DR. McCLARY: There have been some comments, questions and suggestions concerning the time of our meeting next year. We ask for an expression of the wishes of those in attendance and then the Board will decide, not necessarily according to what you want to do, as they have told us in the past. But I think some years past it has been suggested that this meeting be held to coincide with the American Feed Manufacturers Association, and that is what was done this year.

Someone has suggested that we try to get away from complete weekend meetings by holding the PBA meeting on Thursday and then the Poultry Breeders Roundtable meeting on Friday and Saturday. Since you college people are such a necessary part of our meeting, we want to do what will fit in with their plans.

I know in the past it has been difficult for some people with teaching duties to get away from their teaching on school days. That was the original reason, I understand, for having it on the weekend. So tomorrow morning we will ask for an expression of your wishes in regard to holding the meeting at the same time with the American Feed Manufacturers Association or immediately before or after, and also getting away from a complete weekend meeting.

Now without further comments we will get into the program. In the introduction this morning I couldn't help but notice the absence of [name] and Dickerson, and they have been in the forefront of our meetings in the past and I hope they get to the meeting this year before it is over. (Inaudible)

Dr. Lush set a good example for us this morning in conducting the meeting.
and the discussion of the topics, and we will try to equal his example. We will abide by the same rules. We will ask you to please speak up in the case of questions in the discussion, please state your name before you state your question, always stand when you are asking your question. The middle mike is now working.

DR. BRILES: Please come to the middle of the room and use the mike.

DR. McCLARY: This morning we were kind of up in the clouds with the topic, Concealed Genotypic Variation, and these are traditionally the topics we hear about at this national Poultry Breeders Roundtable. In the beginning, the attitude was taken that we should strive for the top in our topics and discussion, and if they happen to relate to the industry in which we were involved that was all right, it wasn't objectionable, but we wouldn't try to bother with that particularly.

We are getting a little bit away from that this afternoon in that we are actually getting down to some topics that involve poultry. I think this is going to attain more importance, this particular topic or this phase of topics, in man's use of poultry environment.

I think we are fortunate in having Dr. Guhl as our speaker this afternoon, a man of his ability in leading this work, both in his ability to interest other people in this special work and his persistent pursuit of the work himself. Now I don't think it is necessary to take valuable time from his time in giving a detailed pedigree of Dr. Guhl. I think most of us, practically all of us, have heard him talk before and are familiar with his work the past several
years at Kansas State University in the field of the behavior of chickens. He was the featured speaker at the World Poultry Congress in Sidney, Australia, last summer. I was fortunate enough to hear him there, and I can assure you that his paper was one of the most interesting at the Congress.

Dr. Guhl tells me he will use slides in his talk and that his talk will pave the way for the next speaker. This again is a good example of teamwork here, teaming up with Dr. Craig in pursuing this problem.

It is a pleasure, Dr. Guhl, to have you present your paper.
DEVELOPMENT AND MAINTENANCE OF THE SOCIAL STRUCTURE IN POULTRY FLOCKS

A. M. Cuhl
Department of Zoology
Kansas State University

The early history of the domestication of chickens revolves around cock-fighting (Hale, 1962). Aldrovandi (Lind, 1963) nearly 400 years ago gave historical accounts of how fighting cocks served to stimulate courage in troops. Selective breeding focused on behavior; later it was on appearances by fanciers; and most recently on egg production and broilers, almost to the exclusion of behavior. Certain behavior traits might also be eliminated when undesirable. Goodale et al (1920) showed that broodiness was inherited; Riddle et al (1935) and Byerly and Burrows (1936) demonstrated the relation between broodiness and the hormone prolactin; and Saeki (1957) found indications that broodiness is sex-linked. Although some traits are objectionable in certain phases of poultry production, they may not be without value in other respects. For example, Hutt (1962) suggested that broodiness may have beneficial effects on viability. To one interested in behavior it was surprising that problems with fertility were investigated in various ways other than with sexual behavior. Hale (1955) showed that the high infertility among Broad Brasted Bronze turkeys was due to marked variation in the levels of sex drive in both males and females.

Two very general questions may be raised here to give this afternoon's presentations some goal for deliberation. First, with the potentials of modern genetics, and especially with artificial insemination, could desirable patterns of behavior be placed in jeopardy? For example, with selection directed toward a few desirable traits and to the exclusion of reproductive behavior, could the
results inadvertently develop strains that could not reproduce themselves normally? On the positive side, could strains be produced that may be more adjustable to maintenance in groups or to individual cages?

SOCIAL ORGANIZATION

Various domestic animals establish some kind of social organization based on aggressiveness (Hafez, 1962), and the more they are confined as groups the more significant the social order in their activities and in management. A brief description of the peck-order among chickens may serve as a background.

When individuals are marked by colors, or numbered tags, they can be identified. Records can be made, in code by color or number designations, of pecks and threats according to the one pecking and the one pecked. When these are tabulated on a chart it will be noted that domination is in one direction between any two individuals, that is, peck-rights are established. The birds may then be ranked in an order according to the number of individuals each may dominate by pecking without retaliation. This is the social order or peck-order. The order may be a straight line hierarchy or be geometrical due to pecking triangles. Each bird has precedence in competitive situations over those listed beneath it. Thus special habits are formed by each bird toward each of its flockmates. As these habits become fixed by reinforcement, these attacks and avoidances become less severe, or symbolic, and less frequent. With this reduction in social tension, energy is conserved and the flock becomes integrated.

When is the social order established? Chicks reared together begin to form some social dominance relations at about five weeks of age. Cockerels being more aggressive than pullets, begin earlier and with more intensity, and keep the females from feeders if not separated. Social habits are formed early
and the establishment of social inertia facilitates integration; thus making an ideal flock as far as reduced social tension is concerned.

Birds reared on a range present critical problems when housed at sexual maturity, since many of them meet as strangers. As adults or subadults they have the tendency to establish social dominance relations when they first meet as strangers. These first meetings are called initial encounters and result in fighting and pecking to form peck-rights. Each individual engages each of the others before a social order is formed, and repeated engagements occur until social dominance relations are developed into habits and individual recognition is instantaneous. In large flocks this may require several weeks. If strangers are added to an organized flock they must engage each of the resident birds and since the numerical odds are against them they usually settle for bottom ranks. Furthermore, such birds are driven about, form strong escape reactions, are persecuted and become culls. Therefore all birds to be housed together should be penned on the same day. Integrated flocks may be subdivided but should not be combined.

Thus we can conclude that the peck-order has definite practical value in flock management. It is an order of precedence in all activities and therefore obviates the necessity for fighting in any competitive situation. It conserves energy and presumably increases feed efficiency. This has been demonstrated some years ago with small flocks (Guhl and Allee, 1944). With observations extending over 55 weeks, a well integrated flock was contrasted with one in which the peck-order was kept in a state of flux. It was found that organized birds had less social tension, consumed more feed, and laid more eggs than did unorganized birds.
From the viewpoint of individual birds, high rank is associated with advantages since these birds have a free run of the pen. The differences between those at top and bottom levels in the peck-order are commensurate with the level of flock integration and also with the attempts in flock management to reduce competition for feed, water and nests. McBride (1960) has shown that the relationship between rank and productivity is curvilinear and that the slope of the ascending curve is determined by management.

SEXUAL BEHAVIOR AND SOCIAL ORGANIZATION

Mating behavior is a chain reaction in which the behavior of one sex is the signal, or stimulus, that evokes the next step in the sequence. Psychological and physiological factors influence the initiation, progression, and culmination of this complex behavior.

Cocks usually dominate all the hens whereas older hens often dominate cockerels that are then unsuccessful in mating. It has been demonstrated that the passive dominance of cocks over hens facilitates mating (Guhl, 1949). It has also been shown that acquaintance between the sexes reduces tensions between the sexes (Guhl, 1961a), and that inexperienced cockerels need to be conditioned for mating (Justice et al, 1962). The social rank of males and females also exerts a psychological influence on successful mating.

Since cocks take the initiative in sexual behavior, and since relative freedom of activity is associated with rank, one would expect the frequency of mating to be a function of social position. With three males in a pen of hens the lowest ranking cock does the least courting and mating (Guhl and Warren, 1946). In fact, he may be psychologically castrated. The number "two" male may do most of the courting and treading, although he is less successful in completed
matings than the top ranked male. This results from interference by the most dominant male, who is distracted from the hens by his preoccupation with suppressing the sexual activities of the other males. Nevertheless the number of chicks sired is directly related to the rank of the male. Thus one cannot assume an approximately equal number of progeny from each of several males in a breeding pen.

The frequency of mating among hens as related to social position differs from that of the males. Hens at top levels in the peck-order mate less frequently than those at low levels. If this were not so, then there would be selection for high aggressiveness since most of the chicks would be progeny of ranking males and females. Let us examine the behavioral situation among the females.

The most aggressive hens at the top of the social order are in the habit of dominating others, and the more individuals they dominate the more the habit is established. Contrariwise those in lowest ranks are habitually submitting to their social superiors. Since mating is facilitated by male dominance and female submissiveness, i.e., crouching for the male, high rank among hens interferes with mating, whereas submissiveness by the hen stimulates the cock to mount.

This psychological situation was tested by subflocking (Guhl, 1950). Three males were exposed in rotation within a pen of about 30 hens and crouching behavior recorded over a period of 18 weeks. Then the flock was divided into top, middle, and bottom thirds of the peck-order, and tested with the same males for another 18 weeks. As can be seen from the figure, the hens of the top third crouched more often when subflocked, i.e., when the intensity of
domination was reduced, whereas the other thirds showed a decrease. These results suggest that more uniform mating can be obtained when the hens are in small flocks than when in large flocks. It may be of interest that turkeys, according to Hale (1953), also show a positive correlation between frequency of mating by toms and social position. The correlation is negative for the hens.

INTRA-STRAIN VARIABILITY

To the biologists and the geneticist in particular, an awareness of individual variation is basic to his concepts, and so it is with behavior. The peck-order is itself something of a distribution of levels of aggressiveness. However, since the social order is formed during chance meetings by pairs of strangers, the rankings are not as accurate a measure of aggressiveness as are initial paired encounters in which the conditions under which dominance is established are controlled (to be described later). Nevertheless a number of comparisons between ranks in the peck-order and number of initial pair contests won have shown fairly close agreement. Both methods of estimating levels of aggressiveness have been used to measure strain or breed differences as well as individual differences.

Tindell and Craig (1960) established 15 replicated small flocks of Cornell randombred pullets, in which one bird represented each of eight sire families. Mean social ranks in the peck-order for each sire family were obtained. Statistically significant differences between aggressiveness ranks of the sire families were found, indicating that genetic variation was present for aggressiveness. Cuhl et al (1960) crossed two strains and pursued a selective breeding program through the F₄ generation. Selection was for high
and low lines of aggressiveness in each sex. The results showed that selection for levels of aggressiveness was possible.

We turn now to consider the evidence for variability of sex drive. In testing for levels, males were caged within the pen of the females and released singly and successively for nine minutes each day. The order of release was rotated during successive days. Since these males could see and hear the females their sex drive was stimulated and was highest at the beginning and decreased progressively as sexual satiation developed. As can be seen from the figure, the cockerels varied in sexuality, and also that the sexual activity in one category, e.g., courting, was not an indication of the level of his activity in another category, such as evoking the sexual crouch in the females, or in treading (Guhl, 1951). However Siegel (1959) found a correlation between types of mating behavior, but a non-significant correlation between aggressiveness and treadings. Wood-Gush and Osborne (1956) tested 30 cockerels from six sire families and found significant differences between families in mating frequency. Working with turkeys, Hale (1955) found that males varied in their efficiency in completing matings from 12.5 to 97.5 percent. The sex drive interval in females ranged from 1.25 days to as long as 30 days. In chickens, we found that if the socially dominant male had a low sex drive that there was a reduction in matings because he interfered with the treadings of his subordinate males and failed to do much treading himself. Thus one cannot assume that each of several males in a breeding pen will sire a proportionate number of chicks.

Having considered within strain variability of social and sexual behavior, we might now examine various breed and strain differences.
BREED AND STRAIN DIFFERENCES

Breed and strain differences have been indicated by various factors that influence behavior either directly or indirectly. Fennell (1945) concluded that courage, aggressiveness, and shiftiness are hereditary in Game cocks, and that training, isolation, and sexual activity aid in the expression of these latent hereditary characters. Using small samples of seven breeds of chickens, Potter (1949) measured levels of aggressiveness by rank in the peck-orders as well as by initial pair contests. Analysis of variance indicated real differences between the ranks of hens from various breeds. The results of paired contests were confounded by reactions to breeds rather than to individuals, i.e., reactions were influenced by past experience with birds of the breed rather than with the individuals of another breed. Tindell (1962) found significant differences between 10 Leghorn-type strains when aggressiveness was measured by the initial pair contest method. Using intermingled and pure strain flocks of six diverse strains representing four breeds, the data obtained by Tindell and Craig (1959) showed significant strain differences in aggressiveness. It is of interest that differences between four breeds and three strains within one of the breeds were shown by Komai et al (1959) to have a high repeatability.

Strain differences in sexual behavior have had little attention until recently. Wood-Gush (1960) established high drive and low drive lines according to frequencies of mating. Consistent differences were found through the F3 generation. It may be of interest that his low drive line birds were better producers of semen. In a study of sexual maturity, Grosse and Craig (1960) compared 12 strains of six breeds. No significant strain or breed differences were obtained in age at first sperm collection, but the heavy breeds showed natural matings 4.9 weeks earlier than the Leghorn strains.
The gonadal, or sex hormones, are known to influence levels of aggressiveness and submissiveness in vertebrates (Guhl, 1961). The male sex hormone, androgen, increases aggressiveness whereas the female sex hormone, estrogen, appears to augment submissiveness. As is generally known, they also influence sexual behavior (Young, 1961). Allee and Foreman (1955) tested hens of six breeds by the pair-contest method before and after treatment with similar doses of an androgen. The breeds showed the same rank order in percent of contests won after treatment. If breed differences in aggressiveness were solely dependent on androgen levels then equal doses of the hormone should equate with levels of aggressiveness. Hale (1954) made a test with 15 capons each of New Hampshires and Barred Plymouth Rocks given 2.5 mg of testosterone propionate daily. The New Hampshires won 92 percent of the interbreed contests. Apparently breed differences may not be entirely related to differences, if any, of the amounts of androgen secreted by the testes. Related to these results are breed differences in responses to gonadotropic hormones. Jaap et al (1961) has reviewed this endocrine aspect and his experiment showed high heritability estimates.

Thus far it must be evident that research on genetic aspects of behavior have had but a beginning. We might now mention some avenues of study that have possibilities and may become of much interest to the behaviorist as well as the geneticist. Tameness as well as its opposite, wildness, serves as one example. At present the problem is one of definition and of the development of a reasonably reliable method of measurement. Komai and Guhl (1960) tried to introduce such a study. Although the method was rather imprecise, or crude, there was some evidence of strain and breed differences. Estimates of
heritability in picking by Dickerson et al (1961) indicated a 4 percent for individual picking behavior. Even under management designed to promote picking, heritability was lower than for general mortality and restricted to aggressiveness.

Pigment genes appear to have some relation to behavior in some species. Keeler and King (1942) related coat color genes to temperament and domestication in the Norway rat. A survey of the reports on birds by Lee and Keeler (1951) caused them to conclude that pigment variations possess correlates in the modification of morphology, physiology, and behavior. Closer to our interests, Hale and Buss (1960) had indications that black and buff female turkeys ranked higher in the peck-order than recessive whites, and the bronze genotype hens were the lowest. The Fayoumi fowl of each sex have either the barred or cumbian pattern, which, according to Crawford and Smyth (1961) segregate for a single gene difference affecting plumage pattern. Barred males and females have a higher sex drive than the cumbians, but the latter rank higher in the peck-order. To intrigue us further, the Russian Ponomarenko (1960) found breed differences in chickens in their conditioned reflexes. And Maas (1962) obtained statistically significant differences between two strains of mice in the serotonin in their brains. These mice were known to differ in exploratory behavior, in emotionality, and in fighting behavior.

THE MEASUREMENT OF AGGRESSIVENESS

Although ranks in a peck-order are an indication of relative levels of aggressiveness, the initial pair contest method is considered more reliable. Either technique is relative to the individuals tested since no standard opponent is devised. Therefore these measures are not absolute.

The initial pair contest offers some control over several factors that influence the outcome of such contests (Allee et al, 1939). An exhibition
cage may be used as a combat cage and should be placed in a neutral area. This method is based on the tendency of unacquainted birds to settle their dominance relations soon after they meet. If the birds to be tested have been in the same flock, they should be separated for about three weeks before testing since former dominance relations are usually lost during this interval. Interactions between such paired birds vary in intensity from fighting, through pecking, threatening, to avoidance without attack. Dominance relations are established when one consistently avoids the other. Decisions are often reached within a few minutes, and the birds are separated immediately to prevent psychological conditioning. We usually allow a maximum of 10 minutes per contest. If neither submits, or avoids, the contest is recorded as a "no decision" or "no win". When there is no interaction a "no contest" is recorded.

After all the pairings are completed the individuals can be ranked according to the number of contests won. In a series of contests each bird should have an adequate rest interval before paired again. This also prevents conditioning, since nothing makes for success as success, or for failure as failure.

There are essentially four variations in the technique for initial pair contests. They may be called (1) the caged contestant method, (2) the interpen contest method, (3) the teams or panel method, and (4) the random sample method. Each has its advantages and disadvantages. The usefulness of each technique depends on the number of birds to be tested and on the objectives of the test.

Caged contestants: In this method all of the birds to be tested are maintained individually in laying batteries. In the absence of direct social contacts former social relations are lost and the individuals enter the combat cage
without much, if any, conditioning related to social position, or peck-order effects. This method facilitates handling but may be quite time consuming if large numbers of birds are used. However, it does permit a complete round robin of tests, i.e., each bird can be tested with each of the others in the test situation. Fairly accurate selection for high and low levels of aggressiveness can be made, and this is its chief advantage.

**Interpen contests:** Since birds in different flocks are strangers to each other, each bird in one pen can be tested with each in one or more other pens. The only extra equipment needed is one or more exhibition cages to be used as combat cages. These should be placed in an area outside of the pens. There may be two disadvantages. Conditioning, or peck-order effects, are particularly evident with cockerels, and second, the birds may be quite disturbed during catching in the pen. This method is especially useful for testing for differences between lines or strains which are penned separately.

**Teams or panels:** (McBride, 1958) The number of contests required can be reduced by selecting 10 or more birds, varying in levels of aggressiveness, to act as a team against which others can be tested. This reduces the number of contests run for each individual and thus saves some time. The disadvantage is that the members of the team are used repeatedly and therefore may be conditioned for winning or losing, thus their original level of aggressiveness may be altered by learning.

We might at this point consider the amount of work involved by these three methods. By way of example, let us assume that 50 birds are to be measured for levels of aggressiveness. The caged contestant method would require 1,225 pairings, the interpen technique would reduce the figure to 625, whereas the panel
Random sampling: (Siegel, 1960; Craig, unpublished) This method might be considered as a modified interpen technique, and is most useful in testing for differences between lines or strains maintained in pure strain flocks, that is, it offers a convenient method of checking the progeny obtained by selective breeding. A bird from each pen is caught at random for pairing. The number of contests run would depend on the number of birds available, i.e., the number that would constitute an adequate sample of the lines compared.

The measurement of sex drive has more complicating factors than does the estimation of aggressiveness (Guhl, 1950a, 1950b, 1951, 1960; Guhl and Warren, 1946; Justice et al, 1962; Wood-Gush, 1958a, 1958b; Wood-Gush and Osborne, 1956). We might consider three questions. What should be recorded? Which important factors should be considered in designing the test situation? And third, what controls should be used in the procedures?

If large numbers of males are to be rated and time involved is limited, then the number of completed matings within standardized time limits will suffice. For more complete and detailed information the data may include the frequency of courting and of crouching elicited in the females, in addition to treadings. Recordings during observations may be made in code since these behavior patterns may occur in rapid succession.

We might mention some of the more important factors that influence the frequency of mating and that indicate some control in the procedures. Since sexual activity is most frequent late in the day, the tests should be made during late afternoons. The males should be exposed to the females singly and in rotation, because dominance relations between them affect mating. The females should be the same age, or younger, than the males to assure passive dominance
by the males. Since there may be preferential mating, and since the females may become sexually satiated, the number of females in the test flock should be sufficient for the number of males to be tested per day. Sex drive should be high in both sexes, therefore the males should be caged within the pen of the hens for adequate stimulation. Sexual satiation in the males may occur within 10 minutes, and longer exposure yields little addition information. Cockerels should have had previous experience in sexual behavior. For a satisfactory comparison of males, they should be tested with the same flock of females. Our experience has shown some daily variation, therefore as many daily tests per male should be made as the results appear to indicate and time permits.

COMPARATIVE PERFORMANCE OF STRAINS

An appropriate note upon which this brief review could be terminated might be some remarks on methods used to compare the performance of selected strains. Several published reports (Hess et al, 1960; Jaap, 1954; King and Bray, 1959; McDaniels and Craig, 1959; Proudfoot and Gowe, 1961; Tindell and Craig, 1959) have dealt with this subject and with differing conclusions, as might be expected.

The issue centers around two methods; the separate or pure strain flocks versus the mixed or intermingled flock method. Aside from physical factors and statistical design, we might consider some behavior factors that may enter into the plan for testing.

No matter how flocks are penned, each individual will develop special habits with regard to each of the others within the group. These habits persist as social inertia. From a behavioral viewpoint it then becomes obvious that the learning situations during peck-order formation should be worthy of some attention. We might examine the possibilities.
Birds reared together will develop their social habits as they develop and mature. Individual differences in growth rates, especially the maturation of the endocrine and reproductive systems, may affect the social rank attained and thereby the order of precedence at the feeder. In intermingled groups this factor may influence the results if the strains differ significantly in maturation rates, since social inertia will tend to maintain the order of feeding rights.

If the experimental flocks are housed after 8-10 weeks of age, or after aggressiveness is fully developed, then the manner of flock formation may influence the learning situation. No serious problems would be expected if all the birds of a flock were acquainted and had established social dominance relationships. However, if some were acquainted and others were strangers, then the stress would be upon the strangers. The more disproportionate the ratio of strangers to acquainted birds the more stress is placed on the smallest number, with a single stranger probably becoming a social cull within a short time. Since birds also make adjustments to the features and the facilities within the pen, resident birds would have an advantage over the newcomers. Another way to state this is to suggest that all birds to be placed into one pen should be assembled on the same day, or all the birds should be acquainted or all be strangers to each other. The data obtained should also consider whether the flocks are in the process of becoming integrated or whether they are well acquainted. If needed, the intensity of social stress could be estimated by recording the frequency of pecking within each flock.

The fact that some comparisons did not show strain differences in per-
formance does not preclude the possibility of differences between other strains. Unless the above factors were considered, it does not necessarily follow that there is no difference between the two methods of testing. We need more experimentation along this line to establish some standard of procedure as well as to obtain information on strains.

CITATIONS


DR. McClary: Do we have some questions?

Dr. Schultz: You mentioned that you had a test in which you mated three males with about 30 females. What kind of relationships did you get among the three males in various pens?

Dr. Guhl: You mean when I was testing for the receptivity of the females? One male at a time, but rotated. If I had 30 hens in there in the big flock I rotated three males to get a one-to-ten ratio that day. When they were subdivided, one male per flock per day.

Mr. Blunn: (Question inaudible)

Dr. Guhl: I have been wanting to come up and see that work, but I haven't had a chance. I believe you have to work that out for yourself. I like to use a code method. If I use color for identification, for instance yellow, I put a Y, then afterwards whatever I want to put down; or you use wing badges, number of wing badges, you could use color and number combinations, and you can work out a key. If you are thinking, for instance, for pecking, just take Y-G, that means green, then when I tabulate later, I can fill up the page in no time. If sex behavior I would put say Y, meaning the male, dash, and then I indicate which type of sexual behavior occurred, treading, courting, or what type of approach he had, if it was completed or incomplete. Then at the end I would put down the code for the female. Then I would have data for males and females.

Mr. Blunn: Then you have to take it to the IBM machines.

Dr. Guhl: These data don't come as fast as that. Of course you can make it come out fast. I like to use Leghorns because they are active, and studying sex behavior by caging the males you can build up sex drive and get a lot of
information in ten minutes. I am lazy, I guess. I think you might get more
accurate information if you watched a single male in a pen with the proper
number of hens in it but you won't get nearly as much data in the same amount
of time.

DR. CARSON: What effect does the size of the flock have on the establish-
ment of the social order? Do you get several social orders within large flocks?

DR. GUHL: There are some theories on that, with some fairly good evidence
for these theories. None of them are too convincing yet, but I think they are
worth thinking about. For instance, in this group here is a new social
organization. How many people do you recognize and know? If this were a
smaller group it would take us probably an hour or less to know each other
fairly well. There is your problem basically as far as being acquainted is
concerned. You can get a much larger group and if a certain group know each
other you have a _______ club, and some of the others are outside and you
don't contact them very much, and the farther apart they are the less you know
them and they tend to stay apart.

For instance, I have heard of cages with the different partitions, put
birds in a big pen, took out the ones in the center some place, another some
other place here, removed them, they were there since they were chicks, and there
was a wide space. In other words, there is what we might think of like a
territory that each one has.

I have seen situations where this theory wouldn't work at all. You break
up your feeding units and if you subscribe to this theory then you ought to have,
like you do in the city, you have a certain area where your stores, your
shopping center is, and then the neighborhood around that, and here is another
shopping center. You build up a shopping center with milk boxes, feeders and water.
MR. TINDELL: Would you care to speculate as to whether aggressiveness
and submissiveness are—

DR. GUHL: You want to know whether I would speculate on aggressiveness
or submissiveness are necessary what?

MR. TINDELL: Whether they are opposite extremes of the same traits or
whether they are different traits?

DR. GUHL: He knows I am curious about that very same thing. There is
some thinking that submissiveness is the other extreme of the breeding of
aggressiveness. I have reason to suspect that it is not, and I am trying to
collect information that they are probably separate behavior patterns. In the
first place, the male hormone stimulates aggressiveness, female hormone seems to
influence submissiveness. I am collecting some data on this that will illustrate
that. So we have physiological differences.

I don't know how many thousands of these initial ________ tests I have
run, but I have always noticed that some have a very low threshold of submissive-
ness. They are little bullies. They will start a fight in a minute, but will
quit like that (indicating). You will get another like a gamecock, where you
go to cockfights, and that is what interested me in cockfights is what happened
to submissiveness. I don't know whether it is bred out or not, because they
also give them training and they don't give you their secrets. But they are
trying to wipe out submissiveness, they fight to the death. That is as far as
I can go on it. You draw your own conclusions if you want to speculate.

DR. JONES: In looking at your chart there, it would seem likely that you
have more social stress in a small flock, that is, you have more pecks, and so on,
and yet when you get such things as a tough female among a large flock of birds,
this bird almost invariably suffers, whereas if you have the same bird by chance
included in a small breeding pen they frequently do quite well. Now, is this a matter that she is so different than the others that she becomes low in the peck order?

DR. GUHL: Might be several factors involved there. I would say it hinges chiefly around acquaintance. There was a man who worked several years ago on how the chickens recognize each other. He found that head features are very important and when you dub birds you are taking away the major portion of recognition. So in a large flock it is a little harder to get to know one bird in the flock from the others. There has been some other work done on this dubbing and non-dubbing at Virginia, Polytechnic has done some work, Siegels has done some work along this line, and it is basically a matter of recognition. It is hard enough to recognize everybody in a group this big or bigger without making it more complicated by trying to make them all look alike by all having army haircuts.

DR. WYATT: Does bird density seem to have any bearing? I mean if you give them less square feet of floor space per bird do you get more total peck encounters?

DR. GUHL: Frankly, I haven't any data on it. _______ in Australia is interested in something like this. He is bringing out a bulletin now on what he calls social density, which has some bearing on this very same point. But if you don't mind my showing the direction in which I am thinking rather than to say this is so, the closer you get people together, the more careful they are going to have to be about their reactions. If you have several chickens here, here is a very dominant one, this one is less so, and this one still less so, this one may want to peck this one, but if it did it might get pecked by this one.
So there is a certain amount of suppression due to the density. Does that make sense?

DR. SCHULTZ: We have been talking here about fairly small flocks. In a large flock, say of 500 to a thousand hens, has any work been done to determine whether territorial rights are established and may interact with social order? That is, might some bird be dominant in one area of the pen and submissive in another area of the pen?

DR. GUHL: We tried some of that. Jim, do you want to answer that?

DR. CRAIG: Our largest flock size was 400 and actually we had three flock sizes, 100, 200 and 400, and we had a building that we marked off on a grid. Then we would follow a hen for 15 minutes through the pen and watch her and record how much time she spent in each area.

Two things turned out of interest, two primary things. One is that the hen, individual hens had particular areas that they favored. So I think this tends to say yes to your question, there probably is some tendency for sub-flocking.

The other bit of information which supports this, too, we recorded all social interactions for these individual hens that we followed, and found that there was a low correlation, but significant, between amount of time spent in an area and the dominance ratio for that hen in that area. That is, where they spent the most time they were most likely to be higher in social rank, and when they got into a strange area they tended to be more submissive.

Another comment, actually aside from this, but since there seems to be a lot of interest in large flocks, and I think this is where the interest does need to go in the future, it might be surprising for you to know how many social interactions an hour an ordinary hen will encounter, and this is for flocks that
are organized. As you know, disorganized flocks are far more active. We observed about eight interactions an hour.

DR. SCHULTZ: Have you done enough work or have you reached a point to make some recommendations as to maximum number of hens to have in a pen for maximum fertility?

DR. CRAIG: I would like to suggest--Where is Shoffner? Let's put him on the spot. He has been working with McBride, who has been working on just this sort of thing. Is Shoffner here? We caught him out of the room, I guess. I think there is some information coming up, but I don't know the answer to this.

DR. GUHL: I think one answer is that we are trying to crystallize some of these problems to get more people in them more than just what a few can do.

DR. BENNETT: I am curious, you said you take birds in laying batteries and then put them into the ___________ cage for a test. Do you find a great deal of interaction between birds along the line or along the road in laying batteries? Would you have a difference if you had two birds that had been side by side in the laying battery, or if they had been two or three cages apart?

DR. GUHL: You mean as far as their fighting is concerned, or as far as egg production is concerned?

DR. BENNETT: Fighting.

DR. GUHL: Doesn't seem to make much difference. I have tried to get some data on that, but I can't. There is tremendous individual variation. You can get one very ornery individual that will disturb all the rest of them around her.

DR. BENNETT: I am curious, Dr. Guhl, when you made the statement that you didn't like the term preferential mating. Would you care to elaborate on that?
DR. GUHL: That is easy to answer. It assumes that the chickens know what they are doing. I prefer the term non-__________.

MR. KIMHELL: Have you checked to see if birds of one color are pecked more than birds of another color?

DR. GUHL: In a mixed group, you mean?

MR. KIMHELL: Yes, sir.

DR. GUHL: Have we broken that down, Jim?

DR. CRAIG: I don't think we have.

DR. GUHL: That is a very fascinating field to get into and I have been wanting to get into it, but other things have been more interesting. It has a lot to do with _________ problems, and so forth, which are background, and all I can say for the present, without any good data for it, is that if you raise them together they get to know each other as individuals very well. But if you don't and bring them together, then you may have separate groups. Take it from there.

DR. CRAIG: May I make a comment?

DR. GUHL: Yes.

DR. CRAIG: It is just my feeling that this matter of breed recognition is overstressed. I think the work that has been done has been done in very small numbers. I am not saying that this is not something that exists, but I just think maybe the emphasis is overstressed. The data that has been collected has been collected on very small groups and it is quite possible, it seems to me, that if a white bird loses to a black bird and then the next time it meets another black bird it loses again, this may reflect a difference in the potential
aggressiveness of those two stocks, just just breed recognition.

Now, Tindall and I in an experiment we did had three white Leghorn strains, and a ____________, Rhode Island Red and a White Rock all together, and I think there was clearly individual recognition, because we had a White Leghorn strain at the top, one near the middle and one near the bottom of those six strains. If it had been purely breed recognition I think all Leghorns would either have been toward the top or towards the bottom.

MR. BLUNN: I work with rats, not chickens, but I have noticed if I put black hooded and albinos together there is a God-awful fight and it is over in a hurry. If I put three albinos together the fight will go on for 15 or 20 minutes, sometimes a couple of days. We do get some differences there. If I am using the blues, dilutes, yellows and chocolates, they rarely fight. They get along beautifully. Probably a size difference there.

DR. GUHL: I think there is a difference between mammals and birds.

Paul Scott--

MR. BLUNN: I think so too.

DR. GUHL: Paul Scott and I get to talking about that every once in a while and we always draw the line, you know, "Oh, you know all about mammals," "You know all about birds," and we can never satisfy each other.

MR. SIMPKINS: Were these chickens you were working with debeaked?

DR. GUHL: We have had some that are; in some of these experiments they were and some they weren't. If I want birds I go to Jim Craig and say, "I need some birds." "Well, what do you want?" "Well, how about this?" If they are debeaked I take them; if they aren't it is all right too.

MR. SIMPKINS: Did you test the social structure on birds that were not debeaked and later debeaked?
DR. GUHL: I see your question. I did try it one time. I never published it in POULTRY SCIENCE, but I did publish in the trade journal. As far as position of social order is concerned, no, no difference. As far as interaction is concerned, you may get a difference in frequency of interactions, but not necessarily in position in the peck order. Big difference is the same as you have in polled cattle, or with men; if you carry a gun you are ahead of the other fellow.

DR. KING: Recently I had a chance to observe in California the use of red plastic contact lenses on chickens. I wonder if you would care to comment on what this might do to social order. As you know, plastic, in this size, at least, was not very good optically, and I don't think the chickens would be able to tell one from the other.

DR. GUHL: I wouldn't know. Of course they are attracted by red. Do they peck each other's eyes? They do as chicks when they start getting red. I don't know; sorry.

DR. KING: This technique was being used to control cannibalism and apparently very successfully so far.

DR. GUHL: If everything is red, you can't differentiate. That is the theory, isn't it?

DR. KING: Yes.

DR. McCLARY: I think they have raised some objections to this use of contact lenses, the optical people. Incidentally, they use some of the same lubricants. They found by using baby oil that the chickens would immediately scratch those out of the eyes, but they used this quick-drying lubricant the optical people use and it does stay in longer.
DR. BUSS: In establishing peck order is there an advantage or greater ease in using the male or the female? Can you establish peck order easier with males than you can with females?

DR. GUHL: No, with females. They are less aggressive. Male peck order is more apt to change, tends to be unstable, within certain limits as to the size of flock, of course. It is pretty hard to keep the peck order stable among cockrels. One way to look at that, we were talking about distribution here this morning, with the level of aggressiveness on the you would have rather sharp redistribution in the males and in the females. you have a wide distribution, it would follow pretty close to the males.

DR. McCLARY: We are moving along in our time here. I think you will have another shot at this after our break, and I think you can see, Dr. Guhl, from the questions, the interest in this field. I thank you for giving us a very good discussion here.

(Coffee break)

DR. McCLARY: Are you ready to proceed with the program, gentlemen?

I think this is perhaps the first appearance of Dr. Craig on our program, and maybe it will be in order to give a little of his pedigree. After studying at the Universities of Illinois and Wisconsin, he returned to Illinois where he did research and teaching. I think it was at Illinois teaching in which the following event occurred in one of his classes. I think this gives you an example of the thorough job he did in teaching students there.

It seems there was a young lady enrolled in his class and she studied diligently, took copious notes, and at mid-semester returned home, and in a father-daughter conversation she wanted to impress her father with how much she had learned, so she began to tell him all about the cells in our bodies, that
they contain chromosomes and these chromosomes have genes which determine our heredity traits, and she said, "You know, Daddy, there are boy chromosomes and girl chromosomes. You know how to tell them apart?" Not being a geneticist, he said, "No, how do they?" She said, "They just take the genes off!"

So Dr. Craig, we hope, will take the genes off of some of the chromosomes here and tell us what causes these chickens to behave the way that Dr. Guhl told us they do earlier in the program. Dr. Craig.

DR. CRAIG: This may sound pretty dull after that build-up.