

FLOCK SOCIAL BEHAVIOR OF THE ORANGE-FRONTED PARAKEET

By JOHN WILLIAM HARDY

The epigamic and reproductive behavior of the Orange-fronted Parakeet (*Aratinga canicularis*) have been described in a previous paper (Hardy, Condor, 65, 1963:169-199). The present paper describes the flock social behavior as observed primarily in captive birds, but to a limited extent it is concerned with birds in the wild. Study upon which this paper is based was conducted by me in 1959 and 1960. I spent two weeks in July, 1959, in México, near Tuxtla Gutierrez, Chiapas, and Tehuantepec, Oaxaca, observing the postbreeding flocking habits of the species and the period from August, 1959, through May, 1960, observing captive birds.

METHODS

Birds in the wild were observed with field glasses and were not marked or collected. From 12 to 15 birds were housed in an indoor aviary 12 × 18 × 10 feet in height. The captives were color banded and, following study, were sexed, by laparotomy. Details of observational methods and times will be found in Hardy (*op. cit.*: 169-170).

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BEHAVIOR IN THE WILD

The parakeets were in flocks on the mountain slopes near Tuxtla Gutierrez in July. The vegetation was tropical deciduous forest in full leaf, showing considerable agricultural disturbance. Here, the birds were attracted to feed upon fruits of two common trees: a small, scrubby myrrh (*Bursera* sp.), bearing large numbers of small, fleshy, pod-like fruits, and large scattered figs (*Ficus* sp.), from 20 to 50 feet in height, and bearing small, fleshy, round fruits, ranging from unripe to ripe.

At Tehuantepec on the flat coastal plain, the parakeets were frequenting scrubbier vegetation called scrub-thorn. There, however, they spent diurnal hours in the plantation of mangos, coconut palms, and other tropical fruits adjacent to the town. The roosting places were trees and tree cacti on the low hillsides, one mile from the feeding place. The feeding place, although it appeared suitable for roosting, was always deserted by the birds about an hour before dusk, which came about 6:15 p.m. The birds then flew directly to the roosting place.

Activity of the parakeets began soon after sunrise, the birds flying from the roost and milling about noisily, but soon returning to the feeding grounds. By sunrise, the birds grew quiet and commenced feeding, and at this time they could be detected only by careful scrutiny at close range. They sat mainly in the tops of trees in small groups, feeding and calling in barely audible conversational notes.

When an observer or predator is discovered, a group of parakeets becomes quiet and ceases feeding. This pause in activity may spread to other groups in the tree.

If the observer or predator approaches, the birds that detect this call in alarm (see Hardy, *op. cit.*:180-181). Increased alarm causes the birds to fly, but only those groups will fly in which one or more members have detected the predator or observer. Those groups remaining in the tree usually give flock social calls (Hardy, *op. cit.*:180-181), which may induce the flying birds to return, if the intruder makes no further move. The small groups that act independently of one another are seemingly stable and possibly represent family parties. Groups larger than 12 to 15 birds seem always to represent artificial aggregations created by attraction of several small groups to a common food tree.

Feeding ordinarily continues for approximately one-half hour, after which the birds sun and sleep. These activities last but a few minutes, whereupon preening, mutual attentiveness between members of pairs (see Hardy, *op. cit.*:176-178), agonistic behavior, and some feeding occur. The increasing restlessness may end in flight of the entire assemblage, in small groups. The birds may continue in great activity, including flight, for up to one-half hour in this period following the first feeding (usually between 8:00 and 9:00 a.m.), and then proceed to settle again for feeding. The cycle of feeding, resting, agonism-attentiveness, and flight thus begins again and continues to be repeated throughout the day. From about 11:00 a.m. until midafternoon, the phases of the cycle are lengthened so that this period seems one of near inactivity. At this time, some birds feed and some rest in the food trees, but many retire to the thickest groves of trees away from the feeding areas to rest quietly for more than an hour at a time. The pace of the cycle again quickens in late afternoon, but it never reaches the height of morning activity.

It is apparent from this description that in the nonbreeding season, Orange-fronted Parakeets are highly social in small flocks, cyclic and regularly repetitive in phases of daily activity, engage in agonistic behavior that implies social order within the flocks, and maintain pair bonds throughout the year. These facts may serve as a partial basis for judging the biological value of the following account of behavior of the species in captivity.

BEHAVIOR IN CAPTIVITY

Remarks that follow are based on the interactions in a flock of 12 to 14 birds maintained throughout the period of study. Each bird was marked with a color band on either the right or left leg; thus, each individual is referred to by a letter system. The first letter, L or R, indicates whether the bird was banded on the left or right leg. The second and subsequent letters designate color of the band, thus, W for white, Bl for blue, Bk for black, R for red, Y for yellow, O for orange, and combinations such as WBk indicating a two-color band, white over black in this case.

When the parakeets were purchased in market places in México in July, 1959, all but three were adjudged young of the year, about to undergo the first postjuvinal molt. Approximately one-half the birds were taken from nests near Tuxtla Gutierrez by bird dealers. The remainder were from the vicinity of Tehuantepec. Thus, all were of the same race (*A. c. canicularis*), and in captivity they were not distinguishable by other than individual variation. All birds were in good health. LRW, LWR, RY, and LY were pinioned. LBkW, LWBl, and LYBl were judged to be more than a year old. LBkW, LY, RO, and RY were males. All others were females. Pinioned birds seemingly suffered socially only in limited choice of mates, which were other pinioned birds.

TABLE 1
 FREQUENCY OF OCCURRENCE OF BEHAVIORAL COMPONENTS IN AGONISTIC BEHAVIOR*

1 Behavioral component	2 Wins (freq.) $\frac{N}{631}$	3 Losses (freq.) $\frac{N}{19}$	4 Ties (freq.) $\frac{N}{54}$	5 $\frac{WLT}{704}$
Turn-toward	631 (1.00)	19 (1.00)	54 (1.00)	1.00
Head up, Head out	532 (0.85)	17 (0.90)	51 (0.96)	0.86
Gape	495 (0.78)	9 (0.47)	49 (0.91)	0.79
Peck	310 (0.49)	4 (0.21)	24 (0.44)	0.48
Slow advance	55 (0.09)	0 (0.00)	0 (0.00)	0.08
Chase	14 (0.02)	0 (0.00)	0 (0.00)	0.02
Rush	65 (0.10)	1 (0.05)	1 (0.02)	0.10
Flight supplantation	90 (0.14)	0 (0.00)	0 (0.00)	0.13
Greeting bow	17 (0.03)	1 (0.05)	0 (0.00)	0.03
Wing-flap	3 (0.01)	0 (0.00)	0 (0.00)	0.004
Bill-spar	3 (0.01)	0 (0.00)	13 (0.24)	0.02
Head-wave	31 (0.05)	1 (0.05)	5 (0.09)	0.05
Head-waggle	5 (0.01)	0 (0.00)	2 (0.04)	0.01
Pupil-flex	3 (0.005)	1 (0.05)	0 (0.00)	0.01
Inflected whistle	1 (0.002)	0 (0.00)	0 (0.00)	0.001
Popping	2 (0.003)	0 (0.00)	0 (0.00)	0.001
Perch-bite	12 (0.02)	2 (0.00)	0 (0.00)	0.02

* Columns 2, 3, and 4 give number (N) of recorded occurrence in wins, losses, and ties and frequency of occurrence in wins, losses, and ties for each component. Column 5 shows the observed frequency of each component (WLT) in the total number of threats recorded (704).

AGGRESSIVE COMPONENTS OF AGONISTIC BEHAVIOR

In the Orange-fronted Parakeet, a threat or aggressive act is composed of one or more components. These components, which include postures, movements, and positions, differ in their intimidatory effectiveness or "valence." Valence is correlated with the relative proportion of tendencies to attack or flee implicit in these components. These aggressive components, to be described beyond, are characterized by having a dominating tendency to attack. They will be discussed in ascending order of intimidatory effectiveness. The aggressive components which form a threat display when two or more of them are expressed sequentially are not only of different valence but characteristically occur in a display in the same order. Those of weaker effect are seral components which are seldom effectively intimidating without further stronger acts. Those of stronger effect are terminal in the series, seldom failing in intimidatory function and almost always preceded by typically seral components of aggression. The aggressive display is, thus, partly stereotyped, but it may be terminated at any point in the series of components when intimidation has been accomplished. Stereotypy is therefore seen only in the order of aggressive components, not in duration and unity of the phases of the display. Tables 1 and 2 indicate the frequency and context characteristic of each aggressive component plus other less aggressive or ambivalent components of agonistic behavior to be discussed in the following section.

Turn-toward.—The first component in threat or aggression is the Turn-toward (fig. 1B) in which the aggressive parrot directs its anterior toward the opponent. Of course, any bird may direct itself without threat intention toward a nearby fellow, but the casual nature of turning toward a fellow in nonaggressive behavior is

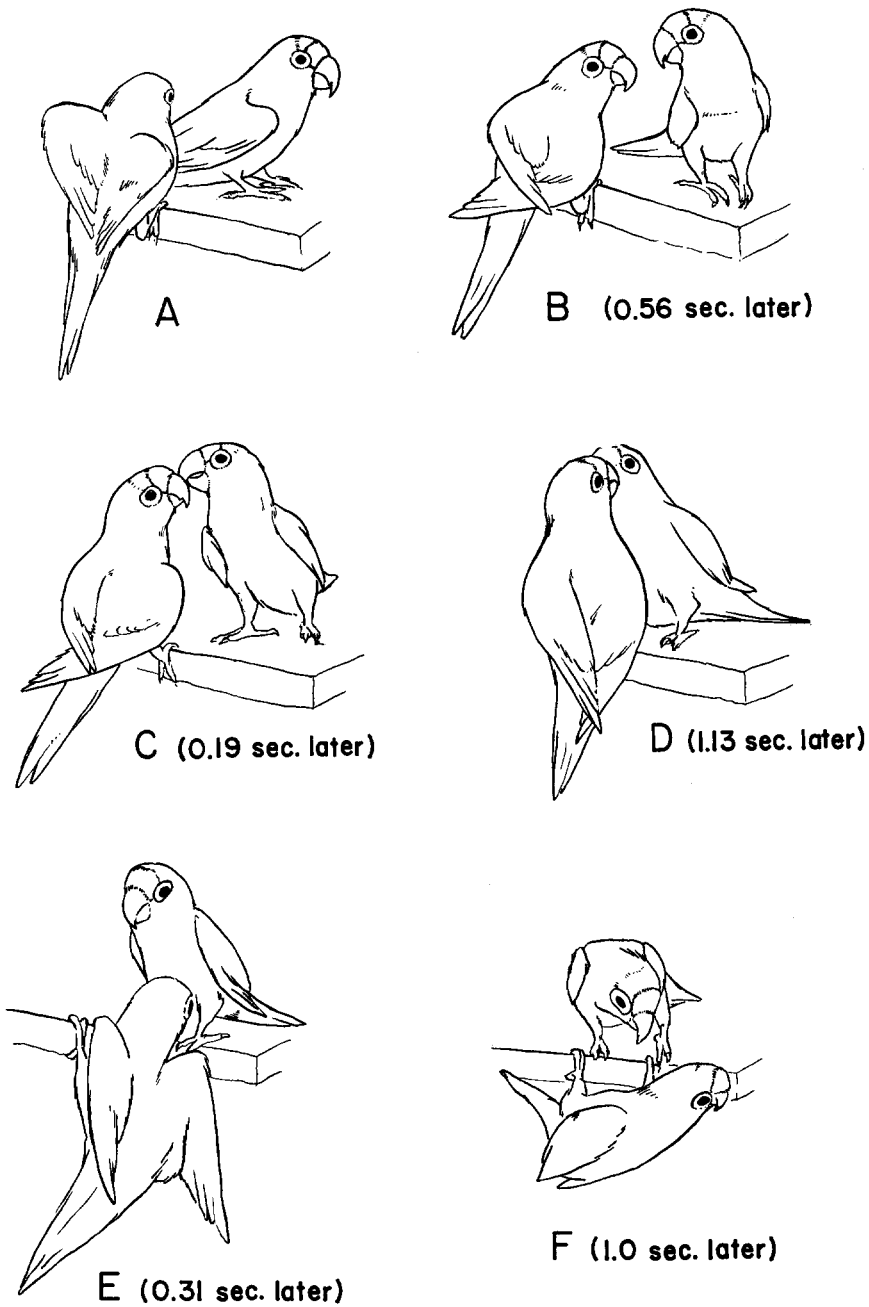


Fig. 1. An agonistic encounter between two Orange-fronted Parakeets at a feeding table. These drawings were copied from selected motion picture frames and depict stages of a complete aggressive act. A, bird on left lands at feeding table; B, bird on right begins the Turn-toward; C, bird on left hesitates and begins to fall backward as bird on right extends head upward; D, bird on right begins lunge forward; E, F, attacker flutters backward and is successfully intimidated. Total time of act 3.19 seconds.

unlike the positive, alert action meant to be defined here. The Turn-toward is formalized, embodying an aspect of stiffness, exaggerated quickness, and readiness. The plumage is appressed and the pupils widely dilated. The Turn-toward is the weakest act that can alone successfully intimidate a fellow parrot; it is considered a true threat component and not an act that precedes the agonistic series. In this study no failures of the Turn-toward to accomplish intimidation were recorded, because a bird that loses after initiating threat by the Turn-toward always proceeds to at least one other component before fleeing.

Head-extension (upward or outward).—The extension of the head (fig. 1C) is typically the second act of the threat display pattern. Extension upward or outward are here grouped together because of their seemingly equal valence and approximately equal frequency of use. Note that for this display, as well as for most displays listed in tables 1 and 2, the success frequency is high, placing great value on initial "intent" of the bird that is first aggressive in an encounter.

I judge the extension of the head outward rather than upward to be an indication of a more aggressive attitude, since a bird which threatens other birds too distant to be actual competitors is more aggressively inclined than one which threatens (by head up) when an opponent has already encroached on feeding territory or actually come in contact with the aggressor. It is necessary to distinguish between an aggressive Head-extension and the avoidance Head-extension, which is given with the plumage of the head fluffed greatly and culminates with a turning away (from the opponent) of the head.

Head-extension signifies readiness to act in all of these cases. The head extended outward allows the opponent to be reached with the beak while at the same time it does not offer much of a target for counter aggression. The head extended upward in the presence of a nearby opponent does offer vulnerable target area for counter-aggression that can be lessened only by the aggressor backing away, which action often elicits chase. However, an opponent that has approached closely in the first place without threatening is usually in normal posture. The advantages of being fully erect (head extended upward) with the head towering over the opponent and offering an advantage for delivering powerful pecks outweigh the disadvantage of vulnerability of the exposed body in this case. Note in table 1 that components in the sequence from this point onward are with increasing frequency terminal in intimidation. Note also that types of Head-extension are referred to in tables as "head up" and "head out" in interests of space.

Gaping.—The wide opening of the gape is characteristic of threat display in many kinds of birds and in other vertebrates, such as snakes and mammals. No specializations in gape color or bill color are to be found in the Orange-fronted Parakeet to accentuate the gaping behavior. Thus, the act of gaping is the effective device in this species. It is still a typically seral component, however, owing its occurrence as an ultimate component in the pattern to the occasionally low threshold of the opponent and not to physical force such as that characteristic of the following components.

The bite of an Orange-fronted Parakeet is powerful. Gaping by a parrot in threat indicates readiness to inflict such a bite upon the opponent; thus, a parrot that extends its head in retaliation to an aggressor and then gapes is not likely to flee. This may cause waning of attack tendencies in the aggressor and may intimidate the latter. One that extends the head upward but does not gape will almost certainly forthwith be attacked and put to flight.

Peck or lunge.—These two actions (fig. 1E, F) are grouped together because they represent different intensities of the same basic component. To a certain extent, again, the occurrence of one instead of the other of these two is based on position of the opponent. But here the intensity of the agonistic tendency is obviously more important. A lunge throws the whole body forward, whereas the peck involves only movement of the gaping beak, head, and neck. Lunging or pecking always are preceded and usually accompanied by gaping. They occur in 48 per cent of all threat display in the captive flock and are the most frequent final components. Pecking and lunging are the only components in the series just described that can inflict physical harm to the opponent. However, even in pecking or lunging, the value to the aggressor is not in this physical damage but rather in the potential of such damage implicit in the severity of the threat.

The components just discussed are the most common form of threat when aggressive tendency far outweighs any other tendency in the Orange-fronted Parakeet. Such a combination occurred in 535 of 704 aggressive encounters (which include some encounters in which mobility in the form of the Rush, Chase, or Slow Advance, discussed beyond, were employed: see table 2). Of these 535, 487 were wins, 15 were losses, and 33 were ties. It will be seen from table 2 that when more ambivalent components entered into threat, the win frequency for the initiator of aggression decreased, while losses and especially ties increased; thus, with ambivalent components included, there were 54 wins, 4 losses, and 21 ties. This still emphasizes the importance of original aggressive intent and initiation of threat, but indicates that ambivalence is correlated with weakening of the aggressive tendency.

ATTACK-MOBILITY COMPONENTS

Most threats in these parrots are accomplished while the aggressor remains stationary, seldom advancing more than an inch in any direction in the process of intimidating an opponent. However, the attack-tendency is occasionally so great that the aggressor moves over a distance of several feet to reach the opponent, continues an assault after the opponent has commenced to flee, or follows or approaches the opponent in order to threaten again from a standing position. These forms of mobility reflect different attitudes on the part of a parrot and are classed here as the Rush, the Chase, and the Slow Advance, respectively.

Run-rush.—There are two types of Rush: Run-rush and Flight-rush. In the Run-rush, the aggressive parrot must be standing on a large limb or on the ground. It then runs at the opponent, most often with head extended outward and bill agape. The wings sometimes are raised slightly, probably in the interest of maintaining balance. Upon reaching the opponent, the aggressor stops suddenly and performs one of several forms of threat display. The Run-rush compared to the Chase or Slow Advance is a frequently used method of carrying the threat to the opponent. It should also be emphasized that all three methods of mobilizing threat display without flight are more commonly employed in parrots than in other kinds of birds. Parrots, unless frightened or travelling a long distance, seemingly prefer walking and climbing about to flying short distances in a tree. I do not know what threat importance the Rush possesses, since it is always terminated with Gaping, Head-extension, or Pecking, but it is a fact that opponents commence to scatter long before termination of the Run-rush and that the terminal threat may thus be anticlimactic.

TABLE 2

THE BEHAVIORAL COMPONENTS OF INITIAL AGGRESSIONS OCCURRING IN AGONISTIC ENCOUNTER*

Serial threat	Won	Lost	Tied
Head up	20	0	2
Head out	15	7	0
Head up, gape	61	1	6
Head out, gape	98	3	4
Head up, gape, peck (lunge)	112	0	12
Head out, gape, peck (lunge)	181	4	9
(Interspersed with above are: slow advance, chase, rush, flap-wings, crouch)	—	—	—
Totals	487	15	33
Flight supplantation	90	0	0
Totals	577	15	33
Head out, gape, peck, <i>bill spar</i>	1	0	0
Head out, <i>bill spar</i> , gape, peck	1	0	0
Head up, <i>wave</i> , gape, peck	12	0	1
Head up, <i>wave</i> , <i>waggle</i> , gape, peck	3	0	2
Head up, <i>bill snap</i>	2	0	0
Head up, <i>pupil flex</i>	0	1	0
Head up, <i>pupil flex-inflected whistle</i>	1	0	0
Popping, <i>pupil flex</i> , head up	2	0	0
Head out, rush, head up, <i>bill spar</i> , <i>wave</i> , <i>waggle</i>	1	0	0
Head up, gape, <i>claw</i>	1	0	0
Head up, gape, <i>bill spar</i>	0	0	6
Head up, gape, <i>waggle</i>	1	0	3
Head up, gape, <i>wave</i>	10	1	2
Head up, <i>wave</i> , gape, <i>claw</i>	2	0	0
Head up, <i>wave</i> , gape, <i>rush</i>	2	0	0
Head up, <i>wave</i> , gape, <i>bow</i>	1	0	0
<i>Bow</i> , head up, gape, chase	7	0	0
Head out, gape, <i>push</i>	1	0	0
Head out, gape, <i>bill spar</i>	0	0	2
Head out, <i>bill spar</i> , gape	0	0	5
Head out, chase, gape, <i>push</i>	1	0	0
<i>Perch-bite</i> , <i>back feathers raised</i> , <i>claw</i>	1	0	0
<i>Perch-bite</i>	4	2	0
Totals	54	4	21
Grand totals	631	19	54

* Turn-toward omitted since it occurs in all encounters.
 Italicized components indicate conflicting tendencies or ambivalence.

Flight-rush.—This is similar to the Run-rush but much rarer. Flight supplantation in birds is rather common, but almost all the records of it in my captive flock occurred in two days between two birds, one of which supplanted the other more than 50 times. Why this behavior should have suddenly been so prevalent between these two individuals and almost nonexistent at other times I do not know.

Chase.—The Chase differs from the Rush in being taken at a slower gait and involving actual pursuit of a moving opponent. Whereas the Rush seems to be undertaken merely to bring the aggressor to the opponent, the Chase is often insti-

tuted after other components of threat have put the opponent to flight; thus, the Chase is often employed against an opponent that has been intimidated several times just previously but which persists in returning to the vicinity of the aggressive parrot. The Chase was observed less often than the Rush but more often than the Slow Advance. Like the Rush, the Chase is best employed on the ground or on a large limb of a tree, but it is not so dependent on a flat surface as the Run-rush. The Chase has no flight counterpart of the Flight-rush and is almost always performed with the head down and wings folded.

Slow Advance.—In the Slow Advance, the aggressive bird walks toward the opponent, with an attitude marked by other components of aggression—usually the head extended upward or outward, sometimes gaping or pecking. Like the Chase, the Slow Advance may be employed toward an opponent which persistently returns to the feeding or resting area of the aggressor. The Slow Advance is often used against opponents that have already been encouraged to flee by other kinds of threat, but just as a bird that is clearly dominant to another individual may put the latter to flight merely by turning toward and extending the head, a clearly dominant bird may also cause a socially inferior bird to flee by merely employing the Slow Advance with head extended. The Slow Advance is the least frequently employed of the three means of carrying the threat to the opponent and is the lowest of these in threat value.

STABILIZING COMPONENTS

There are two behavioral components, Crouching and Wing-flapping, which subserve agonistic intent but are frequently associated with other types of behavior.

Crouching.—In Crouching, the head is extended outward and the body held low, the breast touching the perch, while the wings may be slightly raised. From this position the aggressive bird gapes and pecks or lunges. Crouching is typically assumed by two opposing birds neither one of which is clearly dominating the situation. A bird that is crouching seldom flees but must actively be dispensed with by an opponent. The crouching position is characteristic of high-intensity aggressive tendency, indicating an unwillingness to fly and utmost readiness to attack in the most powerful manner. Crouching might be considered the most exaggerated form of the Head-extension display. Crouching in a nonagonistic act is an intention movement of approach; in such a context the wings are not only extended but waved or fluttered. In agonism, crouching is a position well suited for the launching or catapulting of attack, while at the same time it provides a sturdy stance valuable in protecting the bird from blows and in withstanding attack.

Wing-flapping.—Wing movement is employed in balancing and aggression. Wing-flapping is sometimes an intention movement of flight. It is also characteristic of high-intensity aggression, where the flapping motion is rapid and powerful. In both types of behavior it helps maintain balance. It is in the aggressive context that Wing-flapping seems valuable as an intimidatory component and is sometimes associated with actual fighting contact with the opponent: the aggressor pecks sharply and beats with the wings against the victim.

AMBIVALENT COMPONENTS OF AGONISTIC PATTERNS

Probably most of the components discussed previously under threat and aggression are ambivalent, but in them the aggressive tendency far outweighs other tendencies. In the present category are included those components in which the tendencies to attack, flee, and to perform other movements are in dynamic balance. These

ambivalent components in the context of aggressive behavior signal the waning of the attack tendency in the aggressor and when they are expressed by the opponent encourage appeasement. Thus, in two individuals between which the relationship is equivocal, aggression by bird A may lead to appeasement behavior by bird B, the latter causing thereby a decrease in intensity of attack in the first bird (with a concomitant display of these ambivalent components) and subsequent displaced epigamic mutual attention of several kinds. In two birds between which the relationship is definitely hostile, the socially inferior of the two may often escape intimidation or avoid fleeing by invoking ambivalent behavior through appeasement behavior.

While some appeasive behavior is ambivalent, some of it reflects instead a tendency to behave in an epigamic manner as the subordinate bird of mutually attentive display, or in a feeding or sleeping fashion. Thus, there are several classes of behavioral components present in an agonistic context: wholly aggressive, ambivalent, and appeasive, the last including displaced components of courtship and activities such as sleeping or feeding.

Bowing.—Bowing rarely causes another parrot to flee. It is characteristic of a bird that is in a highly ambivalent state. Bowing may be combined with feeding, in which case the bird feeds or picks up food with head down, suddenly extends the head upward, bows, raises the head, and so on. A group of birds feeding in close quarters may all indulge in this weak form of the bow for several minutes and show no additional signs of growing tension.

Bowing is a method of maintaining individual distance while another activity (in the cited example, foraging) is conducted. A socially inferior bird feeding near its superior, which continually Bows and Head-ups while feeding, will jump back or veer to the side with each bow of the superior bird. When crowding becomes severe, the bowing becomes exaggerated, so that the feeding component becomes a mere stabbing at the ground or swiping at seed in a tray followed by a swift Head-up, then another Bow. Or the lower mandible may be placed against the perch or ground rather deliberately, before the head is brought swiftly upward.

Bow-pecking.—The bowing component here is the same as above and is combined with sharp to weak pecking at the feathers of the opponent or the partner. The behavior may erupt further to aggression or subside to preening attentiveness.

Head-wagging, bill-wiping, bill-rubbing, perch-biting, popping, bill-vibrating, bill-snapping, crane-peering, malar-puffing, pupil-flexing and inflected whistling, bill-sparring, and bill-grasping.—I have previously described these components (Hardy, *op. cit.*:171–174) in a discussion of epigamic behavior. Although all are evidence of ambivalence, they are seral components preceding courtship feeding. When they occur in agonism they are evidence of thwarted aggression and/or response toward appeasement behavior that has been elicited by aggression.

Greeting bow.—This behavior indicates ambivalence concerning whether or not to approach another bird. The wrists are slightly raised and the wings barely to fully extended and quivered slightly. The head is held forward and downward slightly, while the tail is downward and not spread. An accompanying vocalization is uttered: r-r-r-r-r-r-r-r given quietly and seemingly with appeasive connotation. In the field when my camp had two cages of parakeets purchased in the market places, the wild flocks of the species would settle into trees nearby to answer calls and seek their source. At these times one could always hear this vocalization and see the greeting display.

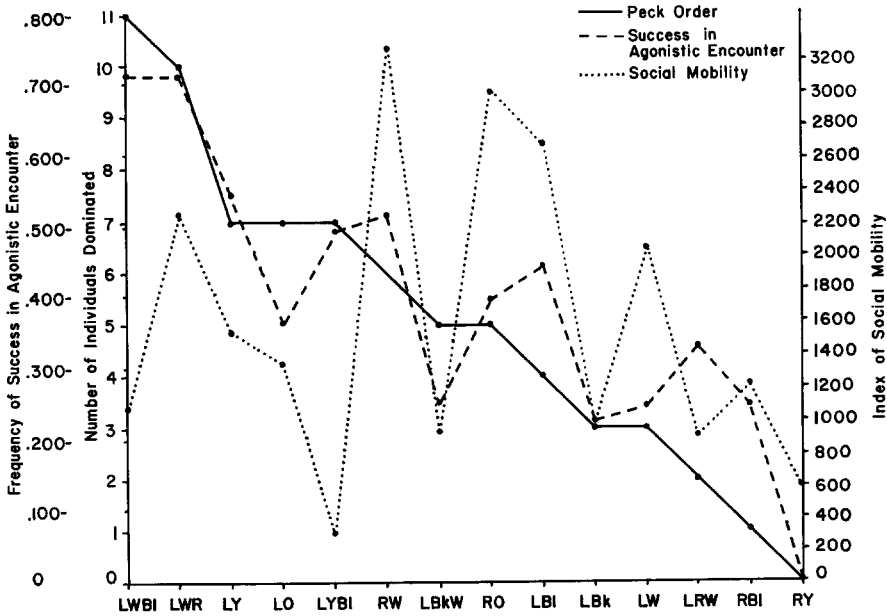


Fig. 2. The relationship between three social characteristics in the flock behavior of captive Orange-fronted Parakeets. Peck order and success in agonistic encounter seem directly correlated, but neither seems related to social mobility.

FUNCTIONS OF AGONISTIC BEHAVIOR

Between August 1, 1959, and May 31, 1960, I recorded 1035 agonistic encounters in which one parrot was dominant and one was subordinate. In addition 352 encounters were equivocal, for a total of 1387 agonistic encounters. In many of these the participants were not identified nor was the form of the threat noted; hence, there is a disparity between these figures and those in the tables. These records were made in approximately 325 hours of observation in which attention was directed specifically toward recording such data.

The peck order.—In the Orange-fronted Parakeet, peck order is maintained by peck dominance, in which the relationship between any two parrots may be judged on the basis of which bird has won the majority of encounters between the two. There may for example be 20 encounters between two individuals within a month's time, with a result that one bird wins 13 times and the other 7 times. Only the several most dominant and subordinate members of the flock are readily recognizable as such without knowledge of their performance in the past.

Table 3 illustrates the peck order of the flock when it was composed of 14 birds in the first five months. Table 4 illustrates the peck order in the succeeding five month period. Note the large number of triangles of dominance which indicates the complexity of the order.

Some individuals in the flock infrequently or never met in encounter, showing that even after 10 months, integration of the flock's members had not fully occurred; in other words, that two or three subgroups were largely independent in the aviary. Some birds had no encounters with each other because they were paired with each

TABLE 3
 PECK-ORDER RELATIONS IN A FLOCK OF ORANGE-FRONTED PARAKEETS BASED
 ON PECK-DOMINANCE FROM AUGUST 1 THROUGH DECEMBER 31, 1959

		LWBI	LWR	LY	LO	LYBI	RW	LBkW	RO	LBI	LBk	LW	LRW	RBI	RY
LWBI	pecks 11:	*1	X	X	X	X	X		X	X		X	X	X	X
LWR	10:		*	X	X		X		X	X	X	X	X	X	X
LY	7:			*			X		X	X	X	X	X		X
LO	7:				*		X	X	X	X		X	0 ²	X	X
LYBI	6:					*	X	X	X	0	X		X	X	
RW	6:						*	X		X	X	X		X	X
LBkW	5:	X						*	X		X		X	X	
RO	5:						X		*		X	X	X	0	X
LBI	4:						0			X	*	X		X	X
LBk	3:				X						*	X	0		X
LW	3:					X				0		*	X		X
LRW	2:				0		X			X	0		*		0
RBI	1:			0					0			X	0	*	
RY	1:													X	*

¹ * means same bird on X and Y axes.

² 0 means tied in number of successes.

other (for example RY and LRW). This fact strongly contributed to the complexity of social order; a bird that is weak in agonistic encounter may be a partner to one which is unusually strong. When this occurs, the weak bird may profit greatly in agonistic encounter because of the help it receives from the mere presence and sometimes the assistance of its partner in struggles. In addition, two closely paired birds may be mutually helpful to each other in this respect and become markedly lower in the peck order when either partner is removed from the flock. LWR and LY and LBI and LW were such pairs. At one time, the computed record of LY during the preceding month of observation had been 25 wins and 6 losses. I then removed LWR to another cage for two hours. LY promptly lost six successive encounters and won none. Moreover LY seemed "lost" without its mate during this time in circumstances involving aggressive action. I had thought LWR to be the more aggressive of this pair and predicted that when LY was removed from the flock, LWR would still be a successful bird. The result was, however, that although LWR did function more successfully than LY, it was still shy and lost two encounters, while avoiding other birds by leaving the food tray or favorite perch at their approach.

There is a general correlation between position in the peck order and win frequency. This is evident in data for the first five months of the study when LWBI, LWR, and LY are first, second, and third in both categories, while the last three or four birds in the peck order are equally low in frequency of wins. In the second five months the correlation is not so good but still evident. There is much less agreement between total number of encounters and position in the peck order or success, indicating that frequency of entry into social intercourse with other birds often has nothing to do with the frequency with which a bird is intimidated. It can be seen, however, that when a bird loses with great frequency (for example, RY in the first five months) it is less likely to be social. At least a moderate ability to succeed in agonistic encounter is thus seemingly important to encourage socialization.

TABLE 4

PECK-ORDER RELATIONSHIPS IN A FLOCK OF ORANGE-FRONTED PARAKEETS
 BASED ON PECK-DOMINANCE FROM JANUARY 1 THROUGH MAY 31, 1960

		LBkW	LWBI	LYBI	LRW	LWR	LY	LO	RW	RO	LBI	RBI	RY	LW
LBkW	pecks 8:	* ¹	X	X		X		X	X		X	X		X
LWBI	7:		*	X	X			X	X	0 ²	0	X	X	X
LYBI	7:			*	X			X	X	X	X	X	0	X
LRW	6:				*	X	X			X	X	X		X
LWR	5:					*	X	X	X			0	X	X
LY	5:		X	X			*			X		X	X	X
LO	5:				X			*			X	0	X	X
RW	5:				X		X	X	*			X	X	
RO	5:		0			0		X	X	*	X		X	X
LBI	4:		0			X	X		X		*		0	X
RBI	3:					0		0		X	X	*		X
RY	2:			0							0	X	*	X
LW	1:								X					*

¹ * means same bird on X and Y axes.

² 0 means tied in number of successes.

Aggressive encounters are most frequent at the time of feeding, next most frequent at the times of bathing or seeking of resting or roosting places. It is at these times that the birds crowd together, all attempting to do the same thing first or simultaneously.

Several feeding places existed in the aviary, but two of these were usually favored over the others. Only one sizeable bathing place existed, while the favorite resting place was three feet below a large light bulb on the roof of the favored food container. On the rare days when the flock did not perform diurnal activities as a group, but instead the individuals or pairs went about such behavior separately, there was almost no aggressive encounter.

The frequency of agonistic encounter is directly correlated with the degree to which the flock behaves as a unit. Moreover, this correlation indicates that aggressive encounter is rarely the result of one bird seeking out another in order to threaten it. Agonism results from the tendency of a bird to assert its command of a position or of an area around a position in which it is attempting to function.

Occasionally a bird will seek out another bird and threaten it. This usually occurs after an encounter that has resulted in the opponent fleeing a short distance. The aggressor waits momentarily and then follows. On two successive days (November 11 and 12, 1959) RW repeatedly flight-supplanted LBkW a total of 47 times the first day and 5 additional times the following morning. Otherwise these two birds seldom encountered each other and never did again in this same manner.

Peck order is difficult to discern in the field in the Orange-fronted Parakeet, although it certainly is maintained if we may judge by the frequency with which aggressive encounter is observable. In the field, as in the aviary, the flock behaves as a unit, its members feeding, flying, and resting together. It is possible that lack of spatial restriction imposed on the wild flock would cause aggressive encounter and peck order to be below the level of expression seen in captive counterparts. However, a wild flock not only may feed in a single tree, but it tends to concentrate its efforts in one small locality even though food may be distributed over the whole tree. Thus, the advantages of greater space in the wild are partly obviated, the birds

TABLE 5
RECORD OF AGONISTIC ENCOUNTER FROM AUGUST THROUGH DECEMBER, 1959

Bird	Won	Lost	Tied	Total	Individuals encountered at least once	Success against individuals encountered*		
						1-5	6-10	11-up
LWBl- ♀	61	16	7	84	13	0.94(7)**	1.00(2)	0.67(3)
LWR- ♂	91	19	15	125	12	0.86(4)	0.94(2)	0.80(5)
LY- ♀	41	20	12	73	11	0.43(5)	0.76(3)	0.73(2)
LO- ♀	31	31	19	81	12	0.72(6)	0.50(3)	0.32(2)
LYBl- ♀	10	7	3	20	10	0.59(9)	—	—
RW- ♀	115	79	24	218	13	0.50(4)	0.47(3)	0.60(6)
LBkW- ♂	23	69	4	96	8	0.53(6)	—	0.19(2)
RO- ♂	82	95	26	203	13	0.00(3)	0.52(3)	0.47(7)
LBl- ♀	76	64	24	164	12	0.41(5)	0.78(1)	0.55(6)
LBk- ?	15	41	11	67	13	0.64(6)	0.18(4)	0.18(1)
LW- ♀	31	77	14	122	12	0.46(7)	0.24(2)	0.24(3)
LRW- ♂	17	23	9	49	12	0.43(9)	0.40(3)	—
RBl- ♀	20	46	15	81	13	0.33(7)	0.23(2)	0.31(3)
RY- ♀	5	31	5	41	10	0.08(8)	0.25(2)	—
Totals	618	618	188	1424 ¹	141 ²	11.79 ²		

* Wins or losses involving collaboration of two or more birds not included here.

** Number in parentheses indicates number of birds met in each frequency.

¹ Average number encounters per bird.

² Average number birds encountered by another bird.

by their own choosing being almost as crowded as in the aviary. The same applies for all activities of the flock outside the breeding season.

The behavioral characteristics that accompany and are correlated with a dominant or subordinate attitude in an individual parakeet exhibit no definite correlation with superficial physical appearance of well being or with size, ability to fly, or other obvious physical characteristics. I have no data concerning correlation of age and social position.

It has been impossible so far in this study to determine the relationship of sex to peck order and to intrapair behavior. This has been so because captivity has seemingly altered mechanisms of sex recognition and pairing. Contributing to this was a disproportionate number of females to males (nine females to four males, with one bird, LBk, undetermined). Among relatively constant partners, RO-LBl, LBkW-LWBl and LRW-RY were the only heterosexual ones. The RO-LBl relationship was further complicated however by a frequent homosexual relationship between LBl and LW, LBl and RBl, and by occasional other combinations between these four birds. The LWBl-LBkW pair was actually part of a trio, as previously mentioned, since a close relationship existed between females LWBl and LYBl. Other pairs were homosexual female associations as follows: RBl-LBk, RW-LO.

In the following list the first bird of a pair normally dominated its partner, but where the two are separated by an asterisk, the relationship was highly variable: LBl-LW, LWBl*LBkW, LWBl-LYBl, LRW-RY, RW-LO, LBl*RBl, LBl*RO, RBl-LBk, LWR-LY.

Because many of these pairs were homosexual, no conclusions can be drawn as to the difference in role of each sex.

With only four males in the flock, it would be expected that each would find little competition for a female partner. The fact that none of the four held the

TABLE 6
RECORD OF AGONISTIC ENCOUNTER FROM JANUARY THROUGH MAY, 1960

Bird	Won	Lost	Tied	Total	Individuals encountered at least once	Success against individuals encountered*		
						1-5	6-10	11-up
LWBl-♀	32	8	4	44	11	0.76(9)**	0.71(1)	0.92(1)
LWR-♂	37	16	5	58	9	0.64(6)	0.67(1)	0.74(2)
LY-♀	24	14	7	45	10	0.45(8)	-	0.73(2)
LO-♀	15	33	8	56	12	0.47(8)	0.00(1)	0.33(2)
LYBl-♀	39	21	0	60	11	0.72(6)	0.86(4)	0.08(1)
RW-♀	28	30	5	63	12	0.45(8)	0.64(3)	0.27(1)
LBkW-♂	26	3	3	32	8	1.00(6)	0.64(2)	-
RO-♂	91	47	47	185	11	0.43(2)	0.72(1)	0.57(8)
LBl-♀	26	41	29	96	12	0.45(6)	0.35(3)	0.39(3)
LW-♀	22	87	15	124	12	0.00(2)	0.17(3)	0.29(7)
LRW-♂	27	26	13	66	12	0.29(7)	0.67(4)	0.71(1)
RBl-♀	34	60	17	111	12	0.17(7)	0.00(2)	0.61(3)
RY-♀	16	24	10	50	10	0.30(8)	0.83(1)	0.37(1)
LBk***-?	0	7	1	8	7	0.00(7)	-	-
Totals	417	417	164	13)998	13)142	76.76 ¹	10.92 ²	

* Wins or losses involving collaboration of two or more birds not included here.

** Number in parentheses indicates number of birds met in each frequency.

*** LBk does not enter into calculations beyond column 6.

¹ Average number encounters per bird.

² Average number birds encountered by another bird.

exclusive partnership of a female suggests that other factors were interfering. Underlying all of these was confinement in an aviary.

In a frequent triangle-quadrangle relationship among LBl, LW, RO, and RBl, RO and RBl competed with LW for LBl's attention. Both RO and RBl easily dominated LW, but each also attempted to dominate LBl; LBl, although it occasionally accepted the attention of RO or RBl, also easily dominated LW, which in turn weakly defended against RO or RBl. The complicated intragroup behavior that occurred each day among these four birds, usually ended with LBl and LW being mutually attentive most often, while RO and RBl were thwarted. LWBl-LBkW-LYBl formed another social group. LWBl dominated LBkW and LYBl. LBkW also dominated LYBl and unlike LYBl resisted strong aggressive or epigamic behavior of LWBl with occasionally strong aggression. Their relationship maintained a kind of dynamic balance, the group remaining a trio because of ties between LWBl and the other two, there being no attentiveness between LBkW and LYBl.

Of the four males present in the flock, two were nonfliers which may have effectively removed them as potential mates for any but flightless birds.

Social success.—Examination of tables 6 and 7 concerning relative and actual success in agonistic encounters for each bird indicates additional characteristics of aggressive success in the social interaction of the flock. Note that RY with the lowest win frequency in the flock was also the bird with the fewest encounters (discounting LBk which died early in the second five months). RY often avoided aggressive encounter and was a consistent loser. Toward the close of the first five months and throughout the second five, RY gradually became aggressive, attained good physical condition, as indicated by plumage condition and general demeanor, and seemed no longer shy of other birds. But RY's success as indicated by decisions in encounters

TABLE 7
SOCIAL MOBILITY IN THE FLOCK FROM AUGUST 1, 1959, THROUGH MAY 31, 1960

Bird	Total social encounters	Number of birds encountered	Index of social mobility
LWBI	139	13	1807
LWR	194	12	2328
LY	129	11	1419
LO	148	13	1924
LYBI	91	13	1183
RW	292	13	3796
LBkW	139	10	1390
RO	399	13	5187
LBI	271	13	3523
LBk	86	13	1118
LW	255	13	3315
LRW	126	13	1638
RBI	203	13	2639
RY	102	12	1224

did not improve, although it often exhibited strong aggressive or defensive actions. On the other hand LYBI was shy at first and like RY had a low frequency of encounters. But unlike RY, LYBI was still a moderately "successful" bird. Note how LYBI became a much more integrated member of the flock in the second five months, number of encounters increasing and success in these being somewhat higher. Similar integration of LBkW occurred.

In the column headed "Individuals encountered at least once" (tables 5, 6) note that most birds in the flock had met most of the other birds in agonistic encounter. Since a bird had met each bird it had encountered an average of about 9 times, complete integration was slowly being approached. I arbitrarily decided that frequent encounter between two birds in the time of observation during the five-month period could be said to have occurred if the two had met each other agonistically over 10 times.

There is no consistent trend of increasing or decreasing success of a bird correlated with its encounter with those birds which it has met in the three categories of frequency (final three columns of tables 5 and 6). Thus, failure to meet often in agonistic encounter may not indicate avoidance because of probability of being intimidated, nor does it indicate that a bird goes out of its way to make contact with individuals to which it is superior. The frequency with which certain birds associate is undoubtedly dependent upon factors other than agonistic success or peck order.

Social mobility.—As mentioned, I noted social subgroups within the flock of captive parakeets. Social contact can be measured not only by frequency of agonistic encounter but also by frequency of "amicable" association, including pair and partnership behavior. An index of social mobility was computed by multiplying the number of birds encountered by number of social encounters. Social encounters included the sum of agonistic encounters and the value of 11 was arbitrarily assigned for each bird that a given individual was known to associate with frequently in non-agonistic ways. Table 7 summarizes these data.

In the flock of 14 parakeets there were three subgroups (see table 8), one large one (LO, LWR, LY, RW, LBI, RO, LW, RBI, and LBk), and two smaller ones (LRW, RY) (LBkW, LYBI, LWBI).

TABLE 8
 NUMBER OF AVAILABLE FREQUENT ASSOCIATES EACH BIRD HAD INSIDE AND OUTSIDE
 ITS OWN SUBGROUP

		Social subgroup		
Parakeets in three groups		1	2	3
	RW	6	1	1
	LWR	6	1	0
	LW	7	0	0
	RO	8	0	0
1	LY	4	0	0
	LBI	8	0	0
	RBI	6	0	0
	LBk	4	0	0
	LO	4	0	1

2	RY	0	1	0
	LRW	2	1	0

	LWBI	2	0	2
3	LBkW	0	0	2
	LYBI	0	0	0

Examination of social mobility reveals the degree of integration of birds into the flock, in whatever way this is accomplished. Social mobility has a general relationship to actual mobility but in addition indicates the degree to which a bird moves freely among other flock members. All birds in the flock probably visited all areas of the cage each day. Birds not capable of flight were of course restricted more from visiting different areas and tended to have places which they frequented most often. Thus, LWR and LY "owned" the top of a seed bin and, except when overwhelmed several times a day by other birds feeding in a group, defended it against trespassers. I noted that some birds were more capable of dominating other birds or of entering into sociality of other types in specific parts of the cage. Thus, LWR and LY were more capable of agonistic success in and around the seed bin than at any other place in the cage. LBkW was capable of agonistic success only in the top-most branches of a tree and only rarely even attempted to intimidate or enter into a social group outside that tree. In his place, however, LBkW was invincible, owing to his peck advantage over LWBI, the highest bird in the order.

Comparison of factors of social integration and success.—There was a general relationship between position of a bird in the peck order and its success in agonistic encounter, in this study. In contrast, there was no correlation of social mobility with these other two social phenomena, partly for the reason that nonagonistic factors are considered in computation of social mobility (see fig. 2).

SUMMARY

This paper concerns the nonepigamic and nonreproductive behavior of the Orange-fronted Parakeet (*Aratinga canicularis*), a species of México and Central America. Studies were conducted in the wild in Chiapas and Oaxaca as well as in aviaries where marked, sexed, captive birds were observed. In the wild, the species is highly

social in flocks when not breeding. These flocks of up to 15 birds are nomadic in foothills and lowlands, feeding on figs, myrrh, and cultivated fruits in and around scrub thorn and tropical deciduous forests. Birds in a flock are in pairs, show evidence of peck order, behave as units in most activities, and are largely independent of other flocks, each of which may represent family groups or aggregations of a few families. The birds are cyclic in diurnal behavior, engaging in flight, feeding, resting, epigamic and agonistic behavior, and then flight again in sequence and at intervals throughout the day. The birds desert the feeding areas and commence to go to roost before dusk.

Captive birds are social, have a complex peck order maintained by peck dominance through weakly ritualized aggressive behavior involving a sequence of components that include Turn-toward, Head-extension, Gape, Peck or Lunge. Ambivalent components also frequently expressed indicate weak aggressive tendency. They also may serve to reduce aggression in an opponent. Pair bonds are maintained throughout the year and are often integral in the social success and social mobility of individuals. Position in the peck order and success in aggressive encounters are directly correlated, but the social mobility of a bird is not, depending on a combination of agonistic and other nonagonistic factors, such as pair bond.

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