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GOLDIE'S BIRD OF PARADISE: DISPLAY, NATURAL HISTORY AND TRADITIONAL RELATIONSHIPS OF PEOPLE TO THE BIRD

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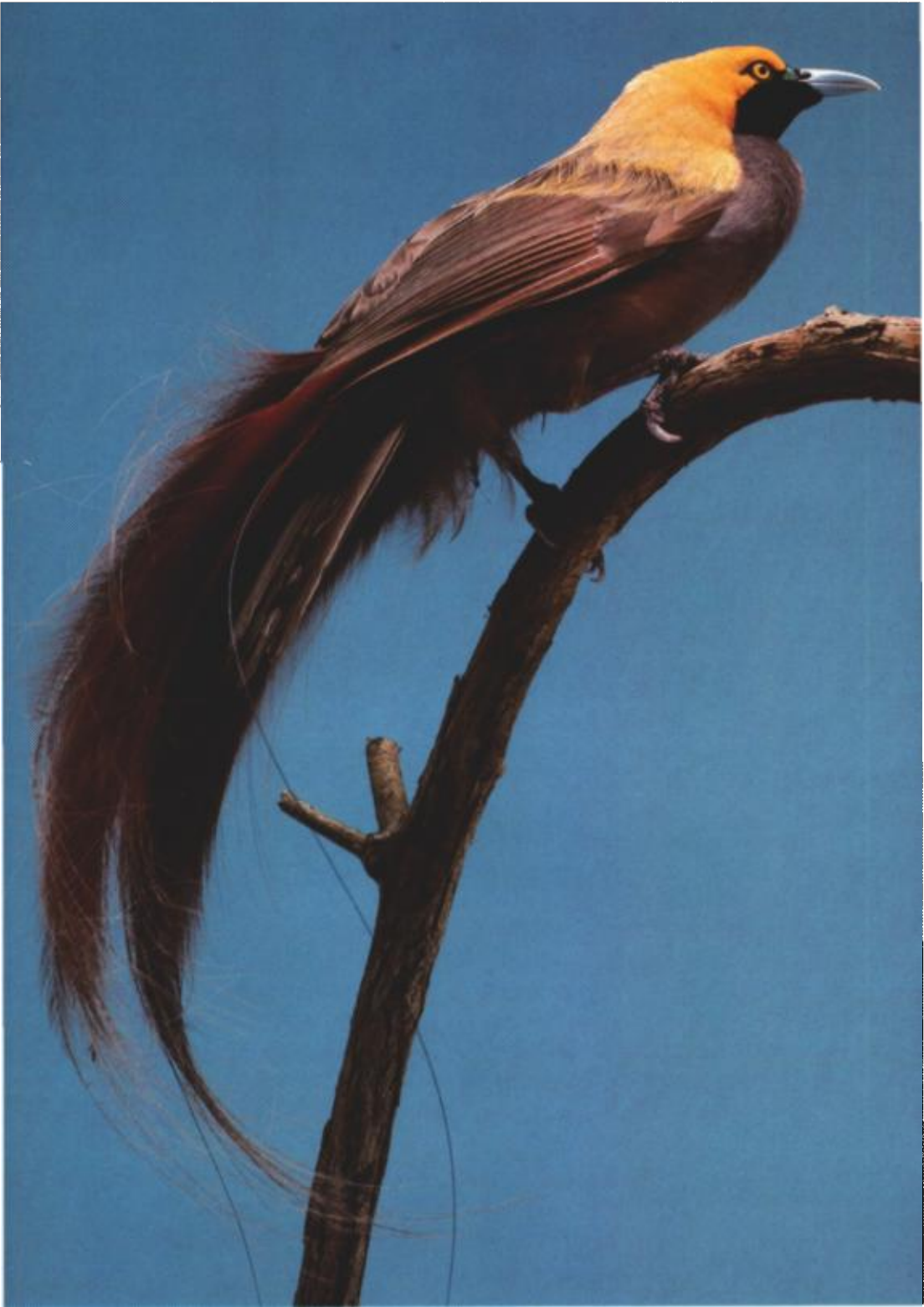
Goldie's Bird of Paradise (*Paradisaea decora*) occurs only on Normanby and Fergusson islands in the D'Entrecasteaux Archipelago, Papua New Guinea. Its display and habits have not been previously reported. Because of its restricted range, it is high on the list of 33 species of birds of paradise in Papua New Guinea about which the Wildlife Division desires information to aid in the formulation of conservation policies. Our visit to Fergusson Island to study *P. decora* was a result of the close ties between the Wildlife Division and members of the Papua New Guinea Bird Society.

The D'Entrecasteaux Archipelago is close to the southeastern tip of New Guinea, and is less than 18 miles from nearest New Guinea mainland. *P. decora* has not been found on Goodenough or Dobu, other islands in the group. That it is not on Goodenough is an unexplained distributional anomaly, as that island is within sight of Fergusson and suitable forest is present. Dobu is a relatively small, low island, heavily populated and with little remaining undisturbed forest. The absence of *P. decora* is not surprising as it is a species of the mid-mountain forests.

Both Fergusson and Normanby have large human populations in some areas; the lower ridges are, or have been, gardened to the top. Where there are fewer people, ridges have forested tops and *P. decora* is plentiful. So long as sufficient forest remains, these birds should remain unthreatened.

METHODS

We observed *P. decora* from 8-11 November 1978, for a total of 18 h. Our base was Nade, on the southwest coast of Fergusson Island. Residents of Nade who were familiar with the



Adult male Goldie's Bird of Paradise (*Paradisaea decora*).
Photograph by W. S. Peckover.

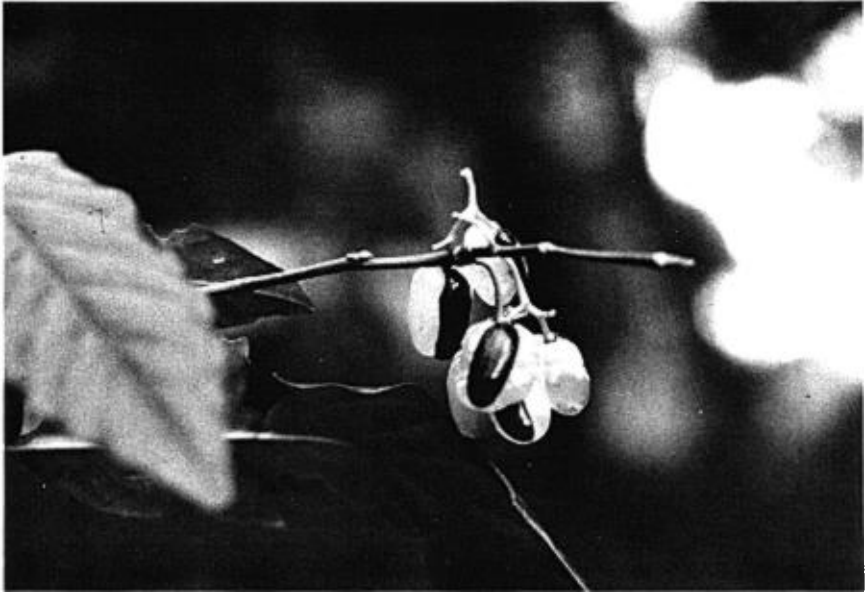


FIG. 1. Tree fruit most frequently taken by *P. decora*, *Medusanthera laxiflora* (Icacinaeae).

displays of *P. decora* led us to their display arena on a ridge northwest of Nade. The very steep trail led upward through active and fallow garden areas until virtually undisturbed lowland forest was reached at about 750 ft (250 m). Two adult males, the first *P. decora* seen, were feeding on the ground in an area free of undergrowth at 1100 ft (360 m). One display tree was beside the trail at 1200 ft (400 m).

The weather during our stay was unusually good for the season. The days were generally sunny, with some periods of overcast skies. We had rain only once, during the night of 6–7 November; whereas, the Whitney South Sea Expedition encountered heavy rains on Fergusson in November 1928 (Hannibal Hamlin, unpubl.).

STUDY AREA

The display arena consisted of 4 main trees, with another used occasionally. They were spaced in a rectangle approximately 100 × 50 yards (92 × 46 m) on a steep, south-facing slope just below the crest of a ridge, at 1200 ft (400 m) elev., in mature lowland forest with a fairly even but open canopy about 90–100 ft (30–33 m) high. The display trees were of at least 3 species but were similar to each other in that they had tall, straight trunks and a rather shallow crown that was not densely leaved. The displays were performed on mid-canopy limbs 60–70 ft (20–23 m) from the ground. Some brief display occurred in the outer branches, but the main displays took place on limbs near the center of the tree. The main display limbs were quite open and the observer could look up and see the displaying bird against the sky.

We estimate that 8–10 plumed males displayed in this arena, usually 2 to a tree. On occasions when 3 or 4 plumed males were displaying in the same tree, the additional birds



FIG. 2. *Plerandra stahliana* (Araliaceae), said to be a food tree of *P. decora*.

had apparently moved in from other arena trees. No more than 2 females and 6 unplumed males were seen at a time.

RESULTS

Foraging and comfort activities.—Only plumed males were observed feeding and, usually, only when they left the display tree to feed nearby. Fruit of *Medusanthera laxiflora* (Icacinaceae), a black seed covered by pink flesh on 1 side only (Fig. 1), was apparently a preferred food item. It grew in clusters on a slender understory tree ca. 30 ft (10 m) tall. Nade men told us that this tree grows only in the forest. In fact, these trees commonly grow beneath the display trees and are perhaps disseminated by the birds themselves. Once a bird fed on red fruits growing in clusters on another understory tree.

Another tree, *Plerandra stahliana* (Araliaceae) (Fig. 2), had no ripe fruits during our visit, but local residents indicated that it was also a food source for *P. decora*. This tree is said to grow on the coast as well as in the forest. A grub, approximately 2 in (50 mm) long, was also said to be eaten by *P. decora* and to live in decayed wood.

As noted above, *P. decora* visits the ground to feed. We saw 2 plumed males foraging in forest litter at 1100 ft (366 m) and another male feeding on the ground beneath a display tree. Once an unplumed male quietly

foraged for several minutes around a decayed tree trunk near a display tree and elicited no response from the adult male present in the display tree. Ground foraging has not been reported for other species of *Paradisaea* as far as we have been able to ascertain. That this is usual in *P. decora* is indicated by the fact that local residents were well aware of this habit and expected to see the species at the particular spot where we first encountered it.

Twice *P. decora* visited knot holes on trees, which were apparently filled with water. Once a male flew from a display tree to such a knot hole and drank, then returned to the display tree. On another occasion, a female bathed in a knot hole. When she flew, water drops could be seen falling from her feathers. Both of these knot holes were about 30 ft (10 m) from the ground.

Plumed males preened frequently between bouts of display, paying special attention to the flank plumes.

Leaf plucking.—Plumed males regularly plucked leaves near or over a main display limb, and as a consequence the display limbs appeared more open than the remainder of the crown of the display tree. A male would take a leaf by the petiole, break it off with a twist of his head and drop it. Six bouts of leaf plucking, each with only 1 male present, were observed in 2 different display trees. Five bouts occurred when there was no display activity in the arena and the birds had been quiet for some time. Once a male plucked leaves during a brief display. Usually a male reached up and broke off single leaves over his head, but 4 times it was observed that one flew up and caught a small limb in his bill, pulling it down to his original perch. He then either bit off a branch with several leaves (once) or held the branch under his foot and plucked individual leaves (3 times). In 1 bout a bird plucked and dropped 17 leaves in quick succession.

Calls.—We noted a varied assortment of loud, unmusical calls given by *P. decora*, both during display and sporadically during non-display periods. A first attempt at describing these calls and their contexts is given below.

Wok-wok.—this call, usually given by the male when no female is present, is often answered by non-displaying males in other trees. It appears to be mainly a contact call between males, and is undoubtedly homologous to the crow-like calls reported for other species of *Paradisaea*.

Whick-whick.—this call has 2 forms. The low-intensity, softer version, heard in the same circumstances as *wok-wok*, also appears to be a contact call between males. The high intensity *whick-whick* is very loud, liquid and ringing, and the bird jerks his head back sharply as he calls. This call occurred in 2 contexts, the usual one being when a female was present in the display tree, but it was also twice given just before the male dived

rapidly out of the display tree and out of sight down the side of the ridge. No other bird was seen on either occasion.

“Growling.”—this is a low call given by a single male at the beginning of a display bout with a female present. In fact, “growling” seemed to indicate presence of a female, often before she was seen by us.

Duetting.—duetting is done by 2 males displaying together, often in the presence of a female. This begins as a loud ringing metallic *waak* given alternately by the males. As the duet continues the ringing notes become increasingly rapid until a continuous metallic rattling is given by both birds and is best described as “gargling.” Duetting is the characteristic call at an active arena and can be heard ringing through the forest for quite some distance. Duetting only involved 2 males. Duetting birds stand 4–10 ft (1.5–3.5 m) apart, usually facing each other, and give the duetting call almost always with plumes raised. One, or both birds, may run up and down the limb while duetting.

Display postures.—Plumed males.—Display occurred either on a horizontal or sloping, nearly vertical, limb. On horizontal limbs, the male stood across the limb with his head slightly below horizontal. The wings were open and were moved up and down with a rowing motion; they were always below the level of the back. The flank plumes were raised in 2 stages—the shorter plumes were raised until their shafts were vertical, then the longer ones were brought up until their shafts were also vertical. The plumes cascaded back and down; at no time did they fall forward over the bird’s head. (In repose these 2 groups of flank plumes are obvious—the tail shows between them.) The central tail wires are also raised during display.

When the male is displaying on a steeply sloping limb, his body is parallel to the limb. In such cases he may move either up or down the limb, but the head, wing and plume positions are as above, except that the rowing movement of the wings may go below the level of the limb although never above the level of the back.

Displaying males were never observed to hang upside down from a limb. The only time the head was much below the level of the body was when the male was moving down a sloping limb.

Unplumed males.—The unplumed males were very active in the display tree, hopping about the female, or females. Except for the absence of plume erection, their display postures were indistinguishable from those of plumed males. These unplumed males could be told from females by their larger size (wing averaging 177 mm in unplumed males and 159 mm in females; see Table 1 for additional measurements) as well as by behavior.

Females.—The females were very quiet in the display tree and remained

TABLE 1
MEASUREMENTS OF *PARADISAEA DECORA*^a

| | Wing range ($\bar{x} \pm SD$) | Tail range ($\bar{x} \pm SD$) | Exposed bill range ($\bar{x} \pm SD$) | Tarsus range ($\bar{x} \pm SD$) | Weight ^b |
|----------------|-------------------------------------|-------------------------------------|--|---|---------------------|
| Plumed males | 176–182 (180 \pm 2.0) N = 9 | 134–144 (139 \pm 2.9) N = 8 | 33.5–35.0 (33.9 \pm 0.49) N = 8 | 42.0–46.0 (43.7 \pm 1.17) N = 9 | 237 |
| Unplumed males | 174–182 (177 \pm 2.5) N = 9 | 136–145 (140 \pm 3.4) N = 9 | 33.0–34.5 (33.5 \pm 0.59) N = 8 | 42.0–44.5 (43.3 \pm 0.75) N = 9 | — |
| Females | 156–165 (159 \pm 4.0) N = 4 | 124–130 (128 \pm 3.0) N = 4 | 32.0–34.0 (32.9 \pm 1.03) N = 4 | 38.0–39.0 (38.5 \pm 0.57) N = 4 | — |

^a Measurements in mm of museum skins.

^b Weight in g of male photographed.

motionless for long periods. When soliciting copulation, they opened their wings slightly and quivered them rapidly. No sound was heard.

Display.—The longest and most complete bout of display we observed was on 11 November. When we arrived at 06:10 display was already in progress, and it continued for an hour. This display bout is described in detail below and then other, less complete, bouts are compared with it.

At 06:10 three plumed males were present and 2 were duetting. The third male disappeared soon after our arrival. There were up to 6 unplumed birds present, 2 of which were identified as females on the basis of smaller size and quiet behavior. The unplumed males hopped actively about.

One female sat on the horizontal display limb between the duetting males, and the other was on a limb nearby. The display and duetting by the 2 males increased in intensity. A few times these males chased away the unplumed males, but they mostly ignored them.

At the peak of the dual display and duetting, 1 male stopped performing and moved away from the main display area, sitting quietly throughout the remainder of the display. The display was continued by the remaining plumed male, whose movements had become very slow and the display almost static; there was no audible vocalization. The unplumed males had moved in until they were all around the female, and 2 or 3 of them started making rowing movements with their wings. The plumed males made no attempt to drive them away. The female stood quietly near the displaying plumed male.

At this point the female left the main display area several times, but returned almost immediately. Sometimes the plumed male went with her. Throughout this period the male's plumes remained in display position.

While standing near the displaying male, the female began soliciting by quivering her wings, held slightly out from the body. The male continued his slow and rhythmic display. Several times in the 5 min that the female solicited, 1 displaying unplumed male moved in and copulated with the female and once 2 unplumed males in succession copulated with her. These copulations were brief, lasting only a few seconds, and there was no preliminary neck rubbing, although once the unplumed male did put his wings down around the body of the female (see below). The female did not leave or stop soliciting after these copulations, but remained near the displaying plumed male.

After about 30 min of display, the plumed male began hopping stiffly up and down near the soliciting female (from below we could see that his feet left the limb and came back to the same place). He edged over to the female, put his neck and breast on her back and rubbed back and forth. Then he mounted her, brought his wings down around her body and they copulated. While still mounted he rubbed his neck and breast on her back again, and then they copulated again. In all, the copulatory sequence lasted for approximately 30 sec.

After the plumed male had copulated with the female, all of the birds remained in the tree and the entire sequence of events was repeated, starting with duetting and joint displays by the 2 plumed males. We had no way of knowing whether or not the male that now displayed alone was the one that had displayed alone during the previous display bout. The unplumed males were around as before, were chased away on several occasions during the duetting and joint displays by the 2 plumed males, but were tolerated during the period of intense display by the single adult male. Once again they copulated briefly several times with the soliciting female. The displaying plumed male copulated with the female as before, dismounted and moved immediately to the second female and copulated with her—this copulation lasting only a few seconds. The first female moved away about 10 ft (3.5 m), after the male dismounted, and began preening. After the second copulation all birds left the tree. It was then 07:15.

On 1 other occasion we observed copulation in the presence of unplumed males (8 November, 13:45). In this case there were 4 unplumed males, 1 female and 4 plumed males in the tree. The sequence of events was as described above except that 4 plumed males were displaying together and there was much chasing of unplumed males. When a single plumed male began his display, the other 3 sat quietly in the tree, and the

unplumed males did not interfere or attempt to copulate with the female. The displaying male mounted and copulation lasted about 25 sec.

Six other times 2–5 unplumed males were observed in display trees, both with and without females present. Usually, the 1–4 plumed males displaying together chased the unplumed birds when they appeared. Only once did a plumed male interrupt a static display to chase an unplumed male.

We observed 1 display sequence that ended in copulation, when no unplumed birds were present in the tree. This was on 8 November, 12:00–12:20. When the single female appeared in the tree there were 2 plumed males present. She was greeted by low growling by at least 1 male. For the most part the second male sat quietly in the same tree, but twice approached and displayed briefly near the female. The main display perch in this tree was a sharply sloping limb. The female sat on a horizontal limb branching from it. The male hopped slowly up and down the sloping limb, zigzagging his body back and forth as he did so, so that he alternately presented back, front and side views to the female. The female watched him continuously, sometimes facing him, sometimes peering sideways at him with head cocked. This female appeared quite wary and frequently flew to the outer branches, where the male followed her and displayed. They always quickly came back together to the main display perch. Movements by the male around the female were always slow and deliberate. Several times he gave high intensity *whick-whick* calls in front of the female, but generally no calls accompanied the display. After 15 min of display by the male the female began soliciting and the male gradually moved closer to her, hopped up and down on the branch next to her (we did not see neck and breast rubbing on this occasion) and mounted her with his wings down around her body. Copulation lasted about 15 sec. Then both birds flew from the tree in opposite directions.

On 9 and 10 November displays were sporadic and bouts were of short duration. There seemed to be fewer plumed males in the vicinity of the arena. Females were seen only 4 times and they remained in display trees only briefly. Each time their arrival occasioned growling by the male(s).

Twice unplumed males were seen in a display tree. Both times they were chased away, but the display was terminated. No female was seen on either occasion.

In contrast, on these 2 days there were frequent short bouts of display that usually consisted of duetting if there were 2 plumed males in the tree and loud calling, *whick-whick* and *wok-wok*, if there was only 1 male per tree. Display postures were sometimes assumed.

DISCUSSION

The following brief discussion refers only to our observations of *P. decora*. A comparison of *P. decora* with other species of *Paradisaea* and a discussion of the development of polygyny and evolution within the genus *Paradisaea* will be published at a later date.

P. decora displays in an "exploded arena," i.e., one in which individual courts are sufficiently widely separated for the owners to require vocal rather than visual contact (Gilliard 1969:53). In our study the arena comprised 4 main trees with a fifth used occasionally. Two to 4 plumed males displayed in each tree. It seems likely from our observations that there are usually 2 plumed males per tree, with a third and fourth male sometimes coming to the tree, probably from adjacent trees. These additional males were sometimes, but not always, present when unplumed males as well as females were in the display tree. These third and fourth males did not perform the duetting display and usually disappeared soon after it began.

It is noteworthy that 1 of the 2 males duetting when a female is present moves aside and sits quietly just at the point when the duet reaches peak intensity. The remaining male continues to display, usually silently, in a slow and rhythmic manner, uninterrupted by the second male. This suggests that there is a dominant male in any 1 tree, perhaps insuring that mating is not interrupted.

The frequent calling between trees by males and the duetting of pairs of males in trees when no female is nearby seem to us to be a possible means for setting up and maintaining a male-male hierarchy within the arena group. Gilliard (1969:53) has suggested that the loud calls of birds displaying in exploded arenas enable the birds to remain in auditory contact. We would go a step further and suggest that it also serves to establish and maintain a male-male hierarchy among the 8–10 birds within the arena observed. This would explain why there are so many reports of long periods of male display among arena birds when there are apparently no females present.

Once this hierarchy is set up, any individual male has a "territory" within the arena—a tree in which he is either dominant or not, depending on his interactions with the other male in the same tree. A female coming into the arena may then select a tree (not necessarily a male, but more appropriately stated, a locality within the arena complex that is attractive to her for some reason). In so doing she then triggers display by the males in that tree. If there are 3 or 4 males present, 1 or 2 males soon quietly leave, and a pair of duetting males remains. We saw no indication that

the female chooses one or the other male—and we looked for it. Rather it seems to us that the relationship between these 2 males (and probably among all of the males in the arena) had already been determined, perhaps by duetting when no female was present. This would explain why 1 male stops displaying and sits quietly among the foliage while the other continues a static display and eventually mates with the female. To us this implies that choice of the male by the female is not necessary to explain polygynous mating systems in arena birds, as has usually been postulated, but that they may be understood in terms of male-male dominance hierarchies alone. That females permitted copulation by unplumed males and that a plumed male copulated in succession with the 2 females present lend support to the idea that mating is controlled by a male-male dominance hierarchy. Competition among males for dominance can explain the evolution of ornate display plumes and large size, having evolved in response to agonistic encounters and used secondarily in courtship. It is unnecessary to invoke choice of the most “attractive” male by the female, as is currently done in the literature.

That plumed males tolerated the presence of unplumed males in the display tree and permitted repeated copulations by them with the female to whom the male was displaying we find extremely difficult to explain. In the arena of *P. decora* that we observed there was at least 1 band of unplumed males that moved around through the arena trees. In a tree where only males were present or in one with a female and with 2 or more plumed males displaying together, the unplumed males are chased away. Here we believe that the unplumed males are chased because the displays are those concerned with setting up or maintaining the male-male dominance hierarchy (LeCroy, unpubl.). When a single male is displaying to a female with the slow, rhythmic movements that are characteristic of the display shortly before copulation, such bands of unplumed males are not only not driven away, but are actually allowed to copulate with the female, and neither male interferes. One might assume that the unplumed males are inept or infertile and that therefore such copulations rarely result in a fertile egg. This may well be the case, especially since the copulations we saw were of short duration. However, an unplumed male Raggiana Bird of Paradise (*P. raggiana*) is known to have sired young in captivity (Delacour 1964:232), and this cannot be ruled out in *P. decora*. One may imagine that an unplumed male on the court of a dominant plumed male is in a stressful situation in which ineffective copulations of short duration are the rule. In the captive situation mentioned above no plumed male was present and actual copulation was not observed.

If fertile eggs do in fact result in the wild from copulations with unplumed males, such behavior might be tolerated, in an evolutionary sense.

Kin selection can be invoked as an explanation if the unplumed males were closely related to the dominant males in an arena, as they might very well be if the dominant males in these long-lived birds do most of the mating. But evidence of relatedness in bird of paradise display groups will not be soon forthcoming, so we are left with a behavioral enigma which on the face of it appears maladaptive in neo-Darwinian terms.

On the other hand, the ability of unplumed males to sire young might ensure the survival of populations in the event of shortages of plumed males. This could well explain how it was possible for the heavy cropping of plumed males of some species of *Paradisaea* in the nineteenth and early twentieth centuries to continue unabated for nearly 50 years (Gilliard 1969:32).

We also don't know the age at which display plumes are acquired by males in the wild or how hormonal levels mediate plumage changes or behavioral parameters. It is entirely possible that the various plumage stages seen in museum skins do not represent yearly molts. Individuals may differ greatly in the age at which they acquire fully adult plumage, and lack of a position in the male hierarchy could conceivably inhibit plume growth.

TRADITIONAL RELATIONSHIPS OF THE PEOPLE TO THE BIRD

Like other ethnic groups of Papua New Guinea, the people of Nade, Morima and other nearby villages on Fergusson Island have myths and folklore about the colorful bird of paradise of their area. The people of Nade told us that, historically, these birds were very important and there was a great deal of interaction between birds and people. Old traditions relating to Goldie's Bird of Paradise are said to be dying out, but the bird is still greatly respected and is an important spiritual token to 1 group of villages. The plumes are apparently no longer sought for human adornment.

The people talked much about a beautiful dance they perform on very special occasions—an interpretive imitation of the birds displaying. It has special magic and because of this, performers must observe some rigid social taboos that include not eating certain foods for more than 1 week before the day of the dance; other taboos were not revealed to us. The performers are required to submerge themselves in a cold water stream for a long period while preparing their minds for the dance. Just before the dance, a magic chant is offered to the originator of the dance—this bird of paradise.

The dance itself is performed by 2 men dressed in grass skirts with *P. decora* plumes on the rump and cassowary (*Casuaris* sp.) feathers, from the mainland, stuck in armbands and carried. They mimic the sound of

the birds as they dance. The women and other decorated men stand around the dancers. The women wear no plumes, carrying leaves instead.

There is apparently a widespread belief in Papua New Guinea that the birds of paradise with tail wires are able to use them to secure grubs. People on Fergusson told us that *P. decora* could probe with the tail wires into a hole in rotten wood and cause a grub to come to the surface where it could be captured. We were told a similar story in the Kratke Mountains in the Eastern Highlands.

Color plays an important part in the identification of birds by the villager. On Fergusson the dull, unplumed males and similarly garbed females are called *Wagolina*, which interpreted literally means "dull." The fully plumed males are given a different name—*Siae*.

Traditional hunting methods.—Before the National Government declared birds of paradise protected in 1966, Fergusson Islanders occasionally hunted *P. decora* for its plumes. One popular hunting method used a snare leg trap called a "dell." The hunter made a loop at the end of a long vine and took it to a display tree or a fruiting food tree. At the selected site on a fruiting tree, the hunter would drop most of the fruit, leaving only a few attached to the branch. The loop was then placed where the bird was expected to perch. The hunter made a hiding place below, taking the end of the string into his blind. If a bird did not soon arrive, he would mimic its cries to lure it. As soon as the bird stepped into the loop the hunter gave the string a sudden pull, catching the bird by the legs and pulling it down to where he was hidden.

Another method of capture involved making a fine net of pandanus fibers and setting it across a gully used by the birds. After choosing a suitable location, the hunter would cut down some of the trees to make an easier flight path. The net was then set between 2 trees and ca. 20 ft (6.5 m) above the ground. The hunter hid nearby; as soon as a bird flew into the net, he would climb one of the trees, lower the net, capture the bird and re-set the net.

Traditionally, the people believe that there is an almighty ruler of all creation. Each living thing, flora or fauna, has a human and spiritual component, the harmony of relationships being determined by the spiritual components of the totality of living things. If the spiritual component is upset, then disorder results and confusion and disharmony in the human world is the inevitable consequence.

It is believed that hunting success depends on observing certain norms of behavior. No man whose wife is pregnant may accompany a hunting party. Men who are going on a hunt may not sleep with their wives the night before. Failure to observe these restrictions would bring bad luck to the expedition. Perhaps some member of the party would get hurt or the hunt would be unsuccessful.

The people were quick to quote examples of such misfortunes where the taboos had not been observed. As a matter of fact, we were told that the reason no bird went into our nets (set up to secure birds for photography), was that the wife of a man who accompanied us was pregnant. The bird in the frontispiece was lured in by a local resident, caught (probably by the first hunting method mentioned above) and brought to us. After being photographed, weighed and measured, it was banded and released.

SUMMARY

Our observations of display at an arena of *P. decora* on Fergusson Island, Papua New Guinea, are described. Four trees comprized the arena and 8–10 plumed males were in attendance. Displays included male-male displays, female-male displays and displays by unplumed males. Copulations of plumed and unplumed males with females were observed. We stress the importance of setting up male-male hierarchies and postulate that plumes have evolved mainly in response to male-male pressures; display of plumes to a female may be secondary. The female does not seem to select a male but may be drawn to a particular limb within the arena, mating with whichever male is displaying. This is supported by the fact that soliciting females allowed unplumed males to copulate with them. That plumed males permit this would indicate that either these matings virtually never produce offspring in the wild or some form of kin selection is involved.

We have also given a brief description of the traditional role of *P. decora* in the Fergusson Island culture.

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