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CHAPTER I

INTRODUCTION

Various writers have been concerned with the social organization of nonhuman primates and with the phenomenon of dominance as an index of social status in monkeys. Considerable evidence suggests that aggressive behavior is a determinant of social status in the macaque groups. Within recent years authors from a number of different disciplines have investigated the phenomenon of aggression in a wide variety of species, including man. Research concerning aggression appears to be stimulated, at least in part, by interest in three theoretical areas: psychoanalysis, learning theory, and ethology.

That the topic is of general interest is attested to by the significant number of monographs (Beres, 1952; Fairbairn, 1940; Fisher & Hinds, 1951; Hartmann, Kris & Loewenstein, 1949; Hitschman, 1948; Saul, 1956) and surveys (Ardrey, 1961; Berkowitz, 1962; Buss, 1961; Carthy & Ebling, 1964; Scott, 1958a; Lorenz, 1966) of the theoretical and experimental work executed in the area of aggression which have been published since Freud's (1920) earlier publication: *Beyond the Pleasure Principle*. Technological advances in the methods of modern warfare may have lent some additional impetus to the widespread interest in understanding the nature of aggression.

Much speculation has centered around the functions of aggression in animals and numerous investigators (Carpenter, 1964; Collias, 1951; Hall & DeVore, 1965; Hediger, 1950; Howard, 1920; Lorenz, 1966; Nice, 1941; Tinbergen, 1951; Wynne-Edwards, 1962) have made use of the concept of territoriality in describing animal behavior which may be defined as aggressive or threat behavior used to defend a territory. Considerable experimental work has been done with animals in an attempt to answer some of the questions posed about the phenomenon of aggression.

Justification for Animal Research

To paraphrase Alexander Pope's comment, the proper study of mankind is--animals, particularly those species nearest the human species on the phylogenetic scale. The enormous significance of the evolutionary-biological base of man is increasingly being taken into account in any serious attempt to theorize about the behavior of man. Man's heritage from the lower animals can no longer be refuted or denied. Nor would there appear to be any scientific reason to do so.

Lorenz has suggested that "the long-sought missing link between animals and the really humane being is ourselves" (1966, p. 229) and asserts further that this belief carries with it an attitude of modesty about oneself and optimism about the future evolution of mankind.

There is much positive evidence to support the relevance of studying nonhuman primates in order to learn about human primates. From Aristotle and Galen to Darwin and Huxley the analogies between human and other primate structure and function have been pointed out repeatedly. Experimental work with animals has demonstrated mammalian capacity for such "human" qualities as neurosis (Cherkovich, 1959; Liddell, 1955; Masserman, Aarons, & Wechkin, 1963), psychosis (Harlow, 1962a), and gastric ulcers (Brady, 1958).

Some species may even show concern for one another as demonstrated by monkeys avoiding food after 22 hours deprivation in order to avoid inflicting pain on a conspecific (Wechkin, Masserman & Terris, 1964). Other macaques are reported to have transmitted "cultural" phenomena (Kawai, 1965) whereas Fabri (1962) reports on a selective response to objects which may be a rudimentary esthetic sense in monkeys. Other researchers (Miller, Murphy & Mirsky, 1959) have shown that monkeys communicate affect to one another by facial expression. Carpenter (1964) argues the validity of assuming that phenomena such as culture, society, language, and "mind" exist on the level of human evolution only, and suggests further that the animal-human dichotomy is an oversimplified explanatory concept which is untenable.

Moreover, at least one author (Hume, 1959) states the case for studying animal behavior--even intuitively, by the researcher representing to himself by analogy the subjective experience of other species of animals. He points out that every analogy breaks down if it is pushed too far and that anthropomorphism is no exception. Hume concludes that:

> Anthropomorphism is _prima facie_ justified in advance by the fact that the human race is akin to the lower animals through the process of evolution. Opposition to Darwin's theory . . . is dead so far as the descent of man's body is concerned, but a similar sentiment in respect of mental kinship seems still to exert an unconscious influence on many . . . . (1959, p. 2).

As Lorenz points out, when analogous developments occur in similarly functioning organs from different phylogenetic origins the organs are called by the same name whereas analogues in social behavior called by the same label, such as love, fear, shame, anger, etc., are another matter entirely.

> When Cephalopods, like the Octopus, Squid, and Cuttlefish, on the one hand and vertebrates on the other have invented, independently of one another, eyes built on the same principle as the lens camera, and when in both cases, these organs have similar constructional units such as lens, iris, vitreous humor and retina, no reasonable person will object to calling both the organ of the Cephalopods and that of the vertebrate an eye--without any quotation marks. We are equally justified in omitting the quotation marks when speaking of the social behavior patterns of higher animals which are analogous with those of men (1966, p. 218-219).

Although some authors firmly believe anthropomorphism is justified, there are those who seem equally convinced that analogies between human behavior and animal behavior are not helpful or scientific (Morgan, 1894; Munroe, 1955). The latter group, almost Cartesian in some rare instances, are especially reluctant to consider social behavior of animals as analogous to that of man.

But for those researchers whom we may risk labeling as integrationists or synthesizers perhaps the best of two possible experimental worlds can be gained. The behavior of organisms becomes more complex as one goes up the phylogenetic scale, and increasing complexity may result in emergent properties. By recognizing the genuine limitations of any analogy at either end of the continuum--from complete identity to complete disparity--this approach in comparative methods can be an indispensable tool of scientific research when used critically and with due caution.

Relevance of Ethology to Human Behavior

Nevertheless, when two disciplines by different methods and approach arrive at similar findings, concepts, and theories, additional weight and significance would seem to be lent to each theory individually. In their conceptualizations concerning humans and animals, personality theorists (Erikson, 1963; Freud, 1948a, b; Sullivan, 1953) and ethologists (Kortlandt, 1955; Lorenz, 1937, 1966; Tinbergen, 1951) make use of similar concepts such as "critical periods" or "stages of development" in describing the developing organism. Without exception these theorists emphasize the important extent to which human or animal behavior can be shaped by events which occur (or do not occur) during certain critical or sensitive stages of development.

The general concept of critical periods assumes that there are specific periods in ontogeny during which the organism is sensitive to certain kinds of stimuli and that these stimuli can be related to significant characteristics of later behavior. Psychoanalysis (Freud, 1949) presents such a concept in the theory of psychosexual development. Erikson (1963) presents a theory of stages in ego development which he postulates as an integration of ever increasing complexity between the maturation of an individual and the social institutions in his environment. Sullivan (1953) also conceptualizes development in stages and as an interpersonal dynamic which effects and is effected by significant others in the environment. In humans and in animals certain things have to occur at certain sensitive periods or learning does not develop normally; i.e., Harlow's (1961) study of monkeys reared in isolation and Spitz' (1946) study of deprived children.

The concept of critical periods has been supported by a host of animal studies (Beach & Jaynes, 1954; Hess, 1959; Kortlandt, 1955; Lemmon & Patterson, 1964; Lorenz, 1937; Scott, 1958, 1962; Tinbergen, 1951; Warriner, Lemmon & Ray, 1963) which in turn have led to some pertinent formulations. Deprivation may prevent the development of a response during an early critical period, when it would have appeared without learning, or would have been learned readily, whereas at a different developmental level a difficult process of learning or adjustment is required. The development or maturation of the organism before the critical period increases the tendency for the response to occur. An animal deprived during the critical period may have its tendency to respond modified, even though deprivation may not completely prevent normal development. Deprivation may, however, alter the course of the development from what it would have been if experiences were normal. In some cases this is the opposite to normal development. The animal under severe deprivation may be quite deficient compared to another animal at the later critical age.

Developmental psychologists in an analytic approach to the ontogeny of learning have divided increasingly complex behavior from birth to maturity into relatively discrete stages and have become especially interested in the hypothesis of critical periods for learning, for infant stimulation, and for the formation of social relationships (Zimmerman & Torrey, 1965). The results of a rather comprehensive survey of critical periods in a number of different species (Scott, 1962) suggest that the maturation of the affective processes--emotional and motivational--is crucial in determining what, and how quickly, an animal will learn at any particular stage of development.

In personality theory affective behavior, motivational and emotional maturation are considered of the utmost importance for the later development of the individual. Most psychoanalytic theories and later extensions of these theories emphasize the critical period of early childhood in the development of enduring aggressive trends in the individual personality.

The observations from which these theories arose are, for the most part, only known retrospectively from the clinical situation and only rarely can such theories be subjected to external validation.

Theoretical Views of Aggression

Freudian metapsychology, learning theory, and ethology each views aggression as of central dynamic significance. Freud's (1948, 1955) dual instinct theory conceptualizes the individual as innately and genetically endowed with a given amount of energy directed toward destruction (and ultimately death). This instinct must be expressed externally for if inhibited it seeks indirect routes of expression and may turn back upon the individual himself; however, libido or life instinct opposes the death instinct. Post-Freudians lack consensus in regard to the dualism of the conflicting life and death instincts. Although some psychoanalysts (Federn, 1932; Klein, 1948; Menninger, 1938) have accepted the concept of a death instinct, others (Fenichel, 1945; Jones, 1957) reject it and consider the death instinct unnecessary in accounting for an aggressive instinctual drive. A contemporary analyst (Toman, 1960) views aggression as an aspect of primitive, biological desires. According to this authority such primitive desires are usually satisfied in aggressive and destructive ways, but aggressive energy blocked by frustration is not dissipated and remains to be expressed in one way or another which may or may not be healthy either for the individual or for society.

The learning theorists have developed Freud's hypothesis that aggression resulted when behavior aimed at gaining pleasure or avoiding pain was frustrated (Dollard, Doob, Miller, Mowrer & Sears, 1939). Learning theory views aggression not as an innate, biologically determined, instinctual drive, but as a learned response to frustration. This latter hypothesis, i.e., the strength of the tendency to aggressive behavior varies with the amount of frustration, has been supported experimentally and is clearly within the stimulus-response framework of learning theory. Later Mowrer (1960) suggested that learning theory has not given enough attention to the intervening variables (such as the inner, affective-ideational components of aggression) between the stimulus of frustration and the response of aggression.

There is no doubt that aggression can occur as a result of frustration. This finding, however, does not necessarily preclude the theory that aggression is a basic drive. Currently, drive is often defined simply as a tendency to be sensitive to stimuli of a certain class and to respond in any of a variety of ways that are related to the attainment of a certain goal. Although various incompatabilities exist between the two theories, they are not considered necessarily mutually exclusive; indeed each may supplement the other. Subsequent evidence, converging from a variety of sources, may help to resolve some of the issues about the basic nature of aggression.

The third and most recent group of theories stem primarily from ethology--although biology, zoology, comparative behavior, sociology, anthropology, and psychology have contributed also. Findings in these areas suggest similarities in conceptualizing aggression in animals and in man. Naturalistic and experimental studies of animals have demonstrated an inherent physiological mechanism for the organization and expression of aggressive behavior (Carthy & Ebling, 1964; Lorenz, 1964, 1966). Ethology views aggression as one of the drives which functions to preserve the individual and perpetuate the species. According to Lorenz, contemporary man's aggressiveness is closely akin to or identical with the spontaneous instinctive drive of his earlier animal ancestors.

> There cannot be any doubt, in the opinion of any biologically-minded scientist, that intraspecific aggression is, in man, just as much of a spontaneous instinctive drive as in most other higher vertebrates. The beginning synthesis between the findings of ethology and psychoanalysis does not leave any doubt either, that what Sigmund Freud has called the "death drive", is nothing else but the miscarrying of this instinct which, in itself, is as indispensable for survival as any other (1964, p. 49).

Recent palaeo-anthropological discoveries verifying the predatory, cannibalistic Australopithecinae suggest that mankind has had an evolutionary heritage of "carnivorous aggression" (Dart, 1953) not only from the "lower animals" but from his own direct ancestory.

Functions of Aggression

In natural conditions there are compelling reasons why animals manifest aggressive behavior. Aggression serves a function for survival of the species (Allee, 1954; Carpenter, 1934, 1964; Darling, 1937; Hall, 1960; Lorenz, 1966). In order to survive all animals must be distributed over space proportionate to the amount of food available (Wynne-Edwards, 1962), thus aggression serves to establish a territory or life space (occasionally time space). Aggression serves in the selection of more vigorous mates for procreation and defense of the young. It may be equally important in the establishment of a social hierarchy. Hierarchial organization is particularly crucial among social animals that develop over a lengthy period of time and learn from the old, experienced leaders of the group.

In many species where the female alone tends the young, she can be seen to be much more aggressive than the male. Kawai (1958) and Kawamura

(1958) have analyzed female social status in natural groups of Japanese macaques and the latter describes a group of 29 led and dominated by a female. Petter (1965) reports seeing females leading the group among several species of lemurs, whereas Jay (1963) reports the lemur female hierarchy is not rigid or well defined; however, females ally against other females--and frequently were observed to ally against males. An occasional female may slap and chase a male.

Intraspecific aggression is found wherever there is individual personal recognition of partners and mutual bond, according to Lorenz (1966). Therefore, inhibitory mechanisms for deflecting aggression from the mate, the young, and others of the same species have appeared. These inhibitory mechanisms have been called "redirection" and "ritualization". Each may become an end in itself, thus establishing a bond between individuals as they mutually redirect aggression against, for example, the territorial neighbor (Tinbergen, 1951). Or fighting may become ritualized into display, threat, submission and appeasement as in wolves (Murie, 1944). Although aggressive behavior may have survival value for the species, under natural conditions individuals do not fight to the death with members of their own species. Usually serious conflict is aborted and little damage occurs.

Social Status in Monkeys

The social behavior of nonhuman primates in free-ranging groups has been of interest to various writers (Altmann, 1959, 1962; Bolwig, 1959; Carpenter, 1934, 1964; Collias & Southwick, 1952; DeVore & Washburn, 1963; Furuya, 1957; Hall & DeVore, 1965; Imanishi, 1960; Jay, 1965; Kawamura, 1958; Koford, 1963; Kortlandt, 1962; Kummer & Kurt, 1963; Mizuhara, 1964;

Miyadi, 1964; Simonds, 1965; Tokuda, 1952, 1962; Zuckerman, 1932) who have provided evidence of social ranking among many species. Within the social structure of a primate group, individuals appear to evaluate one another relative to the evaluating individual's position among the other members of the group. Aggressive behavior in male monkeys is frequently seen as the determinant of status or leadership, whereas other variables, such as influence of consort, estrus, and kinship ties have been suggested as possible determinants of status in females (Carpenter, 1964; Kawai, 1965; Tokuda, 1962; Yamada, 1963). Several investigators report that the determinants of female hierarchies are difficult to discover (Hall & DeVore, 1965; Kawai, 1958). The purpose of the present study is to investigate the determinants of social status in female macaques.

At least 20 free-ranging groups of indigenous macaques have been studied thus far by the researchers at the Japan Monkey Center. Itani (1965) investigated the Takasakiyama group under natural conditions and again after the group was provisioned. The provisioned feeding area afforded close study of the social structure of the group. Mothers with infants, juveniles, and fully adult, dominant males occupied the center of a group. Less dominant and subadult males were on the periphery of the nuclear group--with adult males nearer the center than subadults. All monkeys were spaced more or less in concentric circles around the core, although a few solitary males were observed to have no contact with the group. The relative position and distance of the various members of a group from one another was assumed to reflect the nature of the social relationship between individuals. When the group was on the move, this same order of progression was observed. Less dominant males moved to the front, rear, and sides with dominant males in the core of the group in company with mothers and infants.

A similar spacing was found among <u>Papio</u> <u>ursinus</u> (Hall & DeVore, 1965). The core group was composed of estrus females, mothers with infants, and a few of the most dominant males. These authors found that the baboon female hierarchy also was difficult to determine, and have suggested that this may be partially because female status is variable and perhaps more subtly defined than that of the male baboon. The function of the less dominant males on the periphery seems to be to watch for predators and to give the alarm call. The adult dominant males ensure maximum protection for mothers with infants and keep a degree of order within the group. They probably sire the largest number of progeny also by virtue of their closeness to the females. Hall & DeVore (1965) suggest that the social behavior of the baboon is one of the species principal adaptations for survival.

Kawai (1958, 1960) distinguishes two types of rank among Japanese macaques: dependent rank which is influenced by the presence of other animals and basic or independent rank. Dependent rank is defined as the rank which the infant assumes from its own mother's social rank within the group. Later, if the infant is protected by other high-ranking members of the group it may assume some of the special privileges accorded them. The effects of dependent rank are strongest at the central part of the troop and become progressively weaker the further removed the individual is from the core. According to Kawai, the male animal in the periphery of the group must depend entirely upon his own strength to establish his social rank. The female, staying within the center of the group, depends more upon kinship ties and rank is influenced by factors other than physical strength. Tokuda (1962), for example, reports on the influence of the female estrus cycle on the female's relative social rank. The female in estrus appears to be more highly prized by all other members of the group. In general, the male Japanese macaque is dominant over the female, although one exception is reported: The Minoo-B group (Kawamura, 1958) which is led and dominated by a female.

Nevertheless, Carpenter (1964) states that the male plays the most prominent role in controlling the group and is clearly dominant in natural groups with the possible exception of gibbons. He suggests, however, that among females there is a "dominance gradient . . . of a lower slope" (p. 361) than the one among males, but that the two overlap. Thus, some of the most dominant females are more dominant that some of the least dominant males.

In a study of rhesus on Santiago, Carpenter (1942) found that females became more aggressive during their periods of estrus and searched actively for males. In groups with a shortage of potent males, females were reported to have joined other groups of rhesus. Two females joined groups of <u>nemestrina</u> in order to solicit and to form consort relationships which endured during the period of estrus--after which the females returned to their own groups. Another study (Carpenter, 1934) points up the differences between howler monkeys and macaques in regard to the amount of intraspecific aggression displayed. Howlers were found to live in organized groups with stable memberships and occupy a definite, limited range. Individuals in the group were characterized by extreme cooperativeness in response to external threat, in feeding, and in progressions of movement. There was little evidence of sharply defined relationships or of intragroup fighting as in the Japanese macaques.

Other findings (Altmann, 1962; Collias & Southwick, 1952; DeVore, 1965; Furuya, 1962; Koford, 1963; Jay, 1965; Washburn & Hamburg, 1965) also suggest that social organization may differ decidedly among various species of primates and even within a particular species. For example, Mason, Green & Posepanko (1960) found that female rhesus threatened the experimenter significantly more often than the males, whereas Harlow (1965) found that the infant male rhesus makes more threats and is more aggressive in play than the female. Such differential findings concerning aggressive behavior as related to sex, age, between species, and within a particular species, lead to the posing of several crucial questions for which answers are sought.

Approach in Animal Studies

There are a variety of ways to approach the study of animals depending to a large extent on the way the animal is maintained. Monkeys may be studied in the wilds under natural conditions, in their natural habitat but provisioned, in an artificial habitat resembling the natural state, or in the laboratory--indoors or outdoors. In the present study, the subjects were caged under laboratory conditions and an approach was planned taking into account the experimental conditions which required daily handling of the animals. The experimental design necessitated moving the animals from cage to cage as conditions demanded, collecting physiological data daily, such as: rectal thermometry, vaginal inspection, noting the physiological correlates of estrus, i.e., skin pigmentation, etc., and regular weighing. It was necessary to feed and water often as well as to administer medications orally. Thus, the approach included having the experimenter in close contact with the subjects of the colony, in a sense, becoming a participant observer within the group.

The stump-tailed macaque (*Macaca speciosa*) was selected for the present study for several reasons. One of the major reasons was that the approach planned for the study required almost daily handling of the animals. *Speciosa* are reported to be notably less vicious than some other macaques and, in general, are relatively docile and tractable. The experimental animals behaved in accordance with this prediction (Kling & Orbach, 1963). The second reason *speciosa* were selected for study was that the animals were available for the present investigation. *Speciosa* seem to have been relatively neglected as a species for systematic study compared to the rhesus.

Classification of Macaca Speciosa

Since primate behavior may differ markedly from species to species or even within a particular species, the subjects will be identified as fully and accurately as possible. Although primate taxonomists do not agree completely in their systems of classification and nomenclature, macaques usually are considered a single genus (Simpson, 1945, 1962; Fiedler, 1956) of the subfamily Cercopithecinae. Other genera derived from this subfamily are: "black apes", "baboons", "gelada", "mangabey", "guenon", and "patas". Both Cercopithecinae and Colobinae derive from the family Cercopithecidae. Colobinae include: "langur", "snub-nosed monkey", "pig-tailed langur", "proboscis monkey", and "guereza". Cercopithecidae in turn derives from the superfamily Cercopithecoidea. These are the Old World catarrhine monkeys of the suborder Siminae.

Pertinent Questions Raised

The questions which the present study seeks to answer are: What are the determinants of social status in female macaques? What is the role of aggression in the determination of social status among females? Does the female share actively in aggressive functions for survival of the species? Once established is the social structure rigid or can it be altered even though the group is composed of the same members? Can the hierarchy be varied by administration of sex hormones? By administration of a tranquilizing drug? By blocking olfactory cues denoting a state of estrus? To what extent does olfaction convey or communicate the stimuli of estrus to the male? What are the effects of estrus or consort relationship on social status?

Additional questions raised by a study of Macaca speciosa concern the reproductive cycles since this species has not yet been studied systematically. Pertinent questions in this area are: What is the length of the menstrual cycle? What is the length of gestation? Duration of menses? Time of ovulation? What are the physical correlates of estrus in the speciosa?

CHAPTER II

PROBLEM

The Stump-Tailed Macaque (Macaca speciosa) has been studied very little, if we may generalize from the literature. Other nonhuman primate species which have been studied rather thoroughly are: the olive, hamadryas, yellow, and chacma baboon; the rhesus, Japanese and bonnet macaque; langurs; colobus monkeys; howler monkeys; the gorilla, chimpanzees; gibbons; and orangutans. Carpenter (1964) after a number of comparative studies provided some generalizations concerning social organization in nonhuman primate groups, whereas other researchers (Altmann, 1962; Bolwig, 1959; Collias & Southwick, 1952; DeVore & Washburn, 1963; Hall & DeVore, 1965; Imanishi, 1960; Itani, 1965; Jay, 1965; Kawai, 1960; Kawamura, 1956, 1958; Koford, 1965; Kortlandt, 1962; Kummer & Kurt, 1963; Simonds, 1965; Zuckerman, 1932a) have tended generally to focus on one to three species for study.

Investigators of social organization in monkey groups mainly have focused on male social status in the group as of major importance believing female social status to be variable and subtly defined; however, Kawai (1958) and Kawamura (1958) have analyzed female social status in natural groups. The latter described a group of 29 Japanese macaques led and dominated by a female. Largely, however, students of social organization among monkeys have not investigated those variables which determine social status among females. Obviously, physiological factors are of some importance but the consensus seems to be that these alone do not account for social status. Variously, kinship ties, a state of estrus, and consort relationships have been suggested as possible factors influencing the female's status in a group. Moreover, although social behavior and various aspects of socialization have been studied experimentally (Bernstein, 1962a; Butler, 1954, 1965; Harlow, 1962a, b, 1965; Mason, 1965; Riopelle & Rogers, 1965; Yerkes, 1929, 1940), there has been a paucity of research concerning social status in female monkeys other than those studies which determined dominance between two females.

Analysis in the laboratory is a valuable and necessary approach to the study of social organization (Jay, 1965). Obviously various approaches; viz., field, laboratory, and artificial colonies, are worthwhile and yield data which are mutually supplemental. All of these approaches seem necessary to the analysis and understanding of the complexities of social patterns in primate behavior. Specifically, detailed experimental analysis is essential if the complex factors which determine social behavior are to be evaluated. In the present study the opportunity to control and to vary certain conditions (as well as to collect physiological data by systematic observations which would not be possible under natural conditions) was considered to be highly advantageous. Ideally, a field study of <u>speciosa</u> should be made also in order to check observations made in the laboratory against those made under natural conditions.

In the present study the problem as perceived was to observe, record and measure the social interaction among a number of <u>speciosa</u> females of comparable age and developmental level. Repeated observations were to be made at a standardized time daily over a period of 14 months, under systematically varied conditions. To extend Altmann's (1962) characterization of social interaction: "Who does what to whom, and in what order?" another phrase was added: <u>and under what conditions</u>?

The four females of the original colony, not previously caged together, were to be integrated in the first stage of the study and observations made as outlined above. The relative social status of each female was inferred from the number of anogenital presentations she received from the other females rotated in adjoining cages. The hypothesis was that when caged together the females would establish a linear social rank which would be at least partially determined by aggressive behavior, and that the highest ranking female would be the most aggressive, etc. A later phase of the study concerned the integration of two new females into the existing colony. The resulting changes, if any, in linear ranking effected by the additional females were to be observed and recorded. Cross comparisons were to be made of each monkey in the existing group relative to the two new females.

The second purpose of the study was to vary, if possible, the social hierarchy which would be established if the hypothesis in regard to linear ranking among females proved correct. Varying the hierarchy of the social organization, and behavior of the females within the hierarchy, was to be attempted by administration of sex hormones, by administration of a tranquilizing drug, and by disguising olfactory components of sexual stimuli denoting a state of estrus.

A third area of investigation involved systematic observations of the physical properties and characteristics of each subject used in the study. Data were to be collected on body weight, dentition, body temperatures, time of ovulation, duration of menses, length of menstrual cycles, length of gestation, and physical correlates indicating a state of estrus. The physical correlates to be investigated were: amount and viscosity of mucus, openness of vulva, protrusion of clitoris, congestion and coloration of the anogenital region.

CHAPTER III

METHOD

History of Subjects

Seven Stump-Tailed Macaques (*Macaca speciosa*) were obtained. Chiquita (C) was purchased from a family who obtained her as an infant. She was reared with the children of this family, dressed in clothing, and was reputed to be toilet-trained although this behavior was not in evidence on her arrival in August, 1964. Apparently C had been bathed and perfumed judging from her body and hair odor. At that time C preferred the company of humans to that of other monkeys.

In December, 1964, three females and one male *speciosa* were purchased directly from several importers. All four *speciosa* were ill on arrival and were discovered to be heavily infested with parasites. Despite immediate treatment one of the females died subsequently. The other animals survived and the missing animal was replaced. These four monkeys were named: Jackson (Ja), Mamie (Ma), Josie (Jo), and Lena (L), respectively.

In January, 1966, two young adult, pregnant macaques were ordered to supplement the colony. None of the original four females were pregnant as yet and it was felt that the male might not yet have achieved fertility although he was apparently fully capable of copulation. The additional females arrived January 28, 1966, and although specified to be pregnant subsequently proved not to be. Nevertheless, the additional animals provided further data on the integration of new members into an established social hierarchy.

The *Macaca speciosa* used in the study ranged in weight from 10.0 to 18.8 pounds at various times during the study. The largest monkey, Ja, gained 6.8 pounds in a nine-month period. His decided growth spurt was attributed to the physiological changes of puberty. The females also increased in weight during the course of the experiment with the exception of C, considered to be imprinted to humans, who lost weight from December to February dropping from 11.5 pounds to 10.0 pounds. In general, however, the increases were steadily upward although some variability was noted.

Treatment of Subjects

The preliminary phases of the study consisted primarily of: (1) rotating the females in individual, adjoining cages so that each monkey had equal opportunity for interaction with the other three, (2) beginning observations of the interactions among the four females, (3) allowing the experimenter time to become acquainted with the monkeys in order to be able to discern body configuration and individual physical characteristics, and (4) a period of time for the experimenter to establish dominance over the monkeys (Asakura, 1958).

Each monkey was handled every other day for purposes of rotation during the preliminary phases of the study. Additional time was allotted to each animal approximately three times per week. Collar and chain control was exerted over each individual as it sat on the experimenter's lap. When a monkey attempted to spring away or to lunge at another monkey, the chain was an effective means of stopping the lunge. Handling and controlling the animals was considered essential to carrying out later stages of the study which included administration of drugs, taking temperatures rectally, and moving the animals from one cage to another as experimental conditions demanded.

Experimental Design

After the preliminary phase described above, the first stage of the experiment involved the integration of all female macaques in one cage. They were introduced to the cage singly at $2\frac{1}{2}$ hour intervals beginning with the female judged to be least dominant and proceeding upward in rank until all original four females were together in one cage. Two observers recorded the interactions in a code (using Altmann's 1962 checklist, adapted) for the first 30 minutes while the experimenter described the observed behavior on tape. Tabulations were made of all observed behaviors, which later were categorized as "aggressive", "submissive", and "friendly" under each condition. Observations were made daily over the following 44 days judged to be a settling period. The next 40 days were a period of Enovid administration in which exactly the same observation, categorization, and tabulation procedure was followed. When this treatment stage was concluded, observations were continued in the same manner for an additional 44 days in order to establish a subsequent base line of behavior.

Later, two additional monkeys (M and S) were introduced in the same manner as in the integration of the original colony except that the most dominant female (Ma) of the original colony was introduced first to the new females (who were judged to be submissive) and so on downward in social rank. In the second integrative attempt with newcomers the order of introduction was reversed. The latter order was used so as to give the least dominant monkey, (C) imprinted to humans, the advantage of interacting with very submissive monkeys before the more dominant animals were introduced. Observation, categorization, and tabulation of these data as employed previously were the same.

The method of observation was to record on a data sheet "Who does what to whom, and in what order?" (Altmann, 1962) and under what conditions since experimental conditions were varied systematically. Code was used (see Appendix) in order to record rapidly the observed interactions. Ten-minute time samples were taken daily at 12:00 noon for 15 months, from March 15, 1965, to June 15, 1966. Almost all observed social interactions among the females were readily categorized as aggressive, submissive, or friendly behaviors which were then tabulated. On occasions, additional observations were made at various times of the day and often for longer periods of time when, for example, one of three separate experiments was in progress or when an unusual situation developed.

An investigation of reproductive cycles and a survey of sexual behavior were conducted concurrently with the above in order to study the effects of estrus and mating on social status among females. (Observations of female interaction were made each day prior to the collection of other data). Length of the menstrual cycles, duration of bleeding, and physical correlates associated with estrus were systematically noted and recorded. Time of ovulation was established by daily temperature-taking for nine months. When a female reached the peak of estrus she was placed with the male for periods ranging from 30 minutes to 24 hours, when other conditions warranted, and two independent observers recorded the interaction for the first 15 minutes. The male's differential treatment of the females was carefully recorded. Periodically, the male was introduced to the total group of females.

Individual differences in weight, size, body configuration and dentition were noted and recorded.

The final stage of the study consisted of experimental manipulation of variables hypothesized as determinants of social status. For example, estrus has been reported as a period of elevated status for female monkeys, thus Enovid administration controlled the estrus variable. Aggressive behavior was manipulated by Librium dosage and olfactory stimuli denoting a state of estrus were blocked experimentally. The method used for each of these experiments is presented in the subsection devoted to each experiment, respectively, in Chapter VI.

Equipment

The equipment used in the study consisted of a Wollensak tape recorder with two microphones permanently installed outdoors. Each was placed two feet from the cage and seven feet from the ground. The dual placement of the microphones was spaced and directed so as to give distributed coverage of the entire cage area.

A Yellowsprings telethermometer was used for taking temperatures.

Care of Monkeys

Housing. The female animals were initially housed in individual adjoining cages, 22" x 30" x 22", constructed of 1" x $1\frac{1}{2}$" welded wire. The male monkey was housed in a separate cage, 37" x 28" x 40", which was placed approximately eight feet from the females. The cages were installed inside a laboratory in which the temperature was kept constant at 78 degrees Fahrenheit, where the monkeys remained from March 15, 1965, until

June 2, 1965. On June 2, 1965, the animals were moved to larger, outdoor cages within a large courtyard surrounded on three sides by the walls of the Psychological Clinic, University of Oklahoma, and on the fourth side by an eight foot chain-link fence.

Three large cages were used during the period from June 2, 1965, to June 15, 1966. Cage I and Cage II measured 6'4" x 10' x 4'8". Cages I and II were roofed and had large entry vestibules so that animals could be switched about more easily and with less danger of escape. A third cage measuring 5' x 10' x 5' was unroofed. Three smaller cages, 22" x 30" x 22", were used inside the laboratory when it became necessary to isolate monkeys.

A large wooden box (with a small opening at one end), measuring 19" x 26" x 23", was placed in each of the large cages. Two 2" x 8" and two 1" x 8" wooden platforms, 8 feet long, were suspended in one large cage (Cage II), two at the top of the cage against either side and two at mid-height. A large tree limb was hung across the width of Cage I. During severely cold weather, each box was supplied with fresh litter daily and several clean burlap bags were placed in each cage daily, usually one for each monkey.

Cages I and II were mounted on cement blocks 2 feet high; the cage housing Ja was mounted on blocks 10 inches high above a concrete base. Heavy gravel was placed under the other two cages and drainage ditches were dug in such a way that water drained away from the cages when the quarters were regularly hosed down.

Feeding. The basic diet of the animals was a commercial product[1]

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[1]Purina Monkey Chow

"designed to meet all the nutritional requirements of monkeys in one balanced food and consisting of ground wheat, corn, alfalfa, soy bean, sucrose, dried skimmed milk, brewer's yeast, and other vitamin supplements". The monkeys also received fresh fruit and/or fresh vegetables daily. After the macaques were observed catching and partially eating small birds which flew into their cages, raw hamburger was offered also.

During one period each animal was given daily a small glass of an instant breakfast drink[2] mixed to the proper proportion with water. In addition, each monkey was administered approximately 0.6 cc of vitamin supplement[3] daily. Water bottles with stopper and sipper were attached to each cage and filled as often as necessary, usually 4 to 6 times daily although during summer months additional replenishments were required. During winter months and particularly in freezing weather, warm, sweetened tea was offered since this liquid does not freeze as rapidly as water. Also, hot, cooked field corn was given the animals during such weather.

Medication. When the macaques appeared lethargic, developed diarrhea, or ran a temperature above 103.5 degrees, medications were administered and fecal samples obtained. The samples were analyzed for parasites by a laboratory and the necessary medication administered when parasites were discovered. As a precautionary measure in August, 1965, Sabin polio vaccine for three types of viruses was administered orally on a sugar cube to each animal. When an animal was wounded during intragroup fighting, lacerations were treated if judged to be serious.

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[2]Tang

[3]Polyvisol

CHAPTER IV

AGGRESSION AS A DETERMINANT OF SOCIAL STATUS AMONG FEMALE MACAQUES

In this phase of the present experiment the hypothesis was that aggression is at least one of the determinants of social status among female macaques. Other variables have been suggested as influencing social status in females (Carpenter, 1942; Kawai, 1958; Tokuda, 1962), nevertheless, intraspecific aggression functions for the survival of the species (Lorenz, 1964, 1966) and is necessary in establishing a territory, in selecting a mate, in defending a family, and in establishing a social rank order. The latter is especially useful to those species whose young develop and learn over a lengthy period of time since the knowledge gained by experienced older leaders would seem to be of great survival value to the group. The female may be an active participant in such vital survival functions. Clearly, the *speciosa* young learn from females as well as males.

It was anticipated that the initial integration of the original colony would be extremely aggressive and perhaps even injurious to the lower status females. The animals in the present study although familar with each other had not been previously caged together and had only limited interaction up to the first experimental integration. Further, fighting is more severe where cage space is limited since territory rights cannot be fully respected and less dominant animals cannot easily escape.

First Integration

The animals were moved from the laboratory on the Lemmon farm to large, outdoor cages in the courtyard of the Psychological Clinic. On June 4, 1965, the females were placed together in one large cage for the first time. In order to prevent the other three females from "ganging up" on the female imprinted to humans, C was placed in the cage first. Thus C had the first opportunity to establish a territory. The other females were introduced singly at $2\frac{1}{2}$ hour intervals beginning with L who appeared to be less dominant than Ma and Jo. The inference about social status was based on observed interactions among the females while they were in adjoining cages; for example, L presented to both Ma and Jo more often than they presented to her, whereas Jo presented most often to Ma. It may be noted that C was an exception to this behavior. She presented infrequently and when she did present, she was often pinched or ignored instead of receiving the positive response usually given the female who assumes submissive status. More aggressive behavior such as swatting, pulling, pinching and biting, was directed toward C than any of the others while L was second in the amount of aggressive behavior received from others. Although L received some positive attention from the others, she was excluded frequently from grooming behavior and sexual play between Ma and Jo. Since C almost never received such friendly gestures, she appeared to be lowest in status and L appeared to be the next lowest.

As planned, L was introduced to the big cage after C had occupied it for two days. Two observers recorded the interaction on data sheets while the experimenter dictated a description of interaction on a tape recorder. Each observer was well-acquainted with the individual monkeys, knowing them by name and by body configuration. It was found that the observers independently reached almost complete agreement as to the interaction observed when the tape was transcribed and compared with the other two sets of data.

Condition I

From the interactions between C and L, the first two females to be integrated, it was readily apparent that L was the dominant monkey. During the first thirty minutes together, L displayed 31 different behaviors toward C which were identifiable as aggressive, such as lunging, chasing, biting, and threatening vocalizations, whereas C displayed only one such behavior. Further L never displayed submissive behavior toward C; conversely, C displayed 42 submissive behaviors including running from, moving away from, whimpering, shrieking, pacing, and bouncing in agitation. Thus, from either tabulation of aggressive behavior or of submissive behavior displayed in the interaction, there can be little doubt that L is dominant over C. Table 1 presents a tabulation of interactions during the three conditions of the original integration.

Condition II

Jo was introduced to the cage containing C and L. Tabulations of the first 30 minutes of interaction are shown in Table 1. It may be noted that all aggressive behavior observed was directed toward C, while all friendly behavior was directed either from L toward Jo (12) or from Jo toward L (5) with L more highly motivated toward eliciting positive response from Jo. L groomed Jo for lengthy periods of time, followed her about, and lipsmacked toward her. Table 2 shows the instigator monkey and recipient monkey of each behavior.

It may be noted that the behavior observed between L and C in Condition I (Table 1) varied considerably with the addition of another monkey, Jo, under Condition II (Table 1). A comparison of aggressive behavior manifested by L under each condition (Table 3) shows that L dropped from 31 aggressive acts when alone with C to 7 aggressive acts upon the addition of another still higher-status monkey.

When the fourth monkey (Ma) was added to the group of three (under Condition III), L then exhibited 27 aggressive behaviors. Jo's aggressive behavior changed from 3 (when with L and C) to 46 when another monkey of higher rank was added. These decided changes in behavior as related to the number of monkeys in the cage seem to indicate that social dominance interactions are quite complex and vary relative to the status of the individual animals in the cage at any specific time.

Condition III

At 5:00 p.m., Ma was introduced to the cage containing the other three females. Since the interaction occurring during this 30 minute observation seemed in fact to determine all following interactions among the *speciosa* females throughout the next 14 months, a verbatim account (transcribed from tape and translated from the code) will be included. Interactions of course became more complex as the number of monkeys involved in the interaction increased. The account of observations obtained under Condition III follows:

C whimpers repeatedly as the experimenter draws near with Ma in her arms. Jo calls to E insistently and loudly. C continues whimpering. L voice threatens toward C. C whimpers again as Ma is put in the cage. Jo starts toward Ma. Ma starts toward Jo. L chases C, much threatening vocalization. Jo joins L in chasing C. L bites C around head while Jo bites the leg. Jo and L start toward Ma. Jo and Ma go into a ventral embrace while L hugs Ma from the back. Much loud vocalization during the

Table 1

Tabulation of Observed Behavior in Original

Integration of Females

	Condition I		
Monkey	Aggressive	Submissive	Friendly
Chiquita	1	42	0
Lena	31	0	0
Josie			
Mamie			

	Condition II		
Monkey	Aggressive	Submissive	Friendly
Chiquita	0	25	0
Lena	7	1	12
Josie	3	0	5
Mamie			

	Condition III*		
Monkey	Aggressive	Submissive	Friendly
Chiquita	0	24	0
Lena	27	20	24
Josie	46	16	23
Mamie	89	1	20

*Chiquita hid after 10 minutes, thus escaped much aggression.

Table 2

Analysis of Table 1 Condition II Showing Monkey

Instigator and Recipient of Each Behavior

Instigator	Aggressive Behavior Recipient		
	Chiquita	Lena	Josie
Chiquita	-	0	0
Lena	7	-	0
Josie	3	0	-

Instigator	Friendly Behavior Recipient		
	Chiquita	Lena	Josie
Chiquita	-	0	0
Lena	0	-	12
Josie	0	5	-

Instigator	Submissive Behavior Recipient		
	Chiquita	Lena	Josie
Chiquita	-	9	8
Lena	0	-	1
Josie	0	0	-

Table 3

Aggressive Behaviors as Related to

Number of Monkeys in Cage

Instigator	No Extra	Extra
Chiquita	1	0
Lena	31	7

Extra - Chiquita and Lena with Josie added

Instigator	No Extra	Extra
Chiquita	0	0
Lena	7	27
Josie	3	46

Extra - Chiquita, Lena, Josie with Mamie added

Table 4

Tabulation of Interactions During

Settling Period of Integration

10-minute Observations Daily

Monkey	Aggressive Behavior	Submissive Behavior	Friendly Behavior	Total
*Chiquita	21	31	23	75
Lena	70	50	53	173
Josie	125	26	69	220
Mamie	155	2	107	264
Total	371	109	252	732

*Chiquita in small cage inside large cage where she could threaten without fear of reprisal.

clasping and hugging, lipsmacking at each other. L begins to groom Jo. C seems very agitated, paces faster and faster during the noise, whimpers loudly, limping as she paces.

C's tail is bleeding, she utters shrill cry, moves to far end of cage, continues pacing. L grooms Jo while Jo grooms L. Sudden loud shrieking, wild scramble with vociferous threat vocalizations with all females chasing C vigorously. Shrieking and squealing continue as all three try to bite C. C is bleeding, drops of blood on floor of cage. (At this point not all the interaction was recorded as the E's were trying to determine the full extent of C's injuries and to decide whether to remove her from the cage.) Ma, Jo, and L are all biting and pulling at C. The vocalizations are of such volume and intensity as to drown out the E's voice on the tape. C breaks away, runs with Ma after her. Ma gives C a voice threat and slows. C in far corner begins to pace while Ma moves closer and bites her tail. Jo and L join Ma and also bite C around anogenital area. L bites C's hand. Ma bites her again, C pulls away and runs rapidly. Ma and Jo voice threat her. Ma chases C. L and Jo are close together, L mounts Jo. M chases C as C runs. All three after C, C runs rapidly. Jo and L together, sometimes after Ma. Ma after C. C lunges away. L and Jo clasp each other, lipsmack, grimace. Ma chases C. Jo follows. C runs. Jo and L stop. Jo grooms L. Ma is opposite, looks at C, starts toward her, and voice threatens. C shrieks. Ma after L now, L grooms Ma, lipsmacks. L voice threatens C. C paces very agitatedly. Ma voice threatens C. L and Jo chase Ma from the mid-high platform. Ma chases C as C runs. L moves toward Ma. Jo follows. L clutches Jo's buttocks. Ma bounds after C. C runs. L moves toward Ma, Ma moves toward C. C tries to get out of the cage. L mounts Jo.

Ma drops down from platform toward C. Jo and L move to box, on downward and chase Ma. Jo after Ma vigorously. Ma attacks C. Jo immediately joins in attack on C and bites her on the ear. C escapes, Jo and L run after C, bite again. Jo hangs onto C and jerks at her. L moves to Ma, Jo moves to L. L and Ma appear very excited, each inspects and manipulates genitalia of the other. Jo moves to them and gets in between. L mounts Jo, dismounts, licks at Jo's anogenital area, moves to Ma. Jo follows. Ma runs to C, bites her. C runs into box with Ma chasing all the way. L joins chase, then moves toward Jo. Jo clutches L, L hugs Jo. Ma looks toward C and voice threatens. Ma corners L, lipsmack and grimace. L gives Ma a direct stare, and makes one grab at Ma, then moves to box. Ma runs after L, they go into a ventral embrace. Jo moves to them and tries to get in between. L then clasps Jo. <u>L presents to Ma</u>. Ma clasps and licks genital region; Ma begins to nibble at the area as both appear to get more excited. L clasps Ma's leg with her hand reaching back. Jo goes to them, Ma leaves L, goes to Jo. L moves to Jo. Jo presents to L. L grooms her back and buttocks, some licking. L mounts Jo, dismounts, remounts, rubs her genitalia along Jo's anogenital region and on up back. Much excited vocalization. L dismounts, remounts as Ma comes to them. L dismounts.

L into box, Jo follows. Ma than follows the two of them. L moves to Ma. Ma has teeth marks on her lip. Ma toward L, Jo toward Ma. L clutches at Jo, ventral embrace, lipsmack, then L voice threatens Ma. Jo presents to L. They go to box and peer in at C. L moves to Ma, clasps her from behind, turns to Jo and grooms. L presents to Jo, moves to Ma. Ma leaves. Jo presents to L. Jo into box, L follows. Ma watches, moves to box and tries to get in. Jo reaches out and pushes Ma back. L out, Jo follows. Ma mounts L, down and nibbles at anogenital region, Jo out and gets between them. Jo and Ma hug. L moves near, Jo mounts L. Ma licks and chews at L's tail. Ma licks at Jo. L leaves, moves toward C. Ma mounts Jo. L calls, Ma moves toward her, L runs. Jo mounts Ma, clasps. Ma moves from Jo to L, L mounts Ma. Ma clasps L with hand. Ma mounts Jo, presses her genitalia to Jo, vocalization. Jo presents to Ma, Ma mounts again clasping her close. L watches, moves away as they move toward her. L presents as Ma comes close, Ma mounts and turns so that her face is on L's anogenital area while L's face is pressed against Ma's anogenital area. Much pressing against and vocalization. Jo moves near, L runs. Jo goes to L and clasps her from behind, mouths L's genitalia. L presents to Ma, Ma mounts, makes several pelvic thrusts. Jo moves to them. L runs. Ma mounts Jo briefly, leaves. Jo moves to Ma, L follows, sudden fight erupts. Jo and Ma tussle with Ma biting Jo. L into box, Jo follows, comes out with L, threatens Ma. Ma into box, comes out and grabs L. L runs. Ma stops chase to mount Jo. L jumps down and away while watching other two, looks at C, looks back at Ma and Jo. Ma remounts Jo. Ma into box and out, mounts L when she presents. Jo out and voice threatens L. Jo presents to Ma, Ma hugs Jo, L watches. Jo and Ma into box, Ma pushes L back when she tries to enter, voice threatens. Jo lunges at L. L runs. Ma mounts Jo, dismounts, Jo presents, Ma remounts. Ma moves to L, L runs. Jo to water. Ma pushes L off platform. Ma mounts Jo. L bounds over, Jo voice threatens L. Jo presents to Ma. Ma clasps, both into box. L tries to enter, Ma throws her out. Ma chases L. Jo follows and threatens L. Ma back to Jo, then mounts L. Jo threatens, Ma mounts Jo. L moves away, stares at them and lipsmacks. Jo again threatens L. Ma and Jo into box. L tries to get in. Out of box, Ma grabs at Jo. Jo presents, Ma mounts. Less vocalization now, much quieter. Jo gives a shrill cry, Ma goes to her and swats her with hand, pinches her face. Jo pulls and grabs at Ma's leg. Jo threatens Ma. Ma forces Jo into presentation position, mounts, then moves to L. Ma chases Jo, Jo presents, Ma mounts. Ma chases Jo. Jo runs, Ma bites Jo, Ma into box with L. Jo voice threatens into box. Ma out and pushes Jo down. Ma chases Jo, grabs her by the hair on her head, mounts, dismounts. Jo presents, Ma mounts. Ma back into box. Jo peers in, voice threats. Ma threatens Jo. Ma leaps out, lunges after Jo. Jo runs. Ma away and back into box. Ma out, chases Jo, grabs at her. Jo presents, Ma mounts, and leaves. Jo jumps into box. Ma into box and tosses Jo out. Ma bites Jo. Jo presents. Ma mounts. Jo calls insistently, looks into yard, into box. Ma appears. Jo lipsmacks. Ma to Jo, pushes Jo off until she falls. Ma to Jo, mounts. Ma leaves, Jo follows. Jo voice threatens into box. Ma out and chases Jo, then back in. Jo sits and stares at box. Ma sticks head out, grimaces, threatens Jo. Ma walks toward Jo, Jo presents, Ma mounts, leaves to go into box. Jo follows, gets on top of box, and threatens into box. Ma out, chases and bites Jo. Jo runs, Ma catches her, pulls Jo into presentation position, chews at area (no bites visible), Ma to box, Jo follows. Ma pushes her, then lunges at her. Jo moves away. Ma bites her own foot. Ma starts to box.

Jo presents. Ma mounts. Ma grabs at Jo, bites and pinches her, but no visible teeth marks. L comes out. Ma goes to L. Jo threatens L, presents to Ma. Ma mounts, then back to L. 5:30 p.m.

The interactions of the females as they battle for status or dominamce appeared to be quite complex. Frequently, it was difficult to pinpoint the causal factors which stimulated or evoked specific behaviors. Several factors probably contributed to intensified aggressive interactions among these females: they were not a natural group and had not been previously caged together, thus territoriality and social rank had to be established rapidly. Further, there was little opportunity for lesser status females to flee and escape more dominant females in the cage although C hid in the box after the first 10 minutes of interaction. Since the monkey imprinted to humans (C) seemed not to supply the appropriate communicative signals to indicate that she understood her own status in relation to others in the colony she undoubtedly evoked considerable aggressive behavior during the early phases of integration. Clearly, the most aggressive monkey in the interaction reported above displayed the least number of submissive behaviors, also. See Table 1. The female designated as number one in social status, Ma, as inferred by the number of presentations to her by other females while in the individual cage situation, was observed in 89 aggressive acts. On the other hand only one definable submissive behavior occurred when Ma ran from L and Jo as they chased her simultaneously. Ma's usual pattern when attacked thereafter was to start aggressive behavior toward C and thus seemed to "displace" both L and Jo's attentions toward C instead of toward herself. The turning point in the interaction seemed to be when L presented to Ma. It may be noted also that a few moments later Ma battled with Jo until Jo finally presented. During the subsequent period of the experiment and in all ensuing interactions with the other three females, Ma was never so hard-put to establish dominance and thus to maintain her status in the colony. She was not forced to battle continuously for the first position and in fact her aggressive behavior afterward often consisted only of a direct stare, mounting, or simply a threat vocalization. She lunged, chased, bit and cuffed, however, when the other females did not respond with the proper signals to indicate they regarded her as number one in the group. Ma's status seemed relatively secure in that all females tended to accept her as dominant over them after an initial 30-minute battle in the first integration. A settling period lasting approximately a week was observed.

Generally, L and Jo displayed very little viciously aggressive behavior toward Ma after this first encounter and all aggression toward Ma decreased over time. Later, on those occasions when Jo or L overstepped their own positions in the hierarchy, Ma rather quickly settled the matter with a direct stare, a threat vocalization, a slack-jaw threat, or infrequently a chase and/or a bite to the offender. Thus, it would seem that Ma actually established her position during the first encounter and stabilized her position within approximately a week. Once the hierarchy was established there was no appreciable change. By any of the three measures thought to indicate social dominance, (1) most aggressive, (2) least submissive, or (3) first in food-taking tests, Ma is clearly the number one monkey in the hierarchy during the first encounter.

As reported in Table 1, Jo displayed the second largest number of aggressive behaviors with L third and C (with no aggressive behavior) fourth. C in her withdrawal as a competitor for a position in the hierarchy left the real battle to take place among Ma, Jo, and L.

Under each experimental condition, food was offered after the 30-

minute observation period was completed. In each case the monkey manifesting the most aggressive behavior took food first. Under the first condition, L alone took food. Under the second condition, Jo took food first, L took food second, and C was not allowed to take food. Under the third condition, Ma took food first, Jo was second taking four pieces of food, and L did not take food or even look at it until Jo moved away from the vicinity. C did not even approach the food.

Therefore, judging from three different measures of behavior observed: aggression, submission, and food-taking, it is obvious that the earlier inference concerning social status among the four females was correct. They ranked in this order: Ma, Jo, L, and C. These findings support the hypothesis that females establish a linear ranking in social organization. Further, in this case, once the hierarchy was established it was quite stable. The only exception to the status findings occurred under Condition II where L displayed more aggressive behavior toward C than Jo did. Under Condition III, Jo is clearly more aggressive than L and this may be due in part to the influence of Ma who later appeared to protect Jo and even when "chastising" her appeared to "play bite" with less vigor so that no teeth marks were visible nor any severe wounds inflicted. Also under Condition II it may be noted that L displayed more friendly behavior toward Jo than Jo displayed toward L. Thus L appeared to be "currying favor" with Jo by grooming her for lengthy periods of time while Jo simply sat slumped over.

It was necessary due to her injuries to remove C from the cage for several days while her wounds healed; however, she was placed in a smaller cage which adjoined the large cage on one side. When the E attempted to place her back in the cage after her wounds healed, she immediately became the focal point of a vicious attack by everyone. It was decided to keep her near the other monkeys, but to protect her to a large extent from their aggressive behavior. The problem was solved by placing a small cage inside the large cage, attaching it into the corner of the larger cage. This provided protection from attack on two sides; however, C manifested extreme anxiety in the situation (cowering in the far corner, shrieking, sucking the skin of her arm). The top of her cage then was covered with a metal sheet so that she could not be threatened from above, and one side of the cage was covered with a very fine screening which did not permit the other females to reach into C's cage. This left one side only exposed through which any tactile interaction could occur. This situation afforded C an opportunity to live close enough to the other monkeys to observe their behavior and perhaps to learn some monkey "cues". The design also allowed opportunity for interaction, although such was rare except for aggressive threat vocalizations directed toward C. The hope was that she would learn the "correct" monkey responses and eventually become an integrated member of the colony.

Periodically, the E attempted to "teach" C certain responses, particularly, the signal which apparently indicates acceptance of another monkey as dominant, i.e., presenting. Despite repeated efforts in this direction, C's performance was sporadic during the duration of the study. From the interactions recorded during the first integration of the group, it appears likely that imprinting effects (C to humans) prevented C from giving or responding to behaviors which facilitate cooperation within a social group of nonhuman primates. The early history indicates that C was removed from her mother and the group at a young age and, therefore, lacked opportunities for learning those behaviors which are essential to survival in the wilds.

The imprinting variable cannot be controlled in the present study since imprinting has already occurred. Nevertheless, it is considered of some importance to determine how C's behavior differs from those females whose experiences during the early, critical periods were within the monkey group.

Settling Period

After the first integration of the female speciosa, 10-minute observations were made and recorded daily at approximately 12:00 noon, plus or minus 30 minutes on occasions, for a period of 44 days, from June 5, 1965, to July 18, 1965, at which time another phase of the experiment began.

The observed behavior was categorized under three headings: Aggressive, Submissive or Friendly behavior. The behaviors included in each category are outlined in the appendix. Some non-social behaviors did not fall within these definable categories and were not included in the tabulation.

The period of time directly after the first integration was judged to be a settling phase in which each animal determined its own social status in the hierarchy as well as all the other females' positions within the social structure. Table 4 shows that the linear hierarchy which was established during the initial integration was maintained over the following 44 days as evidenced by number of aggressive behaviors observed in a straight-line from the number one monkey down to number four. The reverse order was tabulated for number of submissive behaviors with the exception of C who appeared to lack knowledge of presentation behavior indicating submissiveness. Her submissive behavior consisted largely of whimpering, pacing, shrieking, and moving back from other females.

Integration of Additional Females

Two additional females, Sarah (S) and Mary (M), were housed inside the laboratory in separate cages until April 17, 1966, when they were moved to outdoor quarters. When these two females were first placed together in one cage, neither displayed extreme aggressive behavior. To the contrary, each animal revealed a tendency to stay close to the other and on occasion to cling to one another; however, with food-getting tests S always took first and M second. Also M presented readily to S. Since little behavior observed between the two could be defined as aggressive, a period of two weeks was allotted for settling social status instead of the longer period allowed the four females of the original group.

The intent was to integrate the additional monkeys into the existing colony with as little bloodshed as possible. Since previous experience with the colony seemed to indicate that the new females would be assaulted viciously if they were introduced to the original four females en masse, a plan was devised to introduce the original group singly to the strangers. This method was advantageous also in that it allowed the experimenter time to observe how each female of the original colony would cope with a new situation individually.

Procedure

The plan as conceived was that after social status between M and S was stabilized, the members of the existing colony would be introduced singly at intervals of 8-minutes, beginning with the most dominant female and continuing down the rank hierarchy to the least dominant female until all female speciosa were integrated. If interaction among the females was not so vicious that some monkeys were wounded severely, the male monkey would be introduced last. Observations were to be made and recorded after each entry. This plan was followed to the letter with one exception: the female imprinted to humans (C) sustained severe injuries on face, toenails, heels, and callosities. Therefore, she was removed before the male monkey was introduced into the females' cage.

An alternate plan of integration was devised primarily in order to afford C the greatest possible advantage in interactions during a second integrative attempt. The order of introduction was changed with C to be introduced first to M and S since in all observed interactions M and S appeared to be very submissive and quite "willing" if not eager to accept the two lowest status positions in the group. It seemed probable that if C over the months of the study had learned any of the behavioral and verbal cues necessary for survival in the colony, she could best use these communicative signals in interactions with submissive monkeys. These would seem so particularly with individuals other than those monkeys from whom she had previously experienced vicious onslaughts and severe injuries. Additionally, a period of five days was to be allowed for settling after C was introduced to M and S before the next monkey was introduced.

After this settling period the remaining monkeys were to be introduced singly at 8-minute intervals, beginning with the number two monkey rather than the number one monkey in the hierarchy since number two was definitely less aggressive toward C than number one. Number three was then to be added and finally number one was to be added last. Integrating in this order accomplished at least two conditions thought to be highly advantageous to C. By leaving the most aggressive monkey to be introduced last, C was afforded an opportunity for several days of interaction within a group which appeared to be friendlier toward her. Secondly, although the number one monkey occasionally seemed to direct an attack toward C in which she did not actively and directly participate, it was the number three monkey who most often carried out the threat with a direct and persistent onslaught which usually left C bloody and torn. Since the number three monkey was nearest C in rank order, it seemed of some importance to observe her behavior within the group, and particularly toward C, when the number one monkey was not present.

Results of First Attempt: Newcomer Integration

The plan of integration as outlined was followed up to the fourth addition, C, who had to be removed from the cage after eight minutes due to numerous wounds. Table 5 shows the number of aggressive, submissive and friendly behaviors displayed by each monkey under each condition as an additional female was introduced to the group.

When Ma was introduced to M and S, Ma very quickly asserted her social dominance over them mainly by repeated mountings, a few lunges, voice threats and one bite--13 aggressive acts in all. M and S were extremely submissive in that they presented to Ma immediately, lipsmacked, and manifested no aggressive behavior whatsoever toward Ma. At one point after grooming S, Ma presented to S as if inviting grooming; however, S made no response while almost simultaneously M presented to Ma who then clasped her. When food was offered Ma took first; neither S nor M took any.

When Jo was introduced to the cage she vocalized shrilly, ran directly to Ma and presented. Ma mounted her while Jo looked back lipsmacking at Ma. Ma leaned forward and placed her mouth on Jo's mouth as if "kiss-

Table 5

Tabulation of 8-minute Observations Under Each Condition

in First Attempt: Newcomer Integration

Monkeys in Cage	Aggressive Behavior	Submissive Behavior	Friendly Behavior	Total
Mary	0	7	2	9
Sarah	0	3	0	3
Mamie	13	1	5	19
Mary	0	4	6	10
Sarah	0	0	1	1
Mamie	1	0	12	13
Josie	0	1	9	10
Mary	0	2	0	2
Sarah	2	3	0	5
Mamie	9	0	4	13
Josie	3	1	9	13
Lena	3	1	4	8
Mary	0	2	0	2
Sarah	0	2	0	2
Mamie	1	0	1	2
Josie	1	0	0	1
Lena	5	1	0	6
Chiquita	0	5	0	5
Mary	1	0	0	1
Sarah	0	4	0	4
Mamie	10	8	5	23
Josie	3	4	0	7
Lena	18	3	1	22
Jackson	24	0	3	27

*Chiquita removed under last condition.

ing" her. Although S and M were each the recipient of some friendly behaviors such as grooming and embracing, the greatest amount of interaction occurred between Ma and Jo. Twenty-eight friendly behaviors were displayed out of 34 total number of all behaviors during the 8-minute observation. This observation again emphasizes the close friendly relationship between Ma and Jo, the number one and number two monkeys of the hierarchy. When food was offered Ma took first, Jo second, and the new females took none.

When L was added to the cage the number of aggressive behaviors again rose with Ma displaying nine of the 17 total. When Ma bit L, Jo joined Ma in biting and threatening L. L's behavior consisted mainly in either displacing (Fenichel, 1945) aggression on to M and S after she herself was attacked, or in trying to elicit a positive response from Ma by grooming or lipsmacking at her. When food was offered Ma took first, Jo second. The other three took none.

The imprinted monkey was then introduced into the cage, whereupon the three dominant monkeys even before entry threatened her with loud, aggressive vocalizations, lunges, and attempts to attack her through the wire of the cage. C reacted by trembling and shuddering visibly. She was thrown into the cage despite her reluctance. The attack was so immediate and vigorous that, in order to protect C, a powerful stream of water was aimed directly at L and was an effective deterrent. The first skirmish left C with wounds on face, toenails, heels, and callosities. It was necessary to protect her from the other females by the method mentioned above until she could be removed from the cage. Thus the tabulation (Table 5) of aggressive behaviors does not reveal the true state of affairs and may not be compared with the tabulations made under other conditions. No food was offered.

After C was removed, the male was placed in the cage with all the remaining females. Ma presented to him immediately and copulation occurred within the first few minutes. After withdrawal the male lunged at M; however, Ma continued to present and Ja tended to mount Ma, dismount, and then lunge at another female. Jo tended to stay near Ma and Ja, while L attacked both S and M at various times. Both newcomers were bleeding from their wounds with S the more severely injured. At times the other animals joined L in an attack on S and appeared to be curious about the wounds. Ja again copulated with Ma after she presented. When he mounted M a short time later, Ma pulled him off the other female and again presented. L then bit M. S and M were both removed. Ja alone took food when it was offered; however, when he dropped a banana peel Ma picked it up and ate it.

The interactions during the first attempt at integration were extremely aggressive and vicious leaving the three females lowest in the hierarchy with numerous injuries. The number four animal from the bottom of the hierarchy also had several wounds and only the two top females escaped injury. The injured animals were medicated and isolated in individual cages for a period of three weeks until all wounds were healed.

Results of Second Attempt: Newcomer Integration

The second attempt to integrate was made two months after the first attempt at total integration. After the wounds healed, an additional period of time was allotted to rotating the animals in various cages so that each animal became acquainted with every other animal under conditions conducive to amicable social interaction. It was determined that any monkey who was isolated for a time would "welcome" any other monkey placed in its cage and would manifest friendly behavior toward it even though within the group it might be extremely aggressive toward this same monkey. One exception to this finding was L, the number three monkey, who would not tolerate C, the number four monkey.

Rotations as described allowed the experimenter to make cross-comparisons of social status between each monkey in relation to every other monkey. All indices of status were tabulated and food-getting was used as the final test in each case. In no case was there any change in the hierarchy as observed and enumerated previously.

When this phase was completed, C was introduced to M and S's cage for a period of five days. The five-day period was allotted C in the hope that she could become accustomed to social interaction with other female monkeys and could perhaps utilize some of the behavioral and verbal cues she might possibly have learned over the past months of the study. In interactions with the more dominant monkeys she was invariably wounded before she had an opportunity to display any of the behavior she might have learned.

Table 6 shows that C during the first 8 minutes in the cage with S and M (the two least dominant monkeys) displayed five aggressive and four friendly behaviors. On the other hand S and M together displayed three submissive and six friendly behaviors. From these observations it can be inferred that C had, in fact, learned some of the monkey signals and could use them with more submissive monkeys. When food was offered, C took all the grapes while S and M appeared not to see the food. An interesting phenomenon occurred at this point, one which had occurred often among the higher ranking monkeys also. S suddenly cuffed M, chased, and then bit her while C ate grapes. This phenomenon of displacing aggression

Table 6

Tabulation of 8-minute Observations Under Each Condition

in Second Attempt: Newcomer Integration

Monkeys in Cage	Aggressive Behavior	Submissive Behavior	Friendly Behavior	Total
Mary	0	2	0	2
Sarah	0	1	2	3
Chiquita	5	0	4	9
Mary	0	1	1	2
Sarah	0	0	0	0
Chiquita	5	3	2	10
Josie	2	1	2	5
Mary	0	2	0	2
Sarah	0	0	0	0
Chiquita	4	6	1	11
Josie	1	1	0	2
Lena	3	0	2	5
Mary	0	2	0	2
Sarah	0	2	0	2
Chiquita	0	3	0	3
Josie	1	1	3	5
Lena	3	1	3	7
Mamie	0	0	5	5
Mary	0	4	2	6
Sarah	0	9	0	9
Chiquita	1	2	0	3
Josie	7	2	0	9
Lena	11	3	1	15
Mamie	8	5	6	19
Jackson	19	0	6	25

onto the next monkey lower down in rank was observed frequently among speciosa.

C maintained the number one position in social interactions with S and M throughout the following five days. C, however, appeared at times to be rather uncertain as to what her behavior "should be"; for example, after giving a voice threat and a vigorous chase she would start to bite the other animal, stop, look around, make another motion as if to bite but rarely completed this behavior. Mounting behavior also was extremely infrequent although she would go through the usual sequence of behavior right up to the mount. At this point she was more apt to simply clasp the hindquarters of the other animal rather than mount. It would appear that she had not yet learned the full repertoire of speciosa behavior and/or lacked experience in actually performing these behaviors.

The number two monkey of the original group (Jo) was added next after the five-day period allowed C for interactions with M and S. From previous observation of interactions between Jo and C it was known that Jo usually joined in any attack on C. As Jo was introduced to the cage, C began to run in the opposite direction. Jo stopped the chase to inspect M. C paced, glancing apprehensively toward Jo. The skin around C's eyes became intensely red and she began to defecate as Jo moved toward her. C presented and Jo inspected the region, then clasped C from the rear. As Jo moved away, C turned to clasp Jo's hindquarters. Later, Jo presented to C. Such interactions between the number two and number four monkey were highly unusual if not unique up to this time.

Table 6 shows the number of behaviors manifested by each monkey in the three different categories of behavior. C's aggressive behavior was directed entirely toward S and M. In food-getting tests, Jo took first, C second, and S managed to snatch the third piece which provoked a chase, voice threat, and bite from C. Obviously, in this situation C's behavior differs decidedly from that in the first integration attempt (Table 5).

The number three monkey of the original group (L) was the next addition. C continued aggressive behavior toward S and M while L was mainly preoccupied with a few voice threats and direct stares at C or in grooming Jo at length. Again, such interaction between the number three and number four monkeys is in direct contrast to L's usual aggressive attack upon C. Although C maintained as much distance as possible between herself and L during the first seven minutes of the 8-minute observation period, she seemed more assured during the last minute as evidenced by movements nearer to L and by increased voice threats toward S and M.

When the number one monkey, Ma, was added to the cage containing M, S, C, L, and Jo, she immediately clasped L who presented as Ma entered the cage. Ma then alternately clasped, inspected, and manipulated L's genitalia; L responded to this behavior by bending forward until she was reaching through her hind legs to clasp at Ma's genitalia. Reciprocal manipualtions continued until Jo moved close to Ma and presented. As Ma clasped Jo, L clasped Ma's hindquarters and simultaneously voice threatened C who bounced up and down lightly in the corner of the cage in the stereotyped repetitive pattern she usually enacted when agitated and frightened.

The number one monkey when introduced to the total group of females displayed <u>no</u> aggressive behavior at all, whereas both the number two and number three monkeys threatened lower status females. In the first integrative attempt when the number one monkey was introduced to M and S, she displayed 13 aggressive behaviors during the first 8 minutes and nine aggressive behaviors during the second eight minutes after the number three monkey was added. Thus her behavior was strikingly different when she was the last animal added to the group instead of the first to be introduced to the new females. Nevertheless, in food-getting tests, Ma as usual was first and Jo second. The other females took no food.

CHAPTER V

EFFECTS OF ESTRUS AND MATING ON SOCIAL STATUS

Physiological Findings Concerning Reproduction

Daily examination of the females' anogenital regions was begun, and a subjective judgment made as to the degree of openness of the vulva, the amount and viscosity of mucus in and around the vulva, the amount of congestion or tumescence observable in the anogenital area, and the protrusion of the clitoris. Temperatures were taken rectally by Telethermometer daily beginning September 8, 1965, and continuing until June 8, 1966. Daily body temperature readings were necessary in order to establish the point at which ovulation occurred as shown by a dip in basal body temperature followed by a peak. Records were kept of the appearance of menstrual blood in order to determine the length and duration of the menstrual cycles. Examinations were made daily of the vaginal vestibule with a nasal speculum.

These investigations were made systematically in an attempt to determine the observable physical correlates of estrus in _speciosa_. Such information is especially vital for breeding purposes in the species since _speciosa_ do not manifest the extraordinary tumescence and vivid coloration over a large area that a _nemestrina_ manifests at the peak of estrus. The follicular phase is easily determined in the _nemestrina_ by simply observing the tumescence and coloration of the perineal region (Kuehn, Jensen and Morrill, 1965) whereas detumescence of the luteal phase is equally easy to ascertain. The physical changes in nemestrina during the phases of an estrus cycle are indeed striking whereas in speciosa tumescence is decidedly more subtle and therefore more difficult to detect. Coloration in speciosa appears to be affective and varies also during the phases of the estrus cycle from pale pink to bright red with considerable inter-individual difference. The changes in tumescence and coloration in speciosa are not so dramatic and clear cut as in nemestrina, however.

Many of the data gathered during this study are of practical value in terms of establishing a breeding colony of speciosa for future experimental work.

Menstrual Cycles

The results of this study on a total of 29 complete menstrual cycles in four speciosa over a period of nine months reveal important characteristics of the menstrual cycle in Stump-Tailed macaques (speciosa). The onset of menstruation or the first day of external bleeding is considered the line of demarcation between menstrual cycles and is counted as the first day of the cycle.

Two females were found to have rather regular menstrual cycles, whereas the other two females were somewhat irregular in periods of bleeding. This irregularity was attributed in one animal to a severe weight loss during which she did not menstruate for 82 days. Seven complete menstrual cycles were followed in Ma and L. The length of Ma's cycles ranged from 20 to 40 days while L's ranged from 21 to 39 days. The means of their cycles were 28.6 and 27.6 days respectively, and the standard deviations were 5.6 and 5.2 respectively. Seven menstrual cycles were observed in

Jo and eight in C. The length of Jo's cycle ranged from 6 to 30 days and C's from 13 to 82 days. The means of their respective cycles were 16.3 and 32.5 days while the standard deviations were 8.2 and 20.2 respectively. See Table 7.

The mode of all menstrual cycles was 25 days with 15 of the 29 cycles falling between 25 and 30 days. Nine cycles fell below 21 days with Jo and C contributing seven of the nine. Five cycles were above 30 days with C contributing three of the five. Thus, the length of menstrual cycles varied considerably among these speciosa.

Duration of the menses or actual days of bleeding were from one to seven with the individual means as follows: 2.1, 2.8, 2.6 and 3.8 days. The standard deviations were: 0.6, 2.2, 1.2 and 1.6 and it is immediately apparent that the duration of menses shows decidedly less variation inter-individuals than the length of the menstrual cycles. See Table 7 for individual mean, range and standard deviation.

Judging from these data, it appears that the female speciosa may have a menstrual cycle which is very near in length to the rhesus menstrual cycle (Allen, 1927; Hartman, 1932). These researchers found a modal cycle of 28 days in length. The average speciosa cycle was 26.2 days. On the other hand, the females with more regular cycles averaged 28.1 days. These findings are much closer to rhesus length of cycle than to nemestrina menstrual cycles (Kuehn, Jensen and Morrill, 1965) which have been observed to be on the average 30 to 40 days in length. In rhesus, the duration of menstrual flow is reported to last from four to six days and ovulation occurs most often on the 12th or 13th day following the onset of menses (op.cit.). In nemestrina much less is known about the reproductive cycle; however, Zuckerman (1937) suggests the general relationship between men-

Table 7

Average Menstrual Cycles

Monkey	Duration	S.D.	Interval	S.D.	Temp. Peak	S.D.
Mamie	2.1	0.6	28.6	5.6	9.6	4.2
Josie	2.8	2.2	16.3	8.2	9.3	3.6
Lena	2.6	1.2	27.6	5.2	13.5	3.2
*Chiquita	3.8	1.6	32.5	20.2	10.6	2.7
Total Ave.	2.83		26.2		10.8	

*Chiquita: Missed one period during severe weight loss.

Range of Menstrual Cycles

Monkey	Duration of Menses	Interval or Length	Temp. Peak
Mamie	1-3	20-40	4-16
Josie	1-7	6-30	4-15
Lena	1-5	21-39	7-17
Chiquita	2-6	13-82	7.5-15
Total Range	1-7	6-82	4-17

Duration of Menses in days.
Interval is the period of time in days between the first day of one menstrual period and the first day of the following menstrual period.
Temperature Peak is the number of days from the beginning of a menstrual period until a decided peak in body temperature occurs.

struation and ovulation is similar to that in rhesus.

Duration of menstrual bleeding appears on the average to be fewer days in speciosa than in rhesus, being 2.83 days among the speciosa in the present study; however, as mentioned the range of duration was from one to seven days.

Temperature Peaks

Temperatures were taken rectally by Telethermometer at 12:00 noon, recorded, and graphed daily so that time of ovulation as shown by a slight dip in basal body temperature followed by a peak in temperature could be determined. When two marked peaks occurred in one menstrual cycle, as it did once each in two monkeys and three times in one monkey, the average of the peaks was taken rather than to risk skewing the data by selecting one peak and omitting the other.

The temperature peak as designated here is the number of days from the beginning of a menstrual period until a decided peak in body temperature occurs. The total range of temperature peaks was from four to 17 days from the onset of bleeding. Ma's range was four to 16 days, the mean was 9.6 days, and the standard deviation was 4.2. L's range was seven to 17 days, the mean was 13.5 days, and the standard deviation was 3.2. Jo's range of temperature peaks was four to 15 days, the mean was 9.3 days, and standard deviation was 3.6. C's range was 7.5 to 15 days, the mean was 10.6 days, and standard deviation was 2.7. The mode for all temperature peaks was 15 days, the median was 10 days.

The speciosa females revealed a rather consistent tendency to have temperature peaks varying from one to three days before the onset of bleeding and occasionally showed a slight rise in body temperature throughout the duration of the menses. These rises in temperature seemed to be associated with the phenomenon of menstruation rather than ovulation.

Thus, on the basis of these data, ovulation can be said to occur between the 9th and 13th day of the menstrual cycle on the average, with the total range being from four to 17 days in *speciosa*. This finding is again very close to those findings in rhesus (Allen, 1927; Hartman, 1932) where ovulation is thought to occur most often on the 12th or 13th day of the menstrual cycle.

Physical Correlates

The physical correlates investigated such as degree of congestion, amount and viscosity of mucus, degree of redness in the sexual skin, and protrusion of the clitoris while appearing to be closely related to basic physiological changes associated with the menstrual cycle in *speciosa* probably require more accurate and sophisticated measurement than was possible in this study. Although there were many individual variations in these correlates, in general, it can be stated that a copious amount of mucus in and around the vulva and vaginal vestibule when accompanied by an intense redness of the sexual skin about the perineum and about the eyes and face mask often occurred simultaneously with a peak in temperature. The period of increasing redness of sexual skin, increasing tumescence of the anogenital region, and increasing amounts of mucus in the vaginal vestibule immediately after menstruation was inferred to be the follicular phase of estrus at which time estrogen levels increase until the ripening Graaffian follicle releases the ovum. When ovulation occurs the body temperature rises. After a 24-hour period in which pregnancy is most likely to occur if other conditions are suitable, detumescence sets in and the intensity of color fades as the luteal phase progresses until the next menses begins.

One other judgment about physical correlates was made when the experimenters noted that females who usually submitted readily to insertion of the probe for temperature-taking would become actively aggressive and difficult to handle due to their inclination to either clasp, groom, or threaten the experimenter. Such behaviors frequently were noted to occur on the day of the peak in temperature and were considered to be an indication of the peak of estrus or ovulation. After a 24-hour period, the females again became more submissive to the experimenters and were easier to handle.

Length of Gestation

Critical factors in establishing a breeding colony include ascertaining ovulation time and length of gestation. In the present colony the number one female conceived and subsequently delivered a male infant 157 days after copulation with the male. Copulation occurred at the time of ovulation as indicated by a peak in the female's body temperature.

The female's regular menses occurred April 10 although traces of menstrual blood were observed during vaginal examinations on April 16, 17, and 27. She was observed copulating with the male on April 14 although not at temperature peak and again on May 1 when at temperature peak. Thus in estimating the expected birthdate the copulation during temperature peak was judged as the more probable time of conception. It seems likely also that the blood observed on April 27 although an irregular menstrual flow precipitated ovulation five days later at which time she conceived. (The temperature peaks denoting ovulation ranged from four to 16 days from the onset of bleeding in this particular female.)

The possiblilty may be considered, however, that conception occurred on April 14. If that was indeed the case, the gestation period was 173 days. Therefore, it is probably safer to estimate length of gestation in *speciosa* (based on one pregnancy and delivery) as ranging from 157 to 173 days. This particular finding again emphasizes the similarities in *speciosa* reproductive cycles to those in rhesus which are estimated to have gestation periods ranging from 158 to 173 days (Krohn, 1960) and possibly to *nemestrina* which are reported as averaging 170 days gestation (Kuehn, Jensen, and Morrill, 1965).

Summary

In summary, on the basis of data obtained in this investigation, the length of menstrual cycles in adult *speciosa*, on the average, is 28.1 days while the duration of menses, on the average is 2.83 days. Ovulation is thought to occur, on the average, between the 9th and 13th day of the menstrual cycle. The gestation period in *speciosa* is estimated on the basis of one pregnancy to be 157 to 173 days. The period of 157 days, however, is considered the better estimate for two reasons: (1) menstrual blood was observed subsequent to the first possible conception, and (2) a temperature peak indicating ovulation occurred at the time of the second possible conception. Some basic physical correlates appear to precede and accompany estrus; however, these findings are based on subjective judgments and require more accurate measurements and further investigation. Considerable interindividual variability was noted in all aspects of the reproductive cycles of *speciosa*.

Copulatory Behavior

The period from October of 1965 to January of 1966 was the initial phase of the study of copulatory behavior in speciosa although this area of study was of general interest throughout the duration of the investigation. One of the experimenter's objectives was speciosa copulation for breeding purposes. The male stump-tailed macaque was introduced systematically to the females for purposes of copulation. The females were allowed equal time with the male, usually a 24-hour period during the period judged to be the female's peak of estrus. The differential behavior of various pairs was observed and recorded. Periodically, the male was introduced into a large cage with all the females under varying conditions of estrus in order to determine the effects of estrus on the female hierarchy when a sexually potent male was present in the group. The question for which an answer was sought: Does the female at the peak of estrus, and thus presumably more attractive to the male, assume the social status of the dominant male within the established female social hierarchy?

After January the male was considered a sexually experienced animal and appeared to be fully capable of copulation. The repertoire of sexual behavior and interaction within the social structure seemed relatively established by that time; however, differential treatment of females by the male was observed throughout the following months. The experimenter's primary focus and endeavor during the initial phases of pubertal and adult sexuality was study of behavior--aggressive, submissive and friendly--which might indicate changes in sexual or social interaction, particularly, of any changes which might reveal a shift in the females' behavior or social status in the established linear hierarchy. A secondary objective was copulation for breeding purposes since the hope was to establish a breeding colony of speciosa.

In this study the following observed characteristics of behavior and of estrus were used as a means for selecting females for placement with the male:

1. Sexual skin tumescence, although subtle when compared to some other primates, is discernible.

2. Increased protrusion of clitoris from labial folds seems to be related phenomenon.

3. Increased vividness in red coloration of anogenital region and of face mask is known to be associated with estrogenic hormone increase.

4. A copious amount of mucus can be observed in the vulva which stands open.

5. Increased aggressiveness and general increased activity level appear to be characteristic of increased sexual motivation.

6. A decided peak in basal body temperature preceded by a slight dip indicates ovulation and a receptivity or readiness for copulation if not actual active seeking and approach to the male.

7. Increased lipsmacking and increased presentation behavior, which consists of the female orienting the anogenital region toward the male with the tail held up rigidly erect to facilitate intromission, indicate receptivity to copulation.

These clearly definable and observable characteristics or signs occur in various combinations and are either correlates of estrus or indicate estrus behavior in the female _speciosa_ monkey. These criteria have been used to ascertain maximal periods of receptivity to copulation.

The act of copulation consists of the male grasping the waist or hindquarters of the female with his hands while mounting her with his feet clasped tightly on the popliteal region of her hind legs. This places the male in correct position to effect intromission while the female bears the brunt of the male's entire weight during copulation. The experienced female usually reaches back to clasp the male's leg or loin area with her hand pressing him to her. The female turns her head, occasionally twisting the entire upper torso, to look into the male's face. As the male begins pelvic thrusts which tend to increase in vigor and rapidity the female tends to increase lipsmacking while gazing into the male's face. The animals may begin vocalizations to each other during thrusting. These vocalizations differ in quality from any others heard in the group, being softer, more intense and almost continuous, but with a vibratory quality and at times a guttural sound. Vocalizations are intensified as ejaculation occurs.

In many instances, the male makes a series of mountings with intromission and thrusting before ejaculation is reached. The number of thrusts tends to increase with each additional mounting. The interval between mountings usually involves an inspection and exploration of the female's genitalia and anus, including finger and tongue manipulation of the clitoris, vulva and anus, and occasionally the thrusting of an index finger into the female's vagina. On some occasions the male immediately after inspection of the genital area would back away and lunge vigorously at the female. When she sank to the floor under the impact of his lunge, he would pull her back into presentation position (sometimes by her tail or the hair of her rump) and remount. When the female continued to present during the lunges, the male would usually cease lunging to remount. Whereupon the entire sequence would be repeated, usually until orgasm was achieved. Mount latency (of the first mounting in a sequence) varied from one to 15 seconds while number of pelvic thrusts varied from seven to 82 to reach orgasm.

Orgasmic Behavior

The female's clasping of the male, turning to look into his face, and unique vocalizations during copulation are described above. These behaviors are continued during orgasm. Coloration around the eyes of both male and female becomes vivid and often exhibits a mottled look during copulation.

After increasing the tempo and strength of pelvic thrusting, the male at the time of ejaculation tends to utter a deep guttural sound (occasionally a squeal), holds the female's buttocks closely against his groin, and suddenly becomes rigid. Within a second or two, slight vibratory paroxysms are observable in the male who simultaneously begins a low guttural sound which lasts for several seconds. The hair on and around his neck stands out in a ruff during this time giving him a rather "lionish" look.

From 10 to 22 seconds after copulation the male withdraws from the female. Usually he eats the ejaculate adhering to his penis while the female usually begins grooming the male immediately.

Tie of Sexual Organs

Although a survey of the literature reveals no mention of a "tie" in primates between the male and female sexual organs after copulation, this phenomenon was noted after every observed copulation among <u>speciosa</u> used in this study. During the early stages of the experiment, the belief was held that physically the male could withdraw if he wished to do so. By December it had been demonstrated conclusively that the male could not withdraw immediately after ejaculation. Considerable evidence which at-tests to this statement began to accumulate in various ways. On several occasions a female, directly after the male's distinctive behavior which indicates orgasm, became startled or frightened by sudden loud noises outside the cage or by a more dominant female in the cage and began to run about the cage area. In these instances, the male monkey was dragged for over a meter, shrieking and apparently in pain, by the female as she sought to escape. Apparently, the male was physically unable to withdraw from the female even when he attempted to do so. It appeared that he was forced to accompany the female for a time.

Other observations of similar incidents made over a period of 16 months support the previous statement that a tie of the sexual organs occurs in speciosa monkeys.

A short time after the first incidence of the above behavior was observed, the male was seen (by two observers) thrusting high onto the back of a female. Intromission was not effected and the male continued thrusting between his hand and the female's back until ejaculation occurred. During ejaculation the glans penis was observed to flare out in a circular, but rather elongated, bell-shaped swelling which extended markedly the circumference of the glans penis. The flared swelling of the glans penis did not subside for 10 to 15 seconds. This same phenomenon has been observed on two other occasions since the first event. On the basis of these observations, it appears that due to a physiological change in the sexual organ during ejaculation the male speciosa is physically unable to withdraw from the female for 10 to 15 seconds after ejaculation.

Seasonality. Further evidence to support the finding of a physiological change in the male's glans penis during and immediately after ejaculation, occurred during extremely hot weather in July 1966. The animals had spent the previous winter outdoors in variable weather conditions including very cold temperatures although they had lived within a laboratory under constant temperature conditions up to June, 1965. Thus, it is possible and even probable that some changes were occurring in the reproductive cycle toward seasonality of reproduction (Washburn and Hamburg, 1965; Lancaster and Lee, 1965). Copulations occurring in July were inferred to produce extreme pain in the male since he shrieked repeatedly directly after ejaculation, and began clutching, pulling and pinching at his loins, legs and toes. He appeared to make some attempts at withdrawal, but only shrieked louder at this point and then slumped down on the female and remained there quietly after the initial period of "frenzy". The tie lasted 22 seconds whereupon the male withdrew and began to examine and to groom his penis very carefully. After three such copulations, a small "raw" looking spot was discernible on the glans penis.

On the basis of these findings accumulated over a 16-month period of daily observations and study, it may be concluded that among the _speciosa_ monkeys used in this study there is a tie between the sexual organs of the male and female monkeys during copulation _provided the male ejaculates_. This tie occurs during and directly after ejaculation. It seems to be produced, at least in part, by a physiological change in the glans penis of the male which exhibits during ejaculation a decided flaring which does not subside for at least 10 to 15 seconds. _Speciosa_ may differ from rhesus and _nemestrina_ in this respect. It seems of some importance to pinpoint the differences as well as the similarities among animals on the phylogenetic scale.

Further study may perhaps reveal physiological changes in the sexual anatomy of the female *speciosa* also during copulation or orgasm. During the course of this study it was observed that individual female *speciosa* differed from time to time in the accessibility of the posterior vagina as well as accessibility of the vaginal vestibule. Accessibility appeared to be associated with the female's particular phase of estrus which is also related to the amount of mucus in the vagina. During the latter part of the luteal stage, the posterior vagina tended to be inaccessible to the speculum. On occasions, after the speculum was inserted, there appreared to be a tightening or constriction of the vaginal lumen. It is possible that during the later stages of copulation and after excessive vasocongestion of the vaginal wall, a constriction of the lumen of the vagina occurs as the glans penis flares, thus producing the observed tie of sexual organs. This phenomenon if found in the female monkey would be consistent with Masters and Johnson's (1965) findings as to the sexual response of the human female.

Association Between Aggressive and Sexual Behavior in the Male

During orgasm, the male's unique vocalizations, distinctive to that particular function and never heard at any other time, were observed on a number of occasions to change to a decided threat vocalization. This phenomenon was likely to occur if another female came close to the mating pair during the male's orgasmic vocalization. It appeared to the experimenter that the male's eyes would suddenly focus on the female who came near and he would at that instant change to an intense "hu-hu" vocalization which denotes threat. On a few occasions the male animal during orgasm would seem to suddenly become aware of an experimenter or caretaker outside the cage and change instantly from orgasmic vocalizations to aggressive threat vocalizations. The male rarely threatened the experimenter at any other time.

On the other hand, the male monkey switched very rapidly from aggressive behavior with a female monkey to sexual behavior. This observation is consistent with Freud's (1948) statement that a number of his patients reported genital excitement during fighting or wrestling. Indeed, with the male *speciosa* aggressive behavior tended to be a preliminary activity to sexual behavior. Many times when one or two females were biting, threatening or chasing another female, the male would join the dominant females in "chastising" the offender only to suddenly stop biting the submissive female and begin sexual behavior.

The Male's Differential Treatment of Females

The male's behavior differed somewhat with each female, although true copulatory behavior (which commenced November 26, 1965) in general followed a regular sequence or pattern in each case. When placed with all females, the male from December onward gave preferential treatment to Ma, the most aggressive female of the group, whatever stage of estrus she might be in. This preference seemed to be an interactional process; for example, when placed in the females' cage the male would start directly toward Ma whc invariably presented to him the moment he entered the cage.

When the male on occasions began to give his attention to another female, Ma would present persistently to the male while managing also to get in between him and the other female. If the male did not mount her, she would begin grooming him. These tactics usually gained the desired result; when they failed Ma simply attacked the less dominant female. At this point, the male seemed to have one of two possible choices; he either joined Ma in the attack on the other female (which he did usually) or he attacked Ma (which he did rarely).

Although the male did not begin true copulatory behavior until November 26, 1965, by December 9th he appeared to be an experienced male in sexual interactions with the number one female; for example, four copulations in 25 minutes. This was not the case with the other three, less dominant females. With these females Ja continued much of the behavior which had been observed with various females previous to actual copulations and which seemed to denote an ineptness or inexperience on the part of the male. He quite often mounted the female backward, occasionally from the side, and once stood on a female's back. He was observed thrusting high past the vulva, at times around the anus or onto the back of the female. This behavior with the other three females continued for approximately six weeks past the time the male began actual copulations with them, although with the number one female such inept behavior was not observed once copulation was achieved.

This finding raises a question of some importance: Why did the male learn so rapidly the correct behaviors for copulation with the number one female when with the other three females he continued incorrect mounting and thrusting behaviors well past the achievement of copulation with these females? The male monkey copulated with the number three monkey (L) on November 26, the number one monkey (Ma) November 28, the number four monkey (C) November 30, and the number two monkey (Jo) December 17. Yet he was not observed mounting Ma incorrectly after their first copulation. With the other females, such inept behavior persisted for a length of time after copulation began.

It is difficult to account for the male's differential treatment of the females unless the effect of the female's behavior upon the male is considered. Even here it is difficult to pinpoint exactly what the female does to evoke the correct response or to help the male in copulatory behavior since both L and Jo presented in what seemed to be the same manner as Ma (C imprinted to humans was the exception). The major observable difference was that Ma was by far the most persistent female in presentation behavior and also the most active in clasping the male during mounting interactions. On the basis of these observations, it would appear that the female's active participation including correct positioning, maneuvering, and clasping of the male facilitated correct responses from the male. This conclusion is consistent with other data collected relating to Ma's superior knowledge and skill of those cues and behaviors in social interaction which are necessary for survival in a colony.

The third monkey in the female's linear hierarchy (L), appeared noticeably slower in learning such cues. The male monkey copulated with her when she was introduced singly into his cage, but with appreciably more incorrect mountings, dismountings, and remountings. When Ma was placed in the cage with these two, Ja clearly preferred Ma. When all the monkeys were together, the male again gave the number one female the major portion of his attention while L ranked second in number of copulations observed. The number two monkey (Jo) appeared to assume status secondary only to Ma, probably due to Ma's protection of and preference for her. Toward the latter stages of the study, it was noted that Jo was beginning to initiate behavior similar to Ma's in interaction with the male in that she presented persistently to the male.

Table 8

Number of Observed Copulations

11-26-65 to 6-6-66

Female	No. of Copulations	Social Rank
Mamie	24	1
Lena	12	3
Josie	7	2
Chiquita	7	4

The male's behavior with the monkey imprinted to humans (C), differed considerably from his treatment of the other females. Although the male attempted copulations with C, mounting, thrusting, inspecting, etc., he usually desisted rather quickly and treated her much as a dominant male treats a "yearling" in the wilds (Itani, 1959). Even after successful copulations with C the male tended to treat her differentially.

When together Ja and C were observed often playing together, tumbling and rolling about on the floor as if wrestling. No shrieks were heard from C at these times. She was seen chasing the male and pulling at him while he responded as if in play with no lunging, biting or threat vocalizations.

When the male stopped to take food, C would again pull at him as if "teasing" in order to evoke a playful response. She was much more active at such times than in observed interactions with females. In many instances she seemed not in the least fearful of the male as inferred from her behavior. They often groomed each other for lengthy periods of time and were seen on numerous occasions sitting together in a ventral embrace.

When copulations occurred, C simply stared straight ahead, neither reaching back to clasp the male nor to turn and look into his face during thrusting and orgasm as the other females did. She emitted no vocalizations during the male's characteristic orgasmic vocalizations.

Imprinting effects. The conclusions are that C by virtue of her early experience with humans and lack of experience with a monkey group during the early critical period had not learned many of the behavioral and verbal cues necessary for living within the social structure of a monkey group. She obviously evoked a differential response from the male than the other females within the group. Ja treated her most of the time as if she were a much younger monkey. His sexual behavior with her was not as aggressive nor as intensive, while her sexual behavior with him appeared to be a passive receiving during copulation rather than an active participation such as Ma's.

Grooming is not sexual behavior per se, nevertheless, it often precedes or occurs immediately after copulation and is an extremely important social function in the life of a monkey. One very marked difference between C and the other females is in the method of grooming. C picks very carefully with index finger and opposable thumb at only one hair at a time. The other females use both hands in the process and Ma is especially proficient. One hand parts a large area of hair and presses it down while the other hand rapidly parts bit by bit through the area grooming many hairs along the part. This observed behavior is very similar to Furuya's (1957) description of the grooming behavior of wild Japanese monkeys. C apparently has never learned the more effective and rapid method of grooming. Nor does she reciprocate when another female grooms her, and such unilateral efforts then are apt to cease. Monkeys appear to need or to want a response, an interaction, in order to expend the effort to be social. Many of the drives of each individual in a group are satisfied or reduced by interactions with others in the group. But the interactions are reciprocal in these cases. This reciprocity of interaction is considered to be fundamental to the dynamics of a group.

Effects of Estrus and Mating on Social Status

Tokuda (1962) has reported that a female in estrus is more highly prized by the group in the wilds and that consort relationships bestow a certain amount of special privileges on the female in proportion to the dominance of the male. These effects were observed to some extent within the small colony of this study; for example, C who was invariably attacked at any other time was allowed into the cage with other females for a 24-hour period during estrus without violent abuse. Ma was observed to groom for lengthy periods the female in estrus and to be especially interested in her hindquarters as inferred from numerous inspections, manipulations and licking behavior. Carpenter (1942) found that female rhesus groom the female in estrus more during this time. The male *speciosa* too was observed to afford some degree of special protection for a brief time to the estrus female with whom he had just copulated. This was not invariably so, however, for if Ma (number one) attacked the other female, he often after a few token defense behaviors joined Ma in the attack. Once Ma pulled Ja off an estrus female during a copulatory attempt and actually succeeded in supplanting the other female as recipient of the male's attention. Thus Ma's aggressive behavior overcame any elevation in status which might have otherwise accrued and served an important function in maintaining her own social position. Ma was also the first female of the colony to conceive and deliver an infant.

It appeared that the male of this colony when with all females accepted the rank established by the females and generally preferred the females in the same rank order as the social hierarchy despite the particular state of estrus. Only very brief periods of elevated status occurred among the less dominant females in estrus after copulations with the male.

Judging from observations of the animals used in this study, the number one female in social status appears to lead a much more active and aggressive role within the social structure of the monkey group than has hitherto been suspected, although one group of Japanese monkeys reportedly is led by a female (Kawamura, 1958). It is possible, of course, that the male speciosa used in this study is unusually docile and friendly; however, he is judged to be a pubertal male and this may be a highly significant factor. As he matures further, he may possibly become less easily influenced by the dominant female. Among speciosa monkeys, it is clear that social learning as well as aggression plays a critical role in social status among females. Moreover, the most aggressive female of a group may influence the male's acceptance of an established social hierarchy. It is also possible, however, that a new female highly preferred by the male might effect decided changes in the existing social hierarchy.

CHAPTER VI

MANIPULATION OF VARIABLES HYPOTHESIZED AS DETERMINANTS OF SOCIAL STATUS IN FEMALE MACAQUES

Part I: Enovid Experiment

It has been demonstrated that among free-ranging monkeys the female in estrus is more highly prized by other members of the group (Carpenter, 1942; Tokuda, 1962) and may attain special eating privileges during the maximum estrus phase as well as intensified social interactions such as lengthier grooming periods and more numerous genital inspections and manipulations. Such interactions are considered basic to the dynamics of a monkey group at all times, but the appearance of estrus in a female clearly intensifies and increases the amount of social interaction with both male and female members of a group. During the maximum estrus phase a female normally has considerably increased amounts of estrogen.

Several researchers (Birch & Clark, 1946, 1950; Crawford, 1940; Nowlis, 1942; Yerkes, 1940) have been interested in the behavioral effects of increased gonadal hormones in chimpanzees. Increased estrogen levels have been investigated in both female and male chimpanzees; also the behavioral effects of increased androgen levels have been studied in both sexes. Crawford (1940) reported that subordinate female chimps often obtained more food while in estrus than at other times while Birch and Clark (1946, 1950) reported that one subordinate female chimp responded to both estrogen and androgen treatment in the same way: she obtained most or all of the peanuts in food-getting tests under the effects of either hormone, whereas prior to either treatment she had obtained few, if any, of the nuts. The same researchers reported that androgen enhanced a dominant male's food-getting scores. Conversely, estrogen decreased his scores to the point that he was subordinate to his cage mate. Other experimenters (Allee, 1940; Ball, 1940; Noble & Borne, 1940; Noble & Greenberg, 1941) have conducted sex-hormone studies on such widely different infraprimate animals as fish, reptiles, birds, and mammals. The latter experimenters found that generally androgens enhanced dominance behavior of both females and males; estrogens either reduced aggressiveness or had no effect.

Mirsky (1955) investigated the effects of both gonadal hormones on dominance behavior in rhesus that had been gonadectomized two months prior to the experiment. The experimenter obtained a base line measure of the group structure and interaction in order to measure any changes which might occur under hormonal conditions. The results of this study show no change in the hierarchy of dominance-submission under either of these hormones. In view of the findings of other primate studies cited previously, this is a somewhat unexpected result; however, the author emphasizes that aggression and dominance are not invariably influenced by sex hormones and that the social behavior of macaques is markedly refractory to change.

Clearly, it is not safe to generalize across species concerning such phenomena, particularly since differential effects have been found even within a species. The present study was designed to investigate the effects of a relatively small amount of estrogen combined with a larger amount of progestin contained within a contraceptive pill (Enovid-E).

With the very rapid rise since 1955 in the use of oral contraceptives, which utilize higher than normal levels of estrogen and progesterone to inhibit release of the monthly ovum, the area of gonadal hormone investigation has become of increasing interest to scientist and layman alike. The clinician hears varied and contradictory accounts from female clients who take "the pill". A few women report no physical or psychological effect can be detected while others attribute to it symptoms ranging from weight loss to weight gain, from nausea to increased appetite, from lack of energy to an increased tempo of activity, from increased sexual desire to loss of sexual desire, from increased irritability to increased placidity, and so on.

According to Astwood (1965) in The Pharmacological Basis of Therapeutics and Tyler (1964) in a medical journal the undesirable effects of Enovid in humans usually are nausea, dizziness, occasional vomiting, headache, and discomfort in the breasts. These authors find also in women users of Enovid a tendency to gain weight and an increase in physical vigor without a consistent change in libido. The physiological and psychological effects of oral contraception seem to be of more than passing interest to a number of people.

The effects of Enovid are being studied in various ways; for example, Kar, Chandra, & Chowdbury (1965) administered Enovid to rhesus monkeys for varying lengths of time and then sacrificed the animals in order to study the ovaries histologically. They found very slight weight increase in the ovaries, the increase in weight being proportionate to the length of Enovid administration.

The purpose of the present experiment is to study the effect of an oral contraceptive, viz., Enovid-E, on the behavior of nonhuman primate subjects who cannot be influenced by prior knowledge of the usual undesirable effects of the pill. The subjects used were the female Macaca speciosa studied throughout the present overall investigation of the determinants of social status in females.

Problem

Several studies concerning the effects of increased steroid hormones in infraprimate animals revealed differences in the behavior of the animals while under the effects of the hormone dosage. Generally, androgen increased aggression and estrogen either decreased aggression or caused no change. On the other hand, increased dosages of sex hormones in chimpanzees produced differential effects and in one case a female responded to estrogen with increased dominance in food-getting test. In this same female androgen produced similar results. Mirsky found no significant difference in dominance behavior of rhesus monkeys with increased dosage of either estrogen or androgen. Verbal reports from individual women using oral contraceptives vary widely and may be influenced by psychological factors aside from physiological effects. This may be one major advantage in administering Enovid to nonhuman primates since the subjects will not be susceptible to "expected" effects of the pill.

The primary objective of the present investigation was to control the variable of ovulation in a colony of female speciosa in order to study the females' linear ranking during a quiescent period in the reproductive cycle. Since estrus in the female monkey produces significant, measurable changes in the social behavior of other members of the group, a treatment which suppresses ovulation might logically be expected to produce some changes in behavior within the social structure and perhaps some shift in the linear social hierarchy. Previous studies of increased estrogen levels report a decrease in aggressive behavior or no change in infraprimate animals. On the other hand, a study of chimps found an increase in aggressive behavior from the effects of both estrogen and androgen. A study of rhesus monkeys reported no change, thus the research literature presents some ambiguities as to the results which might be expected with another species of primate, stump-tailed macaques (speciosa).

Specifically, this investigation attempted to determine if Enovid-E treatment can be demonstrated to produce changes in observable behavior within the social structure of a small colony of female *Macaca speciosa*. Two hypotheses were tested.

Hypothesis 1: Female stump-tailed macaques (*speciosa*) under hormonal effects of Enovid-E do not manifest changes in the linear rank of the existing hierarchy.

Hypothesis 2: Female stump-tailed macaques (*speciosa*) under hormonal effects of Enovid-E do not manifest behavior significantly different from the base line of behavior obtained.

Method

Subjects. Four female stump-tailed macaques were used; these females had established a linear ranking in their social structure and were dominant in this order: (1) Ma, (2) Jo, (3) L, and (4) C, reared from infancy by humans. The females ranged in weight from approximately 11 to 13 pounds.

Procedure. Ten-minute observations of the interactions were made and recorded daily at approximately 12:00 noon, plus or minus 30 minutes on occasions. As a control against the possibility of differential behavior at an "expected time" (arrival of the E) a three-day control period was run in which behavior was observed on a randomized basis during the animal's waking hours. These observations were compared with an equivalent number of observations taken at the standardized time. No significant differences in behavior were found. Additionally, a one-day control period was run in which time samples were obtained every hour throughout the day from dawn to dark. These observations were made from a distance of 150 feet with the aid of powerful binoculars. The E was situated within a building before daybreak and the animals appeared unaware that she was in the vicinity. Other than expected diurnal fluctuations in behavior throughout the day, such as less activity on first awakening, decreased activity as dusk approached and during napping periods in the afternoon, no significant differences were found.

The observed behavior was categorized under three headings: Aggressive, Submissive, or Friendly behavior. The behaviors included in each category are outlined in the appendix. Some behaviors did not fall within these definable categories and were not included in the measure.

Ten-minute observations were made daily from June 5, 1965, to October 8, 1965. The first segment of time (44 days) from June 5, 1965, to July 18, 1965, was the initial settling phase in which the animals were first integrated. This period appeared to be a time in which the females determined the relative social status of each member in the colony and established a hierarchy which then remained extremely stable over time. The females were first integrated on June 4, 1965, and the following 44 days of observed interactions were judged not to be an accurate measure of base line behavior. It was anticipated that aggressive behavior would be appreciably higher during earlier stages of integration, particularly during approximately the first week.

The second segment of time, July 19, 1965, to August 28, 1965, was the 40-day period of Enovid-E administration. The third segment of time, August 30, 1965, to October 8, 1965, was the 44-day period after completion of Enovid treatment and is considered to be an accurate base line measure of "normal" behavior.

Enovid-E administration. One tablet of Enovid-E containing 2.5 mg of norethynodrel (progestin) and 0.1 mg of mestranol (estrogen) is the recommended human adult dosage. One-fourth tablet was administered to each female *speciosa* daily for 40 days. Length of the *speciosa* menstrual cycle was unknown at that time since the cycle had not yet been studied systematically, therefore, length of rhesus cycles and length of *nemestrina* cycles were used as a basis for determining the number of days to administer Enovid. Rhesus have an average menstrual cycle of 28 days (Hartman, 1932) while *nemestrina* average from 30 to 40 days in length (Kuehn, Jensen and Morrill, 1965). In order to have some degree of confidence that the total menstrual cycles of *speciosa* was treated, the longer cycle was used as the base for administration.

A second stage of the Enovid experiment consisted of administering Enovid to only one-half of the females in the colony--those lowest in status, whereas no drugs were given at this time to the females of higher status. The final stage of the experiment then was to reverse this procedure by administering Enovid to the other half of the colony--those females highest in status, whereas no drug was given at this time to the lower status females.

The Enovid tablet was crushed in a glass mortar with a glass pestle, ground finely, and mixed with an instant breakfast drink[1]. One cup of

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[1]Tang

water was added and the mixture stirred until dissolved thoroughly. Each female was apportioned one-fourth of the liquid and drank from a rubber syringe applied to a glass tube. Each subject had been trained previously to sit on the E's lap and to drink from the apparatus. The females had cultivated a taste for the drink and sipped the dosage readily.

Results

Hypothesis 1. At no time during differential Enovid treatment to the female colony nor during Enovid treatment to all females was there any change in the linear rank of the female social structure. In food-getting tests conducted daily with either grapes or banana slices offered to the group, Ma continued to be number one, Jo continued to be number two, while L remained number three and had to be removed from the cage in order to receive fruit. It was necessary for C, in order to escape serious injury, to be housed in a small cage within the larger cage which protected her from physical attacks (as described in a previous chapter). She clearly remained the number four monkey during Enovid treatment as attested by the fact that she required protection at all times.

The number of aggressive behaviors observed during Enovid treatment to all females ranked the females in the same order with the number one monkey exhibiting the greatest number of aggressive acts and so on down the straight-line rank. The only "apparent" exception to this occurred with C (number four) who was housed in a protected environment and could, therefore, voice threaten without fear of reprisal. She numbered 47 aggressive threats whereas L (number three), who was housed in the same cage with the other more dominant animals and could not escape retaliation, numbered only 41 aggressive acts. There can be no question, however, that L was dominant over C (as attested by the fact that C required protection from L continuously) despite the slightly larger number of aggressive behaviors exhibited by C. The number of observed aggressive acts were: Ma, 161; Jo, 108; L, 41; and C, 47. There were no observed instances of dominance interaction contrary to the direction implicit in the linear hierarchy of the group.

The number of observed submissive acts were in the reverse order: C, 71; L, 55; Jo, 13; and Ma, 2. These data are presented in Table 10.

On the basis of these data, it can be concluded that neither Enovid-E treatment to all females nor differential treatment to the females effected any changes in the established linear hierarchy of the female macaque colony. Thus, hypothesis 1 is accepted as supported by these findings.

Hypothesis 2. Table 10 presents the number of observed interactions categorized as Aggressive, Submissive, and Friendly behavior during Enovid-E administration for each individual monkey as well as the total number of each of these three categories of behavior. Table 9 presents the measure of base line behavior which is the number of observed interactions in these same three categories of behavior when the animals were not under the effects of Enovid-E. Table 4 is duplicated for convenience in comparison of the settling phase of integration with base line behavior and with behavior under Enovid treatment.

A comparison of the base line behavior with the behavior under the effects of Enovid reveals an increase in total numbers of behavior observed under Enovid treatment in all three categories of behavior with the most marked increase occurring in the total number of aggressive behaviors. Also, individually, each animal exhibited an increase in aggressive behav-

Table 4

Time I: Settling Period of Integration

10-minute Observations

	Aggressive Behavior	Submissive Behavior	Friendly Behavior	Total
Chiquita	21	31	23	75
Lena	70	50	53	173
Josie	125	26	69	220
Mamie	155	2	107	264
Total	371	109	252	732

Duplicated for convenience in comparison

Table 9

Time II: Measure of Base Line Behavior

10-minute Observations

	Aggressive Behavior	Submissive Behavior	Friendly Behavior	Total
Chiquita	9	37	19	65
Lena	31	42	48	121
Josie	52	18	63	133
Mamie	66	3	89	158
Total	158	100	219	477

Table 10

Time III: Interactions During Period of Enovid Treatment

10-minute Observations

	Aggressive Behavior	Correction Factor	Submissive Behavior	Correction Factor	Friendly Behavior	Correction Factor	Total
Chiquita	47	(52)	71	(78)	23	(25)	155
Lena	41	(45)	55	(61)	52	(57)	163
Josie	108	(119)	13	(16)	47	(52)	187
Mamie	161	(177)	2	(2)	97	(107)	286
Total	357	(373)	141	(157)	219	(241)	791

NOTE: Correction factor for difference in number of days observations.

ior during Enovid administration from base line behavior although the individual increases varied considerably from monkey to monkey.

Under the hormonal effects of Enovid, essentially no change occurred in the submissive behavior of the number one and number two monkeys of the hierarchy. A slight increase from 42 to 61 was noted in the submissive behavior of the number three monkey; thus the number four monkey was the largest contributor (41) to the total increase in submissive behavior.

Friendly behavior increased slightly under the effects of Enovid. The number one monkey contributed the largest portion (17) of the total increase, the number two monkey contributed the next largest portion (12), the number three monkey contributed 9 friendly behaviors, and the number four monkey increased by only 6 over her base line behavior.

A three-way analysis of variance was calculated on transformed data. It was necessary to convert the raw scores to Z scores in order to equalize behavior scales used in the observations. These behavior scales were frequencies of observed behavior in three categories. An inspection of Table 11 shows that significant differences were found in behavior during the three time periods ($p < .05$) and in the behavior of individual monkeys ($p < .01$) whereas the interaction effect of behavior times monkey is highly significant ($p < .0001$).

The means for significant effects of time are: Settling Phase of Integration (Time Period I) 50.9; Base Line Behavior (Time Period II) 46.5; Enovid Treatment (Time Period III) 52.6. Thus Enovid administration to female Macaca speciosa appears to effect overall behavior in such a way that the increase is similar to the original settling phase of the first integration and is significantly different from the base line of behavior obtained.

A two-way analysis of variance calculated for base-line behavior and behavior under Enovid treatment yields an F of 12.14 which shows that the difference between the two conditions is significant at the .01 level of confidence. The simple effects of time for each of the three behaviors show that aggressive behavior contributes the greatest amount to overall behavior increase with an F of 12.75 ($p < .01$) whereas submissive behavior reveals a trend being significantly different at the .09 level of confidence. Friendly behavior is not significantly different. Thus the increase in amount of behavior derives largely from an increase in aggressive behavior during Enovid treatment. Figure 1 illustrates these findings.

From the figures of significant means in Table 12, it is readily apparent that the behavior of individual monkeys varied greatly in aggressiveness, submissiveness, and friendliness. Figure 2 shows that the four monkeys differ in aggressiveness, and seems to indicate that aggressiveness is positively related to friendliness but negatively related to submissiveness. Figure 3 shows that Ma (number one monkey) and Jo (number two monkey) displayed more aggressive behavior (hence more friendly behavior but less submissive behavior) than L and C (number three and number four).

In summary, although significant increases were noted in two categories of behavior under the effects of Enovid, the most significant increase is found in the number of aggressive behaviors ($p < .01$). Thus, hypothesis 2 is not supported and must be rejected. On the basis of these data, it can be stated that female Macaca speciosa under hormonal effects of Enovid-E manifest aggressive and submissive behavior significantly greater than their base line of these behaviors, with aggressive behavior contributing the larger portion to the total increase.

Table 11

Analysis of Variance

Source	df	SS	MS	F	Significance
B	2	.167	.084	.00	NS
T	2	237.167	118.584	6.48	$p < .05$
M	3	350.000	116.667	6.38	$p < .01$
BT	4	137.167	34.292	1.87	NS
BM	6	2,269.166	378.194	20.68	$p < .0001$
TM	6	122.833	20.472	1.12	NS
BTM (error)	12	219.501	18.292	---	---
Total	35	3,336.000			

B - Behavior: Aggressive, Submissive, Friendly
T - Time Period: I, II, III
M - Monkey: Chiquita, Lena, Josie, Mamie

Anova calculated on transformed data

Table 12

Means for Significant Effects

Behavior x Monkey

	Aggressive	Submissive	Friendly	Monkey
Chiquita	41.0	57.7	37.3	45.3
Lena	45.0	58.7	47.7	50.4
Josie	54.0	45.7	50.7	50.1
Mamie	60.0	38.3	64.0	54.1

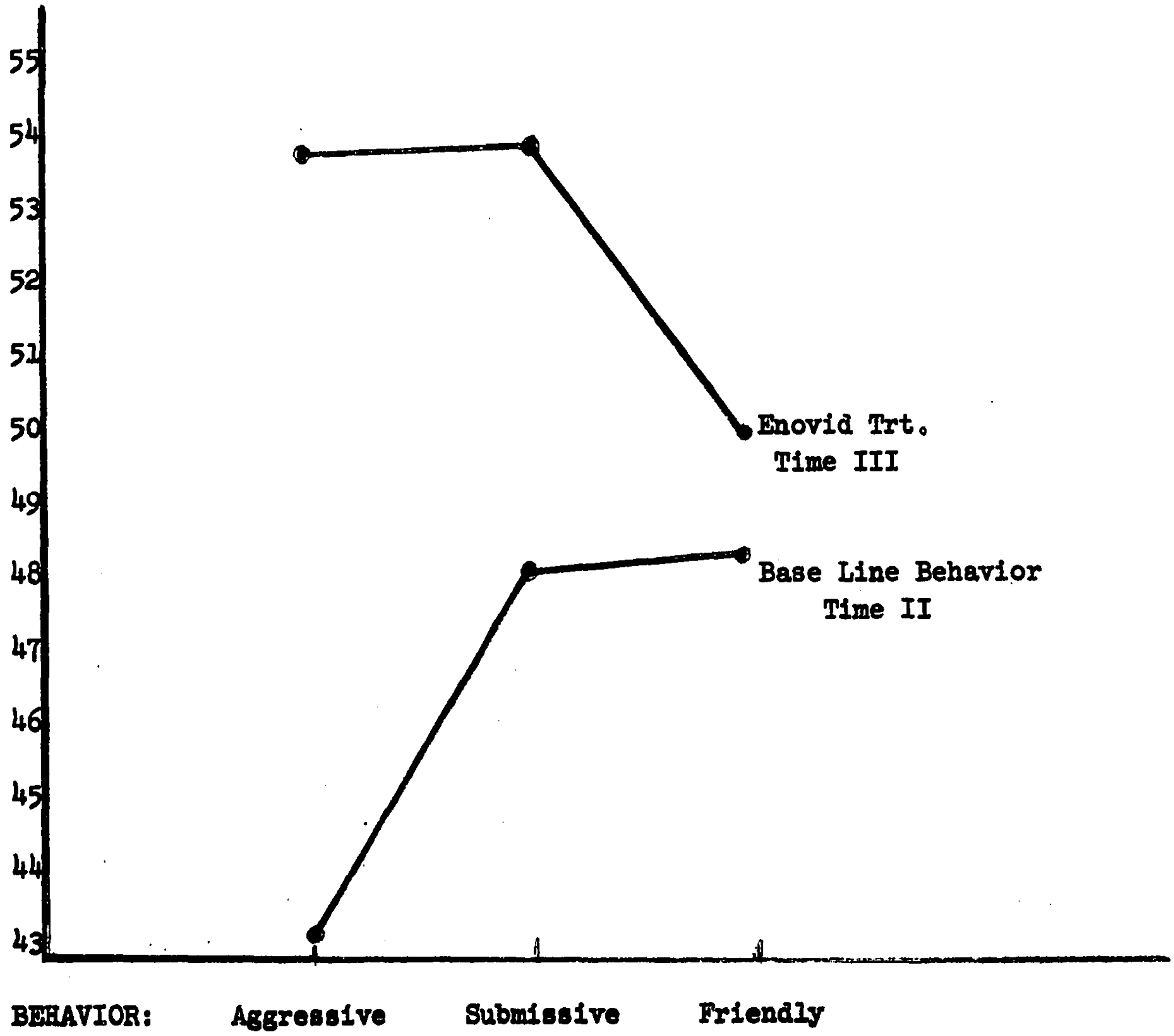

Fig. 1. Means for significant effects of Time II and Time III in each category of behavior.

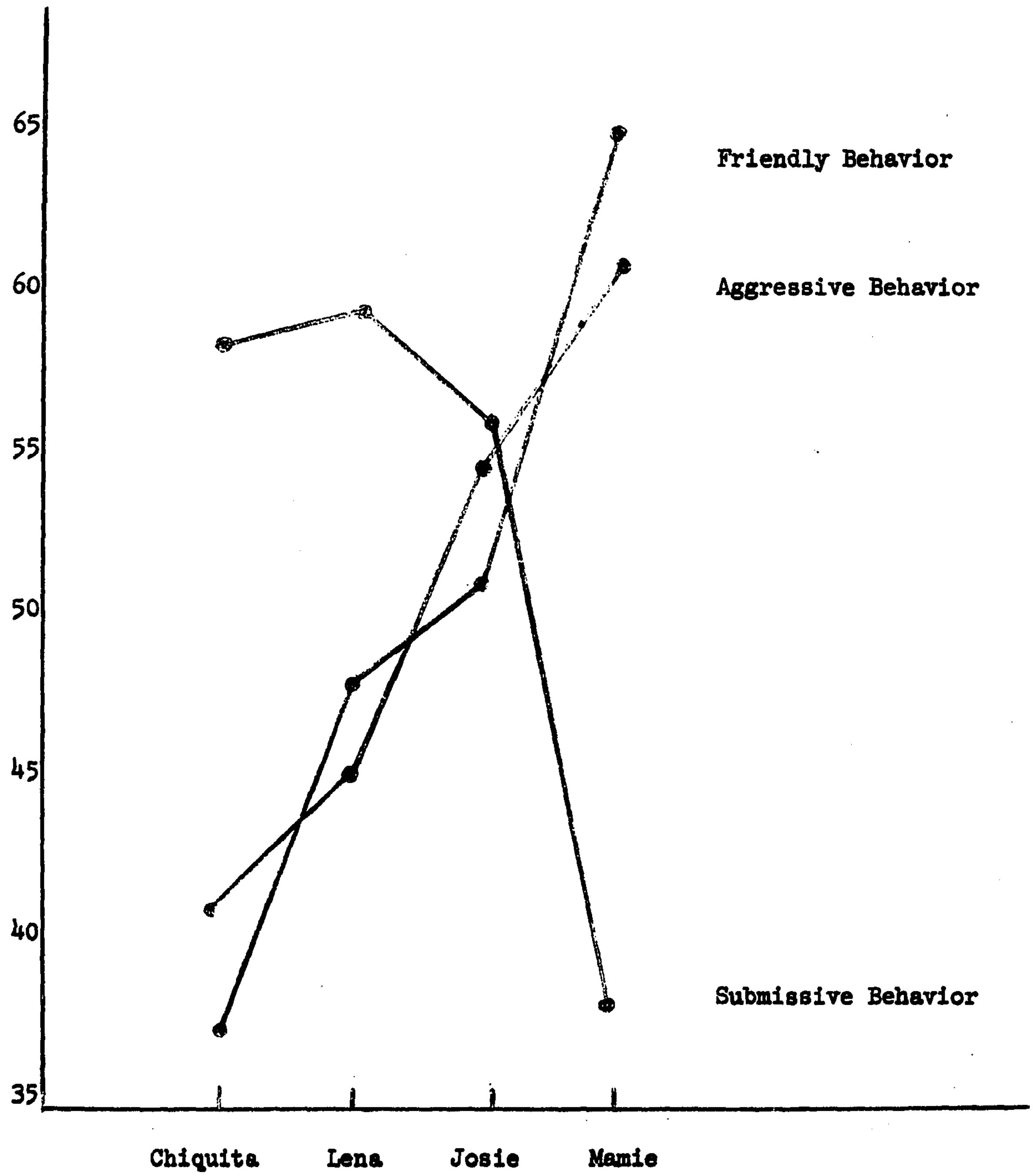

Fig. 2. Monkey times behavior interaction effect. This seems to indicate that the four monkeys differ in aggressiveness, which is positively related to friendliness but negatively related to submissiveness.

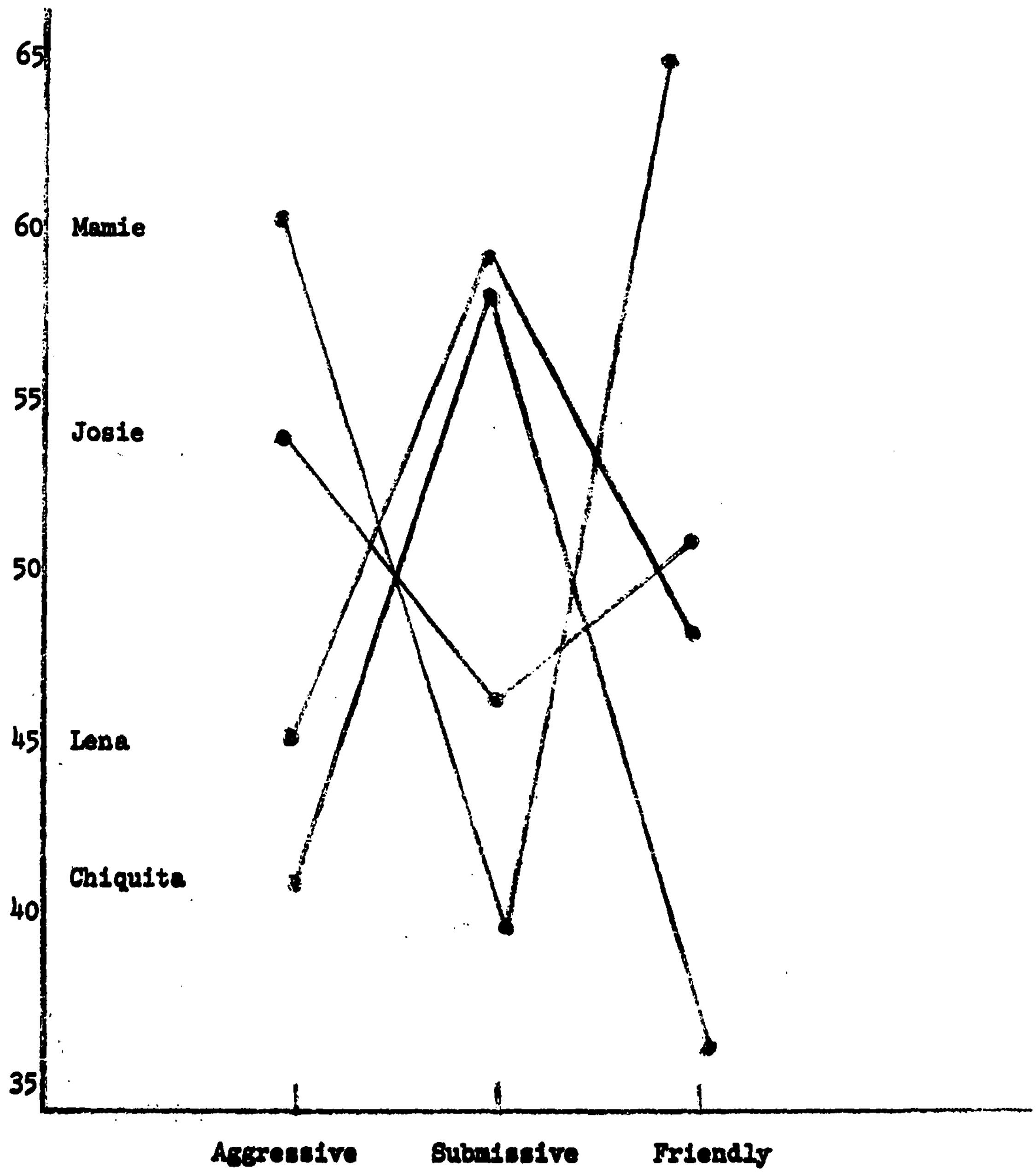

Fig. 3. Monkey times behavior interaction effect. Mamie and Josie more aggressive (hence more friendly but less submissive) than Lena and Chiquita.

Subsidiary Findings

Some subsidiary observations which were not included in the original formulations were made which pertain to Enovid treatment.

Male's masturbatory activities. The male animal was observed to engage in genital play, manual manipulation of the penis, fellatio and pelvic jerking on numerous occasions previous to Enovid treatment of the females. He tended to become particularly excited and agitated when the female monkeys were handled. Since they were handled daily, the male often was observed engaged in masturbatory activities up to August 14 when he ceased these activities. Enovid administration commenced July 19 and the females had been under the hormonal effects of Enovid for 26 days when the male's autoerotic activities ceased. These observations may possibly indicate that the male had been receiving some sexual stimuli which ceased at about the time the females had received Enovid for 26 days. On the seventh day after Enovid treatment terminated the male again was observed to begin masturbatory activity. This latter observation was made just one day after a female monkey began withdrawal bleeding. It would appear that when the effects of Enovid wore off, whatever stimuli the male received from the females was again activated.

Withdrawal bleeding. The length of time from termination of Enovid to withdrawal bleeding varied considerably, being six days, 28 days, and 31 days. One female had no showing of blood until December 17 which was $3\frac{1}{2}$ months later.

Male's behavior toward females. The male was introduced into the female's cage twice during the 40-day period. Three of the females presented to him (with Ma--the number one monkey--as usual the most persistent in this behavior) and the male mounted repeatedly. Intromission was not achieved, however, as inferred by the lack of characteristic copulatory behavior described elsewhere. Both Ma and Jo appeared psychologically ready, if not eager, for copulation, but not physiologically capable. In the ensuing fight which erupted, L was severely bitten by Ma and Jo.

Pigmentation. Two of the four females developed dark splotches or "freckles" across the face mask while under Enovid treatment. One of these two had a few medium-sized dark splotches before the administration of Enovid; by the sixth day after beginning Enovid her splotches had increased noticeably in size and new ones had developed. The other had no splotches until Enovid was administered and developed small dark spots across the face mask observed on the 20th day of treatment. She also manifested a bright pink color at the tip and base of both nipples during treatment.

Part II: Effects of a Tranquilizing Drug On Social Status

It has been observed that the social structure in macaques and other terrestrial primates is generally more rigid than in arboreal monkeys (DeVore, 1963; Maslow, 1936, 1940; Mason, 1965). Ground-living monkeys, particularly macaques and baboons, tend toward larger more cohesive groups and display more fighting, aggressive interactions and other dominance activities than tree-living monkeys. Terrestrial monkeys are more vulnerable to predators, therefore, the rigid social organization of these groups may contribute to species survival. Maslow (1936, 1940) in a comparative study found that species differ markedly in qualitative expression of dominance and characterized Old World terrestrial monkeys as vicious and brutal in their dominance interactions.

Some attempts have been made to alter dominance status among rhesus by administration of tranquilizing drugs (Leary & Slye, 1959; Leary & Stynes, 1959). In the first study, chlorpromazine was administered to the dominant monkey of a pair of cagemates. The dosage was at a level which reduces most activity including food-getting. Behavior in food-getting was tested while the cagemate was tranquilized. No significant change in dominance resulted, although the drugged monkey did not get as much food during the drugged state. Less "nervous" behavior such as weed-picking and husking on the part of the submissive monkey was observed during the period his cagemate was drugged. In the second study, both chlorpromazine and meprobamate were administered since there is a difference in their locus of physiological activity. The results failed to show that drug treatment had a significant effect on social dominance in rhesus, although some individual monkeys lost much of their aggression under chlorpromazine (not under meprobamate). Food-getting diminished also under chlorpromazine.

Thus, altering dominance status in rhesus by administration of chlorpromazine and meprobamate was largely unsuccessful; however, rhesus are notoriously more vicious and aggressive in interaction than the more docile speciosa (Kling & Orbach, 1963) used in the present study. Therefore, it seemed possible that a differential effect might be obtained with another, less aggressive species, although the comparative aspects of the study were not the major consideration.

Since a comparative approach was not the basic area of interest, another tranquilizing drug was selected for administration. Librium was selected, primarily because it has been widely heralded as a successor to the tranquilizers and reportedly, affords faster, superior control of common emotional disturbances such as anxiety, tension, agitation, and fear. According to Jarvik (1965) in The Pharmacological Basis of Therapeutics, the chlorpromazines have high sedative effect and are used in the treatment of psychotic patients in manic states; however, Jarvik concludes that although chlorpromazine inhibits movement, it does not necessarily impair behavior.

Librium contains chlordiazepoxide hydrochloride (7-chloro-2-menthyl-amino-5-phenyl-3H-1, 4-bendodiazepinc 4-oxide hydrochloride) and produces signs and symtoms of CNS depression, including drowsiness and lethargy (Medical Pharmacology, Goth, 1965). Jarvik (1965) states that chlordiazepoxide is one of a variety of centrally acting drugs which produce diminution in reactivity and emphasizes that this drug is similar in effect to the phenothiazines which diminish spontaneous motor activity in every species of animal studied, including man. Further, indifference to environmental stimuli and consequent taming are easily seen in naturally aggressive wild animals such as monkeys. Goth (1965) characterizes Librium as a sedative with anti-anxiety, muscle relaxant properties.

Objective

The primary objectives of this phase of the present study were two-fold: (a) to alter the social hierarchy, if possible, by administration of Librium, and (b) to integrate C (the monkey presumably imprinted to humans) into the group. The attempt was to introduce C under conditions whereby she might be tolerated by the other females without aggressive attacks. Librium administration to the other females and the possible resulting "taming" effect was viewed as a condition under which C might possibly have the opportunity for some success experience with other *speciosa* and benefit thereby from amicable social interaction.

Mirsky's study (1960) demonstrated that social learning is important in dominance interactions. Brain lesions in the amygdala of monkeys reduced their dominance rank in the original group; however, when three amygdalectomized animals were provided with post-operative success experience with small animals and then returned to their original groups, each animal retained its former position or gained in rank. It seems, therefore, that an animal lacking in social experience might possibly learn the behavioral and verbal cues used in communication provided he is exposed to smaller or more submissive monkeys than himself.

Method

Librium is available for human consumption in tablets varying from one to 50 mg with the usual human dose being 25 to 100 mg daily. A decision was made that 10 mg would be the maximum dosage administered the *speciosa* who averaged approximately 11 pounds. Smaller amounts were administered first and the animals watched carefully for unusual effects.

The dosage of Librium was varied in the following manner: First administration under Condition A was 3.5 mg each to Ma, Jo and L. Second administration under Condition B was 5.0 mg to each female. Third administration was 10.0 mg to each female. The original plan was to exclude C from administration of the drug; however, under Condition A the undrugged monkey manifested intense fear reactions clinging tightly to the *E* and whimpering. Although the variables influencing aggression against another monkey are not completely known, it seemed possible that C's behavior might induce or provoke attack from the others. Therefore, she was drugged under Conditions B and C in order to decrease the amount of observable behavior inferred to denote fear.

A second stage of this experiment consisted of administering Librium to one-half of the females in the colony--those lowest in status, whereas no drug was administered to those females of higher status. The final stage of the experiment then was to reverse this procedure by administering Librium to the highest status females and giving no drug to the lower status females.

To prepare the dosage, the drug was removed from the capsule and placed in a glass mortar, one teaspoon of an instant breakfast drink[1] was added, and the mixture then ground with a glass pestle. One cup of water was added and the ingredients were mixed until thoroughly dissolved. The liquid medication was then divided equally among the animals and administered orally by syringe and glass tube so that no portion was lost. The animals had been previously trained to sit in the E's lap and drink from the syringe.

The animals were then placed in their usual cages: Ma, Jo and L in Cage I while C remained in her individual cage attached to the large cage. Two hours were allowed for maximal effects of the drug to be reached. The animals' behavior was observed and recorded for ten minutes, then C was introduced into Cage I by the E who carried her into the cage. Three independent judges observed the interactions during a 10-minute period while C was in the cage. Tape recordings were made of the animals' vocalizations during a 10-minute period of time under all three conditions of drug dosage. The vocalizations on tapes were later judged for loudness and intensity on a five point scale ranging from Extremely Low to Extremely High

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[1] Tang

by three independent and impartial judges. A fourth tape was made of vocalizations by the four females when they were integrated in one cage and not drugged. This fourth condition (D) was judged also.

The four tapes were placed on four Wollensaks and arranged on a desk in a private room. Volume was set at 8 while treble and bass controls were set exactly the same on each Wollensak and at the same levels as when recording. Order of presentation was randomized and occurred in this order: Condition B (5 mg Librium), A (3.5 mg), C (10 mg) and D (no Librium). Each judge was handed four white, unlined 3 x 5 cards marked with the 5-point scale. Each card was numbered respectively in Roman numerals from I to IV to coincide with the four presentations. The judges were told that they were to judge the loudness and intensity of monkey vocalizations. They were asked to circle the number of the scale (1 - Extremely Low, 2 - Moderately Low, 3 - Moderate, 4 - Moderately High, 5 - Extremely High) which they judged to fit the particular presentation. A one-minute sample of each tape was run previous to the actual evaluation in order that the judges might have some basis for evaluating the differences. The tapes were then reversed to the point where the E first entered the cage with C and replayed for the first three minutes of time C was in the cage.

Results

Dominance or social status, as measured by food-getting, remained the same under the varied dosages of Librium with Ma, Jo and L remaining in that order in the linear hierarchy already established. When all females were drugged, dominance, as measured by the number of total aggressive behaviors displayed, decreased in direct proportion to the amount of Librium administered (Table 13) although one monkey (L), nearest C in the hierarchy, showed only a very slight decrease in the number of aggressive behaviors toward C as the Librium dosage increased, until 10 mg were reached. When L was under the effects of 10 mg of Librium she displayed no aggressive threat vocalizations, biting, lunging, or cuffing behavior toward C. The total number of aggressive behaviors displayed toward C decreased from 17 (no Librium) to seven (3.5 mg) to four (5.0 mg) to 0 (10 mg). A qualitative report of observed behavior made by three independent judges at the scene will be included in the next section.

Table 13

Number of Aggressive Behaviors Toward an Imprinted Monkey

Under Varying Dosages of Librium

Condition	D	A	B	C
Mamie	10	4	2	0
Josie	3	0	0	0
Lena	4	3	2	0
Total	17	7	4	0

Condition: D - no Librium, A - 3.5 mg, B - 5 mg, C - 10 mg

The three independent judges scaled the volume and intensity of animal vocalizations as: Extremely High under Condition D (no Librium); under Condition A (3.5 mg) two judges scaled the vocalizations Moderate while one judged them as Moderately High; under Condition B (5 mg) two judges scaled vocalizations as Moderate while one judged them as Moderately Low; under Condition C (10 mg) all three judges scaled the vocalizations as Extremely Low. Thus, the only ambiguity appears in the difference between the dosage of 3.5 mg Librium and 5 mg Librium where only one judge detected a difference in the volume and intensity of vocalizations.

On the basis of data obtained, it can be stated that Librium administered to speciosa produced a marked decrease in the amount of aggressive behavior (and in the loudness of threat vocalizations) toward one another or toward a monkey not accepted within the colony. The decrease in aggression was in direct proportion to the level of the dosage. As the level of the Librium dosage rises, the total amount of aggressive behavior decreases. No change in the linear ranking of the existing hierarchy was obtained by differential drug treatment to the females. However, when all females were under Librium treatment, aggressive behavior subsided until it was virtually nonexistent. After the drug wore off, no persisting effects of the drug were apparent in the behavior of the more dominant animals toward the monkey imprinted to humans nor to each other.

Qualitative Report

Librium: Condition A. (3.5 mg each to Ma, Jo and L.) Two hours later, Ma was decidedly more docile toward humans, allowed herself to be picked up, clung to one of the experimenters while lipsmacking at him. Ma clung to his shoulder instead of the usual leap away, when he released her. When Ma was set down with the other females, Jo clasped Ma from behind hugging her hindquarters. L then hugged Jo from behind in the same way. This pattern of interaction was to become a familiar one repeated over and over again by the animals. It was later dubbed the "choo-choo-train" progression by the E's after the three monkeys began occasionally moving in this hooked-together fashion which is reminiscent of children playing "train" together.

When C was carried into the females' cage by the E, both Ma and L threatened her with vocalizations and attempted to grab and bite her; however, there was a definite decrease from the norm in the total amount of aggressive behavior displayed toward C as judged by three independent observers at the scene and according to analysis of aggressive vocalizations recorded on tape.

With the first dosage of Librium, the E was able to pick up L--the most directly aggressive female toward C--and hold L in one arm while holding C in the other without a fight erupting. This bit of by-play would have been impossible without the Librium dosage. On every previous occasion when C was taken into the females' cage by the E, the E was hard-put to defend C from the other female speciosa and often had to cuff the females in order to prevent their vicious assaults on C.

Under the present condition, C was released after ten minutes by the E who moved back away from the monkeys, whereupon, Ma grabbed C's tail and pulled vigorously. C then sprang into the E's arms. A slight increase in lipsmacking (a friendly behavior) was noted during the drugged state and much more grooming occurred between Ma and L during the period between 3:00 and 4:00 o'clock. While the Librium was in effect the animals were observably lethargic. Jo's behavior differed in that she withdrew from Ma and L and mostly just watched them.

Condition B. (5 mg to each female). C was introduced by the E into the female's cage two hours after the Librium dosage. There was a moderate amount of threat vocalizations from the other females; however, they made no attempt to lunge, grab or to bite at C and only twice did they cuff at her. Thus, the more violently aggressive behaviors were totally absent under this dosage, although threat vocalizations from a distance were only slightly less than under Condition A. There was a decided increase in lipsmacking behavior by all females. Ma and L again spent lengthy periods in grooming behavior. Jo again withdrew from the other two.

Condition C. (10 mg to each female.) Two hours later, C was introduced to the females' cage. The other three female monkeys simply sat and watched. L gave two extremely soft threat vocalizations when external noises in the courtyard erupted. Ma clasped L from behind and Jo clasped Ma from behind, then L turned and groomed Ma's foot. Long quiet pauses were broken only twice by extremely soft voice threats which all three independent judges and observers at the scene rated as extremely low vocalizations. Under this dosage, C's violent trembling ceased altogether.

Part III: Olfactory Components in Sexual Stimuli

Pheromones, or odors to which a sexual response is made, have been given increasing attention of late. Nolbandov (1964) cites Signoret's experimental studies with swine which demonstrated that odors alone raised female's lordosis response 31% when the females were in estrus. How pheromones function to increase sexual response in certain species of animals is not yet known. Certainly, the importance of olfaction in sexual response appears to vary among species along with other sense modalities such as sight, hearing, touch, and so on. The relative dominance of the different sensory modes may be affected by the environment in which the animal lives; for example, a monkey with acute vision living in a dense forest may be forced to rely on auditory or olfactory communication over distances (Marler, 1965).

It has been theorized that human primates are furthest removed from "animal-like" sexual influence via olfaction; however, Money (1963) reports that the sense of smell in women seems to be related to the sexual cycle and is hormone regulated. Perfume manufacturers and perfume users appear to believe that sense of smell is an important component of sexuality in humans although such odors are contrived and often mask or disguise true sexual odors. Nevertheless, such manufactured odors when cultivated can in some instances become pheromones for humans.

There is as yet no general agreement as to the role of olfaction in communication or in sexual stimulation among the various species of monkeys. Jay (1965) states that in monkeys and apes olfaction definitely plays a much more limited role in communication than it does in the prosimians where vision is restricted. Since monkeys are mainly diurnal, vision and hearing are used for distance communication while the sense of touch is important in close range communication. According to Marler (1965) the need for distance signals will vary according to the system of social organization so that those animals staying in close proximity to each other within a group will develop and utilize multiple signals, including visual, auditory, tactile and olfactory stimuli, for close range communication.

The male monkeys of many species sniff at the anogenital area of estrus females. During the present study, the male <u>speciosa</u> was observed on numerous occasions to smell the genitalia and walk away without mounting. These observations led the experimenters to speculate about the "information" gathered by the male via the sense of smell and to raise the question as to what degree this sense modality conveyed or communicated the condition of estrus in the female. Since a state of estrus in female <u>speciosa</u> is not as obviously discernible to humans as estrus is in some other species of macaques (for example, rhesus or <u>nemestrina</u>, where extreme tumescence and coloration are immediately apparent) olfactory communication would seem to be more functional in <u>speciosa</u>.

In order to investigate the relative dominance of olfactory and visual stimuli in *speciosa* monkeys, the olfactory components of estrus were disguised and the male's subsequent behavior with the female was observed closely by three independent observers.

Method

Oil of anise was used to disguise the olfactory stimuli of estrus. Oil of anise was selected because its overpoweringly pervasive scent covers other odors so effectively as to render them imperceptible. Also it was ascertained by experimentation that oil of anise in the nostrils was not so highly uncomfortable to humans as to preclude administration to the male *speciosa*. The male *speciosa* was swabbed copiously with oil of anise in the nostrils and across the face mask. A female in estrus, as evidenced by a peak in temperature and manifesting other physical correlates of estrus as set forth in Chapter V, was swabbed copiously about the anogenital region and into the vagina. The vulva, anus, callosities, clitoris, labia and entire rump area were covered thoroughly with oil. After a five-minute interval the entire swabbing process was repeated a second time. The male was then introduced into the female's cage.

Results

The male mounted the female immediately without any inspection of the anogenital region, thrust two times, dismounted, pulled the female's tail up, sniffed at the genitalia, and remounted. The male achieved orgasm after 19 thrusts (66 seconds after entry into cage) and the "tie" between the two lasted 15 seconds. Ejaculate was observed when the male withdrew. Two more copulations occurred within the next 13 minutes.

Although the scent of oil of anise permeated the area and was overwhelmingly strong to the observers, it appeared to have no deterrent effect on the behavior of the male monkey. Apparently olfactory components did not play an important function in the sexual communication between these two animals.

Judging by this one example of manipulation of olfactory variables it seems fairly certain that olfactory cues were not necessary for this particular male monkey to recognize a state of estrus in the female. Other sense modalities appear to be dominant over the sense of smell. An experienced male with an experienced female obviously does not rely solely on olfactory signals, if at all, to convey a state of readiness for copulation. It appears that other signals via vision, hearing and touch play a more dominant role in communication among <u>speciosa</u>.

CHAPTER VII

DISCUSSION

In a first integration of female macaques not previously housed together in one cage, aggressive behavior appeared to determine the relative social status of each individual in the colony and, in fact, appeared to determine also the kind of social interactions which occurred subsequently among the animals over the next 16 months. The females of the present study established a linear social rank which was extremely stable and which did not change during Enovid treatment nor during Librium treatment, although under each condition the number of aggressive behaviors manifested differed significantly from the measure of base line behavior obtained. Under Enovid aggressive behavior increased, whereas under Librium aggressive behavior decreased. Aggressive behavior appears to be positively related to friendliness, but negatively related to submissiveness.

Strength of the animal as inferred from size and weight was not a significant factor in determination of social status. For example, the number three female in status was the largest and weighed more than any of the other females; the number six female in the social hierarchy was the second largest female in weight. Nor does age appear to be a significant variable in determination of status since the infant of the highest ranking female (introduced at the age of six months) assumed rank just below his mother in the hierarchy and over all the other females of the colony. The infant chased, bit, and mounted the adult females, particularly the number two female who gave way to him in chase and also presented to him as if he were an adult male. Clearly, in *speciosa* kinship ties and perhaps the sex of the animal may be determinants of the status an individual is accorded.

Although some elevation in status of females during estrus was observed briefly, the overall effects of estrus and mating on female social status were rather negligible. The male, when with all females, tended to accept the social rank established by the females and generally preferred the females in the same rank order despite their particular state of estrus. Further, the male demonstrated that other sense modalities appear to be dominant over olfaction in communicating those cues denoting a state of estrus in a female. The male often appeared to be influenced by the number one female of the colony who led a very active and aggressive role in the life of the group. It was concluded that aggressive behavior serves an important function in establishing social status among female *speciosa* which in turn has survival value for the species.

Newcomer Integration

Several factors may have contributed to the observed differences in behavior during two integrative attempts with additional females. One of the critical factors may have been that in interactions with submissive newcomers, the monkey imprinted to humans was afforded an opportunity to establish a dominant position over them. As higher status females were introduced singly in the second integrative attempt, she was able to maintain her new social status. The new monkeys then became the focus of aggressive attacks from the animals at the top of the social hierarchy since in speciosa the least dominant monkey is usually the prime target for displaced aggression.

The order of introducing the females into the cage in the second attempt may have played some part in the decrease of aggression directed toward the monkey imprinted to humans. The two females displaying the largest portion of aggression toward the imprinted monkey in the first attempt were introduced last during the second integration; however, it is difficult to account for the decrease in aggressive behavior once they were in the cage with her unless one of two hypotheses can be accepted. The first, mentioned above, is that the new females instead of the imprinted monkey became the principal target of aggression which indeed appears to be the case from a qualitative and quantitative analysis of the data. However, judging from the observations it appears that some change occurred which decreased the total amount of aggressive behavior. The second hypothesis is that the imprinted monkey's behavior changed also and that she had the opportunity for performing those behavioral and verbal cues necessary for interaction in a group of speciosa. She may have at least partially learned such cues and behavior while in close proximity to other speciosa over the months of the study, but particularly during the rotation period just prior to the second integration at which time she also had an opportunity to practice these skills.

The acculturated animal is handicapped in social interactions within the colony. But given the opportunity for learning with lower ranking monkeys, the imprinted animal may be able to change its reference group. However, one other variable may have influenced C's ability to change reference groups from human primates back to speciosa. The change occurred at the time her menstrual cycle began to stabilize and this too may have been a significant factor in C's greater acceptance in the colony.

A comparison of the two periods in which the male *speciosa* was introduced to the group of females shows one striking difference in behavior. In the integrative attempt with the new females, the imprinted monkey had to be removed in order to protect her from the other females before the male was added, whereas during the second integrative attempt she remained in the group and did not sustain serious injury although both new females were severely lacerated, bitten, and had to be removed. Thus, the females lowest in status became the target of aggressive interactions. When all *speciosa* were together the male became the number one monkey and the number one female became number two in the total colony structure. In interactions with the male, the number one female displays much submissive behavior, whereas with females only she rarely displays submissive behavior.

The implications of these findings, concerning the integration of additional monkeys and an imprinted monkey into a colony, are obvious for the experimenter who is attempting to establish a breeding colony of *speciosa*.

Enovid Study

The results of the Enovid study are entirely consistent with Mirsky's (1955) findings that no change occurs in the social status of animals in an established linear hierarchy under the effects of sex-hormones to produce a shift in the straight-line social structure; however, another aspect of the present study demonstrates that striking differences in aggressive behavior do occur while the animals are under the effects of Enovid-E. The latter finding seems to present an inconsistency since it has been demonstrated that estrogens generally either cause a decrease in aggressive behavior or have no effect on infraprimates, whereas studies of estrogen effects on chimpanzees are inconclusive. Possible mechanistic explanations which are considered include the possibility that the amount of progestin (norethynodrel) contained in Enovid, or the combination of progestin and estrogen in Enovid, produced a differential effect which was reflected in the increase of aggressive behavior.

Another possible interpretation may be considered. Although the complex interaction of the pituitary gland with the thyroid, adrenals and gonads is not completely understood, it is known that the pituitary gland can either be stimulated or inhibited by certain endocrine secretions (Goth, 1965). The pituitary or "master gland" secretions influence growth and activity in all the other endocrines, notably the thyroid, the adrenals, and the gonads. Secretions from certain of these glands in turn stimulate or inhibit the pituitary. It would appear possible that the thyroid gland may be stimulated by the hormones contained in Enovid-E with a resulting increase in the general activity level; however, this interpretation does not explain why the greatest amount of increase is found in aggressive behavior.

Perhaps the behavioral differences found in the present study more properly reflect marked differences between certain primates and infraprimates. If so, the results of the present study reemphasize the point Beach (1950) has stressed concerning the necessity for studying many kinds of animals to avoid the error of overgeneralizing from a few. The macaque monkey, as other terrestrial monkeys, is notably more aggressive and displays more dominance activities than the chimpanzee or the infraprimates studied in the investigations cited earlier.

Maslow (1936, 1940) characterized ground-living monkeys as vicious and brutal in their dominance interactions. It seems probable that an animal whose social behavior characteristically exhibits a considerable degree of aggressiveness would be likely, under hormonal effects which increase the general activity level, to manifest a proportionately greater degree of aggressive behavior. The results of this study show that the changes from base line behavior were not proportionate in <u>all</u> behaviors. The greatest increase occurred in aggressive behavior.

A further question then that the present study raises is: Under Enovid which suppresses ovulation, why do the females manifest more aggressive behavior than they do normally? The female rhesus is more aggressive during the peak of estrus (Carpenter, 1942) and the present investigation provided empirical evidence for this phenomenon in <u>speciosa</u>. Future research includes the possibility of determining the individual effects of each hormone contained in Enovid. A question still to be answered is: Which of the two hormones contained in Enovid evokes an increase in aggressive behavior, or is it the combination of the two?

Other research possibilities include administration of progestin only to females during the follicular phase of the reproductive cycle in order to determine if pregnancy can occur when the female is under the effects of progestin alone. At least one medical authority (Astwood, 1965) states that even if ovulation is not suppressed, the effects on the genital tract of mucus secreted under progestin is inimical to conception. It is well-known from animal experimentation that the endometrium must be in just the right stage of development under estrogen and progestin for nidation to take place. The utilitarian implications of contraception which does not suppress ovulation are considerable, particularly since the issue has been raised recently as to the possible causes of increased multiple births since the advent of oral contraception. Two additional questions then are raised: What effect will progestin alone have on the ability to conceive? And, what effect will this hormone alone produce in the social behavior, particularly aggressive behavior, of the organism?

Subsidiary Observations

It was observed that while under Librium treatment the close, friendly interactions between the number one and number two female monkeys dropped out completely, concomitantly with the overall decrease in aggressive behavior. This observation lends additional credence to the earlier finding that aggression is positively related to friendliness. The number two female, prior to administration of Librium, appeared to be favored by the number one female. When in the same cage, these two usually stayed close together whether sitting or moving about. The number two female often interferred actively when friendly behavior occurred between number one and number three females. Under Librium effects, the number two monkey simply sat alone and occasionally watched the number one and three females groom one another.

One significant and dramatic observation which has received only incidental mention up to this time occurred after the number one monkey had aggressively established her status with the other females and was then relatively secure in that the others very rarely challenged her number one position. It was at this precise time, when it was no longer necessary to defend her social position by direct aggression, that the number one monkey began a stereotyped, masochistic ritual which occurred only intermittently but nevertheless endured over the remainder of the study. The ritual frequently occurred when a lower status female took food and often immediately after the following sequence of interactions: the number one female would start a lunge toward another female, who would then present the anogenital region, whereupon the number one monkey would cease the lunge. The number one female would at this point begin spasmodic but rhythmical motor patterns of body jerks as she simultaneously clutched with her right hand at the hair on the side of the head. After several jerks at her hair, she would bring her hand to her mouth and begin biting at the wrist while clasping the left hand tightly with the right, as spasmodic body jerks continued. After a few weeks of this pattern another behavior developed in which she clutched at the labia as she bit at her wrist, or occasionally as she jerked at the hair on her head. Teeth marks were often visible on her wrist and arm. The segments of repetitive behavior in the series lasted for varying periods of time.

When the hair was completely removed from the right side of the head, she then denuded the left side; later she repeated the behavior with her ankles sometimes by clutching at the hair but occasionally by plucking it out. When lesser status females provided the appropriate submission cues, this appeared to inhibit a discharge of the aggression onto them and the number one female did not attack them. Aggression which is not expressed directly to an object, displaced, or sublimated is often turned inward against the self (Freud, 1915; Menninger, 1938).

The major findings of the present study, then, were that intraspecific aggression occurs with great frequency among female <u>speciosa</u>, particularly until a social rank is well-established. Once the hierarchy is settled aggression decreases significantly, although the amount of aggressive behavior may be both increased and decreased by Enovid and Librium treatment respectively. The social rank, however, remains remarkably stable over time. In the present colony aggressive behavior appeared to determine the relative social rank of females to a much greater extent than the temporal effects of estrus. An attempt will be made in the next section to relate these findings to certain pertinent theories of behavior, specifically to the theoretical aspects of aggression.

Pertinent Theories Related to Present Findings

The three major sources of theory concerning the nature of aggression were considered briefly in the introduction of this paper. These theories derive mainly from psychoanalytic theory, learning theory, and ethology. Although various important incompatabilities exist among these theories, they are not considered mutually exclusive. Some further consideration to several eclectic aspects of these theories may be useful to the purposes of the present study.

The instinct theorists contend that aggressive tendencies are unlearned responses to some excitation, although the exact form of these responses in man and other higher animals can be modified through learning. Some instinct theorists view aggression as a genetically determined behavior which is found universally among the members of a particular species and which appears in a way characteristic of the species at the proper time (without opportunity to learn) just as nest-building characteristic of their species occurs in birds reared in isolation. In this approach the view is held that aggression has to be elicited by an appropriate stimulus. Instincts are regarded as innately constructed stimulus-response patterns but the stimuli to aggression are not ever-present.

On the other hand, Freud and some of his followers see aggressive actions as impelled by constantly driving forces of energy which must be released either directly or indirectly in order to achieve reduction of tension which builds up in the organism. The validity of this mechanistic motivational model has been questioned by several investigations (Berlyne, 1960; Harlow, 1953; Olds & Milner, 1954) which demonstrate that an organism at times seeks external stimulation. Berkowitz (1962) concludes that there is no evidence that animals seek the complete elimination of excitation as postulated in the "death instinct" theory, but that they seem to desire an optimal level of stimulation, and perhaps occasional variation in this level also.

Scott (1958a) also concludes that there is no empirical reason to postulate an innate, constantly active tendency (arising within the body) for fighting in the sense of an internal driving force. "There is, however, an internal physiological mechanism which has only to be stimulated to produce fighting" (1958, p. 62).

The frustration-aggression hypothesis and formulation as explicated by learning theory views aggression as a learned response to frustration which results when there is interference with ongoing goal-directed activities. Criticisms have been leveled at this theory by authors who maintain that not every frustration increases aggressive behavior and that not all aggression is the result of frustration (Maslow, 1941). Further, it was charged that the importance of cognitive factors within the organism were neglected in this approach. Learning theory concepts, however, have been useful in the study of aggressive behavior.

In the present investigation, clearly, there were several factors which the subjects may have experienced as "frustration" and which may have increased the number of aggressive interactions. Such conditions as capture, removal from the natural group, decided limitations in space as opposed to the natural habitat, a colony of females rather than the usual sex distribution in a natural group, and a new integration with "strangers" not of the original colony (which in turn apparently necessitated an extremely rapid formation of social structure) all probably increased the aggressive interaction.

Nevertheless, other data obtained in the present study seem to indicate that learning theory does not account completely for all of the aggressive behavior observed. One of the more significant of these behaviors occurred when the infant speciosa male was two months old and began to voice threaten the experimenter. His mother, the number one female of the colony and the first female in the group to conceive, was isolated from the other females within the first hour of her delivery. She and her infant were housed indoors in a fairly spacious cage where she was a totally permissive mother for over five months. This female, the highest in social status in the colony, never threatened the experimenter and, in fact, often presented to her as a mark of respect and submission to her. Nor was she ever observed to voice threaten her infant. Yet after two months the infant began soft voice threats toward the experimenter. Later, he began to lipsmack toward her as his mother did rather than threaten. The infant's spontaneous aggressive behavior which appeared apparently without learning seems to lend support to the various ethological theories.

Lorenz views aggression as one of the drives which functions to preserve the individual and perpetuate the species. Aggression is considered basic to establishing territoriality, to selection of more vigorous mates, and to defense of progeny. Such functioning appears to be of value to survival. In those social animals where learning continues over a long period of development, aggression serves a function in establishing a social ranking among the animals of a group. Social status is particularly important in those species in which the young learn from the more experienced, higher ranking animals.

Implications for Mankind

In mankind, technological advances may occur with such rapidity as to upset the equilibrium of those social behavior patterns which have evolved culturally to inhibit direct expression of aggression. There seems little doubt that inhibitory mechanisms function less effectively when weapons can be used at a distance. In light of recent developments in regard to the tools of war, man's potentiality for destructiveness may outweigh his ability to control, "redirect", or "ritualize" aggression. History provides examples too numerous to cite of man's inhumanity to man from the beginning of recorded time. The tendencies of *Homo sapiens* toward destruction and even extinction of their own kind are well documented and need no further elaboration.

With the population explosion and over-crowded living conditions becoming even more congested, frustrations will most likely continue to increase. Within whichever theoretical light aggression is viewed, the results of man's aggressive acts, and his further potentiality with warfare, are enough to give one pause. Whether aggression is viewed as a learned response to frustration as learning theory suggests, or as an instinctual drive which must be expressed spontaneously as both Freud and Lorenz suggest, the implications for banning nuclear and atomic warfare are obvious. Perhaps, only by realizing and understanding his own potentiality for aggression can man take steps to protect himself.

"No beast is more savage than man when possessed with power answer-able to his rage." Plutarchs Lives

Additional Research Possibilities

Future research in the area of aggression might logically investigate mother-infant interaction by detailed observations over time in order to pinpoint when certain behaviors appear and under what circumstances, particularly the conditions under which aggressive-threat behavior is elicited. Again, the question is: "Who does what to whom, and in what order?" It may also be of value to isolate an infant from the mother in order to compare the incidence and amount of threat behavior with that of another infant reared by the natural mother.

As the colony increases kinship ties and their effect on social status may be further studied. Several investigators suggest that such ties may influence status. Koford (1963) finds that dominant mothers rear dominant males. Do they also rear dominant females? Is there differential treatment of male and female infants by the mother? Repeated observations of a large colony under conditions simulating the natural state, which are recorded on tape in code by a sophisticated observer may lead to a better understanding of the very complex social behavior of large groups.

Cross fostering of infants among various macaque species may be helpful in determining the effect of a different species mother on temperament and behavior. Comparative studies with other species of female macaques concerning the determinants of social status might be of considerable interest to some investigators and would help in pinpointing the difference among various species.

The factors of spacing, tolerance limit, and social learning which determine the balance of a natural group might be worked out under experimental conditions and would be of much utilitarian value to those engaged in establishing a breeding colony or in simply maintaining animals for the laboratory.

CHAPTER VIII

SUMMARY

Various writers have been concerned with the social organization of nonhuman primates and with the phenomenon of dominance as an index of social status in monkeys, particularly male monkeys. But equal attention has not been given to the determinants of social status in females. Among the macaques there is considerable evidence that aggressive behavior (including threat as well as overt fighting) is a determinant of social status in males, whereas it is not so clear which variables determine social status in females. A state of estrus, consort relationships, and kinship ties have been suggested as possible influences of social status in females. The present research was designed to observe, record, and measure the social interaction among a small colony of female macaques and to investigate the determinants of social status in females.

In the first part of the experiment four female stump-tailed macaques (<u>Macaca speciosa</u>) were introduced singly at intervals into an unfamiliar cage until all were integrated. The animals had not been caged together prior to this time, but were familiar with each other. They had lived for five months in adjoining cages and were rotated every other day during this period to allow for equal familiarization. Initial interactions of the first integration were highly aggressive and appeared to determine the relative social status of each individual in the colony. The linear social rank established during the initial 30-minute battle was remarkably stable over the following 16 months. Two additional females were later integrated into the colony by similar procedures. The new females assumed the two lowest positions in the social hierarchy. Ten-minute repeated observations of social interactions were made daily at a standardized time over the 14 months following the first integration and a measure of base line behavior obtained.

In a second part of the experiment three variables hypothesized as determinants of social status were manipulated experimentally: a state of estrus by administration of an oral contraceptive, olfactory stimuli of estrus by disguising olfactory components with oil of anise, and aggressive behavior by administration of a tranquilizing drug. Nevertheless, the linear social rank which was established initially remained invariant over the duration of the study. Under Enovid treatment, although social rank did not change, behavior differed significantly from the base line behavior obtained, with the largest increase occurring in the amount of aggressive behavior displayed. Submissive behavior also increased, showing a trend, whereas friendly behavior did not change significantly. The number one and number two monkeys were the large contributors to the increase in aggressive behavior. Aggression appears to be positively related to friendliness but negatively related to submissiveness. The male monkey when introduced to the females under Enovid treatment preferred the number one female in the social hierarchy as evidenced by number of mountings and attempted copulations. Further, olfactory cues denoting a state of estrus appear to have no causal relationship to social status in females. The male *speciosa* demonstrated that olfaction plays very little, if any, part in his ability to perceive a state of estrus in a female. Other sense modalities appear to be dominant over the sense of smell. Under Librium dosage linear social rank again remained stable; however, the total number of aggressive acts decreased in direct proportion to the amount of Librium administered. Under heavy dosages, a monkey imprinted to humans received only soft threat vocalizations although prior to Librium treatment she sustained severe physical wounds when introduced to the other females.

A third area of investigation was conducted concurrently and involved gathering as many data as were feasible concerning the physical properties and characteristics of the subjects. A survey was made of the sexual behavior and reproductive cycles. Length of menstrual cycles, duration of menses, time of ovulation, and length of gestation were studied systematically. Findings indicate that speciosa are very similar to rhesus in reproductive cycles, and are perhaps closer to rhesus than to nemestrina. Physical correlates indicating a state of estrus, body weight, and dentition were recorded.

The male was introduced periodically to the females en masse, and females at the peak of estrus were introduced to the male's cage for a period of time ranging from 30 minutes to 24 hours as conditions warranted. The male's differential treatment of the females was described as well as characteristic copulatory and orgasmic behavior. A discovery was made that a "tie" of the sexual organs occurred in the Macaca speciosa during copulations provided the male ejaculated. This phenomenon appears to be due to a pronounced flaring of the glans penis during ejaculation. Median post ejaculatory intromission time was from 11 to 22 seconds. The male appeared to accept the social rank of the females as established by the females, and generally preferred the females in that order despite their particular state of estrus. Although the male copulated with the females in estrus, he clearly preferred the number one female in social status as evidenced by number of copulations and time spent with her. The number one female appeared to lead a very active and aggressive role within the social structure of the colony and frequently influenced the male's sexual and social behavior.

It was concluded that social status among females is, at least in part, determined by aggressive behavior. The explanation was suggested that intraspecific aggression serves a similar function in both male and female *speciosa*, and that such functioning is of value to survival. Since aggression per se is basic to establishing territoriality, to selection of more vigorous mates for procreation, and to defense of young, an actively aggressive female contributes to survival of the species. Moreover, aggression achieves an important function for survival in the establishment of a social rank (Lorenz, 1966) because social status is of considerable consequence in animals where learning continues over a long period of development. In such animals the young learn from the higher ranking animals, both male and female.

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APPENDICES

Appendix A

Behavior categorized as Aggressive:

1. Lunge toward
2. Chase
3. Grab
4. Pinch or pull at
5. Bite
6. Slap
7. Voice threaten
8. Mount
9. Direct stare
10. Slack-jaw threat

Behavior categorized as Submissive:

1. Presents to
2. Runs from
3. Pulls away from
4. Moves from with apprehensive looks
5. Whimpers
6. Paces in agitation casting looks toward
7. Gives way to another animal in motion, or when food is presented.

Behavior defined as Friendly:

1. Grooms
2. Clasps or hugs hindquarters, dorsal embrace
3. Ventral embrace
4. Follows
5. Calls to
6. Sit together consistently, huddle, play together with no voice threats during tumbling or wrestling
7. Manipulation of genitalia of another monkey

NOTE: Going to water bottle, food box not included in the three categories of behavior above. Urination, defecation not counted as behaviors.

Appendix B

CHECKLIST*

1. Presents sexually
2. Mounts
3. Ventral embrace (face to face)
4. Sucks at or licks genital area
5. Puts finger into vagina
6. Grooms (state region)
7. Chases
8. Runs from
9. Pulls
10. Bites
11. Cuffs
12. Lunges toward
13. Moves toward
14. Moves away from
15. Voice threat "Hu, Hu"
16. Voice call (high, shrill)
17. Voice, infant sounds (soft, or whimper-like)
18. Stares at
19. Avoids looking at
20. Looks at apprehensively
21. Plays (any complex interaction which seems in this spirit)
22. Touch mouths together
23. Takes food or water

*a revision of Altmann's (1962) checklist