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EARLY EXPERIENCE AS A VARIABLE IN
MATE SELECTION AMONG PIGEONS

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EARLY EXPERIENCE AS A VARIABLE IN
MATE SELECTION AMONG PIGEONS

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CHAPTER I

INTRODUCTION

Within the past ten years a great amount of research has been concerned with the effects of early experience upon later behavior. At least five survey articles covering various aspects of this field of investigation have recently appeared (Anastasi, 1958; Beach & Jaynes, 1954; Bindra, 1957; Drever, 1955; King, 1958). To a large extent, this research appears to have been stimulated by interest in three theoretical areas (Anastasi, 1958; King, 1958).

The first of these is psychoanalysis. Studies falling in this category have been primarily concerned with the effects of various degrees of traumatic childhood experience upon adult performance (Hall & Whitman, 1951; Hunt et al., 1947; Levy, 1934; Seitz, 1954).

The second area is the field of ethology. It would appear that formulations regarding the phenomenon of imprinting have proved especially stimulating to research

efforts. Investigations of this type have generally involved observing the effects of placing a young animal with a foster species to be reared. In addition, some studies have been concerned with the possible existence within the animal's life of critical periods during which learning of various kinds can be optimally accomplished (Cushing & Ramsay, 1949; Hess, 1958; Jaynes, 1956, Jaynes, 1957, Jaynes, 1958a, Jaynes, 1958b; King, 1957; Levine & Lewis, 1958; Moltz & Rosenblum, 1958; Ramsay, 1951; Scott, 1958b; Scott, Fredericson, & Fuller, 1951; Scott & Marston, 1950; Stanley & Monkman, 1956).

A number of investigations have also been stimulated by that aspect of the theory proposed by Hebb (1949) which postulates early sensory experience as a prerequisite for later learning ability. Most of these studies have dealt with the effects of various degrees of sensory deprivation in infancy upon later learning performance (Bingham & Griffiths, 1952; Forgays & Forgays, 1952; Forgas, 1955; Hymovitch, 1952; Siegel, 1953; Weininger, 1956).

Comparative Psychology and Mate Selection

The present investigation is a study of the effects of early experience upon mate selection in a lower order monogamous species. Advantages of the approach of comparative psychology are numerous. The life histories of laboratory subjects can be rigorously controlled and known in detail. Procedures can be introduced which enable the investigator

to obtain conditions which are not widely available under natural conditions. Responses of the lower animals are not complicated so much by the higher intellectual processes. Motives can be inferred directly from an empirical observation of behavior, and criteria can be well specified in advance. Certainly there are disadvantages. These cluster around the argument that, since human beings are not being dealt with directly, the results obtained may not be applicable to human behavior and are of no use to the psychologist.

Constriction of Interest in Comparative Psychology

These objections have not gone unregarded in the history of psychology. During the early growth of psychology as a science within the United States, and particularly during the period of 1900-1925, there was a high level of interest in the establishment of a Comparative Psychology. Both the number of articles dealing with the behavior of lower animals and the number of species utilized in these investigations were great. Gradually, however, the studies of psychologists have come to focus upon the direct study of human behavior and experience and upon the laboratory behavior of the rat. This trend has continued until today comparative psychology is an ill-defined, polymorphous area.

The problem of defining comparative psychology has not yet been solved. Since it is usually considered to be a method rather than an area of psychological investigation, it has, at least in this country, no

substantial subject matter of its own. In most cases comparative psychology is confused with learning experimentation involving animals or, sometimes, with any experiment in which animals are used (Hess, 1956, p. 305).

The present definition of comparative psychology in the United States seems to be: All psychology dealing with animals that is not treated under learning, motivation, and physiological psychology; or, to state it another way, studies on animals that do not conveniently fit anywhere else (Verplanck, 1958, p. 101).

A Method of Phyletic Comparison

Some psychologists, however, have maintained interest in the method and content of comparative psychology. Schneirla, Beach, Yerkes, Carpenter, Zuckerman, and Mowrer are but a few of these. But a majority of investigators have focused their efforts upon the study of primates, remaining as close phylogenetically as possible to human behavior.

Various authors (Beach, 1950; Schiller, 1952; Scott, 1953; Verplanck, 1955) have pointed to the pitfalls and restrictions which can result from a rigid narrowness of interest in psychology. They reason as follows: If psychology is to be a science concerned with behavior and experience, it should prove useful, if not mandatory, for psychologists to have data regarding the behavior of a great number of species obtained under a variety of conditions.

The least that can be gained from the possession of such data is a knowledge of the natural behavior and modes of adjustment of the lower animals. Schiller (1952) has pointed out that an investigator should be thoroughly familiar with

the behavioral repertoire of his experimental subjects before he begins an investigation. Few psychologists would dispute the validity of this principle. Despite such unanimity, however, an investigation of the native behavior of the Norway rat has only recently been undertaken. As a result of this investigation it now appears possible that the multitude of investigators who have been concerned with hoarding behavior may have been laboring mistakenly under an anthropomorphic interpretation of this bit of mammalian behavior (Scott, 1955). Verplanck makes the point very well:

More than once . . . a psychologist has controlled literally out of existence the necessary environmental conditions for, or necessary behavioral correlates of, behavior that he wished to experiment upon (Verplanck, 1958, p. 102).

Another possible result of studies of the lower animals would be a more thorough understanding of the biological significance and motivation of animal behavior. It would seem likely that valid generalizations and hypotheses about behavior could be established after data are available concerning a wide sampling of behavior. But the question arises: Is it possible to generalize from species to species and, more importantly, from lower order species to human beings?

The prevailing attitude toward this question seems to have been best expressed by Schneirla (1946; 1951). He argues that with the addition of each higher level function (such as the abstractive-intellective facility) the total configuration

of variables mediating behavior tends to shift. An aspect of behavior or motivation does not exist unchanged at the next higher phyletic level. Wholesale generalization from one phyletic level to another is, therefore, rather susceptible to error. This argument is no doubt a valid one. When principles derived solely from the study of lower animals are applied directly to human behavior, the application may be viewed with suspicion (Beach, 1960). This does not mean, however, that there is nothing of relevance to human behavior in the behavior of the lower animals. Yet some psychologists seem to attempt to understand human behavior from a viewpoint which takes into account only those characteristics which are restricted to the functioning of the human being (Bierens de Haan, 1929; Revesz, 1944).

Scott phrases the problem as follows:

There will probably always be a tendency to maintain that human behavior is in some way sacrosanct, and that the factor of language modifies it to such an extent that no generalizations are possible, but there is no justification for man's denying his sociological poor relations any more than his biological ones, and in the long run a more moderate view will probably prevail (Scott, 1958a, p. 67).

Burton argues in a similar vein:

There is nothing in the human makeup, physical or psychical, the beginnings of which cannot be found lower in the animal scale, gradually unfolding as we progress towards higher specialization. This, so far as the physical attributes are concerned, no zoologist will deny, but there is a curious unwillingness on the part of many to admit a measure of reasoning or emotional behavior in even the higher animals. If we are logical, and especially if we accept the theory of organic evolution, a greater measure of mental capacity and

emotion must be accepted, even though it is not possible to gauge them by ordinary laboratory methods (Burton, 1953, p. 259).

In support of psychology it should be pointed out that most psychologists are extremely interested in the development of the child prior to the full development of the abstractive-intellective processes. But except for this short period of early life some psychologists apparently choose to ignore the "animal nature" of the human being.

Much of the objection to comparative psychology can seemingly be resolved by utilizing the approach which has been suggested by Scott (1953; 1958a). He recommends that a series of species be extensively studied under a variety of conditions. Generalizations should then be derived which attempt to take into account the data at hand. If these generalizations prove valid, then and only then are we prepared to ask the question: What if the same is true of man? This procedure places our speculations directly in the realm of empirical investigation.

Many writers in the field of animal behavior cite similarities between animal and human behavior. Such analogies, however, cannot be considered to be homologies (Boyden, 1943). Nevertheless, it is believed that a complete study of the behaviors of lower animals may prove an invaluable starting point for a more complete understanding of the significance, motivation, and evolution of behavior wherever it occurs. It is possible that the present study may yield

generalizations with implications regarding human behavior. Inferences and speculations regarding human behavior are not the primary aim of this study and must await validation through further research.

Species Observations Available to Psychologists

There are presently available a number of reports of observations of some species. These are available in sufficient detail to allow for generalization and speculation about behavior in general. Examples of these reports are Darling's (1938; 1947) studies of the Red Deer, Carpenter's (1934) study of the howling monkey, Murie's (1944) study of the wolves of Mt. McKinley, von Frisch's (1947; 1950; 1955) studies of the behavior of bees, Vowles' (1954) study of the method of orientation of the ant, Nice's (1943) study of the song sparrow and bird behavior in general, Nissen's (1931) investigation of the field behavior of the chimpanzee, Kortlandt's (1955) extensive study of the European Cormorant, and Whitman's (Riddle, 1919) study of the behavior of pigeons. Primarily consisting of precise observations, these studies are rich in behavioral descriptions and constitute an apparently untapped source of data for many psychologists.

These articles appear in a wide variety of sources. The difficulty caused by this scattering of sources is alleviated in part by the appearance of several books (Burton, 1953; Lorenz, 1952; Nice, 1943; Scott, 1958a) which are attempts at synthesis.

The Rise of Ethology

The diversity of sources concerned with animal behavior indicates a lack of concentrated, systematic study in the field. One reason for this unsystematic attention has been the hesitancy of any science explicitly to include the study of animal behavior under its domain. This reluctance on the part of psychologists has already been mentioned. The related disciplines of zoology and biology have often ignored the behavior of their subjects and focused primarily upon taxonomy and anatomical structure. As Maeterlinck poetically phrased it in speaking of one entomologist,

In all this immense work, which absorbed a long and indefatigable life, no allusion is ever made to the habits of insects, to their peculiarities, their psychology, in a word their life. They are regarded as though they were crystals, lifeless objects, samples, or numbered specimens (Maeterlinck, 1936, p. 23).

A partial void has thus been created between disciplines. As O'Donnell points out,

Except for the work of a few naturalists, animal behavior as a special field of study had fallen between the biologists and the psychologists, each insisting that it lay more in the other fellow's field (O'Donnell, 1957, p. 59).

In this gap have appeared the ethologists who, as Kortlandt says, are

. . . a special brand of zoologists who prefer to do their work in the open air (Kortlandt, 1955, p. 219).

More precisely, they are a rather small group of scientists, primarily composed of European zoologists, who have made the study of animal behavior their major interest.

Unfortunately, a large portion of their writings has not been widely available in English until recently. More unfortunate still has been the fact that American psychological thought has not been receptive to much of this work. In fact, it would appear that, had it not been for the work on imprinting published by Lorenz (1935; 1937) and Tinbergen (1951; 1953), the work of the ethologists might still be largely unknown in America. Awareness of their work appears to be spreading, however. For example, the works of Lorenz, Tinbergen, von Frisch, Heinroth, Kortlandt, and Heidiger seem to be increasingly familiar to psychologists.

A portion of the resistance of psychologists to the works of ethologists was perhaps well founded. Some ethologists claimed to have established a new science and ignored already existing knowledge, particularly in the field of psychology (Kortlandt, 1955). In fact, as recently as 1951, Tinbergen (1951) viewed psychology as an endeavor concerned exclusively with the introspective investigation of subjective experience in human beings.

Working in a theoretical vacuum, their initial attempts at theory were for the most part rough and unclear. Constructs which have been abandoned or revised in modern psychological theory were evident in their early work. This scientific self-sufficiency appears, however, to be subsiding to some degree (Verplanck, 1958).

But American psychology is still reluctant to accept or to evaluate this work critically.

The American answer to this work [ethology] has not been consistent with the scientific attitude. No research has been done to test any of the hypotheses advanced by Lorenz and others. Instead, polemic articles have been written (Hess, 1956, p. 305).

In 1957 Bindra (1957) could find only two investigations (Hirsch & Tolman, 1955; Rockett, 1955) that bore directly on specific aspects of the Lorenz-Tinbergen theory. More recently, however, several other pertinent articles have appeared (Hess, 1958; Hess, 1959; Jaynes, 1956; Jaynes, 1957; Jaynes, 1958a; Jaynes, 1958b; Moltz & Rosenblum, 1958).

Whose prerogative or responsibility is the study of the behavior of the lower organisms? Is it the province of psychology, as Kortlandt (1955) believes? Should it be most closely tied with sociology as Tinbergen (1953) seems to feel? Should it be reserved for the zoologists who are most familiar with anatomical features of the lower animals? This type of questioning seems rather irrelevant. Nevertheless, ethology has unfortunately found it necessary to flourish as a separate science, and, as Kortlandt has pointed out:

Any artificial barrier between branches of science, or between groupings of scientists will tend to cut off existing possibilities of scientific contacts and teamwork. This regrettable state of affairs is even symbolized in the term "ethology" as opposed to "psychology" for this denomination is a verbal magic intended to create a barrier that does not exist (Kortlandt, 1955, p. 219).

Progress in Research in Animal Behavior

Despite somewhat unsystematic attention, research in animal behavior has continued. Sexual practices and mating behaviors, dominance relationships, parental behavior, and territoriality are but examples of the topics which have been examined. Ornithologists, both professional and amateur, have been responsible for much of this work. A brief search of the literature reveals that the life and behavior of birds has been more thoroughly reported than that of any other group of lower animals. This is probably best accounted for by Burton (1953), who points out that birds are primarily visual animals, as are human beings. Thus we more readily appreciate the significance and variety of their behavior.

The courtship and mating practices of birds have received an especially great amount of study. The physiological aspects of sexual and reproductive activity, the maturation of the sex drive, courting behaviors and their function, the role of dominance in sexual behavior, the recognition of the mate, and many related phenomena have received considerable attention. These data provide a rather extensive background for experimental work with birds and are one of the factors which led to the choice of birds as subjects in this experiment.

Individual Preference in Mate Selection

Some authors in the field of animal behavior seem to feel that it is ridiculous to imply that an individual animal

might have a preference for the type of mate which it selected.

As to the nature of the mate, this is a matter of no importance; it needs neither be an animal of the same species nor the opposite sex. . . . The satisfaction is variable in kind, the object merely being to dispose the genital sensation. . . . The sensation is not directed in any way towards an object, and can therefore not be "unnaturally" satisfied, being "blind" itself (Loeser, 1940, p. 77).

Though there may be some species for which this description would be applicable, there seems to be some evidence that it is not true throughout the animal kingdom. In their book, Ford and Beach refer to the many criteria of physical attractiveness among the several cultures of man. They then say:

Man is the only animal capable of formulating abstract concepts of beauty, ugliness, or sexual attractiveness, but by their behavior animals of other species sometimes demonstrate an obvious preference for one type of sexual partner as compared with another. If an anthropologist were studying a native tribe whose language he could not understand and whose sexual mores were comparatively free, he would be in the position similar to that of the comparative psychologist who investigates sub-human animals. By observing the types of men and women that were consistently avoided, he could formulate some ideas as to the tribe's standards of attractiveness and repulsiveness (Ford & Beach, 1951, p. 90).

These authors feel that among the monkeys and apes the behavioral attitude of the male is a more important variable than anatomical characteristics. This variable has of course been pointed out by many authors in connection with many different species. Contrary to popular opinion, however, no single behavioral attitude is held in high esteem by all of the species of monkeys and apes.

Carpenter cites evidence for preferential selection of mates among pigeons. He mentions the case of one male who ignored the advances of a female with whom the male was caged. When another female was introduced, the male immediately courted and mated with the new bird. Carpenter's conclusions after a series of such observations are as follows:

When a male is put into a cage with females all of which are in a state of readiness and he immediately sets up a relationship with a particular bird, and then maintains that relationship, it is evident that there are some factors of causal efficacy entering into association when young. Chance alone does not operate. . . . It may be said that physiological readiness alone does not suffice, but a psychical factor of selection enters in (Carpenter, 1929, pp. 25-27).

In his studies concerned with imprinting, Lorenz (1937; 1952) has repeatedly mentioned that an animal who becomes imprinted to a foster species will sometimes restrict his sexual advances to members of this foster species. This finding implies a discrimination between potential partners and a plasticity and modifiability of this selection process.

Burton comments as follows:

If we admit a degree of intelligence, however slight, we must as readily admit a choice of mate. . . . The theory of sexual selection has been widely accepted by zoologists, and this connotes choice of one particular mate from among a number available (Burton, 1953, p. 261).

A final source of information on the matter of personal preference in mate selection among lower animals comes from a recent article by Guhl, Allee, and Collias (1945). In the summary paragraph, they mention the phenomenon of personal preference in mate selection which they have observed

and which other investigators have reported. Though they consider the evidence for such a phenomenon to be somewhat weak, they conclude that there may well be a basis for its existence.

Individual Recognition Among Animals

Most of the experimental work which has been reported on inter-individual recognition among animals has dealt with species in which a dimorphism or a differential coloration exists between sexes. These studies have dealt with the ability of individuals to discriminate sex on the basis of these cues. Marler (1955) lists the chaffinch, the flicker, the parakeet, the yellow-throat (Geothypis trichas), the chicken, the lizard, the stickleback, and certain cichlid fishes as species which have been demonstrated to possess specific physical characteristics which make it possible for other members of their species to identify the sex of the individual member.

The studies which have been concerned with the social order in groups of animals (Baron, 1957; Diebschlag, 1941; Marler, 1955; Masure & Allee, 1934; Schelderup-Ebbe, 1922) are implicitly based upon the animals' ability to discriminate between individuals. These experiments have repeatedly demonstrated that a given animal learns, many times on first encounter, to discriminate consistently between individual group members and to react differentially to them. As one

author states, "All group organizations among birds are apparently based on the ability of birds to recognize and remember their flock mates as individuals" (Alee, 1942, p. 143). Among chickens, such recognition and memory for individual flock mates has been assumed to last only two to three weeks when a bird is separated from the flock. It appears, however, that three weeks may be an underestimation even for chickens (Smith & Hale, 1959). Observations such as those reported by Carpenter (1929) and Whitman (Riddle, 1919) indicate that pigeons can retain their memory for individuals for much longer periods of time.

Among some species and under some circumstances, individuals may not recognize individual animals outside of their own breed, but may react similarly to all members of the alien breed (Potter, 1949). Thus, when mixed flocks of chickens are studied, there is a definite tendency for members of one breed to dominate all the members of another (Hale, 1957).

A study which demonstrates the influence of early experience upon such recognition is that of Fisher and Hale (1957). The purpose of their experiment was to examine the reactions of male chickens to stuffed models. These models were placed in several postures, the major dependent variables being the sexual and aggressive behaviors of the males. For some unexplained reason they utilized models of the White Leghorn breed and living males of the Plymouth Rock and

New Hampshire breeds. Among their experimental animals they found two rather discontinuous groups which they labeled the reactors and the non-reactors. As the names would imply, the non-reactors had only minimal interaction with the models. The authors trace this strong tendency to a lack of early contact with other breeds. Thus, though there is great morphological similarity between the breeds utilized, the birds could discriminate between their own breed and the other breed and tended not to respond to the models if they had not had contact with the other breed previously.

Only a few experiments have dealt specifically with the process of individual recognition among species which are not dimorphic. Newman (1956) reports finding individual recognition among brook and rainbow trout. Studies with birds have involved plucking or dyeing individuals and then studying the reactions of other group members to them. Such work has been reported by Guhl and Ortman (1953) with chickens and by Bennett (1939) with ring doves. The most consistent finding of these investigations is that an abrupt change in the coloration of the animal serves to disrupt the social hierarchy for a period of time.

Despite an absence of conclusive experimental validation, there appears to be fairly wide acceptance of the idea that animals recognize each other as individuals. Lorenz bluntly states that "animals do recognize each other, particularly among close knit groups" (Lorenz, 1952, p. 147).

Tinbergen phrases it somewhat differently, "As we have seen, many social animals respond to the species' social releasers only when provided by certain individuals, which they know personally" (Tinbergen, 1953, p. 85). Craig (1908) mentions that birds are able to make exceedingly fine discriminations between individuals. Nice comments that "birds undoubtedly recognize their mates personally" (Nice, 1943, p. 204). In fact, she believes the process of pair formation to be largely dependent on the capacity for personal recognition.

The problem of pair formation is primarily that of recognition--specific and sexual. "Courtship may be defined as an elaborate sexual response involving recognition, selection, and pursuit" writes Abbott [1941]. "Courtship is, in fact, an almost exclusive visual process; courting animals (not insects exclusively) depend almost entirely upon visual impressions that they receive." This is doubtless true of many fish, and partially true of birds, but with birds voice also plays an important role (Nice, 1943, p. 192).

The cues which are utilized by the birds in making such discriminations are summarized by the following authors:

The evidence is in favor of an explanation on the basis of recognition, visual and auditory, having primarily to do with behavior (Bennett, 1939, p. 355).

The keenness of the eyes of a bird is adequate ground for crediting to the bird a recognition of the intruding bird in terms of new and strange perceptive cues of size, coloring, and form (Carpenter, 1929, p. 16).

It is suggested that coloring, size, quality of voice and general demeanor have effect in the mating process of selection (Carpenter, 1929, p. 24).

Cues involved in individual recognition include voice, color and facial characteristics (Collias, 1952, p. 144).

Birds undoubtedly recognize their mates personally by visual and/or auditory cues. . . . Facial cues are utilized and after these, the voice (Nice, 1943, p. 204).

It seem[s] probable that in several species of birds both the adults and the young largely acquire, rather than inherit the ability to recognize other members of the family to which they belong, using color, voice, size and form as cues (Ramsay, 1951, p. 16).

Apparently such recognition has its beginnings in the early life of the bird. Lehrmann (1954) concludes that initially the parent bird responds to the movement of the young bird's head against its breast, but shortly thereafter it is able to recognize its young on the basis of sight and sound. Lorenz (1935) points out, however, that the young come to recognize their parents before their parents recognize them. The work of Hess (1958), Jaynes (1957; 1958a; 1958b), Lorenz (1937; 1952), Ramsay (1951), and Tinbergen (1953) indicate that among birds this process is well under way during the first few days of life and is based on such cues as voice, color, size, and movement.

However, in some species no such learning seems necessary. For example, in a parasitic species, such as the cuckoo or the cowbird, it appears necessary that an animal be able to identify members of its own native breed without learning (Nice, 1943; Scott, 1957). The vast majority of species, however, are not parasitic, and it has been demonstrated that such birds appear to learn after birth to identify their own kind (Craig, 1908; Cushing, 1941; Lorenz, 1952; Nice, 1943; Scott, 1958a).

Craig seems to express the viewpoint of most investigators in the following statement:

Hence we must believe that the young doves have no inherited tendency to mate with birds of a particular kind; they learn to associate with a particular kind during the period when they are being fed, when the characteristics of their nursing parents are vividly impressed upon their young minds (Craig, 1908, p. 90).

In summary, then, it would appear that there is sufficient evidence to warrant the following conclusions:

1. Among great numbers of species the young individual has little innate attachment to his own native species. This attachment and the prerequisite recognition must be acquired.
2. Animals have been observed to behave in ways which seem to indicate that they have preferences for the type or class of mates they select.
3. It is widely held that animals are able to differentiate between individuals on the basis of a variety of characteristics.

Theories Capable of Predicting Mate Selection

Several formulations are available which enable one to cast the process of mate selection into a theoretical framework. Though derived from different orientations and different disciplines, these theories appear to predict the same results. If this is the case, they would appear to be equivalent in so far as mate selection is concerned.

The Craig-Whitman contribution. During the first ten years of this century, several investigators were interested in the study of the behavior of pigeons. Two of them, Craig (1908) and Whitman (Riddle, 1919), discussed the possible bases of pair formation among pigeons. Although their speculations cannot be regarded as being complete theories, they historically precede and seem to set the pattern for the three positions which follow.

Craig is quoted as follows:

The parents make no conscious effort to education their young. Nevertheless they educate them unconsciously in some very important matters. . . . We must believe that young doves have no inherited tendency to mate with birds of a particular kind; they learn to associate with a particular kind during the period when they are being fed, when the characteristics of their nursing parents are vividly impressed upon their young minds (Craig, 1908, pp. 89-90).

Riddle summarizes Whitman's observations and conclusions as follows:

The sexual activities are aroused by and are directed towards certain stimulating objects. What is the nature of these stimuli, and what are the reasons for their effectiveness? . . . Previous social environment is undoubtedly one factor. As a matter of fact, pigeons normally pair with members of their own species, and this preference has generally been regarded as instinctive in character. But the data of this volume show rather conclusively that the species preferences exhibited by birds at maturity are to a large extent acquired and are functions of the social environment in which the birds were reared (Riddle, 1919, p. 98).

The range of stimuli to which an instinctive tendency will respond may be modified by habits acquired long before the first expression of the instinct. The first expression of a delayed instinctive tendency may thus be in part a function of all that the organism has previously acquired (Riddle, 1919, p. 28).

The fact that the range of stimuli to which an instinctive act is susceptible may be modified by experiences previous to the first expression of the act develops a novel and important principle of instinctive modification for the more prevalent doctrine assumes that instincts become modified only through the influence of simultaneous activities.

It is possible that previous experience is efficacious in part by removing fear and distrust or indifference and substituting therefore a more positive attitude of familiarity (Riddle, 1919, p. 98).

Both Craig and Whitman would seem to predict that mating behavior of pigeons will be directed toward birds possessing characteristics similar to those of the parents.

Imprinting. One of the primary formulations of the ethological school has been that of imprinting. This word has been used to symbolize a process apparently present in the following typical observations. Very young animals of many species will readily respond to foster parents, even of another species, as if they were their own. This process of attachment is not easily reversed and the young animal quite often seeks the company of the foster species in preference to its own native species. This process has been observed among many species, including geese, ducks, turkeys, goats, sheep, dogs, and pigeons. Imprinting as used here refers only to the observed attachment of the young animal to a parent figure and is not intended to imply knowledge of occurrences inside either participant. Although this phenomenon has been observed throughout the centuries, Heinroth (1910) seems to have been the first to take note of it in a scientific manner, and Lorenz (1937; 1952) and Tinbergen (1951) have continued its investigation and given it wide publication.

According to these authors, the process appears to be limited by at least three restrictions. First, to be acceptable to the young, the parental substitute must fall within a certain range of either size or coloration or both.

Second, the parent figure has to engage in certain behaviors. For example, Lorenz (1937) found that if young ducks were to accept him as a mother substitute, he had to squawk in his best approximation of the mother duck's call.

A third restriction has to do with the time when imprinting can take place. Though the optimal time varies with the species and to some extent with the individual, it must always take place early in the animal's life (Fabricius, 1951; Hess, 1958; Hess, 1959; Jaynes, 1957; Jaynes, 1958a; Jaynes, 1958b).

These observations led Lorenz to the following conclusions. During the very early life of the animal there is a critical period during which the young animal will become imprinted to any stimulus object falling within a range of acceptable variability. This stimulus object thereafter serves to identify the class of objects toward which future social behavior will be directed (Lorenz, 1937; Lorenz, 1952).

Thus, it can be predicted that a young bird, if left undisturbed with its parents, will become imprinted to them whether they are natural or foster parents. Since mating is a social behavior appearing later in the animal's lifetime, parental characteristics should influence the bird in his mating behavior.

Beach and Jaynes reviewed the rather scant literature pertinent to this point and, after making a plea for more well controlled studies, concluded: "Thus it is seen that a bird's early experience can exert a marked influence upon the future social life of the individual, and also perhaps on the future of the species" (Beach & Jaynes, 1954, p. 250).

Hess offers a similar conclusion: "So far the results are inconclusive, but they do suggest that experimental imprinting of mallards affects their adult behavior, particularly with respect to courtship patterns" (Hess, 1958, p. 90).

Psychoanalysis. Psychoanalytic approaches to the study of behavior (Fenichel, 1945; Freud, 1924; Freud, 1928), while having been directed toward the study of man rather than the lower animals, seem to offer some general principles which appear applicable and instructive in considering developmental factors in lower animals. A brief summary of principles involved in the instinctual-maturational formulation of psychosexual development follows:

Each instinctual urge first manifests itself as a rather diffuse energy state. In this initial state, instincts are not specifically directed toward designated objects. They are only unshaped and uncanalized amounts of nervous energy which arise from bodily functions. There are, however, certain factors which tend to direct the impulse toward a particular type of satisfaction. These factors include the

nature of the instinctual urge, the neuro-muscular equipment of the organism, the environment of the organism, and the erogenous zone involved.

These instincts come to be more or less irreversibly associated with or conditioned to an object, class of object, or activity which is found to satisfy the instinct or impulse. In the early stages the different instincts mature and are satisfied more or less independently of each other. With further maturation, these initial instincts form larger combinations. As these new levels are attained, the objects which have become associated with the gratification of the lower level instincts serve to focus these higher instinctual strivings for gratification toward similar objects. This developmental process has been variously labeled ascending integration, step by step development, and development en briques.

Thus, it would seem that the animals with which the young animal is associated, if they serve to fulfill its lower order needs or instinctual demands, in time become objects of satisfaction for the young animal. When other higher level instincts appear, the young animal should tend to seek out as objects of gratification animals with characteristics similar to those of its parents. More specifically, if the parent figure has served to satisfy the bodily needs of the young, when mature the young should tend to mate with a partner having characteristics similar to those of its parents.

Kortlandt's hierarchy of instincts. A third theoretical system which seems applicable to this problem is Kortlandt's (1955) conceptualization of the hierarchy of instincts. This work was first published in 1950 after extensive observation of the European Cormorant. After that time, Kortlandt discovered the works of the psychoanalysts, and, finding similarities between their work and his own, he made a study of their writings and republished his theory with some modifications.

Essentially, he believes that there exists within the developing organism a series of discrete instincts which operate in much the manner outlined in the section above. These instincts make their appearance as diffuse energy states which become conditioned to an object, act, or situation which serves to satisfy the instinct. Kortlandt's main contribution to the theory lies in his conception of the hierarchical arrangement of these appetites, as he calls them.

According to Kortlandt, these appetites are manifested in behavior in a specifiable, temporal order. He makes it plain that presently there is no way of ascertaining the internal neural or chemical basis for this regularity and that his concern is only with manifest behavior.

One of the most fundamental principles involved in this system is that in order for the organism to fulfill its biological potential it must pass through the lower levels of the hierarchy before progressing to the higher levels.

Thus if the higher level appetites are satisfied without allowing satisfaction of some of the component, lower level appetites, the lower level instincts will continue to seek gratification.

Kortlandt theorizes that the satisfaction of a lower level instinct by an object, or class of objects, will tend to orient the animal toward seeking similar objects when it attempts to satisfy instincts higher in the hierarchy.

The observations upon which this theory is based and its ramifications are too numerous to cover here. For the present the important aspect is that Kortlandt postulates an appetite for being paired as a top level instinct in one of the hierarchies. Subordinate to this appetite are such appetites as owning a nest, sexual behaviors (both male and female in each), and many others. These are in turn supported by many lower level appetites, some of which make their appearance in the behavior of the nestling bird. This theory would predict that if lower level appetites were gratified by the parents, the characteristics of the parents would serve to direct the object choice of the higher level appetites, such as the appetite for being paired. Again we have the same prediction: the bird mated with should have characteristics in common with the parent birds.

Choice of Mate--A Masculine or Feminine Prerogative?

The literature does not provide a clear answer to the question of which animal in a pair plays the more important role in the mating process. Lack (1940) and Craig (1908) seem to feel quite strongly that it is the male who assumes the aggressive attitude and compels the female to submit to him. This view is called into question by Riddle (1919), who has observed that, though the male usually takes the initiative, the female can also do so; and by Nice (1943), who observes that during the breeding season the female is often as eager as, if not more eager than, the male.

Some authors believe that the female assumes the more significant role in pair formation. "It is my opinion that the behavior of the hen initiates the approach of the cock and that the nature of her behavior determines whether or not other advances are made" (Carpenter, 1929, p. 45). Noble (1936) cites observations which make it rather clear that among flickers the male merely announces his availability and the presence of a nesting site and it is the female who responds differentially.

Probably more accurate is the conviction on the part of some authors that the female is at least not a passive participant in the process. Tinbergen (1953) points out that there are only a few species in which the male can force the female to copulate against her will. Nice supplies a pertinent argument: "After all, in nature the female is free

to come and go. If she really feared the male, she would stay away from him" (Nice, 1943, p. 198).

There is a widespread belief that male animals of most species always assume complete command of the mating situation and inevitably play the more active role in precoital courtships. Nothing could be farther from the truth. Distribution of the initiative varies from species to species, but in the main the relationship is a reciprocal one in which both partners are sexually aggressive and each contributes to the complete arousal of the other. The relative sexual readiness of the male and the female frequently determines which individual will solicit and which will respond (Ford & Beach, 1951, p. 102).

Currently, most authors seem to agree that the mating is probably a mutual process in which each animal must respond in a certain manner to the other in order for mating to pursue its natural course. Morris (1956) has elaborately developed this type of sequential approach among certain fishes. Whitman seems to have been attempting to describe the same type of interlocking sequence.

These mourning-doves, then, like ring-doves, do not know the difference between the sexes until they meet and exchange salutations. The male's place is to coo and strut, while the female retreats, bowing and showing herself off if she happens to be disposed. If she does not retreat, the male tests her by pecking and claiming his mastership. The behavior is the only guide they have in selecting a mate of the right sex (Riddle, 1919, p. 28).

Craig seems to go a step further:

Each bird contained in its nervous system, not only a train of explosive material, ready to be touched off, but also an accurate 14-day chronometer; the male chronometer and the female chronometer must be wound up at the same time and set going synchronously in order that the birds may enter synchronously upon the feeding of the young. Asynchronism may and sometimes does occur, and it may cause loss of the eggs and of the young. But the number of such accidents is reduced to a minimum by

the fact that it is difficult for either male or female to start any of the reproductive operations without the elaborate preliminary ceremony. In other words, it is difficult for either the male or the female to start any of the reproductive operations without the active cooperation of its mate. Whenever either bird is more ready than the other, the first is retarded by the influence of the second and the second is accelerated by the influence of the first. Thus, synchronization is effected by mutual adjustment, not by the adjustment of either bird exclusively (Craig, 1908, p. 94).

It is interesting that Yerkes, in the following quotation, describes the behavior of chimpanzees in terms similar to those used above by Riddle in describing the behavior of doves.

The male characteristically demands, commands and as is necessary physically imposes his will, unless he is the subordinate male, whereas the female cajoles, requests, begs and as necessary uses to achieve her aims various forms of sexual allure, physical play, and petting. The behavioral pictures of masculinity and femininity are sharply contrasted, for manifestly the values of the sexual relation differ fundamentally. For the male the relation is marked by impulsiveness, directness, immediacy, and appears an end in itself; for the female, indirectness, delay and prolongation of interest indicate that it is a means to varied advantages and is so habitually used (Yerkes, 1940, p. 186).

And among some fish:

Fighting fish recognize the sex of a member of its own species not by seeing it but by watching the reactions which it gives to the dances of the dancer (Lorenz, 1952, p. 24).

It appears evident that there is no clear answer to the question regarding which animal, male or female, determines whether a mateship shall be formed, but it is generally believed that both partners are involved in the process.

Mateships and Liaisons--Monogamy Defined

It was mentioned earlier that this study will be concerned with an examination of some of the factors underlying the courtship and mating behaviors in lower order monogamous species. A monogamous species was selected for at least three reasons: (1) It is felt that by using a monogamous species the investigator can be more certain of the attraction and the attachment of the two animals over a period of time. (2) It would seem that in a monogamous species the influence of the parental characteristics would be of more importance in influencing the type of mate than in a species in which mateships are not continuous. This is because both parents participate in the care of the young. In addition, the relationship between the bird and its mate would be more intense and continuous than in non-monogamous species. (3) Monogamy is the primary mateship pattern of human beings, and using a species whose pattern is similar may provide an opportunity for speculation concerning human behavior. Some objections may be immediately forthcoming concerning the idea that human beings are primarily monogamous. This objection, however, is felt to arise from a confusion of terms, for monogamy should not be confused with absolute sexual fidelity. Several authors differentiate between sexual behavior and being mated (Burton, 1953; Carpenter, 1929; Craig, 1908). Ford and Beach (1951) differentiate between liaisons (relatively impermanent sexual unions) and mateships

(permanent economic-sexual unions). Kortlandt (1955) is clear in stating that the sexual appetite should not be confused with the appetite for being paired, even though many of the same behavioral mechanisms are involved. Therefore, monogamy is herein defined as a mateship group composed of one male and one female who are associated for economic-survival purposes as well as for primary sexual relationships. This does not mean that coitus need be restricted to the mate.

Both Murdock (1949) and Ford and Beach (1951) point out that despite the theoretical sexual and mating freedom permitted in many societies, monogamy is the predominant mateship pattern in the vast majority of human cultures. It would appear justified to speculate that any pattern of human relationships which appears in so many divergent cultures might well have roots in the biological-evolutionary heritage of the human being.

Among the lower animals there are several species which have been reported to be monogamous. Murie (1944) in his study of the wolves of Mt. McKinley cites observations which lead him to the conclusion that these animals are primarily monogamous, even though they live together in groups. Lorenz (1952) and Scott (1958a) both mention that the Lupus branch of the dog family is monogamous. Ford and Beach (1951) mention several species of monkeys and apes that are usually monogamous. Lorenz (1952) points out that the cichlid fishes are the first animals in the phylogenetic scale

that are monogamous. Among the birds, a majority of the species are monogamous, at least over the course of one breeding season (Nice, 1943). O'Donnell (1957) talks extensively about the monogamy of geese. But the classic example of monogamy among the lower animals is the pigeon and dove family, Columbidae. Many authors have pointed out, however, that the relationship between two mated pigeons or doves is not unalterable or one of absolute sexual fidelity (Carpenter, 1929; Craig, 1908; Girton, 1775; Maeterlinck, 1936; Riddle, 1919). Nevertheless, the primary mateship grouping among this variety of birds is monogamy.

For several reasons, then, the pigeon has been selected as the subject of this experiment:

1. It is a convenient laboratory species.
2. It is primarily monogamous.
3. There is a great deal of material available concerning the habits and life cycles of the pigeon along with a wealth of material concerning its breeding, mating, and courtship behaviors.

CHAPTER II

PROBLEM

Many authors in the field of animal behavior have concluded that among certain species of animals the individual animal may be influenced in his mating behavior by his early experience with other animals. This process is such that at maturity the animal tends to mate with an animal possessing characteristics similar to those possessed by its parents. A thorough check of the literature has revealed no carefully controlled investigation of such a hypothesis, though theoretical bases for such a process appear to be abundant.

A monogamous species of bird, namely the pigeon, has been selected as the subject of this investigation, since this animal appears to offer some major advantages for this type of investigation.

Specifically, this investigation will attempt to determine if parental characteristics can be demonstrated to influence the pigeon's mating behavior in a free choice situation.

Hypothesis 1: The male pigeon is influenced by early experience in such a way that he will tend to mate with a

female who has characteristics similar to those of his parents under the conditions of the experiment.

Hypothesis 2: The female pigeon is influenced by early experience in such a way that she will tend to mate with a male who has characteristics similar to those of her parents under the conditions of the experiment.

CHAPTER III

METHOD

Subjects

Twenty-three pairs of pigeons served as breeding stock. The subjects of the experiment were 64 of their offspring. The 23 pairs of parents consisted of 10 pairs of stock White King pigeons and 13 pairs of stock Black King pigeons. These breeds were selected because of their common background and similarity of size and breeding habits (Levi, 1957). These breeds differ primarily in two major respects, coloration and body contour. The White King is a large bird of solid white coloration. Its body contour is such that it carries its tail feathers on a line more or less parallel to the ground. The Black King is of approximately the same size but is of dark gray to black coloration. In some cases two faint dark bars cross the wings. The Black Kings utilized in this experiment carry their tail feathers at an angle of approximately 20 to 45 degrees above the horizontal, which gives them the appearance of having a more curved, semi-circular contour.

Both of these breeds are prolific and consistent breeders and are highly valued by commercial squab raisers because of this and because of the size of the squabs. Most of the parental stock utilized in this experiment had been under observation for some time. Though there were fairly large variations between pairs as regards percentage of fertile eggs, there were no consistent observations which would lead to the conclusion that the breeds differ in parental behavior.

Preliminary manipulation of breeding stock. The 23 pairs of parent birds were introduced to their individual cages simultaneously and allowed a period in which to become accustomed to their quarters. The cages were covered with cloth so as to make them relatively private. The birds were allowed to keep eggs which were laid if sufficient time remained to rear the young before the experimental manipulation began. If a pair did not lay until late in this preliminary period, their eggs were removed. Throughout the experiment eggs were taken from birds when this was necessary to keep the mating cycles of the various pairs in close temporal harmony.

Experimental manipulation of the young. The young birds which were to serve as subjects in this experiment were raised under four conditions.

Condition A: White King parents were allowed to keep and rear their own young. Thus, these young birds

never saw a pigeon with breed characteristics which were different from their own native characteristics from the time of hatching until later in the experiment, at maturity. They were handled by the experimenter only when absolutely necessary, as when banding the young and when cleaning the nest boxes. In so far as possible, the experimenter remained out of view of the young while they were in the nest. It was felt that this was especially important during the first week or so after hatching so as to minimize the possibility of becoming imprinted to the experimenter. Once they left the nest, however, it was believed on the basis of available evidence that the critical period for imprinting had passed. At the age of approximately 40 days, the young birds were removed from their parents and placed in the individual cages out of sight of all other pigeons until the beginning of the experiment (see Appendix B).

Condition B: In this condition, Black King parents were allowed to rear their own young. This condition is identical with Condition A except for the breed of birds involved.

Conditions C and D: In these conditions, exchanges of eggs were made between Black King parents and White King parents. A pair of Black Kings and a pair of White Kings whose second egg was laid within two days of each other were selected and their clutches switched. A difference of two days in the laying of the second egg was selected because it

has been mentioned as the maximum difference in hatching time the birds will tolerate if they are to act efficiently as foster parents. If the adopted eggs do not hatch within two days of the time that their own eggs would have hatched, many birds will abandon a nest. On the other hand, if the eggs hatch too soon, the parents are sometimes not ready to feed the young with the necessary pigeon milk (Carpenter, 1929; Patel, 1936). It has been repeatedly demonstrated that birds will accept foster young readily, particularly if they are hatched as members of their own brood (Cushing, 1949; Ramsay, 1951). Both eggs were always exchanged so that there were no mixed broods.

The aim in these conditons was to rear a group of young in view of parents who have characteristics which are different from those of their own breed (see Appendix A). In other respects these birds were dealt with as were the birds in Conditions A and B. Thus, Condition C consists of the White King young which were raised by the Black King parents, and Condition D consists of the Black King young which were raised by White King parents.

The experimental design is represented in Table 1.

When the isolated birds reached maturity (Riddle, 1931), two males and two females were selected to represent each of the four conditions. Thus, each replication of this design included 16 subjects. It was necessary to have at least one male and one female to represent each condition,

Table 1

Conditions of the Experiment

Condition	Parental breed and coloration	Offspring breed and coloration
A	White King	White King
B	Black King	Black King
C	Black King	White King
D	White King	Black King

since it is not possible to conclude definitely which bird of a pair plays the major role in pair formation or if it is essentially a mutual process.

Criteria for Sexing Subjects

During the entire experiment close observations were made in order to determine the sex of the young birds. Sexing is a difficult process with pigeons, and no clear criteria have been developed which allow absolute differentiation of sexes. It was long assumed that each clutch contained one male bird and one female bird. Levi (1957), however, has produced data which indicate that the sex of two siblings is a chance matter. Therefore, it can be expected that 25 per cent of the clutches will contain two males, 25 per cent two females, and the remaining 50 per cent one male and one female.

In order to determine the sex of a group of young birds, close observation of both physical characteristics and behavior are necessary. The criteria utilized in the present study are as follows:

1. Relative size. It is a general observation that while the squabs are in the nest the male is generally the larger of the two. While this is not an infallible criterion, the size differential, particularly if it is considerable and permanent, is many times useful.

2. Secondary physical sexual characteristics. As the birds develop there are certain rather clear signs of the sex of the birds which emerge as secondary physical sexual characteristics: (a) Size and shape of head. At maturity the head of the male is generally larger, heavier looking, and less delicate than that of the female. (b) Size of cere. The male's cere is larger, thicker, and more profuse, giving the top of his head a more convex shape. More simply stated, the larger cere of the male fills more of the area of the upper bill and forehead.

3. Secondary behavioral sexual characteristics. There are also certain behavioral manifestations which differentiate the sexes: (a) Aggressive reactions. The male is the more aggressive animal in most circumstances. Once the adolescent stage has been passed and the full, mature voice begins to develop, this difference is usually apparent. He typically displays a particular manner of charging,

threatening, and turning. The female sometimes displays similar behavior, but never to the same degree (Craig, 1911; Carpenter, 1929). One investigator (Valentini, 1951) has demonstrated that he could accurately differentiate sexes in pigeons at the end of the second month on the basis of their aggressive reactions in a competitive food-getting situation. This criterion was not of great value in the present study since there was little opportunity to observe the birds in competitive situations. (b) Depth and use of voice. The voice of the male at maturity is deeper and louder and is used in more pursuits than is the voice of the female. Her voice usually maintains an adolescent, high pitched quality and is used much more sparingly than the male's. (c) Display reactions. The display reactions of the pigeon incorporate much of the behavior mentioned above in this section. More components, however, are characteristic (strutting, jumping, tail sweeping, etc.), which make this behavior distinguishable from aggressive reactions. Females seldom engage in display reactions.

4. The Gestalt. The above-listed items do not exhaust the indications of sex which the experienced pigeon fancier utilizes in sexing his birds. The overall impression of the birds, based on past experience, was utilized as another factor in determining the sex of the birds.

As was mentioned previously, it was necessary to exercise extreme care in sexing the birds which were to be

included in the experimental replications. Certainty was a necessity. In order to reduce the probability of error, two individuals with long experience in raising pigeons made independent observations and assessments of the sex of the birds. These, along with the present investigator's observations and estimates, were utilized in the selection of birds for inclusion in the various replications. There was found to be general agreement among the three judges. When disagreement did arise, the bird was eliminated from consideration if this was possible. In some cases, however, this was not possible, and the majority decision was accepted.

Not only was it necessary for the birds to be of the correct sex, but they also had to be of approximately the same age. Birds were selected, therefore, on the following bases. First, they had to fulfill the requirements of one of the four conditions. Second, they had to be of the correct sex so as to have two males and two females in each of the conditions. Third, from the young who fulfilled the above requirements, those who were nearest to being the same age were selected.

Equipment and Housing

The 23 pairs of parent birds were housed in 23 wire cages 3' x 3' x 3' (see Appendix A). This cage size was deemed sufficient to avoid the unusual, aggressive behavior observed by Hollander (1945) in cages of less than 24 cubic feet. These cages were arranged and covered with cloth so

that the young raised in any cage were able to see only birds similar in characteristics to their parents. It was initially planned to cover all cages completely, but it became too dark in some cages and some of the cloth had to be removed.

Forty-five smaller cages, 2' x 2' x 2', were also constructed (see Appendix B). These cages were utilized for individually housing birds during the period between their removal from the parents' cage and the start of the experiment. In these cages visual contact with other birds was not possible.

All of these cages were provided with a supply of water and standard mixtures of food and grit. The larger cages were also supplied with a two-nest nesting box and a supply of nesting materials.

In another building, a 9' x 12' x 8' pen was constructed for the experiment (see Appendix C). This pen was arranged in such a way that birds in it could not see birds outside the pen. Twelve double nesting boxes were placed around the room at eye level, spaced at approximately one foot intervals. Food, grit, and water were available in the pen. Two roosts crossed the cage below the level of the nest boxes.

A standard numbered pigeon band was placed on the left leg of each squab at the age of 6-10 days. In addition, a large, clearly marked mating band was affixed to the right

leg of each bird selected for inclusion in the experiment.

The Experiment

The age at which pigeons reach sexual maturity is to some extent dependent upon the season in which they are hatched (Riddle, 1931). The age at maturity of the birds in this experiment varied between approximately four and five months. At the time when there were sufficient mature birds available to constitute a replication of the design, these birds were banded and were introduced into the large pen described above. In so far as possible, the birds were left undisturbed. Observations were made from a vantage point which made possible a clear view of the loft but which left the experimenter largely out of view of the birds. Observations were made at every opportunity, but no less frequently than one time per day. Notes were kept of pertinent occurrences.

The purpose of these observations was to ascertain pairings. The following criteria have been mentioned by various authors (Carpenter, 1929; Craig, 1908; Riddle, 1919) as being indicative of a mated pair: perching together, sitting in a nest together, calling to one another, being consistently in the company of one another, defending a mutual territory, billing behavior, and consistently copulating with one another. When several of these behaviors had been observed and, in the opinion of the investigator, a mateship had been verified, the two birds were removed from

the loft. Observations were continued until all of the birds were mated.

Despite the caution used in sexing the birds, four judgments were later found to be incorrect. The birds were observed especially closely during the first week following their introduction to the mating pen, and when it became evident that a bird had been incorrectly sexed, it was immediately removed and a bird of the correct sex was substituted. This substitution did not appear to affect the other birds significantly.

Treatment of the data. Four replications of the experimental design were conducted. Each replication consisted of 16 subjects, four from each of the four conditions. Two of these replications were assigned to each of the two hypotheses of this study. A table of random numbers was utilized in this procedure. Replications one and three were thus assigned to hypothesis one, which is concerned with male choice of mate according to parental characteristics. Replications two and four were assigned to hypothesis two, which deals with female choice of mate on the basis of parental characteristics.

The probability distribution was calculated for the number of possible correct matings in each replication with the hypothesis that the matings were random with respect to color. The probabilities of the two replications assigned to each of the hypotheses were then pooled.

It was decided that the minimum number of correct matings necessary for the rejection of the null hypothesis would be 12 ($\underline{p} = .067$).

CHAPTER IV

RESULTS

Hypothesis 1

Data for replications one and three appear, respectively, in Tables 2 and 3. These replications were assigned to the test of hypothesis one, that a male pigeon will tend to mate with a female similar in characteristics to the male's parents. An analysis of these tables shows that, of the eight males in replication one, all eight mated with females who were similar in characteristics to the males' parents. In replication three, six males mated in accordance with the hypothesis. Thus, a total of 14 males in the two replications mated in accordance with the hypothesis. Since 12 correct matings had been selected as the minimum for statistical significance, the first hypothesis was supported.

Hypothesis 2

Tables 4 and 5 contain the results of replications two and four, the two replications assigned to test the second hypothesis. Hypothesis 2 was that a female pigeon will tend to mate with a male similar in characteristics to the female's

Table 2

A Summary of Data from Replication 1

Pair	Sex	Band number	Condition ^a	Date hatched	Sibling in nest	Hypothesis supported
1.	M	6004	A {Ww}	3/29	yes	yes
	F	6012	C {Wb}	3/29	yes	
2.	M	6049	A {Ww}	5/6	yes	yes
	F	6043	C {Wb}	5/1	yes	
3.	M	6018	B {Bb}	4/18	yes	yes
	F	6028	D {Bw}	5/3	no	
4.	M	6059	B {Bb}	6/8	no	yes
	F	6003	D {Bw}	3/24	no	
5.	M	6030	C {Wb}	4/27	yes	yes
	F	6014	B {Bb}	4/3	no	
6.	M	6031	C {Wb}	4/28	yes	yes
	F	6052	B {Bb}	5/12	no	
7.	M	6026	D {Bw}	4/28	yes	yes
	F	5599	A {Ww}	3/19	yes	
8.	M	6045	D {Bw}	5/3	yes	yes
	F	6050	A {Ww}	5/6	yes	

^aIn parenthesis upper case letter refers to color of experimental bird, lower case letter refers to parental coloration.

Table 3

A Summary of Data from Replication 3

Pair	Sex	Band number	Condition ^a	Date hatched	Sibling in nest	Hypothesis supported
1.	M	6096	A {Ww}	8/23	yes	no
	F	6093	D {Bw}	8/20	yes	
2.	M	6083	A {Ww}	7/25	yes	yes
	F	6086	C {Wb}	8/9	no	
3.	M	88	B {Bb}	9/14	yes	yes
	F	6092	D {Bw}	8/20	yes	
4.	M	6094	B {Bb}	8/20	yes	yes
	F	10	B {Bb}	9/1	yes	
5.	M	27	C {Wb}	8/8	yes	no
	F	6089	A {Ww}	8/3	yes	
6.	M	6090	C {Wb}	8/7	yes	yes
	F	6084	B {Bb}	8/20	yes	
7.	M	23	D {Bw}	9/27	no	yes
	F	8085	A {Ww}	8/23	no	
8.	M	6079	D {Bw}	8/5	no	yes
	F	72	C {Wb}	8/8	yes	

^aIn parenthesis upper case letter refers to color of experimental bird, lower case letter refers to parental coloration.

Table 4

A Summary of Data from Replication 2

Pair	Sex	Band number	Condition ^a	Date hatched	Sibling in nest	Hypothesis supported
1.	F M	6070 6080	A {Ww} C {Wb}	6/24 7/7	no no	yes
2.	F M	6021 6022	A {Ww} C {Wb}	6/5 6/5	yes yes	yes
3.	F M	6064 6054	B {Bb} B {Bb}	5/3 5/20	yes no	yes
4.	F M	6072 6077	B {Bb} B {Bb}	6/22 7/11	yes no	yes
5.	F M	6055 6075	C {Wb} A {Ww}	6/1 7/17	yes no	no
6.	F M	6056 6074	C {Wb} D {Bw}	6/1 7/5	yes no	yes
7.	F M	6065 6039	D {Bw} D {Bw}	6/15 6/4	yes no	no
8.	F M	6078 6061	D {Bw} A {Ww}	7/7 6/9	no yes	yes

^aIn parenthesis upper case letter refers to color of experimental bird, lower case letter refers to parental coloration.

Table 5

A Summary of Data from Replication 4

Pair	Sex	Band number	Condition ^a	Date hatched	Sibling in nest	Hypothesis supported
1.	F	60	A {Ww}	10/10	yes	yes
	M	9842	A {Ww}	10/5	no	
2.	F	9900	A {Ww}	10/5	yes	no
	M	85	D {Bw}	10/11	no	
3.	F	6076	B {Bb}	10/13	no	yes
	M	5	B {Bb}	10/14	yes	
4.	F	31	B {Bb}	10/14	yes	no
	M	16	C {Wb}	10/10	no	
5.	F	2999	C {Wb}	10/12	yes	yes
	M	8	D {Bw}	10/12	yes	
6.	F	46	C {Wb}	10/11	no	no
	M	9845	A {Ww}	10/10	no	
7.	F	28	D {Bw}	10/12	yes	yes
	M	2998	C {Wb}	10/12	yes	
8.	F	9898	D {Bw}	10/10	no	no
	M	6083	B {Bb}	8/20	yes	

^aIn parenthesis upper case letter refers to color of experimental bird, lower case letter refers to parental coloration.

parents. Of the eight females included in replication two, six mated with males similar in characteristics to the females' parents. In replication four, four of eight females mated in accordance with the hypothesis. This made a total of ten correct choices in the two replications. Since this number is not statistically significant, the second hypothesis was not supported.

Subsidiary Findings

Although not included in the original formulations, there are at least three questions which may be partially answered from data obtained in this experiment. These questions deal with the effects upon mate selection of the several sets of variables discussed below.

Effects of sibling characteristics. The presence or absence of a sibling was not a controlled variable in this experiment. Little information is available concerning the effects of sibling characteristics on the imprinting process, but the general opinion seems to be that the effects are insignificant. This conclusion is probably due to the fact that the young of most species are not similar to the parents in coloration or other characteristics until the critical stage for imprinting is past. This is certainly true among pigeons, who do not feather appreciably until they are from two to three weeks of age. Nevertheless, there might be some effect in being reared with a sibling as opposed to being raised alone, exposed solely to the parents.

In testing this possibility, Conditions C (white young, black parents) and D (black young, white parents) were utilized. The differential coloration between parents and young in these conditions made it possible to ascertain the possible effect of sibling characteristics. The question is: Does the presence of a sibling different in breed from the parents significantly effect a bird's tendency to mate with a bird similar in characteristics to its parents? Nineteen birds in Conditions C and D were raised with a sibling and 13 birds were raised singly. In these conditions both siblings were always the same color and this color was always different from that of their foster parents. Of the 19 birds raised with a sibling, 10 mated with a bird similar in characteristics to their foster parents, while 9 did not do so. Of the 13 birds raised singly, 7 chose according to foster parents' color while 6 did not. These differences are obviously not significantly different from chance. Sibling characteristics do not appear to significantly influence mating behavior.

Breed differences. It is possible that the two breeds of birds utilized in this study differ in their susceptibility to imprinting. Howells and Vine (1940) have demonstrated such breed differences among chickens. In an attempt to provide an answer to this question, the 32 Black Kings from Conditions B and D were grouped in opposition to the 32 White Kings in Conditions A and C. Among the Black Kings 20 matings

were in accordance with parental characteristics. Among the White Kings 18 matings were correct. Thus, there does not appear to be a significant difference between Black Kings and White Kings as regards susceptibility to imprinting as reflected in mate selection.

Condition differences. One or more of the four conditions might be more effective in producing the hypothesized results than the combination of variables in the other conditions. In order to evaluate this possibility, a determination was made of the number of matings in each of the conditions which was in accordance with parental characteristics. Condition A had 10 such matings, B had 11, C had 8, and D had 9. While Conditions A and B, which did not involve a cross between the two breeds, were slightly more efficacious in producing matings in accordance with the hypotheses, the advantage was small.

CHAPTER V

DISCUSSION

Earlier in this paper, four positions are described which give rise to the prediction that animals tend to mate with animals similar in characteristics to their parents. None of these formulations mention sex differences as a significant variable in connection with this phenomenon. In fact, the present author has found only one study which considers the possibility of sex differences in phenomena similar to imprinting. In that study, no significant differences were found as regards ease of imprinting (Jaynes, 1958).

In the present study, however, what seem to be definite sex differences were noted. Male pigeons did mate with females similar in characteristics to their parents. In the two replications assigned to a test of hypothesis one, 14 of 16 males mated in accordance with the hypothesis. This finding does not appear to be unique to the combination of replications which were randomly assigned to hypothesis one. Although it must be in the form of post hoc reasoning, it will be noted that five of the six possible combinations of two

replications would yield significant positive results. Thus, it can be rather definitely concluded that among male pigeons, early experience with parents does serve to focus later mating behavior upon females who possess characteristics similar to the male's parents.

Among female pigeons, however, early experience with parents is not reflected in their matings. The two replications which were pooled in a test of hypothesis two yielded 10 of 16 correct matings. Although this finding is in a positive direction, it is not sufficiently different from chance to warrant a rejection of the null hypothesis. In this case, it is again quite enlightening to survey all of the possible combinations of replications which might have been used to test this hypothesis, had the random assignment at the beginning of the experiment been different. No possible combination of the four replications would have yielded significant positive results for females, and four of the six possible combinations would have yielded eight or less correct matings.

Thus, the present study has possibly uncovered a variable that has been overlooked or unreported in the past. In experiments and general discussions of the effects of early experience upon later behavior, the possibility that the two sexes might be affected differently by this experience has not been considered.

It is impossible, however, to conclude definitely that male pigeons are affected differently by early experience than are females, although this appears to be a likely possibility. The experimental design does not permit a determination of the effect which male mating behavior may have had on female behavior. It may in fact have served to limit the female's alternatives seriously. One aspect of the data is interesting in the light of this possibility. Six of the 32 pairings in this experiment were not in accordance with hypothesis one. One would expect that these six pairings would be random with respect to hypothesis two. This, however, does not appear to be the case. Five of the six matings were in accordance with hypothesis two. While this is not conclusive evidence, it does serve to raise a question concerning interaction effects. It is conceivable that a combination of male dominance and the permanence of effects of early experience on the males may have resulted in a diminished possibility for female preference to be demonstrated. Thus, it might be that in the five cases mentioned above some factor (possibly reduced masculine dominance) made it possible for female preference to be demonstrated.

Although, as is mentioned above, it is impossible to conclude definitely that early experience affects male and female pigeons differently, it would seem that individuals interested in investigating the effects of early experience

upon later behavior should be aware of the possibility of sex differences in the effects that they are attempting to ascertain.

Possible Explanations of Sex Differences

Vocal stimulation. In searching for alternative explanations of the aforementioned sex differences, one variable immediately suggests itself. Though the young birds were visually isolated from each other, only a minimal attempt was made to control auditory stimulation. At least one author (Craig, 1908) has devoted a great deal of attention to the effects of vocal stimulation among pigeons. In the process of pair formation, male pigeons in particular expend a great deal of time and energy in vocal display, calling, cooing, etc. Pigeons appear to recognize the call of their mate, and possibly the voices of many, if not all, of their loft associates. Study of these observations is advisable, but presently it is important to point out only that it is highly probable that vocalizations do play a role in the mating process.

The young pigeons in this experiment did hear as well as see their parents. It is possible, but not thought to be highly probable, that the females mated with males on the basis of vocal similarities with the parents. (Individuals interested in further study in this area will find Thorpe (1956) a valuable reference.) A more likely variable involves the auditory stimulation present during the period

when the birds were visually isolated from one another. As the birds matured, there began to be a considerable amount of vocal activity. Since the male pigeon is much more vocal than is the female, the male birds did most of the calling and cooing. An attempt was made to avoid systematic errors which might result from such vocal stimulation by randomly interchanging the birds from time to time. Nevertheless, lasting effects of this auditory stimulation are conceivable. Females may have been attracted by the voice of a nearby male, and later, in the mating cage, when courted by this male, responded to his voice. It is entirely possible that male and female pigeons are equally susceptible initially to visual imprinting but that auditory factors can at least partially overcome the original effects of the process. In a natural setting, there are undoubtedly many factors which lead to the breaking down of the bonds which are established during imprinting (Jaynes, 1958b). It should be mentioned that the supposed irreversibility of the imprinting process is one point at which the formulations of Lorenz (1935; 1937; 1952) and Tinbergen (1951; 1953) have been seriously questioned (Hess, 1959; Moltz & Rosenblum, 1958).

Although it is not justifiable to overlook the possible importance of auditory stimulation among these birds, it appears that visual stimulation has been adequately demonstrated to be a more important variable in the courting activities of pigeons and doves. Bullough (1951), Lehrman

(1958), and Matthews (1939) have demonstrated that visual stimulation by its mate is sufficient to produce oviposition in a female pigeon or a dove.

The law of effort. Hess (1958; 1959) has recently demonstrated that the strength and permanence of imprinting in ducks is proportional to the amount of energy which the young duck expends in following its parent or parent surrogate. He has termed this the law of effort. In the present study controlled observations were not made during the time that the young birds were in the nest. Nevertheless, it is interesting to speculate on what the relationship might have been between the parents and the young in view of the sex differences which were found to exist.

Newly hatched pigeons are covered with down, their eyes are closed, and they are not able to move about easily. When one of the parents is covering them they will, if they are hungry, raise their heads and move them in a searching fashion among the breast feathers of the parent. It would appear that at this time the young are responding to a synthesis of stimuli which could be termed feathers-and-warmth-above. Somewhat later, but still before the eyes open, the young will respond to a slight motion of the nest with searching, soliciting movements. At the age of approximately six to ten days the eyes open and the young become able to make a characteristic high pitched peeping sound. The eyes are quickly utilized as another means of recognizing the

parents, and the young birds begin to solicit upon seeing the parents. The peeping sound is utilized in drawing the attention of the parents, and when the young are very hungry they sometimes peep when the parents are not in sight. The usual procedure after the squab's eyes have opened is as follows: upon sighting one of the parents, the squab begins to peep loudly if he is hungry. At the same time, he raises himself and moves to the front of the nest, spreading and slightly fluttering his wings. The extent of and energy involved in these movements is directly proportional to the degree of hunger, up to the point of starvation when the activity begins to subside, apparently because of a loss of vitality.

It would be illuminating to ascertain if male pigeons expend a great deal more effort in soliciting food and comfort from their parents than do female pigeons. If this was found to be true, then Hess' law of effort would seem applicable to this situation. As was previously mentioned, there were no observations made in the present experiment which shed light on such a proposition. One study, however, has been reported that seems to bear tangentially on such a hypothesis. Valentini (1951) has reported that he could discriminate consistently between male and female pigeons at the age of two months on the basis of their behavior in a competitive food-getting situation. Under these circumstances, he found the male pigeons to be more aggressive than the females.

Of course, even if it is found that the male is much more active in obtaining food from its parents than is the female, the reason for this will still not be known. The obvious explanation is that the male is by nature more aggressive. Other alternatives might involve a preferential treatment of the female by the parents or a larger demand for food by the male, since he is usually the larger bird.

This type of speculation opens a whole new area for future research. For example, it could be asked what effect different degrees of parental attentiveness might have upon the bird at maturity. Practical experience with pigeons indicates that there are differences in the amount of attentiveness that parent birds show their young. Hybrid birds, bred for various physical characteristics held in high esteem by breeders, are almost invariably poor parents. Of course, there are non-genetic factors which can influence parental attentiveness. Some degree of experimental manipulation of parental attentiveness should be relatively simple. For example, one could allow the birds only enough food to sustain existence. There is no doubt that the young birds would then expend a great deal more energy in soliciting nourishment from the parents than if they were provided with a continual supply of food. The law of effort would indicate that birds with inattentive parents should become more permanently attached to the parents. Later social behavior should be proportionally affected.

Factors in Mate Selection

Rather than having ascertained which bird of a pair plays the most important role in mating, this study has only helped to clarify one of the determinants of one of the partners' behavior. Apparently, one of the major determinants of the male's mating behavior is his parent's characteristics, particularly color. The role of the female pigeon in pair formation and the factors influencing such behavior are still unknown quantities. The investigator who wishes to pursue this problem further is faced with several avenues of approach.

Is the female passive? As was mentioned earlier in this paper, there are a few authors who feel that the female is a victim of conquest by the male. The conclusions of authors who discuss the roles of the male and the female in the courting process are ordinarily patterned in the following manner. The male's role is usually relatively easy to outline. With notable exceptions, he is generally described as the aggressor, the one who goes about courting in an active manner. The female's role is usually much harder to define and is many times described primarily in negative ways. For example, if one were to characterize the role of the female pigeon in the courting sequence, it could generally be said that her role is to neither attack nor vigorously flee from the male. Succinctly stated, "The indifference of the female, real or apparent, is a recurrent

theme in all writings on animal courtship" (Burton, 1953, p. 49). Thus, a first alternative may be that the female does not play an active part in the selection process. If this is the case, when the female is mature and ready to mate, the first active male who earnestly solicits her in courtship becomes her mate.

On the other hand, the female is seldom described as being absolutely passive or indifferent. Though in comparison to the male she is relatively passive, there are usually some subtle mannerisms in which she indulges which seem to function to display her availability. For example, the female pigeon will many times nod her head slightly when she is receptive to mating. Thus, an argument can be made for the idea that the female does respond selectively to the courting males. This second alternative will probably be found to fit the data more closely than the other alternative when this phenomenon has been sufficiently studied. In the words of Burton, "It is much more probable that the actual selection was, in fact, determined by a synthesis of sensual stimuli which defies analysis" (Burton, 1953, p. 261).

Aggressiveness and related variables. The natural vigor of the male, his style of sexual approach, his ability to obtain and hold a territory, his physical characteristics, his antagonistic aggressiveness, his position in the social hierarchy are some of the variables which may make a male attractive to a female. Naturally, these variables are not

distinct one from the other. Aggressiveness is variously related to social position, territory obtained, and style of sexual approach to such a great extent that one could be led prematurely to the conclusion that aggressiveness may be the only variable worth consideration. It is doubtful, however, that a simple relationship exists between aggressiveness and desirability as a sexual or mating partner, although a certain amount of aggressiveness is necessary. Guhl et al., have studied this relationship with chickens and conclude:

Despite the advantage of a high social level of aggressiveness in competitions for food and space, beyond some undefined point, female aggressiveness appears to interfere with the mating process. Also, beyond a considerably higher level, aggressiveness of a cock toward associated hens . . . lessens his chance for mating (Guhl, Collias, & Allee, 1945, p. 385).

The postulation of aggressiveness as the major variable in social interactions among animals has been attacked by Schneirla (1946), Scott (1953), and Stewart and Scott (1947). Each of these authors points to differences between aggression or dominance and such phenomena as leadership and ascendancy, which they carefully attempt to differentiate from antagonistic aggressiveness. Findings such as those of Wood-Gush (1957) definitely serve to undermine any attempt to establish a simple relationship between aggression and sexual attractiveness or even between level of testicular hormone and aggressiveness. He found no correlation between peck-order position and sexual drive among male chickens. In addition, there were large individual variations in the

reactions of the cocks to equal doses of testicular hormone. He concluded that the hormone may merely serve as a basis for the appearance of sexual responses, with the relative strength of the sexual response being dependent on other factors.

Observations during the present study revealed that while the most aggressive males were usually the first to mate, some of the most passive males secured mates early in the mating period. One pair, for instance, mated and had eggs before the experimenter was aware that a courtship was under way. The relationship between aggressivity and mating potential is unclear at present and deserves further study.

Opinion and observations. The author is convinced that although mating is a mutual endeavor, the male plays the more important role in determining whether a mateship shall be consummated and maintained. One series of observations is reported as a sample of the type of observation upon which such a conclusion is based. In replication three, 6090, a white male raised by white parents, took possession of the territory on top of the nesting boxes shortly after the members of the replication were moved into the mating pen. This upper territory was a highly valued territory and was usually shared by one or two of the more aggressive males in a replication. In this instance, however, 6090 drove all other birds from this territory and within a week had sole possession. During the next week, two white females

(72 and 6089) were frequently observed in this upper territory. Number 72 strutted to and fro before the male in the most seductive fashion possible for a female pigeon, while 6089 frequently drove 72 from the upper territory. It was obvious that they were competing for the favor of the male. The male, however, never seemed to respond to 6089 and drove her away when she landed in his vicinity. Within the next few days it appeared that 6090 and 72 had almost consummated a mating. They were found together in a nest box and 6089 had disappeared from the scene. The author was on the verge of removing this pair, but noted that a black female (6084) had moved into one of the upper nest boxes and was quietly calling. Since it was early in the replication, it was decided to leave 6090 and 72 in the mating pen a few days to make certain of their mating. In the following two weeks an interesting series of events occurred. The male 6090 began to spend less and less of his time in the company of 72, although she continued to pursue him and to display before him vigorously. At the same time he began to court the black female. The black female, however, did not move to the top territory, but spent most of her time on a perch which was just below the level of the nest boxes. Thus 6090 was forced, if he was to continue his courtship, to spend less and less of his time in his original upper territory. Portions of this upper territory were gradually usurped by other birds, until 6090 had as his territory the tops of only two

or three boxes. Eventually, 6090 and 6084 mated. Nevertheless, 72 was still displaying to 6090 and sometimes drove 6084 from the upper territory. The male 6090 finally mated with one of three females available to him. The female he mated with was the only one of the three that was the color of his parents. Other conclusions are as follows: Vitality, sexual aggressiveness, holding a choice territory, and general aggressiveness do seem to arouse a positive response in some females. Solicitation by the female is not sufficient to assure a mating.

Spatial Contiguity as a Factor

Spatial contiguity is certainly one prerequisite for mating to occur. Early in the experiment it appeared that this factor might seriously influence the results. It was noted that the Black Kings did not fly to the upper perches as soon as the White Kings. They spent a much higher proportion of their time on the floor of the mating pen than did the white birds. When the breeding pairs were being observed prior to their assignment to the breeding cages it was observed that the Black Kings, much more often than the White, made their nests on the floor. At that time it was concluded that these birds might well have been raised on the floor themselves and thus developed a preference for the floor as a breeding area (Mayr, 1940). However, this conclusion does not appear to be a valid one. The young birds in this experiment were all raised at the same distance above the

floor of their breeding cages, and this differential preference for perches was still observed. It would appear that some other factor, perhaps a greater inherent facility for flying in the White Kings, accounts for this difference.

It was feared that this difference might lead to an accentuated tendency for white birds to mate with white birds and black birds to mate with black birds, since all birds seemed to spend a greater proportion of their time in the vicinity of their own breed. It has often been mentioned that the possession of a valued territory seems to increase the mating potential of a male (Collias, 1944; Kortlandt, 1955; Riddle, 1919; Taylor, 1932) and that the owner of a territory wins most of the aggressive encounters within his territory (Carpenter, 1929; Potter, 1949; Ritchey, 1951). Since the higher perches are generally thought to be favored perches and since White King males first claimed these perches, it was felt that these males would be the first to mate and would not relinquish the upper perches.

These fears proved to be unfounded. Despite the partial isolation by breed that resulted from the above mentioned factor, the birds readily crossed breed lines in establishing their matings. Birds mated on the floor of the enclosure, particularly in the corners, at about the same time that the birds on top of the nest boxes were acquiring mates. As the mated pairs were removed, other birds rapidly took possession of their territories (Taylor, 1932).

At least two conclusions can be drawn from the above observations. First, one should not be too quick to designate one particular territory as the favored territory. Anthropomorphically, the author thought that the upper territories would be highly valued. However, some of the lower territories were apparently as highly valued by some birds. Secondly, partial segregation of the breeds, caused by what appears to be inherent differences in type of territory occupied, did not lead to mating by breed. Thus, spatial contiguity seems to be a necessary but not sufficient condition for mating.

Phylogenetic Comparisons

Though the writer completely agrees with Beach (1950, p. 115) that the primary aim of the comparative psychologist is the exposition of general laws of behavior despite their immediate applicability to the problems of human existence, it seems appropriate to speculate about the cross-species implications of the present study. Following the procedure for phylogenetic comparison established earlier in this paper, it should be determined whether the general pattern which was found among pigeons is typical of other lower order species. However, systematic studies of the effects of early experience upon mate selection are presently non-existent. If future studies result in findings similar to those of the present study the following question could legitimately be posed: What if the same is true of man?

If the same is true of man we would expect to find that males would mate with females who were similar in external appearances to the male's parents. Of course, if one were to seriously attempt to test such a proposition, a rather special set of circumstances would have to be provided so that effects of variables other than parental characteristics would be minimized at least until the critical period for imprinting in humans had passed. Of course, it is quite probable that other factors play a more important role in mate selection among human beings than does any simple imprinting process. Nevertheless, if a suitable setting could be found, it might prove interesting to investigate such a prediction.

The determinants of mate selection among human beings are far from being well-delineated. For example, after an extensive study of the factors involved in human mate selection, Winch concludes, "In mate selection each individual seeks within his or her field for that person who gives the greatest promise for providing him or her with maximum need gratification" (1958, p. 88). It is possible that one of the reasons that such studies seldom produce much more than this type of vague statement is that they have not sufficiently considered the possibility that male and female animals, regardless of the species, may be influenced in their choice of mate by a dissimilar set of influences.

Burton's comment serves to emphasize the current lack of understanding of the determinants of human mate selection:

Man may, in some respects, tower above the rest of the animal kingdom, but his roots are still firmly imbedded in it, and no way is more strikingly demonstrated than in an objective analysis of his behavior during a courtship. So we may ask the question: Do human beings consciously choose a mate? Anyone who has reflected seriously on the question must agree that there is no clear Yes or No in answer to it. . . . It seems most likely that human choice of a life-partner is not conscious or rational, but an intuitive process. In other words, we choose our partners by means very similar to those used by animals, or by the higher animals at all events (Burton, 1953, p. 262).

Concluding Remarks

There were many interesting observations and speculations which are somewhat unrelated to the present study or are still too poorly understood to be reported in this paper. Sufficient questions have been raised to occupy much additional research time. The author can begin to appreciate the words of Maeterlinck:

One would never have done if one had to answer all of the questions which present themselves in respect to these points, or indeed in respect to any other detail of life, for the simplest question relating to life brings the universe and the gods themselves into the field (Maeterlinck, 1936, p. 62).

In writing the present paper, the author has attempted to utilize language which will impart the full significance of the animals' behavior, without violating an objective outlook. This has been impossible in some instances. Some terms have been used with full knowledge that they might

connote a conscious process and premeditated intention. Of course, there is no way at the present time to ascertain a non-verbal animal's facility for premeditated intention. These terms were used only because the author is not aware of other terms which would concisely designate the process involved.

As Burton warns:

There has been a good deal of condemnation of taking the anthropomorphic view. That is to say the zoologist has strongly warned us against reading into the behavior of animals meanings and motives that are the hallmark of human behavior. The wisdom of this has, however, been somewhat overdone. Moreover, the scientist has seemed to have fallen into another pitfall, a sort of inverted anthropomorphism, of judging animal conduct in a human bushel. In other words, in his anxiety not to view animal conduct in human terms he has failed to see that he is not always viewing it from the animal's point of view, but from a neutral standpoint, which is neither one nor the other (Burton, 1953, p. 235).

The present author can only plea with Carpenter

I have tried to avoid the errors of theomorphism, or the attributing of animal characteristics to man, and of anthropomorphism, or attributing human characteristics to animals. The lack of an appropriate and adequately specialized language makes it difficult to avoid these errors so I can only hope that I have partially succeeded (Carpenter, 1942, p. 204).

CHAPTER VI

SUMMARY

Many authors in the field of animal behavior have been concerned with the effects of an animal's early experience upon its later behavior. The present investigation was concerned with the following problem: Does early interaction with parents so affect an animal that at maturity he will mate with an animal which is similar in characteristics to his parents? The subjects of the experiment were 32 Black King pigeons, 16 of which had been raised by Black King parents and 16 by White King parents, and 32 White King pigeons, 16 of which had been raised by White King parents and 16 by Black King parents. In each of the groups of 16 pigeons, half were male, half were female. After having been raised in exclusive visual contact with their parents for approximately 40 days, these birds were isolated until maturity. Two males and two females were then selected to represent each of the four possible combinations of parent-young coloration. These 16 birds were placed in a mating pen and observations were made to determine which of these birds mated. Four such replications of the experiment were conducted.

It was found that males did mate with females who were similar in characteristics to their parents, while female pigeons did not do so. This sex difference was unexpected and appears to be a unique addition to knowledge in this field.

Various possible explanations of this difference were discussed, as were its ramifications for future research.

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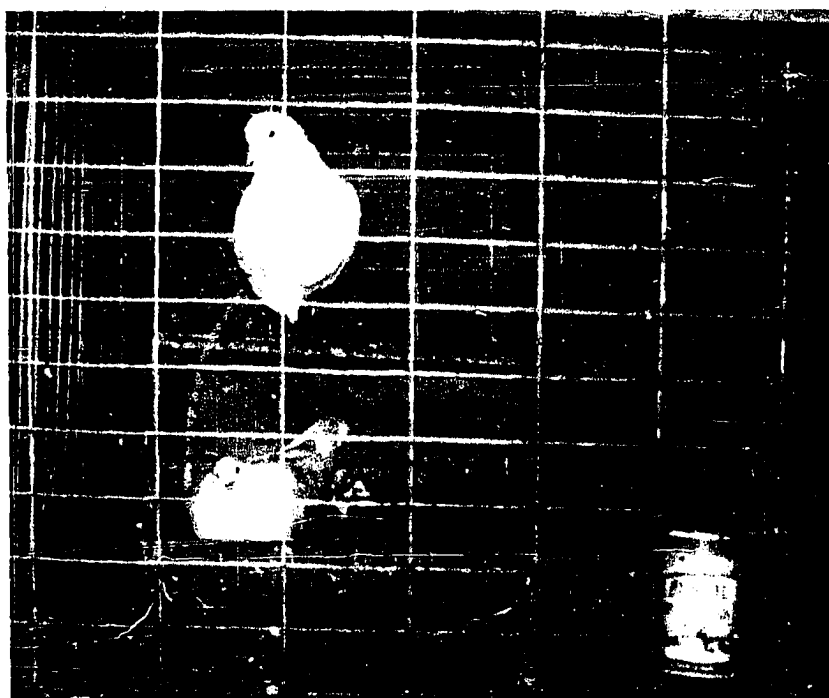
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APPENDICES

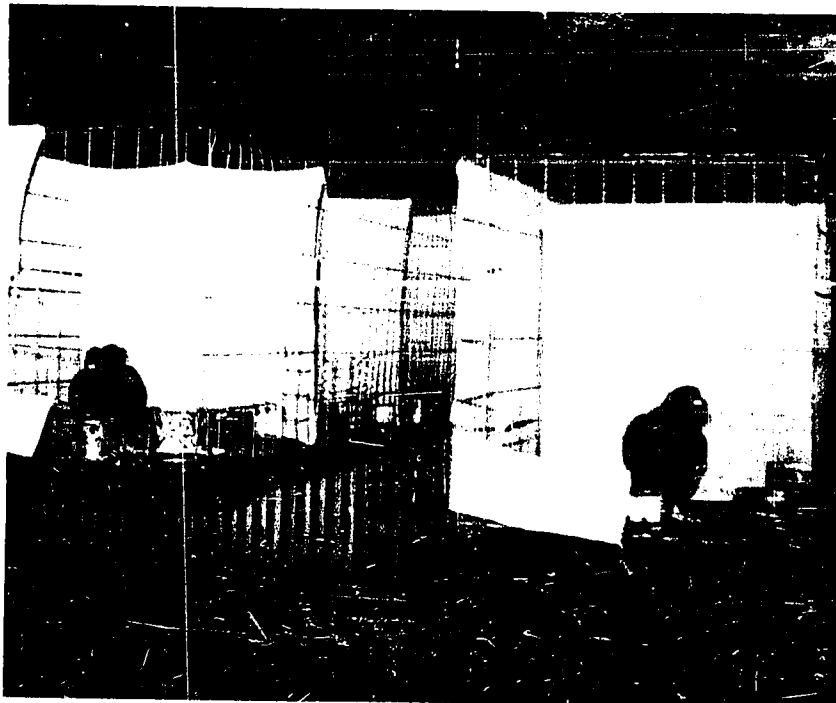
Appendix A

Pigeons in Breeding Cages



Appendix B

Pigeons in Isolation Cages



Appendix C

Pigeons in Mating Pen

