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MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN NO. 162

Species Limits in the Indigobirds (Ploceidae, *Vidua*) of West Africa: Mouth Mimicry, Song Mimicry, and Description of New Species

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Ann Arbor, Michigan 48109

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May 26, 1982

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INTRODUCTION

The indigobirds (*Vidua*, subgenus *Hypochera*) are small, brood-parasitic finches. They are widespread and common but local in Africa. Although their biology has been the subject of recent field work in West Africa, the species limits of the group in this area are not well known. Indigobirds are all morphologically similar, and no differences in plumage pattern or in morphological proportions among species are known (Payne, 1973). Species of indigobirds in the past have been described mainly on the basis of differences in the color of the gloss of the breeding plumage of the males.

Within one indigobird species (*V. funerea*) in southern Africa, plumage color or gloss in the otherwise blackish plumage of the breeding males may vary from green to blue to purple in different areas (Payne, 1973). Females of all species are small streaked brownish birds. Field work that associated the songs of individual birds with their plumage color, leg and bill color in southern Africa showed consistent associations of behavior and morphology among three species (*V. chalybeata, V. funerea, V. purpurascens*). The consistent difference in song in males across populations of a single species of indigobird was the species of firefinch (*Lagonosticta*) whose song was imitated (Payne, 1973). The indigobirds are brood parasites and in this species complex in southern Africa each species mimics the song (males) and apparently parasitizes (females) a single species of firefinch host (Payne, 1973). Each male mimics the song of its host species of firefinch (Nicolai, 1964; Payne, 1973, 1976, 1980). The young indigobirds learn these songs of the host while in the care of their foster parents. Moreover, the females that visit and mate with each kind of male differ from each other morphologically, with females and males of a single species generally having similar colors of the bill and feet. The morphological differences among females and the high degree of assortative mating among the morphologically different forms of indigobirds living within a local area provided evidence to confirm the distinctiveness of the three species in southern Africa (Payne, 1973).

Indigobirds of West Africa are less well known. It has been impossible to test whether the different morphological forms of indigobirds in an area are distinct species by determining whether mating is highly assortative, because females themselves are not known to be morphologically distinguishable (Payne, 1973, 1976). Although the criterion of song mimicry might be used as a test of species distinctiveness, song mimicry alone appears to be an insufficient test, for several reasons: (1) Occasional birds in southern Africa may sing the "wrong" songs, mimicking a species other than the usual fosterer of their own species, and not mimicking their own species' usual fosterer species. These instances are uncommon (2 cases

in nearly 400 birds, Payne, 1973, 1980), but they indicate that species limits cannot be determined simply by hearing one or two singing males of each kind (Payne, 1973, 1976). (2) Hybrid parasitic finches, including indigobird x other whydah species groups within the genus *Vidua,* sing the song of their foster parent species, and not a mixed or intermediate song. This unmixed mimetic song is to be expected if the song differences are determined by the experiences of the young parasite in the care of foster parents, rather than by additive genetic differences among species (Payne, 1980). (3) Indigobirds learn their song mimicry both from the foster species and from other conspecific indigobirds in experimental conditions (Payne, unpublished observations). Although it is not possible to use song mimicry of the foster species alone as "the key" to species identity within the indigobird complex, the mimetic song is nevertheless a strong indicator of species limits. Female indigobirds are attracted to the songs of their host species and to mimetic songs of their own species, and not to the mimetic songs of another firefinch or indigobird species, both in observational field conditions and in aviary playback experiments with *V. chalybeata* and *V. purpurascens* (Payne, 1973).

An additional test of species distinctiveness among local populations would be the presence of any covarying traits that are genetically determined differences and not simply acquired differences such as the learned dialectal song differences among the populations. One indigobird species is well known to mimic the mouth pattern of the nestling young of its foster species. The mouth color pattern of the Village Indigobird (*V. chalybeata*) matches the pattern of the young of its fosterer, the Red-billed Firefinch *L. senegala* (Nicolai, 1964; Morel, 1973; Payne, 1973). A second species, the Dusky Indigobird (*V. purpurascens*) has a different color pattern which matches that of its foster species, the Pink-backed Firefinch *L. rhodopareia,* whose mouth pattern has been illustrated (Payne, 1973). Supporting identification for these young indigobirds was obtained by rearing nestling *V. chalybeata* born in captivity to maturity, and by rearing nestling and fledgling *V. chalybeata* and *V. purpurascens* from Zambia into maturity (Payne, 1973, 1977a, unpublished observations). In all cases (N=17) the identification based on mouth colors of the young birds was verified by the plumage and the bill and foot color of the birds at maturity. These developmental observations show that, in these two species, indigobirds that mimic as young the mouth pattern of the young of one species of host are conspecific, and differ consistently from those birds that mimic the young of another species of fosterer. The nestling mouth pattern of the other species of indigobirds was unknown before 1970, as was the pattern of the other firefinch species, all occurring in West Africa (Immelmann et al., 1965; Nicolai, 1964, 1974; Payne, 1973, 1976). In another parasitic

finch, the Pintailed Whydah *Vidua macroura,* the young mimic the mouth pattern of several species of waxbill *Estrilda* fosterers with a single all-purpose mimetic pattern, and parasitizes at least five of these species, all of which have a similar mouth color pattern (Friedmann, 1960; MacDonald, 1980; Payne, unpublished observations). It might be possible for one or more forms of parasitic finch such as an indigobird to have a jack-of-all-trades mouth pattern and so be a parasitic generalist within a limited set of foster species (Payne, 1976). Thus to provide evidence of species distinctiveness of the indigobirds from the mouth pattern of the young, it is necessary to show both (1) that the foster species each have different mouth patterns, and (2) that each foster species is mimicked specifically by the mouth pattern of a locally co-occurring indigobird.

In the years 1973–1980 I found the young of most of the species of foster firefinches and parasitic indigobirds, and my associates in West Africa, particularly Mary G. Dyer in Nigeria, have discovered some of the other species as nestlings or fledglings. Each species of firefinch that we have observed in West Africa (*L. senegala, L. rara, L. larvata, L. rubricata,* and *L. rufopicta*) has a distinctive mouth pattern that differs from the others, and each also has an indigobird parasite which as a young bird mimics the details of these mouth patterns. We have not succeeded, however, in rearing these young indigobirds to maturity to verify that each individual grows up to look like the local males that mimic the song of the same firefinch, as we did for two species in southern Africa.

In the present study I have used two criteria together to determine whether locally coexisting populations of indigobirds, identifiable by the color differences in the male breeding plumage, are distinct species. (1) If each species of parasitized firefinch has a mouth pattern unlike other local firefinches, and if each species has a corresponding indigobird parasite with a species-specific visual mimicry in the mouth pattern of the babies, then genetic species-specific differences occur among the indigobird parasites of these firefinch species. (2) If each local population of indigobirds has a consistent association of breeding plumage and song mimicry of a single species of foster firefinch, and if different sympatric populations each are morphologically distinct and mimic a different species of firefinch, then each population defined as a set of morphologically and behaviorally similar individuals is distinct at the species level. By requiring both of these criteria to be satisfied we can exclude the probability that indigobirds are morphs of a single variable species, even in the absence of evidence for or against assortative mating.

To determine whether geographically remote populations are conspecific or are distinct species, I have relied mainly on my field observations of song behavior in different areas of West Africa.

Hence, if two populations are distinguished as species A and B in one area, by the criteria of the preceding paragraph, then any population that shares the same firefinch song mimicry with A in another area is considered conspecific with A, regardless of whether the male breeding plumage is similar to that of A. In some areas (e.g. northeastern Nigeria) it has been possible to trace morphologically intermediate populations between different areas (northern Nigeria and northern Cameroon) that differ in plumage but mimic the same songs. I have used the geographical distribution of the firefinch species and indigobird populations mainly as secondary supporting evidence of the host-parasite species pairs, but have used it as a best guess to species relationships of certain indigobird populations where no information was available on local song and brood parasitism. Distributional coincidence of indigobird and firefinch species alone is insufficient evidence of parasite-host relations and of species determinations of unstudied indigobird populations in part because the birds in much of West Africa have been observed and collected so incompletely. Species of firefinches have been found within the past 40 years in countries and entire regions where they earlier were unknown (e.g. Bannerman, 1949, knew of only one record of *L. rara* in Africa west of Nigeria; Serle, 1957, collected both firefinches and indigobirds not previously known for eastern Nigeria; Erard and Roche, 1977, discovered a new population of *L. rhodopareia* in Chad). I have therefore used the co-occurrence of certain indigobird and firefinch species with caution, as species will likely be found where they are not now known to occur. As a result of this conservative approach I find it impossible to say which species certain museum specimens of indigobirds are associated with, including certain type specimens.

New field observations in West Africa have provided material to evaluate the species limits in the indigobirds. In the present study I attempt to define the species limits within the group on the basis of the association of (1) mimicry of the mouth pattern of the young host species by the young parasites, (2) mimicry of the song of the host by the adult male parasites, and (3) male breeding plumage. I review the nomenclatural problems within this group. Birds that have been called "*Vidua camerunensis*" and "*Vidua nigeriae*" over the past 60 years (e.g. Bannerman, 1949; Nicolai, 1968; Payne, 1968a, 1973, 1976) each prove to be a composite of three distinct species. Furthermore the original taxonomic descriptions of *camerunensis* and *nigeriae* are inadequate to determine the species involved or to associate with any particular one of the component species. These names are here regarded as *nomina dubia*, and new names of species or subspecies are introduced where necessary to provide an unambiguous name for future work with these birds. Two new species and two new subspecies are described. I also comment on the validity of three recently

described forms of indigobirds (Nicolai, 1972; Payne, 1973) in light of recent field work. Forms not discussed here in detail include those in southern and eastern Africa for which a previous review (Payne, 1973) is appropriate.

ACKNOWLEDGMENTS

I thank Chris Risley, Randy Breitwisch, and Kathy Groschupf for assistance with the field work. Mary G. Dyer found nests and took photographs and tape recordings of firefinches and indigobirds in Nigeria that were essential in showing the species-distinctiveness of the mouth pattern of certain firefinches and the species-specific mouth pattern mimicry of certain indigobirds. G. D. Field, Rev. H. O. Watkins, and P. W. Ball in Sierra Leone, D. S. Djangmah and the Department of Zoology, University of Cape Coast, E. O. I. Asibey and the Department of Game, and M. and D. Lieberman in Ghana, N. J. Skinner, R. E. Sharland, M. I. Dyer, R. Wilkinson, and H. Q. P. Crick in Nigeria, and A. Allo, T. Murphy, S. Braut and the Norwegian Protestant Mission, and J. Surges in Cameroon all were helpful in the field studies in West Africa. For permits and facilities in Zambia I thank W. F. H. Ansell, W. L. Astle, G. B. Kaweche, and G. C. N. Zyambo (National Parks and Wildlife) and R. J. Dowsett and J. Makawa (National Museum of Zambia). I am grateful to the curators of the museums that allowed examination of their material; the museums are identified in Appendix I. Goetz Rheinwald and Jürgen Nicolai made available information on the holotypes of specimens from the Museum Alexander Koenig, Bonn. M. Louette kindly loaned specimens of indigobirds that he collected in Cameroon during the past 10 years, and he provided information on local distribution of *Lagonosticta* species in Cameroon including birds that he observed or collected (since published, Louette, 1981). G. Mauersberger and B. Stephan of the Berlin Museum, Universität von Alexander Humboldt, kindly sent for examination the type specimen of *Lagonosticta rhodopareia umbrinodorsalis* Reichenow 1910. P. R. Colston, I. C. J. Galbraith, K. C. Parkes, J. Steinbacher, M. A. Traylor, C. Voisin, and R. L. Zusi provided further information on specimens and localities. Mary Dyer, John Elgood, Hilary Fry, Arthur Green, and Frank Walsh made available their sight observations of firefinches and indigobirds. Peggy Moore, Selma Isil, and Laura Payne helped in audiospectrographing the songs. Janet Hinshaw, Elizabeth Johns, Margaret Van Bolt, and David Westneat prepared the manuscript and illustrations for the printer. For critical comments on the manuscript I thank Luis Baptista, Ken Creighton, John W. Fitzpatrick, William D. Hamilton, Philip Myers, and Robert W. Storer. Reeve M. Bailey suggested the parallel of species indeter-

minacy of certain type specimens of larval fishes with that of the indigobirds. The research was supported by the National Science Foundation (BMS75-03913, BNS78-03178), a research grant from the National Geographic Society, and the Research Fund of the University of Michigan Museum of Zoology.

METHODS AND MATERIALS

My field work in West Africa involved five expeditions, the first two of which have in part been reported. (1) Nigeria, 12 July–7 September 1968 (Payne, 1968a, 1973, 1976), (2) Sierra Leone, 8–27 December 1973 (Payne, 1976), (3) Ghana (Legon, Cape Coast, Elmina, Damongo, Larabanga, Mole National Park) 5 September–24 November 1975, (4) Cameroon (Garoua, Ngaoundéré, Tibati, Banyo), 2 January–12 February 1979, and (5) Cameroon (Garoua, Ngaoundéré, Tibati, Mbakaou, Banyo), 16 October–12 November 1980, and Nigeria (Kano, Rano, Zaria, Dumbi Hill, Yankari, Enugu, Kagoro, Kogum), 15 November–2 December 1980 (Fig. 1). Field work was also carried out over several years in south-central Africa in Zambia from 1972 to 1979. Birds were sought out, songs were tape-recorded, and when possible some individuals were shot or captured in mist nets for comparison with museum specimens. All available museum specimens were examined.

Songs of indigobirds were recorded in the field with a Uher 4000-series tape recorder at 19 or 9.5 cm/sec using a Uher M-516/517 microphone and a 60-cm metal parabolic reflector (except in 1973, when no reflector was available). From 1975 onward an attempt was

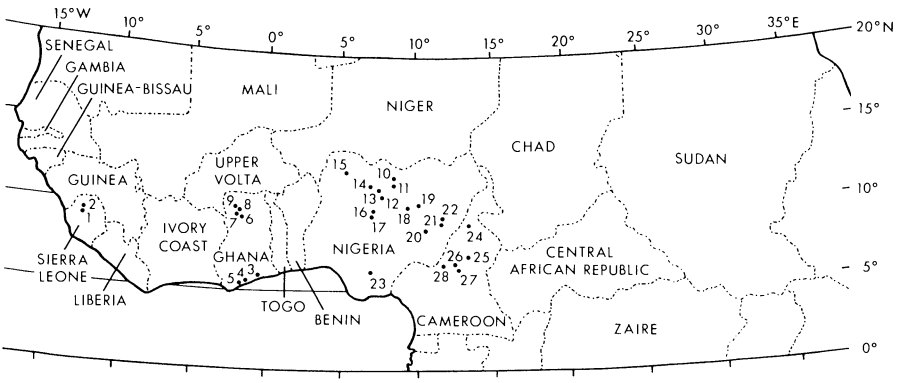

Fig. 1. Map of countries of West Africa. Numbers indicate the localities of field observations in the present field work, 1968–1980. 1 Kabala, 2 Musaia, 3 Legon, 4 Cape Coast, 5 Elmina, 6 Damongo, 7 Larabanga, 8 Mole National Park headquarters dam, 9 Lovi, 10 Kano, 11 Rano, 12 Dumbi, 13 Zaria, 14 Gusau, 15 Sokoto, 16 Kagora, 17 Kogum, 18 Panshanu, 19 Bauchi, 20 Yankari, 21 Numan, 22 Kiri, 23 Enugu, 24 Garoua, 25 Ngaoundéré, 26 Tibati, 27 Mbakaou, 28 Banyo.

made to record at least 100 songs from each bird to sample the individual's repertoire of both mimetic and nonmimetic songs. All songs were analyzed spectrographically using either a Kay Elemetrics "Vibralyzer" 7030-A (wide-band setting) or a Princeton Applied Research FFT 4512 Real Time Spectrum Analyzer with 35 mm film. Approximately 5400 West African indigobird songs were examined. One bird that was netted but not recorded in the field was recorded in captivity after being implanted with testosterone. For comparison the songs and calls of firefinches were recorded in the field and in captivity for all species, and were audiospectrographed in the same manner. Similarities in the audiospectrograms of firefinches and indigobirds were the basis for recognizing song mimicry in the indigobirds. Illustrations of the songs in this paper were prepared using high-contrast photography of the Kay audiospectrograms.

Measurements of specimens were taken as follows: Wing, flattened, bend of wing to tip of longest primary. Tail, from insertion of central rectrices to tip of longest rectrices. Bill length, from base of bill to tip of bill. Bill width, from lateral extremeties of the rami of the lower jaw. Tarsus, from proximal end of tarsometatarsus on ventroposterior surface to distal end of last undivided tarsal scute on anterior surface.

The indigobirds generally retain an incompletely pneumatized condition of the skull well past the first year; fewer than 5% of all birds collected had a completely pneumatized skull. In both captive and wild indigobirds the skull does not pneumatize completely until the bird is at least three years of age. Nevertheless, birds often appear in full breeding plumage at only one year of age. In captive birds and in birds color-banded in the field in Zambia and observed over a period of four years, no change is apparent in breeding plumage with age (Payne, 1973; Payne and Payne, 1977). It is unlikely that any variation in plumage color observed in the present study is related to age. Birds in their first breeding season generally have less than half of the dorsal aspect of the cranium completely pneumatized (stippled appearance due to columns of bone between the two layers of the skull); older birds have more than half of the dorsal aspect pneumatized. In the descriptions of new forms in the present paper I have included only the older birds, where the skull was more than half pneumatized.

The colors used to describe male breeding plumage for all specimens collected are those of a comparison series of 9 museum specimens that were used as color standards (Table 1). Photometric spectral reflectance curves for these specimens have been published (Payne, 1973: 212, 214). Colors used for the plumage of indigobirds that were seen in the field but were not collected are used in a more general sense. In these cases "green" corresponds approximately to the classes 1–3 of Table 1, "blue" to classes 4–6, and "purple" to

TABLE 1

COLOR STANDARD SPECIMENS USED FOR DESCRIPTIONS OF INDIGOBIRD BREEDING PLUMAGE

Color description	UMMZ specimen	Methuen color equivalent[1]	
		color plate chip	color name
green	217280	25F7	dark green
blue-green	217279	24F8	dark turquoise
bluish-green	217278	22–23F8	dark blue
green-blue	217277	22F8	dark blue
blue	217276	21F8	dark blue
purple-blue	217275	19–20F8	blackish blue
purplish-blue	217274	18F8	dark violet
bluish-purple	217273	17–18F8	dark violet
purple	217272	17F8	dark violet

[1]Methuen color equivalent refers to the color plate chip and color name in Kornerup and Wanscher (1967) that is most similar to the color standard specimen. The color descriptions in the first column are used throughout to indicate the color of museum specimens of males in breeding plumage.

classes 7–9. Colors of the bill and feet were described from the live bird or just after the bird was collected, using the plate, row, and column numbers (hue, intensity, and tone respectively) and the color names of these plates in a field color guide (Kornerup and Wanscher, 1967). For birds that were collected when the guide was not used, the colors were subjectively recorded. All color notes were made within 5 minutes of the time that the bird was netted or found in the nest (or shot, in the case of a few adults).

The colors of the mouths of the live young birds were compared directly in the field to the color plates (Kornerup and Wanscher, 1967). Most young also were photographed. Mouth patterns and colors for certain birds were recorded from color photographs alone (Kodachrome K25 or K64) in the field, rather than with the guide. The films were highly accurate in color reproduction, judging from color comparisons of the transparencies of the mouth markings and of the color plates with notes made from the live birds. The film images were therefore used as a source of mouth colors for certain young birds. The mouth colors of the young change with age. After fledging (about 18 days after hatching: Morel, 1973; Payne, 1973) the young firefinches and indigobirds retain the colors for about 2–3 additional weeks, when they then become independent of the adult firefinches. The palate colors in the young firefinches then become obscured by melanin, which spreads from the black palate spots (Kunkel and Kunkel, 1975), and the tubercles at the gape darken and regress. The palate colors of the young indigobirds fade, the spots do not spread but sometimes persist into the adult in the form of gray points (fading from the larger black spots of the young) and the tubercles lose their original color and regress at about the same rate as

in the young firefinches (Payne, 1973, observations in the present study). Thus the characteristic colors of the mouths of the young finches appear for only about 5–6 weeks after hatching. The colors also change rapidly (within 5 minutes) after death. Museum specimens (skins and pickles) show none of the colors of the mouths of the live young finches, though the pickles retain the shape of the gape tubercles and the ring of five black spots. These spots are similar in all species of firefinches and indigobird young (Payne, 1973, the present study) and do not offer further diagnostic information.

The determination of indigobird species depends largely upon specimens of known song. Because certain indigobird species vary in color across West Africa, and because I have not visited all areas that are represented in museum collections, populations occur for which the song- and the host-species relationship and hence the species of indigobird involved is unknown. Although the following description summarizes the variation within the known indigobird species over several areas of West Africa, it has been impossible to identify the indigobird specimens of some areas to species.

For purposes of the description of variation in the indigobird species, particularly the pale-winged species other than *V. chalybeata*, I take the area of "West Africa" to include all areas between the equator and 20°N (indigobirds approach this latitude along the Nile River) and west of the eastern boundaries of Sudan and Zaire. Biologically the fauna and flora of the open woodlands extending between the equatorial forests and the Sahara are broadly quite closely related (Keay, 1959; Moreau, 1966; Werger and Coetzee, 1978). This is true particularly in the vegetation belts included in Keay (1959) type 8 (forest-savannah mosaic), 16, 17, and 20 (moist woodlands and savannas). The vegetation belts extend eastward into Uganda as do the host species of firefinches (Hall and Moreau, 1970; Payne, 1973; Britton, 1980), but the indigobirds apparently do not; only the widespread *V. chalybeata* is known in Uganda (Payne, 1973). One species of pale-winged indigobird also extends up the Blue Nile valley into Ethiopia and is mentioned, but otherwise *V. chalybeata* is the only indigobird on the Ethiopian plateau, a biologically distinct region.

Vidua chalybeata (MÜLLER)

VILLAGE INDIGOBIRD

The Village Indigobird *V. chalybeata* is widespread over bushy country in Africa, avoiding deserts, humid woodlands, and forests. The species is the best-known indigobird both systematically and biologically (Morel, 1973; Payne, 1973, 1979; Payne and Payne, 1977).

Fig. 2. Mouths of two nestling Red-billed Firefinches *Lagonosticta senegala*, in their nest at Muckleneuk Farm, Choma, Zambia, April 1973. Note the conspicuous white tubercles at the gape and the pattern of five black spots on the palate and roof of the mouth. The identity was determined by rearing the young in captivity under a foster species, the Bengalese Finch *Lonchura striata*.

Throughout West Africa the male in breeding plumage is distinguishable from other indigobirds by the black or dark brown color of the flight feathers of the wing and tail, and by the orange feet (Payne, 1973). The flight feathers of the other species in West Africa are pale brown. Foot color of *V. chalybeata* however varies with the breeding condition of the bird, and late in the season birds may have feet as pale as some other local species. Females sometimes have bright orange feet, but at Garoua, Cameroon, in October 1980, females that visited male *V. chalybeata* on their call-sites had pale feet, including one female with an egg in the oviduct. The species is generally smaller (mean wing length) in both sexes than are the other West African indigobirds.

V. chalybeata is a species-specific brood parasite of the Red-billed Firefinch *Lagonosticta senegala*. The young indigobirds mimic the mouth pattern of the young firefinches, with which they are reared together in the nest by the adult firefinches. The mouth pattern consists of a yellow hard palate, an orange roof of the mouth, five black spots arranged in a circle on the hard palate, white tubercles at the gape, each with a dark blue base, and a blue commissure between the white tubercles (Nicolai, 1964; Morel, 1973; Payne, 1973; Figs. 2, 3). I have seen this pattern in several subspecies of *L. senegala*

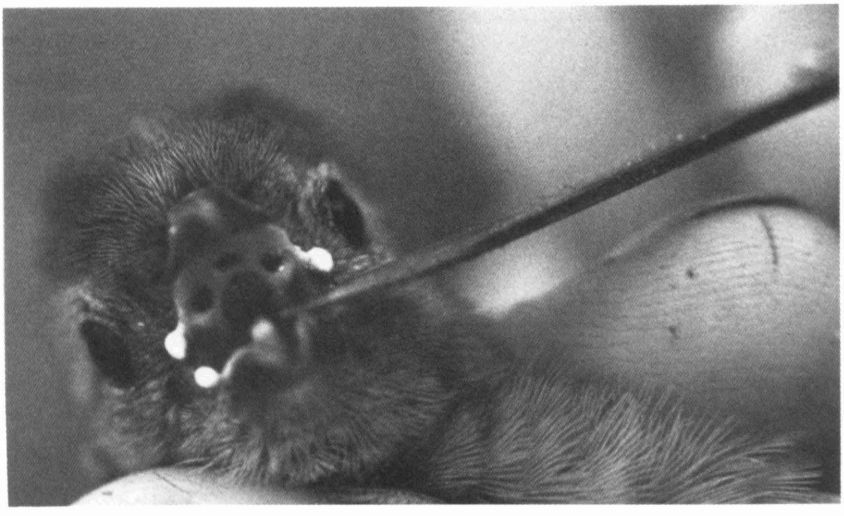

Fig. 3. Mouth pattern of a juvenile Village Indigobird *Vidua chalybeata* at Lochinvar National Park, Zambia, June 1972. The bird was recently independent and was attracted to a singing adult male *V. chalybeata*, where he was caught in a net. Note the similarity in shape and coloration of the tubercles to that of the foster species *L. senegala*. Juvenile indigobirds can be distinguished from juvenile firefinches by their streaked plumage on the head and back, and by the brown, not red, feathers of the rump.

including captive *L. s. senegala* from Senegal and in wild juveniles in Nigeria (Zaria) and Cameroon (Garoua). I have not observed live young of the West African *V. chalybeata*, but I have photographed nestlings and juveniles in Zambia, and they have the same colors as in the local *L. senegala*, which match the West African *L. senegala*. In Senegal, M.-Y. Morel found the local *V. chalybeata* to match the mouths of the nestling *L. senegala* (Morel, 1973, in litt.). Nicolai's birds, illustrated in color (Nicolai, 1964) from birds observed in Tanzania, had the same pattern. Some variation may occur in *L. senegala* in that some individual young have three black spots, not five (Serle, in Bannerman, 1949; Payne, 1973), but all young that I have seen in West Africa had five spots. All kinds of indigobirds and all species of firefinches have five black spots arranged in the same pattern (Payne, 1973); only the tubercles and mouth lining differ in color and pattern among the species.

Male *V. chalybeata* mimic the calls and songs of *L. senegala*. These appear to be learned from the foster parents and also from other indigobirds that mimic the same species of fosterer (Payne, 1973, 1980, unpublished observations). Each male indigobird sings several variations of mimetic song, although each individual firefinch has only one song type. Examples of mimicry of song in West African *V. chalybeata* are shown in Fig. 4.

The distribution of *V. chalybeata* in West Africa falls within the

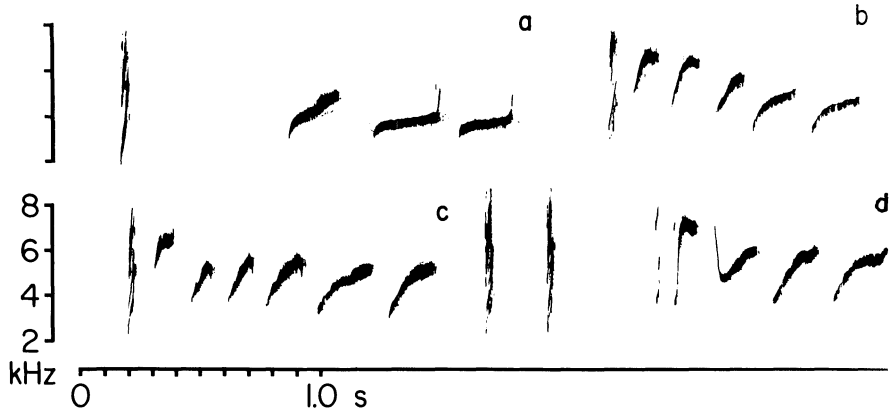

Fig. 4. a, song of Red-billed Firefinch *Lagonosticta senegala* at Zaria, Nigeria, 19 July 1968. b, mimetic song of Village Indigobird *Vidua chalybeata* at Dumbi Hill, Nigeria, 30 November 1980. c,d, mimetic songs of a *V. chalybeata* at Zaria, Nigeria, 1 August 1968. Note the introduction of each song with an abrupt alarm note, and the slurred, usually rising notes, which are similar in form to the contact notes of *L. senegala* (Payne, 1973). Each firefinch generally has a single song type, and each indigobird has several mimetic song types (e.g. c,d).

distribution of its host species *L. senegala* (Fig. 5). Localities on which the maps are based are listed in Appendix I and II. The breeding seasons of the two match closely, with both species tending to breed mainly July to October throughout West Africa (Morel, 1973; Payne, 1973). As noted in more detail elsewhere (Payne, 1973), the breeding seasons of all species of *Lagonosticta* are about the same in any local area. All species of *Vidua* indigobirds that live together locally have a similar breeding season as well, and no species differences are evident.

Vidua chalybeata chalybeata (MÜLLER)

Fringilla chalybeata P. L. A. Müller, 1776, Des Ritters Carl Von Linne . . . vollstandiges Natursystem . . . , p. 166: "Brasilien" (Senegal substituted by W. L. Sclater, 1930, Syst. Avi. Aethiop., p. 807). Holotype: apparently none.

syn. *Hypochera aenea* Hartlaub, 1854, J. Ornithol. 2, p. 115: Senegambia. Holotype: Bremen Museum, not examined (Bannerman, 1949:372).

Diagnosis.—Within the species, the nominate subspecies is characterized by a male breeding plumage that ranges among birds from glossy green to glossy blue-green. The flight feathers are black. The size is smaller than in the forms of east and southern Africa (Payne, 1973) with male wing length averaging 62.73 ± .48 S.D. mm (range 60–65 mm) in 80 birds from Senegal, but not different from the other West African subspecies of *V. chalybeata.* Females from Senegal are small (wing length of *V. c. chalybeata* averages 60.56 ± 1.42 mm, range 57–62 mm, N = 9) but overlap in size females of other species of

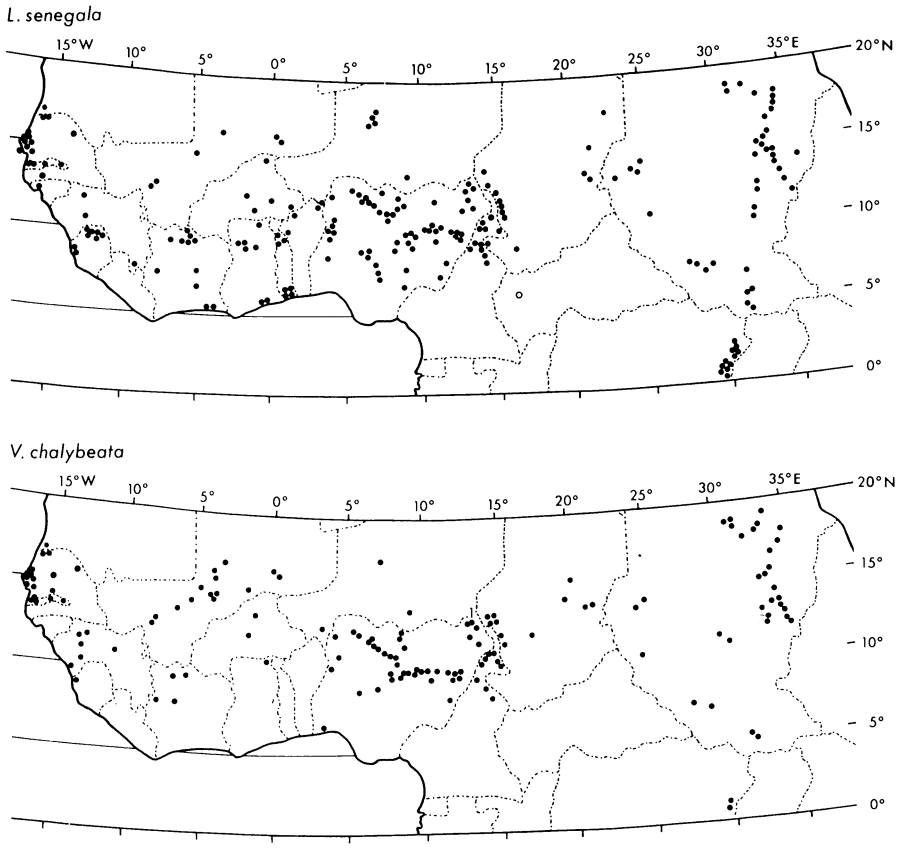

Fig. 5. Distribution of the Red-billed Firefinch *Lagonosticta senegala* and its mimetic brood parasite, the Village Indigobird *Vidua chalybeata*, in West Africa. The open figure represents a sight observation requiring confirmation (see Appendix I).

West African indigobirds (see Table 4). Foot color in the one female with data was reddish brown. Females are indistinguishable from other forms of indigobirds in West Africa in their plumage.

Distribution.—*V. c. chalybeata* occurs in the Upper Guinea region in Senegal, The Gambia, Guinea, and Sierra Leone, into Mali, where it intergrades with the bluer subspecies *V. c. neumanni* to the east. The greenest birds occur in Senegal and Guinea. Greenish-blue birds and birds intermediate between green and greenish-blue also occur in Senegal and Guinea with no apparent geographic difference.

Vidua chalybeata neumanni (ALEXANDER)

Hypochera neumanni Boyd Alexander, 1908, Bull. Brit. Ornithol. Club, 23, p. 33: Yo, near Lake Chad [Northern Nigeria]. Holotype: BMNH 1911.12.23.3306, male in breeding plumage.

Diagnosis.—*V. c. neumanni* is characterized by a male breeding plumage of glossy blue; the flight feathers are black. In size the birds are small (wing length averages 61.40 ± .75 mm, range 59–64 mm, in 25 birds from Nigeria). Wing length of 8 females taken in Cameroon and Nigeria in the present study, from black-winged males at their mating sites, was 59.13 ± .99 mm, range 58–61 mm. With the samples available, most females in West Africa with a wing length of less than 61 mm are *V. chalybeata*; other species however have females as small as 60 mm (see Table 4). Females are not distinguishable from those of other West African indigobirds in color or pattern of the streaked plumage. Foot color of the 6 females from Nigeria was orange to light pinkish orange and pinkish, slight orange cast (all birds taken in August), and foot color of the 2 from Cameroon was reddish-grey 8C(2-3) and pastel red 7(A-B)4. All female *V. c. neumanni* had orangish feet, as did some females of other species (see Table 4). Bill color was whitish to brownish or gray, indistinguishable from the other West African indigobirds.

Male breeding plumage intergrades in color with the blue-green of *V. c. chalybeata* in Mali and with the purplish-blue of *V. c. ultramarina* in Sudan. Birds of the Sudan are more purplish-blue than birds of Nigeria, though some (Darfur, but also scattered localities along the White Nile and the Nubian Nile) are indistinguishable from birds of Nigeria. Traylor (1968) regarded *neumanni* as a synonym of *ultramarina* but noted that "the western birds average more bluish." The holotype of *V. c. ultramarina* (Gmelin 1789) was not located (and probably does not exist), but most of the 61 specimens examined of males in breeding plumage from Ethiopia are more purplish than any of the 66 specimens of males from Sudan.

Distribution.—Blue-glossed, black-winged *V. chalybeata* range across West Africa from Mali to Sudan. They are found north of the forest and approach the coast only around Lagos, Nigeria, and from Sierra Leone northwards through Senegal. They occur in several isolated, vegetated areas along the southern edge of the Sahara (Agadez and the Aïr Mountains, Niger), and are the common indigobird along the Niger River north of 12°N, around Lake Chad, and along the Nile.

Vidua chalybeata centralis (NEUNZIG)

Hypochera chalybeata centralis Neunzig, 1928, Zool Anz., 78, p. 113: Kissenji [Rwanda]. Holotype: Berlin Museum 278, male in breeding plumage.

syn. *Hypochera ultramarina* (Gm.) var *orientalis* Reichenow, 1894 Vögel Deutsch-Ost-Afrikas, 3, p. 188: Paregebirge [northeastern Tanzania]. Holotype: not located.

syn. *Vidua chalybeata okavangoensis* Payne, 1973, Ornithol. Monogr., 11, p. 234. Maun, Botswana, at the edge of the Okavango Swamp. Holotype: UMMZ 217254, male in breeding plumage.

Diagnosis.—Within the species, *V. c. centralis* is characterized by a breeding plumage of dull blue to greenish-blue; the flight feathers are brown. The birds are larger than the forms *V. c. chalybeata, V. c. neumanni,* and *V. c. ultramarina,* with little overlap in wing length. The wing length of 109 males from Kenya (excluding the coast) averages 67.17 ± .49 mm (range 64–70 mm), 22 males from Uganda average 67.09 ± .75 mm (range 65–70 mm), 35 from Zaire (Kivu and Haute-Zaire: Ituri) measure 67.71 ± .50 mm (range 64–70 mm), and 24 from northern Botswana measure 66.13 ± .76 mm (range 64–69 mm) Payne, 1973). Females average larger than females of these other three subspecies, with mean wing length in 13 females from Kenya of 64.69 ± .79 mm (range 63–67 mm) and 11 from Botswana with 63.18 ± 1.0 mm (range 61–66 mm). Foot color of both sexes is orange. Males have white bills; females have whitish or light horn bills. The birds differ from the three forms compared above in their larger size, dark brown (not black) flight feathers in male breeding plumage, and by a duller gloss in the male breeding plumage. They differ from *V. c. amauropteryx* of southern Africa in having the bill white, not reddish, in both sexes. The flight feathers are darker brown than in the other West African species; the females are similar in breeding plumage but most are more heavily streaked above than the other West African species.

Distribution.—This subspecies enters the area here considered "West Africa" in the Ituri region of Zaire, southwest of Lake Edward (= Lake Mobutu Sese Seko). The form is widespread in Kenya, Uganda, Rwanda, Burundi, Tanzania, Zaire (Kivu), Angola, Namibia (= South-West Africa), and the Western Province (formerly Barotseland) of Zambia from Balovale southward (Payne, 1973). To this range should be added the western Cape Province of South Africa (Aughrabies Falls on the Orange River); the only local firefinch is *L. senegala* (Winterbottom, 1968: 254, *in litt.*). I also found it in the Northern Province of Zambia and tape recorded it at Sumbu, Zambia, on Lake Tanganyika, in March, 1972, where it mimicked the local songs of *L. senegala.*

Between the northeastern and western ends of Zambia, *V. c. centralis* is replaced by *V. c. amauropteryx. V. chalybeata* is not known with certainty to occur in southern Zaire, and the eastern and western white-billed birds appear to be geographically separated. The foot color was not recorded in most museum specimens of indigobirds taken in southern Zaire, and because *V. c. centralis* and *V. funerea nigerrima* both have dull blue-glossed plumage and dark brown wings, it is impossible to identify indigobirds to species in this region without foot color data (orange or red in *V. chalybeata,* whitish in *V. f. nigerrima,* Payne, 1973). The 2 (of 16) male specimens from Shaba (= Katanga) and Tanganika areas of southern Zaire with

foot color data were whitish footed *V. f. nigerrima.* Only 2 of the 8 male indigobird specimens from Kasai in southwestern Zaire had foot color data; both birds (BMNH 1953.54.473, 1953.54.475), from St. Joseph Mission, Luluabourg (= Kananga), had "roses" (probably reddish) feet and were likely *V. chalybeata.* Both *L. senegala* and *L. rubricata* (the host species of *V. funerea nigerrima*) occur at this locality (Payne, 1973). Eastern and western populations of *V. c. centralis* are possibly linked through southern Zaire.

Nomenclature.—The name *Vidua chalybeata orientalis* (Reichenow, 1894) is preoccupied by *Vidua paradisaea orientalis* (Heuglin, 1871), as the indigobirds and the paradise whydah species complex are considered congeneric. In addition to the morphological similarity of the females, hybrid specimens are known between the species groups (Payne, 1980). As the two groups are best united in the genus *Vidua,* the next oldest name, *Vidua chalybeata centralis* Neunzig, is appropriate for the present subspecies.

V. c. okavangoensis Payne 1973 was described on the basis of difference in bill color in the birds of the Okavango region and the form *V. c. amauropteryx* (Sharpe) of southern Africa. Although this difference is consistent throughout the region, the Okavango birds are not morphologically distinguishable from *V. c. centralis* of East Africa. In size the southern birds average smaller, but the differences are slight, and there is considerable overlap. No color differences are apparent. *V. c. okavangoensis* should then be regarded as a synonym of *V. c. centralis.*

Vidua raricola, NEW SPECIES

JAMBANDU INDIGOBIRD

Holotype. UMMZ 204008, male in breeding plumage, collected by R. B. Payne (no. 6495) on 6 November 1980 at Banyo, Cameroon, 6° 45′N, 11° 50′E, at 1050 m.

?syn. *Hypochera nigeriae* Alexander, 1908, Bull. Brit. Ornithol. Club, 23, p. 15: Kiri, R. Gongola [Nigeria]. Holotype: BMNH 1911.12.23.3302, male in breeding plumage. The name is a *nomen dubium.*

? syn. *Hypochera chalybeata camerunensis* Grote, 1922, J. Ornithol., 70, 398: Weg Nola-Mbaiki, südöstliches Neukamerun [= Central African Republic]. Holotype: Berlin Tessman 950, male in breeding plumage. The name is a *nomen dubium.*

? syn. *Hypochera chalybeata sharii* Bannerman, 1922, Bull. Brit. Ornithol. Club, 43, p. 29: Ratu, Gribingui River, French Equatorial Africa [= Central African Republic]. Holotype: BMNH 1911.12.23.3308, male in breeding plumage. The name is a *nomen dubium.*

Description of Holotype.—Plumage glossy green (25F7), white patch on flanks, wings light brown (outer edge of primaries 5C4, vane of flight feathers 5D3), bill white, feet reddish grey (11B2) (color code of Kornerup and Wanscher, 1967), iris dark brown, no fat, no molt, wing 65 mm, tail 39 mm, bill length 6.4 mm, bill width 6.0 mm, tarsus 15 mm, weight 11.8 g, skull 30% unpneumatized, testes enlarged (6×4 mm). Its song mimicked *Lagonosticta rara* (recorded on tape RBP 1980 52B; see Fig. 9).

Supporting material on which the species is described includes 7 males in glossy green breeding plumage, 1 male in mixed breeding and nonbreeding plumage, 1 male in nonbreeding plumage, five females, and three male and female juveniles, taken at Banyo and Ngaoundéré, Cameroon, in 1979 and 1980. The adult males all were tape-recorded and mimicked the songs of *Lagonosticta rara*. The two younger juveniles, both from Banyo in January 1979, had the mouth pattern of nestling *L. rara*. The females were netted at the call-sites of males that mimicked the songs of *L. rara*. The supporting material also includes a green male from Sierra Leone (song recorded) and two bluish-green to green-blue males from Ghana (song of one recorded). Specimens are identified in Appendix I. Localities where I have tape-recorded indigobirds as mimics of *L. rara* are Ngaoundéré, Tibati, Mbakaou, and Banyo in Cameroon, Lovi (Mole Park) and Damongo in Ghana, and Kabala in Sierra Leone.

Diagnosis.—The species *V. raricola* is characterized among the indigobirds by the mouth pattern of the immature birds, which mimic the mouth pattern of nestling Black-bellied Firefinches *Lagonosticta rara*. The pattern consists of a gray-pink palate (pink proximally) with five black spots, a large reddish or magenta spot on each side of the lateral aspect of the palate, and a pair of pale blue tubercles at each side of the gape with blue color becoming dark blue at the base (Figs. 6, 7, Table 2). The species is also characterized to a limited extent by the breeding plumage of the male. Breeding plumage is blackish with a green to blue gloss, the color varying from region to region in West Africa but consistent within a local population. The flight feathers are pale brown. The bill is whitish. Foot color in 8 males examined in Cameroon ranged from greyish-orange (6B3) to reddish grey (11B2). This range of color overlapped completely the color of the blue-plumaged *V. funerea* and the purple-plumaged *V. wilsoni* which occured together with *V. raricola* at Banyo, Cameroon. Males of this species mimic the songs of their host species *L. rara*. Plumage color is identical to that of some populations of other species of indigobirds (Table 3). The bill and foot color likewise are similar to that of the other three species of pale-winged indigobirds in West Africa. Nevertheless, the morphogenetic unique-

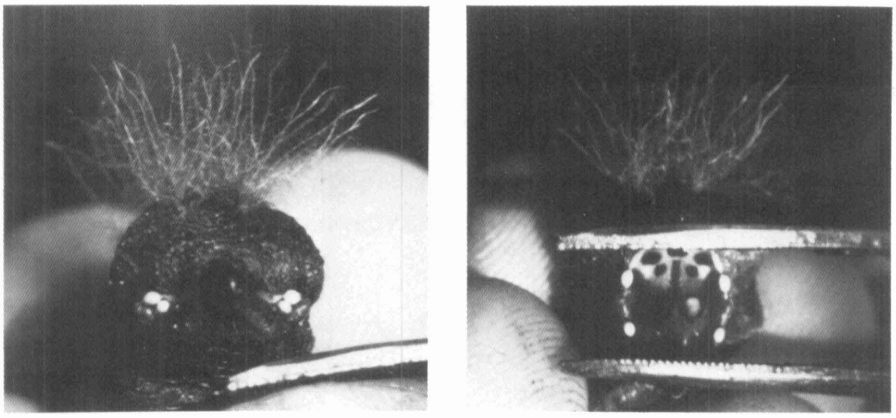

Fig. 6. Mouth pattern of a nestling Black-bellied Firefinch *Lagonosticta rara* at Zaria, Nigeria, 21 November 1975. Note the configuration of the gape tubercles in the open and closed mouth, the richly pigmented gape area (violet red to dark blue) between the pale (blue) tubercles, the dark (violet red) area on the sides of the roof of the mouth, and the ring of five black spots on the pale (purplish white to pale reddish lilac) palate and roof of the mouth. Photograph by M. G. Dyer.

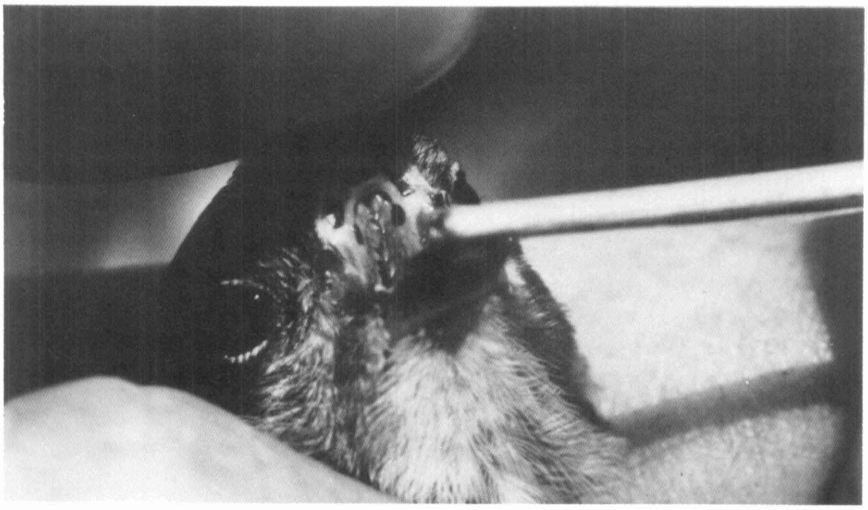

Fig. 7. Mouth pattern of a juvenile Jambandu Indigobird *Vidua raricola* caught on 21 January 1979 at Banyo, Cameroon. The colors and pattern matched those of the Black-bellied Firefinch *Lagonosticta rara.*

ness of certain young indigobirds in mimicking the mouth pattern of *L. rara,* the restriction of these young to the localities where *L. rara* occurs and where adult male indigobirds mimic the songs of *L. rara,* and the morphogenetic distinctiveness of these males from other locally sympatric male indigobirds that mimic other species of firefinches in Cameroon and in Sierra Leone together indicate that the population behaves as a species distinct from the others. This

TABLE 2

MOUTH PATTERN OF YOUNG FIREFINCHES *LAGONOSTICTA* AND INDIGOBIRDS *VIDUA* IN WEST AFRICA

Firefinch species	Indigobird species	Color of mouth lining of model and mimic[a]			
		Tubercles tip/base	Commissure	Horny palate	Buccal cavity
L. senegala	*V. chalybeata*	white/blue 19B7	blue 19B7	pastel yellow 2A3–4	orange ("pastel red") 10A5
L. rara[b]	*V. raricola*	pale blue 21A3/ dark blue 21E6	violet red 14B7 to bluish gray 22B3	purplish-white 14AB2 to purplish grey 14B2	purplish white 14A2 to reddish lilac 14B4; lateral spots violet red 14B7
L. larvata[b]	*V. larvaticola*[b]	pale blue 21A3/ dark blue 21E5	dark blue 21E6 to pale yellow 4A3	pale yellow 4A3	orange 4B6–5A6
L. rubricata	*V. funerea*	blue 20A2/19B7	blue-black 18B4	pale yellow 3B2-4A3	pink ("pinkish white") 9A2
L. rufopicta	*V. wilsoni*	white flange (no tubercles)	white to dark blue 21E7	reddish lilac 14B2	reddish lilac 14B4

[a]Color codes refer to Methuen color guide (Kornerup and Wanscher, 1967).

[b]Colors of *L. rara*, *L. larvata*, and *V. larvaticola* were taken from color film transparencies; colors of other species were taken from the live bird in the field and confirmed with color film.

TABLE 3

MEASUREMENTS OF MALE INDIGOBIRDS OF THE PALE-WINGED SPECIES COMPLEX IN WEST AFRICA INCLUDING SPECIMENS OF KNOWN SONGS.[1]

Species	Plumage[2] color	Locality	Song mimicry	N	Wing, mm		
					$\bar{x}$	SD	(max-min)
V. raricola	1-green	Cameroon	*L. rara*	8	63.25	1.83	(60–66)
	3-bluish-green	Ghana	" [3]	2	63.0	–	(63–63)
	1-green	Sierra Leone	" [3]	2	62.5	–	(62–63)
V. larvaticola	3-5-bluish-green to blue	N. Nigeria	*L. larvata*	15	65.27	.70	(65–67)
	3-bluish-green	Cameroon (Garoua)	"	1	63.0	–	–
	4-5-blue	Chad, C.A.R.	" [4]	8	64.25	1.16	(63–66)
V. funerea sorora	5-blue	Cameroon	*L. rubricata*	4	64.5	1.29	(63–66)
	5-blue	Cameroon	" [5]	11	65.09	1.22	(63–67)
	3-6-bluish-green to purple-blue	E. Nigeria (Enugu)	" [6]	31	64.68	.98	(63–67)
	5-blue	Sierra Leone	" [7]	7	62.86	1.07	(61–64)
V. funerea maryae	1-green	N. Nigeria	"	2	67.5	–	(67–68)
V. wilsoni	7-9-purplish-blue to purple	Cameroon, Nigeria, Ghana	*L. rufopicta*	7	62.44	1.33	(60–65)

[1]Samples from areas of less certain song- and host-species association are not included.

[2]Color numbers and descriptions refer to color standard specimens of indigobirds (Table 1).

[3]One bird was tape-recorded; the other was caught in the same site on the same day.

[4]None were recorded; most were associated with *L. larvata* by distribution, but the sample may include other blue species as well.

[5]None were recorded; birds were associated with *L. rubicata* by local distribution but the included Tibati specimens also occurred with other firefinch species.

[6]None were recorded (Serle, 1957).

[7]None were recorded; other blue birds at Kabala mimicked *L. rubricata*, and the specimens measured all were associated with *L. rubricata* by distribution.

TABLE 4

MEASUREMENTS OF FEMALE INDIGOBIRDS TAKEN WITH MALES OF KNOWN SONG AND PLUMAGE[1]

Species	Catalog no. UMMZ	Identity of Male		Locality	Wing (mm)	Foot color[2]
		Plumage color	Song mimicry			
V. raricola	220057	green	*L. rara*	Kabala, Sierra Leone	62	grey-mauve 14(C–D)3
	204001	"	"	Ngaoundéré, Cameroon	64	gray-orange (=brownish orange) 7C3
	204002	"	"	"	60	" 7 (B–C) (2–3)
	204003	"	"	"	65	" (greyish-orange) 6B4
	204005	"	"	"	61	dull red 9C4
	–	"	"	"	63[4]	" 9C4
	204013	"	"	Banyo, Cameroon	64	greyish-orange 6B3
V. larvaticola	217003	bluish-green	*L. larvata*	Zaria, Nigeria	64	whitish mauve
	217002	"	"	"	61	pale purplish gray
	217004	"	"	"	65	whitish-pink-mauve
	217005	"	"	"	62	med. light purplish gray
	217007	blue	"	"	64	pinkish flesh-gray
	217006	bluish-green	"	Panshanu, Nigeria	65	quite pale fleshy gray-whitish
V. funerea	204015	blue	*L. rubicata*	Banyo, Cameroon	62	greyish-red 7B3
	204017	"	"	"	62	dull-red 8C3
	217008	green	"	Panshanu, Nigeria	64	pink-gray-flesh
V. wilsoni	220782	purplish-blue	*L. rufopicta*	Cape Coast, Ghana	62	gray-mauve-white
	220781	purple[3]	"	Mole, Ghana	60	horn gray
	217016	"	"	Zaria, Nigeria	63	light purplish
	217017	"	"	"	63	light gray with pink-purplish tinge

[1]Table does not include females taken from black-winged males (*V. chalybeata*).
[2]Color numbers and letters refer to plate, column, and row numbers of Kornerup and Wanscher (1967).
[3]Male not captured; sight observation only.
[4]Female color-banded and released.

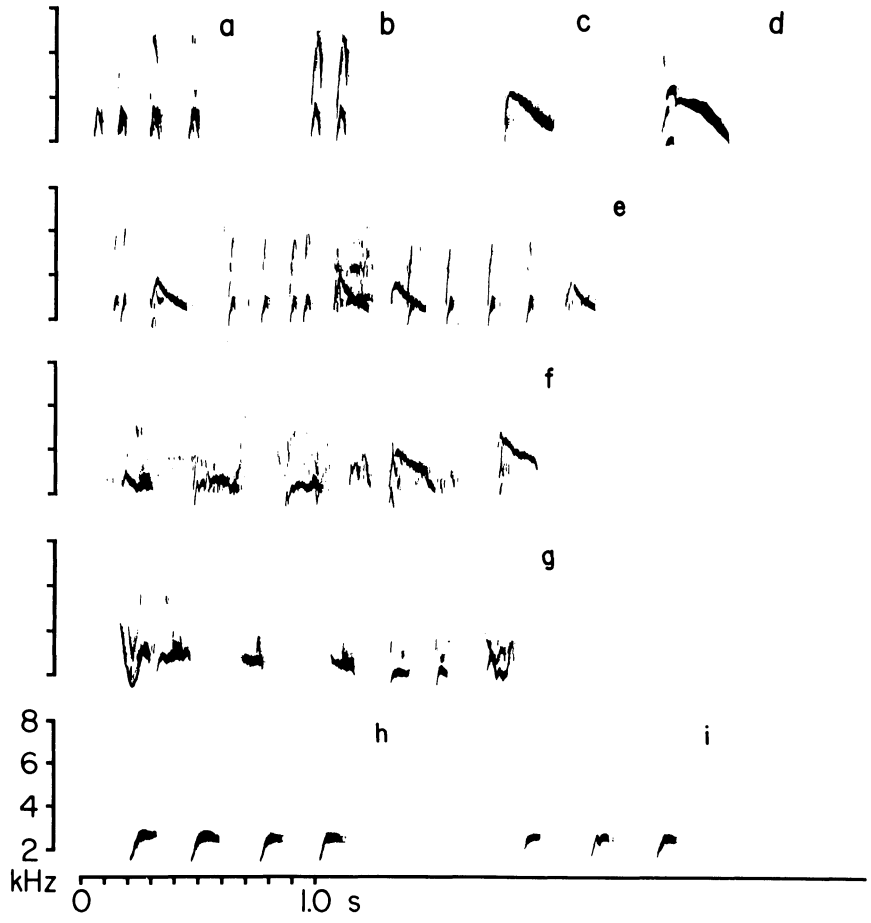

Fig. 8. Calls of the Black-bellied Firefinch *Lagonosticta rara* recorded in northern Nigeria. a, alarm calls, adult male, Dumbi Hill, 30 November 1980. b, alarm calls, Zaria, 1976. c, contact call, Zaria, 1980. D, contact call, Zaria, 1976. e, mated pair, one giving alarm calls and the other giving contact calls, Zaria, 1980. f, g, apparent unstereotyped, soft songs, Zaria, 1980. h, i, repeated calls of male *rara*, Zaria, 1976. The calls in b, d, h, and i were recorded in the field by M.G. Dyer.

diagnosis recognizes that it may be impossible to identify to species those birds in regions where the song behavior is unknown.

Female *V. raricola* are morphologically similar to other species of indigobirds as adults. Five females caught at the call-site of a green male *V. raricola* song mimic of *L. rara* at Ngaoundéré, Cameroon, were indistinguishable in plumage, size, and bill and foot color from female indigobirds associated with other kinds of males in West Africa (Table 4). Juveniles are apparently indistinguishable in size and plumage from those of other West African species of indigobirds.

Song Mimicry.—The songs of the Black-bellied Firefinch *L. rara* have not previously been published on recordings or in audio-

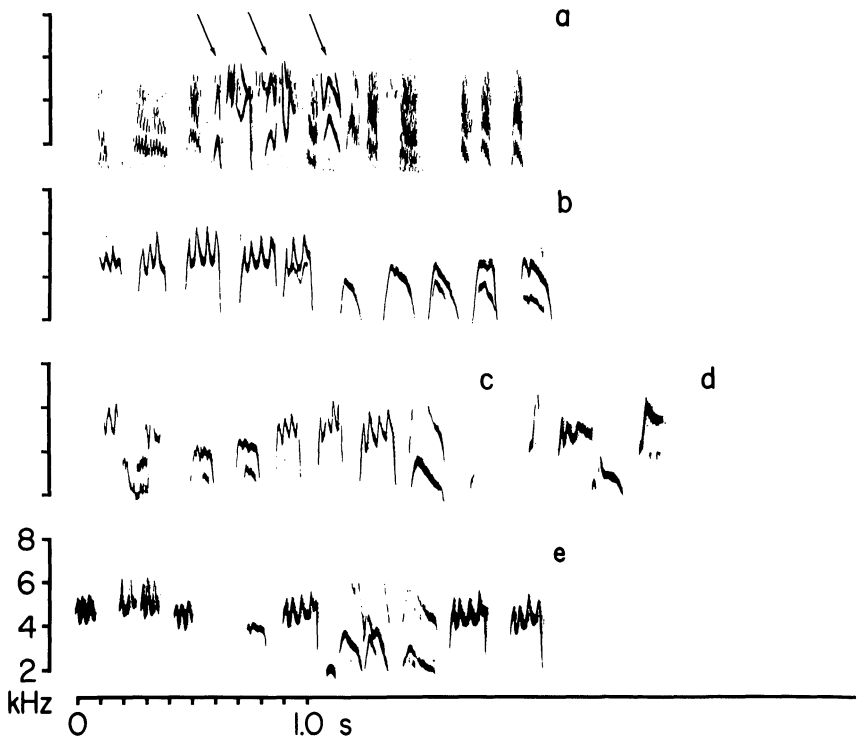

Fig. 9. Mimetic songs of a green Jambandu Indigobird *Vidua raricola* in northern Cameroon. a, nonmimetic song with incorporated mimetic alarm calls (indicated by arrows) modified to varying degrees by a green indigobird UMMZ 202400 at Banyo. b, series of modulated notes and contact notes, same indigobird. c, intergrading series of modulated notes and contact notes of "Pastorale," a green indigobird at Ngaoundéré. d, sequence of mimetic notes of a green indigobird UMMZ 204008 (the holotype of *V. raricola*) at Banyo, with the lower note resembling the contact note of *L. rara* in Fig. 8 c, d. e, similar sequence of a green indigobird at Tibati.

spectrogram form, and it has only now become possible to associate its songs with the mimetic songs of the indigobirds. Earlier descriptions of the song (Immelmann, Steinbacher, and Wolters, 1965; Mackworth-Praed and Grant, 1973) are accurate as far as they go, but are not adequate to identify the species. Nicolai (1967, 1972) referred to the song as mimicked by certain indigobirds, but no audiospectrograms are tape recordings were made available. Güttinger and Nicolai (1973) published audiospectrograms of an alarm call and a contact call identified as *L. rara*. Their contact call closely resembles those recorded by Mary Dyer and by me in Nigeria (Fig. 8b, c), but their alarm call appears to be of *L. rufopicta*, not *L. rara*, when compared with the alarm calls of captive birds from Nigeria that I have recorded (Payne, 1973; 82, 84; compare Fig. 27). Samples of tape-recorded calls and songs of *L. rara* and its mimic *V. raricola* are shown in Figs. 8–11.

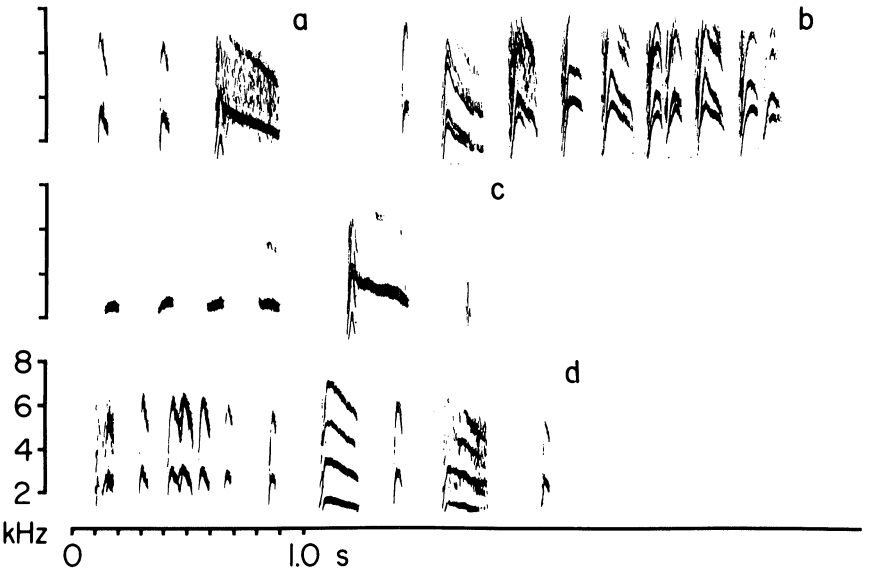

Fig. 10. Mimetic songs of a blue-green Jambandu Indigobird *Vidua raricola* UMMZ 200534 from Lovi, Mole National Park, Ghana. a, notes resembling alarm call and contact call of *L. rara* (see Fig. 8 a–d). b, series of notes resembling possible developmental calls of *L. rara* (Fig. 8 g, h) followed by mimetic contact call (Fig. 8 c, d). d, series of mimetic calls suggesting origin of modulated note in Fig. 9 b from run-on mimetic alarm calls of *L. rara* (see Fig. 8 a, b).

Green or bluish-green indigobirds in Cameroon, Ghana, and Sierra Leone all were recorded with calls that mimicked the alarm calls and contact calls of *L. rara.* The recordings indicate the mimicry of the developmental sequence of calls from the begging call of the juveniles. *V. raricola* resembles *V. chalybeata* in repeating in the adult song the course of vocal development of the young juvenile and newly independent firefinch foster siblings (Payne, 1973). The intermediate stages in call development allow a tentative identification of other calls of the *V. raricola* indigobirds as mimicking the developmental stages in the vocal behavior of the *L. rara* firefinches (Figs. 9–11).

Ecology and Local Sympatry in Cameroon.—At Banyo I found three color forms of indigobirds, each mimicking a different species of firefinch (12 green indigobirds *V. raricola* and 1 brown bird in sparrowy nonbreeding plumage mimicking *L. rara,* 5 blue indigos *V. funerea* ssp. mimicking *L. rubricata,* 3 purple indigos *V. wilsoni* mimicking *L. rufopicta*). Some habitat differentiation among the indigobirds was also evident, with greenish *V. raricola* occuring only

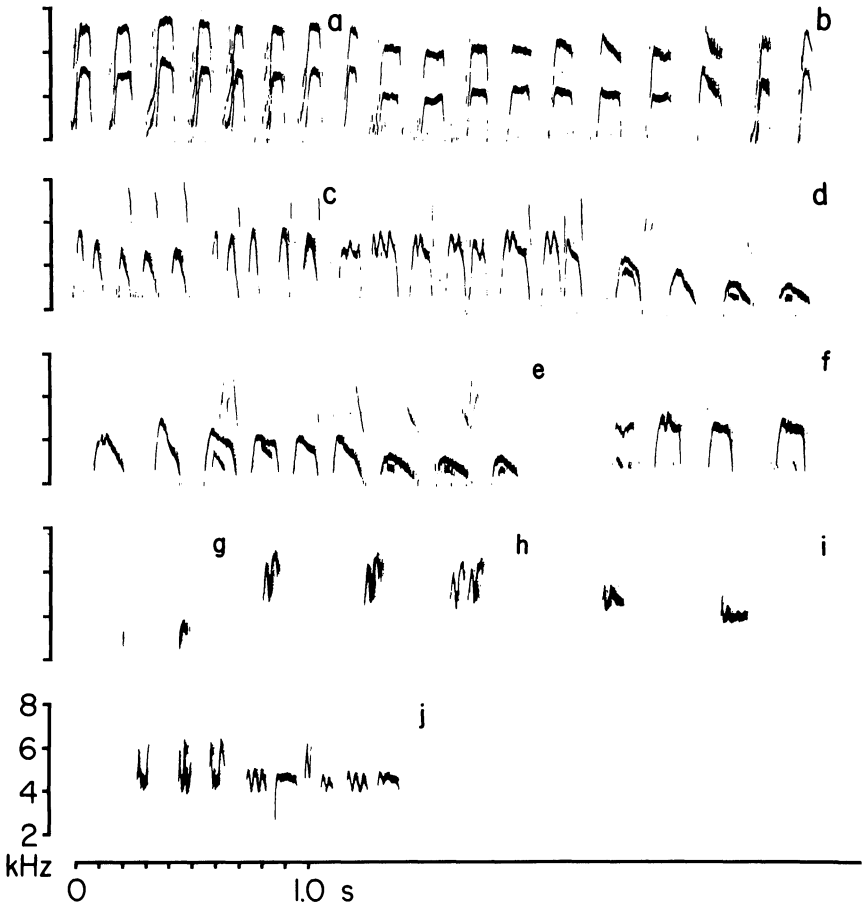

Fig. 11. Mimetic songs of a green Jambandu Indigobird *Vidua raricola* UMMZ 220056 from Kabala, Sierra Leone. a, calls resembling juvenile begging call of several species of *Lagonosticta* firefinches (Payne, 1973, Audiospectrograms 4, 5, 20). b, sequence of calls intermediate between juvenile begging call and contact call of *L. rara*. c, sequence of calls resembling modified alarm calls of *L. rara*; this sequence is similar to calls recorded from several purplish *Vidua wilsoni* mimics of *L. rufopicta* (e.g. Payne, 1973, Audiospectrogram 14b). d, sequence of calls suggesting development of the contact call of *L. rara* from modulated juvenile begging calls (cf. Fig. 11 b). e, series of intergrading contact calls stereotyped into a mimetic song of *L. rara*. f, calls intermediate between b and d. g, mimetic alarm call of *L. rara* (Fig. 8 a,b). h, double note intermediate in structure between the higher trace of *L. rara* alarm call (Fig. 8 b) and the mimetic figures of *V. raricola* in Figs. 9 b, d, and 10 d. i, calls resembling slightly modulated calls of *L. rara* (Fig. 8 g) in an apparently unstereotyped sequence. j, series of modulated calls intergrading with other notes of *L. rara* and its mimics (Figs. 8 g, 8 h, 9 b, 10 d, 11 h, 11 i).

in the grassy areas away from the villages in Ngaoundéré, Tibati, Mbakaou, and Banyo, and with the purple *V. wilsoni* occuring in villages in Tibati, Mbakaou, and Banyo. At Ngaoundéré the birds were on different ground but no habitat difference was noted. No habitat differences were apparent between the green *V. raricola* and blue *V. funerea* at Banyo; the birds were on neighboring territories in scrub at the edge of fields cultivated for manioc and pineapple. (Figs. 12–14). The two indigobird species frequently chased each other in territorial disputes. Nevertheless all local *V. raricola* shared their nomimetic songs as well as mimetic songs, and none matched the songs of the neighboring indigobirds of the other two species, each of which had their own set of nonmimetic and mimetic songs.

The territorial behavior of the green male *V. raricola* and the blue male *V. funerea* was apparently directed towards each other as well as towards the males of similar plumage. To test the behavior of the males, in 1980 we captured the established, singing resident males at their call-sites at Banyo. Males approached and were caught in the net when we played a tape recording of the song of another species *V. chalybeata* and when we placed a stuffed male *V. chalybeata* in breeding plumage near the net. All males attempted were caught, indicating that different species of indigobirds are interspecifically territorial and are actively aggressive toward each other, and are not simply dispersed in a mosaic of habitats with each kind of male using a particular habitat patch peculiar to its species. Males were "saved" as museum study skins as they were removed. The experimentally vacated call-sites were then observed over the next few days. Although interspecific chases were seen between green and blue birds at some sites, the replacement pattern was highly nonrandom. Green males replaced green males in 6 trials, blue males replaced blue males in 3 trials, and a blue male mimic of *L. rubricata* replaced a green male mimic of *L. rara* in 1 trial. If the males were in fact behaving as a single species, then the replacements at each kind of site should be proportional to the number of individual males in the active replacement pool. The observed values were significantly different from the expected values (Fisher's exact test, $p=0.033$). The results are consistent with the idea that these indigobirds behave as distinct species.

At Ngaoundéré, Nicolai (1968) reported a blue indigobird mimicking *V. rara* and a green indigobird mimicking *L. larvata*. In 1980 I found four indigobirds singing at Ngaoundéré in the same locality, a stream just east of the airport. Three green birds (I collected one in breeding plumage and another in sparrowy plumage with a few dark, apparently green feathers) mimicked *L. rara*, and a purple bird (not collected) mimicked *L. rufopicta*. The green birds looked bluer under an overhead sun than early in the day. Some variation in plumage is likely, though none is evident in the specimens of known

Fig. 12. Habitat of three species of indigobirds *Vidua raricola, V. funerea,* and *V. wilsoni* and three firefinches *Lagonosticta rara, L. rubricata,* and *L. rufopicta* at Banyo, Cameroon. Indigobirds sang on small territories defended from each other in the row of trees in the middle distance along a creek at the base of the hill, Hoséré Banyo.

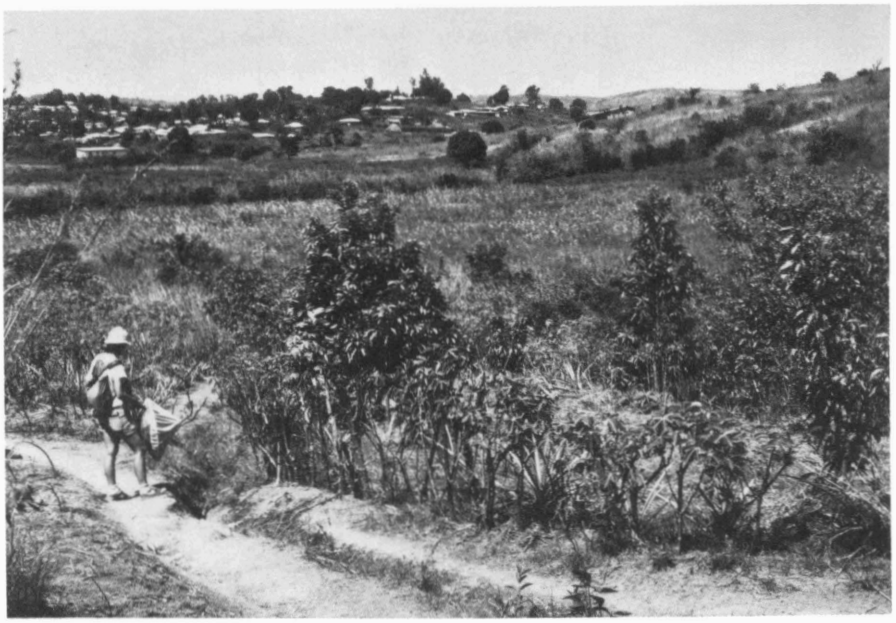

Fig. 13. Recording a Jambandu Indigobird *V. raricola* east of Banyo, Cameroon.

Fig. 14. Male Jambandu Indigobird *V. raricola* singing from manioc plant in a recently mulched cultivated field on the outskirts of Banyo, Cameroon. The indigobird and the females that he attracted fed on small grass seeds that had fallen from the annual grasses in the field.

L. rara song mimicry that I collected in Cameroon. Bates (1924, p. 21) saw and collected green birds and blue birds at Tibati and collected the firefinch *L. rara*. The other firefinch species *L. larvata*, *L. rubricata*, and *L. rufopicta* were collected later. I saw greenish-blue, blue, and purple indigobirds at Tibati. The purple birds mimicked *L. rufopicta*. The greenish-blue and blue birds all mimicked *L. rara*. Of these, six were tape-recorded, one other (blue, at the mission on the Meng River) mimicked the same song. In retrospect these birds were probably bluish-green, but I did not use the color standard book or specimen on these birds in the field, and the birds were not collected. No mimics of *L. rubricata* were heard at Tibati, and it is unknown whether the blue indigobird collected by Bates was *V. raricola* or *V. funerea*. I have tentatively listed the specimens of Bates in Appendix I as including both species.

The other green indigobirds south of Ngaoundéré in Cameroon fall within the distribution of *L. rara*, with the exception of two specimens from Abong Mbang, collected by Good (1953), at the north edge of the forest region. The only known firefinch in this region is *L. rubricata*. However, *L. rara* was collected at nearly the same latitude at Kombetiko by M. Louette, and it may turn up near Abong Mbang. Local edaphic conditions in this part of Cameroon provide open vegetation (Letouzey, 1968), possibly suitable for this firefinch.

Fig. 15. Singing green Jambandu Indigobird *Vidua raricola* on call-site near Musaia, Sierra Leone, on 19 December 1973. Note the pale wing.

Song Mimicry and Geographic Variation in the Upper Guinea Region.—Green indigobirds in northern Sierra Leone prove to be *V. raricola* as they mimic *L. rara*, not *L. rufopicta* as previously reported (Payne, 1976). One call (Fig. 11c) of a green mimic closely resembles an early developmental call retained in the adult of the purple *V. wilsoni* mimics of *L. rufopicta* (see Fig. 28e). This call, similar in the development of the vocalization of both indigobirds and probably of both firefinch species, was the basis of the earlier misidentification. The many other mimetic calls of the green indigobird from Kabala resemble *L. rara* seen at Kabala flying over the call-site of the indigobird. The mimetic identity of these was not known until after tapes were available of *L. rara* in Nigeria. The green indigobird (Fig. 15) near Musaia north of Kabala (Payne 1976) had the same songs as the Kabala bird. The firefinch *L. rara* was seen at Kabala and the female of a pair netted on 23 December had a small ovary and a bare brood patch, so had bred recently.

V. raricola in Ghana was seen in 1975 at Lovi Camp in Mole National Park and was observed and tape recorded on the escarpment 3 km E of Damongo. A brown male was recorded but not captured at Lovi on 21 October; its mimetic and its dialectal nonimetic songs all matched an adult from Lovi tape-recorded in captivity and later skinned (UMMZ 200534). The mimetic songs matched *L. rara* (Fig. 10). Another adult male was netted with the first in a chase, but it died before its song could be recorded. Both of these adults were blue-

green, as blue in glossy color as some of the blue mimics of another species of *Vidua*, the *L. larvata* mimics in Nigeria. Two males that appeared blue in the field at the Damongo scarp shared the Lovi *L. rara* mimetic songs; neither was captured. The male collected at Lovi by Harvey and Harrison (1970) and identified as "*camerunensis*" may be the same form, *V. raricola*, and is listed as this in Appendix I. *L. rara* mimics in Ghana are bluer than their counterparts in Cameroon and Sierra Leone. Firefinches seen by Greig-Smith (1976) and by myself in Mole were *L. senegala*, *L. larvata*, *L. rara*, and *L. rufopicta*. I netted and photographed all of these species at Lovi. I saw *L. larvata*, *L. rara*, and *L. rufopicta* at the Damongo scarp, and *L. senegala* fed and sang in the beer garden in Damongo. Further field work is necessary to determine the geographic extent and distinctiveness of the blue form of *V. raricola*.

The species also occurs in Nigeria. The mouth pattern described for a juvenile (UMMZ 200836) caught by Mary Dyer and described and skinned by C. J. Risley at Zaria, Nigeria, 26 November 1975, matches the mouth of young *L. rara*. The firefinch *L. rara* is common at Zaria, but no indigobirds have been found there mimicking their song. A green-glossed, pale-winged indigobird (BMNH 1928.7.20.248) from Kogum is probably *V. raricola* by size; it is smaller (wing 63 mm) than the green *V. funerea* of the Jos Plateau, and the habitat at Kogum appeared suitable for *L. rara*. Serle (1957) found both *L. rara* and *L. rubricata* common at Enugu. I have tentatively listed (Appendix I) his green bird from Enugu as *V. raricola* and his blue birds as *V. funerea*.

Occurrence in Zaire and Sudan.—No field work has been carried out to match the song behavior with the morphological variation in indigobirds of the other regions of West Africa. However, the distribution of firefinch species and of the color forms of indigobirds (excluding the dark-winged *V. chalybeata*, which presents no local problems) in the Haut-Zaire Province of Zaire and the adjacent Equatoria Province of Sudan suggests that *V. raricola* occurs in blue plumage in this region. When all known local specimen records are plotted and distributions of the color forms of indigobirds are compared with that of the firefinch species, using here "green" as color classes 1–3, "blue" as 4–6, and "purple" as 7–9, of Table 1, then the blue indigobirds are associated with *L. rara* (see Figs. 16, 21, 25, 29). The localities where bluish *Vidua* have been collected together with *L. rara* are, in Sudan: Lado-Mongalla and Nimule, and, in Zaire: Api, Bafuka-Mauda, Faradje, and Gangala-na-Bodio. Presumably these blue birds are conspecific with the green indigobirds in north-central Cameroon and the blue indigobirds in northern Ghana. Until

fieldwork is completed across this area to determine whether these in fact mimic the songs of *L. rara*, and samples of birds of known song have been collected to determine whether they change in color abruptly in a local geographic area, I recommend no subspecific taxonomic distinction.

Hall and Moreau (1970:335) suggested that many of these same blue indigobird specimens from Zaire were *V. wilsoni* and were associated with *L. rufopicta*. This association, based on their distribution map, is misleading. The authors did not examine themselves most of the *Vidua* specimens involved in Zaire, but rather accepted the identification of Schouteden (1963, and earlier publications), who simply labelled as *"wilsoni"* all indigobirds of Haut-Zaire (B.P. Hall, personal communication). In color most of these birds (specimens listed in Appendix I) were blue, not purple. In fact the map in Hall and Moreau (1970:337) of the distribution of *L. rara* shows a closer match with the birds in question than does their map of *L. rufopicta* in the region of Haut-Zaire and in the Equatoria Province of Sudan. Field work is needed to document the occurrence of *V. raricola* in this area more directly than with the distribution of color forms of indigos and their association with the firefinch species.

Pale-winged, bluish indigobirds in Duma in the Lower Uele area of northwestern Zaire, in the Central African Republic, and in Chad may include the species *V. raricola*. The problem of identification of these birds is discussed in the nomenclatural comments section (pp. 50–53).

Breeding Season.—The breeding season of *V. raricola* coincides with the end of the rains in northern Cameroon. A newly independent juvenile and an older juvenile that had lost its mouth colors but had not yet begun to molt were taken on 12 January 1979 at Ngaoundéré, and on 21 January 1979 two juveniles with regressing mouth colors were taken at Banyo. Males were singing and courting females in late October at Ngaoundéré, Tibati, and Mbakaou, and in early November 1980 at Banyo, but only one green male was seen at Banyo in late January 1979. Two of the five females taken 27–28 October 1980 at Ngaoundéré had an egg in the oviduct. The firefinch *L. rara* is known for Ngaoundéré, Tibati, Mbakaou, and Banyo, and K. Groschupf saw one nest-building on 9 November 1980 at Banyo, at a time when *V. raricola* was singing intensively nearby.

In Nigeria no breeding records are known for *V. raricola*, except for the grown juvenile taken at Zaria in November. Nests of its host *L. rara* are known at Kafanchan in July (Serle, 1940), at Enugu (egg in oviduct) in October (Serle, 1957), and at Zaria in November 1975 (young about three days old, Mary Dyer, Fig. 6). In Sierra Leone a

female indigobird netted with a green male *V. raricola* had an egg in the oviduct on 23 December 1973. A male *L. rara* collected at Kabala in the same area had enlarged testes and a female had an inactive brood patch, so had bred and had not begun the postbreeding molt.

The breeding season of *L. raricola* is similar to that of other indigobird species with which it occurs (*V. funerea* in Sierra Leone, *V. funerea* and *V. wilsoni* in Cameroon).

Distribution.—*V. raricola* occurs from Sierra Leone eastwards to Ghana, Nigeria, and Cameroon. It occurs in much the same habitat as other pale-winged species of indigobirds. Throughout its range it occurs with the Black-bellied Firefinch *L. rara*, its host species (Fig. 16). On local distributional grounds it probably occurs also in Haut-

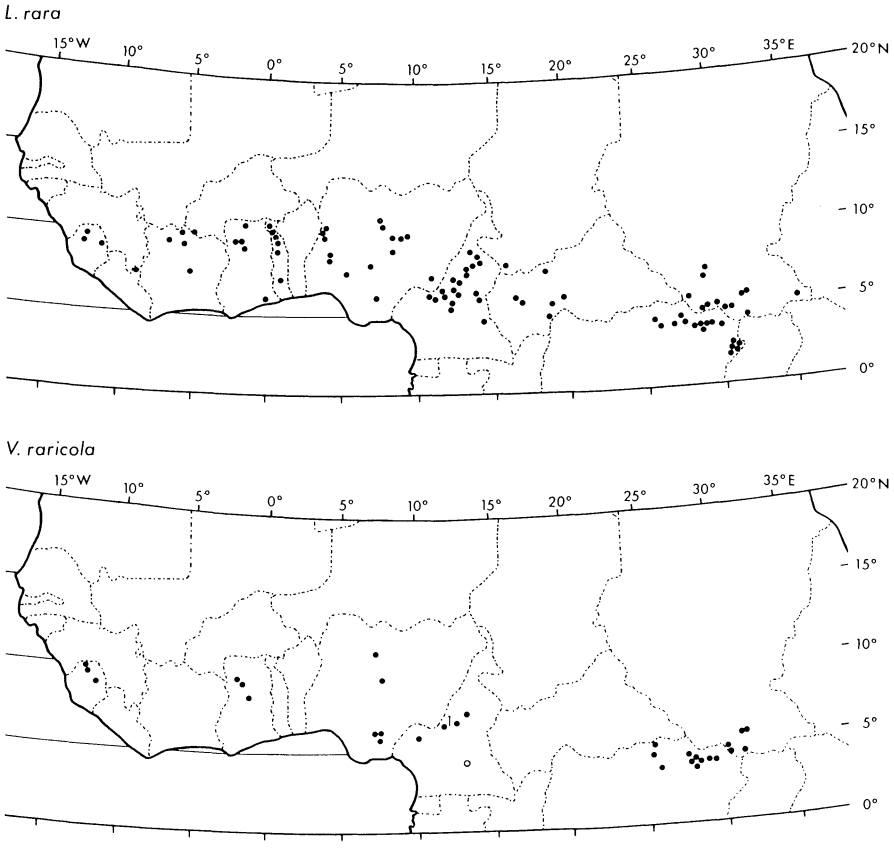

Fig. 16. Distribution of the Black-bellied Firefinch *Lagonosticta rara* and its mimetic brood parasite, the Jambandu Indigobird *Vidua raricola* in West Africa. The open figure indicates a locality of green indigobirds with no known local *L. rara*. The distribution of *V. raricola* in Sierra Leone, Ghana, and Cameroon is based in part on specimens of known mimetic song. Localities in southern Sudan and northeastern Zaire are based on the distribution of bluish-plumaged, pale-winged indigobirds in this area with *L. rara*, as discussed in the text.

Zaire and in the Equatoria region of Sudan. Fry (1980) noted a similar overall distribution in West Africa of *L. rara* and *"V. nigeriae"*, which name had been used for the green indigobirds. However, green males occur in three different species of pale-winged indigobirds in West Africa, and the birds identified as *"nigeriae"* in fact belong to all three of these species. Fry's distribution map was based on Hall and Moreau's (1970), and they included several specimens as *"nigeriae"* that I regard as blue or blue-green. Most of the indigobirds mapped as *"nigeriae"* by Fry are in fact green or blue-green *V. raricola*. Local field work of populations in this area is needed.

Etymology.—The species name *raricola* refers to the affinity of this brood parasite species for its foster species and song model, the Black-bellied Firefinch *Lagonosticta rara*. The common name Jambandu Indigobird is based on a common greeting of the Fulani people at Banyo, translated "How's your body?" The name is appropriate to accompany the description of the new species and to prompt further questions that are necessary to describe species of indigobirds: "Who are your babies?" and "What is your song?"

Vidua larvaticola, NEW SPECIES

BAKA INDIGOBIRD

Holotype: UMMZ 216994, male in breeding plumage, collected by R.B. Payne (no. 4855) on 6 August 1968 at Zaria, Nigeria, 11°10′N, 7°40′E.

?syn. *Hypochera nigeriae* Alexander, 1908, Bull. Brit. Ornithol. Club, 23, p. 15: Kiri, R. Gongola [Nigeria]. Holotype: BMNH 1911.12.23.3302, male in breeding plumage. The name is a *nomen dubium*.

?syn. *Hypochera chalybeata camerunensis* Grote, 1922, J. Ornithol., 70, 398: Weg Nola-Mbaiki, südöstliches Neukamerun [= Central African Republic]. Holotype: Berlin Tessman 950, male in breeding plumage. The name is a *nomen dubium*.

?syn. *Hypochera chalybeata sharii* Bannerman, 1922, Bull. Brit. Ornithol. Club, 43, p. 29: Ratu, Gribingui River, French Equatorial Africa [= Central African Republic]. Holotype: BMNH 1911.12.23.3308, male in breeding plumage. The name is a *nomen dubium*.

Description of Holotype.—Plumage glossy blue (22F8), white flank patch, wings light brown (outer edge of primaries 5C3, vanes of flight feathers 6D4), bill white, feet light purplish (not whitish) with slight brown cast, iris dark brown, no fat, no molt, wing 65 mm, tail 40 mm, bill length 6.4 mm, bill width 6.4 mm, weight 13.0 g, skull 15% unpneumatized, testes enlarged (6×4, 5×4 mm). Its song (recorded on tape RBP 1968 25B) mimicked *Lagonosticta larvata* (see Figs. 18–19).

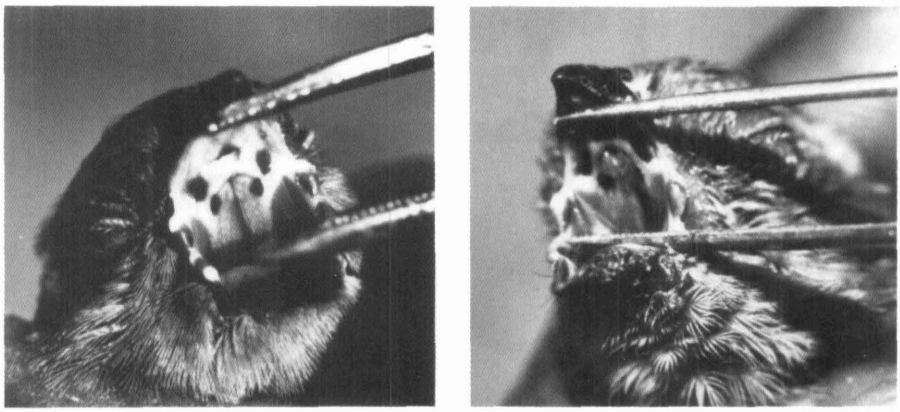

Fig. 17. Mouth patterns of a juvenile Black-faced Firefinch *Lagonosticta larvata* and a Baka Indigobird *Vidua larvaticola* at Zaria, Nigeria. Note the similar pale mouth, pale (blue) tubercles, the dark (blue) saddle-like swelling posterior and medial to the pale tubercles, and the pale (yellow) palate and (yellow to orange) roof of the mouth with five spots. *L. larvata* photograph 29 November 1975, *V. larvaticola* photograph 18 December 1976, both by M.G. Dyer.

Supporting material on which the species is described includes 9 additional males in blue or greenish-blue breeding plumage from Zaria, a male 98 mi NW Yola on the Gombe-Yola Road, and two males 25 mi W Bauchi, all in Nigeria. All males mimicked the songs of *L. larvata*. Additional material includes 6 females shot from courting males at Zaria and 25 mi W Bauchi, one sparrowy-plumaged male, and two juveniles from Zaria with well-developed mouth colors.

Diagnosis.—The species *V. larvaticola* is characterized by its species-specific mimicry of the Black-faced Firefinch *Lagonosticta larvata*. The mouth pattern of the immature indigobirds of this species mimic the mouth pattern of their foster species in having a yellow hard palate, an orange interior of the mouth, a ring of five black spots on the palate, a pair of blue tubercles at each corner of the mouth, and a dark blue shallow ridge located on the edge of the mouth posteriomedially to the tubercles.

Two juvenile indigobirds observed in family groups of *L. larvata* were captured, photographed, and collected by Mary Dyer at Zaria, Nigeria. The two juvenile *Vidua* match precisely the species-specific mouth pattern of nestling and fledgling young of *L. larvata* as photographed by Mary Dyer at Zaria. (Fig. 17). The breeding plumage of the males varies regionally from green to blue. As in all kinds of indigobirds, the males have a white flank patch, which is usually hidden by the wings (Payne, 1973). The flight feathers are light brown. The bill is whitish. The feet are light purplish; in the one specimen compared with a color guide the feet were greyish violet

(17B3). In size the males are indistinguishable from most other West African indigobirds, and in plumage color they match some populations of two other species (Table 3). However within a local area they are often distinct in plumage. Males mimic the songs of their host species *L. larvata*.

Adult females are indistinguishable in color, pattern, and size from adult females of most other West African indigobird species (Payne, 1973:256; Table 4). The juvenile plumage appears identical to that of the other species in the region.

Song Mimicry.—Adult males mimic the songs and call notes of their host species *L. larvata* (Fig. 18). Representative mimetic songs are shown in audiospectrogram form in Fig. 19. *Vidua larvaticola* has been studied most intensively at Zaria, Nigeria. At Zaria in 1968 I tape-recorded and collected 10 specimens of pale-winged indigobirds that mimicked the songs of *L. larvata*. Of these, 9 were blue and the other (UMMZ 217001) was bluish-green. In addition I recorded and collected 5 adults from other localities in northern Nigeria; all were blue but one (from 25 mi W Bauchi, UMMZ 216984), which was green (Payne, 1968a, 1973). At Dumbi, 17 km S of Zaria, I saw a male in worn blue breeding plumage in late November 1980 but it did not sing. Firefinch species at Dumbi were *L. larvata, L. rara, L. rufopicta,* and *L. senegala*.

South of the Benue River at Garoua, Cameroon, I recorded songs of two bluish to greenish indigobirds in January 1979 and three in October 1980. In both seasons singing was sporadic and mimetic songs were infrequent. Mimetic begging calls were recorded from several indigobirds but could not be identified further because the begging calls of the firefinch species themselves all are similar. One bird (UMMZ 202404) mimicked the distinctive alarm calls of *L. larvata* and proved to be bluish-green. Two others (not collected) perched next to a male *V. chalybeata neumanni* and both were slightly greener than that glossy blue bird. I also taped a pale-winged bluish-to-purplish male in January 1979 and in the same tree taped a male (not collected—the same bird?) in November 1980. All of these pale-winged indigobirds at Garoua shared their nonmimetic local dialectal songs in both years, and they had the same nonmimetic dialectal songs across years, so it is likely that all were conspecific. Similar specimens were collected at Garoua and Siddiri by Riggenbach in 1909 (Berlin Museum); these were at the time called *chalybeata* (Reichenow, 1911). The scarcity of mimetic songs in more than 300 songs that I recorded at Garoua and audiospectrographed may be due to the lateness of the season. Birds chattered more than they sang, and they did not sing frequently. Plumage was worn; birds flocked together most of the day. In each year I netted a juvenile with regressed mouth granules and no remaining juvenile mouth color.

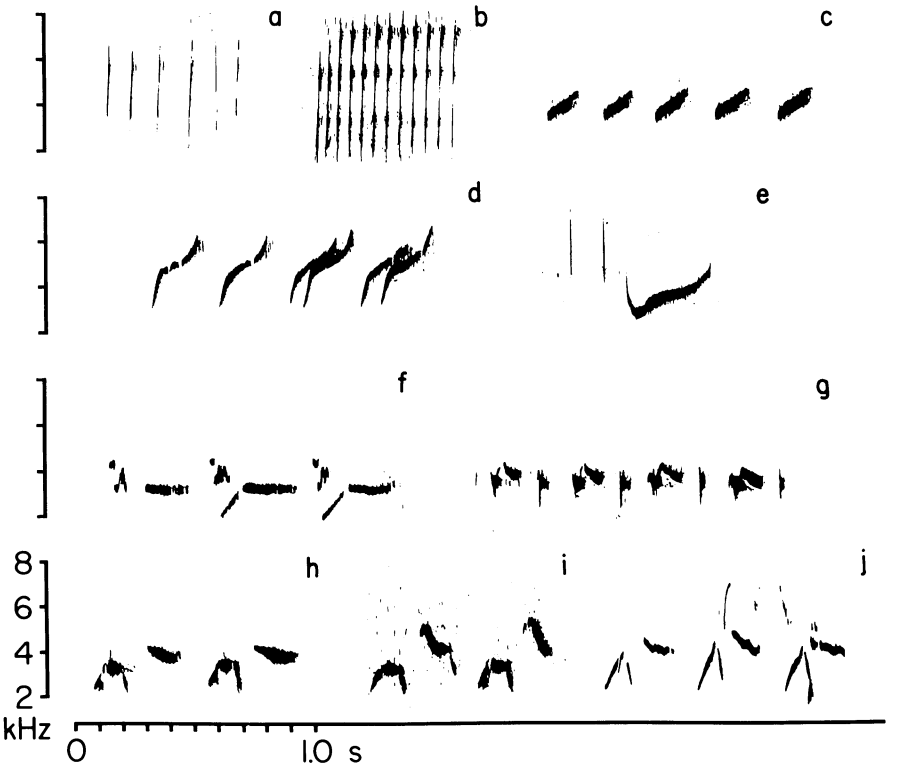

Fig. 18. Vocalizations of the Black-faced Firefinch *Lagonostricta larvata* in Nigeria. a,b, alarm calls Dumbi, 30 November 1980. c, slurred whistles, Zaria, 1 December 1980. d, inflected whistles, Zaria, 1976 (M.G. Dyer). e, alarm calls and slurred whistle, Zaria, 2 December 1980. f, bipartite whistle series, Zaria, 1 December 1980. g, bipartite inflected whistle series, Dumbi, 30 November 1980. h,i, bipartite slurred whistles "whee-hew", Zaria, 1 December 1980. j, "whee-hew" variant, Zaria, 1976 (M. G. Dyer).

No *L. larvata* were observed. The Garoua indigobirds appear to represent *V. larvaticola.*

Nicolai (1968) reported a green indigobird at Ngaoundéré mimicking *L. larvata,* and a blue indigobird mimicking the Black-bellied Firefinch *L. rara.* He did not collect either bird to verify the match of song mimicry and color; he captured a blue bird (possibly the one heard to sing) (Payne, 1973). I found no mimics of *L. larvata* at Ngaoundéré; I did find green indigobird mimics of *L. rara.* Blue pale-winged indigobirds that I encountered and was also able to collect in northern Cameroon mimicked *L. rubricata,* not *L. larvata.*

Ecology and Local Sympatry in Northern Nigeria.—At Zaria I found three species of co-existing indigobirds in July-September 1968, and four species of firefinches. *V. chalybeata* and its host *L. senegala* was the most widespread, occurring in the town gardens of Zaria (Sabon Gari), around the gardens of the residential parts of the

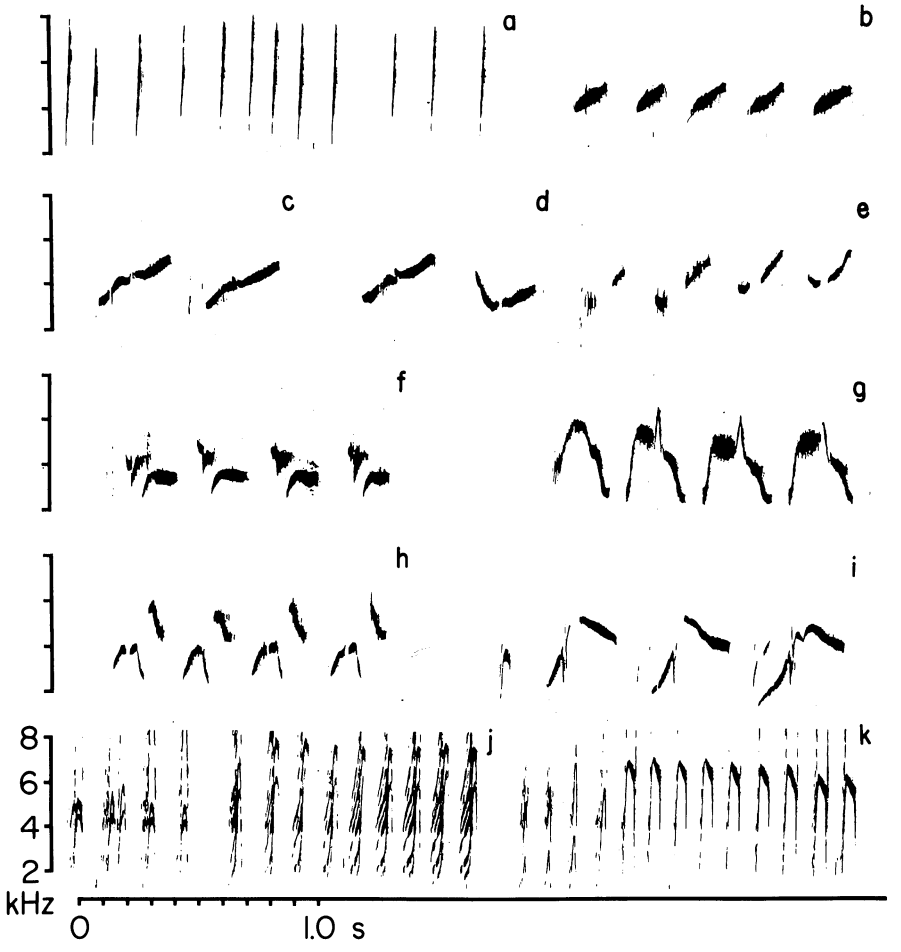

Fig. 19. Mimetic songs of the Baka Indigobird *Vidua larvaticola* UMMZ 216994 from Zaria, Nigeria, on 29 July 1968. a, notes resembling alarm calls of *L. larvata* (Fig. 18a, b). b, slurred whistles resembling *L. larvata* (Fig. 18c). c, d, e, slurred whistles resembling calls of *L. larvata* (Fig. 18 d, e). f, bipartite inflected whistle series resembling calls of *L. larvata* (Fig. 18f, g). g, h, i, bipartite slurred whistles "whee-hew" variants resembling calls of *L. larvata* (Fig. 18 h, i, j). j, mimetic begging calls (not differentiated among species of *Lagonosticta*; Payne, 1973; Fig. 24 h, i for *L. rubricata* mimics), k, trill resembling that of other species of indigobirds, e.g. *V. raricola* Fig. 11d, *V. wilsoni* Fig. 28e, perhaps derived from the immature begging call.

campus of Ahmadu Bello University 8 km NW of the town, and near brushy areas of the surrounding countryside especially along the Kubanni River, in the woods at the base of Kufena Hill, and along Bee-eater Creek near Basawa, northeast of Samaru. (All of these local spots are considered "Zaria" in the map and in Appendix I.). *L. larvata* was seen at Kufena Hill, and both this firefinch and blue-glossed, pale-winged *V. larvaticola* were common along Bee-eater Creek (Fig. 20). A call-site was found along the same creek where the singing male indigobird was a purplish-glossed, pale-winged *V.*

Fig. 20. Habitat of three species of indigobirds *Vidua chalybeata, V. larvaticola,* and *V. wilsoni* and four firefinches *L. senegala, L. rara, L. larvata,* and *L. rufopicta* near Zaria, Nigeria, in August 1968.

wilsoni. L. rufopicta was locally widespread; *L. rara* was less common but was seen throughout. All sites were within 8 km of the University. All three species were territorial chasing each other as well as individuals of similar appearance and song (Payne, 1968a, 1973). Re-examination of their songs shows that the apparent instance of two species sharing a nonmimetic song (Payne, 1973) involved a mislabeled song. All three species of indigobirds at Zaria had totally different song repertoires (except for their simple chatters), as did the three indigobird species at Banyo, Cameroon. All but one *V. larvaticola* was replaced on its site by another *V. larvaticola* after it was shot; in one instance a *V. chalybeata* replaced the removed *V. larvaticola.* All four *V. wilsoni* that were removed in sequence from the *wilsoni* call site were replaced by the next *V. wilsoni* male. Mary Dyer tape-recorded *V. larvaticola* in Samaru gulley in 1975 and 1976. The type locality study area along Bee-eater Creek had degenerated in 1980 with nearly all scrub being replaced by crops; I found no *L. larvata* or *V. larvaticola* at Bee-eater Creek in December, though *L. senegala, L. rara,* and *V. chalybeata* were still present on the banks of the creek.

Two kinds of pale-winged indigobirds lived together at Panshanu pass, Nigeria. Blue *V. larvaticola* and green *V. funerea* had different local sites and had distinct, nonoverlapping nonmimetic songs as well (Payne, 1973).

The local coexistence of indigobirds, the mimicry of a different firefinch species' song by each kind of indigobird, the differences in nonmimetic song as well as in song mimicry, and the experimental replacement of each male by another male of the same appearance and song all support the view that distinct species of indigobirds occur sympatrically in northern Nigeria.

Breeding Season.—*V. larvaticola* breeds at the same time as its host species *L. larvata* in Nigeria. Male *V. larvaticola* in breeding plumage sang at Zaria from July through early September in 1968, during the late rainy season. Laying females each with an oviducal egg were collected on 9 August and 3 September, as they were courted by a pale-winged, blue glossed male at his call-site. Pairs of *L. larvata* were seen courting in July and August, and a female was seen flying with her tail cocked as seen in incubating firefinches, though no nest was found. Mary Dyer caught a recently fledged *L. larvata* at Zaria in November, 1975, together with a fledged young *V. larvaticola* with similar mouth markings. The following year in December she caught an older juvenile *V. larvaticola* with slightly regressed mouth tubercles and color but still recognizably the pattern of *L. larvata.* Further south in Nigeria, Serle (1940) found nests of *L. larvata* at Kafanchan in July and at Nasarawa in August. I know of no other nesting records of *L. larvata* in West Africa.

Geographic Variation.—All but one *V. larvaticola* observed at Zaria was blue, 1 of the 3 collected 25 mi W of Bauchi was green, and the pale-winged birds collected near Garoua, Cameroon, where I heard them mimicking only *L. larvata,* were mostly green. Thus some regional variation occurs in plumage color, and in the proportion of blue and green birds within a locality. Variation in blues and greens is suggested further west in Africa, with green birds in The Gambia, and further east with green birds in southern Sudan and Haut-Zaire, but it has not been shown with field work that these poulations in fact are host-specific mimetic parasites of *L. larvata.* Nor is it certain whether any or all of the blue indigobirds from the Chari and Tomi River areas of the Central African Republic (C.A.R.) are this species.

Distribution.—*V. larvaticola* is best known in northern Nigeria and northern Cameroon. On distributional grounds it is probably also represented in the west in The Gambia, Guinea-Bissau, Guinea, Mali, Ivory Coast, Ghana, and Togo. Bluish and greenish-glossed, pale-winged birds occur throughout this area between 10° and 15° N. I previously regarded most of these birds as "*camerunensis*" (Payne, 1973); Hall and Moreau (1970) mapped some as "*camerunensis*" and some as "*nigeriae.*" The distribution of these birds corresponds closely with that of *L. larvata,* including the Lavender Firefinch *L. l.*

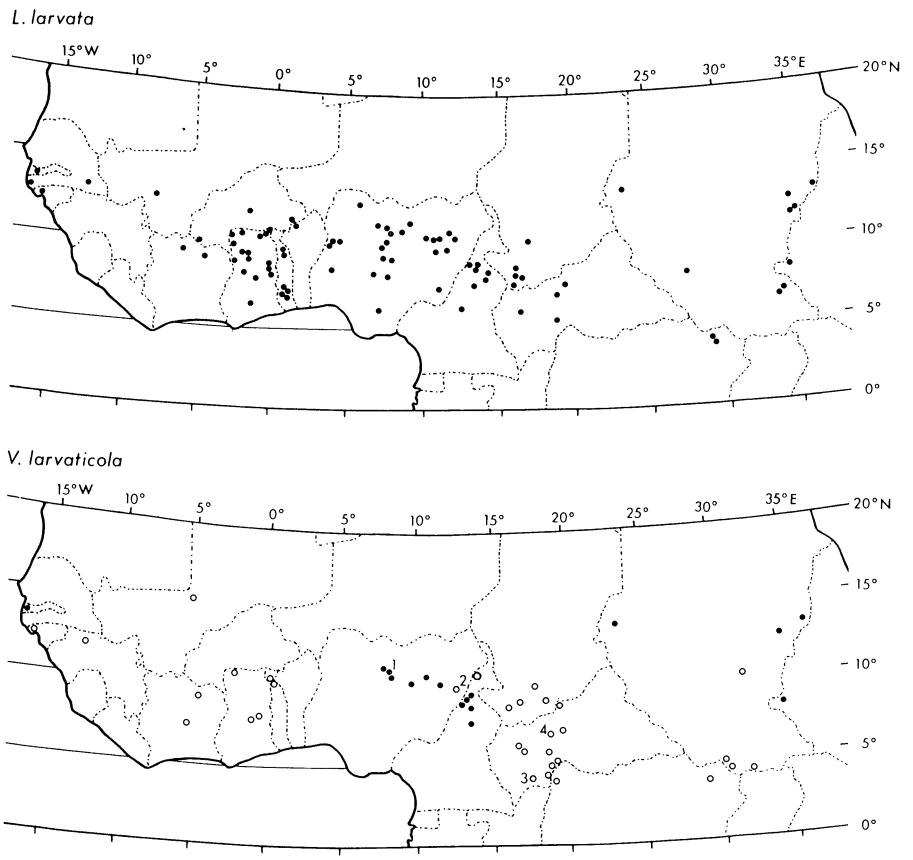

Fig. 21. Distribution of the Black-faced Firefinch *Lagonosticta larvata* and its mimetic brood parasite *Vidua larvaticola* (excluding localities E of 35°E in Ethiopia). Localities indicated by solid figures are of indigobirds identified as *V. larvaticola* by their association with *L. larvata* (and with no other likely firefinch species) (Gambia, Sudan, Ethiopia, and some Cameroon localities) or by their song (most localities in Nigeria, Garoua and Ngaoundéré in Cameroon). Open figures indicate birds of questionable species identity; these blue and green birds probably include *V. larvaticola* but may also include *V. raricola* and *V. funerea*. Numbers indicate type localities; 1 Zaria, 2 Kiri, 3 Nola-Mbaiki, 4 Ratu on Gribingui River.

vinacea in The Gambia, Guinea, and Guinea-Bissau. In color and size the birds are mainly bluish and cannot be distinguished morphologically in the adults from the blue *V. funerea* of Sierra Leone or from blue *V. larvaticola* of northern Nigeria. The greenish bird (*"nigeriae"*) listed by Jensen and Kirkeby (1980) from the coast of The Gambia is probably *V. larvaticola* on distributional grounds as *L. larvata* is known for the same area. The species is also found in the east with bluish, pale-winged indigobirds in Ethiopia and eastern Sudan along the Blue Nile as far downstream as Roseires and near the border at Gallabat and at Gambela. *L. l. larvata* occurs throughout this area and is the only firefinch with a similar local distribution

(Fig. 21). On distributional grounds *V. larvaticola* also occurs locally in Darfur, western Sudan, where a bluish-green (not greenish as in Payne, 1973) specimen was taken at Kulme and where *L. larvata* was the only local firefinch except for *L. senegala* (Lynes, 1924). The distribution of *L. larvata* and the occurrence of blue, pale-winged indigobirds in the Chari region of Chad and the Central African Republic (C.A.R.) and in southeastern C.A.R. and the upper Uele region of Zaire, and the occurrence of greenish, pale-winged birds in Haut-Zaire and in the Equatoria District of Sudan, further suggests a widespread distribution of this indigobird in northern Central Africa. Field work is necessary in these areas before the local distribution of green and blue indigobirds can be used to establish their species identify and geographic variation.

Etymology.—The species name *larvaticola* describes the affinity of this indigobird for its host species *Lagonosticta larvata.* The common name of Baka Indigobird comes from the Hausa greeting, "Baka," translating "You are welcome," heard in their habitat in Nigeria.

Vidua funerea (de Tarragon)

VARIABLE INDIGOBIRD

Variable Indigobirds *Vidua funerea* mimic and parasitize the African Firefinch *Lagonosticta rubricata.* The nomenclatural problem presented by the original description of the species *V. funerea* has been discussed earlier (Payne, 1973). No holotype is known, and the plumage description does not allow the specimen to be distinguished from several kinds of indigobirds. However the specimen was collected in "Natal," South Africa. *L. rubricata* is the only firefinch that is widely distributed in Natal, and almost all male indigobirds that have been collected in Natal are purplish-blue, white-billed, red-footed birds in localities where *L. rubricata* occurs. In both Natal and Transvaal, indigobird males of this description mimic the songs of *L. rubricata* (Payne, 1968b, 1973). In this instance there seems no reasonable likelihood of confusion, and the name *V. funerea* applies to these *L. rubricata* mimics. The mouth colors of the young have not been determined for either the host or the parasite species in southern Africa. Mouth colors of both *L. rubricta* and *V. funerea* are known only for those birds described here in Cameroon.

V. funerea varies in color across southern and eastern Africa. In southern and eastern Africa plumage colors of different regional forms range from bluish-purple or purplish-blue (*V. f. funerea* (de Tarragon, 1874)) in South Africa, bluish (*V. f. lusituensis* Payne,

1973) in eastern Zimbabwe, green (*V. f. codringtoni* (Neave, 1907)) in the highlands in northeastern Zimbabwe, Zambia, southern Malawi and neighboring areas, and dull bluish to purplish-blue (*V.f. nigerrima* (Sharpe, 1871)) in Angola, northern Zambia, northern Malawi, and southern Zaire (Payne, 1973). Another population of indigobirds that mimics the song of *L. rubricata*, is known for Nigeria. I previously regarded these (Payne, 1976) as a distinct subspecies "*V. f. nigeriae*," but the type of this name is of uncertain species, and it is necessary to describe and name the green population of pale-winged indigobirds that mimics *L. rubricata* on the plateau of north-central Nigeria as a distinct form. In addition, another morphologically distinct form of *V. funerea* represented by the blue-plumaged mimics of *L. rubricata* in the northern Cameroon highlands proves distinct. I describe two new subspecies of *V. funerea* for West Africa.

Vidua funerea maryae NEW SUBSPECIES

Holotype. UMMZ 216982, male in breeding plumage, collected by R. B. Payne (no. 4946) on 30 August 1968 at Panshanu, Nigeria, 30 miles east of Jos, at 10°06′N, 9°13′E, elevation about 1100 m.

? syn. *Hypochera nigeriae* Alexander 1908, Bull. Brit. Ornithol. Club, 23, p. 15: Kiri, R. Gongola [Nigeria]. The name is a *nomen dubium*.

Description of Holotype.—Plumage glossy green (24F8), white patch on flanks, wings light brown (outer edge of primaries 4B2, vane of flight feathers 5D3), bill white, feet whitish to purplish gray, iris dark brown, wing 68 mm, tail 39 mm, bill length 6.1 mm, bill width 6.3 mm, tarsus 15 mm, skull 40% unpneumatized, testes enlarged (6×4 mm). The song mimicked *Lagonosticta rubricata*; audiospectrograms published in Payne, 1973: 77 (Aud. 14 a, h, k), recorded on tape RBP 1968 27B.

Only two males in breeding plumage are known, both from the type locality. The other was taken on 28 August 1968, had the same colors, and measured wing 67 mm, tail 39 mm, bill length 6.0 mm, bill width 6.5 mm, tarsus 15 mm, and also mimicked *L. rubricata*. Two males in nonbreeding plumage were taken, and one female. The female is indistinguishable in plumage and color from females of other West African indigobirds (Table 4). The habitat is illustrated in Payne, 1973: 201.

Diagnosis.—*V. f. maryae* is distinguished in male breeding plumage from other subspecies of *V. funerea* by its green gloss, pale wings, and large size. Other populations of *V. funerea* in West Africa are smaller and blue. *V. f. maryae* differs from the green-glossed *V. f. codringtoni* of south-central Africa by its pale wings (*codringtoni* has

blackish wings) and its pale feet (red-orange in *codringtoni*). Greenish, pale-winged birds also occur in Zaire (Kasai and Kwamouth) but those birds are nearly all smaller (Payne, 1973: 276). The other known populations of *V. funerea* are blue or purplish, not green, and are readily identifiable by color of the male breeding plumage. Females are indistinguishable from some other subspecies of *V. funerea*. The juvenile plumage is unknown.

Song Mimicry.—The song of *V. f. maryae* mimics the song of the local *L. rubricata*. Songs of two of these indigobirds have been illustrated earlier (Payne, 1973: 77). Both of these indigobirds and the local *L. rubricata* had a long, rapidly descending trilled song which I have not heard elsewhere in West Africa.

Breeding Season.—No information is available regarding breeding on the Jos Plateau except for the presence of birds in breeding plumage and with enlarged testes in August. Serle found a nest of the host species *L. rubricata* at Kafanchan, Nigeria, in August and a female with a yolked egg in the ovary at Agwada in June (Serle, 1940). In late November 1980 the habitat at Panshanu was dry and we found *L. rubricata* but no indigobirds.

Distribution.—The form is apparently restricted to the northern plateau of Nigeria. The only specimens recognized as this form are from a rocky wooded hillside within 1 km of Panshanu, Nigeria. Green, pale-winged indigobirds are also known from observations on the Jos Plateau escarpment at Kagoro. Mary Dyer has sent me her tape recordings of two of these birds from Kagoro and they also mimic *L. rubricata* firefinch song.

The host species *L. rubricata* is known from Panshanu, Kaduna, Kafanchan, Kogum, and Kagoro, all on the Jos Plateau and its slopes. The firefinch also lives on scattered inselbergs in northern Nigeria between Kano and the Jos Plateau. I saw the firefinch at the Rano inselbergs in November 1980 but noted no indigobirds except for the black-winged *V. chalybeata*, which presumably parasitized the locally common firefinch *L. senegala*.

Green-glossed, pale-winged indigobirds are known from other parts of West Africa (Hall and Moreau, 1970; Payne, 1973), but these are mainly smaller and appear to be mostly populations of *V. raricola* or *V. larvaticola*. However, a green bird from Kara, Mali, occurs near the little-known firefinch *L. rhodopareia virata* and may represent a brood parasite for it or for *L. larvata*.

Nomenclature.—The name *V. f. maryae* replaces my earlier use of *Vidua funerea* form *"nigeriae"* (Alexander 1908) for the population on the northern plateau of Nigeria (Payne, 1976). As discussed

earlier, the holotype of *"nigeriae"* may refer to any one of three indigobird species which has a green population or green individuals in eastern Nigeria and northern Cameroon. The name *V. f. maryae* also replaces my earlier broader use of *Vidua wilsoni* (Payne, 1973: 251) to refer to the northern Nigerian birds, as the birds that mimic *L. rubricata* now are known to be specifically distinct from *V. wilsoni.*

The subspecific name acknowledges the field work of Mary Dyer in Nigeria, in particular her help with the indigobirds. An appropriate common name is the Plateau Indigobird.

Vidua funerea sorora NEW SUBSPECIES

Holotype. UMMZ 203995, male in breeding plumage, collected by R. B. Payne (no. 6494) on 6 November 1980 at Banyo, Cameroon, 6°45′N, 11°50′E at 1050 m.

> ? syn. *Hypochera chalybeata camerunensis* Grote, 1922, J. Ornithol., 70, 398: Weg Nola-Mbaïki, südöstliches Neukamerun [=Central African Republic]. Holotype: Berlin Tessman 950, male in breeding plumage. The name is a *nomen dubium.*
>
> ? syn. *Hypochera chalybeata sharii* Bannerman, 1922, Bull. Brit. Ornithol. Club, 43, p. 29: Ratu, Gribingui River, French Equatorial Africa [=Central African Republic]. Holotype: BMNH 1911.12.23.3308, male in breeding plumage. The name is a *nomen dubium.*

Description of Holotype.—Plumage glossy blue (21-22F8), white patch on the flanks, wings light brown (outer edge of primaries 5B3, vane of flight feathers 5D4), bill white, feet light orange (6A4), iris dark brown, wing 63 mm, tail 37 mm, bill length 6.8 mm, bill width 5.8 mm, tarsus 14 mm, testes enlarged (6×4 mm), weight 13.0 g, skull 30% unpneumatized. The song mimicked *Lagonosticta rubricata,* recorded on tape RBP 1980 52B.

Four specimens in breeding plumage were collected at Banyo. The four, as well as one male that was recorded but not captured, mimicked the local songs of *L. rubricata.* These birds differed from other local indigobirds in breeding plumage and song: three local purplish indigobirds *V. wilsoni* all mimicked the speies *L. rufopicta,* and 13 green indigobirds and one brownish immature male *V. raricola* all mimicked the species *L. rara.* Foot color ranged from light orange (6A4) to pale red (8A3), all within the range of variation in *V. raricola* at the same locality. Two females were taken from known male *V. f. sorora* but were not obviously different in plumage, size, or color of the bill and feet from females taken from males of other West African pale-winged indigobirds. Measurements are given in Tables 3 and 4.

Diagnosis.—*V. f. sorora* is differentiated from other subspecies of the species by its glossy blue breeding plumage and light brown wings in the male and by its small size. The plumage is more glossy and is bluer (less purplish) than *V. f. nigerrima* of central Africa south of the Equator, and the wings are paler than in *nigerrima*. It differs from *V. f. maryae* of the northern Nigerian plateau in color and size (smaller in *sorora*). It differs from other subspecies of Africa south of the Equator in plumage color (green in *codringtoni*, purplish in *funerea*, and more purplish-blue in *lusituensis*) and in the wing color (darker in all of these). The females are not morphologically distinguishable from females of several other kinds of indigobirds.

The mouth pattern of two young in the nest of a *L. rubricata* at Banyo matched two smaller young of the host in the same nest as well as three nearly-fledged young *L. rubricata* in another nest (Fig. 22). The hard palate was yellow, the buccal cavity was pink, five black spots formed a circle on the palate, the tubercles were blue with some magenta at the base, and the commissure between the tubercles was blue-black. The young were identified by size only; when the nest was reexamined a week later to check the identification by plumage, the nest was empty, apparently predated. The description presumably

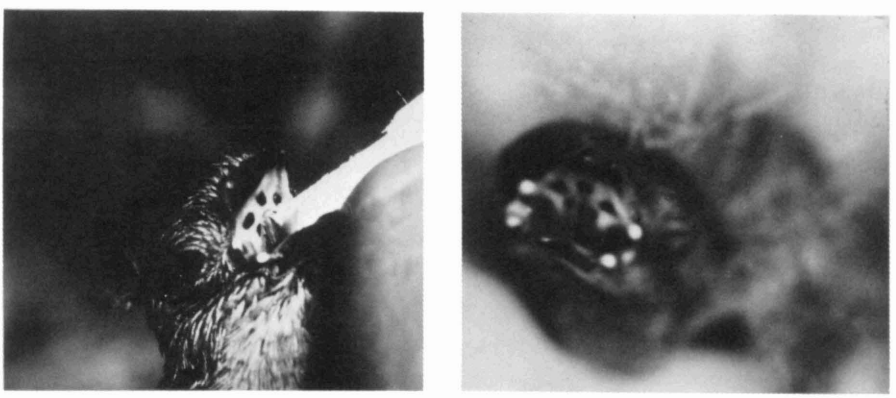

Fig. 22. Left: mouth pattern of a nestling African Firefinch *Lagonosticta rubricata* at Banyo, Cameroon. Note the light (blue) pair of tubercles, the dark area (blue) at the proximal base of the tubercle (differing in position from that of *L. larvata*), and the pale (yellow to pink) palate with the pattern of five black spots. Among the three nestling firefinches in the nest, all well-feathered and with a red rump, one had magenta proximal to the dark blue base of the tubercle.

Right: mouth pattern of a nestling finch thought to be a Variable Indigobird *Vidua funerea* at Banyo, Cameroon. Two large nestlings (including this one) and two small nestlings were found together in a nest of *L. rubricata*. The nestlings were predated before their feathers emerged for a positive identification. The mouth color pattern matched that of the smaller *L. rubricata* in the nest and of the larger *L. rubricata* nestlings in another nest (Fig. 22 left).

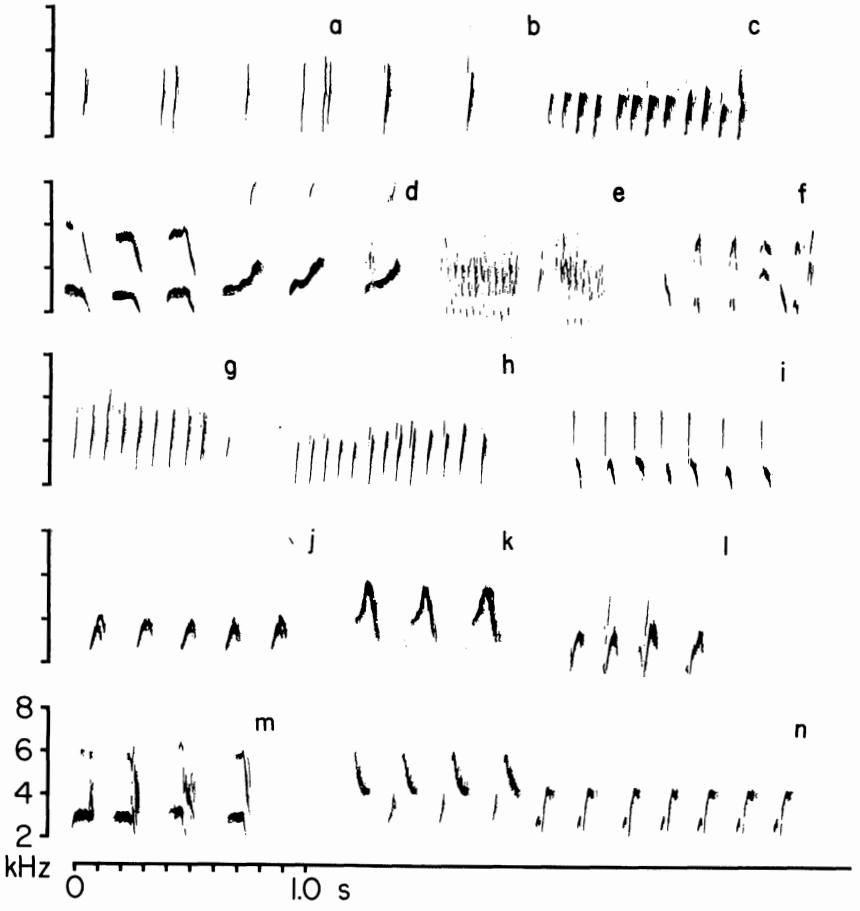

Fig. 23. Vocalizations of the African Firefinch *Lagonosticta rubricata* at Banyo, Cameroon. a, alarm calls, adult pair at nest with three young nearly ready to fledge, 7 November 1980. b, alarm calls, adult male, given immediately before trilled song, 21 January 1979. c, alarm calls, adult male, 21 January 1979. d, slurred whistles, 7 November 1980. e, a barely audible soft raspy note, adult male, giving muted song to female, 21 January 1979. f, another recurring phrase in muted sexual song of adult male, given to female at close range, 21 January 1979. g, trill, 11 November 1980. h, trill, 21 January 1979. i, complex trill, 5 November 1980. j, slurred trill, 9 November 1980. k, slurred notes, 21 January 1979. l, m, two variants of a four-note song given by adult male who also had several intermediate varities of this song (with the third note always the highest in pitch), 21 January 1979. n, two trills, the first and second halves apparently given one by the male and one by the female of a duetting pair, 11 November 1980. The adult male on 21 January 1979 and the pair on 11 November 1980 also had other song figures not included here (and not mimicked by the local indigobirds). The large local repertoire of *L. rubricata* is paralleled in other firefinch populations (Payne, 1973; Brunel *et al.*, 1980).

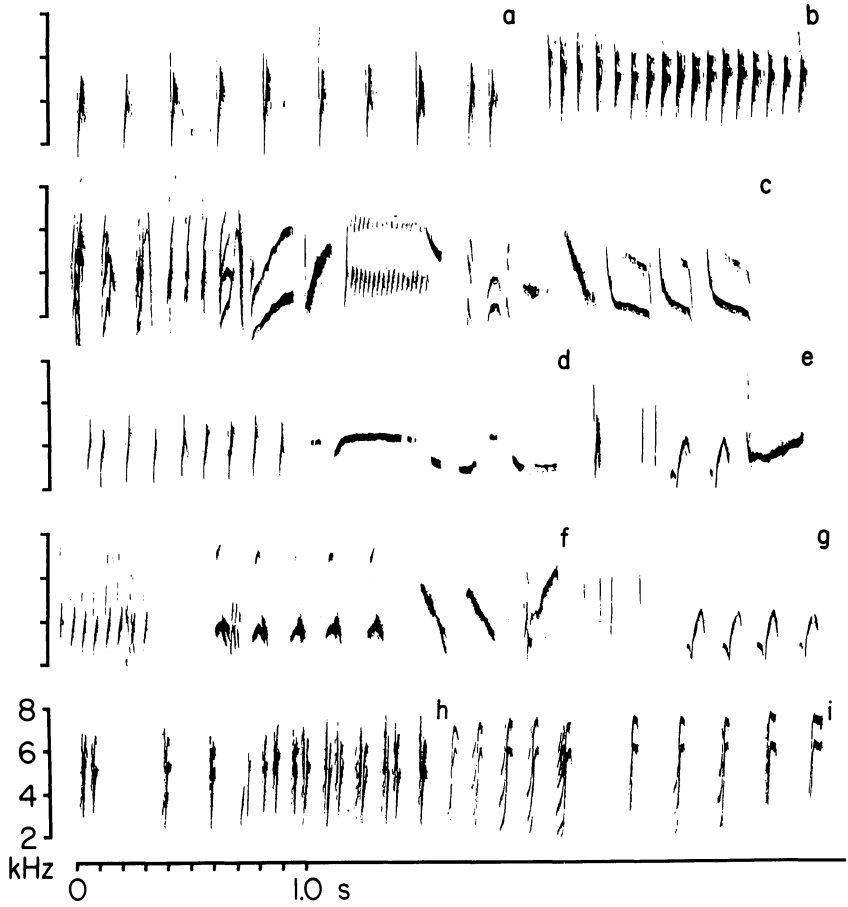

Fig. 24. Mimetic songs of blue-glossed Variable Indigobirds *Vidua funerea* at Banyo, Cameroon. Compare the song figures with those of the song model *L. rubricata* (Fig. 23). a, b, notes resembling alarm calls of *L. rubricata* (Fig. 23 a, b, c, d). c, long complex song given by all five *V. funerea* recorded at Banyo. This song was not tape recorded from a firefinch, but elements in it resemble the soft raspy note e and recurring phrase (Fig. 23 f) of the sexual song of *L. rubricata*. d, mimetic trill resembling trill of *L. rubricata* (Fig. 23 g), followed by slurred whistles. e, short complex song with elements resembling *L. rubricata* (see Fig. 23 a, d, g, l, n). f, longer complex song (as in c, d, and e, given by all local *V. funerea*) with elements resembling *L. rubricata* (Fig. 23 g, j, d). g, stereotyped sequence related to e. h, i, mimetic begging calls resembling nestling or juvenile firefinches.

applies to the young of other forms of *V. funerea* and *L. rubricata* as well. The juvenile plumage is unknown.

Song Mimicry.—Blue-glossed, pale-winged indigobirds were heard and tape-recorded mimicking the songs of *L. rubricata* at Banyo, Cameroon, and at Kabala, Sierra Leone (Table 3). No other blue pale-winged indigobirds were heard to mimic any other host species on the Adamawa Plateau in Cameroon or in Sierra Leone. Calls and songs of the Banyo *L. rubricata* and the *V. f. sorora* mimics are illustrated in Figs. 23 and 24. A smaller sample of calls and songs of the Kabala song models and mimics are illustrated in Payne (1976).

Breeding Season.—Blue *V. funerea sorora* indigobirds were active in chasing and singing at Banyo from 6 to 10 November 1980. At one tree, a bird replaced another within a day of the removal of the first one, and he in turn was replaced by another blue male the day after his removal. A female *V. funerea* was captured with an oviducal egg on 6 November. Breeding of the host species *L. rubricata* at Banyo begins late in the rainy season. We found three nests. The most advanced nest had three young firefinches nearly fledged, another nest had two firefinch nestlings less than a week old and parasitized by two nestling indigobirds (and predated shortly afterwards), and a third nest was under construction. The nests were well concealed in vegetation within 1 m of the ground. Two were built just under the bent stalks of maize in old cultivated lands, and the other was on the ground under coarse dried grass on the bank of a wooded stream. Regular rains had ceased by this time, though we were caught in heavy afternoon downpours on 7 and 8 November. Later in the season two years before, on 20–22 January 1979, Banyo was dry and dusty. We found no nests but family flocks of *L. rubricata* were common. Some young were netted and most juveniles had begun the post-juvenile molt; most adults were well into the postbreeding molt. No *V. funerea* were observed singing in January.

Distribution.—*V. f. sorora* occurs throughout suitable habitat together with its host *L. rubricata* in Cameroon on the Adamawa Plateau (Tibati, Galim, Banyo) south to the northern border of the equatorial forest. Its host species *L. rubricata* is the only firefinch common south of the plateau (Fig. 25). Most Cameroon specimens attributed earlier to "*camerunensis*" (e.g. Payne, 1973) are in fact *V. f. sorora*. The blue-glossed, pale-winged indigobirds in Sierra Leone are indistinguishable in color and size from the Cameroon birds (Table 3), and are associated in local distribution with *L. rubricata*. In Nigeria the blue-glossed birds ("*camerunensis*") collected by Serle at Enugu also are indistinguishable in color and size from the blue *V. f. sorora* from Cameroon, but it has not been determined whether

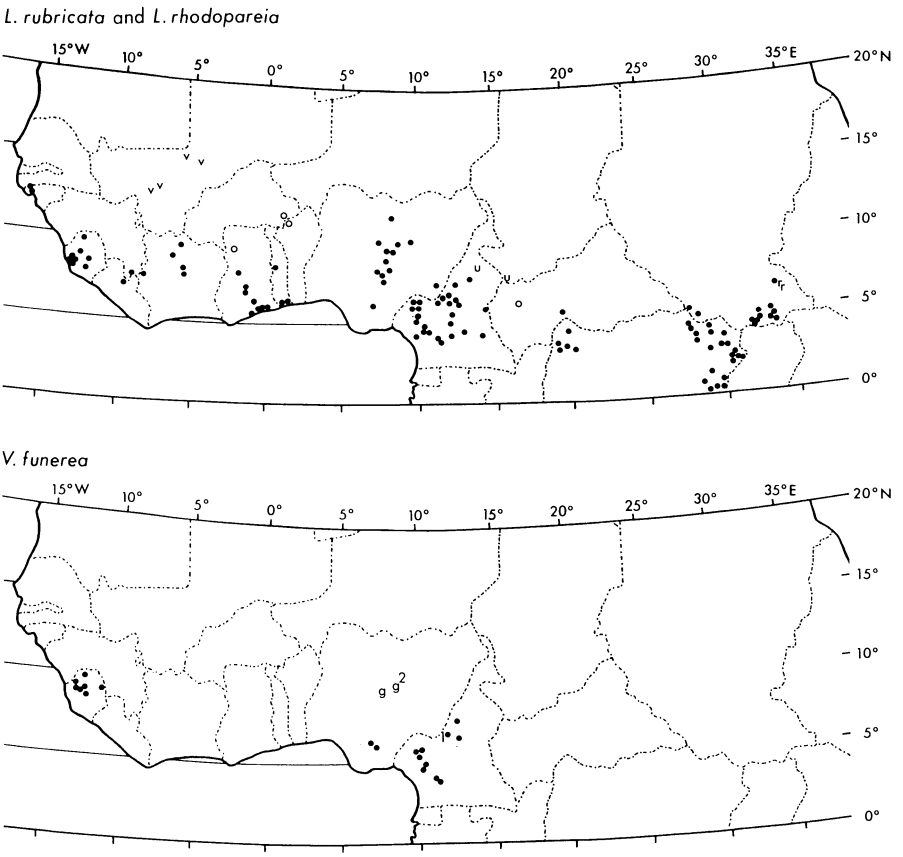

Fig. 25. Distribution of the African Firefinch *Lagonosticta rubricata* and the Pink-backed Firefinch *L. rhodopareia* and of the *rubricata* brood parasite Variable Indigobird *Vidua funerea* in West Africa. Solid figures indicate specimens or sight observations. Open figures for *L. rubricata* indicate observations that require confirmation (see Appendix I), v indicates the firefinch *L. rhodopareia virata*, u indicates *L. rhodopareia umbrinodorsalis*, and r indicates *L. rhodopareia rhodopareia*. For *V. funerea*, solid figures indicate localities of *V. f. sorora*, g indicates localities of *V. f. maryae*, and numbers indicate the type localities, 1 Banyo, 2 Panshanu, for these indigobirds.

these birds mimic *L. rubricata*. Serle (1957) found four species of firefinches at Enugu including both *L. rubricata* and *L. rara* as the two most common, and both were in the same habitat in farm patches in savanna country. I tentatively identify these blue indigobirds as *V. f. sorora* rather than *V. raricola* because they are similar in appearance to the Banyo mimics of *L. rubricata* and rather than *V. larvaticola* because (although the adult birds are morphologically similar to that species in Zaria) *L. larvata* was less common at Enugu (Serle, 1957). Blue-glossed indigobirds from other parts of West Africa from Guinea to Togo and from the Central African Republic to Sudan might include some of this form, but I have tentatively listed

them all together under *V. larvaticola.* Field work is required in these areas.

The name of the subspecies is based on the close relationship of this indigobird with the other forms of the indigobird species. The local common name of *V. f. sorora* is the Gala Indigobird.

NOMENCLATURAL COMMENTS

nigeriae Alexander, *camerunensis* Grote, and *sharii* Bannerman as *nomena dubia*

In the preceding sections three names were listed as possible but questionable synonyms of *V. raricola, V. larvaticola, V. funerea maryae,* and *V. f. sorora.* Each of these three questionable names (*nigeriae, camerunensis, sharii*) was based on a specimen in male breeding plumage and each was described adequately by the criteria of its day. However with recent field observations indicating the presence of three species of indigobirds in West Africa, each varying in plumage color from green to blue, it is impossible to determine to which species each of the three type specimens in fact belongs. Each of these names appears best regarded as a possible but questionable synonym, that is, as a *nomen dubium* ("The name of a nominal species for which available evidence is insufficient to permit recognition of the zoological species to which it was applied," Mayr, 1969: 407).

The name *Hypochera nigeriae* Alexander 1908 is a *nomen dubium.* The specimen cannot be matched with certainty to any of the three known species of indigobirds with green breeding plumage and pale wings in West Africa. The specimen probably belongs to one of these three species, but it is impossible to determine which one. In size the holotype of *nigeriae* is not distinguishable from any of the three species with green populations in West Africa (*V. raricola, V. larvaticola,* and *V. funerea maryae*). One wing of the type specimen is larger than the other (65 mm left, 67 mm right). The wing lengths fall within the range of all three specimens (Table 3), and in size and color the specimen could equally well be any one of these three species.

It is also impossible to associate the type of *nigeriae* with any one indigobird species on the basis of the geographical distribution of either indigobird species or the firefinch species, because of the considerable overlap in distribution in the general area where the type was collected (Figs. 16, 21, 25). The mimetic song was of course not noted at the time the bird was collected, and the local host population was not determined (years later, indigobirds were discovered to be brood parasites: Friedmann, 1960). When I visited Kiri,

Nigeria, the type locality of *nigeriae*, on 26 August 1968, I found an overgrazed village area with little habitat suitable for the firefinch species except for *L. senegala*, which was seen in the village. Its local mimic indigobird *V. chalybeata* was tape-recorded and collected in the village. But at the time the holotype was taken the grass was tall—humans and livestock had thrived since the famine times of Alexander's expeditions. Boyd Alexander himself did not visit Kiri; the type was apparently taken by his collector José Lopes, who accompanied by G.B. Gosling brought the expedition's boats up on the Niger and Gongola Rivers and met Alexander further to the north (Alexander, 1907a, b; Talbot, 1906). The expedition took no firefinches at Kiri. Alexander wrote no field notes on the trip (H. Alexander, 1912: 57).

Other green indigobirds have not been tape-recorded or collected within 50 km of Kiri. The closest localities where pale-winged indigobirds have been taken are 98 mi NW Yola, Nigeria (about 76 km from Kiri) (Payne, 1968a, 1973), and Garoua, Cameroon, 140 km from Kiri. The first (UMMZ 218988) was *V. larvaticola*, a blue mimic of *L. larvata*. At Garoua I taped three birds in 1979 and four in 1980; these mimicked *L. larvata*, and the only one collected was a worn bluish-green. Riggenbach collected a blue-green male at Garoua and another blue-green male and a bluish-green male at Siddiri 18 km W of Garoua, in 1909. Green indigobird mimics of *L. larvata* also occur 25 mi W Bauchi, Nigeria (Payne, 1968a, 1973). In addition, green *V. funerea* mimics of *L. rubricata* occur on the plateau at Panshanu, Nigeria, and green *V. raricola* mimics of *L. rara* are known in Cameroon within 200–320 km of Kiri. The firefinch *L. rhodopareia umbrinodorsalis* occurs together with *L. rara* and *L. larvata* 220 km upstream on the Benue River at Sakdjé, Cameroon. The Benue River valley is continuous with no apparent isolating barriers between that locality and Kiri, which lies at the exit of the Gongola River into the Benue River valley 17 km from Numan, at the junction of the Gongola and Benue rivers. Any of four firefinch species thus could have been the fosterer of the type specimen of *nigeriae*, and any one of these three indigobird species' populations may have been the source of the green Kiri specimen.

Evidence that indigobirds may disperse over considerable distances from their breeding grounds while in breeding plumage is available from observations of *V. funerea* in Zambia. The holotype of *V. funerea codringtoni*, an adult male taken early in the breeding season in Zambia, was collected in the Luangwa Valley, a habitat unsuited and unknown for its host species *L. rubricata* (Benson and Irwin, 1967; Payne, 1973). Both host and indigobird breed 130 km distant at Chipata. This same indigobird appears at the end of the breeding season in Lochinvar National Park, Zambia. Although my field associates and I have seen it there in three years in May and June,

after the breeding season of the local indigobird species, *V. funerea* is absent from Lochinvar during the breeding season, and its host *L. rubricata* is known no closer than Mumbwa and Chilanga, more than 80 km distant (Benson and Irwin, 1967; Payne, 1973).

In Nigeria the holotype of Alexander's *nigeriae* was taken on 22 July 1904, early in the season compared to other breeding Nigerian birds (Payne, 1973) and to the birds at Garoua, Cameroon. It may have been a nonbreeding bird at Kiri.

Because the holotype of *nigeriae* is a *nomen dubium* and might belong with any of the three known green species of pale-winged indigobirds in the region, and any of four firefinch species might have been its foster species, it seems inadvisable to continue the use of the name.

The holotype of *camerunensis* was collected by G. Tessman between Nola and Mbaiki in southeastern Central African Republic (then a part of German Neukamerun) on 28 October 1913. Tessman collected no firefinches in this area (none seen in Berlin Museum; also Grote, 1924, lists none). Nola and Mbaiki are about 190 km apart; presumably the type came from near Mbaiki as it is outside the forest zone (Bouet, 1942). The only record in the C.A.R. of *Lagonosticta* occurring within 100 km of this area is *L. rara* at Bangui, about 80 km NE of Mbaiki. However, further west in Africa particularly in neighboring Cameroon, *L. rubricata* occurs near the edge of the tropical forest, and it is known from several localities in northwestern Zaire, with Bobito being the closest to Mbaiki (164 km SE). Furthermore *L. larvata* occurs within the C.A.R. with the closest locality being Kaja Djerri (210 km NE). Other blue pale-winged indigobirds have been collected in the C.A.R. (Fig. 21) and presumably at least some of them are conspecific with the type of *camerunensis,* but the species identity of these birds is as uncertain as that of the type. The blue, pale-winged indigobirds collected both south of Bangui at Duma and north of Bangui and Ft. Possel and in Mbru country by Schubotz in 1910 are the closest specimens that look like the type of *camerunensis,* but Schubotz (the zoological collector on the Mecklenburg expedition of 1910–1911) collected no firefinches at these localities either (none in Frankfurt Museum; none mentioned by Grote, 1924, from the Hamburg Museum, the other repository of the collection; Schubotz, 1912; Von Weise und Kaiserwaldau, 1913). J. Steinbacher has examined and sent me a photocopy of Reichenow's manuscript of this Mecklenburg trip; the original manuscript is in the Senckenburg Museum in Frankfurt. No other firefinch localities are mentioned in the manuscript. It cannot be determined at this time to which biological species the holotype of *camerunensis* belongs, and the name is a *nomen dubium.*

The type of *sharii* was collected by Boyd Alexander on 16 September 1905 at Ratu on the Gribingui River in the C.A.R. Ratu was not located in Alexander's (1907a, b) trip description or maps, but

by date the locality on the Gribingui River would be about 7°28′N, 19°E. Alexander collected the firefinch *L. larvata* at Ratu, Majim, Irena, and on the Bamingui River in the C.A.R., whereas other firefinch species were taken at only one site each, neither at Ratu (*L. rufopicta* on the Bamingui River, *L. rara* at Kaja Djirri). The limited specimens available suggest *L. larvata* as the foster species of *sharii*, but other firefinch species occur in the area. The other complication involving *sharii* is that the type is morphologically almost identical to the type of *camerunensis*: both are green blue (Methuen dark blue nearest 22F8) with pale brown primaries and a wing length of 65 mm. Grote and Stresemann compared another B. Alexander specimen (BMNH 1911.12.23.3307 from Irena) with the holotype of *camerunensis*, and Grote wrote Bannerman "I found the two birds identical" (correspondence of 16 October 1923 in BMNH at Tring). The two types were reasonably thought to refer to the same species, and with *camerunensis* having priority the name *sharii* has not been used since (Bannerman and Bates, 1924). Although no morphological differences are evident, the two birds may not be conspecific. The scanty evidence on the distribution of firefinches suggests different species associated with the two, but the distributional evidence is not convincing for either case, and both names appear to be *nomina dubia* and should not be used at least until the local populations have been studied in the field and all questions of identity solved.

A parallel situation where a species was named and a holotype exists but the species name is a *nomen dubium* as it cannot be matched with other specimens occurs in fishes. The larvae of the lamprey *Ichthyomyzon* are morphologically indistinguishable, though adults of different species can be distinguished. Several species occur which can be told apart in the adult stage but not in the larvae, and only those names that can be associated with an adult stage are useful (Hubbs and Trautman, 1937). As the larval holotypes come from the areas where two or more species are known and cannot be matched with a certain species population, so are indeterminate, a later name of an adult specimen must be used to designate each species. In the indigobirds it is the immature rather than the adult that consistently across populations indicates the genetic distinctiveness of each species.

Vidua wilsoni (HARTERT)

WILSON'S INDIGOBIRD

Wilson's Indigobird is associated in song mimicry, in mouth mimicry of the young, and in distribution with its foster species, the Bar-breasted Firefinch *Lagonosticta rufopicta*. Indigobird mimics of *L. rufopicta* were first tape-recorded in northern Nigeria, but at the

time the song model was misidentified as that of *L. rara*, whose songs were not known (Payne, 1968a, 1973, 1976). These birds were all purplish in color and resembled the holotype of *V. wilsoni*, also from Nigeria.

Vidua wilsoni wilsoni (HARTERT)

Hypochaera wilsoni Hartert, 1901, Nov. Zool., 8, p. 342: Yelwa, Nigeria. Holotype: AMNH 452337, male in breeding plumage.
syn. *Hypochera lorenzi* Nicolai, 1972, J. Ornithol., 113, p. 236: Emene near Enugu, Nigeria. Holotype: Bonn 79.997, adult female.

Diagnosis.—The species is characterized among the indigobirds by the mouth pattern of the nestlings, which mimics the mouth pattern of the foster species, *L. rufopicta*. The mouth pattern consists of a pinkish palate with five black spots, a commissural flange of white enlarged both above and below the gape, and blue at the corner of the gape (Fig. 26). *V. wilsoni* differs from other species of indigobirds in West Africa in the plumage of the breeding male, which is purplish to purplish-blue. The flight feathers are light brown, not blackish. The white flank patches are usually concealed by the wings and are like those of the other indigobird species. The males mimic the songs and calls of *L. rufopicta*.

The nominate subspecies is characterized by the diagnosis of the species, and further is small. Wing length of 16 specimens of males from Nigeria averages 62.69 ± 0.30 mm (range 60–65 mm). The males are smaller than the other species of West African indigobirds, on the average, but overlap in size with them (Payne, 1973:252; see also Table 3). The bill color is whitish gray. The foot color is pale purplish, pinkish, or light gray with a tinge of these colors, though

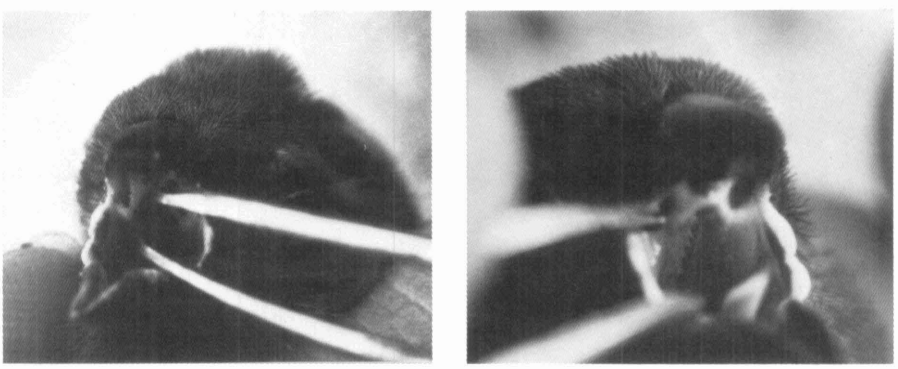

Fig. 26. Left: mouth pattern of a juvenile Bar-breasted Firefinch *Lagonosticta rufopicta* at Cape Coast, Ghana, on 25 September 1975. Note the enlarged flange-like corners of the gape, white across the gape, with a black line inside the mouth. The mouth lining is light pink (reddish lilac), not yellow. Right: mouth pattern of a juvenile Wilson's Indigobird *Vidua wilsoni* captured at Cape Coast, Ghana, on 2 October 1975. The bird (UMMZ 220772) matches the mouth pattern of juvenile *L. rufopicta*, its local foster species.

the two color-coded specimens taken in Cameroon matched more closely the color "dull-red" (Methuen 9B3).

Females are not distinguishable from those of other indigobirds in West Africa, although they average smaller than those of the other pale-winged species (Payne, 1973:236; Table 4). The juvenile plumage is apparently the same as that of other indigobird species.

Song Mimicry and Geographic Variation.—In my field experience in West Africa, all purplish, pale-winged indigobirds have been mimics of the firefinch *L. rufopicta*. Five males that I recorded and collected at Zaria, Nigeria, were as purplish as the holotype of *V. wilsoni* (Payne, 1973). Examples of song mimicry are shown in Figs. 27 and 28. A purplish indigobird was also tape-recorded and observed at close range along the river in Yankari Game Reserve, Nigeria, on 22 November 1980. Two purplish birds and a brown replacing bird at Tibati, and three purplish birds at Banyo, Cameroon, were tape-recorded as they mimicked *L. rufopicta* in October and November 1980. Another purplish bird was seen well and was recorded with this song at Ngaoundéré, Cameroon, near the airport in October, 1980. The two males collected in Tibati, and Banyo are indistinguishable in color and size from the Nigeria birds. Four purplish to purplish-blue males were tape-recorded near the grounds of the university at Cape Coast, Ghana in 1975. All mimicked *L. rufopicta*. One was captured (UMMZ 220767) and proved to be purplish-blue, slightly bluer than the Nigerian *V. wilsoni*. I saw one juvenile indigobird in a family group of *L. rufopicta* at Cape Coast University farm. No other kinds of indigobirds were seen here. In the following two years MacDonald (1980) continued observing finches at Cape Coast, and found all local indigobirds to be purplish mimics of *L. rufopicta*, the common local firefinch. *L. rubricata* also occured but mainly in different habitats and no indigobirds were found mimicking its song. MacDonald (1980) found a juvenile indigobird being fed in a family group of fledged *L. rufopicta*, providing additional evidence for the local parasitism of *L. rufopicta* by *V. wilsoni*. I also tape-recorded purplish indigobirds of this form mimicking *L. rufopicta* at Legon and in the area of Mole National Park in northern Ghana (Damongo, 2 birds, Larabanga, one bird, and Mole motel, one bird). A purplish *V. wilsoni* was collected at Lovi in Mole Park by Harvey and Harrison (1970). *L. rufopicta* was seen in all these localities but Larabanga.

Breeding Season.—The breeding season of *V. wilsoni*, like that of the other indigobird species, falls late in the rains. Birds at Zaria, Nigeria, mated in August, and I saw no young out of the nest by early September. The rains at Zaria peak in August and September (Hore, 1970). At Ngaoundéré, Tibati, Mbakaou, and Banyo, Cameroon,

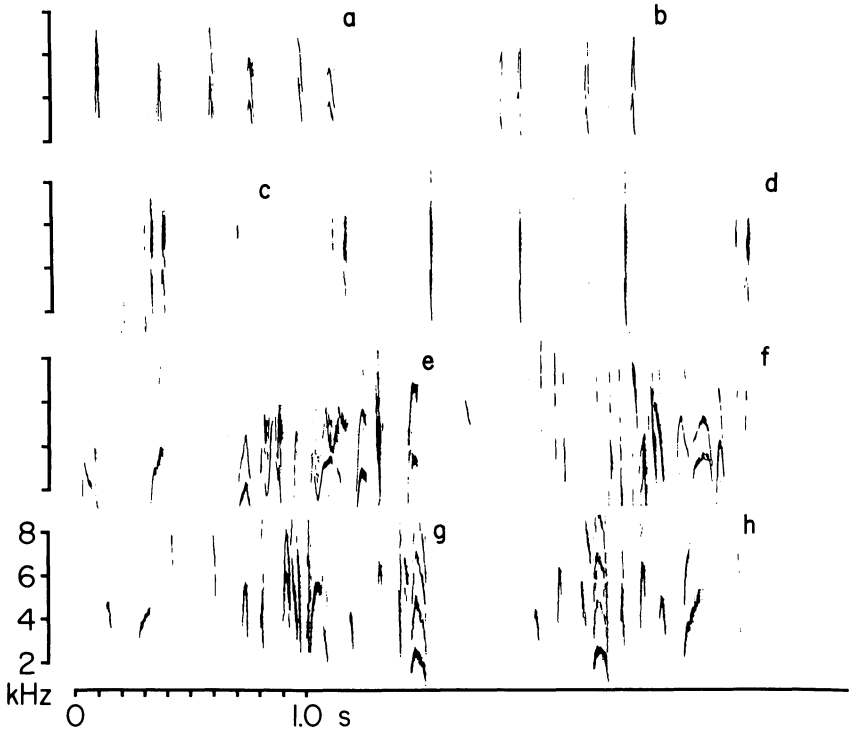

Fig. 27. Vocalizations of *Lagonosticta rufopicta*. a, alarm calls *L. r. rufopicta*, Yankari National Park, Nigeria, 22 November 1980. b, alarm calls, Banyo, Cameroon, 11 November 1980. c, d, alarm calls, *L. r. nitidula*, captive, netted at Lochinvar National Park, Zambia, on 6 April 1972. e, song, *L. r. rufopicta*, juvenile molting into adult plumage, Tibati, Cameroon, 18 January 1979. f, song, *L. r. rufopicta*, captive, netted at Zaria, Nigeria, in August 1968. g, h, songs, *L. r. nitidula*, captive, netted at Lochinvar National Park, Zambia, on 6 April 1972.

birds were singing in October and November. The host firefinch *L. rufopicta* was netted at Banyo in November with an egg in the oviduct, and another was seen nestbuilding. The rains are greatest in this region from July to September (Letouzey, 1968). No young were seen in late October, 1975, at Mole National Park, Ghana, where the rains had just ended. Along the coast at Cape Coast, Ghana, I saw and collected 12 juveniles in September and early October. Adults sang only sporadically, and some were in post-breeding molt. A female had an egg in the oviduct on 10 September 1975. MacDonald (1970) found *V. wilsoni* to breed from April through September at Cape Coast, and its host *L. rufopicta* to breed in the same months. Breeding probably is earlier along the coast than inland in Ghana because of the local difference in rainy seasons. The rainiest months in the north are August and September whereas on the coast the rains are heaviest in May and June (Walker, 1957).

Distribution.—Purplish-glossed, pale-winged indigobirds are found across West Africa from the western end of the woodland areas in Senegal and Guinea-Bissau through Ghana, Togo, Nigeria, and

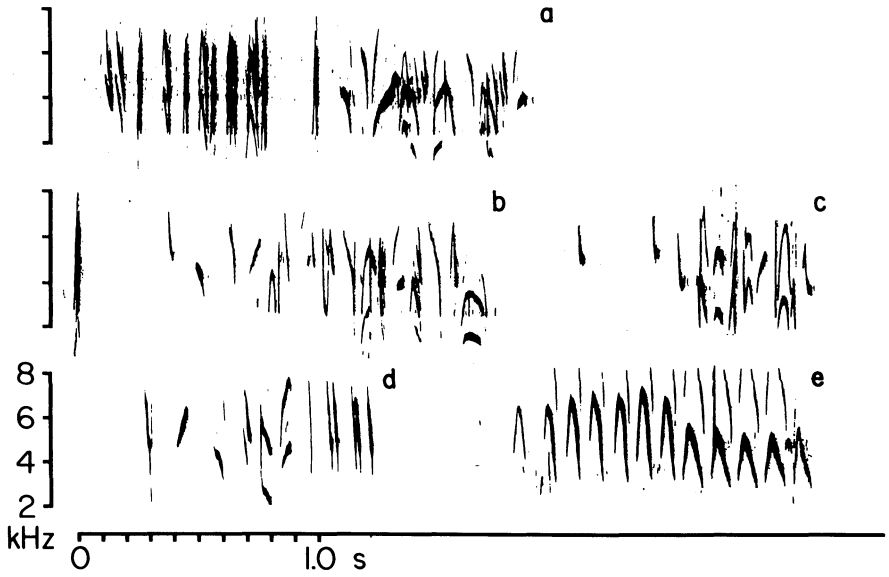

Fig. 28. Mimetic songs of Wilson's Indigobird *Vidua wilsoni*. Compare the song figures with those of the song model species, the Bar-breasted Firefinch *Lagonosticta rufopicta* (Fig. 27). a, b, alarm calls and songs, Yankari National Park, Nigeria, 21 November 1980. c, song, Ngaoundéré, Cameroon, 27 October 1980,d, song, Zaria, Nigeria, 1 September 1968, UMMZ 217013, e, trill resembling that of other species of indigobird, perhaps derived from begging call, Zaria, Nigeria, UMMZ 217013.

Cameroon, and extend eastwards through the Central African Republic, the Uele district of Zaire, and southern Sudan. All occur within the range of *L. rufopicta* and in most cases all are known to occur in the same locality as this firefinch (Fig. 29, Appendix I). *L. rufopicta* is known for the two localities of *V. wilsoni* in Zaire (Yakoma, Gangala-na-Bodio), and is known near the localities of *V. wilsoni* in Sudan. Hall and Moreau (1970) have also pointed out the correspondence of the distribution of *V. wilsoni* and *L. rufopicta* in Nigeria. *L. rufopicta* extends eastward into Uganda and western Kenya (Britton, 1980) and Ethopia (Erard, 1974). *V. wilsoni* is unknown in East Africa. The listing (Payne, 1973:332) of *V. wilsoni* from N'Gabe, Congo, is in error: the bird (AMNH 345194) and a similar one (MRAC 74937) from Boma, Zaire, are purplish-blue specimens that are associated distributionally with *L. rubricata*. Both localities are south of the equator and both are well outside the range of *L. rufopicta*. The two specimens are *V. funerea nigerrima*.

Nomenclature.—The recent name *lorenzi* of Nicolai (1972) is based on a bird discovered as a nestling in the nest of *L. rufopicta* in southeastern Nigeria. Although no adult indigobirds were collected, Nicolai heard purplish birds in southeastern Nigeria mimicking the songs of *L. rufopicta*. The nestling was kept alive and it was described

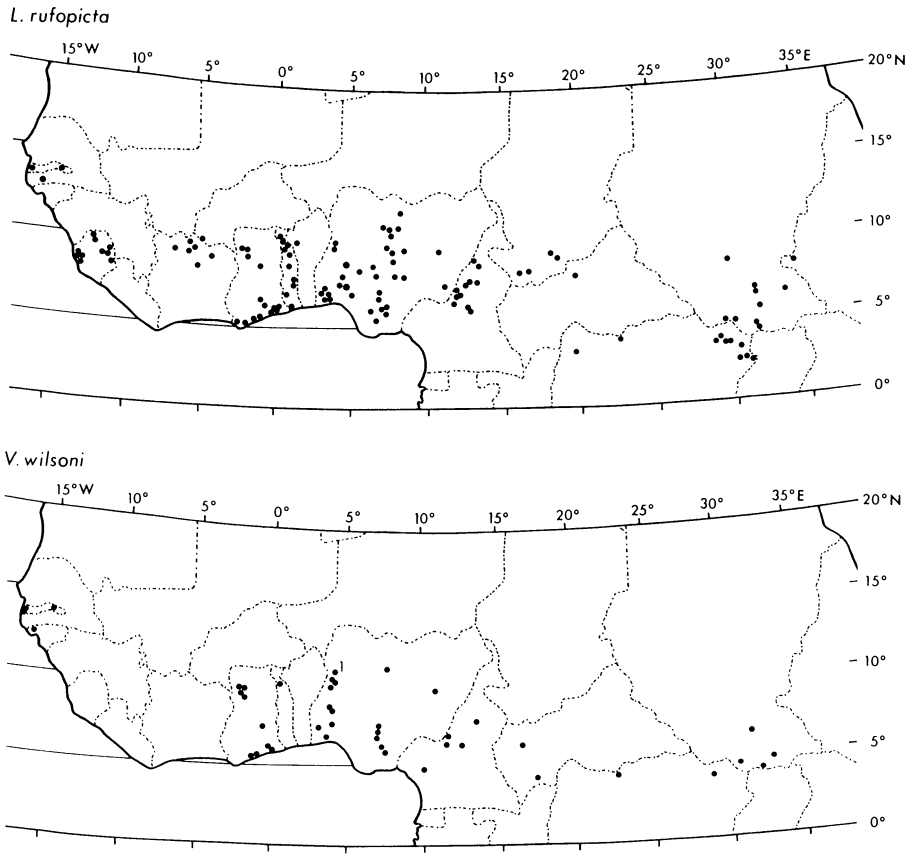

Fig. 29. Distribution of the Bar-breasted Firefinch *Lagonosticta rufopicta* and its mimetic brood parasite Wilson's Indigobird *Vidua wilsoni* in West Africa. The number 1 indicates the type locality of *V. wilsoni*. Populations of purplish indigobirds that mimic the songs of *L. rufopicta* are known to the west (Damongo, Larabanga, Lovi, Mole) in Ghana, to the southwest (Legon, Cape Coast, Elmina) in Ghana, to the east (Zaria, Yankari) in Nigeria, and to the southeast (Abakaliki-Afikpo, Nicolai, 1972), as well as east in Cameroon. The association of purple-glossed plumage and mimetic song in populations surrounding the area of the type locality as well as the close match in distribution of *V. wilsoni* to *L. rufopicta* support the view of *V. wilsoni* as a species-specific mimic and brood parasite of *L. rufopicta*.

in print as a new species. A photograph was published of the young bird (Nicolai, 1972); the bird was not prepared as a museum specimen at the time of description. The description included the mouth pattern and juvenile plumage. The bird was preserved as a museum specimen two years later, after it died in an aviary mishap (J. Nicolai, *in litt.*). The bird had molted its plumage several times. G. Rheinwald of the Bonn Museum has kindly examined the specimen and has sent me a description of the bird and color photographs of the type together with a specimen of a female indigobird that I had examined and compared with others previously. The type specimen was sexed as a female. The plumage is streaked above, and it resembles that of

the adult females of all five species of West African indigobirds in my series of known identity. The streaking is by comparison less distinct than in an adult female *V. chalybeata* from Addis Ababa, Ethiopia (Bonn Huyn 7.3.21). There is no indication of the color of the bill or feet on the label of the type, nor was there in the original description. Insofar as it is impossible at this time to identify any of the indigobird species in West Africa from the female plumage, the holotype of *lorenzi* can be identified to species only from its history as a nestling in a nest of *L. rufopicta* and from its mouth pattern as described by Nicolai as matching that of *L. rufopicta*. Although the bird was not preserved as a permanent museum specimen at the time of its original taxonomic description, and it had passed into another morphological stage of its life before it was preserved, the description itself appears to me to meet the requirements for nomenclatural availability of the International Code of Zoological Nomenclature (1961). I regard the type specimen of *lorenzi* as unambiguously referable to *V. wilsoni*, and the name *lorenzi* to be a synonym of *V. wilsoni*.

Vidua wilsoni incognita (NICOLAI 1972)

Hypochera incognita Nicolai, 1972. J. Ornithol., 113, 237: Angola.

Nicolai described as a new species a captive indigobird that mimicked the firefinch *Lagonosticta rufopicta nitidula*. The material available included the holotype and another captive from Katanga (= Shaba), Zaire. No exact localities were known; the birds were aquired in Europe through the pet trade, and their origin is uncertain. The holotype mimicked the song of *nitidula*; the other bird mimicked the alarm call (Nicolai, 1972). The male breeding plumage was dark purple ("dunkelvioletten"), the wings were brown ("braun"), and the feet were a light flesh color ("hellfleischfarben"). Nicolai contrasted the plumage color with that of *Vidua funerea nigerrima* (Sharpe 1871) from the description of the holotype, but did not examine that specimen nor did he refer to other museum specimens or color standards. Nicolai implied that *incognita* was more glossy than *nigerrima*, but the plumage of the holotype of *nigerrima* is dull because of seasonal wear (Payne, 1973:248–249), and Nicolai made no direct comparison of these specimens. The holotype has since been lost (J. Nicolai, *in litt.*).

Nicolai proposed that his captives represented a new species because they mimicked the song of a different species of firefinch. However, *nitidula* itself appears not to be a distinct species of firefinch, but rather it is a geographic form of the Bar-breasted Firefinch *L. rufopicta*. The forms are allopatric and approach in east-central Africa (Hall and Moreau, 1970). They differ mainly in rump color, red in *rufopicta* and brown in *nitidula*. Populations of *L. rufopicta* from Sudan, Ethiopia, northeastern Zaire, and adjacent

Uganda are recognized as a subspecies *L. r. laterita* distinct from the populations further west in being grayer (less brown) in the upperparts of the plumage (Mackworth-Praed and Grant, 1972). Populations of the form *nitidula* that are nearest to the northern *L. rufopicta* are intermediate in plumage color tone (darkness) between those birds and the populations of *nitidula* to the southwest (Chapin, 1954: 532); the southwestern birds have been described as a separate subspecies (*plumbaria*) characterized by paler, less reddish plumage below (Clancey, 1962). The gradient of more red to less red in the plumage in the geographically replacing series of forms *rufopicta- laterita- nitidula- plumbaria* suggests a single species of firefinch, and in fact these have previously sometimes been regarded as conspecific (White, 1963; Britton, 1980). The plumage differences of the extremes of *L. rufopicta* and *nitidula* are no greater than in the geographic forms of another firefinch, *L. larvata vinacea* and *L. l. nigricollis*. Moreover, the songs and alarm calls of *nitidula* are indistinguishable from those of *L. rufopicta*. The vocalizations of *L. rufopicta* recorded in West Africa are apparently indistinguishable from those of a male *nitidula* from Zambia (Fig. 27). The song and alarm calls appear sufficiently similar that an indigobird female that was attracted to one would be attracted also to the other—female indigobirds are specifically attracted to the songs of their host species and to those male indigobirds that mimic the same set of songs, and not to the songs of other kinds of firefinches (Payne, 1973). The mouth markings of juvenile *nitidula* and its brood parasite are not known. Because the firefinches *L. rufopicta* (including *laterita*) and *nitidula* (including *plumbaria*) are all simply subspecies of a single species, and because their songs are apparently identical, I regard the indigobird *incognita* as a form of *V. wilsoni*.

The holotype of *incognita* was larger (wing length 69 mm: Nicolai, 1972) than any purplish West African indigobird (Payne, 1973), and it seems reasonable to recognize *incognita* as a distinct subspecies within *V. wilsoni*. However, because the plumage was apparently similar to that of *V. funerea nigerrima*, it is impossible to recognize any indigobird museum specimens from the range of *L. rufopicta nitidula* as belonging to *V. w. incognita*. I have looked for indigobird mimics of *L. r. nitidula* in Zambia, but I found none at Livingstone, Lochinvar, and the Northern Province and Luapula Province between Lake Tanganyika and Lake Mweru (*nitidula* occurs in these localities). Field work in Angola and Zaire is desirable to rediscover this indigobird. It is unknown in the field.

DISCUSSION

The species distinctiveness in the colors of the mouth patterns in the young in all West African species of firefinches *Lagonosticta* and

TABLE 5

SONG MIMICRY, PLUMAGE COLOR, AND KNOWN DISTRIBUTION OF INDIGOBIRDS IN THE PALE-WINGED WEST AFRICAN SPECIES COMPLEX.[1]

Indigobird species	Song mimicked	Plumage color of male indigobird[2]		
		green	blue	purple
V. raricola	*L. rara*	22 Cameroon (Ngaoundéré, Tibati, Banyo),[f] 1 locality ? captive[b] 3 Sierra Leone.[e]	3 Ghana,[f] Cameroon,[a] 9 locality ? captive,[b] E. Nigeria[b]	
V. larvaticola	*L. larvata*	1 N. Nigeria,[c,d] 1 Cameroon (Ngaoundéré),[a] 6 Cameroon (Garoua)[f]	18 N. Nigeria[c,d,g]	
V. funerea	*L. rubricata*	4 N. Nigeria (Panshanu,[c,d] Kagoro[g])	6 Sierra Leone,[e] 5 Cameroon (Banyo).[f]	
V. wilsoni	*L. rufopicta*			6 N. Nigeria (Zaria[c,d,e,g], Yankari[f]), 2 E. Nigeria (Abakaliki),[b] 8 Ghana (Legon, Cape Coast, Mole)[f]

[1]Includes only those observations of known mimetic song.

[2]Numbers refer to number of individual indigobirds tape-recorded or heard in each locality to mimic the firefinch indicated.

References: a=Nicolai, 1968; b=Nicolai, 1972; c=Payne, 1968a; d=Payne, 1973; e=Payne, 1976; f=Payne, 1975–80 observations in Ghana, Nigeria, Cameroon; g=M. G. Dyer 1975–79 observations.

the precise 1:1 morphological mimicry of each firefinch by an indigobird *Vidua* (Table 2) indicate that genetically distinct indigobirds each parasitize and mimic a single species of firefinch. Because the young are specific mimics (rather than mixed or generalist mimics) in this morphological trait, there is evidence of genetically separate populations of indigobirds each parasitizing a single species of firefinch. Each indigobird is recognizable morphologically up to the time of independence of the young from the foster parents, at which time the nestling mouth colors disappear. The association of the mouth colors of the nestling and fledgling indigobirds with the distinctive mouth colors of each of the firefinch species mimicked locally in song by the adult indigobirds gives us direct evidence that each kind of indigobird is a species specialized genetically as well as behaviorally for parasitizing a single species of host.

The variation in plumage color within each species of indigobird in the pale-winged species complex in West Africa is summarized in Table 5. It is impossible to determine the song-mimicry behavior, and hence the species, of museum specimens alone. Distinct species are sometimes indistinguishable in their plumage color and size alone, at least in certain allopatric populations. Nevertheless within the intensively worked areas where birds have been tape recorded and the singing birds collected for comparison with a series of color standards, the birds in each song-mimicry group are morphologically distinct in male breeding plumage from other coexisting indigobirds. Each species may vary in appearance among different regions of West Africa. This geographical variation is most evident in *V. funerea*, which is blue in Sierra Leone, green in northern Nigeria, and blue in Cameroon. The same species varies regionally from green to purple in the southern half of Africa (Payne, 1973), so it is not without parallel to find the colors of the males varying across West Africa. Plumage color also varies in *V. raricola* and in *V. larvaticola* from green to blue. Within the areas where field studies of song and plumage have been carried out, it is possible to identify most individual specimens to species by the male breeding plumage. Until field work of this nature has been completed in other areas, it will not be possible to so identify all indigobird specimens to species, even the breeding males. The coexistence of different color forms of indigobirds in localities with no birds of intermediate coloration further supports the plural concept of species of indigobirds. In several localities, two or more forms occur together and each mimics the song of a different species of firefinch. By the test of sympatry, birds of different morphological appearance (male breeding plumage) have different song behavior and so (in combination with the known species-specific attractiveness of song to female indigobirds, and to the host-specificity of the mouth markings of the young) give evidence of species distinctiveness in the following species combina-

tions: *V. chalybeata, V. larvaticola,* and *V. wilsoni* at Zaria, Nigeria; *V. larvaticola* and *V. funerea* at Panshanu, Nigeria (based on a small population sample); *V. raricola* and *V. funerea* at Kabala, Sierra Leone; *V. chalybeata* and *V. larvaticola* at Garoua, Cameroon; *V. raricola* and *V. wilsoni* at Mole National Park and Damongo, Ghana, and at Ngaoundéré, Mbakaou, and Tibati, Cameroon, and *V. raricola, V. funerea,* and *V. wilsoni* at Banyo, Cameroon. This list includes all possible two-way sets of species except for *V. chalybeata* and *V. raricola, V. chalybeata* and *V. funerea,* and *V. raricola* and *V. larvaticola.* There is no question of *V. chalybeata* being conspecific with any of these forms; *V. raricola* and *V. larvaticola* are species distinct from each other on the strength of mimicking different species of hosts and of having two distinctly different mouth patterns in the young, both in allopatry and at Zaria in sympatry. Other localities are known from museum specimens only where as many as three color forms occur together; the Lado region in southern Sudan, the Uele district of Haut-Zaire, and the Enugu region of Nigeria (Lynes, 1924; Chapin, 1954; Serle, 1957; Schouteden, 1963; Hall and Moreau, 1970; Payne, 1973; Appendix I).

The close association of locally distinctive male breeding plumage and the species-specific song mimicry of the male indigobirds, together with the color mimicry of the mouths of the immatures, allows us to distinguish the species of indigobirds. The species are *V. chalybeata, V. raricola, V. larvaticola, V. funerea, V. wilsoni,* and *V. purpurascens.* This last species, the Dusky Indigobird, is as far as now known extralimital to West Africa and occurs in eastern and southern Africa as a host-specific mimic and brood parasite of the Pink-backed Firefinch *L. rhodopareia* (Payne, 1973).

Further field work may show that certain other firefinches are sufficiently distinct to be regarded as distinct species, and if the songs and mouth patterns of these are unique and are mimicked by morphologically distinct indigobird populations, then additional species of the indigobird brood parasites may yet be discovered. The red-billed populations of Angolan firefinches now recognized as the subspecies *L. rubricata landanae,* the sexually monomorphic firefinches of Mali recognized as *L. rhodopareia virata,* and the broad-primary gray-headed firefinches of northern Cameroon and Chad *L. rhodopareia umbrinodorsalis* (Hall and Moreau, 1970; Payne, 1973; Erard and Roche, 1977; Brunel et al., 1980; see p. 83) all deserve further field study. No indigobirds are known to be associated with *virata* or *umbrinodorsalis.* The species nomenclature of *V. funerea nigerrima* would need to be reconsidered if *landanae* proves to be a distinct species. Two other West African estrildids that have sometimes been considered members of *Lagonosticta* are Dybowski's Twinspot *Eustichospiza dybowskii* and the Lavender Waxbill *Estrilda caerulescens.* Both have distinctive calls and songs (tape

recorded at Banyo, Cameroon, and at Zaria, Nigeria); neither was mimicked by any local *Vidua*, and neither is known to be a fosterer of any parasitic finch.

Might different indigobirds within an area simply be genetic "morphs" rather than distinct species? Certain species of brood parasitic cuckoos (Cuculidae) are polymorphic or at least are locally variable in egg color. In the best-known species, the Grey Cuckoo *Cuculus canorus* of the Old World, some females lay spotted eggs, others unspotted, and the background color of the egg also varies among females. Individual females are often species-specific parasites and lay most or all of their eggs in the nest of a host species with eggs similar to their own. Males within a local cuckoo population all have the same song and behavior, and there is no evidence of local "races" or "gentes" in terms of assortative mating within a population; rather, females appear simply to be genetically variable in egg pigmentation of their eggs (Payne, 1977b). There is no parallel in any of these cuckoo species either of song differences or of morphological differences among the males within a local population, let alone any evidence of association of morphology and behavior, as there is in the sympatric populations of different indigobird species.

It is further unlikely that the indigobird young found in the nest of a firefinch of any particular species match the host young as a result of different success in survival of matching and nonmatching morphs of young indigobirds by the time the surviving individuals were found in the nest. Evidence that individual female indigobirds are highly selective in parasitizing a single species is available from several observations. First, female Village Indigobirds *V. chalybeata* in my aviaries parasitize *L. senegala* (and once parasitized *L. rhodopareia*), but never parasitized nesting finches of other species (Bengalese Finches *Lonchura cucullata*, Stawberry Finches *Amandava subflava*, Violet-eared Waxbills *Granatina granatina*, and Red-cheeked Cordon Blues *Uraeginthus bengalus*). Second, all indigobird eggs found in the field in the nests of *L. senegala* and incubated under captive Bengalese Finches in Zambia proved on hatching and examination of the nestling mouths to be *V. chalybeata*, though the firefinch nests were from localities where both *V. chalybeata* and *V. purpurascens* (a brood parasite of the Pink-backed Firefinch *L. rhodopareia*) occur as breeding indigobird species (Payne, 1977a). The eggs of the indigobird species are indistinguishable; all species lay plain white eggs and the eggs overlap in size (Payne, 1977a). Thus the young had no possible prior visual discrimination by the firefinch fosterers as the eggs did not hatch until they were tested experimentally under another species. These observations indicate that indigobirds are unlike the egg-polymorphic parasitic cuckoos, and that the matching of the mouth colors of the young indigobirds and their foster species is an immediate result of the species-specific

parasitic laying behavior of the female indigobirds, not of post-hatching discrimination by the foster firefinches against any nestling mouths that do not match the color patterns of their own young.

Another possible parallel is that of the polymorphic tropical butterflies *Papilio dardanus* of Africa and *P. memnon* of India and Wallacea. In these butterfly species, females are often mimetic (resembling other local distasteful butterflies), and are polymorphic, with different females mimicking different local butterfly species. Although females look different, the males of breeding pairs are alike. In breeding experiments, crosses between morphs within the same population show strong dominance expression of the genetic differences, with the offspring closely resembling one mimetic model. Crosses between remote populations show a breakdown of any mimicry, with the offspring being intermediate in appearance and not resembling closely the young of any one morph. The results match the prediction of R. A. Fisher's theory of the evolution of dominance of coadapted local genes; in *P. dardanus* a single supergene determined in a switch-like manner the mimetic form of the offspring (Clarke and Sheppard, 1960; Ford, 1964, Clarke, Sheppard and Thornton, 1968; Owen, 1971). Thus what at first were thought to be distinct species of butterflies turn out with close analysis to be genetic variants of the same species. In addition to the evidence of the assortative mating in the indigobirds (shown in three species of the *Vidua* indigobirds in southern and eastern Africa (Payne, 1973)), two differences should be noted between the biology of mimicry in the *Vidua* species and the polymorphic *Papilio* that bear on the question of species distinctiveness. The parasitic finches in West Africa differ morphogenetically among sympatric forms not only in one sex of the adult (male breeding plumage) but in both sexes of the nestling (mouth pattern). It is unlikely that a single gene or supergene would have an effect expressed in such different ways in two life stages. Furthermore in birds the females are the heterogametic sex (Gowen, 1961; Ford, 1964), and there is no cytological basis to suggest male sex-linked polymorphism of plumage color.

The fact that female indigobirds cannot at present be identified from museum specimens does not argue that they are not distinct species. As with larval fishes that cannot be distinguished morphologically, the females are simply one of the indistinguishable life stages that are morphologically similar among the closely related species. It may be possible to test the species-distinctiveness of the females (1) by determining morphological or biochemical differences of the females with further field work, (2) by observing the social interactions and mating of color-marked individual females in mixed-species populations of indigobirds (Payne, 1980; Payne and Payne, 1977), or (3) by capturing a female observed to associate with a particular male, plucking a patch of feathers, and then injecting her

with LH (luteinizing hormone): viduine finches of either sex develop the characteristic male breeding plumage of their species with this hormonal treatment (references in Payne, 1973). If females that were netted with green males develop green plumage, and females taken with blue males develop blue plumage, the response would support the view that the local greens and blues behave as distinct species.

The considerable similarity among the indigobird species in the morphology of the adults makes it impossible to diagram their evolutionary relationships among each other at this time. The males are all little black finches with differences in plumage gloss (if the light is just right). The females are not obviously distinguishable. The West African *V. chalybeata* appear to be the most distinctive, with blackish primaries in the male in contrast to the light brown primaries of the other species, and it seems likely that members of the brown-winged species complex (*V. raricola, V. larvaticola, V. funerea,* and *V. wilsoni*) are more closely related to each other than any one is to *V. chalybeata.* Within the brown-winged species, *V. wilsoni* is the most distinctive in appearance (smaller size and purplish plumage). The other three species are not always morphologically distinguishable across West Africa, though each is nevertheless distinct from the others in several areas of local sympatry.

Even these broad outlines do not hold for the most widespread species across their entire range, however. In south-central Africa, *V. chalybeata* has paler wings than *V. funerea codringtoni* and *V. f. lusituensis* (Payne, 1973), and *V. chalybeata* is not obviously distinguishable in any plumage characters from *V. f. nigerrima* in southern Zaire and Angola (Payne, 1973), differing only in foot color and in song.

Other possible sets of characters might be useful in describing phenetic resemblances and cladistic relationships among the indigobird species. But song behaviors, in which the differences between sympatric species and between different populations of the same species both appear to be entirely due to differences in the individual experience of each bird (Payne, 1973), and not to any genetic differences, are not useful as evolutionary characters. Furthermore the mouth patterns of the young mimic the foster species, and are not necessarily more similar in the most closely related species of brood parasites.

Hybridization or introgression and a net-like pattern of relationships among the different forms of the indigobird species as well as subspecies have been suggested as interpretations of variation (Traylor, 1966; Payne, 1973:278). Close similarity in plumage color no more demands reticulate evolution as an explanation than it does an immediate sister-species relationship between any two species. I find no compelling evidence in the present study for my earlier suggestion (Payne, 1973) of possible reticulate evolution among the

indigobird species. An evolutionary process of character divergence in male breeding plumage might be proposed in those instances, emphasized here, where different song populations have distinct plumage, and where plumage color may even reverse in other local populations (green and blue forms of *V. raricola*, *V. larvaticola*, and *V. funerea*). However in southern and eastern Africa there are several instances where species live together with no apparent interbreeding yet have male plumage color that is identical or nearly so, with the species differing morphologically only in the color of the bill and feet (e.g. *V. chalybeata* and *V. purpurascens* in northern Kenya, *V. funerea* and *V. purpurascens* in the eastern Tranvaal of South Africa) (Payne, 1973). Finally, the mode of speciation in the indigobirds is of interest insofar as the birds are species-specific brood parasites, the males copy the songs of their host species, and the females are sexually attracted to this song of the males with an upbringing like their own—an experience that differs among species. Because of the potential for differentiation and speciation of two or more populations from a single population with no attendant geographic isolation, the indigobirds and other parasitic finches possibly have speciated "culturally" without allopatry (Payne, 1973). Again, the evidence is not yet available to allow us to determine whether the indigobirds have in fact speciated in this manner. On the contrary most of the species are geographically variable, so some genetic differentiation of populations has been associated with geographic isolation. Perhaps biochemical or genetic analyses will be useful in unravelling these historical events of evolutionary history.

The relationships of the indigobirds to those of their host species are more clear. The indigobird species are barely distinguishable from each other, or are not at all, and in juvenile plumage, female plumage, and adult plumage as well as in several characteristics of osteology, feather arrangement, and other morphology are all closely related to each other (Friedmann, 1960; Payne, 1973). The host firefinches are more similar to each other than any one is to any indigobird, with the exception of the mimetic vocalizations (which, at least in the brood parasite species, are learned from the host species and from conspecifics) and the mimicry of the babies' mouth patterns. The situation is similar to that of another species complex of brood parasites, the bumblebees (*Bombus*) and the cuckoo-bee species (*Psithyrus*) that parasitize them. Cuckoo-bees often resemble a local *Bombus* species in external color and pattern. The resemblance is greatest in areas where the *Psithyrus* species are species-specific parasites on a single *Bombus* (Plowright and Owen, 1980). Analysis of morphological characters (wing venation) suggests that the *Psithyrus* species are all more closely related to each other than any one is to its model in the mimicry system (Plowright and Stephen, 1973). The visual mimicry of the indigobirds and the cuckoo-bees

differs primarily in that mimicry is apparently directed towards predators in the bees, but towards the foster parents to gain their parental care in the young indigobirds.

Mouth mimicry in the young and song mimicry in the adults both are important elements in the syndrome of the species-specific brood parasitism of the indigobirds. It is uncertain which evolved first in the parasitic finches, but mouth mimicry likely was the prior adaptation. At least in one species of viduine, the Pin-tailed Whydah *V. macroura,* the parasite mimics the mouth pattern but not the song of its foster species; this bird parasitizes several closely related species of waxbills *Estrilda* all with different vocalizations but with a common nestling mouth pattern. The foster firefinch *Lagonosticta* species on the other hand all differ from each other in their nestling mouth patterns. In their parasites, the learned song mimicry apparently cues the female indigobirds to the genetic identity of the male indigobirds. Mimetic songs of the males are directed towards the females, who are attracted selectively to the mimetic songs of males that mimic their own foster parent species (Payne, 1973). Evolutionary sexual selection has led to a sexual signal that assortatively attracts as mates those birds with a common early experience and success in being reared in the same specialized nest environment. At least in most instances the females are thereby attracted to males with the same mouth-mimicry genes as their own. This mechanism for assortative mating is important in the indigobirds, as the males court indiscriminately all visiting little brown birds including females of all species of *Vidua* (Payne, 1973, 1980) and they mate and occasionally hybridize when they catch these females unaware (Payne, 1980). Probably the resulting hybrid young have a smaller chance of success in foster parental care than do the normal nonhybrid young parasites; the mechanism of "parental" recognition and the colors of the mouth pattern of young hybrids are unkown. It appears that the species-specific mouth patterns of the young in the various firefinch *Lagonosticta* foster species in West Africa has forced the evolution of species-specific mimicry of the young brood parasitic indigobirds, and this morphogenetic specialization in turn has written the stage directions and the song for events in evolutionary sexual selection.

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APPENDIX I

LOCALITIES AND SPECIMENS EXAMINED

The following list includes all known localities of identifiable indigobirds *Vidua* and firefinches *Lagonosticta* in West Africa. For indigobirds, unless indicated otherwise each specimen is an adult male in complete or partial breeding plumage. Males in nonbreeding plumage are included only for the species *V. chalybeata*, which has blackish remiges, or for individuals taken at a call-site of an identified male in breeding plumage. Female and juvenile *V. chalybeata* are included only if they were taken in localities where other species are unlikely and if they were small (wing 61 mm or less). Females are otherwise included only if they were taken with an identified male. Juveniles are included only if their nestling mouth pattern was recognizable; older juveniles are excluded.

Museum specimens of indigobirds are identified by an abbreviation of the museum and the museum catalog or register number, or by collector's name and field number if a separate museum number was not written on the specimen label. Museums that made available specimens that were used in the study were ABU (Ahmadu Bello University, Zaria, Nigeria), AMNH (American Museum of Natural History), ANSP (Academy of Natural Sciences of Philadelphia), Berlin (Universität von A. Humboldt), Bonn (Zoologische Forschungsinstitut und Museum Alexander Koenig), BMNH (British Museum of Natural History), CM (Carnegie Museum), Cornell (Cornell University), D (Durban Museum), FMNH (Field Museum of Natural History), Frankfurt (Natur-Museum und Forschungs-Institut Senckenberg), IRSNB (Institut Royal d'Sciences Naturelles, Brussels, Belgium), KMZ (Zoologisk Museum, Copenhagen), KNM (National Museum of Kenya), LACM (Los Angeles County Museum), LSU (Louisiana State University), MCZ (Museum of Comparative Zoology, Cambridge, Mass.), MRAC (Museum Royal d'Afrique Centrale, Tervuren), NMNH (National Museum of Natural History, Washing-

ton, D. C.), NMSR (National Museums of Rhodesia—Bulawayo, Salisbury, and Umtali), Paris (Muséum National d'Histoire Naturelle), ROM (Royal Ontario Museum), U. Malaya (University of Malaya, Kuala Lumpur), UMMZ (University of Michigan Museum of Zoology), and Yale (Peabody Museum).

Field observations are included for indigobirds only for observers who distinguished among the different species. Several publications (e.g. Hall, 1977) have listed indigobirds either as "sp." or simply as *V. chalybeata* regardless of the song and plumage. In most such cases it is impossible to know what species were observed. Bannerman (1949) and some other authors called any blue-glossed, pale-winged birds "*camerunensis*" and any green-glossed, pale-winged birds "*nigeriae*.' In these cases it is usually possible to identify the species involved as these observations were made in regions of West Africa where recent field work has associated the song, species-specific brood parasitism, and male breeding plumage, and I have applied the species names used in the present work in these cases.

Local records of *Lagonosticta* firefinches were taken from (1) museum specimens that I examined, (2) museum specimens that were examined and listed by the curators of the collections involved, (3) additional specimen records in Bannerman (1949), (4) published field observations or specimen records not confirmed since 1965 by criteria (1) or (2), and (5) recent unpublished field observations. The source for records in the last two categories is given with the locality. Identification of firefinches is generally not a problem and I have not included museum and specimen number documentation for these localities. Unpublished sight observations are indicated by the initials of the observer: MGD = Mary Gartshorne Dyer, JHE = John H. Elgood, CHF = C. Hilary Fry, AAG = Arthur A. Green, RBP = Robert B. Payne, DW = David Wells, JFW = Frank Walsh.

All localities listed for indigobirds or firefinches were located on maps, gazetters, or historical accounts, and the distribution maps for each species were plotted from this information. A gazetteer with latitude and longitude for all specimens and sight observations is available as Appendix II. For the other localities, "n.l." indicates that the locality was not found, and vague localities that have not been pinpointed to the level of resolution of the distribution maps, either from collector's itineraries or from other historical documentation, are listed in quotes (e.g. "El Abiad" = Bahr el Abiad refers to several hundred km of the White Nile from Fashoda to Khartoum in Sudan; Schubotz, 1912). Localities that were not found or that were vague are not included on the distribution maps of the species. The localities are spelled as they appear on the specimen labels or (especially where a locality has changed spelling) as they appear on current maps. Alternative names for the same locality are included in parentheses, as are major variants in spelling. Where two or more localities are

known for the same name or for certain otherwise obscure localities, I have added additional descriptions of the region involved, either without punctuation following the locality or in parentheses. Sources used include current and historical maps, the published gazetteer of Chapin (1954), an unpublished itinerary of museum expeditions of the Field Museum of Natural History, a privately circulated list of African bird localities by B. P. Hall (1968), the Times Atlas, and United States Office of Geography published gazetteers available for most African countries.

The basis for inclusion in the list is geographic (west of the boundaries of Ethiopia-Sudan and of Uganda-Zaire; north of the equator). Localities north of 20°N, known only for *L. senegala* in Algeria, are included in the list but are not mapped. Localities in Ethiopia are listed only where they apply to the pale-winged indigobird species complex; thus *V. larvaticola* and *L. larvata* are included (but are mapped only if they are west of 35°E) whereas the widespread *L. senegala, L. rubricata, L. rhodopareia,* and *V. chalybeata* are not included. For localities of other firefinches and indigobirds in Ethiopia and for all species in East Africa see Britton (1980), Erard (1974), Jackson (1938), and Payne (1973).

Vidua chalybeata chalybeata

GAMBIA: "Gambia" (AMNH 156104), Madina Niumi, R. Gambia (BMNH 77.7.11.456, 89.7.20.403), Salikeni (BMNH 1929.2.18.486). Observed throughout (Jensen and Kirkeby, 1980).

GUINEA: Conakry (Paris 1897.1094), Fouta Djalon (Paris 1900. 265–7), Kirita (Paris 1900.262), Sementa (?=Semini), (Paris 1900.–), Sokotoro (Paris 1900.263), Timbo (Paris 1900.261).

MALI (includes intergrades *V. c. chalybeata* × *V. c. neumanni*): Ansongo (BMNH 1932.8.6.750, 1932.8.6.752, 1932.8.6.751 ♀, KZM 25132, Paris 1933.1645–6), Bamako (Paris 1962.3865–6), Diré (Paris 1962.3869), Fiko (BMNH 1932.8.6.758–9, Paris 1933.1645), Gao (BMNH 1932.8.6.754–6, 1932.8.6.753 ♀, Paris 1938.1168), Hambori (BMNH 1932.3.18.16), Kami (Paris 1966.759), Kara (MRAC 105750, 105751 ♀, 105749 sparrowy ♂, Paris 1962.3869), Ke Masina (BMNH 1932.8.6.757 laying ♀), Kulikoro (= Kaulikora) BMNH 1930.3.4.342 ♀, Paris 1962.3867), Niafunké (Paris 1962.3868), Sanga (Paris 1939. 751), "Soudan Français" (Paris 1894.366, 1894.368), Timbuktu (FMNH 282519, 285242, KZM 25123–5).

MAURITANIA: Rosso (Browne, 1981).

SENEGAL: Bandia (van den Elzen and Wolters, 1978), Cap Vert (BMNH 88.9.20.749, MRAC RG2153, Paris 1892.B14), Dagana (BMNH 1929.3.16.52), Dakar (AMNH 269550, MRAC 68207, Paris 1882.B7, Yale 46295–6), Diourbel (AMNH 452289–98), Fandène (AMNH 452256), Kirtaona (n.l.) (AMNH 452264–79, 452281–8 ♀♀, Berlin Riggenbach 2742–3, 2815, BMNH 1918.8.26.76–8), Matam (van

den Elzen and Wolters, 1978), Mboro (Paris 1966.1120), "Natal" (AMNH 452306 *ex* Jardine, probably Senegal), Ndilla (Paris 1968.939), Nianing (BMNH 1928.5.2.88–9, 1928.5.2.94 ♀), Richard-Toll (FMNH 278472–3, 278475–81, Paris 1962.821), "Senegal" (AMNH 452299–300, ANSP 14453, 14456–60, Berlin Delbrück 2172, NMNH 146251, Paris B15, B16, 1958.444), "Senegambia" (ANSP 73954), Thiès (AMNH 452257, 452259–61, Yale 46293–4).

SIERRA LEONE: Mapololon 10′ (BMNH 1938.6.5.31).

Vidua chalybeata neumanni

CAMEROON: Garoua (UMMZ 203992–93 ♀♀ with ♂♂ *neumani*), Guémé (MRAC B1.137, B1.139), Koza (MRAC B2.703, B2.839–41, B2.894, B2.748 ♀), Mayo Sala (Monard, 1951), Mokolo (MRAC B1.1153, B1.1185, B1.1190 ♀, B1.1189 juvenile), Mora (van den Elzen, 1975), Rei Bouba (Frankfurt Houy 30), Sir (MRAC B1.970), Waza (MRAC B1.1367, B1.775 ♀, Paris 1967.809–10), Yagoua (MRAC B1.257, B1.455, B1.472, B1.590, B1.804, B1.855, B1.893–94, B1.2189, B1.2308, B1.2312–13, B1.2394–95, B2.354).

CHAD: Abéché (Paris 1965.576–77, 1965.1372–73), Abilela (Berlin Haberer 482/261, Frankfurt Mecklenburg 259, 263), Abarin (Frankfurt Mecklenburg 914), Besgom (Berlin Mecklenburg A365), Bol (IRSNB 40390), Fort Lamy (= Ndjamena) (Bonn 61.2466, IRSNB 40389, Paris 1934.1336, 1955.407–08), Lake Chad (Vielliard, 1972), Logone-Gana (Paris 1972.157, 1972.159 ♀), Ouadi Enne (Newby 1980), Ouadi Djedit (Newby, 1980), Ouadi Hàddat (Newby, 1980).

GHANA: Morago River (NMNH 462822).

IVORY COAST: Boundiali (LACM 46206 new primaries blackish; older primaries pale, this species?), Dialakoro-Cercle de Mankono (Paris 1911.1640), Sinematiali (FMNH 286150), Touba (Bouet, in Brunel and Thiollay, 1969).

NIGER: Agadez (Bonn 61.2467, 61.2468 ♀), Dosso (AMNH 452341), Zinder (AMNH 452315 juvenile ♀).

NIGERIA: Bama (FMNH 122693–4 sparrowy ♂♂), Bauchi (BMNH B. Alexander, 1904), Birnin-Kebbi (MRAC 54935), Borgu (Wells and Walsh, 1969), Denge (RBP), Dumbi (RBP), Farniso (AMNH 452310, 452313) Fatika Shika (RBP), Ganye (RBP), Gombe junction 4 mi W and 13 mi W (RBP), Gusau (UMMZ 217157), Gusau 4 mi N (RBP), Gusau 50 mi W and 62 mi W (RBP), Jos (BMNH 1963.11.9), Jos 26 mi E (RBP), Jos 5 mi NW and 15 mi NW (RBP), Kaduna RR S of town (RBP), Kaduna 20 mi SSE (RBP), Kano (AMNH 452314), Kiri (UMMZ 217160; 217060 ♀ collected with ♂), Lagos (ANSP 54279–80), Loko (AMNH 452301), Maiduguri (FMNH 122692 ♀), Malamfatori (CHF), Narode (RBP), Nasarawa (Serle, 1940:45), Numan (UMMZ 217161; 217058–59 ♀♀ collected with ♂), Numan 6 mi NW (RBP), Pategi (JHE), Rabba (BMNH 90.3.23.3), Rano (RBP), Riman Mukur (RBP), Shagunu (U Malaya D. Wells),

Sokoto (UMMZ 217158, 217159 sparrowy ♂), Talata Mafara 39 mi W. (RBP), Toro (RBP), Vom (BMNH 1963.7.1 alcoholic), Yankari—Gegi River (RBP), Yo (BMNH 1911.12.23.3306 holotype of *neumanni*, 1911.12.23.3304–05), Yobe River–Lake Chad (ABU–CHF), Zaria (AMNH 452308, UMMZ 217162–66; 217061–63 ♀♀), Ziam (= Riman Zayam) (BMNH 1911.12.23.3438 sparrowy ♂, RBP).

SUDAN: Atbara (Christensen, 1960), Berber (BMNH 1903.8.5.9–11), Bunzuga (ANSP 100734), Debba (Bonn 176), Dongola (AMNH 452467, Frankfurt 31.7.06), "El Abiad" (= "Bahr el Abiad") (D 12474), El Erian (Bonn 216, 219, 220), El Fasher (BMNH 1920. 12.22.613), El Fifi (ANSP 118673, 118675), Gezira al Fil (AMNH 202824–26), Insel Argo (Bonn 115), Jebel Marra (BMNH 1922.12.8. 1937–38), Jebelein (AMNH 26541), Kadugli (ANSP 93323–25), Kerma (AMNH 452344–45), Khartoum (AMNH 452358–59, BMNH 1915.12. 24.1722, 1916.9.20.1041–42, Frankfurt nd), "Kordofan" (AMNH 452361), Lado (AMNH 452465), Makwar (ANSP 100735), Merowe (AMNH 452347), Mongalla (AMNH 452362), Musran Island (AMNH 260540), Naikhala (AMNH 452342–43), Ntinakok (BMNH 1947.100.341), Omdurman (BMNH 1902.12.17.53–54), Roseires (BMNH 1915.12. 2418, 1915.12.24.1719 sparrowy ♂), Sennar (AMNH 452356, KMZ 25128–29), Shendi (AMNH 452348–50, BMNH 1901.10.1.32, 1915.12.24.1717), Singa (BMNH 1919.12.17.1304–05, MCZ 63567), Talodi (UMMZ 91746, ANSP 93327), Tauila (BMNH 1915.12.24.1714, Bonn 172), Telàweit (Kassala) (FMNH 293513, 274229 ♀, 293514 ♀), Wad Medani (= Medani) (ANSP 93326, 100736, ROM 24.10.20.172), Wadi Naja (Bonn 421–23), Wau (BMNH 1935.7.9.–, 1936.9.13.305–06), "White Nile" (= Bahr el Jebel) (BMNH 49.2.8.26), Zeidab (ANSP 104432–34, 104436–37, UMMZ 91745).

UPPER VOLTA: Ouagadougou (JFW), Kaya (JFW). *L. senegala* seen feeding free-flying *Vidua* young at Ouagadougou (JFW).

Vidua chalybeata centralis

ZAIRE: Bunia (MRAC 38512), Kasenyi (AMNH 264549–50, ANSP 122512, MRAC 34464).

Vidua raricola

CAMEROON: Abong Mbang (FMNH 274896–7 this species?), Bambalang–Ndop Plain (BMNH 1966.16.3996), Banyo (UMMZ 202400, 204007–12, 204014 sparrowy ♂, 204013 ♀, 202398–99 juveniles), Ngaoundéré (UMMZ 204004, 204006 ♂ mostly sparrowy plumage, 204001–03 ♀♀, 204005 ♀, 202401–02 juveniles; also Nicolai, 1968), Tibati (BMNH 1923.10.26.404, 1926.8.8.539).

GHANA: Damongo scarp (RBP), Lovi, Mole National Park

(UMMZ 200534, 220766, BMNH 1968.89.12 cf. Harvey and Harrison, 1970), Yegi (BMNH 1927.7.20.154).

NIGERIA: Enugu (BMNH 1966.16.3997 this species?), Kogum (BMNH 1928.7.20.248 this species ?), Zaria (UMMZ 220836 juvenile).

SIERRA LEONE: Bintumane Peak 1800′ (BMNH 1951.50.35), Kabala (UMMZ 220055–56, 220057 ♀), Musaia (RBP, Fig. 15).

SUDAN: Abbi Obed forest (BMNH 1947.26.8), Lado (AMNH 452464), Mongalla (BMNH 1915.12.24.1711–12 both worn, molting), Nimule (Berlin 66.708).

ZAIRE (all this species?): Api (MRAC 24942–43, "Auellgebietsches Uelle" (Berlin Schubotz), Bafuka (MRAC 41934, 41936), Camp Aru (MRAC 68432, 68450), Congo/Nil km 999 (MRAC 54519), Faradje (AMNH 161944–47, 161949), Gangala-na-Bodio (MRAC 37700, 65541–42, 72945, 85696, 89039, 94254–55, 94344, 94652, 103154–58, 103160, 105802), Nagero (IRSNB 36376), Niangara (AMNH 161943), Tukpuo (MRAC 34998), Zobia (IRSNB 32.947).

Vidua larvaticola

CAMEROON: Garoua (Berlin Riggenbach 1017, UMMZ 202404, 202403 juvenile ♂, 203994 juvenile ♂), Mabas (MRAC 1.938 blue, B1.1250 green, this species? out of known local range of foster species of this complex), Ngaoundéré (Nicolai, 1968), Poli (MRAC B.2.2 this species?, 2.19 ♀ this species?), Sidderi (Berlin Riggenbach 971–2 this species?), Toukté (MRAC B.2.154, 2.145 ♀ both this species?), Touroua (MRAC L75.506 this species?).

CENTRAL AFRICAN REPUBLIC (any or all this species?): Badingoua (Frankfurt Mecklenburg 436), Bangui (Paris 1938.1089–90), Bozoum-Bangui (Blancou, 1939), Dalia (Blancou, 1939), Irena (BMNH 1911.12.23.3307), Mbru (Frankfurt Mecklenburg 3), Nguro (Frankfurt Mecklenburg), Nola- Mbaiki (Berlin Tessman B950 holotype *camerunensis* = this species?), Ratu on Gribingui River (BMNH 1911.12.23.3308 holotype *sharii* = this species?, 1911.12.23.3407 ♀), Yakota near Krebedge (BMNH 1911.12.23.3309).

CHAD (this species?): Damrau (Grote, 1928), Doba (Vielliard, 1972), Moundou (Vielliard, 1972), Sahr (Vielliard, 1972).

ETHIOPIA: Gambela (NMNH 568296), Machigay 15 mi S Lake Tana 6000′ (BMNH 1927.11.5.801).

GAMBIA: Kuntair (BMNH 1929.2.18.477, 1929.2.18.479–80), Fajara (Jensen and Kirkeby, 1980, as "*nigeriae*").

GHANA (this species?): Tumu (Sutton, 1970), Yegi (BMNH 1927.7.20.154), Yendi (NMNH 462821).

GUINEA (this species?): Dabola (Berlin Klaptroz B805), Fouta Djalon (Paris 1900.264).

GUINEA-BISSAU (this species?): Gunnal (BMNH 1910.5.6.1429, 1910.5.6.1437).

IVORY COAST (this species?): Bavé-Komoé (MRAC 114872), Bouaké (FMNH 277335).

MALI (this species?): Kara (Paris 1966.757), "Soudan Français" (Paris 1894.369).

NIGERIA: Bauchi 25 mi W (UMMZ 216984–86, 217006 ♀, 216991 sparrowy ♂ this species?), Dumbi (RBP), Kiri (BMNH 1911.12.23.3302 holotype *nigeriae* = this species?), Panshanu (UMMZ 216987), Samaru farm (RBP), Yola 98 mi NW (UMMZ 216988), Zaria (UMMZ 216992–217001, 217002–5 ♀ ♀, 217007 ♀, 220835 juvenile ♂, MGD–RBP uncatalogued juvenile alcoholic).

SUDAN: Gallabat (BMNH 1927.11.5.803), Kulme (BMNH 1922.12.8.1939), Malakal (BMNH 1921.11.29.47), Nimule (Berlin 399.66.710), Rimo (AMNH 452468), Roseires (BMNH 1915.12.24.1720–21 prebreeding molt), Yei (Frankfurt Mecklenburg 1/82).

TOGO (this species?): Mangu (Berlin Thierry), Paio (MRAC 115.205).

ZAIRE (this species?): Duma (lower Uele) (Frankfurt Mecklenburg 124, 170), Faradje (AMNH 161948).

Vidua funerea maryae

NIGERIA: Kagoro (MGD), Panshanu (UMMZ 216982–83; 216989–90 sparrowy ♂ ♂; 217008 ♀).

Vidua funerea sorora

CAMEROON: "Bafiagebeit" (Berlin 225, 956, B1135, Bamale-Ndop plain (BMNH 1966.16.4006), Banyo (UMMZ 203995–8, 204015 ♀, 204017 ♀, 204016 sparrowy ♂, 204018 sparrowy ♂), Donenkeng (CM 118662), Dschang (Bouet, 1942), Galim (MRAC 1.2955), Kumbo to Bamenda 4000′ (BMNH 1922.11.25.288), Obala (Germain et al., 1972, "*wilsoni*" probably this species), Tibati (BMNH 1923.10.26.403, CM 118651–3), Yaoundé (Germain et al., 1972, "*wilsoni*" probably this species).

NIGERIA (all this species?): Abakaliki (BMNH 1955.59.824), Enugu (BMNH 1955.59.825–47, 1966.16.3998–4005).

SIERRA LEONE: Batkanu (BMNH 1939.3.13.52), Bendugu (BMNH 1946.40.79), Bumban (BMNH 1937.1.3.32 postbreeding molt), Kabala (Payne, 1976), Makeni (BMNH 1946.40.78), Rokupr (BMNH 1937.1.3.33), Wonkufu (BMNH 1931.6.7.207–8).

Vidua wilsoni

CAMEROON: Banyo (UMMZ 204000), Dodo (BMNH 1922.11.25.287), Ndom (CM 118179), Ngaoundéré (RBP), Tibati (UMMZ 203999).

CENTRAL AFRICAN REPUBLIC: Dalia near Bozoum (Blancou, 1939), Nola-Mbaiki (Berlin 92B950).

GAMBIA: Observed at Abuko, Cape Creek, Chamois (Jensen and Kirkeby, 1980).

GHANA: Accra (Wink, 1979), Cape Coast (UMMZ 220767; five others tape-recorded RBP; 220768–69 juvenile ♂♂ molting with a few purplish-black feathers; 220782 ♀; 204028, 220770–80 juveniles), Damongo (RBP), Elmina (RBP), Kratschi (Berlin 223), Larabanga (RBP), Legon (RBP), Lovi (BMNH 1968.89.13 cf. Harvey and Harrison, 1970; RBP), Mole National Park (UMMZ 220781 ♀ with a purplish tape-recorded ♂).

GUINEA-BISSAU: Gunnal (BMNH 1910.5.6.1430).

NIGERIA: Abakaliki-Afikpo (Nicolai, 1972), Abeokuta (BMNH 77.11.25.45), Agongu (AMNH 452339), Agoulerie (BMNH 1906.2.1.198), Anambra Creek (AMNH 452338), Enugu (AMNH 1966.16.3991–95), Emene (Nicolai, 1972), Epe (JHE), Ibadan (JHE), Igbetti (JHE), Ilorin (JHE), Kishi 20 mi N (AMNH 789171), Kpatchi Island (Wells and Walsh, 1969), Shagunu (U. Malaya D. Wells), Yankari-Geji River (RBP), Yelwa (AMNH 452337 = holotype *wilsoni*), Zaria (UMMZ 217009–13; 217014–15 sparrowy ♂♂, 217016–17 ♀♀).

SENEGAL: Diattacounda (van den Elzen and Wolters, 1978), "Senegal" (IRSNB 36753), "Senegambia" (BMNH 74.2.11.29 questionable locality, Payne, 1973:257).

SUDAN: Nimule (Berlin 66709), Rimo (Paris 1882.2750), Sheikh Tombe (AMNH 452340, BMNH 1915.12.24.1716), Torit (BMNH 1936.9.13.260–63).

TOGO: Kande 11 mi S (MRAC 118333).

ZAIRE: Gangala-na-Bodio (MRAC 85697, 88307, 103159), Yakoma (MRAC 41936).

Lagonosticta senegala

ALGERIA: Tamanrasset (introduced: Heim de Bàlsàc and Mayand, 1962).

BENIN: Gaya, Natitingou (AAG), Pendjari National Park (Green and Sayer, 1979, AAG).

CAMEROON: Garoua (RBP), Koza, Mao Godi, Maroua 35 mi W, Mayo Sala (Monard, 1951), Mokolo, Mora (van den Elzen, 1975), Mozogo (van den Elzen, 1975), Rei Bouba, Rei Bouba 25 mi N, Touroua, Waza, Yagoua.

CENTRAL AFRICAN REPUBLIC: Bozoum (Blancou, 1939, ? this species or *L. rufopicta*).

CHAD: Abéché (Salvan, 1969), Bol, Borkou and Enned: (Heim de Bàlsàc and Mayand, 1962), Fort Lamy, Jintilo (Dragesco, 1969), Léré, Logone-Gana, Maniling, Moundou, Mundjeffa, Riggil (n.l.), Wunnda.

GAMBIA: Bathurst, Brikama (Cawkell, 1957), "Gambia,"

"Gambia River," Madina Niumi, Kuntair. Observed throughout (Jensen and Kirkeby, 1980).

GHANA: Damongo (RBP), Lovi (RBP), Mole National Park headquarters dam (RBP), Tamale (JFW, RBP), Volta River [probably N of 10°], Weija (Grimes, 1972), Winneba road (Grimes, 1972).

GUINEA: Fouta Djalon, Mamou, Nzérékoré.

GUINEA-BISSAU: Bissao.

IVORY COAST: Adiopodoumé (Brunel and Thiollay, 1969), Bingerville (Brunel and Thiollay, 1969), Bouaké, Boundiali, Korhogo, Man, Nafoun, Taléré, Torgokaha, Toumodi, Wamelhoro.

MALI: Ansongo, Bamako, Bandiagara, Gao, Kara, Kulikoro "Soudan Français," Tombouctou.

MAURITANIA: Rosso.

NIGER: Aïr (AAG), Agadez, Aouderas, Gaya, Timia, Zinder.

NIGERIA: Agenebode, Agoulerie, Bauchi, Birnin-Kebbi (JHE), Bida (CHF), Borgu (Wells and Walsh, 1969), Bussa (JHE), Dan Gora forest reserve (CHF), Denge (RBP), Dumbi (RBP), Ganye (RBP), Gassagar, Giri, Gombe junction 1 mi S (RBP), Gombe junction 13 mi W (RBP), Gombe junction 27 mi W (RBP), Gongola R 25 mi E Bauchi, Gusau, Gusau 4 mi N (RBP), Hadejia (RBP), Ibi Ilorin (JHE), Jagindi (RBP), Jos (JHE), Kaiama (JHE), Kaltungo 15 mi N (RBP), Kano, Katsina (JHE), Kiri (RBP), Kogum (RBP) Lokoja, Maiduguri (JHE), Maiduguri 45 mi SE, Malamfatori (CHF), Narode (RBP), Natu Lake (CHF), Niger R. at 11°30′N, Niger R. at Kaduna R.-Katcha (CHF), Numan, Numan 6 mi NW (RBP), Obudu (Heaton and Heaton, 1980), Pankshin (JHE), Panshanu (RBP), Panyam (JHE), Pategi (JHE), Potiskum (JHE), Rano (RBP), Riman Zayam (RBP), Samaru farm (RBP), Serti (Hall, 1977), Shagunu (DW), Sokoto (JHE, RBP), Toro (RBP), Yankari (JHE, RBP), Yelwa (JHE), Yobe R.-Lake Chad (JHE), Yola 100 mi N, Zaria.

SENEGAL: Bandia, Dagana, Dakar, Diattacounda, Diourbel, Kayar, Kirtaona (n.l.), Matam, Mboro, Nianing, Richard-Toll, Sangalkam, "Senegal," Thies, Tili-bu-Bakar (n.l.).

SIERRA LEONE: Alfaia (RBP), Bendugu (Serle, 1949), Dankawali (Serle, 1949), Dogoloya (RBP), Freetown (RBP, Field, 1968), Kabala (RBP), King Tom (Freetown), Musaia (RBP), Rotifunk, Serekolia (Serle, 1949), "Sierra Leone," Tholagoday (RBP).

SUDAN: Akona, Atbara, "Bahr el Gebel," "Bahr el Ghazal," Berber, Binue (n.l.), Bor, Buram, Dongola, Duem, Dulgo, El Fasher, Fazogli, Gallabat, Gaz-abu-Gumar (n.l.), Gedaref, Gezirat al Fil (Medani), Gondokoro, Jebel Ahmed Alga, Jebel Marra (4000′, 5000′, 6400′, 8000′), Juba, Kalokitting, Kamisa, Khartoum, Lado, Letti, Malut, Medani (= Wad Medani), Merowe, Meshra el Rek, Musran Island, Naikhala, Rejaf, Roseires, Salimat el Alimat (n.l.), Shendi, Shereik, Singa, Tauila, Talodi, Telàweit (Kassala) Tonj, Urbi, Wadi Naja, Wau, Zeidab.

TOGO: Borgou, Lama-Kara (JFW), Lomé (Browne, 1980), Paio, Porto Seguro, Sansanné-Mango (= Mangu), Sebbe, Togoville.

UPPER VOLTA: Arli National Park (AAG), Fada Ngourma 25 mi W, Oursi (JFW), Ouagadougou (JFW), Volta River.

ZAIRE: Beni, Boga, Bogoro, Bunia, Dele, Fataki, Irumu, Kasenyi, Landju, Mahagi, Mahagi Port, Nyangabo.

Lagonosticta rara

CAMEROON: Banyo, Bini, Boki (van den Elzen 1975), Galim, Kombetiko, Kongola (Reichenow, 1911), Koubadjé (Monard, 1951), Mayo Sala (Monard, 1951), Mbakaou, Mboula (near Meiganga), Ngaoundéré (Nicolai, 1968, RBP), Ribao, Ribao Plain 3000′, Sakdjé (Monard, 1951), Tibati, Tibati-Ngambé, Tibati-Tingura, Tibati-Yoko, Yoko.

CENTRAL AFRICAN REPUBLIC: Bamingui (AAG), Bangui, Bozoum (=Bosum), Bozoum-Bangui (Blancou, 1939), Kaja Djerri, upper Kemo River.

CHAD: Dagbao.

GHANA: Abokobi (Grimes, 1972), Damongo (RBP), Lovi (RBP, Greig-Smith, 1976), Mole National Park headquarters dam (RBP, Greig-Smith, 1976), Sisili Valley (JFW).

IVORY COAST: Bouaké (Brunel and Thiollay, 1969), Korhogo (Brunel and Thiollay, 1969), Madiani Mountains, Niellé.

LIBERIA: Mt. Nimba (Hall and Moreau, 1970).

NIGERIA: Borgu (Wells and Walsh, 1969), Dororo, Dumbi (RBP), Enugu, Indanre, Iseyin, Iseyin 15 mi N, Kafanchan (Serle, 1940), Kishi 20 mi N, Lokoja, "Niger River," Panshanu, Serti (Hall, 1977), Shagunu (DW), Zaria, Zaria-Bauchi mi 81 (RBP).

SIERRA LEONE: Bumban, Kabala, Saiama.

SUDAN: Aloma Plateau, "Bahr el Ghazal," Lado, Kajo Kaji, Mongalla, Nimule, Rangu, Rudu (Bowen, 1931), Tambura, Wau, "between White Nile and Bahr el Ghazal," Yei.

TOGO: Aledjo, Borgou, Fazao, Lama-Kara, Nuatja.

UPPER VOLTA: Comoé Valley at 10°08′N 5°14′W (JFW).

ZAIRE: Angodia, Api, Bosodula, Faradje, Gangala-na-Bodio, Garamba, Ishwa, Kibali R., Mahagi, Mahagi Port, Mangbetu country (Emin, in Chapin, 1954), Mauda, Mswa (Emin, in Chapin, 1954), Niangara, Niarembe, N of Albert Edward, Tingasi.

Lagonosticta larvata

BENIN: Pendjari National Park (AAG).

CAMEROON: Boki (van den Elzen, 1975), Koum, Ngaoundéré (Nicolai, 1968), Poli, Sakdjé (Monard, 1951), Tibati, Touroua.

CENTRAL AFRICAN REPUBLIC: Bamingui R., Bozoum (=Bosum), Kaja Djerri, Irena, Ratu on Gribingui River.

CHAD: Bekao, Majim, Makanené, Makou, Moundou.

ETHIOPIA: Bunio, Didessa, Dura R., Gambela, Gelongol, Gumad R. 100 mi SW Lake Tana, Gumad R. 130 mi SW Lake Tana, Koko, Koscha, Sidisto, Takazai Valley.

GAMBIA: "Gambia," Makka Niumi. Observed throughout (Jensen and Kirkeby, 1980).

GHANA: Binduri, Bole, Damongo (RBP), Dokonkade, Ejura (= Ijura), Gambaga, Kete-Kratschi, Kumasi, Kintampo, Lawra, Lovi (RBP), Mole National Park headquarters dam (RBP, Greig-Smith, 1976), Masaka, Red Volta River (JFW), Tumu (Sutton, 1970), Wa.

GUINEA-BISSAU: Gunnal.

IVORY COAST: Bavé-Komoé, Korhogo (Brunel and Thiollay, 1969).

MALI: Bamako (Malzy, 1962).

NIGERIA: Anara forest reserve (CHF), Ankpa, Bauchi (JHE), Bauchi 25 mi W (RBP), Bima, Biu-Bauchi, Borgu (Wells and Walsh, 1969), Dumbi (RBP), Enugu, Falgore (Sharland and Wilkinson, 1981), "Gongila R.," Hinna, Iseyin 15 mi N, Kaduna (JHE), Kafanchan, Kogum (RBP), Kontagora (CHF), Lokoja, Maska Dam (RBP), Nasarawa, Ruan Gizzo, Serti (Hall, 1977), Shagunu (DW), Takai (Sharland and Wilkinson, 1981), Tatara, Yankari (CHF), Yola 98 mi NW (RBP), Zaria.

SENEGAL: Casamance, Kiokolo-Kobo, "Senegal."

SUDAN: Boma, Boma Plains, Chak Chak, Djur, Famaka, Gallabat, Kulme, Roseires, Roseires 25 mi S.

TOGO: Aledjo, Atakpamé, Evou, Lama-Kara, Nuatja, Témedja.

UPPER VOLTA: Arli National Park (AAG), Comoé Valley at 10°08′N 5°14′W (JFW), Ouagadougou (JFW).

ZAIRE: Faradje, Garamba.

Lagonosticta rubricata

BENIN: Pendjari National Park (Green and Sayer, 1979) (observation needs confirmation).

CAMEROON: Abong Mbang, Ankonolinga, Babadjou, Bafia, Bafiagebiet, Bamenda, Bambini 5 km N, Banyo, Epako (Bouet, 1942), Galim, Garoua Boulai, Iboñ, Kimbe R. (Wum), Kumbo-Bamenda, Makondo Mafifigi, Mbakaou (RBP), Mbaniti, Mieri, Ngaoundéré (RBP), Ngikinda, Njassi, Nkongsamba, Obala (Germain et al., 1973), Ribao, "Sanaga River" (= "Oberes Sannagebiet"), Tibati, Wum, Yaoundé, Yoko (Monard, 1951), Yoko 50 mi S, Yukuba.

CENTRAL AFRICAN REPUBLIC: Bozoum (Blancou, 1939), Haut Kémo.

GHANA: Abokobi (Grimes, 1972), Accra, Achimota (Grimes, 1972), Cape Coast, Ejura, Fanti, Kintampo, Lovi (Harvey and

Harrison, 1970, but not Greig-Smith, 1976, nor RBP), Mampong, Weija (Grimes, 1972).

GUINEA: Bossu.

GUINEA-BISSAU: Bissao, Gunnal, "Portuguese Guinea."

IVORY COAST: Beoumi, Bouake, Bou R. (S of Katiola), Korhogo (Brunel and Thiollay, 1969), Sipilou.

LIBERIA: Gbanga (Allen, 1930).

NIGERIA: Afu Hills, Agwada, Ankpa, Aza, Enugu, Jos (JHE), Kaduna (JHE), Kafanchan, Kagoro Hills, Kogum (RBP), Panshanu (RBP), Rano (Sharland and Wilkinson, 1981, RBP), Serti (Hall, 1977).

SIERRA LEONE: Benguema, Bo, Freetown, Gloucester, Kabala (RBP), Knoll 1800′, Rokupr, Tungie.

SUDAN: Bangangai forest 50 mi WNW Yambio, Boma Plateau 4000′, Didinga Mts 5 mi N Char 4400′, Didinga Mts Eros, Didinga Mts Mt Lotuke 5000′, Didinga Mts Nagishot, Didinga Mts Naligedi 6000′, Imatong Mts Leone 4200′, Imatong Mts Lolengi 5700′, Imatong Mts Lotti forest 3700′, Imatong Mts Talanga forest 5 mi W Katire, Sakure 30 mi S Yambio 2000′.

TOGO: Bismarckburg, Landa-Pozanda (Cheke and Walsh, 1980), Lomé (Browne, 1980).

UPPER VOLTA: Arli National Park (Green and Sayer, 1977) (observation needs confirmation).

ZAIRE: Beni, Bobito, Boke, Bosodula, Boyasegese, Bozene, Butembo, Bwamanda, Dika, Djalasinda, Etembo, Faradje, Garamba, Irumu, Kasala-R. Uelle (n.l.), Kasenyi, Kodja Hill (Gaima Range), Mahagi, Mahagi Port, Mauda, Mt. Mé, Mswa (Emin, in Chapin, 1954), Niangara, Nyangabo, Semliki, Vankerckhovenville.

Lagonosticta rhodopareia
(including *virata* and *umbrinodorsalis*)

CAMEROON (*L. rh. umbrinodorsalis*): Sagdsche. Note: The type specimen (Berlin Riggenbach 676, type number 79.36) has the head gray (Methuen 6D(5–6)) (not pink-gray) contrasting in color with the cinnamon (Methuen 6D(2–3)) back. In color it matches the description of *L. rh. bruneli* (Erard and Roche, 1977; Brunel et al., 1980) and differs from *L. rubricata* of the Adamawa Plateau (UMMZ series from Banyo and Tibati, Cameroon), which is uniformly dark brown above (Methuen 5F6) in the juvenile and nearly so in the adult, though the crown is washed with pink (not gray) in the adult. The outer primaries are broad, not narrow, in contrast to *L. rubricata* (the primaries of adult *L. rubricata* are emarginate; the primaries of juvenile *L. rubricata* are only slightly emarginate in some and not at all in others, but the primaries of all *L. rubricata* juveniles in the sample are narrow when compared with the type of *umbrinodorsalis*.

The type is in molt, molting from juvenile to adult plumage. The plumage color of an adult male *L. rh. bruneli* (Paris 1979.635) from the Lam Mountains, Chad, is similar to that of the type of *umbrinodorsalis*. *L. umbrinodorsalis* Reichenow 1910 thus is the same form as and has priority over *L. rhodopareia bruneli* Erard and Roche 1977.

CHAD: (*L. rh. umbrinodorsalis*): Lam Mountains near Dagbao (Brunel et al., 1980.

MALI (*L. rh. virata*): Bamako, Fiko, Kulikoro, Sanga.

SUDAN (*L. rh. rhodopareia*): Boma Plateau 2500′, 4000′, Towat.

Lagonosticta rufopicta

BENIN: Natitingou (AAG)

CAMEROON: Banyo (RBP), Banyo-Genderu, Dodo, Galim, Mba, Mbaniti, Mbakaou (RBP), Ngaoundéré, Poli, Tibati, Touroua, Wokko-Lugere (Reichenow, 1911).

CENTRAL AFRICAN REPUBLIC: Bamingui River.

CHAD: Moundou, Ngara, Sahr (= Ft. Archambault), Yanga (Bahr Sara).

GAMBIA: "Gambia," South Bank. Observed throughout, mainly Lower River (Jensen and Kirkeby, 1980).

GHANA: Abokobi (Grimes, 1972), Accra, Ashanti, Axim, Cape Coast, Damongo (RBP), Dokonkade, Elmina (RBP), Fanti, "Gold Coast," Legon (RBP, Grimes 1972), Lovi (RBP), Mole National Park headquarters dam (RBP), Sekondi, "Volta River," Winneba.

IVORY COAST: Bandama near Tiébila, Boundiali, Ferdessidougou NE (JFW), Korhogo, Niellé, Tortiya (JFW).

NIGERIA: Abakaliki-Afikpo (Nicolai, 1972), Abeitchi, Abuchi, Abeokuta, Abo, Agoulerie, Anambra Creek, Aka Eze (Ogojo), Badagri, Bida, Borgu (Wells and Walsh, 1969), Dumbi (RBP), Emene (Nicolai, 1972), Enugu, Falgore (Sharland and Wilkinson, 1981), Ibadan, Iju, Ikorodu, Ile-Ife (Farmer, 1979), Ilorin, Jebba, Kaduna, Kafanchan, Jos, Kano (CHF, not seen RBP, nor Sharland and Wilkinson, 1981), Kishi 9 mi W. Kogum, Lagos, Loko, Maska Dam (RBP), "Niger River," Niger River between Kaduna River and Katcha (CHF), Oyo, Serti (Hall, 1977), Yankari- Geji River (RBP), Zaria.

SENEGAL: Diattacounda, "Senegal."

SIERRA LEONE: Aberdeen (RBP), Benguema, Freetown (Field, 1968), Kurabondo, Kabala, Kenewa, Mahera, Musaia (RBP), Nérekoro, Sefadu 25 mi NE, "Sierra Leone."

SUDAN: Boma Plains, Bongo (between Djur and Kosanga Rivers), Bor, Gondokoro, Ibba, Kajo Kaji, Kenisa, Rejaf 24 mi S, Tomaya (Emin, in Chapin, 1954).

TOGO: Borgou, Edifou, Lama-Kara (JFW), Lomé (Browne, 1980), Kolekope, Nanergou, Paio, Sansanné-Mango, Sebbe, Sokode.

UPPER VOLTA: Comoé Valley at 10°08′N 5°14′W (JFW).

ZAIRE: Aru, Bwamanda, Congo/Nil km 999, Dungu, Faradje, Gangala-na-Bodio, Mahagi, Mahagi Port, Niangara, Nyangabo (Emin, in Chapin, 1954), Yakoma.

APPENDIX II

GAZETTEER

Abakaliki, Nigeria		6°20′N	8°06′E
Abarin, Maniling, Chad	ca	11°20′N	15°09′E
Abbi Obed forest, near Yei, Equatoria, Sudan	ca	3°58′N	30°22′E
Abéché, Chad		13°49′N	20°49′E
Abeitchi (=Abeschi), Nigeria		7°45′N	8°42′E
Abeokuta, Nigeria		7°10′N	3°20′E
Aberdeen, Sierra Leone		8°28′N	13°17′W
Abilela (=Jintilo), Chad		13°00′N	14°38′E
Abo, Nigeria		5°02′N	6°24′E
Abokobi, Accra Plains, Ghana		5°44′N	0°12′W
Abong Mbang, Cameroon		3°58′N	13°10′E
Abuchi (=Abutschi), Nigeria		5°59′N	6°25′E
Abuko, Gambia		13°24′N	16°39′W
Adina, Togo		7°31′N	1°01′E
Adiopodoumé, Ivory Coast		5°20′N	4°07′W
Afu Hills, Nigeria		8°30′N	7°00′E
Agadez, Niger		16°58′N	7°39′E
Agenebode on Niger River, Nigeria		7°05′N	6°41′E
Agongu, Anambra Creek, Nigeria		6°20′N	6°45′E
Agoulerie, Anambra Creek, Nigeria		6°20′N	6°52′E
Agwada, Nigeria		8°30′N	8°00′E
Aïr, Niger		17°00′N	7°48′E
Aka Eze, Ogoja Province, Nigeria		7°47′N	4°54′E
Akona, Sudan		12°20′N	32°48′E
Akonolinga, Nyong River, Cameroon		3°45′N	12°14′E
Aledjo, Togo		9°15′N	1°12′E
Alfaia, Sierra Leone		9°47′N	11°35′W
Amambara Creek (=Anambra Creek), Nigeria		7°03′N	7°00′E
Anambra Creek, Nigeria		7°03′N	7°00′E
Anara Forest Reserve, Nigeria		10°45′N	7°30′E
Angodia, Zaire		3°31′N	25°47′E
Ankonolinga (=Akonolinga), Nyong River, Cameroon		3°45′N	12°14′E
Ankpa, Nigeria		8°06′N	7°39′E
Ansongo, Mali		15°40′N	0°29′E
Aouderas, Asben, Niger		17°37′N	8°26′E
Api, Zaire		3°42′N	25°28′E
Arli National Park, Upper Volta		11°50′N	1°00′E
Aru (Camp), Zaire		2°53′N	30°51′E
"Ashanti" (=Kumasi), Ghana		6°45′N	1°35′W
Atakpame, Togo		7°32′N	1°08′E
Atbara, Sudan		17°42′N	34°00′E
Auellgebietches, Uelle, Zaire (n.l.)			
Axim, Ghana		4°53′N	2°14′W

Aza, Nigeria		8°06′N	7°30′E
Babadjou, Cameroon		5°40′N	10°12′E
Badagri, Nigeria		6°25′N	2°58′E
Badingoua, C.A.R.		7°50′N	19°00′E
Bafia, Cameroon		4°40′N	11°05′E
Bafiagebiet (=Bafia), Cameroon		4°40′N	11°05′E
Bafuka, Zaire		4°20′N	27°58′E
"Bahr el Ghazal" Province and River, Sudan			
"Bahr el Jebel" (=White Nile), Sudan			
Bahr Sara (=Ouham River), Chad	ca	9°00′N	18°00′E
Balingilingi Station, Nagero P.N.G., Zaire	ca	3°45′N	29°31′E
Bama, Nigeria		11°30′N	13°41′E
Bamako, Mali		12°40′N	7°59′W
Bambalang-Ndop plain, Bamenda, Cameroon		5°58′N	10°20′E
Bamenda, Cameroon		5°57′N	10°09′E
Bamingui River, C.A.R.	ca	8°00′N	19°20′E
Bandia, Senegal		14°37′N	17°01′W
Bandiagara, Sangha, Mali		14°21′N	3°37′W
Bangangai forest 50 mi WNW Yambio, Sudan		4°51′N	27°45′E
Bangui, C.A.R.		4°22′N	18°36′E
Banso (=Kumbo), Cameroon		6°12′N	10°40′E
Banyo, Cameroon		6°45′N	11°50′E
Bathurst (=Banjul), Gambia		13°28′N	16°39′W
Batkanu, Sierra Leone		9°07′N	12°17′W
Bauchi, Nigeria		10°16′N	9°50′E
Bauchi 25 mi W, Nigeria		10°12′N	9°30′E
Bavé, Komoé National Park, Ivory Coast		9°35′N	4°09′W
Bekao, Chad		7°54′N	16°00′E
Bendugu (=Bendugi), Sierra Leone		9°32′N	10°56′W
Benguema, Sierra Leone		8°20′N	13°05′W
Bengui (=Bangui), C.A.R.		4°22′N	18°36′E
Beni, Zaire		0°28′N	29°28′E
Beoumi, Ivory Coast		7°40′N	5°34′W
Berber, Sudan		18°01′N	34°00′E
Besgom, Chad		13°25′N	14°50′E
Bida, Nigeria		9°04′N	6°00′E
Bima, Nigeria		11°00′N	10°40′E
Binduri, Ghana		10°59′N	0°16′W
Bingerville, Ivory Coast		5°12′N	3°55′W
Bini, Cameroon		7°28′N	13°42′E
Bintumane Peak, Sierra Leone		9°10′N	11°04′W
Binue, Sudan (n.l.)			
Birnin-Kebbi, Nigeria		12°30′N	4°11′E
Bismarckburg, Togo		8°10′N	0°30′E
Bissao, Guinea-Bissau		11°50′N	15°40′W
Biu-Bauchi on Gongola River, Nigeria		11°05′N	10°55′E
"Blue Nile Province" (=BNP), Sudan	ca	13°00′N	33°00′E
Bo, Sierra Leone		7°57′N	11°48′W
Bobito, Zaire		2°57′N	19°25′E
Boga, Zaire		1°02′N	29°57′E
Bogoro, Zaire		1°24′N	30°15′E
Boiye River, Takazai Valley, Ethiopia		13°43′N	38°05′E
Boke, Zaire		2°21′N	31°02′E
Boki, Cameroon		8°48′N	13°32′E
Bol, Chad		13°28′N	14°40′E
Bole, Ghana		9°03′N	2°23′W
Boma (=Boma Plain), Sudan		6°10′N	34°30′E

Bongo, Djur River, Sudan		7°14′N	28°42′E
Bor, Sudan		6°18′N	31°34′E
Borgou, Togo		10°46′N	0°35′E
"Borgu," Nigeria	ca	10°00′N	4°10′E
Borkou, Chad		14°49′N	21°15′E
Bosodula, Zaire		4°32′N	20°16′E
Bossu, nr Mt. Nimba, Guinea		7°38′N	8°30′W
Bosum (=Bozoum), C.A.R.		6°18′N	16°22′E
Bouaké, Ivory Coast		7°35′N	4°58′W
Boundiali, Ivory Coast		7°31′N	6°29′W
Boyasegese, Zaire		3°29′N	20°33′E
Bozene, Zaire		2°57′N	19°10′E
Bozoum (=Bosum), C.A.R.		6°18′N	16°22′E
Brikama, Gambia		13°16′N	16°38′W
Bul (=Bol), Chad		13°28′N	14°40′E
Bumban, Sierra Leone		9°10′N	11°53′W
Bunia, Zaire		1°33′N	30°14′E
Bunzuga, Sudan		12°30′N	34°10′E
Buram, S Darfur, Sudan		10°49′N	25°10′E
Bussa, Nigeria		10°12′N	4°30′E
Butembo, Zaire		0°08′N	29°17′E
Bwamanda, Zaire		3°10′N	19°15′E
Cap Vert, Senegal		14°45′N	17°20′W
Cape Coast, Ghana		5°05′N	1°24′W
Cape Creek, Gambia		13°29′N	16°40′W
Casamance, Senegal		12°45′N	16°40′W
Chak Chak, Bahr el Ghazal, Sudan		8°40′N	26°50′E
Chamois, Gambia		13°19′N	14°40′W
Char, Didinga Mountains, Sudan	ca	4°16′N	33°41′E
Comoé Valley at 10°08′N 5°14′W, Upper Volta/Ivory Coast		10°08′N	5°14′W
Conakry, Guinea		9°30′N	13°43′W
Congo/Nil km 999 (=W of Faradje), Zaire		3°40′N	29°17′E
Dabola, Guinea		10°48′N	11°02′W
Dagana, Senegal		16°31′N	15°30′W
Dagbao, Chad		7°39′N	15°52′E
Dakar, Senegal		14°46′N	17°26′W
Dalia, C.A.R.		6°21′N	16°10′E
Damongo, Ghana		9°03′N	1°49′W
Damrau, Chad		10°00′N	17°38′E
Dan Gora Forest Reserve, Nigeria		11°32′N	8°08′E
Dankawali, Sierra Leone		9°38′N	11°19′W
Dchang (=Dschang), Cameroon		5°27′N	10°04′E
Debba (=El Debba), Sudan		18°02′N	30°44′E
Dele, Bunia, Zaire		1°32′N	30°13′E
Denge, Nigeria		12°51′N	5°20′E
Dialakoro, Cercle de Mankono, Ivory Coast		8°01′N	6°09′W
Diattacounda, Senegal		12°34′N	15°40′W
Didessa, Ethiopia		9°02′N	36°07′E
Didinga Mountains, Sudan	ca	4°20′N	33°34′E
Dika, Zaire		4°16′N	27°42′E
Diourbel, Senegal		14°39′N	16°12′W
Dire, Mali		16°16′N	3°29′W
Djalasinda (=Djalasimba), Zaire		2°10′N	30°53′E
Djur, Sudan	ca	8°40′N	28°40′E
Doba, Chad		8°42′N	16°50′E
Dodeo (=Dodo), Cameroon		7°29′N	12°04′E
Dodo, Cameroon		7°29′N	12°04′E
Dogoloya, Sierra Leone		9°42′N	11°33′W

Dokonkade, Ghana		8°36′N	0°30′W
Donenkeng, Cameroon		4°35′N	11°05′E
Dongola, Sudan		19°10′N	30°29′E
Dororo, Nigeria		9°17′N	8°41′E
Dosso, Niger		13°03′N	3°12′E
Duem (=El Dueim), Sudan		14°00′N	32°20′E
Dulgo, Sudan		12°31′N	23°16′E
Duma, Zaire		3°55′N	18°42′E
Dumbi (=Dumbi Hill, Dumbi Woods), Nigeria		10°52′N	7°34′E
Dungu, Zaire		3°37′N	28°33′E
Dura River, Big Abbai River, Ethiopia		9°50′N	37°48′E
Edifou, Togo		7°29′N	0°57′E
Ejura (=Ijura), Ghana		7°23′N	1°15′W
"El Abiad" = White Nile below Fashoda, Sudan			
El Erian, Sudan	ca	18°00′N	31°00′E
El Fasher, Darfur, Sudan		13°37′N	25°22′E
El Fifi (=Al Fifi), Darfur, Sudan		10°03′N	25°01′E
Elmina, Ghana		5°04′N	1°29′W
Emene, near Enugu, Nigeria	ca	6°25′N	7°30′E
Ennedi, Chad	ca	17°50′N	22°50′E
Enugu, Nigeria		6°25′N	7°30′E
Epako (=Eipako), Cameroon		4°32′N	10°51′E
Epe, Nigeria		6°31′N	3°59′E
Eros, Didinga Mountains, Sudan		4°20′N	33°34′E
Etembo, Zaire		0°55′N	28°39′E
Evou, Togo		7°33′N	1°02′E
Fada Ngourma (=Fada Ngurmo), Upper Volta		12°14′N	0°05′W
Falgore, Nigeria		11°07′N	8°40′E
Famaka, Sudan		11°20′N	34°45′E
Fandem (=Fandène), Senegal		14°48′N	16°52′W
Fanti (=Fantee), Ghana		5°10′N	1°12′W
Faradje, Zaire		3°45′N	29°42′E
Farniso, Nigeria		12°02′N	8°31′E
Fashoda, Sudan		9°50′N	32°00′E
Fasogli (=Fazaglow), Sudan		11°15′N	34°45′E
Fataki, 20 km Lusambo, Zaire		0°58′N	29°38′E
Fatika Shika, Nigeria		11°12′N	7°31′E
Fazao, Togo		8°42′N	0°47′E
Ferdessidougou NE, Ivory Coast	ca	9°40′N	5°10′W
Fiko, 30 mi E Mopti, Mali		14°28′N	3°54′W
Fort Archambault (=Sahr), Chad		9°05′N	18°12′E
Fort Lamy (=Ndjamena), Chad		12°05′N	15°05′E
Fort Possel, C.A.R.		5°03′N	19°16′E
Fort Sibut (=Krebedge), C.A.R.		5°50′N	19°02′E
Foumban (=Fumban), Cameroon		5°43′N	10°55′E
"Fouta Djalon," Guinea	ca	11°30′N	12°30′W
Freetown, Sierra Leone		8°30′N	13°17′W
Fumban (=Foumban), Cameroon		5°43′N	10°55′E
Galim, Cameroon		7°05′N	12°25′E
Gallabat, Sudan		12°57′N	36°15′E
Gambaga, Ghana		10°31′N	0°25′W
Gambela, Ethiopia		8°13′N	34°35′E
"Gambia River", Gambia			
"Gambia"			
Gangala-na-Bodio, Zaire		3°44′N	29°08′E
Ganye, Nigeria		8°20′N	12°05′E
Gao, Mali		16°19′N	0°09′W
Garamba, Zaire		4°11′N	30°00′E

Garolle, Bunio, Ethopia		9°00′N	36°00′E
Garoua, Cameroon		9°17′N	13°22′E
Garoua Boulai, Cameroon		5°53′N	14°33′E
Garua (=Garoua), Cameroon		9°17′N	13°22′E
Gassagar, Nigeria		13°00′N	13°30′E
Gaya, Niger		11°53′N	3°27′E
Gaya, Niger River, Benin		11°50′N	3°23′E
Gaz-abu-Gumar, Sudan (n.l.)			
Gbanga, Liberia		7°03′N	9°30′W
Gedaref, Sudan		14°01′N	35°24′E
Gelongol, Ethopia		8°30′N	36°31′E
Genderu, Cameroon		7°23′N	12°00′E
Gezirat al Fil, Medani, Sudan		14°25′N	33°34′E
Giri, Nigeria		9°20′N	12°32′E
Gloucester, Sierra Leone		8°27′N	13°15′W
Gombe junction 13 mi W, Nigeria		10°18′N	10°50′E
Gombe junction 1 mi S, Nigeria		10°17′N	11°04′E
Gombe 27 mi W, Nigeria		10°18′N	10°45′E
Gombe 4 mi W, Nigeria		10°16′N	11°02′E
Gondokoro, Sudan		4°55′N	31°43′E
Gongila (=Gongola) River Bauchi 25 mi E, Nigeria		10°30′N	10°30′E
Grassfields (Freetown), Sierra Leone		8°00′N	13°12′W
Gueme, Cameroon		10°30′N	15°30′E
Gumad River, 130 mi SW Lake Tana, Ethiopia		10°35′N	36°10′E
Gumad River, 100 mi SW Lake Tana, Ethiopia		10°35′N	36°45′E
Gunnal, Guinea-Bissau		12°15′N	15°45′W
Gusau, Nigeria		12°09′N	6°39′E
Gusau 4 mi NW, Nigeria		12°11′N	6°36′E
Gusau 50 mi W, Nigeria		12°30′N	6°10′E
Gusau 62 mi W, Nigeria		12°35′N	6°00′E
Hadejia, Nigeria		12°29′N	10°03′E
Hambori (=Hombori), Mali		15°23′N	2°57′W
Haut Kemo (=Kemo River), C.A.R.	ca	6°17′N	19°27′E
Hinna on Gongila River (=Gongola River), Nigeria		10°15′N	11°48′E
Hoséré Sidiri (=Sidderi), Cameroon		9°10′N	13°06′E
Ibadan, Nigeria		7°26′N	3°54′E
Ibba, Bahr el Ghazal, Sudan		4°47′N	29°07′E
Ibi, Benue River, Nigeria		8°11′N	9°44′E
Iboñ (=ca 10 km SW Babimbi), Cameroon		4°23′N	10°46′E
Igbetti, Nigeria		8°43′N	4°08′E
Iju Waterworks (Lagos W), Nigeria		6°25′N	3°18′E
Ikorodu, Nigeria		6°30′N	3°32′E
Ile-Ife, Nigeria		7°30′N	4°32′E
Ilorin, Nigeria		8°30′N	4°32′E
Imatong Mountains, Sudan	ca	4°21′N	32°55′E
Indanre, Ondo Province, Nigeria		7°10′N	5°00′E
Insel Argo, Sudan		19°23′N	30°27′E
Irena, Shari River (=Chari River), C.A.R.		8°34′N	19°01′E
Irumu, Zaire		1°31′N	29°49′E
Iseyin 15 mi N, Nigeria		8°18′N	3°24′E
Iseyin, Oyo Province, Nigeria		7°58′N	3°32′E
Ishwa, Zaire		2°12′N	31°10′E
Jagindi (RR Station), Nigeria		9°21′N	8°14′E
Jebba, Nigeria		9°09′N	4°48′E.
Jebel Ahmed Alga, Sudan	ca	10°50′N	32°32′E
Jebel Marra, Darfur, Sudan		13°45′N	24°30′E
Jebelein (=El Jebelein), Sudan		12°40′N	32°40′E
Jintilo (=Abilela), Chad		13°00′N	14°38′E

Jos, Nigeria		9°55′N	8°55′E
Jos 4 mi NW, Nigeria		10°00′N	8°53′E
Jos 5 mi NW, Nigeria		10°00′N	8°52′E
Jos 15 mi NW, Nigeria		10°12′N	8°42′E
Jos 26 mi E, Nigeria		10°05′N	9°12′E
Juba, Sudan		4°59′N	31°37′E
Kabala, Sierra Leone		9°35′N	11°33′W
Kadugli, Sudan		11°00′N	29°45′E
Kaduna RR crossing S, Nigeria		10°29′N	7°25′E
Kaduna 20 mi SSE, Nigeria		10°28′N	7°40′E
Kaduna, Nigeria		10°30′N	7°26′E
Kafanchan, Nigeria		9°34′N	8°19′E
Kagoro Hills, Nigeria		9°36′N	8°30′E
Kaiama, Nigeria		9°37′N	3°56′E
Kaja Djerri, C.A.R.	ca	5°52′N	18°55′E
Kajo Kaji, Lado, Sudan		3°56′N	31°40′E
Kalokitting, Darfur, Sudan		12°44′N	24°19′E
Kaltungo 15 mi N, Nigeria		9°54′N	11°08′E
Kami, Mali		14°33′N	4°12′W
Kamisa (=Khaimsa), Sennar Province, Sudan	ca	13°22′N	34°08′E
Kande, Togo		9°59′N	1°04′E
Kano, Nigeria		12°00′N	5°31′E
Kara, Mali		14°09′N	5°01′W
Kasala, Uelle River, Zaire (n.l.)			
Kasenyi (=Kasenje), Zaire		1°24′N	30°26′E
Katebougou (=Katibougou), Mali		12°56′N	7°32′W
Katiola (Bou River S of Katiola), Ivory Coast		8°58′N	5°53′W
Katsina, Nigeria		13°00′N	7°32′E
Kaulikora (=Kulikoro), Mali		13°36′N	8°05′W
Kaya, Upper Volta		13°00′N	1°05′W
Kayar, Senegal		14°55′N	17°07′W
Ke Masina (=Ké Maçina), Mali		13°58′N	5°22′W
Kemo River (=Haut Kemo), C.A.R.	ca	6°17′N	19°27′E
Kenewa, Sierra Leone		8°39′N	11°38′W
Kenisa (=Konisa), Mongalla, Sudan		6°50′N	31°06′E
Kerma, Dongola, Sudan		19°38′N	30°25′E
Kete-Kratschi (=Kratschi), Ghana		7°48′N	0°04′W
Khartoum, Sudan		15°35′N	32°33′E
Kibali River, Zaire	ca	3°37′N	28°34′E
Kimbe River, Num, Cameroon		6°38′N	10°30′E
King Tom (Freetown), Sierra Leone		8°29′N	13°15′W
Kintampo, Ghana		8°06′N	1°40′W
Kipigo Mountain, Aloma Plateau, Sudan		3°40′N	30°30′E
Kiri, Nigeria		9°40′N	12°00′E
Kirita, Fouta Djalon, Guinea		10°38′N	11°50′W
Kirtaona (=Kirtaonda), Senegal (n.l.)			
Kishi 20 mi N, Nigeria		9°26′N	3°56′E
Knoll (Freetown), Sierra Leone		8°27′N	13°12′W
Kodja Hill, Gaima Range, Zaire		3°14′N	29°17′E
Kogum, Nigeria		9°17′N	8°13′E
Koko in Dangija, Big Abbai River, Ethiopia		10°26′N	36°06′E
Kolekope, Togo		7°48′N	1°18′E
Kombetiko, Cameroon		4°40′N	14°35′E
Kongola, Cameroon		6°01′N	13°58′E
Konisa (=Kenisa), Mongalla, Sudan		6°50′N	31°06′E
Kontagora, Nigeria		10°26′N	5°28′E
Kordofan Province, Sudan	ca	13°00′N	30°00′E

Korhogo, Ivory Coast	9°28′N	5°35′W
Koscha, Ethiopia	6°46′N	36°45′E
Koubadjé, Cameroon	8°59′N	13°18′E
Koza, Cameroon	10°52′N	13°53′E
Kpatchi Island, Nigeria	9°36′N	4°39′W
Kratschi (=Kete-Kratschi), Ghana	7°48′N	0°04′W
Krebedge (=Sibut), C.A.R.	5°50′N	19°02′E
Kulikoro (=Kaulikora), Mali	13°36′N	8°05′W
Kulme, Darfur, Sudan	12°35′N	23°37′E
Kumasi, Ghana	6°45′N	1°35′W
Kumbo, Cameroon	6°12′N	10°40′E
Kuntair, Gambia	13°32′N	16°14′W
Kurrabondo, Sierra Leone	9°08′N	10°58′W
Laboni, Imatong Mountains, Sudan	3°51′N	32°40′E
Lado, Sudan	5°01′N	31°41′E
Lagos, Nigeria	6°28′N	3°25′E
Lake Chad, Chad	12°50′N	14°20′E
Lam, near Dagbao, Chad	7°39′N	15°53′E
Lama-Kara, Togo	9°40′N	1°08′E
Landa-Pozanda, Togo	6°00′N	1°12′E
Larabanga, Ghana	9°12′N	1°48′W
Lawra, Ghana	10°40′N	2°49′W
Legon, Ghana	5°36′N	0°14′W
Lendju, Zaire	2°09′N	31°41′E
Leone, near Lotti, Sudan	4°00′N	32°33′E
Léré, Chad	9°59′N	14°13′E
Letti, Sudan	18°30′N	31°00′E
Lita's, Aloma Plateau, Sudan	3°40′N	30°38′E
Logone-Gana, Chad	11°33′N	15°09′E
Loko, Benue River, Nigeria	8°00′N	7°50′E
Lokoja, Nigeria	7°49′N	6°44′E
Lolengi (=Lolianga), Imatong Mountains, Sudan	4°21′N	32°55′E
Lomé, Togo	6°03′N	1°06′E
Lotti forest, Torit District, Sudan	4°00′N	32°35′E
Lovi, Mole National Park, Ghana	9°22′N	2°00′W
M'Bara region, Senegal	15°09′N	16°54′W
Mabas, Cameroon	10°49′N	13°39′E
Machigay, 15 mi S Lake Tana, Ethiopia	11°30′N	37°40′E
Madiani Mountains, Ivory Coast	9°36′N	6°44′W
Madina Niumi, Gambia	13°21′N	16°10′W
Madjamboni (=Nyangabo), Zaire	1°19′N	30°03′E
Mahagi, Zaire	2°06′N	31°13′E
Mahagi Port, Zaire	2°08′N	31°14′E
Mahera coast, Sierra Leone	ca 8°34′N	13°00′W
Maiduguri, Nigeria	11°49′N	13°10′E
Maiduguri 45 mi SE, Nigeria	11°22′N	12°52′E
Majim, Chad	10°40′N	16°20′E
Makanené, Chad (n.l.)		
Makeni, Sierra Leone	8°53′N	12°04′W
Makka Niumi, Gambia	13°24′N	16°10′W
Makonda Mafifigi, Cameroon	3°46′N	10°16′E
Makou, Chad	8°28′N	16°07′E
Makwar, Sudan	14°55′N	33°24′E
Malakal, Sudan	9°31′N	31°40′E
Malamfatori, Nigeria	13°40′N	13°25′E
Mamau (=Mamou), Guinea	10°20′N	12°05′W
Mampong, Ghana	7°04′N	1°17′W

Man, Ivory Coast		7°24′N	7°33′W
Mandjafa (=Mundjeffa), Chad		11°20′N	15°18′E
"Mangbetu country," Zaire	ca	3°20′N	28°20′E
Mangu (=Sansanné-Mango), Togo		10°20′N	0°15′E
Maniling, Chad		11°20′N	15°09′E
Mao Godi (=Mayo Godi), Cameroon		8°52′N	13°54′E
Mapololon, Sierra Leone		9°00′N	13°00′W
Maroua, Cameroon		10°36′N	14°20′E
Marua (=Maroua), Cameroon		10°36′N	14°20′E
Masaka, Ghana		8°38′N	0°28′W
Maska Dam, Nigeria		11°20′N	7°18′E
Matam, Senegal		15°40′N	13°16′W
Mauda, Zaire		4°05′N	27°41′E
Mayo Sala, Cameroon		8°38′N	13°48′E
Mba, Cameroon		7°00′N	11°50′E
Mbaiki, C.A.R.		3°53′N	18°00′E
Mbaniti, Cameroon		6°59′N	11°58′E
Mboro, Senegal		15°12′N	16°55′W
Mboula, Cameroon		6°40′N	14°10′E
Mbru, C.A.R.	ca	6°15′N	19°10′E
Medani (=Wad Medani), Sudan		14°30′N	33°00′E
Melut (=Malut), Sudan		10°26′N	32°12′E
Merowe (=Meroë), Sudan		18°30′N	31°55′E
Meshra el Rek, Sudan		8°28′N	29°16′E
Mieri, Cameroon		4°15′N	13°59′E
Mokolo, Cameroon		10°49′N	13°54′E
Mole National Park (HQ, motel), Ghana		9°16′N	1°48′W
Mongalla, Sudan		5°10′N	31°44′E
Mora, Cameroon		11°03′N	14°09′E
Morago River, Ghana		10°40′N	0°14′W
Moundou, Chad		8°40′N	16°05′E
Mozogo, Cameroon		10°58′N	13°58′E
Mswa, Zaire		1°56′N	30°59′E
Mt. Lotukwe, Didinga Mountains, Sudan		4°10′N	33°46′E
Mt. Mi (=Mt. Mé), Zaire		2°16′N	30°57′E
Mt. Sébé (=Sebbe), Togo		7°50′N	0°47′E
Mundjeffa (=Mandjafa), Chad		11°20′N	15°18′E
Musaia, Sierra Leone		9°46′N	11°34′W
Musran Island, Sudan		12°45′N	32°47′E
N of Lake Albert Edward (=nr Mahagi Port), Zaire		2°08′N	31°14′E
Nafoun, Ivory Coast		9°33′N	6°03′W
Nagichot, Didinga Mountains, Sudan		4°20′N	33°32′E
Naikhala (=Nakheila), Sudan		19°40′N	33°00′E
Nalagedi (=Naligedi), Didinga Mountains, Sudan		4°14′N	33°42′E
Nanergou, Togo		10°55′N	0°09′E
Narode, Nigeria		10°02′N	9°09′E
Nasarawa, Nigeria		8°38′N	7°40′E
Natitingou, Benin		10°17′N	1°19′E
Natu (Lake), Nigeria		12°40′N	5°55′E
Ndilla, Senegal		15°20′N	15°03′W
Ndjamena (=Fort Lamy), Chad		12°05′N	15°05′E
Ndôm, Cameroon		4°25′N	10°49′E
Nerekoro, Sierra Leone		9°12′N	10°42′W
Ngambe-Tibati, Cameroon		6°10′N	12°00′E
Ngaoundéré, Cameroon		7°22′N	13°42′E
Ngikinda (5 km N of Babimbi), Cameroon		4°30′N	10°53′E
Nguro (=Ngouro), C.A.R. ca		4°49′N	18°53′E
Niafounké, Mali		15°59′N	4°00′W

Niamtougou, Togo		9°46′N	1°08′E
Niangara, Zaire		3°42′N	27°53′E
Nianing (?=Nianene), Senegal		13°54′N	16°05′W
Niarembe, Zaire		2°14′N	31°07′E
Niéllé (=Niélé), Ivory Coast		10°12′N	5°28′W
Niger River, Nigeria		11°30′N	3°52′E
"Niger River", Nigeria			
Niger River between Kaduna R. and Katcha, Nigeria		8°42′N	6°07′E
Nimba Mt., Liberia		8°30′N	9°45′W
Nimule, Sudan		3°35′N	32°04′E
Niokolo-Kobo, Senegal		13°00′N	13°00′W
Njasso (=Nyassi), Cameroon		4°15′N	13°50′E
Nkongsamba district, Cameroon		5°00′N	9°50′E
Nnañ (=Bafia), Cameroon		4°40′N	11°05′E
Nola, C.A.R.		3°30′N	16°03′E
Ntinakok, near Wau, Sudan	ca	8°00′N	28°00′E
Nuatja, Togo		6°57′N	1°10′E
Numan, Nigeria		9°30′N	12°03′E
Numan 6 mi NW, Nigeria		9°33′N	12°00′E
Nyangabo (=Madjamboni), Zaire		1°19′N	30°03′E
Nzérékoré, Guinea		7°45′N	8°49′W
Nzoro, Zaire		3°17′N	29°26′E
Obala, Cameroon		4°10′N	10°20′E
"Oberes Sannagebiet" (=Sanaga River), Cameroon	ca	4°40′N	12°15′E
Obudu Plateau, Nigeria		6°40′N	9°10′E
Omdurman, Sudan		15°37′N	32°29′E
Ouagadougou, Upper Volta		12°20′N	1°40′W
Ouadi Achim, Chad		15°50′N	19°45′E
Ouadi Djedit, Chad		14°19′N	19°16′E
Ouadi Enne, Chad		13°30′N	20°30′E
Ouadi Haddat, Chad		14°32′N	19°53′E
Ouadi Rimé, Chad		14°03′N	18°31′E
Oursi, Upper Volta		14°40′N	0°28′W
Oyo, Nigeria		7°50′N	3°55′E
Paio, Togo		10°14′N	0°43′E
Pankshin, Nigeria		9°22′N	9°23′E
Panshanu Pass, Nigeria		10°06′N	9°13′E
Panyam, Nigeria		9°26′N	9°12′E
Pategi, Nigeria		8°40′N	5°41′E
Pendjari National Park, Benin		10°17′N	1°19′E
Poli, Cameroon		8°31′N	13°10′E
Porto Seguro, Togo		6°13′N	1°12′E
Possel (=Fort Possel), C.A.R.		5°03′N	19°16′E
Potiskum, Nigeria		11°45′N	11°04′E
Rabba (=Raba), Nigeria		9°14′N	5°01′E
Rangu, Sudan		5°04′N	28°20′E
Rano, Nigeria		11°32′N	8°35′E
Ratu, Gribingui River, C.A.R.	ca	7°28′N	19°00′E
Red Volta River, Ghana		10°34′N	0°30′W
Rei Bouba, Cameroon		8°40′N	14°11′E
Rejaf, Sudan		4°45′N	31°35′E
Rey Bouba (=Rei Bouba) 25 mi N, Cameroon		8°53′N	13°58′E
Ribao, Cameroon		6°32′N	11°30′E
Ribao plain, Cameroon		6°15′N	11°25′E
Richard-Toll, Senegal		16°27′N	15°41′W
Riggil, Chad (n.l.)			
Riman Mukur, Nigeria		10°08′N	9°24′E
Riman Zayam (=Ziam), Nigeria		10°11′N	9°21′E

Rimo, S Lado, Sudan		4°16′N	30°32′E
Rokupr, Sierra Leone		8°55′N	12°09′W
Roseires, Sudan		11°52′N	34°23′E
Rosso, Mauritania		16°36′N	15°55′W
Rotifunk, Sierra Leone		8°20′N	12°40′W
Ruan Gizzo, Nigeria		12°05′N	5°58′E
Rudu (?=Rubu), Sudan		4°56′N	29°08′E
Rungu, Zaire		3°11′N	27°53′E
Sagdsche (=Sakdjé), Cameroon		8°12′N	13°46′E
Sahr (=Fort Archambault), Chad		9°05′N	18°12′E
Saiama (=Samaia), Sierra Leone		8°50′N	10°28′W
Sakdjé (=Sagdsche, Sakjé), Cameroon		8°12′N	13°46′E
Sakure 30 mi S Yambio, Sudan		4°21′N	28°12′E
Salikeni, Gambia		13°29′N	15°58′W
Salimat el Alimat, Sudan (n.l.)			
Samaia (=Saiama), Sierra Leone		8°50′N	10°28′W
Samaru farm, Nigeria		11°15′N	7°35′E
Samaru gully, Nigeria		11°10′N	7°37′E
"Sanaga River," Cameroon	ca	4°40′N	12°15′E
Sanga, Mali		14°28′N	5°30′W
Sangalkam, Senegal		14°47′N	17°13′W
Sansanné-Mango (=Mango, Mangu), Togo		10°20′N	0°15′E
Sebbe (=Mt. Sébé), Togo		7°50′N	0°47′E
Sefadu 25 mi NE, Sierra Leone		8°50′N	10°56′W
Sekondi, Ghana		4°56′N	1°42′W
Semini (?=Sementa), Fouta Djalon, Guinea		12°26′N	13°12′E
Semliki, Zaire	ca	0°20′N	30°00′E
"Senegal"			
"Senegambia"			
Sennar (=Sennaar), Sudan		13°15′N	33°30′E
Serekolia, Sierra Leone		9°32′N	11°04′W
Serti, Nigeria		7°30′N	11°22′E
Shagunu, Niger River, Nigeria		10°22′N	4°24′E
Sheikh Tombe (=Tombe), Sudan		5°49′N	31°41′E
Shendi (=Shindy, Shandi), Sudan		16°42′N	33°26′E
Shereik (=Shurayk), Sudan		15°22′N	32°47′E
Sibut (=Fort Sibut), C.A.R.		5°50′N	19°02′E
Sidderi (=Hoséré Sidiri), Cameroon		9°10′N	13°06′E
Sidisto, Ethiopia		10°30′N	38°15′E
Singa, Sudan		13°09′N	33°56′E
Sinematiali, Bandama River, Ivory Coast		9°35′N	5°23′W
Sipilou, Ivory Coast		7°55′N	8°05′W
Sisili Valley, Ghana		10°16′N	1°15′W
Sokode, Togo		8°59′N	1°11′E
Sokoto, Nigeria		13°04′N	5°15′E
Sokotoro (=Sokotoyo), Fouta Djalon, Guinea		10°54′N	10°35′W
"Soudan Français" (=Mali)			
"South Bank Province," Gambia	ca	13°16′N	16°38′W
"Sub-Saharan region," Ivory Coast (=near Korhogo)			
Takai, Nigeria		11°34′N	9°08′E
Talanga Forest 5 mi W Katire, Sudan		4°01′N	32°43′E
Talata Mafara 39 mi W, Nigeria		12°46′N	5°28′E
Taléré, Ivory Coast		9°22′N	5°50′W
Talodi (=Talawdi), Sudan		10°38′N	30°23′E
Tamale, Ghana		9°26′N	0°29′E
Tamanrasset, Algeria		22°50′N	5°28′W
Tatara, Nigeria		9°12′N	7°52′E

Tauila (=Tawila, Tawela), Sudan		13°45′N	33°59′E
Telàweit, Kassala Province, Sudan		15°10′N	36°26′E
Tembura (=Tambura), W Mongalla, Sudan		5°38′N	27°30′E
Témedja, Togo		7°31′N	1°05′E
Thiès, Senegal		14°45′N	16°56′W
Tholagoday, Sierra Leone		9°45′N	11°33′W
Tibati, Cameroon		6°27′N	12°33′E
Tiebila (Bandama River), Ivory Coast		9°45′N	5°50′W
Tignère, Cameroon		7°22′N	12°39′E
Tili-bu-Bakar, Senegal (n.l.)			
Timbo, Fouta Djalon, Guinea		11°36′N	13°00′W
Timbuktu (=Tombouctou), Mali		16°49′N	2°59′W
Timia, Asben, Niger		18°04′N	8°40′E
Tingasi, Zaire		3°24′N	27°55′E
Tingura (=Tignère), Cameroon		7°22′N	12°39′E
Togoville, Togo		6°14′N	1°29′E
Tomaya, Sudan		4°38′N	29°50′E
Tombouctou (=Timbuktu), Mali		16°49′N	2°59′W
Tonj, Sudan		7°18′N	28°41′E
Torgokaha, Ivory Coast		9°23′N	5°38′W
Torit, Sudan		4°27′N	32°31′E
Toro, Nigeria		12°04′N	9°03′E
Tortila, Ivory Coast		8°48′N	5°21′W
Touba, Ivory Coast		8°18′N	7°42′W
Toukté, Cameroon		8°32′N	13°10′E
Toumodi, Ivory Coast		6°33′N	5°01′W
Touroua, Cameroon		9°05′N	12°59′E
Towat, Boma, Sudan		6°14′N	34°28′E
Tukpuo, Zaire		4°24′N	25°52′E
Tumbu, Sierra Leone		8°30′N	13°00′W
Tumu, Ghana		10°56′N	2°00′W
Tungie, Sierra Leone		8°30′N	11°34′W
Urbi, Sudan		19°00′N	30°05′E
Vankerckhovenville (=Nzoro), Zaire		3°17′N	29°26′E
Volta River, Ghana	ca	10°36′N	0°28′W
Volta River, Upper Volta	ca	11°10′N	0°20′W
Vom, Nigeria		9°42′N	8°44′E
Wa, Ghana		10°07′N	2°28′W
Wad Medani (=Medani), Sudan		14°30′N	33°00′E
Wadi Naja (=Wad Ban Naqa), Sudan		16°32′N	33°00′E
Wamelhoro (=Wemelhoro), Ivory Coast		10°20′N	5°37′W
Waterloo, Sierra Leone		8°20′N	13°05′W
Wau, Bahr el Ghazal, Sudan		7°20′N	28°04′E
Waza, Cameroon		11°21′N	14°20′E
Weija, Ghana		5°30′N	0°18′W
"White Nile," Sudan			
Wokko-Lugere, Cameroon		9°29′N	12°24′E
Wonkufu, Little Scarcies River, Sierra Leone		9°12′N	12°33′W
Wum, Cameroon		6°23′N	10°04′E
Wunnda, Chad		13°30′N	14°30′E
Yagoua, Cameroon		10°23′N	15°13′E
Yakoma, Zaire		4°06′N	22°23′E
Yakota, near Krebedge (=Fort Sibut), C.A.R.	ca	5°50′N	19°02′E
Yakuba, near Genderu, Cameroon		7°23′N	12°00′E
Yanga, Bahr Sara, Chad	ca	9°00′N	18°00′E
Yankari National Park, Nigeria		9°38′N	10°25′E
Yaoundé, Cameroon		3°50′N	11°30′E

Yegi, Ghana	8°13′N	0°39′W
Yei, Sudan	4°09′N	30°40′E
Yelwa, Nigeria	10°52′N	4°40′E
Yendi, Ghana	7°25′N	1°10′W
Yo, Lake Chad, Nigeria	13°34′N	13°15′E
Yobe River, Lake Chad, Nigeria	13°14′N	13°21′E
Yoko, Cameroon	5°29′N	12°19′E
Yola, Nigeria	9°12′N	12°32′E
Yola 98 mi NW, Nigeria	9°43′N	11°28′E
Yola 100 mi N, Nigeria	10°55′N	12°52′E
Zaria, Nigeria	11°10′N	7°40′E
Zaria-Bauchi mi 81, Nigeria	10°28′N	8°32′E
Zeidab, Berber Province, Sudan	17°26′N	33°52′E
Ziam (=Riman Zayam), Nigeria	10°11′N	9°21′E
Zinder, Niger	13°48′N	8°59′E