

In chicks this leads to the twitter call. Andrew has demonstrated that the chick's twitter develops into several adult calls, one of which is the food call.

When chicks are injected with testosterone the shift from simple twitter to food call occurs quickly. The effect of testosterone on all calls is to make them more prolonged and to occur in bouts. Andrew's theory on the ontogeny of food calls seems to fit galliforms in general. The call is released most readily when there is stimulus contrast, i.e. strange food is much more likely to elicit calling than the normal food supply. Secondly, at least in Bobwhite Quail, the food call is essentially identical in juveniles, in adults outside of the breeding season, and in breeding males. The chief difference is that calling bouts are more sustained and released more readily in breeding males than among females or juveniles.

Andrew (idem) found a continuum in the form of chick calls going from the twitter through peep. In general we found little variation in the feeding call in adult male galliforms. This suggests that there has been some degree of ritualization and development of typical intensity (Morris, 1957) which could serve to make the call more functional as a lure for the female.

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Further examples of dual singing by southwest Pacific birds.—A previous paper (Diamond and Terborgh, *Auk*, 85: 62, 1968) analyzed synchronized duetting between a mated male and female for six species of New Guinea birds. The present paper, based on subsequent field work, briefly describes nine additional cases from New Guinea, New Britain, Fiji, and Samoa. All nine examples involve monomorphic species, and in no instance was I able to collect the singers and prove that they were a male and a female. However the degree of vocal coordination makes it likely that these cases represent male-female duetting rather than male-male countersinging. Cases 1 through 8 are so-called antiphonal duets, while cases 6 and 9 are so-called unison duets (see Diamond and Terborgh, *ibid.*, p. 62 for terminology). Species 1, 2, 4, 5, and 7 are confined to forest, while species 3, 6, 8, and 9 live both in forest and in open second-growth.

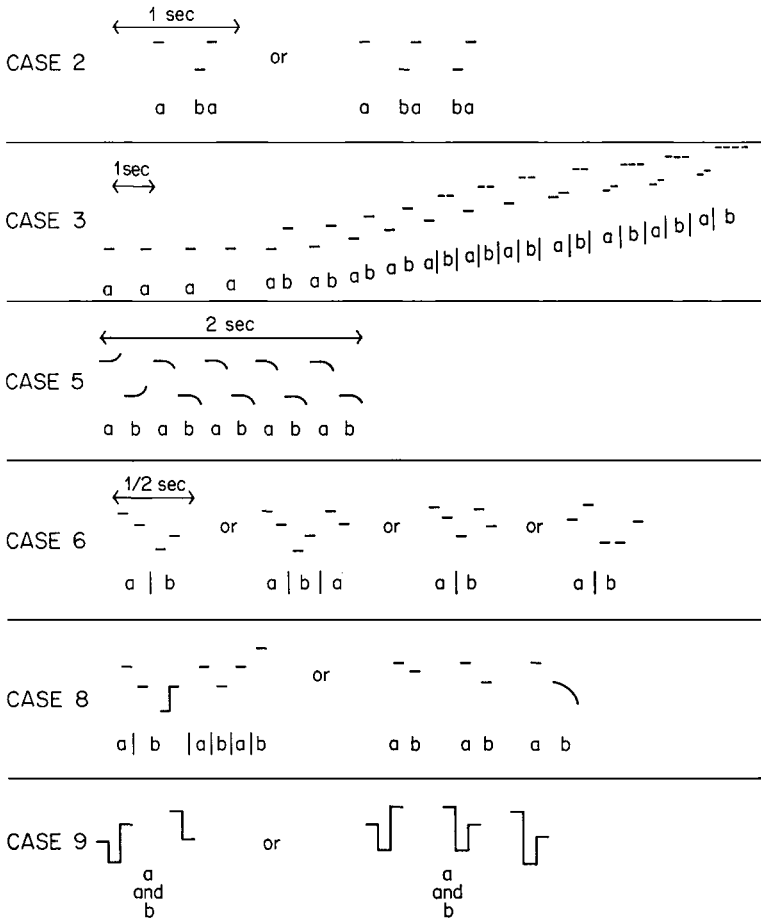


Figure 1. Duets of six southwest Pacific birds. In cases 2, 3, 5, 6, and 8 one individual gives the calls labeled "a," while another gives those labeled "b." In case 9 both individuals give the same call in unison. Case 2, *Centropus violaceus* (New Britain); case 3, *Centropus ateralbus* (New Britain); case 5, *Melidectes ochromelas batesi* (New Guinea); case 6, *Foulehaio carunculata carunculata* (Samoa) and *F. c. procerior* (Fiji); case 8, *Philemon novaeguineae jobiensis* (New Guinea); case 9, *Philemon novaeguineae cockerelli* (New Britain).

1. New Britain Rail, *Rallus insignis* (Rallidae). New Britain.—The call-note is low-pitched, harsh, and suggestive of a dog or pig rather than of a bird. Duetting birds call alternately back and forth to each other for several minutes.

2. Violet-backed Coucal, *Centropus violaceus* (Cuculidae). New Britain.—The loud, booming duets (Figure 1, case 2) sound like a giant hiccup and are given by two birds that sit facing each other on a branch.

3. White-necked Coucal, *Centropus ateralbus* (Cuculidae). New Britain.—The low-

pitched duet (Figure 1, case 3) has a hollow, hooting quality and is given at night as well as during the day. As the duet proceeds, the voices of the singers rise in pitch, and the number of notes delivered per response increases. One singer may start several notes before the other, and the two birds occasionally get out of phase. The singers may either be in separate trees 30 feet apart or else on the same branch in visual contact.

4. Belford's Melidectes, *Melidectes belfordi brassi* (Meliphagidae). New Guinea.—Loud solo calls include hoarse rasps, nasal "caws," and clear, high, piping notes. The duet consists of two birds calling "caw" in rapid and perfect alternation up to 34 times, while the singers sit facing each other on a branch. Previously Diamond and Terborgh (ibid.) described a similar performance that we heard once from the related *Melidectes rufocrissalis*, and were uncertain whether it was a duet or just fortuitous alternation, but I have now heard the performance sufficiently often in exactly interlocking rhythm from *M. belfordi* to be confident that it is a true duet.

5. Mid-mountain Melidectes, *Melidectes ochromelas batesi* (Meliphagidae). New Guinea.—Solo calls consist of four or five nasal slurs with a sweeter quality than the calls of *M. belfordi*. Duets are the same calls given in perfectly interlocking rhythm by two individuals (Figure 1, case 5).

6. Wattled Honeyeater, *Foulehaio carunculata carunculata*, Samoa, and *F. c. procerior*, Fiji (Meliphagidae).—The duetters are usually within a few feet of each other on the same branch and repeat loud, mellow, antiphonal patterns (Figure 1, case 6), which are somewhat more complex on Samoa than on Fiji. There are also unison duets.

7. Giant Forest Honeyeater, *Gymnomyza viridis brunneirostris* (Meliphagidae). Fiji.—The loud, ringing, brisk duet is given by two birds in the treetops, usually perched within 1 foot of each other. Each bird calls about 30 times in perfect alternation at ½-second intervals, the leader at a higher pitch, the follower with a hoarser quality. The duet crescendoes from beginning to end. Occasionally the leader starts and finishes alone and is joined by the follower only in the middle of his vocalization.

8. New Guinea Friarbird, *Philemon novaeguineae jobiensis* (Meliphagidae). New Guinea.—We reported previously that we had listened to this noisy bird in many parts of New Guinea without hearing duets, but that Gilliard and LeCroy (Bull. Amer. Mus. Nat. Hist., 132: 273, 1966) described duets from a locality we had not visited, Bogadjim near Madang. In 1969 I visited Madang and confirmed that many songs of this species within a radius of at least 15 miles are antiphonal duets (Figure 1, case 8). The synchronization is often poor, i.e. the two singers may get out of phase, or one bird may continue after the other stops. The same subspecies does not sing duets 200 miles further west in New Guinea.

9. New Britain Friarbird, *Philemon novaeguineae cockerelli* (Meliphagidae). New Britain.—At Cape Gloucester on the west tip of New Britain, many of the songs were duets. They were not antiphonal duets, as given by the Madang population, but unison duets: two birds delivered the same song repeatedly, nearly or exactly in synchrony (Figure 1, case 9).

Three points of general interest may be noted in these examples. First, in cases 2, 3, 4, 6, and 7 and possibly in some of the other cases the singers are often or always in immediate visual contact. Many duetting bird species live in dense thickets that favor the development of vocal rather than visual displays, but this interpretation of the significance of duetting cannot apply to cases 2, 3, 4, 6, and 7

discussed here nor to the cases of *Campochaera sloetii* and *Coracina montana* discussed previously (Diamond and Terborgh, *ibid.*). Second, the occurrence and form of duetting in *Philemon novaeguineae* and in the previously discussed example of *Pitohui kirhocephalus* is subject to marked geographical variation. Finally, some bird families seem predisposed to the development of duetting, which has arisen in the southwest Pacific in at least two genera of campephagids (*Campochaera*, *Coracina*), three genera of rails (*Rallus*, *Amaurornis*, *Gallirallus*), and four or five genera of meliphagids (*Melidectes*, *Foulehaio*, *Gymnomyza*, *Philemon*, and possibly *Anthornis*).

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Birds nesting at the Kazan Falls.—While engaged in the Canadian Wildlife Service's study of the causes of mortality of barren-ground caribou calves we visited the Kazan Falls (63° 43' N, 95° 46' W), District of Keewatin, N.W.T. on 7, 8, and 14 July 1970 and recorded avian nesting activities at the falls. The river flows through a narrow rock-walled gorge for about 1 km dropping about 17 m. The walls rise vertically about 8 m to 12 m above the river. The rock surfaces of the surrounding cliffs are broken into angular blocks with most fractures occurring at 30- to 60-cm intervals. The surrounding area is one of low relief barren lands.

Five species of birds nested at the Kazan Falls during July 1970: Lesser Snow Goose (*Anser caerulescens*), 21 nests; Canada Goose (*Branta canadensis*), 1 nest; Peregrine Falcon (*Falco peregrinus*), 1 nest; Rough-legged Hawk (*Buteo lagopus*), 1 nest; and Herring Gull (*Larus argentatus*), 15 nests.

Lesser Snow Goose.—We were able to measure the nests' heights above the water and the shortest distance from their centers to the edge of the cliff (Table 1) on only eight nests. The other 13 nests were similarly located along the rimrock. Some nests were on sites vegetated by lichens or grasses and forbs, while several nests were on bare rock. The geese did not have to carry nesting materials for more than 2 m or 3 m to the rock depressions.

TABLE 1
LINEAR MEASUREMENTS FOR THE POSITIONS OF EIGHT LESSER
SNOW GOOSE NESTS ON THE KAZAN FALLS

Height of nest above water	Distance to edge of cliff from center of nest
9.61 m	1.20 m
8.55	0.44
8.35	0.85
8.00	0.98
7.87	1.35
7.71	0.66
7.50	0.70
7.30	0.44