with regard to the pecking stance, however, because the pecking individual was required to stoop in order to reach the other bird. The ranges of the body-to-floor angle overlap for each of the stances studied, so this measurement alone will not necessarily define the stance held by an individual bird.

Angle of Neck with Floor

Once again, the lowest mean angle of this measurement (-4.22°) was shown by birds in the crouching posture. A considerably higher mean value was exhibited by pecking birds (18.33°), while apprehensive birds in this case were higher yet (33.06°). The birds in the threatening posture compiled a mean angle of 58.07° which was surpassed only by the value for the fighting posture of 71.73° .

Increasing level of aggressiveness once again was indicated by increasing mean angles, except in the case of the pecking stance. This anomaly may be explained by the modification of posture necessary to deliver a peck. The ranges of this measurement overlap also.

Angle of Tail with Floor

The highest mean angle was here shown by the crouching birds. This mean of 174.31° was nearly parallel to the floor, and as such may indicate as low level of excitement. Apprehensive birds had the next higher mean, 156.17° , again showing a low excitement level. The three "active" behavior patterns, threatening, pecking and fighting, had closely related means of 81.54° , 92.63° and 102.95° respectively, with considerable overlap within the ranges of the three measurements. These angles may be considered indicative of "excited" birds, since all three postures had means near 90° .

Determination of Stance by Observing Angles

While the ranges of the above measurements were shown to overlap, it is usually possible to determine which stance an individual bird is in by observing the angles of its back with the floor, neck with floor and tail with floor. All three measurements are necessary for this determination. For example, it is observed that the crouching and apprehensive stances are similar, especially the angles of the body with the floor, with both means near 0° . It will be noted, however, that when the angle of the neck with the floor is considered, the angles will seldom be confused. This angle was as low as 0° only twice in 18 measurements for the apprehensive stance, and was never a negative value. In the crouching stance, the neck-with-floor angle was greater than 0° in only four out of 32 measurements. The mean angles for the two postures were -4.22° for the crouch, and 33.06° for the apprehensive stance. The mean angles for the back with the tail of the two stances were similar, 156.17° for the apprehensive stance and 174.31° for the crouch. There was considerable overlap between the two sets of measurements.

Differences between the threatening, pecking and fighting stances were also apparent. It has already been noted that the angles of the body with the floor and the neck with the floor for pecking birds was determined by the location of the bird being pecked. The tail was usually quite erect in this stance, indicating a high level of excitement.

Threatening birds were characterized by moderately inclined bodies (mean body-to-floor angle of 58.07°) and quite erect tails (mean angle of 81.54°). These angles were quite well grouped around the means with the exception of one or two readings for each angle.

Fighting birds, as measured in this study, had the highest value for body and neck angles with the floor (mean values of 40.33° and 71.73° respectively) and showed generally erect tails with a mean of 102.95° . There was considerable variability within each angle of this stance. Lowered readings for the tail angle may indicate that the bird was beginning to lose the contest at the time the measurements were made, or the low reading may have something to do with maintaining balance during a furious fight.

The above data may suggest that the angle of the neck with the floor is the best single measurement for characterizing each stance. Differences within this measurement between stances were greater and more uniform than in other angles measured. The mean angles were as follows: crouch, -4.22° ; peck, 18° ; apprehensive stance, 33° ; threat, 58° ; and fight, 71° . This finding agrees with that of Guhl and Ortman (1953) that features of the neck and head were more important than other features for individual recognition. It is logical to assume that the position of the neck and head will be an important stimulus character also.

Genetic Strain and Type of Behavior

Although not a part of the present study, it is interesting to note that although birds of the high-aggressiveness line threatened nearly four times as often as the low-aggressiveness birds (11 to 3), and pecked seven times as often (21 to 3) the high line crouched twice as often as the low line (22 to 11). Although the size of the sample was quite small, these data seem to indicate separate thresholds for aggressiveness and submissiveness. Even though the high line birds were quick to begin a fight, indicating a low threshold for aggressiveness, their low threshold for submissiveness was shown by their willingness to give up easily.

Correlation of This Study with Other Work

As was noted above, the original work on postures with chickens was done by Foreman and Allee (1959). The postures cited by them were adopted from boxing stances and as such were primarily concerned with the degree of flexion of the legs. This work was largely subjective, and involved stances termed "tall," "low," "deep crouch" and so on. They made no attempt to define their stances in objective terms.

The present study was an attempt to develop a method for determining an objective, numerical measurement to define each stance taken by birds during initial pair encounters. The numerical standards will be constant regardless of the experimenter involved and will be subject to statistical manipulation.

Although the flexion of the legs was the main consideration in the work of Foreman and Allee, this was not measured in the present study. It seemed that other factors measured would be more likely to serve as stimuli

for the interacting birds, in addition to the fact that accurate measurements of the leg angles would be very difficult or impossible to make due to the feathers covering the shank and the frequency of which the birds were at an angle to or facing the camera. In practically all stances the legs were bent to some degree, but the variability was not as great as in the angles noted.

SUMMARY

Agonistic postures during initial pair encounters in the domestic fowl were studied by a time and motion analysis of motion picture films. Apprehensive stance, threatening, pecking, fighting and crouching behavior patterns were investigated, through detailed study of the postures of the body, neck, tail and wings. This research was an attempt to develop a method for determining an objective, numerical measurement to define each stance enumerated.

Motion pictures were taken during initial pair encounters of White Leghorn Hens. The birds were fifth generation descendants of lines bred at Kansas State University for high and low levels of aggression. Films were analyzed with the aid of a Bell and Howell time and motion study projector, which permitted detailed study of single frames. Angles of back with floor, neck with floor, and tail with floor were determined for each stance studied.

Apprehensive birds usually assumed the following posture: the body was parallel or very slightly elevated from the floor, the neck was raised slightly and the tail was lowered. Birds in a threatening stance exhibited a slightly raised body-to-floor angle, raised head and erect tail.

Generally the pecking stance involved a slightly raised body in relation to the floor, a slightly raised neck and erect tail. During a fight, birds assumed nearly all possible stances. The backs of crouching birds were nearly always parallel to the floor, with the neck and tail either parallel or dipping below the level of the back.

It was suggested that the angle of the neck with the floor was the best single measurement for characterizing each stance. Differences within this measurement between stances were greater and more uniform than in the other angles measured. Generally as the level of aggression increased, the angle of the back with the floor and the angle of the neck with the floor also increased. This was not true in the case of the pecking stance, however, since pecking individuals were required to stoop in order to deliver pecks. This posture was dependent on the position of the birds being pecked. The angle of the tail with the floor seemed to indicate general level of excitement, since it was low in the apprehensive and crouching birds, and high in threatening, pecking and fighting individuals.

Differences in the relative frequency of birds from the high and low strains exhibiting the various behavior patterns indicated separate thresholds for aggressiveness. The high-aggressiveness line was more aggressive in beginning encounters, but crouched twice as often as the low line.

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APPENDIX

Sequences of Behavior Patterns

Time	(t) to decision	
	(t) to fight	
	(t) to peck	
	(t) to threat	
	<u>Latency to</u> <u>1st soc.act</u>	
	Winner	
	<u>Persuit</u> <u>walk</u> <u>drive</u>	
Avoidance	<u>Escape</u> <u>step aside</u> <u>walk away</u> <u>run</u>	
	<u>Crouch</u> <u>head low</u> <u>wings spread</u> <u>tail low</u>	
Attacks	<u>Fight</u> <u>exchange pecks</u> <u>use feet</u>	
	<u>Pecks on</u> <u>head</u> <u>neck</u> <u>body</u>	
	<u>Threat</u> <u>head high</u> <u>hackle up</u> <u>tail up</u>	
	No Social Interactions	
	<u>Apprehensive</u> <u>freezes</u> <u>defecation</u>	
	Reel and Frame No.	
	Contestants	
	Contest Number	

Apprehensive Stance

Wings		
	Spread-angle with back	58
	Contracted	
	Stance neutral	
	Stance frozen	
Tail	Not spread	
	Spread	
	Angle with back	
	Angle with floor	
Neck	Hackle raised	
	Hackle smooth	
	Retracted	
	Extended	
	Angle with back	
	Angle with floor	
Back angle with floor		
Reel and frame		
Contestant		
Contest Number		

Threatening Stance

Wings	Spread-angle with back	59
	Contracted	
Stance neutral		
Stance frozen		
Tail	Not spread	
	Spread	
	Angle with back	
	Angle with floor	
Neck	Hackle raised	
	Hackle smooth	
	Retracted	
	Extended	
	Angle with back	
	Angle with floor	
<u>Back</u> angle with floor		
Reel and frame		
Contestant		
Contest number		

Pecking Stance

Wings	Spread-angle with back	60
	Contracted	
Stance neutral		
Stance frozen		
Tail	Not spread	
	Spread	
	Angle with back	
	Angle with floor	
Neck	Hackle raised	
	Hackle smooth	
	Retracted	
	Extended	
	Angle with back	
	Angle with floor	
<u>Back</u> angle with floor		
Reel and frame		
Contestant		
Contest number		

Fighting Stance

Wings	Spread-angle with back	61
	Contracted	
	Stance neutral	
	Stance frozen	
Tail	Not spread	
	Spread	
	Angle with back	
	Angle with floor	
Neck	Hackle raised	
	Hackle smooth	
	Retracted	
	Extended	
	Angle with back	
	Angle with floor	
	<u>Back</u> angle with floor	
	Reel and frame	
	Contestant	
	Contest number	

Crouching Stance

Wings	Spread-angle with back	62
	Contracted	
Stance neutral		
Stance frozen		
Tail	Not spread	
	Spread	
	Angle with back	
	Angle with floor	
Neck	Hackle raised	
	Hackle smooth	
	Retracted	
	Extended	
	Angle with back	
	Angle with floor	
<u>Back</u> angle with floor		
Reel and frame		
Contestant		
Contest number		

TIME AND MOTION STUDY OF AGONISTIC POSTURES DURING
INITIAL PAIR CONTESTS IN THE DOMESTIC FOWL

by

RICHARD HOWARD WILSON

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Agonistic postures during initial pair encounters in the domestic fowl were studied by a time and motion analysis of motion picture films. Apprehensive stance, threatening, pecking, fighting and crouching behavior patterns were investigated, through detailed study of the postures of the body, neck, tail and wings. This research was an attempt to develop a method for determining an objective, numerical measurement to define each stance enumerated.

Motion pictures were taken during initial pair encounters of White Leghorn Hens. The birds were fifth generation descendants of lines bred at Kansas State University for high and low levels of aggression. Films were analyzed with the aid of a Bell and Howell time and motion study projector, which permitted detailed study of single frames. Angles of back with floor, neck with floor, and tail with floor were determined for each stance studied.

Apprehensive birds usually assumed the following posture: the body was parallel or very slightly elevated from the floor, the neck was raised slightly and the tail was lowered. Birds in a threatening stance exhibited a slightly raised body-to-floor angle, raised head and erect tail. Generally the pecking stance involved a slightly raised body in relation to the floor, a slightly raised neck and erect tail. During a fight, birds assumed nearly all possible stances. The backs of crouching birds were nearly always parallel to the floor, with the neck and tail either parallel or dipping below the level of the back.

It was suggested that the angle of the neck with the floor was the best single measurement for characterizing each stance. Differences within this measurement between stances were greater and more uniform than in the other angles measured. Generally as the level of aggression increased, the

angle of the back with the floor and the angle of the neck with the floor also increased. This was not true in the case of the pecking stance, however, since pecking individuals were required to stoop in order to deliver pecks. This posture was dependent on the position of the birds being pecked. The angle of the tail with the floor seemed to indicate general level of excitement, since it was low in the apprehensive and crouching birds, and high in threatening, pecking and fighting individuals.

Differences in the relative frequency of birds from the high and low strains exhibiting the various behavior patterns indicated separate thresholds for aggressiveness. The high-aggressiveness line was more aggressive in beginning encounters, but crouched twice as often as the low line.