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II

FAMILIES VIREONIDAE, SYLVIIDAE, TURDIDAE,
TROGLODYTIDAE, PARIDAE, CORVIDAE,
HIRUNDINIDAE AND TYRANNIDAE

By

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ILLUSTRATED WITH DRAWINGS BY DON R. ECKELBERRY



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GOLDEN-CROWNED SPADE-BILL

RUDDY-TAILED FLYCATCHER

SULPHUR-RUMPED MYIOBIUS

To the memory of

DUNCAN STARR JOHNSON,

1867-1937,

Professor of Botany in Johns Hopkins University,
who introduced me to tropical America

Edited by

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INTRODUCTION

This volume of life histories follows closely the plan of its predecessor. The observations recorded herein were made in the same places as those which fill the first volume, in the introduction to which they are briefly described. But the studies reported here were made over a longer interval of time, extending from 1929 to 1956. Nearly all of my more recent bird watching has been done on my farm at Quizarrá where I have resided since 1941. It is on the northern side of the valley of El General which is on the Pacific slope of southern Costa Rica at an altitude of about 2500 feet.

On the whole, I have treated in the present series birds for which I am able to present fairly balanced accounts, including some information on the several phases of nesting. In the first volume, I rarely departed from this plan, and I omitted a number of species, merely because I could not round out my accounts of them. I had hoped later to make further studies of at least some of these omitted species. However, as the years roll by, I became less hopeful of renewing my acquaintance with birds which I watched long ago in distant regions, or even of making fuller studies of species present on my farm yet so secretive that one may hunt diligently for their nests for years without reward. Hence I have included in this volume a larger number of birds on whose mode of life I have something of interest to report, even if my observations do not add up to a "life history." Yet I have not given space to species of which my notebooks contain still more fragmentary records, such as the description of song, nest and eggs, or method of foraging, even if these have never been described in print. I hope eventually to publish this miscellaneous information in some other medium where it will be accessible to other workers. Some tropical birds are so elusive that only by piecing together scraps of information, gathered over a period of many years by various observers in widely separated regions, are we likely to begin to understand their mode of life.

The present volume deals primarily with species on which I have not hitherto published special reports or on which I published accounts so long ago that I am now able to expand them greatly. Among the latter are the Black-fronted Tody-Flycatcher, the subject of my first ornithological paper, published in *The Auk* in 1930, and the Yellow-green Vireo, of which my account published in 1950 in Bent's "Life Histories of North American Birds" was written about eight years earlier. Full reports of my studies of certain species in families treated in this volume have in recent years appeared in ornithological journals, and to economize space these have been omitted. However, for the convenience of those readers who might not enjoy ready access to these journals, résumés of these papers are included. The species so treated are the Southern House Wren, the White-throated Magpie-Jay, the Blue-and-White Swallow, the Boat-billed Flycatcher, and the Tropical Kingbird. Full citations of these papers, as of all other published material mentioned in this volume, are to be found in the "Literature Cited." In the case of the Tropical Kingbird, I have added to the résumé a number of facts collected since I wrote the paper which appeared in 1954 in the *Proceedings of the Linnaean Society of New York*. Because I have somewhat complete observations on only one Central American representative of the Mimidae, the White-breasted Blue Mockingbird, and because my account of this bird was published in *The Condor* in 1950, this family, although falling within the sequence of families treated in this volume, has been excluded from the present book.

Since the appearance of the first volume in this series, Eugene Eisenmann has earned

the gratitude of every student of Central American birds by the publication, in 1955, of "The Species of Middle American Birds." This work not only provides the only convenient listing of the avifauna of the Central American republics that is at present available, but it gives in broad terms the range of each bird in México and Central America, and it brings us nearer to the realization of that much-desired goal, a set of easily remembered English names applicable to every species of bird inhabiting tropical America. In writing this book I have adopted many of the names suggested by Eisenmann and his colleagues. But I have not followed their nomenclature without exceptions, for in some instances their innovations do not appear to me to improve sufficiently upon older names to warrant making a change, and in other cases I still prefer names which I invented earlier. When I look back over the array of names which, partly as a result of recent changes in taxonomic concepts, partly in deference to editorial policy, and partly as a result of my own dissatisfaction with older designations, I have in the course of more than two decades used in print for the same bird, I am somewhat perturbed. To avoid further confusion, it seems best to retain names which I have already employed in published papers unless there are very strong grounds for making a change. I join Eisenmann in hoping that before long the American Ornithologists' Union will attempt to stabilize the English names of Middle American birds by drawing up an official checklist. Meanwhile, it can do no harm if interested persons invent new designations for these birds whenever they believe that they can improve on those already in use. Nearly everyone who has undertaken to provide vernacular names for the vast array of slightly differing birds of a large tropical region has admitted the difficulty of the project; hence the more suggestions that are given, the easier it will be for a committee on nomenclature to select names that will endure.

As in the first volume, unless otherwise stated, the dimensions given for eggs are in all instances based on measurements made by the author at the nest, to which the eggs were returned after they were measured and described. The incubation period is understood to be the interval between the laying of the last egg and the hatching of the last nestling when every egg in the set hatches. However, where the eggs were given distinguishing marks as they were laid, the incubation period is the interval between the deposition of the last egg and the hatching of that same egg. Nestling periods have been calculated on the assumption that the young left the nest in the order in which they were hatched. Thus if, at a certain nest, two nestlings were hatched on the first and second days of the month and left on the eighteenth and twentieth days, the nestling periods would be given as 17 and 18 days. If the young, in fact, left the nest in the inverse order of their age, the actual periods would be 16 and 19 days, but the average, 17.5 days, would be the same in both cases. The reason for the adoption of different methods for computing the incubation and nestling periods seems obvious: eggs are not necessarily incubated as soon as they are laid, but nestlings invariably grow older at a uniform rate from the moment they hatch. Since we scarcely ever have observations to show just when steady incubation begins at a given nest, the incubation period should be looked upon as a conventionally defined quantity, but one which in most instances seems to approximate closely to the duration of a natural process.

The constancy of incubation and brooding, at nests where a single parent performs these offices, is calculated, not from the total times the bird spent on and off the nest during the periods of observation, but from the averages of the observed sessions and recesses, according to the formula $T = S \div (S + R) \times 100$, where T is the per cent of time on the nest, S the average length of the sessions in the nest which the observer timed, and R is the average of the recesses or periods away from the nest. If, as often happens, unequal numbers of sessions and recesses are included in observation periods

which do not extend from the beginning to the end of the bird's diurnal activity, the use of the averages will give a fairer index of constancy than calculation on the basis of the total time spent on and off the nest while the watcher was present.

In dealing with the songs and other utterances of birds, I have often given imaginative descriptions, as this seems the most effective method of conveying to a reader who has not heard them some notion of what they are like. It is hardly necessary to remark that when I call a bird's song "melancholy," "querulous," "exultant" or the like, this is merely a statement of the subjective impression it made on the hearer, and it does not necessarily reflect the bird's own emotional tone.

Although the several topics included in these life histories have as a rule been treated in the same sequence, I have not rigidly followed a preconceived plan. In each account I have felt free to adopt whatever order of presentation seemed best to accord with the available information. The general summary for each family was conceived in the first place as a method of making comparisons among the several species on which I have information, whether gathered by others or myself, without all the repetition which would ensue if this were done in each separate biography. I had hoped also, in the case of the largely or wholly neotropical families, to present in these summaries a résumé of all that is known of them from the standpoint of behavior rather than from the standpoint of systematics and distribution. In the case of the great cosmopolitan families included in the present volume, such as the thrushes and the jays, this proves to be an impossible undertaking, both because much of the scattered literature is not available to me in Costa Rica, and because even if it were, space to review it adequately is lacking. Thus, these general summaries should be taken not as exhaustive surveys of the pertinent literature on the families in question but as an effort to show something of the uniformities and diversities in behavior, especially as regards nesting, to be found within them.

I should be sorry if anyone should conclude from the examination of these volumes that I have exhausted the field. Actually, the survey of the modes of life of the birds of tropical America, with their almost endless diversity of plumage and habits, has scarcely begun. Nothing could be more gratifying to me than that these imperfect accounts, the fruit of observations carried on with the limited time, strength, and resources of a single individual, should stimulate many others to study the birds of tropical America as living animals.

The order in which the species are arranged under each family, especially in the case of the Tyrannidae, does not follow any existing classification. Although a new sequence is not proposed here, the arrangement employed has been designed to emphasize certain trends in breeding behavior which in turn may be important in a future, perfected classification that is based on both structure and breeding biology.

Although this is not the place to attempt to draw broad philosophical conclusions from the studies here reported, it is perhaps permissible to suggest briefly the form some of these conclusions might take. The birds of any given family or order, as indeed all animate beings, have essentially the same problems to solve. These include procuring nourishment, avoiding dangers, reproducing their kind, and perhaps also attaining a certain subjective state which we can designate as "happiness," "contentment" or some approximately equivalent term. Their diverse structures and habits are the outcome, rather than the cause, of their having solved these fundamental problems in diverse manners, for they were acquired in the course of working out their respective solutions. When we contemplate a great family of birds such, for example, as the American flycatchers, we are reminded in a most impressive fashion of the many different ways in which creatures essentially similar can solve the same fundamental problems. And it

would be difficult for us to decide which of all these so diverse patterns of life is the best or most perfect—if indeed there is an absolutely best or most perfect pattern. The same conclusion might be reached by an anthropologist who surveys broadly all the varied patterns of culture developed over the centuries by a single highly adaptable species of animal—mankind. In a world which inclines increasingly toward the view that only if all nations and peoples adopt precisely the same social and economic arrangements, and the same values, is human happiness and perhaps even survival possible, this result of studies of other kinds of living things should provide much matter for thought.

Some of the accounts which fill the present volume were first drafted in 1946 and 1947, while I held a Fellowship of the John Simon Guggenheim Memorial Foundation of New York, to which I here express my gratitude. I am also grateful to Don Eckelberry for the care he has taken with the drawings which adorn this book; and both he and I wish to thank Mr. Charles E. O'Brien and the staff of the Bird Department of the American Museum of Natural History for extending every facility while he was preparing these illustrations. In April and May of 1956, Mr. Eckelberry spent five weeks on the author's farm in El General, where he had an opportunity to observe a large proportion of the birds which he has portrayed. Most of the others were seen by him on visits to southern México and Guatemala, and his familiarity with the living birds has greatly increased the accuracy and value of his delineations. Finally, I wish to thank the editors of the Cooper Ornithological Society for the care they have taken in seeing this and the first volume through the press, and all those whose generosity has made possible the publication of this series.

Finca "Los Cusingos,"
San Isidro del General,
Costa Rica,
September 29, 1956.

FAMILY VIREONIDAE

YELLOW-GREEN VIREO

Vireo flavoviridis

The Yellow-green Vireo has the distinction of being the only true songbird definitely known to migrate north to Central America from its winter range in South America. The only other passerine birds which appear to be in this category are a few species of the non-oscine American flycatchers. All the other passerines which nest in Central America appear to be permanent residents, but more observations by ornithologists permanently established in various parts of the area are required to confirm this conclusion. The long list of migratory birds in this great isthmus is composed almost wholly of those which come down from the north to pass the winter.

Even if it lacked this distinction, the Yellow-green Vireo would be well worth studying, for despite its plain attire it is a most attractive bird. About five and a half inches in length, its rather long tail and bill and somewhat flat head give it an aspect of trim slenderness. The top of its head and hindneck are plain gray, and the crown is bordered on each side by a dusky line, below which is a superciliary stripe of paler gray, set off by a dull gray loreal streak. The remaining upper parts are bright olive-green, without wing-bars or conspicuous light margins on the wing feathers. The auricular region is light olive-green and the cheeks are very pale gray. The under parts are white, strongly tinged with olive-yellow on the sides and flanks and merging into clear yellow on the under tail-coverts. The eyes are bright red, the bill has a dark upper mandible and lighter lower mandible, and the feet are grayish blue. The sexes are indistinguishable in appearance.

The Yellow-green Vireo is readily distinguished in a good light, even in the treetops, from the Red-eyed Vireo, which in spring and autumn passes through Central America on its annual journeys between its breeding ground in North America and its winter home in South America. In the Red-eyed Vireo the dark margins of the gray crown are much more pronounced, whereas the under plumage shows scarcely any yellow.

The Yellow-green Vireo breeds occasionally as far north as extreme southern Texas but more regularly from northern México to Panamá. Thus it occurs throughout the length of Central America, where it is most abundant in the Pacific lowlands and in the less elevated parts of the highlands. It is rare or absent in much of the Caribbean littoral. Hence in my first three years in Central America, which were passed largely in the Caribbean lowlands of Panamá, Honduras, and Guatemala, I did not make its acquaintance. But later, when I extended my ornithological observations to the interior and the Pacific side, I saw much of it. In Costa Rica, Guatemala, and México it occurs up to about 5000 feet, and I once found a nest as high as 4500 feet in Costa Rica. Throughout its range it inhabits open country with scattered trees, light woodland, orchards, gardens, and shady roadsides. It rarely penetrates far into heavy forest, although at times it forages in the tops of the great trees near the woodland's edge.

We should expect a bird which prefers these habitats to increase in the humid Caribbean lowlands as the original luxuriant rain forest gives way to clearings and plantations in the face of an increasing human population, and apparently it has been extending its breeding area downward toward the coast from the higher elevations of the interior.

ARRIVAL IN CENTRAL AMERICA

The Yellow-green Vireo winters principally on the western side of the Amazon basin, chiefly in Colombia, Ecuador, Perú, and Bolivia. Thence it makes its way northward early in the year. In 17 years in El General, Costa Rica, I have first become aware of its presence, usually through hearing its song, from January 26 to February 14, but in 12 of these years I recorded its arrival in the first 8 days of February. A few days after the vanguard arrives the vireos are singing freely along all the shady roadways and in the small coffee plantations.

Farther north the species has not been recorded until much later. Even in the central plateau of Costa Rica, separated by high mountains from the valley of El General, Cherrie (1890) did not notice it until mid-April, although this seems rather late, as on April 29, 1951, I found a nest with eggs near Cartago. In El Salvador it has been recorded as early as March 25 (Dickey and van Rossem, 1938:472). In Guatemala, according to Griscom (1932:316) it "arrives from the south the first week in April, earliest record late March (Dearborn), but [it is] not generally common or singing until April 15." Van Tyne (1935:37) recorded its presence in northern El Petén, Guatemala, on April 5; and Paynter (1955:238) states that the earliest date for neighboring Yucatán, México, is April 3. In southwestern Tamaulipas, Sutton and Pettingill (1942:26) did not encounter it before April 9. During mid-April it became steadily more common until, by the twentieth, it was abundant in this region.

Hence there is an interval of at least two months between the arrival of the Yellow-green Vireo in southern Pacific Costa Rica and its appearance in numbers in the more northerly parts of its breeding range. This suggests that the population inhabiting the Térraba Valley may be racially distinct from that which breeds in more northerly parts of Central America and that the race *V. flavoviridis insulanus*, whose validity has not been generally admitted, may have other than purely morphological grounds for its recognition.

VOICE

Like a number of other migrants, including the Yellow-throated Vireo, the Solitary Vireo, and sometimes also the Red-eyed Vireo, the Yellow-green Vireo probably begins to sing in its winter home, or at least as it travels northward; for when it first appears in El General at the end of January or in early February, it is already singing freely. As the days grow warmer and the air becomes oppressive with the smoke from innumerable fires set to clear fields for sowing, its voice is heard less often. But as soon as the rains of late March or April cleanse and freshen the atmosphere and the polluted sky recovers its blueness, the vireos become songful once more, and as long as they remain in the region they make no small contribution to its avian chorus. As far as I can learn, only the male sings. As a songster he displays persistence rather than irrepresible zeal. His natural endowment is slight but he makes effective use of his gifts. His refrain consists largely of the repetition of a disyllable, interspersed at irregular intervals with a monosyllable. Rarely he seems to add to his basic phrase a shadow of a third syllable which can be heard only when one listens attentively. *Viree, viree, viree, fée, viree, viree, viree*—he sings tirelessly through the bright days of the dry season and well into the rainy and sometimes gloomy months of May and June, and he may be heard occasionally even in August and September.

Yet despite the simplicity of the song, it is rarely monotonous but possesses a peculiar charm all its own. The vireo avoids monotony by varying the tempo, pitch, and sequence of its syllables. When singing most rapidly he utters his phrases at the rate of about one a second and I have counted as many as 66 in a minute. More often he sings at the rate



Fig. 1. Yellow-green Vireo.

of about 30 phrases per minute, but at times his phrases are produced at half this rate or even less. The speed of singing is subject to sudden and unpredictable acceleration or deceleration. There is also the variety produced by changes in pitch, and when least expected the flow of liquid *viree's* is punctuated by an abruptly higher and sharper *fee*. Whereas spendthrift songsters like some of the thrushes require a long rest after each great outburst of music, the vireo spreads his modest notes over much of the day. In many of his characteristics as a songster, the Yellow-green Vireo resembles his close relative the Red-eyed Vireo, but his phrases are shorter. I have never known them to consist of four or five notes as is true of the northern bird. In the opinion of some, these phrases are also "sharper pitched and less musical" (Sturgis, 1928:369), or "drier and more monotonous" (Eisenmann, 1952:49) than those of the Red-eyed Vireo.

I have also heard, chiefly from females, a little rattle or *churr*, sharp and prolonged, and also a high, nasal *chaaa*, which is sometimes used for scolding. When excited or angry, both sexes complain with harsh, rasping, nasal notes. When feeding newly hatched nestlings, one female voiced a soft *churr* that was almost a trill.

FOOD

The male vireo continues to sing while he forages, but the female seeks her food in silence. They hunt steadily through the crowns of trees, flitting from twig to twig and pausing here and there to scrutinize the foliage with bright red eyes. In this manner they glean from the leaves and finer twigs a variety of insects, larvae, and spiders. They supplement their animal food with the green berries of parasitic mistletoes, the little lead-colored fruit of the aguacatillo (*Persea Skutchii*), and small arillate seeds, such as those of *Clusia* and *Alchornea*, each of which is enclosed in a bright red, fleshy covering. I once saw a parent vireo bring a small dragonfly to its nestlings, but I do not know how it managed to catch this fleet-winged insect.

NEST BUILDING

Arriving in El General long before most of the permanently resident passerine birds have begun to nest, the Yellow-green Vireo is in no hurry to build. On March 18, 1937, I found one individual starting a nest, but I have no other record of building before April. Thus an interval of about two months separates the arrival of the vireos and the beginning of nesting. In this long period pairs are somehow formed, but I have not learned how this is accomplished.

Like other members of the family, the Yellow-green Vireo chooses for its nest site a nearly horizontal, V-shaped fork near the end of a slender branch, usually among clustering foliage. This may be in either a bush or a tall tree, in which case it is likely to be one of the lower boughs at the outside of the crown. The tree or shrub which supports the nest may stand in a dooryard, shady or bushy pasture, coffee plantation, second-growth thicket, beside a road, or on the bank of a river. The height above the ground of 24 nests, of which I have records, varied from 5.5 to about 40 feet, but two-thirds of them were from 6 to 12 feet up. The two highest nests, 40 feet up, were not in El General but in other regions; one was near Colomba, Guatemala, and the other near Alajuela, Costa Rica. The highest nest which I found in El General was only 25 feet up. The nest is often well screened by foliage, and the very first which I discovered, in an *Inga* tree in a Guatemalan coffee plantation, was so adequately concealed that I did not notice it until leaf-eating caterpillars had removed much of the foliage which clustered around it.

I have devoted about fourteen hours to watching the construction of three nests without gathering any evidence that the male helps to build. Since at this season he is irrepressibly songful, were he to take a share in the task, his notes would almost certainly betray his sex; in every instance the individual that brought material to the nest was songless. Often the male sang nearby while his silent partner worked. Watching the formation of a vireo's nest is usually a tedious occupation, because there is so little activity. The female builds as her mate sings, and both hunt food in a leisurely, deliberate fashion, as though there were no reason for hurry. At one nest the maximum rate of bringing material was 10 times per hour, and at the other two nests it was 9 times per hour. Usually it was much less than this, sometimes only once or twice in an hour, and there were long intervals when no work was done. At nest 5, the female made 28 trips to the nest in five morning hours. At nest 21, I watched for five hours, including both

forenoon and afternoon, and saw the female bring material only 18 times. At nest 26, material was brought 18 times in 3.5 hours of the morning.

The cupped nest is given its approximate shape while the fabric is still very thin and delicate, a mere outline of the finished structure. This seems to be accomplished by wrapping thin black fungal strands or similar filaments around the supporting arms of the fork and permitting them to hang in a loop between these twigs, thus forming a sort of suspensory for the materials which will be subsequently brought. It was after the nests had already reached this stage that I found them and watched the process of building. From this point onward the female brought small papery leaves of bamboo or grass, fibrous roots of epiphytes plucked from slender branches, and much cobweb, in no regular sequence. Usually she placed these materials while standing above the nest on one of the supporting arms of the fork. As she did this, one of the building females often spread her wings, apparently to balance herself, and sometimes she covered the nest with an expanded wing. Frequently, after placing her latest contribution, the female entered the nest and pressed herself down into it, with bill pointed upward and wings raised above her back, while she shaped the cup with her whole body. As she flew away she often uttered a sharp little *churr*.

Males vary in the attention they pay to their building partners, but much of the time they sing in the vicinity while the females work. Occasionally the male accompanies her on excursions to find material or follows her when she brings it to the nest. One morning, before his mate had started to work, one male went twice to the nest, rested for a few moments on one of the supporting twigs at its side, and quivered his wings while he continued to sing at measured intervals. At times, when he had remained singing in the crown of the nest tree while the female went afield, he hurried down and alighted close beside her as she returned to the nest. He also undertook to guard the nest, driving away such small intruders as a Bellicose Elaenia and a Silver-throated Tanager. But while he and his mate were absent, a Bananaquit came and without opposition stole a blade of grass from the nest, doubtless for incorporation in a dormitory that it was building among the neighboring trees.

A nest which I found soon after it was begun was completed in about six days. Another nest, which seemed to be about half finished when I first noticed it, had a gaping hole torn in its bottom two days later by a Gray-capped Flycatcher who was collecting material for her own bulky structure. When present, the vireos, or one of them singly, easily put the far larger flycatcher to flight. After her nest was so badly damaged, the female vireo seemed to lose interest in it; but after a day or two she resumed work and soon completed it, about five days after I had first found it.

The completed nest of the Yellow-green Vireo closely resembles that of the Red-eyed Vireo. It is a cup or pouch attached by its rim to the arms of a stout, forked branch. One nest which I carefully examined was built of the following materials: On the very outside were black fungal hyphae, fine as horsehair and almost as strong, which were looped over the branches and served to support the structure and to hold all the other constituents in place. The outer wall was composed of papery pieces of grass blades, fragments of dicotyledonous leaves, strips of plant epidermis which were either flat or else curled or crumpled, and bits of white spiders' egg-cases, with a number of conspicuous tufts of green moss on the surface. Next toward the interior came a layer of narrow strips of bark and coarse vegetable fibers. The lining was composed largely of the slender, curved rachises of a compound leaf with minute thorns, probably *Mimosa myriadena*, mixed with which were a few fine fibers. A small amount of cobweb had been used to bind the materials together. The nest was stiff and firm in consistency. Its height was $2\frac{5}{8}$ inches and its outside diameter was the same. The inside diameter at the top was 2 by $1\frac{3}{4}$

inches and its depth was 1½ inches. Some nests lacked the tufts of cobweb or spiders' cocoons on the outer surface, and most, I believe, were without green moss.

THE EGGS

In four instances, four or five days elapsed between the virtual completion of the nest and the deposition of the first egg. In this interval a few additional bits of material may be brought to the structure by the female. Eggs are laid on consecutive days until the set is complete. Fourteen nests contained three eggs or nestlings and five nests contained two eggs or nestlings. In addition to my own records, Carriker (1910:784) found a nest with three eggs at Puntarenas, Costa Rica, on June 8, 1907; and Alfaro (1927:370) stated that in the central plateau of Costa Rica the set of this vireo consisted of three eggs. These eggs are often rather pointed in form, and in color they are white with fine spots of light or dark brown or chocolate disposed in a wreath about the thick end, with often a few scattered over the remaining surface. The measurements of 11 eggs average 20.3 by 14.8 millimeters. Those showing the four extremes measured 22.2 by 15.1, 19.8 by 15.9, 19.1 by 14.3, and 20.2 by 13.9 millimeters.

In 19 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: March, 1; April, 7; May, 10; June, 1. In addition to these, I have records of a nest with eggs near Cartago, Costa Rica, at about 4500 feet, on April 29, one with nestlings above Turrialba at 2800 feet on June 15, and one with nestlings near Alajuela at about 3500 feet on July 7. Near Colomba, at about 3000 feet on the Pacific slope of Guatemala, I found a nest with eggs on July 18 and one with nestlings on July 26. Here breeding continues later than in El General.

INCUBATION

Incubation is performed by the female alone. I have spent 18 hours watching four nests without ever seeing the male, who might be recognized by his persistent singing, sit on the eggs. Although antbirds, whose nests are usually hung in a crotch much like those of vireos, commonly sit facing out from the fork, Yellow-green Vireos in my experience always sit facing inward, with their heads toward the base of the supporting branch. Since the nest is often somewhat lower on the outer side, this means that the female usually incubates and broods with her head uphill. At nest 4, which I watched for six hours, the female's 9 sessions ranged from 15 to 61 minutes and averaged 28.1 minutes; her 10 recesses varied from 6 to 18 and averaged 8.5 minutes. At nest 14, which I watched for three hours, the vireo's 4 sessions ranged from 9 to 40 minutes and averaged 26.0 minutes; her 4 recesses varied from 11 to 21 and averaged 16.0 minutes. At nest 21, also watched for three hours, the 3 sessions fluctuated from 27 to 36 minutes and averaged 33.0 minutes; the 5 recesses ranged from 9 to 14 and averaged 10.6 minutes. At nest 23, for which I have a six-hour record, the 4 sessions varied from 40 to 56 and averaged 49.3 minutes; the 5 recesses ranged from 10 to 55 and averaged 24.2 minutes. Summarizing these data, one may say that by day Yellow-green Vireos rarely cover their eggs for less than 15 minutes at a stretch nor for more than an hour and that their sessions are usually from one-half to three-quarters of an hour in length. Their absences usually last from 5 to 20 minutes, but they are occasionally much longer. These four females, in the order mentioned, kept their eggs covered for 76.8, 61.9, 75.7 and 67.1 per cent of the observation periods. The first, who sat most constantly, was watched on a cloudy, drizzly morning, the others in dry weather.

On returning from an excursion, the female vireo does not as a rule fly directly to her nest but alights at a point nearer the center of the supporting tree and makes her way to it by hopping and flitting from branch to branch. Often she utters a nasal *cha* or

perhaps a sharp little rattle as she approaches her eggs. Usually she sits in silence, never singing as female vireos of some species have been reported to do; occasionally, especially if she hears her mate singing close at hand, she voices her sharp rattle. As she flies from the nest at the end of her session, she nearly always delivers the sharp rattling call. All four of the females which I watched gave this note as they left their eggs, but some did so more consistently than others. As a rule, the female Yellow-green Vireo sits rather steadfastly when a human approaches, and she may remain on her eggs while one stands beneath her, even if the nest is low. However, I have never been able to touch one of these vireos on the nest, as frequently can be done with other species of this family.

If finally driven off, the female Yellow-green Vireo rises to a higher bough and scolds with an oft-repeated nasal *chaa*, and at the same time she may fan out her tail and raise the feathers of her crown in an excited attitude. Often the male, attracted by her complaints, flies up and adds his protests to hers.

Hummingbirds of a number of kinds, and possibly all of them, continue during the course of incubation to bring to their nest a variety of materials, including much cobweb, which serves to bind the nest together and strengthen its attachment to the supporting twigs or leaf. Similarly, Red-eyed Vireos bring much adhesive material not only while they incubate but at times even while they have young in the nest; Lawrence (1953:56) saw one female fetch cobweb eight times in ten minutes, on the ninth day of incubation. Yellow-green Vireos less frequently take this precaution, and because of their failure to pay sufficient attention to the attachment of their nests, these sometimes break away from the fork on one side or on both and either lean precariously or else fall to the ground. I have on several occasions averted disaster by fastening the nest's rim to the arms of the fork with thread or string. At one only of the four nests did I see the female make an effort to strengthen her fastenings in the course of incubation, and she brought material only twice in a morning. On these occasions she arrived with a skein of white cocoon silk in her bill. Standing at the base of the fork in which the nest hung, she spread the silk over the places where the nest was attached to the fork, first on one side of the bowl and then on the other. She then pulled the skein out into long, white strands which she looped over the supporting twigs so that the silk made contact with both the outer and the inner surfaces of the nest. This action was continued alternately on the two arms of the fork until most of the generous skein had been used up. However, some still stuck to her bill after she had settled down to incubate, facing inward as usual, and she wiped this onto the rim of the nest in front of her. Unlike some other nests, this one remained firmly attached to the tree until the nestlings left it.

Late in the morning while I watched her incubate, this female vireo returned from her recess with a small object in her bill, uttering her nasal *chaa*. Standing on the rim of her nest, she looked attentively down into the cup, turning her head from side to side. Then she swallowed the morsel and resumed incubation. She evidently had brought this food in anticipation of the needs of her nestlings, which did not hatch until eight days later.

The female of nest 4 ate many berries, especially those of mistletoes, indigestible seeds of which she regurgitated at short intervals while sitting on her eggs. These came up surrounded by a colorless, extremely viscous mucilage which caused them to adhere to her bill, so that she could not drop them to the ground. Accordingly, she was obliged to wipe them onto a branch beside the nest to get rid of them. She always sat in the same position, facing the crotch formed by the two branches which supported the nest, and she always attached the seeds to the branch on her left, with the result that a conspicuous mass of them accumulated there. As she stuck another seed on the mass and withdrew her head, a string of mucilage would frequently pull out between her bill and the seed.

The newly attached seeds would sometimes slip down over the older ones and remain attached to the under side of the lowest, thus forming short, bead-like chains. It might be noted that whereas this vireo regurgitates mistletoe seeds, the seeds pass entirely through the alimentary tract of euphonias and retain all their adhesive property when voided.

The ever-growing mass of seeds seemed to annoy the vireo and she tried hard to keep it small. Frequently, while sitting, she plucked off the seeds in her bill, whence she was able to drop many of the older ones on which the gum had dried. Others clung so stubbornly to her bill that she was forced to stick them on the mass again in order to free herself of the encumbrance. At times she ate seeds which she had already attached to the mass, and at other times she promptly swallowed again seeds which had just slipped up into her mouth. On leaving the nest for a recess she almost always carried away a seed, either one which she had regurgitated and still held in her bill, or one which she plucked from the branch beside the nest at the moment of taking wing. Not infrequently she made special trips to the nest for the purpose of carrying away seeds. On these visits she usually plucked a single seed from the cluster and flew off with it, but on one occasion she swallowed one seed and carried a second in her bill. In the course of a single recess from incubation she made four visits to the nest and carried away five seeds.

The viscous substance which surrounded the seeds appeared to be somewhat attractive to insects, and I saw the vireo, while sitting on her eggs, eat two flies or small wasps which had stuck to the cluster. Thus there was a certain advantage in the presence of this mass of gummy seeds, for it brought food directly to the bird's mouth as she warmed her eggs.

The mates of these four vireos varied greatly in attentiveness to their incubating partners. The male of nest 4, where the female had so much trouble with the mistletoe seeds, sometimes sang in the distance, but he did not visit the nest tree once in the course of the morning. The male of nest 23 not only did not visit the nest, but he stayed so far away that I heard his song only once, for three minutes, in the six hours that I watched. But the male of nest 21 came four times in three hours, near the end of the incubation period, to examine the eggs. He remained beside the nest for a few seconds on each visit and he usually sang while there. If he did not sing while actually at the nest, he did so just before his arrival and soon after his departure. On another occasion, he alighted momentarily beside his mate as she settled on her eggs. This male spent much time in the nest tree and in surrounding trees and chased away small trespassers, including Blue Tanagers and Song Tanagers, both much larger than himself.

Most interesting was the behavior of the male at nest 14. This nest was situated above my reach in a spreading sotocaballo (*Pithecolobium*) tree beside a river. The male sang incessantly in the boughs of this tree while his mate attended her eggs. From time to time he went to look into the nest. As his partner returned from a recess to resume incubation, he would hurry up to the nest and stand beside it for a moment. This action, performed three times in as many hours, seemed an act of courtesy or formality, comparable to the custom of certain male flycatchers and tanagers of accompanying their mates to the doorway of the closed nest as they return to their eggs. Once the male vireo went to the nest while his partner was nearby but not yet ready to resume sitting. She came at once to stand beside the nest, too, for a moment; then both flew off again. These visits of the male to the nest kept him informed on what was happening there. As we shall see in the following section, the greater the attentiveness of the male during the period of incubation, the more promptly he begins to take care of the nestlings.

At two nests the incubation period was 14 days and at one it was 13 days.

THE NESTLINGS

First morning.—Nest 14 in the sotacaballo tree beside the river was so high that even with a mirror I could not see its contents, but I had the good fortune to be present while one of the eggs hatched. I began to watch at 7:25 a. m. on May 17, 1940, and seven minutes later the female, who was sitting when I arrived, left the nest carrying the cap of an empty shell. At 7:49 the male went to look into the nest, as he had done so often in the days before the eggs hatched, and perhaps he then first became aware that a nestling had emerged. At 8:07 he brought food to it. At 8:10 the female carried away the larger part of an empty shell. Through the remainder of the hour, both parents continued to feed the young, and the female spent much time brooding. Unfortunately, I cannot tell how soon the male began to bring food after the first nestling hatched. However, since the eggs of Yellow-green Vireos seem to hatch fairly close together, it appears that the male attends the nestlings fairly promptly.

At nest 21, which was only 10 feet up in a guava tree in front of a window, I followed in more detail the events attending the hatching of the eggs. At 2:15 p. m. on May 8, 1943, all three of the eggs in this nest were slightly pipped. At 4:00, just as a hard shower began to fall, I started to watch from the window. The female was then in the nest and she sat continuously until nightfall, rising only from time to time to look down at her eggs. She did not take advantage of a lull in the downpour to go in search of food, and soon the rain grew harder and fell steadily until nightfall. In the interval of lighter rainfall I heard the male singing in the distance, but he did not approach the nest during the last two hours of daylight.

At break of day I resumed my vigil at the window. At 5:18 a. m. when I could barely distinguish the head of the female sitting in her nest, I heard the male singing on the other side of the house. At 5:30 the female rose up and looked down at her eggs. At 5:32 the male was singing in a neighboring tree and she called sharply to him, but he went on with his chanting as though he had not heard. Eight minutes later she again called while he sang nearby. At 5:52 she left the nest for the first time that morning and flew with a sharp rattle to her mate, who was still singing in the next tree. A minute later he went, singing, to alight on the supporting branch a few inches from the nest, but apparently he did not look into it. At 6:02 the female returned, stood on the rim, looked in and repeatedly pushed her bill down into the bowl, at the same time mincingly opening and closing her mandibles. After continuing this for a minute, she settled down to brood while her mate sang close by. She sat very unsteadily, frequently rising up to look beneath herself, then snuggling down again. At 6:10 she flew away with a piece of shell, thereby incidentally informing me that an egg had hatched.

Four minutes later she returned with a tiny particle of food grasped in the tip of her bill, and standing on the rim she offered it to the newly hatched nestling several times before it vanished. As she presented the morsel she voiced a long-drawn *churr*, softer than any note I had hitherto heard from her—almost a trill. After delivering the food, she carried away the large part of an empty shell, then returned and again stood on the rim, lowered her head into the bowl and made swallowing movements, after which she settled down to brood. But ten minutes later she picked up the large part of another egg shell and carried it off, voicing her usual departure note. At least two eggs had now hatched.

When she returned two minutes later, her mate followed and perched close beside the nest but did not look in. He went off, singing, while she appeared to feed a nestling, and she then resumed brooding. She brought food and brooded once more while the male, in spite of his close approaches to the nest, continued to sing in the neighboring trees as though ignorant of the important changes that had occurred there. At 6:54 a. m. the

female left the nest and flew toward him, uttering her usual sharp rattle. A minute later both parents flew together to the nest. The female appeared to feed a nestling while her partner perched close beside her, the feathers of his crown standing almost upright. The female then departed, while the male delayed beside the nest a few seconds longer and then flew off. In the next two minutes the nestlings were fed twice by a parent which may have been either the male or the female, since it neither sang nor brooded. But at 6:59 the male brought food and sang a few notes while he tried to deliver it to a nestling. While he was engaged in this attempt, the female came and perched beside him. He passed the particle to her, and after giving it to a nestling she resumed brooding. The male flew away.

Thus the male vireo first brought food to the nestlings between 47 and 49 minutes after the female removed the first piece of empty shell, and from 43 to 45 minutes after she brought their first meal. Possibly the female had tried to inform him of the hatching by the somewhat trilled note which she uttered as she offered the first morsel to the nestling—a note which I had not heard previously. But I think this is improbable, first because the male did not respond to the note as though it had conveyed definite information to him, and second because I continued to hear this near-trill, expressive of maternal feeling, even after the male was bringing food regularly. The male gave no indication of knowing that nestlings had hatched until, at 6:55 a. m., he saw them with his own eyes, on a visit of inspection to the nest such as he had been in the habit of making during the period of incubation. Possibly the novel activities of his partner, the new sounds she uttered, the sight of particles of food or of an egg shell in her bill, or her more frequent coming and going, stimulated his curiosity and caused him to visit the nest more often than he had previously. This, indirectly, may have hastened his discovery of the nestlings. That the male failed to note the hatching of the eggs on his first approach to the nest indicates that visits of inspection, like other activities of animals, often degenerate into carelessly performed formalities. Yet the prompt bringing of food by both of the male vireos, who had from time to time visited their nests in the period of incubation, demonstrates the value of such periodic inspections.

At 8:23 a. m. the female carried off both parts of the third shell. Since she appeared to remove the shells very soon after the chicks escaped from them, we may infer from this indication that the first egg hatched at about 6:10, the last at 8:23, and the hatching of the set of three eggs was spread over a period of about $2\frac{1}{4}$ hours. In the two hours immediately following his discovery of the nestlings, the male brought food 14 times, the female eight times, and there were two more feedings by a parent whose sex I could not tell with certainty, although it seemed to be the female. She invariably brought very tiny particles; the male sometimes brought green larvae of fair size. The nestlings appeared to be receiving all the food that they could eat, and at times the female swallowed some of the surplus which her partner brought to her at the nest. There was none of the long, patient coaxing of the nestlings to take food that I have seen at other nests with newly hatched chicks—those of the Orange-billed Nightingale-Thrush and the Streaked Saltator, for example. The nestling vireos, which I could not see, usually seemed eager for their nourishment, and when they were full, the female ate the excess.

In the three hours from 6:02 to 9:02 a.m. the female brooded the newly hatched nestlings for 13 periods ranging from 3 to 23 minutes in length and totalling 126 minutes. Her 12 absences varied from 1 to 9 minutes and totalled 54 minutes. As she left the nest, she customarily uttered the rattling note which I had so often heard in the same circumstances before her eggs hatched. The male often sang as he came with food in his bill, and while at the nest he always stood with his head held high and its feathers more or less erected, in what seemed a strained, self-conscious posture.

Older nestlings.—I was eager to learn whether the male of nest 23, who had been so neglectful while his mate incubated, would help to feed the nestlings. Accordingly, I watched for 3½ hours in the morning when the young were five days old. Although in this period the three young were fed 34 times, I identified the male as the bearer of food only three times. Twice he came with an insect while his mate was brooding and she flew off so that he might give the food directly to the young. Once the two parents stood side by side to feed the young. Since the male did not sing on all of the visits when he was positively identified, it is probable that he brought more food than I noted. Yet he could not have been attending the nestlings regularly or he would have come more than twice in the 84 minutes which the female devoted to brooding. In fact, he visited the nest so infrequently that, after 2¼ hours of watching, I had nearly decided that he was ignoring his offspring, when at last he came songfully with food for them. In the 3½ hours the female brooded for 10 periods ranging from 1 to 13 and totalling 84 minutes. Her 10 absences varied from 5 to 27 minutes and totalled 126 minutes. Probably she would have covered her still naked nestlings more constantly if her partner had brought more food for them.

In order to survey the full range of the variation in the males' service to the nestlings, we must return to nest 4. It was at this nest that the female had so much trouble with the mistletoe seeds and was so neglected while she incubated. On June 12, 1936, when the two nestlings were respectively two and three days old, I watched for three hours in the morning when rain was falling either in light drizzles or harder showers. The female alone attended the young, without a visit from her mate. She fed the young 19 times, giving them chiefly insects. These insects were usually fairly large ones, such as green tree crickets, which the female delivered to the young with filmy wings and long antennae still attached. Such large insects were almost more than the tiny chicks could swallow, and the mother bird often found it necessary to place them several times in the mouths upstretched before her, until finally they were gulped down. The female also brought a fat, green larva, which the nestlings likewise had difficulty in swallowing, and a black, winged insect that resembled a wasp. She was a skillful forager and, within two or three minutes after leaving the nest, she often returned with something substantial for her family. Probably in the same brief excursion she also had found enough to satisfy her own hunger. She fed her nestlings so adequately that, by the middle of the morning, they failed to take what she brought to them, and she swallowed it herself. Her efficient foraging left her much time for brooding the naked nestlings, which seemed very necessary on this cold, wet morning. Her 12 periods of brooding ranged from 4 to 17 minutes and totalled 104 minutes, while her 13 absences varied from 2 to 8 and totalled 56 minutes. This does not include one session and one absence which I failed to time when my attention was diverted by the unusual incident related beyond.

This female vireo continued to eat many mistletoe berries and to regurgitate the sticky seeds while sitting in her nest. The cluster of regurgitated seeds on the twig beside her grew considerably after the eggs hatched, because the vireo was too busy caring for the nestlings to devote much time to reducing the accumulation. Occasionally when she left the nest she plucked a seed from the mass and carried it away. The cluster now formed a large swelling on the twig and appeared to contain hundreds of seeds. No other vireo that I have observed, nor any other species of bird, ever had such a "midden" heap beside her nest. The other vireos that I watched were not plagued with mistletoe seeds, probably because they ate fewer of the berries.

Once when this vireo returned to her nest she was followed by a second vireo. After giving the nestlings the food which she had brought them, she flew away, whereupon the visitor alighted on the nest's rim, uttered a few low notes, then hurried off in pursuit of

the female. Soon she returned, fed one of the nestlings, and resumed brooding. Then the stranger, who had followed her closely, perched on the supporting branch and turned to face her. From the redness of his eyes, more intense than that of the female, I inferred that he was a male. The conspicuous yellow corners of his mouth and his somewhat duller plumage showed that he was young, doubtless having hatched earlier in the same season. On his perch, almost within bill's reach of the nest, he swayed from side to side, at the same time opening his mouth wide, as though pleading for food, and emitting low, weak notes. Then he began to utter typical vireo song notes, clear but disjointed. The female seemed to disapprove of this conduct, for she opened her mouth threateningly toward him. However, he continued the queer performance for several minutes, until the female picked a mistletoe seed from the cluster beside the nest and flew away with it, with the intruder in close pursuit. For a long time no explanation of the young male's strange antics occurred to me; but after reading Tyler's description of the courtship behavior of the Red-eyed Vireo (Bent, 1950:335), in which the swaying from side to side was a conspicuous feature, it seemed probable that the stranger at the nest was actually courting the brooding female. Doubtless he would not have dared to take such liberties if the mate of the female had been guarding and attending the nestlings. Although I heard in the distance a song which I took to be that of the male parent, I did not once see him from the blind.

Four days later, on June 16 when the nestlings were six and seven days old, I again watched this nest with the mistletoe seeds beside it, to learn whether the male parent had at last begun to attend it. But again I failed to see him near the nest, although I heard in the distance a song which I surmised was his. As I had noted previously, the female alone fed and brooded the two nestlings. Now she had added berries to the young's diet of insects, and she fed the young 14 times in her first two active hours of the morning (5:38 to 7:42). In this period she brooded 9 times, from 3 to 11 minutes at a sitting and kept the still naked nestlings covered a total of 70 minutes. Her 9 absences varied from 2 to 11 minutes in length and totalled 54 minutes. Of the seven nests containing nestlings which I watched for a half hour or more, this was the only one to which the male did not come at least occasionally with food.

Development of the nestlings.—When newly hatched, the nestlings have tightly closed eyes and the interior of the mouth is yellow or orange-yellow. Their pink skin appears at first sight to be wholly naked, but close scrutiny in a good light reveals a few scattered tufts of very short, fine down on the top of the head, the back, and wings. The young have far less down than most nestling passerines and apparently have less even than young Red-eyed Vireos. Herrick (1905:103) states that young Red-eyed Vireos have "a sprinkling of light down on their heads and backs," and Lawrence (1953:67) reports that when newly hatched they have "a sparse covering of greyish natal down on the back, shoulders and head."

When Yellow-green Vireos are four days old, pinfeathers are pushing out on their shoulders and the middle of their backs, but the future remiges are the most advanced of all. The head is still quite naked and the eyes remain tightly closed. On the fifth day the lids begin to part, and when the nestlings are a week old their eyes are almost fully open. At this age the feathers begin to escape from their sheaths. When the nestlings are eight or nine days old, their bodies are nearly clothed with plumage, although their heads are still almost naked. At ten days of age their bodies are well covered. In the first plumage the young rather closely resemble their parents, but they lack the dark margins which border the adult's gray crown. Their eyes are brown rather than red.

Termination of brooding.—At nest 7 a single nestling was brooded by night until it was 11 days old, but it slept alone on the twelfth night, which was its last in the nest. At

nest 21, in the guava tree in front of my window, which will henceforth largely engage our attention, the female last brooded the three nestlings on the night preceding the morning on which they completed their ninth day. The young then spent three nights alone in the nest before their departure. I did not see the female brood the young during the showers which fell in the afternoon when they were a little more than ten days old. The following afternoon, when it rained long and hard, she covered them for only six or seven minutes, straddling the nest from rim to rim and forming a roof over her young rather than actually brooding them. Perhaps this early cessation of brooding was caused by the fact that when ten days old, the three nestlings already quite filled the nest and left no room in it for the female.

Final afternoon in the nest.—At 1:35 in the afternoon of May 20, when these three nestlings were a little over 11 days old and were well feathered, I began to watch them continuously, for they were becoming restless and I wished to witness their exit from the nest. They preened their plumage vigorously, and sometimes one nibbled the feathers of another's throat. Usually two were down in the cup, while the third occupied the place on top and seemed to be brooding the others, whose heads stuck out from beneath its breast. The young vireos were restless, pushing around and continuing to change their positions—a process which was accelerated when all stretched high above the nest's rim to receive food brought by the parents. When they could free their wings of the encumbrance of their nest mates, they beat them vigorously above their backs. They continually repeated a weak, whining note, but the arrival of a parent bearing food changed these widely spaced monosyllables to a shrill, high-pitched chorus. After one of the young had received the morsel and the parent had gone, cries ceased, mouths gradually closed and necks sank down; preening and wing exercises were resumed. Sometimes a gust of wind, making the long bough sway as though a parent had alighted on it, caused the nestlings to stretch up in expectation of food when none was in sight.

Now the nestlings sometimes dropped their white fecal sacs directly over the nest's rim, letting them fall to the ground. But more often they were delivered to a parent to be carried away, either in the bill or after being swallowed.

When I began to watch in the early afternoon, the sun was shining brightly, but great clouds were gathering in the east. Soon rain began to fall. When the first drops struck the young, they huddled down in their nest until they almost succeeded in making it contain them. The female arrived among the neighboring boughs and flitted back and forth voicing her nasal *chaa*. She seemed to be debating with herself whether she should brood her chicks, but she decided in the negative and departed. However, when the rain grew harder, she returned and formed a roof over the young by straddling the nest from side to side. But this posture seemed too uncomfortable to be maintained for long, and after a few minutes she went off. Even after her departure, the nestlings were not wholly without protection through the slow, steady rain that succeeded the violent downpour. At least, they did not all remain unbrooded, for the two down in the cup were covered by the third which, finding no room there, had perforce to remain on top. This one received most of the rain, while its nest mates snuggled down beneath its breast and seemed cozy and contented. A position on top, where they could preen freely and flap their wings, was that sought in fine weather; but down in the bottom, snug and dry, was the preferred place now. The parents continued to bring food through all but the hardest rain, and the nestlings stretched up for it just as eagerly as in fair weather. When, after much pushing and shifting, all were comfortably settled once more, a different nestling might be on top to take the rain. Thus the young vireos brooded each other by turns through the wet afternoon.

At last the rain settled into a long, slow drizzle; and the nestlings, growing bored with

crouching in the nest, resumed their former activity of preening, stretching, and beating their wings. They appeared to have grown even during the rainstorm. The two in the cup bulged so high above its rim that the one on top seemed at times to be in grave peril of falling off. Whenever those in the bottom grew restless and rose up, it had even greater difficulty in holding on. Finally, to ease its precarious situation, the topmost nestling boldly stood upright on the rim; this was the first time I saw this. Here, facing inward, with its stubby tail over the edge, it perched like a full-fledged bird while it preened its breast and rump and passed its outer wing plumes through its bill from end to end. In this advantageous situation it of course received the next meal. After ten minutes of perching it tried to rejoin its nest mates in the cup, but it was clumsy and slipped down to a neighboring twig, an inch or so below the rim—its first venture into the outer world, I believe. Another determined effort, and it was back on top of its nest mates. Soon, through the constant shuffling about, it was safely down in the nest with another above it.

In four hours the parents brought food 49 times, but not at a uniform rate, for in one of these hours they fed 17 times and in another only 9 times. Since the male seldom sang, I could not always distinguish the members of the pair and so could not keep a separate account for each. The nestlings' food consisted of a great variety of insects, with occasional berries and the red arillate seeds of *Clusia*. Green caterpillars were often brought. Several berries or other small articles were carried at once in the mouth of the parent bird. Several times a particle of food dropped as it was being passed from the bill of a parent to the mouth of a nestling, and then, quick as a flash, the parent dived down and caught the falling food before it was lost in the long grass below the nest.

As it grew dark the parents vanished; and the nestlings, shrinking into the cup as low as they could, slept alone through the rainless, brightly moonlit night.

Departure from the nest.—As the night ended, I resumed my station at the window to witness the departure of the young vireos. Until the arrival of their first meal at 5:21 a.m., they continued to lie quietly in the nest, in the attitudes they had maintained through the night. Soon the parents were bringing food at a rapid rate and the youngsters became noisy and active, stretching their wings, shifting their positions, and often preening. Just at sunrise a nestling perched on the rim facing outward and billed its plumage vigorously. Two minutes later another youngster hopped up to the rim, whereupon the first dropped down inside the nest. At 6:11 the vireo on the rim flew to a neighboring twig, possibly a foot away. The other two then stood on the rim, preening and calling in weak, squeaky voices. They were now so full that they accepted their food sluggishly. By 6:21 the fledgling that had left first was a yard away and another was on a twig close beside the nest. By 6:35 the first had made its way by easy stages to a point two yards from the nest and the last was working along the supporting branch from the nest toward the center of the tree. The nest was deserted.

A few minutes later the female came to the empty nest with a green insect in her bill. She looked in, uttered nasal notes and low, questioning sounds, seemed puzzled and continued to scrutinize the nest, although two of her fledglings were calling only a foot away. She flew up to higher branches, then returned to the nest with the insect. Once more she left the nest and came back to it. Finally she took the food to the fledgling who had gone the greatest distance. When she came next, this time bringing a red *Clusia* seed, she again proceeded to the nest before taking it to one of the young nearby. Not only did the parents do nothing to encourage the departure of the nestlings, they appeared perplexed when they found that their offspring had ventured forth. By going repeatedly to the empty nest with food, the female appeared to be trying to entice the young to return to it, although her behavior at this juncture might be interpreted as due

to habit or perplexity rather than the pursuit of a definite purpose. It was clear, however, that in this as in nearly all other instances when, from concealment, I have witnessed the departure of fledglings from their nest, they have left spontaneously, in obedience to the prompting of their own waxing strength, not in response to parental solicitations.

By seven o'clock the fledglings had scattered so widely that I could no longer keep them all in view from the window. They had been fed 34 times by both parents in one and a half hours. Going outside, I found that one had already reached the crown of a neighboring tree, having flown across the intervening gap of at least six feet. All day the young called and were fed in the trees that surrounded the house. In the evening they did not return to their nest but roosted amid the foliage.

These three nestlings left their nest when almost exactly 12 days old. From other nests, one young left at 12 days, three left at 13 days, and one left at 14 days of age.

In her study of the Red-eyed Vireo in Ontario, Canada, Lawrence (1953) found that nest building required 4 or 5 days, an interval of a few hours to 4 days separated the completion of the nest and the laying of the first egg, 3 or 4 days were required to lay as many eggs, incubation took 12 to 14 days, and the young remained in the nest 10 or 11 days. In the Yellow-green Vireo building takes about 6 days, 4 or 5 days elapse before laying begins, 2 or 3 days are required to deposit the 2 or 3 eggs, incubation occupies 13 or 14 days, and the nestling period is 12 to 14 days. Thus, in the Red-eyed Vireo, the interval from the beginning of building to the departure of the young is 29 days if we allow the minimum time for each separate phase of the nesting operations and 38 days if we allow the maximum time. The mean between these extremes is 33.5 days. The corresponding figures for the Yellow-green Vireo are: minimum, 37; maximum, 42; and mean, 39.5 days. Thus the tropical species takes about 6 days longer to complete its nesting than the closely related northern species. Most of the difference is accounted for by the shorter nestling period of the Red-eyed Vireo, although the interval between the completion of the nest and the start of laying is also much shorter in the northern bird. A comparison of the Southern House Wren with the Northern House Wren reveals a similar acceleration of the reproductive process in the migratory northern species (Skutch, 1953c: 145). In other families, such as the Wood Warblers, the difference in the time required for producing a brood by the northern migratory and tropical resident species may be even greater (Skutch, 1954a: 385). Only in the case of these vireos, however, are data available which permit a comparison between a *migratory* species which nests in the tropics and a closely related migratory species that breeds at high latitudes. To realize the full magnitude of the acceleration in the reproductive activities of the Red-eyed Vireo as compared with the Yellow-green Vireo, we must also take into account the interval between the arrival of the first males on the nesting ground and the start of building by the females. In the northern species this interval is about two or three weeks (Lawrence, 1953), whereas in the Yellow-green Vireo, in El General, it is about two months. Like the Red-eyed Vireos in Canada, the Yellow-green Vireos seem to rear a single brood, at least in El General.

ENEMIES

At nest 14 in the sotacaballo tree, where the male brought food so soon after the young hatched, some misfortune befell the latter when they were but a day or two old. I could not see the contents of this high nest, but, by looking closely through my field glasses, I could distinguish small ants filing in numbers along the branch which supported it. Hence I concluded that they had attacked the nestlings, an event I have observed many times in the lower nests of other species. From time to time the female

came and, standing beside the nest, plucked from it in quick succession many small objects invisible to me, which were doubtless ants. Then she would fly away uttering her sharp rattle. Once the male came with an insect in his bill, singing as was his custom, and stood for a few moments above the nest. Finally he carried the insect to a neighboring bough, swallowed it, and went on singing as before. In the course of an hour the nestlings were neither fed nor brooded, whence I inferred that they were dead. Parent birds not infrequently continue to bring food to a nest in which the young have died or from which they have been taken by a predator; I have witnessed such behavior in the Collared Trogon, Citreoline Trogon, Golden-naped Woodpecker, Golden-masked Tanager, and Yellow-rumped Cacique.

This vireo was in the valley of the Río Pacuar on the southern side of the basin of El General, where in 1940 I had found snakes of many kinds exceedingly abundant. One morning when I revisited a vireos' nest which a few days earlier had contained two nestlings beginning to be feathered, I found the parents greatly excited and uttering harsh, rasping, nasal scolds. Scrutiny of the neighboring boughs failed to disclose the expected serpent, but when I finally looked down, I saw it in the grass almost at my feet. It was a small green tree snake, and in its distended mouth it held a nestling, already dead. The second nestling crouched unhurt amid the herbage, and I replaced it in the nest. Then I noticed a second snake, brown, and much longer than the first, creeping through the bushes below the nest tree. Apparently, attracted by the commotion, it had come to share the feast, which might well have included the smaller green snake.

In addition to the nests pillaged by snakes, it is probable that many are plundered by Swainson Toucans, Fiery-billed Araçaris and Swallow-tailed Kites, all of which I have repeatedly seen remove eggs or young from nests in the clearings where the Yellow-green Vireos build. Because the nests of the vireos are at the ends of boughs, they are especially vulnerable to the kites, for these predators seem to pluck their victims from nests which they can reach while hovering on their broad pinions.

On the Pacific slope of Guatemala, I was shown, on July 25, 1935, a nest containing three nestlings of the Yellow-green Vireo and one of the Red-eyed Cowbird. This was brought to me by a laborer who had misunderstood my request that he lead me to see any nests he might find while working in the coffee plantation. Although I promptly tied it up in the position from which it had come, the parents did not return to attend this mixed family, and the next morning all four nestlings were dead.

DEPARTURE FROM CENTRAL AMERICA

By mid-June most pairs of vireos have brought forth the single brood which they appear to raise in El General. The males sing much less at this time than in March, April and May, although a bright morning may call forth snatches of song in July and August, or even in September. After they cease to sing freely, they are not easy to detect amid the abundant foliage of the trees. In August or September they leave for the south, and I have not seen a Yellow-green Vireo here after September 14. My latest dates for their presence in other parts of Costa Rica are September 27, 1935, when I saw one at San Miguel de Desamparados in the central plateau, and September 28, 1947, when I met one at Piedras Blancas in the Golfo Dulce region of the Pacific lowlands. Cherrie (1890) gave September 29 as the latest date for this vireo's presence at San José. From other parts of Central America and southern México the species appears to withdraw at about the same time. For the Yucatán Peninsula the latest record of its presence is October 3 (Paynter, 1955:238), and for El Petén, Guatemala, the latest date is September 30 (Van Tyne, 1935:37). Griscom (1932:316) states that it is not known to occur in Guatemala after October 1. On a coffee plantation near Colomba, on the

Pacific slope of Guatemala, where in June and July the shade trees were full of Yellow-green Vireos, I found none at the end of September and none in December. The Yellow-green Vireos go southward at the same time that the Red-eyed Vireos from far in the north are passing through Central America on their way to the southern continent.

SUMMARY

The Yellow-green Vireo is one of the very few birds, and apparently the only song-bird, which nests in Central America and then migrates southward. It breeds throughout the length of Central America, chiefly in the Pacific lowlands and into the interior up to about 5000 feet, and it is rare in the Caribbean littoral. It inhabits open country with scattered trees, shady plantations and dooryards, bushy pastures, and the woodland's edge, but it avoids heavy forest.

On its northward migration from its winter home in South America, it reaches the Térraba Valley of Costa Rica about the beginning of February (extreme dates for first arrival, January 26 and February 14), but farther north it has not been recorded until much later, namely, about the beginning of April in Guatemala.

In El General, Costa Rica, males sing as soon as they arrive, and, during the period of their sojourn, they are among the most songful birds of the region. By varying the tempo and pitch of their notes, they achieve a variety of song despite its simplicity. Females seem not to sing.

These vireos subsist largely on adult and larval insects which they glean from the foliage of trees. They also eat a variety of small fruits and arillate seeds.

In El General one nest was begun in mid-March but building does not become widespread until after the first of April, about two months after the arrival of the earliest migrants. The deeply cupped nest is attached by its rim to the arms of a branch of a bush or tree forked in the horizontal plane. The nest may be from 5½ to 40 feet above the ground, in recorded instances, but it is usually from 6 to 12 feet up. The female builds without help from the male, who, however, may attend her closely. She works at a leisurely pace and 10 visits with material per hour was the maximum activity observed in about 14 hours of observation. One nest was completed in approximately six days. The cobweb and silk which help to attach the nest to its supports is sometimes replenished during incubation, but this was observed at only one nest, to which the female brought silk twice in six hours.

Laying begins four or five days after the virtual completion of the nest, and an egg is deposited daily until the set of three, or less often two, white, sparingly spotted eggs is completed.

Only the female incubates, sitting with her head toward the fork of the supporting branch. Four females, watched for a total of 18 hours, took sessions usually between 15 and 60 minutes in length, while most of their recesses lasted from 6 to 20 minutes. They kept their eggs covered from 62 to 77 per cent of the observation periods.

One female had great trouble in ridding herself of the adhesive seeds of mistletoes which she regurgitated while she incubated, and a great knot of them accumulated on a twig beside her nest. During her recesses she made special trips to carry away some of these seeds. Another female brought food to the nest, evidently anticipating the nestlings, eight days before her eggs hatched. Some males escort the female as she returns to the nest or make occasional visits of inspection to it, while others are most neglectful.

The incubation period was 14 days at two nests and 13 days at one nest.

The nestlings are brooded by the female and as a rule are fed by both parents. At six of the seven nests, which were studied at this period, the males brought food, but some males were much more assiduous than others. One male, who frequently inspected

the eggs in the incubation period, first fed the nestlings about 48 minutes after the female removed the first piece of empty shell and about 44 minutes after she first brought food. Nestlings three to seven days old were fed at rates varying from 2.7 to 3.5 times per capita per hour. Young 11 days old were fed at the rate of 4.1 times per capita per hour on a wet afternoon, and next morning, while they were leaving the nest, the three of them were fed 39 times in 1.5 hours, or at the rate of 8.7 times each per hour. A parent with three nestlings brooded by night until the young birds were 9 days old, but another female brooded a single nestling by night until it was 11 days old.

Newly hatched nestlings have pink skin with such minute traces of down that they appear to be quite naked. The interior of the mouth is yellow or orange-yellow. When 10 days old they are covered with plumage. Their eyes are then brown rather than red as in the adults. The nestling period was 12 days for four nestlings, 13 days for three nestlings, and 14 days for one nestling. From one nest the young departed early in the morning without parental urging. A parent brought food several times to the deserted nest before taking it to the fledglings a short distance away.

From the beginning of building to the departure of the young, the production of a brood takes approximately six days longer for the Yellow-green Vireo in Central America than for the closely related Red-eyed Vireo in Canada. This conforms to the general rule that in birds which nest at high latitudes the several phases of the nesting operations require less time than in closely related tropical birds.

When nestlings were killed, apparently by ants, the parents continued for a while to bring food to the nest. Another nestling was taken by a snake.

In El General, 2000 to 3000 feet above sea level, a single brood appears to be reared each year. The vireos disappear from this region, as from other parts of Central America, in the second half of September.

GRAY-HEADED GREENLET

Hylophilus decurtatus

The greenlets of the genus *Hylophilus* are small vireos which, like most other members of their family, lack brilliant colors. Their upper parts are usually olive-green or brownish, and their under parts are whitish, yellowish, or ochraceous. Some of the numerous species have conspicuously light bills, eyes, or legs, which aid in the identification of the species. The genus is confined to the mainland of tropical America and to such nearby islands as Trinidad and Tobago. Some species inhabit the high rain forest whereas others prefer scrubby areas, and nearly all are heat-loving birds which avoid high altitudes.

The Gray-headed Greenlet is a small bird scarcely four inches in length. Its head is gray, darker on the crown than on the sides, and there is a whitish ring surrounding each dark eye. The remaining upper parts are yellowish olive-green, without conspicuous wing-bars. The median under parts are whitish or yellowish white, the sides and flanks are strongly tinged with olive-green, or yellowish olive, and the under tail-coverts are pale yellow. The upper mandible is blackish and the lower is pale horn color. The legs and toes are plumbeous. The sexes are indistinguishable in plumage. The species extends through the Caribbean rain forests from southern México to the Canal Zone. It occurs also on the Pacific side of Central America where humid forests thrive at lower altitudes, as in southern and central Costa Rica, and in restricted areas as far north as El Salvador. In El General, Costa Rica, it ranges upward to at least 3000 feet above sea level. It has occasionally been found at 4000 feet in Costa Rica (Carriker, 1910:779), but it is nowhere abundant at this altitude.

The Gray-headed Greenlets hunt restlessly through the crowns of the trees, not only in the primary forests, where they remain well above the ground, but also in secondary woodlands, plantations, and shady pastures, where they descend lower, sometimes even to forage in bushes. Like other vireos, they search a great deal among the green foliage, and they also pry into curled dead leaves attached to trees or caught up in vine tangles. Often, while pursuing their investigations, they hang with head or back downward. Occasionally they vary their insect diet with vegetable food, and I have seen them eat the small seeds of the tree *Alchornea latifolia*, each of which is enclosed in a soft, bright red aril.

Although it is difficult to learn about the social life of birds that move so constantly through the clustered foliage, I have one observation which suggests that they remain paired in December.

VOICE

In the valley of El General, the Gray-headed Greenlets begin to sing early in the dry month of February and continue through most of July. Delivered in a soft, clear voice, the song, at its best, is long-continued, varied, and melodious, and it needs only greater force to make it outstanding. However, the voice is so weak that one must listen attentively, preferably when more powerful songsters are silent, to appreciate the sweetness and beauty of the modest song. In February one male greenlet sang *chichi-cher cher cher cher chichi-cher*. At times it sang a longer version: *chichi-cher cher cher cher cher cher chichi-cher chichi-cher*. There were also different combinations of these same notes, but all its songs were variations of the same theme. The female answered more shortly *chichi-cher chichi-cher*. In June I heard a greenlet singing *whicheet wich chi cher* in low bushes in a



Fig. 2. Gray-headed Greenlet.

neglected pasture. Usually, however, the song is simpler, *chi chi*, or *chi chi cher*, given in a low, sweet voice. Although, as already mentioned, the male's song is sometimes answered by a briefer refrain which seems to be that of his mate, a female that I watched through the nesting period never sang in my presence, whereas her mate was most songful.

Gray-headed Greenlets scold with rather harsh, nasal notes, somewhat like those of the Tawny-crowned Greenlet, but not so full as in that species. They also utter a faint *churr* or rattle, lower than but suggestive of certain notes of the Yellow-green Vireo, and also a weak, sharp note.

NEST AND EGGS

I passed 20 nesting seasons in localities where the Gray-headed Greenlet was abundant before at last my search for its nest was rewarded. On a number of mornings in mid-April of 1955, as I walked through the pasture in front of our house in El General, I noticed a pair of greenlets in the shade trees; their persistence in staying in this area

led me to look for a nest. But it was so well screened by clustering foliage that it escaped me until April 17. At this time I noticed an inconspicuous structure attached 14 feet above the ground to one of the drooping lower boughs of a large muñeco (*Cordia*) tree which was growing close to the bank of the Río Peña Blanca and was about 75 yards from the woodland on the opposite side of the narrow pasture. Although the nest appeared to be nearly finished, I watched from a blind on the following morning in the hope of learning something about the process of building. From 7:00 to 8:00 a.m. the nest was visited only five times. Once the greenlet brought a long, thin fiber which it coiled down into the hollow. On other visits the bird came with nothing visible in its bill; but apparently it had brought cobweb, which it applied to the rim and outer surface, and it spent much time shaping the nest. The bird that visited the nest never sang in my presence, although the mate sang often in the neighboring trees—*chi chi* or *ch' wi chi*. It seemed that the female alone was putting the finishing touches on the nest. After 8:00 a.m. I waited another half hour without seeing her again.

A few weeks later I watched a greenlet gather nest material at the edge of the forest on the opposite side of the pasture. With its sharp bill, the bird tore fibers from the outside of slender, decaying stems near the ground. After it had taken some of these fibers into its bill, it gave its head a shake, and, when some of the material broke with this testing, it dropped the remainder to the ground. When it had gathered a billful of satisfactory material, it flew up into the trees and I lost sight of it.

The completed nest was a deep cup, almost a pouch, attached by its rim to two widely diverging branchlets of a long, drooping, leafy bough. The bulk of the structure was formed of many dead leaves, including small dicotyledonous leaves that were almost whole and fragments of larger dicotyledonous leaves. There were also many narrow bamboo leaves and strips of other monocotyledonous leaves. This thick mass of leaves was held together by a few fibers, and the nest was attached to the twiglets by fibers and much cobweb. In the bottom was a sparse lining of fine, light-colored vegetable fibers. The outside dimensions were $3\frac{1}{2}$ inches in height by $2\frac{1}{2}$ inches in diameter at the top. The interior was $1\frac{3}{4}$ inches in both diameter and depth.

Although the nest was finished by April 18, nearly a week elapsed before the eggs were laid. Both eggs were deposited between my visits at 11:00 a.m. on April 24 and 1:00 p.m. on the following day. The two eggs were white, scarcely glossy, spotted and blotched with pale brown, heavily on the large end and sparingly elsewhere. They measured 17.5 by 13.5 and 18.3 by 13.5 millimeters. This nest with eggs, found at an altitude of about 2500 feet in the valley of El General, Costa Rica, is the only one which, as far as I can learn, has ever been seen by an ornithologist.

INCUBATION

From a blind set in the rocky pasture near the nest, I watched from 11:40 a.m. to 6:10 p.m. on April 30 and from 5:25 to 11:43 a.m. on May 1. The female greenlet sat restlessly on her eggs. Her 20 timed sessions ranged from 7 to 25 minutes and averaged 15.3 minutes, while her 21 timed recesses ranged from 7 to 26 and averaged 14.0 minutes. Calculated on the basis of these averages, she covered her eggs only 52.2 per cent of the time. This rhythm of sitting and going on excursions was observed throughout the morning of May 1, from the first departure of the female at 5:50 a.m. onward. This procedure was also observed on the afternoon of April 30 until 3:56 p.m., at which time the greenlet settled on her eggs and remained constantly until nightfall. Although there had been much sunshine in the early afternoon, the sky had now become very dark, but only a light drizzle of rain fell for about one hour. Hence, the greenlet might have taken additional outings and sought more food in the late afternoon without exposing her

eggs to a drenching. Thus the percentage just given indicates the assiduity of the female only over a short day extending from about six o'clock in the morning to four in the afternoon. Perhaps in this case it would be fairer to calculate the bird's constancy in sitting by her total time in the nest rather than by the averages of her sessions and recesses. If we do this, and consider the active day of the greenlet as lasting 12.5 hours, from 5:45 a.m. to 6:15 p.m., then in this period of 750 minutes the female incubated a total of 455 minutes, or 60.7 per cent of the time. But even this is a rather low figure.

While she rested low in her ample pouch, the female greenlet was always very quiet. She never uttered a songful note while sitting in, approaching, or leaving her nest. Once, while on her eggs, she gave a faint *churr* or rattle when her mate sang close by. When flying from her nest, she voiced weak, sharp notes which I could hear only when she passed close by the blind in which I sat. In contrast to her silence, her mate was a very songful bird, often delivering his musical verses in the vicinity, although the foliage usually concealed him from my view. Once in the early afternoon he went to look into the nest, singing as he did so, but he did not stay to incubate. Had he taken a turn on the eggs, it is probable that his irrepressible songfulness would have revealed his sex to me. Once he chased a migrating Red-eyed Vireo that had been foraging in his muñeco tree.

The set of two eggs had been completed by 1:00 p.m. on April 25 and both hatched between 5:15 p.m. on May 10 and 7:10 a.m. on May 11. Thus the incubation period was approximately 16 days.

THE NESTLINGS

The sightless, pink-skinned nestlings bore no trace of down. The interior of their mouths was yellow. On May 12, the day after they hatched, I watched their nest from 7:01 to 11:01 a.m. In these four hours the young were brooded 11 times, for periods ranging from 6 to 21 minutes and averaging 10.7 minutes. They were left exposed for 10 intervals ranging from 6 to 17 minutes and averaging 11.4 minutes. Thus the young were covered for 48.4 per cent of the four hours, or with almost the same constancy as their mother had shown while she incubated. Now, however, the female came and went more frequently, for she was feeding the young.

All the brooding seemed to be done by the female. When the male came with food and found the female sitting, he passed the food to her and went away. Had the male taken a share in brooding, it is probable that the female would have left at his approach and, after giving the nestlings their meal, he would have covered them, as is true of other birds in which both sexes brood. The nestlings were fed 19 times in the four hours. They were fed at least 8 times by the female, who afterward brooded, and at least 6 times by the male, who either sang or passed his food to his brooding mate. The young were fed 5 times by an unidentified parent who neither sang, brooded, nor passed the morsel to its brooding partner. The nestlings were nourished, as far as I could see, wholly with winged or larval insects, spiders, and the like. The largest objects were caterpillars brought by the male, who sang even with food in his mouth.

By May 17 the nestlings, now six days old, had prominent pinfeathers, those representing the remiges being especially long; but they still bore no down anywhere. Their eyes were about half opened. By May 20 their plumage had so expanded that it nearly covered their bodies, and their eyes were fully opened. On May 22 I again watched the young from 7:00 to 11:00 a.m. In the first hour they were fed 14 times, in the second hour 6 times, in the third hour 6 times, and in the fourth hour 18 times. This made 44 feedings in four hours. Thus the young were fed at an average rate of 5.5 times per capita per hour.

Although they were older, they received, as far as I could determine, no berries or



Fig. 3. Edge of primary forest on a ridge on the author's farm in the valley of El General, Costa Rica. Gray-headed Greenlets, Tropical Gnatcatchers and Gray-capped Flycatchers frequent the tops of the trees; Tawny-crowned Greenlets, Long-billed Gnatwrens, Lowland Wood Wrens and Golden-crowned Spadebills live in the lower levels of the woodland.

fruit of any sort but only insects and their larvae, with possibly some spiders. A very large proportion of the insects were green, suggesting that they had been captured in the foliage. A single insect, held conspicuously in the bill, was brought by a parent on each visit. Both parents fed the nestlings, and the male accounted for at least 15 of the feedings, as I could tell by his singing. But in the last hour of observation, when the day had become dark and gloomy, only 2 of the 18 feedings were made by a bird that sang. Thus it appeared that the male was now feeding his nestlings in silence, and I could no longer distinguish him from his mate. The female did not brood a single time. The feathered nestlings now preened a great deal, and from time to time one stood up in the nest to flap its wings.

Early the following morning, May 23, both nestlings flew out when I raised a mirror above their nest to see whether they were still there. They burst from the nest simultaneously, and the one which I kept in view covered about 25 feet on a descending course before it came down in the grass. I easily caught it and found it most attractive in its fresh plumage, with gray head, olive-green back and wings, and creamy under plumage tinged with yellow on the sides. It resembled its parents in coloration. I placed the young greenlet in the muñeco tree near its nest, but by eleven o'clock I could find neither it nor the other nestling. The young were in the nest a little over 12 days.

SUMMARY

The Gray-headed Greenlet inhabits the more humid lowlands of Central America, from sea level up to 3000 or rarely to 4000 feet. In the woodland it hunts well up in the trees and avoids the dark undergrowth, but in neighboring clearings it sometimes descends into low bushes to forage. It appears to remain mated through the year, but more evidence is needed on this point.

This species subsists chiefly on insects and spiders gleaned from living foliage or extracted from curled dead leaves; it rarely varies its diet with a small fruit or arillate seed.

The male's song is pleasant in tone and at its best long-continued and varied, but it

lacks volume. The female may answer with a few short notes of the same character but usually she is silent. In the valley of El General, the period of song extends from early February to late July.

The single known nest of this species was placed 14 feet up on a drooping bough of a tree which was in a pasture not far from woodland. The nest was a deep cup composed largely of dead leaves bound together with fibers and cobweb. It was attached by its rim to an open fork. Only the female was seen to put the finishing touches on this nest.

Two eggs were laid on consecutive days in late April. They were white, spotted and blotched with pale brown, chiefly on the large end.

Only the female incubated. In 12½ hours of watching she took 20 short sessions ranging from 7 to 25 minutes and averaging 15.3 minutes. In this same period the female took 21 recesses ranging from 7 to 26 minutes and averaging 14.0 minutes. She spent only 52.2 per cent of her active period on the eggs. The incubation period was about 16 days.

The newly hatched nestlings had pink skin wholly devoid of down, and their eyes were tightly closed. The interior of the mouth was yellow. On the day after the young hatched they were brooded by the female, who sat with about the same constancy as when she incubated. The young were fed by both parents, who brought only winged and larval insects and spiders, a single one on each visit. The rate of feeding varied from 2.4 times per capita per hour for day-old young to 5.5 times per hour for feathered young.

The nestlings left the nest at the age of 12 days, when they could fly fairly well. They resembled their parents in coloration.

TAWNY-CROWNED GREENLET

Hylophilus ochraceiceps

Although far from brilliant, the Tawny-crowned Greenlet is one of the more richly and distinctively colored members of its genus. It is about four and a quarter inches in length. In both sexes, the forehead and crown vary from tawny-olive to golden-brown. The back and wings are russet-brown or olive-brown, the rump and upper tail-coverts are greenish olive, and the tail is russet. The sides of the head are dull grayish olive, which becomes paler and grayer on the chin and throat. The chest is ochraceous brown with a yellowish tinge and the more posterior under parts are pale yellowish olive. The eyes are yellow, the bill is dark, and the feet are pink. The species ranges through the tropical rain forests from southern México to northwestern Ecuador and Amazonia. In northern Central America this greenlet occurs only on the Caribbean side, but it crosses to the opposite coast in Nicaragua and is abundant in the dense forests on the Pacific slope and lowlands of southern Costa Rica. In this region it is still fairly common at an altitude of 2500 feet in El General. Nevertheless, in the year and a half that I spent at Rivas, I did not meet it in the forests at 3000 feet, where I devoted many hours to the birds. In western Panamá, however, it has been reported at 4000 feet on the Volcán Chiriquí (Ridgway, 1904:220).

Whereas the Gray-headed Greenlet lives well up in the trees, the Tawny-crowned Greenlet prefers the dimly lighted undergrowth of the dense forest, beyond which it seldom ventures. Here it moves about restlessly, searching for small invertebrates among the leaves of bushes and saplings. Often it keeps company with other small forest dwellers, such as the Sulphur-rumped Myiobius and the Slaty Antwren. These greenlets seem to travel in pairs or family groups; but they move so constantly, and in such open formation, that it is most difficult to learn how many individuals the party contains or what the relationships might be. They draw attention to themselves by their incessantly reiterated, loud, rather harsh, nasal notes, which at various times and places I have written as *day, day, day*, and *doy, doy, doy*, and *deu, deu, deu*. At their nests they also utter low, soft notes; but if they possess a song, I have not, in my many years in the forests where they dwell, become aware of it.

NESTING

On our farm in El General, the Tawny-crowned Greenlet may begin to nest in March, if not earlier, for on April 11, 1954, I found a brownish fledgling that could fly only a few yards. It was accompanied by anxious parents who called attention to themselves by their sharp, animated monosyllables.

On April 8, 1949, I saw, in the same woodland, a greenlet with a conspicuous tuft of seed down in its bill. It carried this to a fork at the end of a thin, horizontal twig of a tall, slender young tree, at a height of about 20 feet above the ground. At this place was a slight accumulation of cobweb and downy material—the beginning of a nest. The nest site was roofed over and well screened by the broad, dark-green leaves of an aroid that grew attached to the slender trunk of the tree. Although I watched from a blind the following morning, no greenlet came near the incipient nest. By April 10 no change was evident in the nest, but by April 16 it had grown greatly. In an hour's watching on this date, I saw a bird bring material to it only once. No eggs had been laid by the morning of April 24, more than two weeks after I found the nest's foundation; but the following



Fig. 4. Tawny-crowned Greenlet.

morning one was present, and by 10:00 a.m. on April 26 there were two. Three days later both eggs had vanished. I saw them only by reflection in a mirror attached to the end of a long pole, and I have no description or measurements of them.

The morning of May 9, 1940, I spent in a blind set in the forest before a nest of the Streak-chested Antpitta. This was near the Río Pacuar in El General, and through the side window I discovered my first nest of the Tawny-crowned Greenlet. The green nest was so inconspicuous amid the foliage of the undergrowth, and the greenlets were so circumspect in their movements, that six days earlier I had passed a whole morning in the same spot without becoming aware of it. Yet the small hemispheric cup had certainly been present and it had contained eggs, for now, on May 9, it held two newly hatched nestlings, which were sightless, pink-skinned, and without a vestige of down. The interior of their mouths was yellow. When I examined these nestlings, their parents flitted through the branches well above me, voicing their deep *doy, doy, doy* mingled with low, soft notes.

In the afternoon, when I had finished my observations at the nest of the antpitta, I shifted my blind to a more favorable position for watching the nest of the greenlets. My watching extended from 2:20 to 4:20 p.m. on May 9 and from 7:00 to 11:20 the following morning. The greenlets, already well accustomed to the brown tent, proceeded at once with their domestic affairs; six minutes after I had entered the blind in its new

position, both came together with food in their bills. After delivering their insects, one departed while the other settled down to brood the nestlings. Apparently only the female brooded the nestlings; for when the male came with food while she was sitting, she took it from him and passed it to the chicks beneath her instead of turning over the nest to the male. Her periods of sitting were surprisingly long for so small a bird—far longer than I later found to be true of the Gray-headed Greenlet. In the afternoon she brooded for 32 minutes; a recess of 5 minutes followed in which she twice brought food to the nestlings. Then after the second feeding, she sat for 57 minutes. After this period she left the nest for 17 minutes, and when she returned and resumed brooding I left. The next morning, which was fair, the female brooded for 86 minutes, after which she was absent 45 minutes; then she returned to brood for 114 minutes, from 9:26 to 11:20 a.m. Usually the female left the nest by hopping sideways along the supporting branch to the main stem, and, at times, she hopped up the trunk to the top of the sapling before she took wing. However, at the end of the longest session of brooding she merely jumped from the nest to the supporting branch and flew directly away.

The naked nestlings were fed only 16 times in the 6 hours and 20 minutes that I watched, or at the rate of 1.3 times per capita per hour. Their diet consisted of small winged insects, larvae and pupae, brought one at a time in the parent's bill. When the female was not brooding, the parents preferred to come together with food, and half the meals were brought in this fashion. Droppings were swallowed by the parent birds. In the long periods of brooding and slow rate of feeding, the Tawny-crowned Greenlets resembled the antbirds, rather than their congeners the Gray-headed Greenlets.

By May 19, when the two young were about ten days old, they were well feathered. They had several large swellings beneath their skin caused by the dipterous larvae called *tórsalos*. Their nest was breaking away from one of the arms of the supporting fork and it hung down on that side. One of the young rested on a twig above the nest, where a leaf sheltered it from the afternoon rain, but the other still lay in the bottom of the sagging cup. For fear of causing their premature departure, I did not tie up the nest. At noon on the following day the two nestlings were in the same positions, but by noon on May 21 the one that had rested so long above the nest had gone. The nestling that had stayed in the cup had vanished by May 22, 13 days after I found the nest. On the assumption that the young were a day old when I first saw them, I have estimated this nestling period to be 13 or 14 days. This is somewhat longer than that of the Gray-headed Greenlet, but it is in keeping with the slower rhythm of feeding and brooding of the Tawny-crowned Greenlet.

After the departure of its occupants, I removed this nest from the supporting branch and examined it more closely. The neat, open cup had been attached by its rim with cobweb to the arms of a horizontal fork of a sapling, seven feet above the ground, and it had been roofed over by a leaf of this sapling. On tearing the nest apart I found the following layers: (1) a green outer covering of moss, (2) next toward the interior, a layer of fine, light-colored bast fibers, (3) a very thick layer of long, soft seed plumes of a buffy color, the principal constituent of the nest, and (4) a thin lining of the same bast fibers as in the second layer.

A nest which I found in 1949 had a slightly different composition. Although there were some large pieces of green moss on the outer surface and the rim, these were insufficient to conceal the light color of the outer wall. The thick walls and bottom were composed chiefly of very light-colored seed down and bast fibers; the former predominated toward the outside, the latter were found in the lining. A few of the fungal strands known as "vegetable horsehair" were bound around the outside of the nest, and masses of cobweb strengthened the attachment to the supporting twigs. This nest measured $2\frac{3}{4}$

inches in outside diameter by $1\frac{7}{8}$ inches high; the interior was $1\frac{3}{4}$ inches in diameter by $1\frac{1}{2}$ inches deep. It is of interest that both of these nests were roofed over by a green leaf.

SUMMARY

The Tawny-crowned Greenlet lives in the dimly lighted undergrowth of lowland rain forest, from sea level up to about 2500 feet in Costa Rica. The birds move restlessly through the undergrowth, usually several together and in company with other small forest dwellers. This species subsists on insects and the like, gleaned from the foliage of shrubs and young trees.

Its usual note is a rather loud, nasal monosyllable, and it appears to have no true song.

In El General it begins to breed in March if not earlier. Only two nests were found, at heights of 7 and 20 feet in the forest. Each was a sturdy cup, attached by its rim to the arms of a fork. The nests were composed of seed plumes and bast fibers, with variable amounts of green moss on the outside. One contained two eggs in April and the other two nestlings in May.

The newly hatched nestlings were pink-skinned, wholly devoid of down, and the interior of the mouth was yellow. They were brooded by a single parent, which sat for very long periods, once in clear weather, for nearly two hours continuously. The young were fed by both parents, which brought winged insects, larvae, and pupae, one at a time and held conspicuously in the bill. The nestling period was estimated as 13 or 14 days.

GENERAL SUMMARY OF INFORMATION ON THE VIREONIDAE

Excluding the pepper-shrikes and shrike-vireos, which are sometimes joined with the Vireonidae, the vireos and greenlets form a homogeneous family of small arboreal birds containing about 36 species. They are confined to the mainland and islands of the Western Hemisphere. In coloration they are among the plainest of birds. Shades of olive, olive-green, gray, brown, and pale yellow predominate in their plumage; even where blue or russet is present, as on the heads of some species, it is rarely of a bright shade. Conspicuous streaking or spotting is absent. The sexes are alike in plumage, and seasonal changes in coloration are slight or lacking. Some species are so similar in appearance that they are more readily distinguished by voice or by habits. Most of the vireos that breed at high latitudes make long migrations, and even some of those that nest within the tropics are migratory.

The food of vireos consists largely of insects and their larvae which are caught as the birds move rather deliberately through the foliage of trees and bushes, peering from side to side in characteristic fashion. Sometimes they hang in an inverted position in order to reach otherwise inaccessible prey. Occasionally they use a foot to hold down a large insect while they peck or tear it with the bill, but they do this less consistently and less efficiently than the related pepper-shrikes and shrike-vireos. Vireos also consume small fruits and arillate seeds, which usually constitute only a minor element in their diet. Rarely, especially while feeding young in a low nest, they forage on the ground. This has been observed in the Red-eyed Vireo by Herrick (1905:109) and Lawrence (1953:71). On the ground, among other things, they capture many small land snails (Stephens, 1917).

The songs of vireos are seldom brilliant, but they usually are sweet and pleasing. Often the song has a decided twang or buzz. The typical song of the vireo consists usually of short phrases separated by distinct intervals. Variety is achieved by altering the length and form of the phrases, their intonation or pitch, and the rate at which they are repeated. Vireos are noted for their incessant singing; in the breeding season their music is continued with extraordinary persistence through much of the day. The White-eyed Vireo, which has a reputation as a mimic, enlivens its performance by introducing various rather tart, harsh notes, such as mews, chucks, and chips. Perhaps the best songsters in the family are the Warbling Vireos of North America and the related Brown-capped Vireos of tropical America. Their song is a long-continued, full, rich warble, at times slightly harsh in tone, with an undulatory or rippling effect. The Tawny-crowned Greenlet seems to be songless.

On rare occasions, in a few species, the female has been heard singing; these species include the Philadelphia Vireo (Lewis, 1921:33; Philipp and Bowdish, 1917:269), the Bell Vireo (Pitelka and Koestner, 1942:103), the Black-capped Vireo (Bent, 1950:226), and the Latimer Vireo (Spaulding, 1937:18). The Philadelphia and Bell vireos were heard singing only at the nest; but the female Latimer Vireo, which while seeking a nest site and building chants responsively with her mate, no longer sings after she begins to incubate. Those male vireos which share the duty of incubation frequently sing while sitting in the nest—a habit shared by the Rufous-browed Pepper-shrike. Solitary and Yellow-throated vireos sing rather freely while in their winter home in Central America, and Red-eyed Vireos sing occasionally while passing northward through the region. Territorial disputes among vireos appear to be settled either by competitive singing or by singing and chasing; vireos seem never to fight with others of their own species.

Nuptial feeding has been witnessed in the Yellow-throated Vireo (Bent, 1950:278, 281), Solitary Vireo (Bent, 1950:311), and Red-eyed Vireo (Lawrence, 1953:53, 59). It appears to occur chiefly in the incubation period. The male Red-eyed Vireo sometimes feeds his mate before incubation begins and often while she attends her eggs. In the latter period, he feeds the female during her recesses rather than when she is on the nest.

Polygamy seems to be unknown in this family.

The nest is placed low in a bush or high in a tree but apparently it is never placed on the ground. The nest is surprisingly uniform in shape throughout the family. It is a more or less deep cup or pocket attached by its rim and hung between the arms of a horizontal fork of a bush or tree. Often the nest is wider below the rim, and the incurved walls give added security to eggs and young when the wind tosses the slender boughs that support the nest. Unlike the structures built by other vireos, the nests of the White-eyed Vireo are pointed rather than rounded on the bottom, so that they have the form of an inverted cone rather than of a cup. Cobweb is nearly always freely used to attach the nest to its supports, and often tufts of cobweb or spiders' cocoons are attached to the exterior surface. Among the materials used are fibers of various sorts, grass blades, papery leaves, strips of flexible bark of vines or other plants, and, where available, *Tillandsia usneoides* or beard-moss. The Tawny-crowned Greenlet and other species use green moss to more or less cover the outside of the nest. The White-eyed Vireo often incorporates scraps of paper or pieces of wasps' nests in its structure. Usually the walls and bottom of vireos' nests are substantial and thick; but the fabric of the Scrub Greenlet's nest, both in Trinidad (Belcher and Smooker, 1937:516) and Costa Rica, is so thin that the eggs can be seen through the bottom.

The nest is built chiefly by the female, but there are many reports of males taking part in the work. Their participation varies not only from species to species but apparently even from pair to pair within a species. Both sexes build in the Hutton Vireo (Van Fleet, 1919), Yellow-throated Vireo (Sutton, 1949:11; Bent, 1950:279-280), Solitary Vireo (Bent, 1950:294), and Latimer Vireo (Spaulding, 1937:20). In the Bell Vireo the participation of both sexes in constructing the nest is reported by Hensley (1950) and Mumford (1952:228), but Nice (1929) and Pitelka and Koestner (1942:102) saw only the female at work. In the Philadelphia Vireo the evidence is similarly conflicting; although Lewis (1921) failed to see the male bring material, Charles E. Doe (*vide* Bent, 1950:352) found both sexes at work on the nest. Likewise in the Red-eyed Vireo, Lawrence (1953:56) found no indication that males brought material; yet others, including Forbush (1929:179-183), Common (1934) and Herrick (1935:227), report that the males take at least a small share in nest construction. In the eastern race of the Warbling Vireo, Audubon (*vide* Bent, 1950:365) watched both sexes build, but Rust (1920) stated that in the western race of the same species the nest was constructed chiefly or wholly by the female. At three nests of the Yellow-green Vireo I failed to see males bring material or shape the structure. A leisurely rate of gathering nest material, with ten or fewer trips per hour by each participant, has been observed not only in this species but also in the Latimer Vireo (Spaulding, 1937:20) and the Bell Vireo (Hensley, 1950). The Red-eyed Vireo may on occasion work much more rapidly, bringing material at the rate of once every 3.2 minutes (Lawrence, 1953:56).

The eggs are white, creamy or pinkish-white and nearly always spotted with shades of brown or lilac, especially on the thick end. The pigmentation is usually light, and sometimes, as in the Black-capped Vireo, the Flat-billed Vireo, and exceptionally in other species, the shells are immaculate. Only rarely, as in some eggs of the Yellow-throated Vireo, could the marking be called heavy. In Central America the Yellow-green Vireo lays sets of three or, less often, two eggs, whereas greenlets of the genus *Hylophilus*

usually lay two eggs. The sets of vireos that nest beyond the tropics, in the north, range from three to five eggs but most often consist of four eggs. If a cowbird drops its eggs into a nest, some species, including the Red-eyed, Solitary, and Bell vireos, occasionally cover these eggs over with a new lining and then lay their own eggs on this false bottom. More often, however, they incubate the foreign eggs along with their own.

Incubation is performed by both sexes in the majority of vireos which have been studied at this period in the life cycle. This is true of the White-eyed Vireo (Bent, 1950: 231), Hutton Vireo (Van Fleet, 1919; Miller, 1953), Bell Vireo (Nice, 1929; Pitelka and Koestner, 1942; Hensley, 1950; Mumford, 1952), Yellow-throated Vireo (Bent, 1950:281), Solitary Vireo (Bent, 1950:295, 311), Philadelphia Vireo (Lewis, 1921; Bent, 1950:353), both the eastern and western races of the Warbling Vireo (Rust, 1920; Bent, 1950:364), and the Latimer Vireo (Spaulding, 1937). In the Red-eyed Vireo, the prolonged observations of Lawrence (1953) failed to disclose that the male covered the eggs, but Forbush (1929) gives instances of incubation by this sex. In the Yellow-green Vireo and the Gray-headed Greenlet, I did not see the male cover the eggs or brood the nestlings; and the failure of a male Tawny-crowned Greenlet to brood makes it very improbable that the male incubates in this species. In the passerines as a whole, males share in building the nest far more often than they share in incubation of the eggs. Hence it is surprising to find that in the vireos the male is credited with assisting in incubation more frequently than he is credited with taking a part in nest building. This may be due to the fact that observational sampling is on the whole more adequate for the period of incubation than it is for the period of nest construction. The available information suggests that in these matters the vireos are in a state of flux or transition, with the males taking an increasing share in the nesting operations.

Even when the male helps to warm the eggs, he sits in the nest less than the female. Thus Spaulding (1937:23) found that a female Latimer Vireo covered the eggs twice as long by day as her mate. In the Bell Vireo, Hensley (1950) found that the sessions of the male averaged 17.8 minutes and those of the female 23.0 minutes in length. The two together kept the eggs constantly covered, and it has been observed in other species that the oncoming partner slips into the nest the moment the other leaves it. When the female incubates unaided, her sessions and recesses are about the average length for a small insectivorous bird. Lawrence (1953:61) found that in the Red-eyed Vireo 53 sessions of five females ranged from 1 to 58 minutes and averaged 25.3 minutes, while their 63 recesses ranged from 1 to 26 minutes and averaged 8.7 minutes. They kept their eggs covered for 71 to 83 per cent of the observation periods. The four female Yellow-green Vireos for which I made records took 20 sessions which ranged from 9 to 61 and averaged 32.7 minutes. Their 24 recesses varied from 6 to 55 and averaged 13.5 minutes. They kept their eggs covered for 62 to 77 per cent of the observation periods. A Gray-headed Greenlet incubated less constantly, sitting for only 52 per cent of the time during her active day.

The incubation period is 12 days in the Warbling Vireo (Rust, 1920), 12 to 14 days in the Red-eyed Vireo (Lawrence, 1953), 13 to 13½ days in the Philadelphia Vireo (Lewis, 1921:41), 13 to 14 days in the Yellow-green Vireo, 14 days in the Bell Vireo (Nice, 1929; Pitelka and Koestner, 1942; Hensley, 1950), 16 days in the Hutton Vireo (Miller, 1953), and 16 days in the Gray-headed Greenlet. These data make one question how effective the male's incubation may be, for the eggs of the Hutton Vireo, constantly covered by both parents, take as long to hatch as those of the Gray-headed Greenlet which are incubated rather inconstantly by the female alone. Since we have only a single determination for each of these species, some irregularity might be suspected here. But we have sufficient observations to affirm with some confidence that the eggs of the Bell

Vireo, which are covered by the two parents alternately, take as long or longer to hatch than those of the Red-eyed and Yellow-green vireos which are warmed intermittently by the female alone.

The newly hatched young have tightly closed eyes, and the inside of the mouth is yellow or orange-yellow in the species for which we have information. Natal down is reduced to mere vestiges or is wholly lacking in the Bell Vireo (Bent, 1950:257), Yellow-green Vireo, Gray-headed Greenlet, and Tawny-crowned Greenlet. It is present in the Philadelphia Vireo (Lewis, 1921:40), the Yellow-throated Vireo, the Red-eyed Vireo, and the Warbling Vireo (Bent, 1950:282, 338, 366). It is remarkable that forms so closely related as the Red-eyed and the Yellow-green vireos should differ in this respect. The young are brooded by both parents in species in which both incubate the eggs, but by the female alone when she alone incubates. The observations of Lewis, however, suggest that the male Philadelphia Vireo, which was first definitely identified on the nest twelve days after laying began, may take a relatively greater share in brooding than in incubation. Once a female Tawny-crowned Greenlet brooded continuously for 114 minutes by day. This is remarkable in that it is far longer than the longest session of incubation of any member of the family for which we have information.

Both parents normally feed the young in all species for which we have adequate observations, although occasionally, at one nest in seven, a male Yellow-green Vireo fails to do so. The studies of both Stephens (1917) and Lawrence (1953) showed that in the Red-eyed Vireo the female feeds the nestlings about three times as often as the male. In the Bell Vireo, however, the observations of Nice (1929) and Hensley (1950) showed more equal participation by the two parents in nourishing the young. The rate of feeding the young is rather slow in this family, seldom exceeding four times per capita per hour even for feathered nestlings, and usually it is considerably less. Food appears always to be carried in the bill, one or a few articles at a time, rather than to be regurgitated.

Injury simulation seems never to have been observed in this family. Parent vireos as a rule sit very steadfastly. In numerous species they permit themselves to be touched on the nest by a human visitor, but sometimes they peck the intruding hand. Some vireos cling to the nest so tenaciously that ornithologists have been obliged to lift them off in order to view the eggs or nestlings which they covered. When finally driven off the nest, they flit around and scold rather than attempt to lure the intruder away. They may boldly attack predatory birds or quadrupeds much bigger than themselves.

The nestling period is fairly uniform in the family, ranging from 10 or 11 days in the Red-eyed Vireo, 11 or 12 days in the Bell Vireo, 12 days in the Gray-headed Greenlet, 12 or 13 days in the Philadelphia Vireo, and 12 to 14 days in the Yellow-green Vireo to 15 days in the Warbling Vireo. On leaving the nest the young can fly weakly.

Helpers at the nest are unknown in this family.

Of the sleeping habits of vireos, scarcely anything is known. Apparently they roost inconspicuously amid the foliage of trees.

FAMILY SYLVIIDAE

TROPICAL GNATCATCHER

Polioptila plumbea

Delicately formed as a hummingbird, restlessly active as a wood warbler, this slender, graceful bird, less than four inches in length, is not easily confused with any of its neighbors. The upper parts are blue-gray, brighter on the male than on the female, and the under plumage is white, clouded with blue-gray on the breast and sides. The long, slender, expressively mobile tail contains black central and white outer feathers. The male is readily distinguished from the female by the glossy, blue-black cap that covers the top of his head from the base of the bill to the hindneck, where it broadens over the sides of the neck with pointed extensions. This black cap arches well above the eye, leaving the lores, the superciliary zone, and the auriculars white like the cheeks and ventral plumage. The slender bill, the eyes, and the feet are dark.

According to modern classification, *Polioptila plumbea* is a variable species, including numerous races, which ranges from southern México to Perú and northern Brazil. The present account deals with the race *superciliaris*, which was formerly considered a distinct species and which is found in the wetter areas throughout Central America. In Costa Rica this race occurs on both sides of the Cordillera, but farther north it is restricted to the Caribbean watershed. Its altitudinal range in Costa Rica is from sea level up to about 4500 feet in the central highlands.

The Tropical Gnatcatcher is at home along the margins of the primary forest, in tall second-growth woodland, in coffee plantations with their regularly spaced shade trees, in shady pastures, and even in roadside trees. Keeping usually well above the ground but on occasion descending into the undergrowth, the diminutive bird flits airily through the foliage, ceaselessly seeking the small insects on which it subsists. Its long, slender tail is nearly always in motion. A male and a female usually hunt together, for the gnatcatchers remain paired throughout the year.

VOICE

The song of the Tropical Gnatcatcher is a slow trill, somewhat high and thin at the outset but becoming deeper, fuller, and slower toward the end. It is not so rich and full as the trill of the distantly related Long-billed Gnatwren, which sings in the depth of the neighboring forest; yet it is a pleasant, engaging song. At dawn I have watched the male gnatcatchers sing in the tops of tall trees which were standing in the midst of low, second-growth woodland. Tirelessly they repeat their simple song innumerable times, continuing from early dawn until the day grows bright. Between repetitions they flit from branch to branch of the chosen song tree. The gnatcatchers also sing much at high noon and in the early part of sunny afternoons. In El General, the season of singing extends from January to June or July.

The gnatcatcher's call note is a fine, thin, nasal utterance that sometimes sounds like *chaaa*.

NEST BUILDING

In El General, nest building sometimes begins early in February. The six nests that I have found in this region were in diverse situations. The first and lowest, discovered while still unfinished on May 26, 1939, was placed 6½ feet above the ground in an

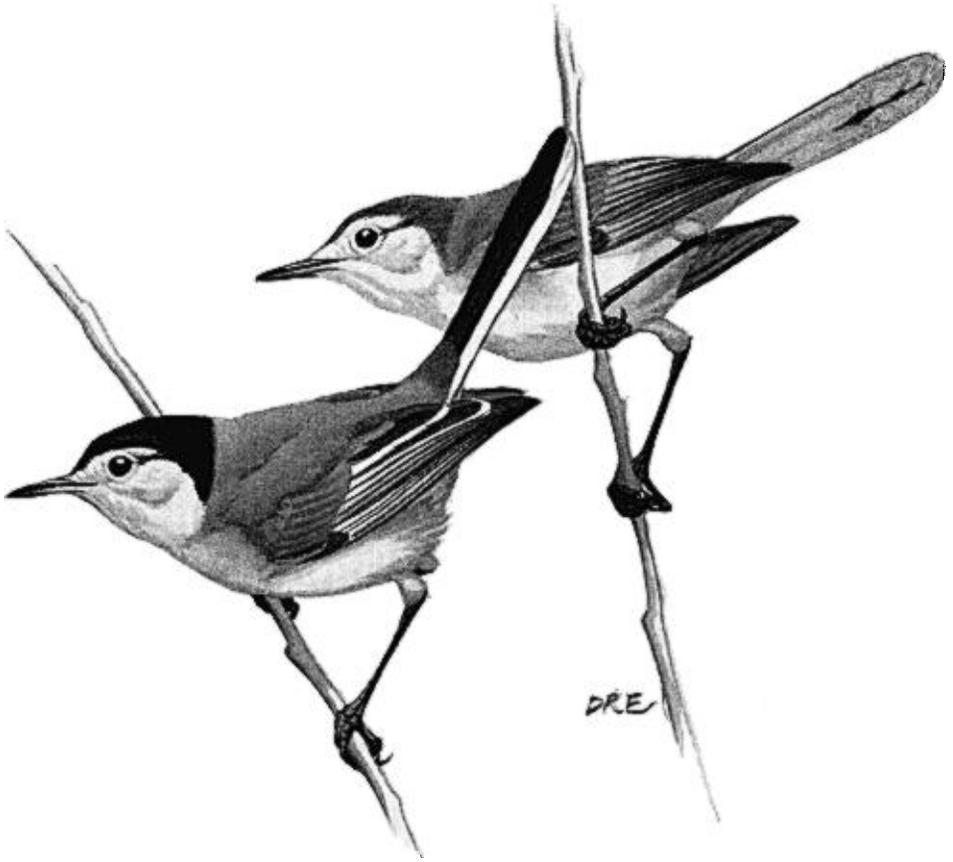


Fig. 5. Male and female Tropical Gnatcatcher.

upright, narrow crotch of a coffee bush on a small plantation. The second, also found before completion, on May 22, 1940, was situated 10 feet up in a murta tree (*Eugenia*) in a pasture which was close beside a stream shaded by trees and vines. The nest was saddled on a horizontal branch about an inch thick, and it was above two ascending twiglets which gave it lateral support at the base only. The third nest was about 18 feet above ground in a fork at the end of a slender, horizontal branch of a guava tree in the yard behind my house. Although this nest was in sight of my study windows, the tiny chalice was so well screened by the foliage clustering close around it, and the parents were so discreetly silent in their attendance, that it escaped my notice until the three young were well feathered and drew my attention by their shrill chorus at meal time. The highest nest, 25 feet up in a copalchi tree (*Croton niveus*) in a pasture, was built at the end of May, 1953, and apparently it never contained eggs, for the female was not interested in it. My seasonally latest nest, which held nestlings on July 12, 1949, was 13 feet up in a tree of *Goethalsia meiantha* which was growing in a pasture. This nest was placed far out on the horizontal bifurcation of a slender, leafy bough that supported it only at the base.

I have made some observations on the construction of four nests. At three of these both sexes helped to build, but they took rather unequal shares, at least while I watched

them. Thus at the first nest the male took the leading part in the work, whereas at the second nest the female built more actively than her partner. All these gnatcatchers, however, were almost equally indifferent to my presence. This was true even at the low nests, before which I sat in the open using the shortest focus of my field glasses. Apparently I could have been much closer without disturbing the birds. The male would go to the nest in the coffee bush while I stood little more than arm's length away. At the nest in the murta tree, the male worked while the boy who had discovered the nest and I stood beneath it.

It was six o'clock in the morning when I began to watch the unfinished nest in the coffee bush, but the gnatcatchers did not begin to work until seven. Between 7:45 and 9:45, the period when building was most active, the male brought material to the nest 16 times, whereas his mate brought material only 5 times; neither worked constantly nor hard. They brought, in no definite order, fine fibrous material, which they arranged inside the delicate little cup, and bits of lichen and green algae from the bark of trees, which they attached to the outside by means of the abundant cobweb that they were continually fetching. I saw the female pull long skeins of soft fibers from the dry outer leaf-sheaths of a banana plant growing close by. Her mate always brought shorter pieces of material which came from a greater distance. Both birds sat in the nest and shaped it with vigorous movements of their bodies. The male sometimes sang as he approached the nest with material in his bill; and almost always as he went off, after placing his material, he delivered his pretty, long-continued trill which began on a high and thin note but became deeper and fuller toward the end.

At the nest in the murta tree, the male gnatcatcher brought material 5 times and the female brought material 10 times in $1\frac{3}{4}$ hours. For a while the male followed his mate as she carried material to the nest, but he brought nothing himself. When he took material to the nest, he moved quite independently of his mate, or he worked in her absence. He sang a great deal as he worked. The high nest in the copalchí tree was built largely, if not wholly, by the male, while his mate busied herself attending the nestlings in a neighboring nest of the Golden-masked Tanager, as will be told in detail later.

The completed nest of the gnatcatcher is a beautiful little cup, as soft and delicate and tastefully embellished as that of a hummingbird. I mistook the first one for the work of a hummingbird until I saw the real builders at their task. The walls contract upward and are composed largely of fine, soft vegetable fibers, apparently often bast fibers, which may be light or dark brown in color. The exterior is encrusted with pieces of foliaceous lichen, bits of moss and liverworts, or tufts of delicate green algae from the bark of trees. These may cover most of the outer surface, or they may be rather sparingly applied. They are attached to the nest by cobweb, which is also used in abundance to bind the whole structure together and to fasten it to the supporting branch. The lining of one nest was of soft gray seed down, apparently of a bromeliad. A nest taken after the young had left measured $2\frac{1}{4}$ inches in outside diameter by $1\frac{1}{2}$ inches in height, but it had evidently been somewhat flattened and broadened by its occupants.

THE EGGS

There were no eggs in the early nest built in February. I believe the nest built in May in the coffee bush was pulled from the crotch by a toucan before completion. At the nest in the murta tree, three eggs were laid on consecutive days, May 27, 28, and 29. These were white and finely speckled all over with brown; the spots were closest together on the large end. In order not to place future studies in jeopardy, I did not risk removing them from the narrow cup for closer examination and measurement. The nest in the guava tree had held no less than three eggs, for this was the number of nestlings I found

in it. My latest nest in the *Goethalsia meiantha* tree contained two nestlings on July 12, 1949.

INCUBATION

As is true of the Blue-gray Gnatcatcher and the Black-tailed Gnatcatcher of the United States, both sexes of the Tropical Gnatcatcher incubate the eggs. I watched the nest in the murta tree from 5:20 to 11:43 a.m. on May 31 and from 1:42 to 6:10 p.m. on June 4. The morning of my vigil was bright and, toward noon, it became warm and sultry. The afternoon of June 4 was hot and oppressive, with the sun burning fiercely through gaps between the clouds. As the sun set, the clouds became heavier and the air grew cooler. At five o'clock a light rain began and soon became hard. The male and female gnatcatchers sat alternately in the nest, but only exceptionally, in the morning, did one remain at its post until the other came to replace it. Usually one went off, leaving the eggs uncovered until the other arrived from 2 to 21 minutes later. In the afternoon the nest was more constantly attended, being left unguarded for only two periods in contrast to eight periods in the forenoon.

The male's sessions on the nest were as follows (in minutes): a.m., 24, 55, 50, 19; p.m., 41, 53, 33; total, 275 minutes; average of 7 sessions, 39.3 minutes. The female's completed diurnal sessions were: a.m., 34, 32, 27, 28; p.m., 31, 27; total, 179 minutes; average of 6 sessions, 29.8 minutes. The nest was left unattended for the following periods: a.m., 13, 2, 14, 6, 3, 21, 10, 16; p.m., 12, 2; total, 99 minutes.

Both in the morning and in the afternoon, the male's sessions on the nest were substantially longer than those of the female. In the morning each of the partners sat until tired or hungry and then went to seek the other. Hence the lengths of the morning sessions depended entirely upon the volition of the incubating bird. In the afternoon, on the contrary, the sessions of the sitting gnatcatcher were as a rule terminated by the arrival of the mate to alternate on the nest. The male's stronger urge to incubate was manifested at this time by his shorter recesses. When a male and a female alternate on the nest and each sits until relieved by the other, the lengths of the absences are spontaneous, whereas the lengths of the sessions on the nest are determined by the length of time the replacing member is absent. Thus during the afternoon the three recesses of the female which I timed were, respectively, 53, 55, and 33 minutes; the three recesses of the male were 31, 29, and 32 minutes. Because the female had settled on the nest for the night when the male arrived in the rain at 5:50 p.m. and offered in vain to replace her, his last absence does not correspond in length with one of her sessions.

While I made these observations, I was seated in the open in a pasture only a few yards from the nest, but my presence did not disturb the birds. The bowl of the nest was so deep that only the bill, the top of the head, and the tail of the sitting gnatcatcher were visible above its rim. The long tail was tilted sharply upward, and its white under surface was the most conspicuous feature of the incubating gnatcatcher. When one of the pair arrived to replace the other on the eggs, it generally announced itself with a few fine nasal mews, whereupon the sitting bird left the nest. The male sang in the trees along the neighboring stream, and sometimes as he left the nest, but he did not sing, as does the male Blue-gray Gnatcatcher, while sitting on the nest. Once the male flew at a Yellow-green Vireo that was feeding a fledgling near his nest and drove the bigger bird away.

While incubating, both male and female gnatcatchers allowed me to come very close to the nest before they left. But whenever I walked directly beneath the nest while the female was sitting, she would leave the nest and drop in a graceful arc before rising to the tops of the low trees on the bank of the nearby river. She appeared to hang beneath her rapidly vibrating wings and to move with extraordinary slowness, seeming to float rather

than to fly from the nest. Doubtless her retarded flight was caused by the position of her tail, which was held upright and impeded her progress. It seemed that this slow flight might be for the purpose of enticing predators from the nest, as other birds attempt to lure intruders away from their nest by simulating a broken wing. The male gnatcatcher was more steadfast on the nest, and he sat for longer periods. To make him desert his post, it was not only necessary to stand directly beneath him, which sufficed to drive away the female, but it was also necessary to make noises. When the male finally left the nest, his flight was normal, not fluttering like that of the female. Only later, when he was driven from newly hatched nestlings, did he use the slow and apparently labored flight.

One afternoon, when the eggs were nearly ready to hatch, my attention was drawn to the murta tree by fine nasal mews uttered almost continuously. Suspecting that the nest of the gnatcatchers was in danger, I quickened my pace and found on my arrival at the nest a small and very slender snake coiled on a dead twig close beside it. The male gnatcatcher was darting within a few inches of the serpent's wide-open, menacing, red mouth, making feints of attack, and uttering the complaints which had drawn my notice. Without waiting to see the outcome of this drama in miniature, I seized a long stick and dispatched the snake. Despite the small size of this reptile, it could have swallowed the tiny eggs in the nest. The short trunk of the tree was clear of foliage, and I surmised that the snake had climbed up the flaky bark.

The eggs in the murta tree nest hatched on June 11, after 13 days of incubation.

THE NESTLINGS

The newly hatched gnatcatchers had dark skin entirely devoid of natal down; in this respect they resembled the young of Yellow-green Vireos. Their eyes were tightly closed, and the interior of their mouths was yellow. While I looked into the nest from a ladder, both parents flitted close about my head, uttering their thin, nasal mews. When I visited the nest again in the afternoon of the day on which the eggs had hatched, I found the male brooding. He bravely continued to cover the nestlings until I raised a mirror attached to the end of a stick. Then he jumped from the nest and flew across to the trees by the river with the slow, fluttering flight; his tail was held erect. This was the first time I saw him leave the nest in this fashion, although the female had done so earlier.

On the morning of June 13, when the young were two days old, I spent two hours watching the gnatcatchers attend their two nestlings; the third had vanished. In the period from 7:18 to 9:18 the male brooded four times, for 20+, 10, 14, and 16 minutes, making a total of about one hour. The female also brooded four times, for 22, 2, 25, and 7+ minutes, a total of 56 minutes. When, after brooding continuously for 25 minutes, the female flew away before the arrival of her mate, the nestlings remained unattended for 4 minutes.

Upon coming to replace its mate on the nest, the parent always brought a small insect, held in the tip of its long, slender bill. Thus the male, which was sitting when I arrived, brought food three times, and the female brought food four times. One of the insects brought by the male was too big for the tiny nestlings to swallow, and after trying in vain to make them take it, he ate it himself and then settled down to brood.

On the nestlings' fifth day, the female, when driven from the nest by my arrival, left in a novel manner. Instead of flying directly to the riverside trees, as had been her habit, she skimmed low over the pasture in the opposite direction with tail held erect in fluttering flight. She covered a distance of about fifty feet and came to rest in a low bush. When I followed and came near, she flew about fifty feet more in the same fashion, maintaining a height of about a yard above the low grass. I followed again, but could not make her give a third exhibition of the fluttering flight. This seemed to be the aerial

equivalent of the "injury-feigning" of a more terrestrial bird. The female gnatcatcher was not always consistent in displaying; in a single day I saw her leave the nest not only with ordinary but also with fluttering flight.

On the fifth day after the eggs had hatched, two of the three nestlings had vanished. Before the third young gnatcatcher was feathered, my sojourn in this region came to an end.

Five years passed before, on June 18, 1945, I found another nest of the Tropical Gnatcatcher situated, as already mentioned, in the top of a guava tree behind my study. I was led to discover it by the sharp nasal cries of the young birds that reached me through the open windows. The three nestlings were already well feathered and bore a fairly close resemblance to the female. All had gray crowns and upper plumage, white underparts, and white outer feathers on their stubby tails. When they opened their mouths for food, they revealed bright lemon-yellow linings. Whenever I stood beneath the nest, the male seemed more perturbed than the female and flitted among the boughs close above me, mewing sharply. Once he ventured very near, then he flew away from me with the slow fluttering flight that I had witnessed so often at the earlier nest. I did not see the female of this pair fly in this manner.

I soon discovered that the parent gnatcatchers, after a slight initial uneasiness, would attend their nestlings while I sat in full view rather close to the nest. I devoted a total of seven hours to watching them. The number of feedings in each hour of my watch is recorded in table 1.

Table 1

Hourly Rates of Feeding of Three Feathered Nestlings of the Tropical Gnatcatcher

Date and hour, 1945	Weather	Feedings by		
		Male	Female	Both
June 19, 6:30-7:30	Intermittent sunshine	23	19	42
7:30-8:30		21	21	42
8:30-9:30		20	21	41
12:30-1:30	Cloudy, threatening	32	11	43
June 18, 2:30-3:30	After shower in early afternoon, sultry	14	13	27
3:30-4:30		23	6	29
4:30-5:30		27	8	35
Totals: 7 hours		160	99	259

It can be seen from table 1 that the male was far more active in feeding the nestlings than the female. At other nests I had found the male more zealous in building and incubating. In five of the seven hours he brought food more often than the female; in one hour both parents came with food an equal number of times; and in one hour the female brought food one more time than the male. So far as I could learn only insects were brought, a single one at each visit. Most of these insects were small, but a few of them were large. Among these were a big green caterpillar and some green orthopterons which the nestlings swallowed with difficulty, leaving the long legs protruding from their mouths. I tried to learn whether the female, to compensate for her less frequent feedings, brought on the average larger objects than the male. But the parents often darted up through the foliage and poked the food into an open nestling mouth so rapidly that it had been swallowed before I could train my binoculars on the nest. Thus I found it impossible to decide this point. Both parents brought chiefly small and middle-sized

insects, with occasionally a conspicuously big one. The food was found mostly amid the foliage through which the gnatcatchers flitted with amazing swiftness and agility, seeming never to tire and need a rest.

The nestlings were active and noisy. When food was brought to them, they cried with a peculiar shrillness that bore a certain resemblance to the mewing calls of their elders, and at the same time they vibrated their wings rapidly. From time to time one would hop up on the rim of the nest, but it did not remain there long. Occasionally the young would beat their wings and preen.

These young gnatcatchers left the nest between 9:20 and 11:15 on the morning of June 20. At the latter hour the nest was empty, but one youngster was perched beside it. In the next few minutes it hopped farther off through the crown of the tree. In the afternoon the family vanished from the yard and was not seen again. When I removed the empty nest, I found it swarming with lice. This explained why the parents, after feeding the nestlings, so often plucked invisible objects from their feet.

A HELPER AT A TANAGER'S NEST

On May 24, 1953, an unusual amount of activity among a group of birds drew my attention to a small nest that was half concealed by the clustering foliage at the outside of the rounded crown of a copalchí tree which was standing in the pasture in front of our house. Two Golden-masked Tanagers and a female gnatcatcher were interested in this nest, and it soon became evident that all three were attending the nestlings. The first question that arose in my mind was whether the structure had been built by the tanagers or by the gnatcatcher and whether its occupants were young tanagers, young gnatcatchers, or perhaps a mixture of the two. Its height, 24 feet up at the end of a long, slender branch, prevented a close examination, and I had, perforce, to rely upon what I could see from the ground. Although small, the open cup appeared too bulky to belong to the gnatcatcher, and furthermore it contained more moss than one usually finds in nests of this species. At meal time two heads would sometimes rise far enough above the rim to be seen from the ground, and the gaping mouths revealed the red interior typical of nestling tanagers rather than the yellow interior of those of gnatcatchers. The fact that two tanagers and only one gnatcatcher took an interest in this nest likewise indicated that it belonged to the former; for at a normal nest of the gnatcatcher both parents are in attendance. Later, when the nestlings became feathered, I had no doubt that they were young Golden-masked Tanagers. When the nest was discovered, it was too late to learn how the female gnatcatcher had become interested in it.

My first extended observation of this unusual nest was on May 25, from 7:00 to 8:30 a.m. In this period the two tanagers fed the nestlings 13 times, usually coming and going together as is their custom. The female brooded three times for 6, 4, and 7 minutes. It was more difficult to see how often the gnatcatcher brought food. Frequently the object in her bill was very small, and, unlike the tanagers, who usually approached the nest from the outer air, she would sometimes make her way to it through clustering foliage that screened her from view. At times I could detect nothing in her bill although I could see her clearly as she approached the nest. A few times she carried to the nest what appeared to be downy building material rather than food. I never saw the nestlings stretch up above the nest's rim to take food from the gnatcatcher as they frequently did when the parent birds arrived with food. Often the gnatcatcher brought very small objects, doubtless insects, which disappeared when she lowered her long bill into the nest; from the ground I could not see what happened to these objects. It seemed that the gnatcatcher brought food as often as either one of the parent tanagers.

Early in the morning, the gnatcatcher spent much time passing restlessly over and

around the nest. Later she devoted considerable periods to resting on its rim, her breast projecting inward over the nestlings. More rarely she seemed to brood, but apparently she was not comfortable, perhaps because either the nestlings or the nest were too big for so diminutive a bird. She spent much more time with the nestlings than the female tanager who ranged far afield with her mate, searching for food.

If the gnatcatcher was sitting on the nest when the tanagers approached, she would leave as they came near. Then she would protest vigorously their presence, darting at and around them, often with her tail spread to reveal the white outer feathers that contrast with the dark central ones; sometimes she darted at the tanagers with her wings drooping. However, I did not see her strike the parent birds; they usually ignored these hostile demonstrations. While the female tanager calmly brooded, the smaller gnatcatcher would flit restlessly around the nest and display. Although the helper obviously resented the presence of the parent birds, the latter rarely revealed displeasure at the intrusion of the gnatcatcher. At most, the tanagers would make a mild, ineffective dart in the direction of their defiant assistant.

Sometimes, after feeding the nestlings, a tanager would pick at the nest. The gnatcatcher did this more often with her sharp bill, seeming to remove vermin or refuse from it. Once she plucked a billful of what appeared to be downy material from the nest, and, after holding it for a while, she swallowed it. Once she carried a small particle away. Although I did not see the gnatcatcher remove a dropping, it was evident that this voluntary assistant engaged in all the parental activities—feeding, brooding, cleaning, and even defense, against the true parents!

On the following day I watched later in the morning, from 9:50 to 11:15. The female tanager brooded from 10:00 to 10:08. At 10:25 the gnatcatcher fed one of the nestlings, then she settled down to brood them. It was a very hot day, and, despite the canopy of foliage above the nest, the gnatcatcher panted with open mouth, while the two nestlings stretched their heads up in front of her, also panting. After sitting for six minutes, the gnatcatcher left as the female tanager arrived to feed and then to brood the young. The smaller bird flitted around the tanager, displaying with spread tail and uttering a sharp nasal *chaa*. Then the gnatcatcher went off, leaving the tanager panting in the nest with the nestlings' gaping mouths stretched up in front of her. After a while the gnatcatcher returned with a comparatively large particle of food. For several minutes she hopped and flitted around the brooding tanager, wishing to give the food to a nestling but not daring to do so while the larger bird covered them. She did not offer the food to the brooding female, as the male tanager or an assistant of the same species might have done. When she ventured too close to the female tanager, the latter pecked mildly in her direction. Soon the gnatcatcher swallowed the morsel and flew away.

The next day, May 29, I watched this fascinating nest from 8:12 to 10:12 a.m. In these two hours the tanagers fed their nestlings 37 times; they came together 17 times, thus accounting for 34 of the feedings. The female gnatcatcher brought food at least 10 times, and possibly more. She spent many minutes flitting in what seemed an aimless fashion about the nest, and amid the dense foliage she may have caught insects which she passed to the nestlings. Her long delays at the nest contrasted with the directness of the tanagers in coming and going. Although the female tanager did not brood the nestlings at this time, the gnatcatcher did for intervals of 6 and 3 minutes. Each of her sessions was interrupted by the approach of the parent birds with food. Their arrival caused the gnatcatcher to jump from the nest and flit around with spread tail to protest their presence; the tanagers ignored her. Compared with the bulky meals of fruit which the tanagers brought, the insects delivered by the gnatcatcher formed a small proportion of the nestlings' diet, but they served to vary it.

On May 30, I discovered that the male gnatcatcher, which I had seen infrequently on the preceding five days, was building a nest in the same tree. This nest was about three yards from and slightly higher than the nest of the tanagers. The neat cup seemed already to have attained its full size, although it looked small indeed when compared with the tanagers' bulky structure. For two hours the male gnatcatcher continued to build with no assistance from his mate, although once she came to inspect his work. He brought chiefly cobweb which he carefully applied with his long bill to the lichen-encrusted outer surface of the nest. He bent far over the side while he sat within the cup and worked with a sideward motion of his head. After finishing his nest, the male gnatcatcher rarely visited the copalchí tree in the pasture, for he did not become interested in the young tanagers. Although I saw little of him, I often heard his song coming from the nearby woods.

Meanwhile the female gnatcatcher continued to be engrossed in the nestling tanagers. Since she had not learned to cooperate harmoniously with the adult tanagers, her attendance at the nest degenerated as the days passed into an effort to keep the parent birds away from their progeny. She spent far more energy protesting the approach of the busy parents than in bringing food to the young. Nearly every time the tanagers came to the nest she darted around and at them, tail spread and wings sometimes expanded. They retaliated by darting at her more often than previously. I witnessed several lively bouts, in two of which the male gnatcatcher joined, apparently more to defend the vicinity of his own nest than because he was interested in the activity at the tanagers' nest. Thus, at times, there were four colorful little birds flying at each other in the foliage, but I did not see one bird strike another. In addition to this chasing in the nest tree, the female gnatcatcher often pursued the tanagers as they flew from the edge of the neighboring woodland to the tree in the pasture. She also chased them as they returned to the woods to hunt for more food. In two hours the parents fed the nestlings 36 times; they came together 15 times, thus accounting for 30 feedings. I credited the gnatcatcher with only 6 or 7 feedings; but, with so many diverse activities to watch, it is possible that I overlooked some of the feedings. It was clear that the parent birds brought the great bulk of the nestlings' food.

The young tanagers, now well feathered, left their nest on June 5, 12 days after I had found them with the gnatcatcher already in attendance. Throughout this period the gnatcatcher continued to show great interest in them. But in the last few days she fed them only once or twice in an hour, or sometimes she did not feed the young at all. The parents continued to bring food at their usual rate of 17 to 22 times an hour for each of them. I wondered whether the decline in the rate of feeding of the nestlings by the gnatcatcher came about because the young tanagers, which were now feathered and stood up in the nest or on its rim to flap their wings in vigorous exercise, distinguished her from their parents and did not open their mouths as she approached. Possibly she brought less food because she devoted an increasing amount of time to her futile attempt to keep the parent birds away by posturing, threatening, and pursuing them as they flew back and forth between the woods and the nest.

It was evident from these observations that, in feeding the nestling tanagers, the female gnatcatcher was actuated by a parental impulse rather than by a social impulse. She showed a strong solicitude for the nestlings, but cooperation with the parent birds in caring for the young was not her intention. In this she differs from the Golden-masked Tanagers which sometimes have the assistance of an extra adult or a young bird of an earlier brood in rearing their young. In this case all the attendants often come and go together, proving that there is a true social bond as well as a parental instinct among them.

Which of these two motives is primary and which is stronger is difficult to decide. Perhaps the helpers feed the young because they have formed the habit of flying with the parents and are led by the contagion of behavior in social creatures to do as the parents do. However, it is equally possible that these assistants accompany the parent birds because they have somehow found the nest and have been led by parental impulses to care for the young, and, because they are engaging in the same activity as the parents, they find it pleasant to come and go with them. Only a careful study of the way in which this cooperation develops in a particular instance could yield the information necessary for determining this point. In species in which helpers are the exception rather than the rule, one is not likely to observe the earliest stages in the development of this association. It is clear, however, that the participation of the gnatcatcher in the rearing of the young tanagers did not lead to increased friendliness between her and the parent birds. On the contrary, their antagonism became more accentuated as the days passed. If the gnatcatcher had been more equal to the tanagers in size and strength, this enmity might have interfered seriously with the rearing of the brood. As it was, the young tanagers suffered no harm, and possibly they benefitted by the addition of insects to their diet. The gnatcatcher herself was apparently diverted from producing a brood; as far as I could tell, she laid no eggs in the nest which her mate had built.

SUMMARY

The Tropical Gnatcatcher lives in light second-growth woods, coffee plantations, and shady pastures from sea level up to about 4500 feet. It searches restlessly through the foliage for its insect food, usually staying well above the ground. It remains paired throughout the year.

The male's song is a simple, melodious trill, which in the valley of El General is heard from February until June or July.

In El General, nest building may begin in early February. The nest is a dainty, compact cup of fine, fibrous materials, encrusted on the outside with lichens, bits of green moss, liverworts or algae, and wefts of spiders' cocoons. It is placed in a bush or tree from about 6 to 25 feet above the ground. Both sexes build, sometimes the male and sometimes the female taking the greater share. One male built alone while his mate attended nestling tanagers. While building, the gnatcatchers are almost fearless of man.

Two sets consisted of three eggs, laid in May, and a set of at least two eggs was laid in June. The eggs are white, finely speckled with brown.

Both sexes incubate. In 9 hours and 15 minutes at one nest, 7 sessions of the male averaged 39.3 minutes and 6 sessions of the female averaged 29.8 minutes. The nest was left unattended for 10 periods averaging 9.9 minutes. The female occupied the nest by night. At this nest the incubation period was 13 days.

When driven from eggs or young, one female would leave the nest with a peculiar, slow, fluttering flight; her tail was held erect and her speed was reduced. Her mate rarely flew in this spectacular fashion, which appeared to be an aerial distraction display. When a small snake menaced the nest, the male darted close to its head.

Newly hatched gnatcatchers have dark skin, devoid of natal down, and tightly closed eyes. The interior of the mouth is yellow. Both parents brood and feed the young with small insects, but at one nest the male brought food much more often than the female. In 7 hours, three feathered nestlings were fed 160 times by the male and 99 times by the female, making a total of 259 feedings, or 12.3 times per nestling per hour. The nestling period is unknown.

A female gnatcatcher fed and brooded two nestlings of the Golden-masked Tanager, and she also cleaned the nest. She was antagonistic to the parents, making continual,

futile efforts to keep them away from the nest. They, in turn, usually ignored her unless she became very annoying. The gnatcatcher's attendance on these nestlings lasted at least twelve days and was terminated only when they took wing. As days passed, however, she devoted less time to caring for the young and more time in attempting to drive the parents away. While the female was so engaged, her mate built a nest in the same tree without her help. She took little interest in this nest and apparently failed to lay eggs in it.

LONG-BILLED GNATWREN

Ramphocaenus rufiventris

In the undergrowth of the lowland forests of Central America and northwestern South America lurks a very small bird with a bill of such extraordinary length, for a passerine species, that ornithologists have been perplexed as to its classification. It has been placed in families so diverse as the Formicariidae and the Sylviidae. Modern systematists mostly agree that this bird and its South American congeners are true song-birds, and they place the genus in the Sylviidae.

The Long-billed Gnatwren is about four and three-quarters inches in length; it is olive-brown on the forehead, crown and hindneck and grayish olive on the back and wings. The sides of its head and neck are bright cinnamon. Its dusky tail feathers bear graduated white tips. The under parts are grayish tinged with tawny except for the throat, which is white spotted with black. The surprisingly long, slender, straight bill equals the head in length and is horn-colored. The sexes are similar in appearance.

The species ranges from southern México to western Ecuador. Throughout Central America it inhabits the lowlands of both coasts, but it is absent from the cacti and thorny scrub of the more arid districts of the Pacific littoral. I found it especially abundant in light woodlands and tall thickets on the Peninsula of Nicoya in Costa Rica. On the Pacific slopes of both western Guatemala and southern Costa Rica, I have traced the gnatwren up to about 3000 feet. On the Caribbean slope it doubtless occurs at least as high, although I have no record of it above 2000 feet.

The Long-billed Gnatwren inhabits both the primary forest and tall, dense second-growth thickets. It keeps near the ground or ascends the vine tangles to a height of twenty or thirty feet, but apparently it never ventures far up into the crowns of large trees. The species seems to prefer dense, tangled vegetation. It hops, flits, and climbs through the vine tangles like a long-billed wren, loosely wagging its long, narrow, white-tipped tail up and down in a deliberate fashion, as it ceaselessly searches for the small insects upon which it subsists. Male and female keep close company throughout the year.

VOICE

The Long-billed Gnatwren's song is a beautiful, clear, long-continued, trilled whistle which is all on the same key. This exquisite trill is deliberate and dreamy rather than rapid and vivacious, and it sounds far away even when the bird is near. This is misleading for the bird watcher and makes it difficult for him to trace the song to its source. The trill is given, I believe, by the male alone, and, in the valley of El General, it is heard throughout the year. There is also a dry trill, very much like the liquid trill in form, but of quite different tone quality. The gnatwren also utters clear, staccato whistles which are surprisingly loud for so small a bird. When angry or alarmed, it sounds a sharp, wren-like ticking, now fast, now slow, and also a low, dry *churr*.

THE NEST

In twenty years of bird watching, I have succeeded in finding only a single nest of the gnatwren. This was discovered in the neighborhood of San Isidro del General, Costa Rica, at an altitude of about 2000 feet above sea level. On the morning of April 4, 1939, while walking at the edge of the forest, I heard the beautiful, even trilling of a gnatwren. While I stood listening, the bird flew into a tangle of vines above me, loosely wagging its



Fig. 6. Long-billed Gnatwren

long tail up and down in characteristic fashion. Here it voiced a number of clear, single whistles followed by a dry trill. Then, becoming silent, it plucked some fine bast-fibers from the bark of a vine, and, with these in its long, slender bill, flew off with its mate. I tried to follow them and find the nest they seemed to be building, but they vanished.

The following day I again heard the beautiful trill, and, guided by the sound, I found the birds. They were about fifty yards from the point where the male had plucked the fibers from the vine. I saw one of the pair gather some fibrous material from among

a mass of epiphytes on a thick trunk and fly away with it. But once more the birds were difficult to follow through the dense undergrowth of the forest, and I did not succeed in meeting them again.

The next day I determined to make the utmost effort to follow the gnatwrens to their nest. Arriving early in the morning in the part of the forest where I had last encountered them, I had not long to wait for the male's song; by following it I again found the pair. One of them was gathering small dry leaves from a slender, scrambling bamboo which formed an impenetrable tangle at the edge of the woodland near the river. The bird selected these leaves with care, and when it had a billful dropped down almost to the ground with them. I felt sure that here at last would be the nest; but in a moment the bird flew off with its leaves, accompanied by its mate. The forest in this place was light and low, with a dense undergrowth of bushes and saplings bound together by a profusion of vines. Slowly I struggled after the birds, which were out of sight before I could begin to move. After proceeding a short distance, I heard them behind me and accordingly reversed my direction. Finally I paused in a more open spot to look about me. I stood there possibly a minute, scrutinizing the bushes and vine tangles around and above me, before I became aware that the nest I so eagerly sought was in view; it was much lower than I had expected it to be.

The nest was situated in a patch of selaginella at the top of a low bank which was separated from the current of the winding Quebrada de las Vueltas by a narrow, level strip of ground overgrown by a tangle of bushes and vines. Supported between the slender, upright stems of the selaginella, the deep, thick-walled, open cup was only eight inches above the ground. The outer layer was of green moss, bound together with cobweb. The generous middle layer of the wall was composed of many small, dry leaves of the scrambling bamboo. A few fine fibers resting upon these suggested that a fibrous inner layer or lining was about to be added. The nest was well screened above by the flat, many-branched shoots of the selaginella and by the overarching frond of a fern.

I concealed myself as best I could among the bushes near the riverside and waited, hoping to see the gnatwrens at work on their nest. One came with fibers in its bill and sat in the nest, apparently not having noticed me, but upon seeing me it promptly fled. After that I waited an hour but the birds did not return. Much as I wished to watch them at work, I dared not disturb the surroundings by setting up a blind. Forest nests have such a precarious existence that I did not wish to increase, in the slightest degree, the possibility of losing this one before the full set of eggs had been laid.

I had found the nest on April 6. Two days later it was thickly lined with fine fibers and appeared to be finished. It now measured 4 inches in outside diameter and 4 inches in height. The cavity was $2\frac{1}{8}$ inches in diameter by $1\frac{3}{4}$ inches deep.

Apparently the only other nest of this species which has been described was that found by Eisenmann (1953:369) on July 15, 1950, near the city of Panamá, Panamá. It was in a damp thicket, about 15 feet from a narrow stream used as a drainage ditch, which was shaded by trees of fair size. It was described by the finder as follows: "The nest was an open cup built among the vertical shoots of a small shrub, about six inches off the ground. It was composed chiefly of grass-stems, with a few twigs and dried leaves, and to the exterior were attached several large dried leaves that hung loosely along the sides and extended below the nest proper, forming a sort of ornamental skirt. Measurements: exterior diameter, 4 inches; interior diameter, 3 inches; exterior depth, 5 inches; interior depth, 3 inches."

The nest of the South American *Ramphocaenus melanurus* has been found more often. In Trinidad, according to Belcher and Smooker (1936:808), this species breeds about two months earlier in the high-level evergreen forests than it does in the drier

monsoon-type scrubs near sea level. Although Belcher and Smooker apparently discovered a number of nests, they gave details of only one which was collected on April 23, 1933, in the Mora Forest near Sangre Grande. This nest was "deeply cupped, composed of dried grasses, leaves, and moss, all intertwined, and lined with brownish black fibers. It was placed in the upright fork of a topped sapling about 18 inches from the ground. The space between the bottom of the nest and the base of the fork (almost at ground-level) was filled with materials similar to those above described, apparently placed there to support the nest itself." Sick (1954:181) found this species building in Espirito Santo, Brazil, in December, but he fails to give details of his observations. He cites, however, other records of the nesting of this gnatwren in Brazil.

THE EGGS

Six days elapsed between the completion of the nest I had found and the appearance of the first egg on April 14. The second egg was laid the following day. These eggs were white, lightly sprinkled with fine, pale cinnamon spots over the whole surface, with these markings heaviest on the thick end. They measured 19.8 by 14.3 and 19.1 by 13.5 millimeters.

Two eggs appear to be the number usually laid by *Ramphocaenus*. The nest of *R. rufiventris* discovered by Eisenmann (1953) held two nestlings in July, and Belcher and Smooker (1936) found two eggs in the nest of *R. melanurus* in Trinidad.

INCUBATION

A few days after the laying of the second egg, I set up a blind in the undergrowth to study the mode of incubation. When I took my place within the blind at 5:35 a.m. on April 20, it was still too dark to distinguish the bird in the nest. At 5:53 the male trilled once as he approached through the dimly lighted undergrowth. The female, which had been invisible, hopped out of the nest and departed. The male settled down to incubate, disappearing from view as he sank into the deep cup. Half an hour later an Orange-billed Sparrow hopped within a hand's breadth of the incubating gnatwren, but it appeared not to notice the nest. The gnatwren paid no attention to the larger bird. At 6:42 the male ended his 49-minute session when the female came in silence to relieve him. I continued my vigil until 12:10 p.m.

The following day I watched from 12:52 until 6:10 p.m. when it had grown so dark that I could no longer see the bird in the nest. I could only distinguish the male by his song. But during the afternoon I did not hear him sing, and so I had no direct means of knowing which sex sat on the nest. By assuming that the female entered the nest at 5:59 p.m. and remained for the night, I could then designate the sex of the incubating bird for each of the five sessions I had timed that afternoon; for the two birds alternated regularly, each sitting constantly until the arrival of the mate.

Morning and afternoon, the gnatwrens kept their two eggs continuously covered, save for the few seconds occupied by the change-over. Except for the first and last sessions of the day which were taken by the male, all of the sessions that I timed lasted for an hour or more. The longest session recorded was one hour and 35 minutes. The male's sessions were, respectively, 49, 89, 95, 88, and 14 minutes. Those of the female were 60, 84, 85, and 90 minutes. If I was correct in believing that the male alone sang, and I found no evidence to the contrary, then the female also took the long night session; for the male sang as he came to replace her at dawn on April 20. The male's five sessions totalled 335 minutes and averaged 67 minutes. The female's four diurnal sessions totalled 319 minutes and averaged 79.8 minutes. In the course of the day the two shared fairly equally in incubation.

Except in the early morning, when the male gnatwren's song announced his coming, the first intimation of the absent partner's return was usually the departure of the incubating bird from the nest. Then, looking up into the tangle of vines and bushes in front of the blind, I would see the newly arrived bird, which apparently had approached through the top of the understory of the woods. Then, by a series of hops or very short flits, often clinging to quite vertical stems, the bird would slowly and deliberately make its way down to the nest. Meanwhile, the bird which had been sitting would make its way from the nest in the same deliberate fashion, hopping and flitting from twig to twig, sometimes sidling up a slender erect stem, until it had gained the altitude at which I had first seen the other, when it would take flight and immediately be lost to view amid the foliage. As the gnatwrens hopped down or up, they slowly and loosely wagged their long, narrow tails. The change-over on the nest was effected with the utterance of a few very low *chips*.

Once settled in the nest, the birds always sat facing the river. From time to time they would rise up to turn the eggs. They sat nearly motionless at first, but toward the end of a long session they would grow restless and move their heads a great deal. Once a lizard, about a foot in length, passed beneath the low nest and hunted among the ground litter very near it. The male gnatwren, then on duty, sat calmly, only rising up slightly in the nest as the lizard passed.

One egg hatched on May 1, the other hatched on May 2, giving an incubation period of 17 days.

THE NESTLINGS

The nestlings were covered with skin of a dark flesh-color, totally devoid of natal down. They were, of course, sightless, and the interior of their mouths was yellow. Their feather rudiments developed rapidly; the pinfeathers pushed through the skin when the young were two days old. These feather sheaths became rather long, as in antbirds (*Formicariidae*), and the feathers themselves did not begin to escape from them until the nestlings were six days old. The plumage then expanded rapidly, with the result that the nestlings were well clothed when seven or eight days old.

On the day when the nestlings were, respectively, two and three days old, the parent covering them allowed me to come within arm's length before quitting the nest. Then it scolded with a low *churr* from the undergrowth. This was the nearest I was able to approach to one of the pair while it sat.

On May 9, when the nestlings were respectively seven and eight days old, I devoted three hours to watching the nest from the blind. In the first hour (5:40 to 6:40 a.m.) the parents fed the young 13 times; in the second hour (6:40 to 7:40), 8 times; in the third hour (7:40 to 8:40), 6 times. Both parents brought food, a single item at a time, and frequently they arrived together to feed the young; but since the birds were similar in appearance, I could not tell which parent brought more food. The nourishment of the nestlings consisted chiefly of small insects; occasionally I recognized a small moth or a minute spider in the bill of a parent.

The parents still approached the nest from above, as they had when incubating, but now they seemed to make their way to it with exaggerated caution. I would first see them in the canopy of bushes and vines twelve or fifteen feet above the ground. From this point, they seemed greatly averse to employing their wings, and proceeded downward, wherever possible, by sidling down thin vertical stems, turning from side to side as they went, and loosely wagging their long, slender tails. When they had descended as far as possible on the first stem, they would deliberately shift to another, reaching it by hopping from one to another of the intermediate twiglets. They used their wings only

when other modes of progression could not profitably be used. The usual path for reaching the nest was down the slender stem of a *Piper* bush which formed a convenient stairway from the clustered foliage above. However, the base of this stem was still several yards from the nest, so that when they had descended to within a few feet of the ground, they hopped to a thin, obliquely ascending vine that grew close to the nest. They then hopped upward along this vine for the distance of a yard. Although by this course they ascended higher above the nest, the vine led them to some low bushes with close-set branches through which they could hop downward to the nest. They did not stand upon the rim of the nest, as most birds do while feeding the young, but clung to the slender, upright stem of one of the supporting selaginella plants which was two or three inches above the nest. Clinging there, they stretched downward and with the tip of the long bill placed the single insect into the upraised, gaping, yellow mouth of a nestling.

The parents' departure from the nest was a reversal of their arrival. Hopping, flitting, and sidling along slender stems as they had previously, but now proceeding upward, they slowly and deliberately worked their way up to the region where the foliage of the undergrowth was most dense. From this place they took flight. Only when they removed a dropping from the nest did they leave in a more direct manner, flying away with their burden through the lowest stratum of the forest vegetation.

I do not know the reason for the gnatwrens' slow and laborious approach to their nest unless perhaps by this gradual, deliberate advance the birds could survey the surroundings from various angles and so detect danger before revealing the position of the inconspicuous nest. Once, when a parent was half way down the long, vertical stem that served as a ladder, it suddenly paused for several seconds. Alarmed by something, it reversed its direction, and when it had gained sufficient altitude flew off through the underwood, scolding with rapid, ticking notes. I could discover no cause for this retreat, unless it was the large but harmless Squirrel Cuckoo which was foraging among the vine-tangles above. While the slow approach to the nest might have been of value for the reason suggested, I can explain the equally deliberate departure only as a reversal of the former.

The male gnatwren sang a good deal early in the morning, within hearing of the blind but out of sight. Once he forgot himself so far as to trill near the nest. Usually the gnatwrens were silent while in the immediate neighborhood of the nest. The nestlings, nearly feathered, were brooded only twice during the 3 hours of my vigil, once for 21 minutes and once for 34 minutes. Each period of brooding was terminated by the arrival of the other parent with food.

By the afternoon of May 13 one of the nestlings had left the nest. Army ants were swarming over the ground and the low vegetation close by, and I feared for the safety of the little birds. But the younger, at least, came through the night unharmed in its nest and doubtless the one in the open did, too.

Next morning, May 14, at ten o'clock, I found the mossy nest empty. Assuming that the two nestlings had left in the order of their age, each quitted the nest when twelve days old. Guided by the scolding of one of the parents, I found a fledgling perching upon a slender, severed stem of bamboo, about a foot above the ground and thirty feet from the nest. It stuck to its perch while I gently lifted it for a closer examination; but, before I had completed my scrutiny, the little bird suddenly took flight. Still weak upon the wing, it covered only about two yards on a descending course before it struck the ground. Then, as I pursued, it continued to fly and flutter ahead of me, never rising far above the litter of dead leaves on the floor of the forest. As it fled it uttered clear, churring notes. The parent scolded with a sharp, wren-like ticking, varying considerably in the rapidity with which the notes followed each other, and also gave a low *churr*.

The upper plumage of the fledgling gnatwren was grayish brown. The head and hind-neck, instead of being rufous-brown and contrasting sharply with the back and rump as in the adults, were of a shade only slightly browner than the more posterior upper parts. I was not given the opportunity to see very clearly the lower plumage of the young gnatwrens. I had not lifted them from the nest for fear of hastening their departure, and I did not continue pursuing the fledgling, for a disturbance in the forest might have attracted enemies. There was a *tórsalo*, or flesh-fly larva, on the young gnatwren's chin.

THE TAXONOMIC POSITION OF RAMPHOCAENUS

I had hoped that my study of the nest life of the gnatwren would yield information which might help to settle the question of the taxonomic position of this genus. Were it a matter of deciding whether a species belongs in the Formicariidae or an oscine family such as the Fringillidae, Thraupidae, Parulidae or Turdidae, observations at the nest would supply details of critical importance. We should then have the contrast between the long incubation period of the antbirds and the usually shorter incubation period of songbirds of about the same size, incubation and brooding by both parents *versus* incubation and brooding by the female only, and the absence or presence of natal down. But in these points some of the undisputed members of the Sylviidae, in which family the gnatwren has usually been placed by those who regard it as an oscine, bear a surprising resemblance to typical antbirds. We may take as a representative of the Sylviidae, or Old World warblers, the genus *Polioptila*, whose allocation to this family is generally conceded to be correct. In the gnatcatchers of the genus *Polioptila* both sexes incubate and brood, the young are devoid of natal down, and the interior of the mouth is yellow, exactly as is true of the majority of the antbirds that I have studied. So far as these points are in question, *Ramphocaenus* might equally well be placed with the Sylviidae or the Formicariidae. The incubation period of 17 days, very long for so small a bird, suggests that the gnatwren is an antbird rather than an oscine. However, this determination was made at a single nest, and it can be matched by that of other small oscines, for example the Buff-rumped Warbler, whose incubation sometimes takes 17 days. Even the song of the gnatwren, which consists of the rapid reiteration of the same note, is of a type common enough in the antbirds, as in other families of the suborder Tyranni, including the ovenbirds (Furnariidae) and the woodhewers (Dendrocolaptidae); yet at the same time it bears a certain resemblance to the song of the Tropical Gnatcatcher. For the decision as to where *Ramphocaenus* should be placed in the taxonomic system we must rely, therefore, upon morphological studies such as those of Rand and Traylor (1953) and Sick (1954), who conclude that this genus is best placed in the Sylviidae.

SUMMARY

The Long-billed Gnatwren inhabits both primary rain forest and tall, dense second-growth woodland, where it hunts insects in the vine tangles, usually within 30 feet of the ground. It is found in pairs throughout the year.

The male's song is a beautiful, long-continued, trilled whistle, all on the same key. In southern Costa Rica it is heard in every month of the year. Several other notes are described.

The nest, a compact open cup, is placed in dense vegetation, 6 or 8 inches above the ground. Apparently only two nests have been found, one by the author in Costa Rica, which held two eggs in April, and one by Eisenmann in Panamá, which contained two nestlings in July.

At the Costa Rican nest both sexes incubated, taking approximately equal shares by

day. Five of the male's sessions averaged 67 minutes, while four diurnal sessions by the female averaged 79.8 minutes. The parent birds together kept the eggs covered throughout the day. Apparently the female incubated by night. The incubation period was 17 days.

Both parents fed the nestlings, bringing each time a single small insect or spider. This they delivered while clinging to an upright stem beside and a few inches above the nest and stretching far downward to reach a nestling's mouth.

In approaching and leaving the nest and young, both parents used, in exaggerated form, a peculiar method which they had followed in the course of incubation. They would first appear in the canopy of foliage four or five yards above the nest; from there they would make their way slowly and cautiously downward by sidling along thin vertical stems, hopping from one to another, and flying only when other modes of progression were impracticable. Their departure was a reversal of the method they had used in approaching the nest.

When newly hatched, the nestlings had skin of a dark flesh-color and they were wholly devoid of down; the interior of their mouths was yellow. The pinfeathers developed rapidly and became conspicuously long before the plumage began to expand, when the young were six days old. A day or two later the young were covered with feathers. They left the nest when 12 days old.

Because of similarities in the nest life of the antbirds and certain Sylviidae, such as *Polioptila*, these observations fail to help decide whether *Ramphocaenus* should be placed in the Formicariidae or the Sylviidae. As far as its nesting habits are concerned, this genus might with equal reason be classified in either of these families.

GENERAL SUMMARY OF INFORMATION ON THE SYLVIIDAE

The Sylviidae, in which the gnatcatchers and gnatwrens are usually but perhaps incorrectly placed, is a huge family consisting of about 400 species, nearly all of which are confined to the Old World. Some ornithologists, for example, Mayr (1946:67) reduce this family, along with several other well known families, to the status of a subfamily in the Muscicapidae, which then becomes a vast, unwieldy aggregation containing about 1400 species. Apart from *Acanthopneuste*, an Old World genus which has extended its range to western Alaska, the New World contains only four genera of the Sylviidae as conventionally understood: *Regulus*, *Polioptila*, *Ramphocaenus*, and *Microbates*, which together contain about 14 species. These are, like most of their Old World relatives, very small, slender-billed, active birds, nearly or wholly lacking in brilliant colors. Sexual differences in plumage, when present, are chiefly confined to the markings of the head. Most exceptional in this family are the exquisite fairy wrens (*Malurus*) of Australia, in which blue, purple, red, and white are prominent in the plumage of the males; the females are more plainly attired.

Those species of the Sylviidae which nest in the more northern parts of North America are migratory, but their annual journeys are not nearly so long as those undertaken by many of the northern wood warblers (Parulidae). Some of the Old World Sylviidae, however, make very long migrations. Annual changes in plumage are as a rule not conspicuous in these generally dull-colored birds. The males of a number of species of *Polioptila*, including the Blue-gray, Black-tailed, Black-capped, and White-lored Gnatcatchers, lose part or all of the black from their heads after the close of the breeding season; but the males of the non-migratory Tropical Gnatcatchers wear the same black caps throughout the year. Non-migratory species, such as the Graceful Warbler of Egypt (Simmons, 1954:266), the Black-tailed Gnatcatcher of California (Bent, 1949:376), the Tropical Gnatcatcher, and the Long-billed Gnatwren of Central America, remain in pairs at all seasons.

The food of the Sylviidae consists principally of insects, spiders, and other minute invertebrates and their eggs. The gnatcatchers and gnatwrens eat only negligible quantities of vegetable food, but a number of Old World warblers, especially of the genus *Sylvia*, vary their diet with small fruits and berries, and the kinglets (*Regulus*) also eat a small amount of fruits and seeds. The Long-billed Gnatwrens hunt in the dark underwood of the tropical forest; the gnatcatchers forage through the treetops or the low, thorny scrub of arid regions. Many of the Old World warblers are marsh-dwellers and hunt amid reeds and sedges, while others find their food on the ground in dry countries where the vegetation is sparse.

The song of many of the Old World warblers has been highly praised for its great sweetness and variety. According to Vincent (1948:309) the Moustache Warbler's song "is of the highest order, rivalling that of any other African bird, a burst of clear and lovely warbling, strong and pure in tone." In America, the Blue-gray Gnatcatcher has been called "one of the sweetest singing birds of the southland" (Pearson, 1936, 3:224). The song of the Tropical Gnatcatcher is sweet in tone and appealing but it lacks variety. The Long-billed Gnatwren trills in a wonderfully soft, clear voice all on the same key, its song resembling that of some of the antbirds (Formicariidae) with which it was formerly classified. Flight songs have been reported for a number of British warblers, including the Whitethroat, Lesser Whitethroat, Reed Warbler, and Sedge Warbler (Coward, 1928:156-193). The Reed Warbler, Sedge Warbler, and Marsh Warbler are said

by the same author to be mimics and to sing by night. Blackcaps, Garden Warblers, Olivaceous Warblers, and Willow Warblers were heard singing by Moreau (1937:30-31) in their winter home in Tanganyika Territory in central Africa. Some of them sang in midwinter. Likewise, I have heard wintering Blue-gray Gnatcatchers sing in an undertone in Guatemala in January.

Nuptial feeding was reported by Lack (1940:177) in the Reed Warbler and, as an abnormality, in the Chiffchaff and in the Wood Warbler. May (1949:41) occasionally saw such feeding, or the symbolized adaptation known as "billing," in the Willow Warbler. In the Icterine Warbler, the male feeds the incubating female (Kendeigh, 1952:254). Among New World species, nuptial feeding appears to have been reported only in the Blue-gray Gnatcatcher (Bent, 1949:351) and even in this bird it seems to be unusual.

Bigamy has been reported as exceptional behavior in the Chiffchaff and Willow Warbler (Tinbergen, 1939:44), and deviations from monogamy appear to be rare in this family.

The nest is placed on the ground, in tussocks of grass, in reeds or other marsh vegetation, in bushes, in the undergrowth of the forest, or well up in trees. In the genera *Apalis*, *Calamonastes*, *Cisticola*, *Malurus*, *Phylloscopus*, *Prinia* and others, it is a covered or domed structure with the doorway in the side or at one side of the top. In the African genus *Eremomela* the nest is a cup attached by its rim to the arms of a forked branch, like that of the vireos, while in *Sylvietta* it is a dangling bag or pouch (Vincent, 1948). In many Old World genera, as well as in the American genera *Poliophtila* and *Ramphocaenus*, the nest is open above. In these two genera it is a well made, beautiful structure, often covered with lichens in the gnatcatchers and with green moss in the gnatwrens. In the kinglets (*Regulus*) the nest tends to be spherical, with a narrow opening in the top well above the mid-point. Like some of the American orioles, a few of the warblers make perforations in leaves and pass fibers or strands of cobweb through them, thereby sewing their nest securely to the surrounding foliage. Among these nests are those of the well known Tailor-bird (*Orthotomus*), the African Barred Wren-Warbler (*Calamonastes*), and the Tawny-flanked Longtail (*Prinia*).

The nest is usually built by the female alone in the British species of *Phylloscopus*, *Cettia*, and some species of *Locustella*, *Hippolais*, and *Acrocephalus*; but in other species of the three last-named genera, and sometimes even in the Willow Warbler of the genus *Phylloscopus*, the male takes a share in building. In several species of *Sylvia*, the male builds cock-nests, sometimes in advance of the arrival of the female, which may then line and lay in one of them (Witherby, *et al.*, 1938, 2:1-104). In Egypt, a male Olivaceous Warbler built a rough nest before a female arrived (Simmons, 1952:205). In the Graceful Warbler in lower Egypt, a non-migratory species in which the sexes remain together throughout the winter, the male starts the nest and does most of the building, while his mate goes into a sort of retirement; later she assists with the work, mainly with the lining (Simmons, 1954:276-278). Even the resplendent male fairy wrens of Australia help their brown mates to build the domed nest (Cayley, 1949:9, 55). In *Poliophtila*, building by both sexes is the rule, and the male not infrequently does the larger share, as in the Blue-gray Gnatcatcher (Nice, 1932; Bent, 1949:349), the Black-tailed Gnatcatcher (Woods, 1921:174), and the Tropical Gnatcatcher. Fragmentary observations on nest building by the Long-billed Gnatwren indicated that both sexes participate in the work.

The eggs are white, cream, greenish, pale blue, buff or brownish, and nearly always they are more or less heavily spotted or blotched with reddish, brown, olive, lilac, gray or black. The few recorded nests of the tropical American species contained 2 or 3 eggs. In Africa south of the Equator most warblers lay from 2 to 4 eggs, rarely 5 (Vincent,

1948). In the North Temperate Zone members of this family lay from 3 to 7 eggs, and sometimes they lay as many as 11.

Incubation is reported to be performed by the female only in the British species of *Phylloscopus* but it is the work of both sexes in most other genera. In *Sylvia*, the male appears regularly to take his turn on the eggs (Witherby, *et al.*, *loc. cit.*). The male also incubates in the Graceful Warbler (Simmons, 1954:279). In *Polioptila* and *Ramphocaenus*, the males take an important share in incubation. Some male Black-tailed Gnatcatchers sit in the nest more than the female by day (Woods, 1928:139). At some nests of the Blue-gray Gnatcatcher the male appears to leave all of the incubation to his mate, but at other nests he takes his full share of this work (Bent, 1949:351). Gnatcatchers sit for periods ranging from a quarter of an hour to an hour, rarely more or less, and they keep their eggs covered most if not all of the time. In common with many birds of the undergrowth of the tropical forest, a pair of Long-billed Gnatwrens took longer sessions, often remaining on their eggs for an hour and a half continuously, and together they kept the eggs covered constantly. Information on the rhythm of incubation of a number of Old World warblers is summarized by Kendeigh (1952:254, table 47).

The incubation periods of European sylviiids range from 11 to 14 or at times 15 days. The incubation period of the Graceful Warbler in Egypt is 11 or 12 days and that of the Olivaceous Warbler about 11 days. The incubation period of the Black-tailed Gnatcatcher was 14 days at one nest (Woods, 1928:140), and that of the Tropical Gnatcatcher was 13 days, also at one nest. In the Long-billed Gnatwren it was distinctly longer, 17 days at one nest, which seemed to be normal. An even longer period of 19 ± 1 days was reported for the tropical African *Cisticola galactotes*, although in *C. erythropis* the eggs hatched in 16 ± 1 days (Moreau and Moreau, 1940:320).

The nestlings when newly hatched have tightly closed eyes. They may be devoid of down, as in the Long-billed Gnatwren, Tropical Gnatcatcher, Black-tailed Gnatcatcher, and the British species of *Acrocephalus*, *Hippolais*, *Sylvia*, and *Agrobates*, and the African species of *Prinia*, *Cisticola* and *Franklinia*. Or the young may bear natal down, as in species of *Phylloscopus*, *Cettia*, *Locustella*, and *Regulus*. The interior of the mouth is yellow or orange-yellow in *Polioptila*, *Ramphocaenus*, and apparently all the British representatives of the family except the Garden Warbler, Blackcap, and Rüppell Warbler, in which the mouth is pink or pinkish red. The food is brought to the nest in the bill of the parent bird, and feeding by regurgitation seems not to occur. In all of those species for which we have information the nestlings are usually fed by both parents, but in some species of *Phylloscopus* they are fed chiefly by the female. Some male gnatcatchers outdo their mates in bringing food to the nest, even after the female has ceased to brood. In 7 hours of watching, feathered nestlings of the Tropical Gnatcatcher were fed at the rapid rate of 12.3 times per capita per hour. Nestlings of the Long-billed Gnatwren 7 or 8 days old were fed 4.5 times per capita per hour. In $18\frac{1}{2}$ hours of observation, nestling Graceful Warblers of varying ages were fed at an average rate of 4.3 times per capita per hour, the female doing most of the work (Simmons, 1954:281). Those males which incubate also brood the nestlings.

Injury simulation has been reported for the Whitethroat (Coward, 1928:157), Willow Warbler and Spectacled Warbler (May, 1949:45-46), Lovely Fairy Wren, and other species of *Malurus* (Cayley, 1949:55), and it has been noted in a rudimentary form in the Graceful Warbler (Simmons, 1954:288). Distraction displays seem not to have been witnessed in New World members of the family. An exception to this is the Tropical Gnatcatcher, which at times when disturbed leaves the nest with a peculiar slow flight which appears to be the aerial equivalent of the "broken wing" display. De-

spite their diminutive size, Blue-gray Gnatcatchers sometimes strike humans who interfere with their nests (Bent, 1949:354).

Nestling periods ranging from 10 to 14 days (rarely as short as 9 or as long as 16) are recorded in Witherby's "Handbook of British Birds." For the Black-tailed Gnatcatcher, Woods (1928:141) reported a nestling period of 14 or 15 days. The young Long-billed Gnatwrens I observed stayed in the nest 12 days. For two tropical African species of *Cisticola*, periods of 14 and 15 days are given by Moreau and Moreau (1940:320), while the Graceful Warbler of northern Africa stays in the nest 13 or 14 days (Simmons, 1954:283), and the Olivaceous Warbler has a nestling period of 15 days (Simmons, 1952:206).

Helpers at the nest have been discovered in this family chiefly in the fairy wrens of Australia. Cayley (1949:42, 51-55) stated that the Variegated Fairy Wren is double brooded, and very often the young of the first brood assist the parents in feeding the young of the second brood. In the Lovely Fairy Wren, one male and three individuals in female plumage fed the nestlings in one nest. A female Tropical Gnatcatcher fed and tried to brood nestling Golden-masked Tanagers while her mate built a nest nearby without her help. In captivity, young Whitethroats fed still younger individuals (Nice, 1943:79).

FAMILY TURDIDAE

GRAY'S THRUSH

Turdus grayi

In southern México and in all of Central America except the high mountains, the Gray's or Plain-colored Thrush occupies the place of the Robin in North America and of the Song Thrush in Great Britain. Of the many species of thrushes inhabiting the region, this one lives on the most intimate terms with man, and it is one of the most generally known and best loved of the songsters. An eloquent commentary on its status in the bird world is the fact that North Americans resident in the Central American countries, who in general have no names for the great majority of the birds and are indeed hardly aware of their existence, recognize this bird as the "tropical robin." The natives, too, although they likewise are without names for most of the birds about them, are familiar with and talk about Gray's Thrush, calling it *sinsontle* in Guatemala and *yigüiro* in Costa Rica.

In plumage, Gray's Thrush is far more modestly attired than the American Robin, being brownish olive on the upper plumage and buffy-brown below, with a pale buff throat streaked with olive. Its bill is yellow or greenish yellow, and its eyes are brown. About nine inches in length, it is slightly smaller than its northern counterpart. To compensate for its duller plumage, it is, in the opinion of many, a superior songster, thereby confuting a widely held conception that tropical birds are brighter in plumage but duller in song than those of northern lands.

Although this species is the nearest approach to the Robin that lowland Central America can claim, it is not quite the same familiar, confiding dooryard friend. Like other thrushes, it forages a good deal on the ground, but it does so in secluded spots. In the regions where I know it best, it does not hop boldly over lawns and pastures in the manner of the American Robin, and it is far more wary of man. Even when it hides its nest in a fruit tree or ornamental shrub in the yard, it has a way of going about its business so silently and discreetly that the young may be ready to take wing before one is aware that there has been any nesting activity. Its innate distrust of man is by no means unfounded. It is not protected by enforced laws or by widespread public sentiment; hence it is all too often the target of the sling-shots of boys and even of men.

Whether it flies up from the ground to perch in a tree or flits from one bough to another, each time it alights the thrush gives its tail the simultaneous vertical twitch and lateral flirt so typical of *Turdus*. Both the up and down twitch and the accompanying spreading and closing of the feathers are strongly pronounced, so that the resulting compound movement is equally noticeable whether one views the bird from behind or from the side. Thus, despite the absence of the extensive white areas on the lateral feathers which make the tails of many birds conspicuous, the plain brown tail of Gray's Thrush serves very well for signalling to its companions.

Hardy and adaptable, Gray's Thrush is at home in the wettest districts of the Caribbean coast as well as in the more arid regions of the interior and the Pacific littoral. In semi-desert regions it is found in the more luxuriant vegetation of the riverside groves, orchards, and irrigated plantations. It ranges to at least 5000 feet in Guatemala and 8000 feet in Costa Rica, breeding even at these upper altitudinal limits. Because of such diverse habitats, the species has developed minor geographical differences in size and plumage which have been recognized in scientific nomenclature; but the vernacular

names given to these geographic races have been misleading, blinding one, who is unacquainted with the living bird, to its essential sameness wherever found. My studies have been concerned chiefly with the nominate race in Caribbean Guatemala and Honduras, and with the race *casius* in Panamá and Costa Rica.

Throughout its range, Gray's Thrush is most abundant in the intensively cultivated districts and for the most part it avoids the unbroken forests, but it forages and, on rare occasions, nests a short distance within the border of heavy woodland. Although during the breeding period its song saturates the air of dooryard, plantation, shady pasture,



Fig. 7. Gray's Thrush

and even city park, it becomes so quiet and unobtrusive after the nesting season is over that it seems to have vanished like a migrant. But it is still living in temporary seclusion among the thickets, groves, river-bottoms and forest margins, not far from its former haunts. Early in the year, before the beginning of nesting operations, I found that the

Gray's Thrushes on a Guatemalan banana plantation were living in quiet secrecy among the willow trees and giant canes that occupied a belt of low, marshy ground between the banana groves and the river. Here they were so wary and distrustful of me that I could not discover what they were finding to eat.

Because of the secretiveness of Gray's Thrush, I have been unable to learn its social habits during the seasons when it does not nest. The birds are usually found singly or a few together in and about some particularly attractive fruiting tree. If pairs remain together in the closing months of the year, male and female do not keep close company as do many tanagers, finches, wood warblers, and other resident birds of tropical America. At the same time, they form no true flocks; for when a number visit the same fruit tree they come and go as individuals rather than in groups. Yet in southern Costa Rica, I have seen two thrushes keeping company, as though mated, early in January.

FOOD

Like other thrushes, this species has a varied diet. Its animal food, which seems to be in a large part gathered from the ground, includes worms, slugs, caterpillars, pupae, and an occasional small lizard. Once in light open woodland near heavy forest, I found a Gray's Thrush following a swarm of black army ants in company with antbirds, wood-hewers, and ant-tanagers. All of the latter birds were habitual attendants of the army ants, and it was most unexpected to encounter a Gray's Thrush in company with these woodland species and occupied in this fashion. All the other birds gobbled down at once such small fugitives from the ants as they could catch, but the thrush collected insects until it had a billful of them to carry to its nestlings.

When foraging on the ground Gray's Thrush is very shy and for this reason is difficult to watch, but while feeding in trees it is less timid. As von Frantzius (1869:290) long ago remarked, it is very fond of wild figs (*Ficus* sp.) of which many species are native to Central America. During the dry season, when more succulent fruits become scarce, it tears away and devours pieces of the hard, green fruiting spikes which dangle in finger-like clusters from the thick boughs of the cecropia tree. The feeding table near my house had been attracting numerous birds for more than two years before I saw a Gray's Thrush come to eat the bananas and plantains displayed there. In March, 1945, a long, severe drought, which appeared to have made food for wild birds scarce, finally forced the pair of thrushes that nested nearby to overcome their shyness and visit the table to eat bananas. Of the twenty-odd kinds of birds that fed at this shelf, these were the most timid. Unlike all the other visitors, the thrushes would not alight on the board if they saw me watching from the porch, but they would lurk among the upper boughs, or in more distant trees, nervously calling *tock tock tock*. I saw them eating bananas only if I suddenly appeared on the porch or cautiously peered from window or doorway. Yet strangely enough, one afternoon when I sat on the porch talking with two visitors, a Gray's Thrush alighted on the feeding tray and ate. Probably it had noticed that our attention was not directed toward the board because we were absorbed in our conversation.

Later, both parents began to carry billfuls of banana from the table to the shed in the lower pasture where they had their nest, but they were still exceedingly cautious in approaching the feeding tray. Then one day in early May a young thrush in spotted plumage came repeatedly to the table and made full meals of banana. It was less shy than the adults, and while feasting it would voice sharp little notes, some of which reminded me of one of the call notes of the Banded-backed Wren. It came and went independently of its parents, and its visits were more protracted than those of the two adults which came. The adults were still carrying away billfuls of the fruit, apparently for less daring brothers and sisters of the young visitor, although it is not impossible

that the latter belonged to another family. Now the parents would infrequently, after much hesitation and flirting of wings, alight on the board while I watched from the porch. Soon they brought their fledglings and carried banana up to them while they waited with wings aquiver on neighboring boughs, but they were always extremely wary and were ready to flee as soon as I appeared. By June wild fruits and insect life had become more abundant and all the thrushes stopped their visits to my feeding table. Through the years their attendance at the board has been sporadic, in sharp contrast to that of the many tanagers which are regular and constant visitors.

ROOSTING

For roosting, Gray's Thrush prefers a dense clump of tall timber bamboos. I have found the bird sleeping in such clumps both in the Caribbean lowlands of Honduras and on the Pacific slope of Guatemala. In both localities they roosted in close association with many other species of birds. But since timber bamboos of this type are not native to Central America but have been introduced, largely from the Old World, it is only infrequently that the thrushes can find such convenient roosting places.

VOICE

Most bird watchers, familiar with both the American Robin and Gray's Thrush, have been impressed by the great similarity in their songs. It is easy to go astray when comparing an old memory with a present impression, especially a recollection of something as complex and variable as the music of thrushes. However, when I went to Honduras in April, 1930, I was able to compare the song of the Gray's Thrush with a very fresh memory of the song of the American Robin which I heard in Maryland only ten days earlier. The songs of the two species of *Turdus* were undoubtedly similar. The song of the Robin seemed to be more vivacious; the song of Gray's Thrush was more tinged with sadness. Perhaps for that very reason it was more finely modulated and expressive of deeper feeling. Despite this difference, the songs are very alike.

In subsequent years, in other parts of Central America, I have heard the strains of other Gray's Thrushes which I believe would be less confused with the music of the Robin. A general similarity to the song of the Robin runs through the songs of all Gray's Thrushes; yet there are great differences in the phrasing, forcefulness, and character of their utterances—differences which in part are individual and in part are geographical. Some of the finest songsters of the species that I have heard were near Cartago in the Costa Rican highlands. Discriminating observers, such as Chapman (1929:395) and Sturgis (1928:367) have not hesitated to declare that they considered the music of Gray's Thrush "distinctly superior" or "much sweeter and more musical" than that of the American Robin; with this judgment I am in accord.

To describe the song of Gray's Thrush adequately is a task beyond the power of my pen. Bird notes are not easy to present in human words, and the song of this thrush is no exception. At the best, the bird pours forth such a cascade of liquid melody, so finely modulated, so richly varied, so full of feeling, so long sustained, that it leaves the hearer speechless with grateful admiration. And so I shall not attempt the impossible. Fortunately there are thrushes of the genus *Turdus* in most parts of the world, and although some have very weak, monotonous songs and others are mimics that almost outmock the mockingbird, the songs of many are of the same type, if not the same degree of excellence, as the song of the Gray's Thrush. If the reader has not heard at least one of them, he has treated himself most unjustly.

The first song of the season of Gray's Thrush is usually delivered in the evening—at least such has been my experience in seven years and in five widely separated regions.

The first morning song might be heard from two to twenty days later, but it is usually heard within a week of the first evening song. The dates both of the beginning and of the cessation of song—and of nesting of which this is an indication—vary greatly from district to district, often within surprisingly short horizontal distances. A cooperative study of the period of song of Gray's Thrush by a number of observers scattered in various parts of Central America and supported by adequate meteorological records should throw much light on the problem of what factors influence the initiation, duration, and termination of the breeding seasons of tropical birds. Perhaps in the not too distant future there will be enough students of birds in the region to undertake such a study. As a first step, I shall place on record a few observations made over a period of fifteen years in scattered parts of Central America.

As far as I know, the Gray's Thrushes begin to sing earliest on the Pacific slope of northern Central America. There the dry season is far advanced while heavy rains are still falling on the Caribbean side of the great isthmus as well as on parts of the Pacific coast farther to the south. On the Pacific side of Guatemala, the dry season normally begins in mid-October and lasts until mid-May. At the end of 1934 and during January of 1935, I collected botanical specimens, at an average elevation of 3000 feet on the large coffee plantations along the northern part of the Pacific slope of Guatemala. The wet season of 1934 had been unusually mild. On January 9, 1935, I heard the first evening song of Gray's Thrush on the Finca Mocá, and a week later I heard the first morning song. By January 25 the thrushes were delivering full evening choruses. I left the country at the end of January, and when I returned to this region late in the following June, I found Gray's Thrushes still singing freely in the coffee plantations about Colomaba, which is at the same elevation as the Finca Mocá and a little farther to the west. They continued through much of July, but with diminishing volume, becoming silent in early August. A nest with one fresh egg was found here on July 19. This is a longer period of singing, and presumably also of nesting, than I have found in regions with a more protracted wet season.

In the humid lower valley of the Río Motagua, on the opposite side of Guatemala, heavy rains continue through January, and sometimes well into February. Here, in 1932 on Alsacia Plantation, I heard the first evening song of Gray's Thrush on February 28 and the first morning song on March 3, but the birds did not sing in fullest chorus until the last week in April. I did not remain in the Motagua Valley until the end of the season of singing, but notes made two years earlier near Tela, Honduras, where climatic conditions are much the same as in adjacent parts of the Caribbean lowlands of Guatemala, supplement those from Alsacia. When I arrived at Tela late in April, Gray's Thrushes were in full song. At daybreak their harmonious liquid notes, rising on all sides from hundreds of swelling throats, filled all the cleared lands of the Lancetilla Valley like a thing palpable, and they formed the rich background against which all lesser bird songs were heard. The thrushes sang through July and well into August; they were last heard at dawn on August 29, and by the end of the month they had become silent. A nest in which the third and last egg was laid on August 14 was abandoned a week later for no apparent reason, but possibly it was because of the waning reproductive urge.

In the basin of El General in southern Costa Rica, where I have spent many years, the rains, which for eight months or more have fallen almost daily, become less frequent and heavy in December, and often they cease altogether early in January. Then follow two or three months which are normally rainless or nearly so. Light showers begin again some time in March and become heavier and more regular in April. May is at times the wettest month of the year, but its heavy deluges fall almost wholly in the afternoons. Here Gray's Thrushes sing with extreme rarity in January. They begin to sing with some

regularity, although usually sparingly, in late February, but they do not come into full chorus until late in March and, in some years, not until April. Since the rains begin about the time the thrushes are singing generously, the people say that the *yigüiros* are "calling the rain."

At their period of fullest song, the Gray's Thrushes flood the valley of El General with liquid melody at daybreak, but they are relatively silent in the brilliant sunlight of the later hours of the morning. At about noon, when the sky begins to cloud over in preparation for the afternoon showers so frequent at this season, the thrushes carol more freely again. They continue to sing lavishly through the cloudy or drizzly hours of the afternoon, becoming silent only during the hardest downpours. Some sing while perching inconspicuously in the foliage; but others, choosing a branch at the top of a tall dead tree standing in the midst of a new clearing in the forest, chant from a post a hundred and fifty feet above the ground. During many an afternoon in April and May, their songs fall so uninterruptedly upon the ear that, for all its beauty, it begins to pall. But in some years, when the early rains have been heavy, the song begins to wane in April, and it is all but extinguished by early June. Other years, in other parts of the basin, there is a little singing through the month of June. If it is not too wet in July, there is a partial renewal of song which never reaches full force, and which is associated with scattered late nesting. But by August the thrushes' period of song has definitely ended. Although the first song of the season is usually delivered in the evening, I have always heard the last brief strains early in the morning.

In 1937, I was greatly impressed by the wide variability, within relatively short distances, in the dates when Gray's Thrushes sang. I had passed the first part of the year in the basin of El General at an altitude of about 3000 feet. Here the thrushes, beginning on February 7, had reached the full climax of their song by late March and were silent again by June 10. A week later I left El General, and on June 28 I found Gray's Thrushes in full chorus at Las Cónovas, a coffee estate near Cartago at an altitude of 4500 feet in the Caribbean drainage. The immediate vicinity was devoid of forest, although great forest-clad mountains rose close at hand in the south. I was told that the dry season had ended unusually late. For a week I enjoyed the most delightful concerts by the Gray's Thrushes, which were nesting on all sides, some building, others incubating, still others feeding feathered nestlings. From this point I continued northward to Vara Blanca, which is still in the Caribbean drainage, but more exposed to the tradewinds, and, in consequence, far wetter than the region about Cartago. Here, in a narrow clearing in the midst of the dripping forests, at an altitude of 5500 feet, I settled down for a year's study. By July 8 the Gray's Thrushes, not uncommon in the vicinity, no longer sang, and I did not hear their music until the following February. In this excessively rainy mountain district they sang far less freely, from March through May, than in drier regions not so heavily forested. The airline distance from El General to Vara Blanca, via Cartago, is less than one hundred miles.

Although a number of Central American nightingale-thrushes (*Catharus*) and solitaires (*Myadestes*) sing more or less freely through most of the year, the singing of species of *Turdus* in the same region is, in my experience, limited rather strictly to the season of reproduction. This is certainly true of Gray's Thrush. The silence of this non-migratory tropical bird through most of the year is more surprising when one recalls that other species of *Turdus*, dwelling far in the north, are songful even in midwinter. Thus, according to Coward (1928:193, 197) in England the Song Thrush sings in every month except August, and the Mistle Thrush sings even in driving snow storms. Yet Gray's Thrush may be heard, but with extreme rarity, singing a few brief songs in the

wet months of September, October, and November. These isolated fragments of melody, breaking the bird's long songless period, are usually heard early in the morning.

Among the call notes of Gray's Thrush, perhaps the one most often used is a throaty *tock*, uttered with varied inflections, which seems to express uneasiness or mild alarm. When anxious for the safety of the nest or young, and often, too, in other circumstances, the adults voice a loud, querulous *keyooo*. If one walks too near a nest containing nestlings, the parents alight nearby and repeat this loud, plaintive call. I have known them to follow after me, raising again and again this mournful complaint; in May I have walked through bushy pastures, where many pairs were nesting, to the accompaniment of an endless sequence of these outcries, until they grated on my nerves. During the closing months of the year, when they do not sing, the Gray's Thrushes about my house usually begin the day by uttering this mournful *keyooo* once or twice.

An incubating female sometimes delivered a low, liquid note when her mate sang close by. When urging young nestlings to take food which they were slow in accepting, she voiced a low *tuck tuck*. Still another utterance of Gray's Thrush is a thin, sibilant, lisping note—a modification of a call widespread in the genus *Turdus*.

NEST BUILDING

On April 4, 1929, I found a fledgling Gray's Thrush, still unable to fly, in a banana plantation near Almirante in western Panamá. This would indicate that in the Caribbean lowlands nest building must begin no later than the first of March. In keeping with this observation, I heard the thrushes singing freely in mid-February some years later at Puerto Limón, Costa Rica, which is a short distance to the northwest along the Caribbean coast. From what has been written about the beginning of song on the Pacific side of Guatemala, I should expect that in this area nest building would start even earlier than at Almirante, but no actual records are available. Most of my observations on Gray's Thrush were made in the basin of El General, where the earliest nests are begun about the middle of March or, in some years, apparently not until April.

The sites chosen for the bulky, open nest are most varied. Usually a tree or tall bush with dense concealing foliage is preferred, but at times the nest is placed in an exposed location. Orange or cypress trees with their dark, crowded foliage are often chosen. The nest may be built in a crotch between thick branches, or far out among the slender terminal twigs, if these are sufficiently close-set to furnish support. The living stump of a slender tree that has sprouted again makes a coveted nest site; the flat top of the stump furnishes a firm foundation, while the densely leafy water-sprouts springing up all around give lateral support and excellent concealment. The tops of living fence posts, so often used in tropical countries, provide similar situations. I have seen a number of nests in such positions.

For many years, a Gray's Thrush has built upon the plantains or bananas in our small plantation. A bunch of green bananas or plantains hanging from a "tree" provides a most convenient nest site. The upturned fingers of the topmost "hand" of fruit prevent the nest from slipping off, and often the small "protecting leaf" forms a roof above it. Sometimes the thrush places her nest in the angle between the broad base of a banana leaf and the false stem, or she may use the elbow at the top of a banana stem which has been nicked and doubled over to bring the fruit within reach of the harvester. An excellent nest site is found in a coconut tree where the broad, flat base of the stalk of a frond springs from the trunk of the palm.

In Panamá, a Gray's Thrush built on the broad, nearly flat top of the leaf of a Panamá-hat plant (*Carludovica palmata*) growing at the corner of a porch. Her first heavy, mud-lined structure caused the leaf to tilt and spill all her accumulated material

to the ground. But a month later she built successfully on another leaf of the same plant and raised her nestlings only two or three yards from the chairs where we sat and talked. Another unusual nest site, which seemed to offer very inadequate support, was the branched stem of a tall wild cane (*Gynerium sagittatum*) growing in a canebrake beside a Costa Rican river.

In the highlands of the same country, I found a nest most curiously situated among the dead outer leaves of a small bromeliad of the "tank" type that was attached to the trunk of a tree growing in a pasture. The leaves of this epiphyte were arranged in a close rosette, and they were so tightly pressed together at their bases that the rain water was held in a little aerial pool that supplied the plant's requirements. This nest, surrounded and supported on all sides by the stiff, dry outer leaves of the rosette, had perhaps the thinnest walls of any nest of Gray's Thrush that I have seen; in so secure a nook, there was no need to make the walls more substantial. The structure was further protected and screened on all sides, both from the force of the elements and from the eyes of nest robbers, by the profusion of ferns, mosses, orchid plants, small bushes, and other epiphytic growths that heavily burdened the tree. Neighboring nests of this species were likewise set in the enormous masses of epiphytes that covered the trunks of the trees in this region of excessive rainfall and humidity, or they were placed on huge stumps in the pastures, where they were completely roofed over and excellently concealed by the matted roots of the epiphytic plants that converted each stump into a miniature garden.

At times the thrush selects an old nest as the foundation of the one she intends to build. This may be either an earlier nest of her own or one made by a bird of a different species. One nest was placed upon the recently abandoned nest of a Song Tanager, and another was located on an old dove's nest.

A Gray's Thrush surprised me greatly by building about 40 feet above the ground in a natural cavity in the tall, columnar trunk of a living ojoche tree which was growing in a pasture. The entrance to the cavity was so narrow that the bird experienced some difficulty in going in and out; but through the long fissure I could see the outer side of the nest and a portion of the thrush as she worked on the nest. I have found two nests built beneath the thatched roofs of rustic sheds. One was supported upon the ridgepole beneath the high-peaked roof. The other was in a dark corner beneath the eaves of a shelter built for horses. It was in the angle between a beam, a rafter, and an oblique strut, all of which were round pieces still covered with bark.

The lowest of the 100 nests of which I have records was placed only 40 inches above the ground, among the densely sprouting water-shoots on the top of a small stump. But this was situated at the edge of a steep bank, so that the height above the ground at the foot of the bank was considerably greater than that given. The remaining nests ranged from 4 to over 100 feet above the ground. However, nests built higher than 30 feet are quite rare; three-quarters of the nests are between 5 and 12 feet above the ground.

With one exception, all the nests of the Gray's Thrush I have seen were situated in dooryards, plantations, shady pastures, hedgerows, or light, open thickets. The exception was a nest built in the forest, a short distance within its edge. The thrush had placed it above the big, clustered leaves of an epiphytic plant growing attached to a slender trunk of a tree that stood beside a clear mountain stream. Its exterior, composed almost wholly of green fern-moss, blended perfectly with the moss that grew over the base of the epiphyte and covered the supporting trunk. I should never have discovered this nest had I not watched the thrush as she built. Here in the ancient forest the well-hidden nest seemed to be far safer than any of those that I had found in the cleared lands of the valley. But this atmosphere of peace and security is deceptive, for nests in tropical

forests seem to be most heavily preyed upon and seldom shelter the young until they are able to fly.

I have watched the construction of six nests, each of which was built by the female alone. Much of the material is gathered from the ground. A thrush which built in a grapefruit tree in front of a plantation house in Panamá found most of her material on the muddy ground beneath the edge of the house. She made numerous journeys back and forth, returning each time with her bill heavily laden with muddy sprays of living



Fig. 8. Nest of Gray's Thrush on leaf of *Carludovica palmata*, near Almirante, Panamá, May 17, 1929. In rainy weather fragments of living vegetation mixed with the mud in the nest's wall took root and sent up green shoots.

Selaginella, *Peperomia*, or dead vegetation. She continued to work until six o'clock in the evening. This concentrated activity was doubtless made necessary by the lateness of the season. The thrush had already wasted the better part of a week in trying vainly to start a nest on one of the fronds of a neighboring tagua palm (*Phytalephas*). These fronds had not furnished an adequate foundation, and she had succeeded only in spreading nesting material over the pinnae of the palm, for a distance of two feet, and scattering more over the ground below.

The Gray's Thrush which built the exceptionally high nest, over 100 feet above the ground in a towering tree standing in a Costa Rican pasture, found most of her material along the banks of a neighboring river. Raising this material to the lofty nest was a laborious process. The bird would fly heavily up to the lowest limb, which was 50 to 60

feet above the ground. From that point she ascended by stages from branch to branch until she attained her high nest, which was well screened by the new foliage of the tree. After arranging her material, she would dive down on a very sharp descent to the fringe of low trees along the bank of the river. Her mate, singing from time to time, perched near the nest while she built, and now and then he inspected her work. Once he picked from the supporting bough a loose tuft of moss, which the female had evidently dropped, and took it to the nest. But this was the height of his exertion; he never tried to bring up any material from the ground a hundred feet below. Other males I have watched have merely rested upon some neighboring bough, singing, while the female toiled.

A female that I watched for two hours in the early morning brought material 16 times in the first hour and 23 times in the second hour while her mate sang in a neighboring tree.

The completed nest of Gray's Thrush is a broad and relatively shallow, open bowl, with walls that usually are massive and bulky. Nests in the neighborhood of Almirante, Panamá, contained many small living plants of *Selaginella*, *Drymaria cordata*, *Tradescantia*, *Peperomia* and grasses in the outer wall. A number of these had been pulled up from the lawn with earth still attached to their roots, and they imparted a green color to the outer surface of the nest. The middle layer was composed of coarse fibers, largely from the decaying leaf-sheaths of the Panama-hat plant, laid down along with much mud. The inner lining was of coarsely fibrous material. During the rainy months of April and May, the living plants in the outer wall rooted in the mud which formed so much of the middle layer, and they flourished wonderfully. The nest built upon the *Carludovica* leaf was surrounded with fresh young sprouts even before the eggs hatched, and soon it became a most attractive aerial garden. The most flourishing plant in this garden-nest was the little chickweed *Drymaria*, which soon had erect shoots four inches high (see fig. 8).

A Costa Rican nest now before me is of very different composition. The outer walls are composed of a thick layer of green moss. Mixed with this is a fair amount of coarse fibrous material, including rootlets and slender, flexible grass stems, and also a small amount of stiff, non-flexible material, chiefly from herbaceous plants. Among the latter are the basal parts of weeds with roots attached and terminal portions bearing dry seed pods. Some of the stems of these coarse weeds stick out stiffly from the sides of the nest for a length of seven or eight inches. Also included in the outer wall is dry, brown "corn silk" gathered by the bird from maize which was stored in the top of the shed where this nest was built. There are also a few curled dead leaves. Within the moss there is a layer of mud, mixed with fibrous material, doubtless from the shores of a neighboring stream, for the nest was built at the end of a long drought. This mud has dried to form a continuous hard shell, which, however, stops short an inch or more below the rim. The lining in the bottom of the bowl is composed chiefly of coarse rootlets, with a small admixture of slender, curving dry rachises of small compound leaves, coarse light-colored fibers, black fungal hyphae, and other similar materials. The nest measures 6 by 8 inches in outside diameter by 4 inches in height. The interior cavity is $3\frac{3}{4}$ inches in diameter by 2 inches in depth.

Another nest, built near the preceding one in July when the breeding season was drawing to an end, is a far slighter and less massive structure. This nest was built in a mandarin tree, and the thrush used a recently abandoned nest of the Song Tanager as a foundation. She covered the bottom of the tanager's nest with a fairly thick but narrow layer of mud, and above this she proceeded to build up her walls, employing chiefly coarse, fibrous rootlets, with an admixture of rachises and fine plant fibers. She placed a little green moss about the rim. Unlike most nests of Gray's Thrush, the walls of this nest are so thin that much light passes through them, for the mud is below rather than

within them. At first sight, I thought that the builder had omitted the mud, and only after removing the nest from the tree did I discover it. This nest measures $3\frac{3}{4}$ inches in inside diameter by $1\frac{3}{4}$ inches deep.

THE EGGS

In the basin of El General, between 2000 and 3000 feet above sea level, the earliest eggs of Gray's Thrush are laid in the last week of March. Although I have found some species of birds, especially tanagers, fairly constant in the time of day when they deposit their eggs, Gray's Thrushes are surprisingly irregular in their hour of laying. I have records of the approximate time of laying of 14 eggs. The eggs are usually laid on successive days. Of three first eggs in sets, one was laid before 6:35 a.m., the second before 7:00, and the third between 7:00 and 10:08. Of six second eggs in sets, the earliest was laid between 6:55 and 8:00, four others before 10:30, and the sixth between 10:35 and 12:00. Of five third eggs in sets, the earliest was laid between 7:00 and 9:00, the second between 9:00 and 10:15, the third between 7:05 and 11:00, and the fourth and fifth between 10:15 and 11:20. All these eggs, therefore, were deposited in the forenoon, but the times ranged from a little after sunrise to near midday. The records suggest that the first egg of a set is laid earlier in the day than the second, and the second earlier than the third. Thus the interval between the laying of successive eggs is somewhat more than 24 hours. However, my records are not sufficiently numerous to prove this conclusively. The Bluebird also lays rather late in the morning, usually from two to four hours after sunrise (Thomas, 1946:156).

Of 77 nests in Guatemala, Honduras, and Costa Rica, 24 contained 2 eggs or nestlings, 51 held 3 eggs or nestlings, and there were 2 sets of 4 eggs. Both of these latter were in the valley of El General in Costa Rica. The eggs are pale blue, pale grayish-blue, or more rarely bright blue. They are speckled and mottled all over, but most heavily on the thick end, with bright rufous, rufous-brown and pale lilac. The measurements of 37 eggs average 27.8 by 20.4 millimeters. The eggs showing the four extremes measured 31.0 by 20.6, 27.8 by 21.4, 25.4 by 20.6 and 25.8 by 19.4 millimeters.

In 67 nests in the valley of El General eggs were laid as follows: March, 10; April, 25; May, 26; June, 4; July, 2.

INCUBATION

The female alone incubates. One thrush slept on her nest during the night following the laying of the first egg, and another one slept on her nest during the night following the laying of the second egg. The full set in each instance contained three eggs.

At a late nest in a mandarin tree which I watched on the morning of July 1, 1944, the female thrush's sessions and recesses, in minutes, were as follows (the recesses are in italics): 20 82 28 84 22 34 11 36. This bird covered her three eggs 74.4 per cent of the time. Her mate appeared in the nest tree only once, in the dawn, when it was still too dark to see him well. Thereafter he stayed away from the nest and out of my sight. I heard him sing only one brief refrain all morning.

On May 22 of the following year, I devoted seven hours to watching a nest built upon a bunch of green bananas hanging in a small plantation. This nest contained three eggs which had already been incubated for ten days. The female's sessions and recesses, in minutes, were as follows: 58 10 53 14 29 11 40 13 188. Her long session of 3 hours and 8 minutes began at 9:30 a.m. and ended at 12:38 p.m. She kept her eggs covered 86 per cent of the time—an exceptionally good record. Her mate never came near the nest nor even alighted on the banana plant that supported it. In fact, I did not see him once throughout the morning, but his beautiful song sounded through the banana grove much of the time. He had a restrained, subdued song, not so gaily

jubilant as the songs of many Gray's Thrushes. The female sat in perfect silence except that once, when the male sang from a point unusually close to the nest, she uttered a low, liquid monosyllable, repeating this several times. She then left the nest to forage. While sitting, she regurgitated seeds from time to time and let them fall to the ground.

At 7 nests, the incubation period, measured from the laying to the hatching of the last egg, was 12 days. In 3 of these nests, all 3 eggs hatched on the same day but at a nest with 4 eggs, the last hatched almost 40 hours after the first. At 3 nests, I made an effort to determine the length of the incubation period in hours. In nest 74, the third and last egg was laid between 10:20 and 11:15 a.m. on March 29, 1945, and it hatched between 3:05 and 5:55 p.m. on April 10, giving an incubation period of 12 days and 6 hours \pm 2 hours. In nest 75, the third and last egg was laid between 9:00 and 10:15 a.m. on May 12, 1945, and it was on the point of hatching at 5:00 p.m. on May 24, when the young one had pushed off the severed cap of the shell but had not yet squirmed out. The incubation period for this egg was 12 days, 7½ hours \pm ½ hour. In nest 96, the third and last egg was laid between 7:05 and 11:00 a.m. on April 24, and it hatched between 7:00 and 12:00 a.m. on May 6, giving an incubation period of 12 days and 0.5 hours \pm 4.5 hours.

At the late nest in the mandarin tree, the last egg was laid on June 22. The eggs did not hatch in the normal period, and I thought that it would be interesting to learn how long the female would continue to incubate. By July 9, one of the eggs had vanished, but the thrush continued faithfully to warm the remaining two. By July 11, however, only one egg remained, and the nest had been abandoned. Thus the female continued to incubate for 17 or 18 days, about 50 per cent more time than the normal period. When she had definitely ceased to attend the nest, I opened the remaining egg and found it addled, with no trace of an embryo. The following year a thrush, probably the same individual, incubated infertile eggs for 19 days at a nest in the same corner of my yard. Laskey (1940:188) found that Eastern Bluebirds, whose normal incubation is 13 or 14 days, continued to incubate spoiled eggs for 21 days before deserting them; and Thomas (1946:156) reports an instance of a female of this species that incubated for 33 days when her eggs failed to hatch. Three pairs of Black-crowned Night Herons in the aviary of Noble and Wurm (1942:217) incubated sterile eggs for 40, 49, and 51 days, respectively—about twice as long as the normal period of 22 to 24 days. A Chestnut-capped Brush-Finch incubated sterile eggs for 19 days before deserting the nest; the incubation period of this finch is not known, but it is probably about 15 days. If their eggs do not hatch in the normal period, birds continue to incubate with a wide margin of safety before finally abandoning them.

THE NESTLINGS

At dawn on May 23, 1937, I began to watch a nest of a Gray's Thrush in which the eggs were on the point of hatching. Before sunrise the female flew off for a fifteen-minute recess. On her return to the eggs, she sat restlessly, constantly rising to look beneath her, and otherwise sitting higher than usual. At a quarter past six she stepped backward to the rim of the nest, picked up the large part of an empty shell and carried it away, returning promptly. A few minutes after she had resumed sitting, the male thrush arrived and perched in the nest tree several feet from the nest. However, his mate made no response and he left at once. The female continued to rise up at intervals and lower her head into the nest. At 6:33 a.m. she carried off the cap of the empty shell. A minute later she returned with a tiny bit of food and endeavored for about 30 seconds to make the nestling swallow it. Failing in this, she ate it herself and settled down to brood. After two brief periods of sitting and two short recesses, she rose again in the nest, lowering

her head into the bottom several times and seeming to eat something; but I could not see what, if anything, it was. Then, at 7:18, she carried away a piece of the shell of the second egg. Returning in three minutes, she brought a very small bit of food and apparently succeeded in making a nestling swallow it. Then she carried off the remaining piece of the second shell, and in two minutes she was back again with another tiny particle of food.

During the next hour and a half, the female thrush fed and brooded, while her mate stayed out of sight. Finally, at 8:59, he visited the nest for the second time that morning. This time he found the female absent. Standing on the rim, he looked intently down into the bowl, lowering his head into it again and again and opening and closing his bill in a mincing fashion. He continued this for two minutes, and then he flew off. Three minutes later he returned, bringing a small pupa, which he presented to the nestlings for about a minute before it was swallowed. While he stood upon the nest's rim, the female returned with two or possibly three small insects in her bill. After the male had disposed of his offering and flown away, the female fed and then brooded the nestlings. I could distinguish the sexes of this pair by the darker bill of the male.

Five minutes later the male thrush returned to feed the nestlings the second time. On his approach the female flew from the nest to give him free play. Before he left, his mate returned, after only a minute's absence, to resume brooding, and he flew off as she arrived. He seemed to be a trifle afraid of her when at the nest. When he came again with food, the female once more made way for him to deliver it himself. Perching on the rim, he uttered a low, rapid *tock tock tock tock*. But on a later visit, when he came with his bill heavily laden, the female continued to brood instead of leaving the nestlings uncovered for him. After considerable hesitation, he passed to her all that he had brought with the exception of the last piece. She swallowed all she had received and opened her bill for this, which rather reluctantly, it seemed, he relinquished to her. Instead of swallowing this final particle, she held it in the tip of her bill, evidently intending to give it to a nestling. But he promptly pulled it away from her. Again the female opened her mouth to coax it from him, and again he yielded it to her. But she held it in the tip of her bill as before, and once more her mate snatched it from her. This time he swallowed the piece and departed. In recovering the food from the female when it was not promptly swallowed, he behaved exactly as he would have done if he had given the particle to a nestling which was slow in disposing of it. Clearly he had not been in the habit of feeding his mate while she incubated.

In the first three and three-quarters hours after the first egg hatched, the female thrush brooded the nestlings 13 times, for periods ranging from one to 26 minutes and averaging 11.3 minutes. Her absences, 13 in number, ranged from one to 9 minutes and averaged 3.8 minutes. She brooded 74.8 per cent of the time. Although she came and went much more frequently than either of the incubating thrushes whose records were given earlier, she spent as much time on the nest as the female which incubated in the mandarin tree. She brought food to the nest 8 times in $3\frac{3}{4}$ hours; while the male, which began to feed the nestlings $2\frac{1}{2}$ hours later than the female, brought food 6 times in an hour.

Thus, for three hours after the first egg hatched, this male thrush did not bring food to the nest but left the care of the nestlings to the female alone. The reason for this neglect was clearly that he was unaware that the eggs had hatched. He had come to the nest tree only nine minutes after the female removed the first piece of shell; but she was then covering the nest, making it impossible for him to see what it contained, and she remained quietly sitting, doing nothing to enlighten him. When next he approached the nest, the female was away and he could see what was in it. He stood for two minutes

intently regarding his offspring, then he flew away and within three minutes returned with food for them. He had to see the nestlings to know that they were there, as his mate would not, or could not, inform him. Once he had discovered that there were nestlings, he responded immediately. Thenceforth he brought so much that they could not eat it all. Some of the excess was consumed by the female; some he swallowed himself. Unlike many parent birds, neither parent lost much time in coaxing the newborn nestlings to eat when they were not eager for food. One minute was about as long as either of the thrushes presented food to the nestlings, and if it had not been swallowed at the end of this period, they ate it themselves. The male never brooded, but sometimes he lingered on the rim of the nest for several minutes after feeding, always flying off as the female returned.

At the nest which had been built on the bunch of bananas events attending the hatching of the nestlings followed a somewhat different course. The first of the three eggs hatched either in the night or in the dim light of dawn on May 24. When I looked into the nest with a mirror during the female's first absence, I found that the large part of the empty shell had already been removed. Upon her return, the bird carried away the cap of the shell. At 5:47 a.m. she brought the first food and offered it to the nestling, making a low, clucking sound when the young bird was sluggish in taking it. She then settled down to brood while still holding the food. After sitting for about 25 minutes, she flew from the nest when her mate sang not far off, still holding the undelivered food in her bill. Returning 13 minutes later, she successfully fed the nestling. But when she again brought food, she had to urge the nestling to swallow it by making clucking notes. All through the morning the female brooded and fed the nestling alone; the male, which sang much in the vicinity, did not once appear in sight of the blind from which I watched. Apparently he had not yet learned that an egg had hatched. I had expected, from his inattentiveness during the period of incubation, that he would be slow in discovering the nestlings.

Small worms or possibly slugs seemed to be the food most frequently brought to the nest by this female, but these tiny morsels were difficult to identify when held in her bill. By midday she was offering the newly hatched nestling such substantial meals as an inch-long green caterpillar and a baby lizard an inch and a half in length. But much maternal urging, with the usual low, clucking notes, could not induce the newly hatched young to accomplish what was physically impossible, and in the end the female was obliged to eat these larger creatures herself. In the course of the first 7 hours of the day she fed, or at least offered food, to the single nestling a total of 18 times, or at each return to the nest. She brooded 18 times, for periods ranging from 2 to 36 minutes and averaging 15 minutes. Her 18 absences varied from 3 to 16 minutes and averaged 8.1 minutes. She covered the nest 64.9 per cent of the time. This was a reduction of 21 per cent from the time she had spent on the nest when incubating two days earlier, and it was 10 per cent less than the other female thrush, whose mate brought food more promptly.

The thrush whose nest was on the bananas began her longest period of brooding at noon. During this session, which lasted 36 minutes, the sun was shining through thin clouds and striking down into the nest. She half-stood over her nestlings and eggs, panting, and, meanwhile, the second egg hatched beneath her. She ate the cap and then the main part of the empty shell. The larger part of the shell caused her considerable difficulty; she found it necessary to shake it in order to break off pieces that could be swallowed. In doing this she repeatedly dropped the shell into the nest and picked it up again. Thus the Gray's Thrush may dispose of empty shells either by carrying them off or by eating them, and the same individual may follow both methods. The third egg

at this nest did not hatch until late in the day, during the usual afternoon rain. At five o'clock, the newly hatched bird was just pushing off the cap of the severed shell and was visible as a narrow pink band between the slightly separated parts of the blue egg shell.

The following morning I watched this nest for three hours in the hope of seeing the male thrush discover and attend his offspring. But, although he sang in the vicinity, he did not visit the nest. The female fed the three day-old nestlings six times. She was feeding less frequently than she had when the first nestling was the only one hatched. Now, however, the young took all of the food that she brought, whereas the preceding day much of it had not been accepted by the nestling. The female brooded 7 times for periods ranging from 4 to 25 minutes and averaging 12.3 minutes, and she took 6 recesses, lasting from 4 to 27 minutes and averaging 12.8 minutes. She devoted 49 per cent of the time to brooding.

By May 31, when these nestlings were a week old, the male apparently had neither seen nor fed them, although he still sang near the nest. The female now brooded but little, which circumstance would have made it more difficult to distinguish her from the male had he come to the nest. Therefore I abandoned the attempt to learn when the male began to share in the work of feeding the nestlings.

The newly hatched Gray's Thrush is pink-skinned, with fairly long but very sparse down of the usual passerine distribution; the eyes are tightly closed. The interior of the mouth is orange-yellow. At the age of 6 days the eyes begin to open. When 12 days old the nestlings are well feathered, but if undisturbed they remain in the nest 3 or 4 days longer. I have known the female to brood a 14-day-old nestling through the night; it slept alone only on its last night in the nest. I have records of 7 nestlings which left the nest at the age of 15 days and records of 4 nestlings which left the nest at the age of 16 days. These were spontaneous departures; if frightened, young thrushes may jump from the nest several days earlier.

One evening, as I approached a nest containing two 14-day-old nestlings, I found them both standing up, one on the rim, preening their feathers and stretching at a great rate. They did not appear to notice me standing below. Presently a parent arrived, saw me, and raised the plaintive *keyooo* note of alarm. The nestling still inside immediately crouched down in the nest, where it was invisible to me. The one on the rim stayed there but "froze," becoming perfectly motionless. Next morning both young left the nest.

Parent Gray's Thrushes sometimes become excessively wary about the time the young are ready to quit the nest. Wishing to witness the departure of two young thrushes from their nest on a bunch of bananas, I set up my blind early in the afternoon, in a somewhat sheltered position beneath a neighboring plantain "tree" which was about twenty feet from the nest. Next morning at dawn I entered the blind hoping to see the 15-day-old youngsters leave. Although I waited for two hours, the parents would not come near the nest. Approaching with food, they would perch among some neighboring cassava bushes and call interminably, uttering their robin-like *tock tock*, their plaintive *keyooo* of alarm, and sometimes their thin, sibilant, lisping note. The nestlings became very hungry, looked around brightly, and often called—a sharp *tsip*. Although completely feathered and about ready to leave the nest, the alarm notes and other calls of their parents did not cause them either to abandon the nest or to fly toward the adults for food. Certainly, if I had come close, the young thrushes would have fled. Next morning, unwatched by me, the nestlings flew from the nest.

THE SECOND BROOD

More often than most birds, the female Gray's Thrush will lay again in a nest from which she has lost eggs or nestlings. Twice I have known females which had lost un-

feathered nestlings to lay a new set of eggs, after an interval of about two weeks, in the same nest. In Honduras, a thrush, that had lost three unfeathered nestlings when her nest tilted and spilled them out, built a new nest upon the remains of the old, and two weeks later she had laid another set of eggs.

Twice also I have known thrushes to lose their first egg the day it was laid. In both instances, no more eggs appeared in the pillaged nest, and I wondered what had happened to the subsequent egg, which must have been well formed in the oviduct and ready to be laid the next morning. Had the bird dropped it on the ground? A third nest was found empty on the day after the first egg was laid, but possibly the second egg had been deposited meanwhile and had shared the fate of the first. Two days later this nest was still empty, and I gave it up as lost. However, a week later I was surprised to find the thrush incubating three eggs in this same nest. From the date of hatching and the known incubation period, I computed that the bird must have laid the first egg of this completed set three or possibly four days after losing the ill-fated first egg. Were any of the eggs of this last set ones which might have been laid in the first set?

These re-layings do not, of course, constitute true second broods. But two Honduran nests from which the nestlings had departed, apparently spontaneously, in June, were used for second broods in July. Three nests found in El General with eggs in late June or July also represent possible second broods. However, because they were not in the sites of earlier nests and the parents were unmarked, it was not definitely known whether the adults had successfully reared first broods elsewhere. However, the sharp decline in the number of nests after May makes it clear that second broods are rare in this region. For Central America as a whole, my latest nests are: one found in El General on August 5 which contained a nestling about a week old and two infertile eggs, and one in the Lancetilla Valley of Honduras in which the set of three eggs was completed on the exceptionally late date of August 14. A week later these three eggs were abandoned, apparently merely because the breeding season had come to an end.

ENEMIES

In El General, I have twice seen nests of Gray's Thrush pillaged by Fiery-billed Araçaris. From my window I watched one of these red-billed toucans carry off a week-old nestling, while the parents cried loudly but were unable to defend it. Undoubtedly the bigger Swainson Toucan destroys many a thrush's nest in the same region, although I have not caught it in the act. In the central plateau of Costa Rica, I surprised a White-tipped Brown Jay with a fully feathered nestling Gray's Thrush in its bill. Again the parents complained with loud cries, but they were unable to rescue their offspring.

Yet the thrushes are by no means devoid of spirit in the face of predatory creatures. While I resided near Almirante on my first visit to Central America, a young Black Hawk-Eagle carried off two feathered young Chipsacheery Flycatchers from their nest in a lemon tree close beside the house. For a long time the bird of prey perched in a neighboring tree, clutching in its talons the two dead nestlings along with the straws which had roofed their nest, making no move either to devour its prey or to carry it to a safer distance. At first the hawk was surrounded by an angry crowd of the smaller birds that nested nearby. They darted at its head and complained with a babel of loud cries. But one by one the flycatchers and other birds drifted away, leaving the hawk with its victims. Only the Gray's Thrushes, more pertinacious than their neighbors, continued to watch and to worry the dangerous intruder as long as it stayed there. Three or four of them kept up a spirited offensive, darting again and again at the hawk's head and at times appearing to graze it, and they never ceased to voice their piercing, melancholy calls of alarm.

SUMMARY

Gray's Thrush is resident in cultivated areas of Central America from sea level up to about 5000 feet in Guatemala and to 8000 feet in Costa Rica. It is most abundant in the wetter districts; in dry regions it is largely confined to the river bottoms and irrigated plantations. It ventures for short distances into heavy rain forest to forage and rarely to nest.

This thrush forages much on the ground, seeking worms, slugs, insect larvae and pupae, and occasionally small lizards. It enters trees for a variety of fruits and visits feeding shelves for bananas.

Roosting is by preference in compact clumps of tall bamboo.

With rare exceptions the male delivers his sweet and varied song only in the breeding season. The season's first song was most often heard in the evening.

In western Guatemala, where the dry season begins in October, these thrushes started singing in January and continued until early August. In the Caribbean lowlands of northern Central America, where the dry season begins in February, they sing from March well into August. In the valley of El General, 2000 to 3000 feet above sea level, on the Pacific side of southern Costa Rica, their period of singing is shorter. Beginning sporadically in the usually dry months of January or February, their song reaches its peak when the rains return in late March or April, and it has greatly diminished by May or June. In mountainous regions, one finds Gray's Thrushes in full song in one district after they have ceased to sing in another valley not far away.

The bulky nest, which has an inner layer of mud, is usually well hidden in the foliage at heights of from 3 to over 100 feet. Most often the nest is placed from 5 to 12 feet high. Often it is situated on a bunch of green bananas or plantains and occasionally it may be built in a cavity in a trunk or beneath an open shed. The effective building is done by the female, but the male sometimes picks up a bit of material.

In the valley of El General, laying begins in the last week of March and is at its height in April and May. A few sets are laid in June or July. The eggs are normally deposited on consecutive days in the forenoon, but they are laid at no definite hour. A few were laid soon after sunrise, others toward noon, and the majority at some intermediate time. Of 77 nests from all parts of Central America, 24 contained 2 eggs or nestlings; 51 contained 3; and there were 2 sets of 4.

Only the female incubates. One sat 74.4 per cent of 5 hours and another for 86 per cent of 7 hours; one unusually long session lasted 3 hours and 8 minutes.

The incubation period, determined at 7 nests, was 12 days plus a few hours. Infertile eggs were attended for 17 or 18 days on one occasion and 19 days on another.

The nestlings are brooded only by the female but they are fed by both parents. One male first saw his nestlings three hours after they hatched; then he promptly brought them food. Another male failed to visit the nest both on the morning of hatching and on the succeeding morning; he apparently did not feed the nestlings in their first week.

Nestlings leave the nest at the age of 15 or 16 days if undisturbed; they leave a few days earlier if molested. The parents become excessively shy as the time for nest-leaving approaches.

Females sometimes lay a second set of eggs in a nest from which eggs or nestlings have been lost. But if the first egg of a set is lost from the nest within a day of laying, no more eggs of this set are deposited in this nest. In the lowlands, second broods are sometimes attempted in a nest in which a first brood was reared successfully. But in El General true second broods are of doubtful occurrence and are certainly rare.

Although nests are doubtless pillaged by a large variety of predators, only Fiery-billed Araçaris and White-tipped Brown Jays were actually seen taking nestling Gray's Thrushes.

WHITE-THROATED THRUSH

Turdus assimilis

The White-throated or White-necked Thrush is more distinctively colored than many other members of its genus in tropical America. It is a large bird, about nine inches in length. Its upper plumage, including the whole head but not the throat, varies from bright olive to dark brownish gray. The chin, throat and upper edge of the breast are white or buffy. The upper portion of this light area is conspicuously and boldly streaked with black, while the lower part is immaculate and forms a well-marked crescentic half-collar which contrasts with the gray or grayish brown of the breast, sides, and flanks. This pales to white on the abdomen and under tail coverts. The bill, bare orbital ring, and legs of breeding birds are yellow, at least in the population inhabiting the Térraba Valley in Costa Rica, with which this account is chiefly concerned. The sexes are similar in appearance, although males are often somewhat more deeply colored than breeding females. In El General, where Gray's Thrush is called *yigüiro*, this bird is known as *yigüiro collarejo*—the collared thrush.

The species, as at present understood, ranges from northern México to western Colombia and Ecuador. Next to Gray's Thrush, it is the most widespread of the Central American species of *Turdus*, but it is far less common and familiar. Its vertical distribution extends from sea level up to 5000 feet or a little higher. It inhabits both heavy forest and clearings in which it nests in bushy pastures, second-growth thickets, cane brakes, and riverside trees. Its breeding range is curiously irregular, and the factors which control it are obscure. In 1936 and 1937 I found it nesting in numbers at an elevation of about 3000 feet in the narrow valley of the Río Buena Vista on the northern side of the basin of El General. Judging by its song, it also breeds down to about 2200 feet on the stony flood plains of the broad, open valley of the Río General. But at Quizarrá, 2500 feet in elevation, on the Río Peña Blanca, which is like the Río Buena Vista a northern tributary of the Río General, it occurs only as a straggler and never seems to nest. Yet this area is only a few miles from places where its distinctive song is heard freely in the breeding season. Sometimes I hear it singing loudly in the forest near our house, but it stays only a short while, much to my regret, as it is a splendid songster.

At Rivas, near the lower end of the narrow valley of the Río Buena Vista, I did not see White-throated Thrushes until March 23, 1936, although, except for the preceding ten days, I had been constantly in the field in this area since late November of 1935. By April 1, they were abundant, especially in the trees along the broad, impetuous river, and the valley resounded with their loud songs. Soon I began to find their nests. After breeding they seemed to withdraw from the valley, and I found none from September, 1936, until January, 1937. Toward the end of January I heard their queer, throaty calls with increasing frequency on the forested slopes above the valley, and on February 6 I heard their song for the first time that year. Whether they actually arrived at Rivas about two months earlier in 1937 than in 1936, or whether I noticed them earlier in my second year there because I was then more familiar with them, I cannot tell; but if they were present in 1936 before March, they were certainly very rare and retiring. Since, in the months when they were absent from Rivas, I saw a few in the mountains a thousand feet or more higher, probably they had merely migrated a short distance upward into the then scarcely broken mountain forests. A. W. Anthony (Griscom, 1932:306) noticed

that at Cobán and to the east in the Department of Alta Verapaz, Guatemala, this thrush was everywhere abundant in the coffee-growing belt until October, when most of them withdrew for a period of about three months.

In its dietary habits, the White-throated Thrush appears to be a typical member of its genus, consuming both fruits and invertebrate animals. I have seen these birds eat



Fig. 9. White-throated Thrush

the blue berries of the shrub *Cephaelis elata* and the small, black, berry-like fruits of a tree of the genus *Guatteria*. Sometimes I watched them hunting on the rocky shores of the river, where they used their bills to brush aside fallen leaves and uncover the insects or worms hiding beneath them.

VOICE

The White-throated Thrush is a superb songster. The song of the male, with its great variety of contrasting phrases, somewhat resembles that of the Black Thrush of Guatemala, but this species does not, like that highland musician, imitate the sounds of other birds. The phrases, so far as I have observed, are entirely its own. The male interrupts his full, powerful thrush-notes to deliver trivial phrases in a voice that is weak and high. These chaffy notes, intruding among the full, ringing ones, demonstrate the range and flexibility of the voice but do not add to the beauty of his recital. Gray's Thrush, for example, rarely uses them, with the result that its song, although less forceful and brilliant, is more uniformly sweet. At Rivas, the White-throated Thrushes sang from late March of 1936 into June, but they sang far more freely in early April than

in late April and May, when the males were probably busy feeding the young. Although they were practically silent at Rivas through most of June and all of July, they sang rather freely at points slightly lower, in the broad, open valley of El General, until at least the first of August. On our farm at Quizarrá, I once heard a transient sing on August 20. In 1937, these thrushes began to sing at Rivas in early February.

The call is a guttural, staccato monosyllable which a small boy at Rivas aptly characterized as a "thick" note. The alarm call, uttered when the eggs appear to be in danger, is deep, harsh, and guttural, very different from the querulous *keyooo* which Gray's Thrush uses in similar circumstances. But if more strongly agitated, as when a fledgling is in peril, the parent voices a full, mellow, mournful whistle.

NESTING

At Rivas, 2800 to 3000 feet above sea level, I found or was shown seven nests in 1936 and 1937. The earliest of these nests contained three eggs on March 30, 1937; but one which held a newly hatched nestling on April 12, 1936, must likewise have been started late in March. The latest nest contained three newly laid eggs on June 3, 1936. An eighth nest was found on May 3, 1936, at about 4800 feet at Buena Vista which is above Rivas in the valley of the same name. It held two well-feathered nestlings. Most of these nests were placed in shrubs or small trees which grew in weedy pastures or low thickets and they were, in most cases, draped with vines. One was in a giant cane (*Gynerium sagittatum*) overgrown with vines, in a canebrake beside the river. The highest was in a sotacaballo (*Pithecolobium*) tree on the bank of the river. A very different site was the trunk of a banana plant which had been nicked and doubled over in the customary fashion when the fruit was harvested. The nest was situated ten feet above the ground upon the sharp bend, where it was supported on one side by the projecting end of one of the outermost of the leaf-sheaths which collectively made up the apparent stem of the banana plant. This plant stood in a small plantation well shaded by tall *Inga* trees in which the male sang. In height these nests ranged from 6 to 25 feet above the ground, but only the one in the sotacaballo tree beside the river was above 15 feet.

The nest is a very bulky cup, usually well covered on the outside with green moss. The inside of the nest is made up of a thick layer of mud mixed with fragments of decaying vegetation, and a fibrous lining is found in the bottom.

Four of these nests contained sets of 3 eggs. Two nests had 2 nestlings each and two other nests held a single nestling, but possibly eggs or young had been lost from the latter. The eggs of one set were dull white, very heavily mottled all over with reddish brown. On one of these eggs the mottling was finer and fairly uniform over the whole surface; on the other two it was coarser and heaviest on the thick end, where it obscured the ground color. These eggs measured 29.8 by 20.6, 28.6 by 20.6, and 28.6 by 20.6 millimeters. I have been unable to find any published record of the nesting of this thrush in Central America.

I found the White-throated Thrushes to be close sitters. They cling to their nests until I began to bend down the supporting branch to look into them, or until I almost touched them with the mirror which I raised up on the end of a stick for the same purpose. One female, which was brooding a fully feathered nestling in the rain, permitted me to advance my hand to within a foot of her before she fled and raised her harsh cries of alarm. These caused the youngster to jump from the nest before I could reach it, but since it could scarcely fly, I easily caught it on the ground. While I wrote a description of its plumage, one of the parents, greatly excited, perched only a few feet from me, complaining now with full, mellow, mournful whistles rather than with the harsh notes

I had heard first. Since Ridgway (1907:108) provides a description of the streaked and spotted juvenal plumage, I shall not describe it here, other than to record that the juvenile's bill was grayish, the iris brown, the orbital ring brownish yellow, and the legs gray.

SUMMARY

The White-throated Thrush ranges in Central America from sea level up to about 5000 feet. It is found both in heavy forest and in clearings with low, tangled vegetation, in which it nests. In the breeding season it is inexplicably absent from apparently suitable districts which are only a few miles distant from localities where it nests freely. It performs at least short migrations, disappearing for some months from the areas where it breeds.

It subsists on a variety of fruits and searches among fallen leaves for insects and other food.

It is a superb songster, with a powerful voice and a varied repertoire which includes weak, chaffy notes that detract from the beauty of its performance.

In El General, 2800 to 4800 feet above sea level, eight nests were found from late March to June. They were situated from 6 to 25 feet above ground in vine-draped shrubs and small trees in bushy pastures and thickets, in a cane brake, on a banana trunk, or in a large tree beside the river. The bulky open cup was covered externally with green moss and had a middle layer of hardened mud mixed with fragments of decaying vegetation.

The sets consisted of 2, or more often 3, eggs which were dull white heavily mottled all over with reddish brown. The female permitted a very close approach before she left her nest and uttered her peculiar notes of alarm.

RUFOUS-COLLARED THRUSH

Turdus rufitorques

This large, handsome thrush is about nine and a half inches in length. The adult male in his final plumage is nearly everywhere deep black, with a contrasting band of bright cinnamon-rufous encircling his body. This band is narrow above, where it forms a collar on the hindneck, and very broad below, where it covers the lower throat and all the breast. The chin is whitish, and the upper throat is streaked with black and cinnamon-rufous or it may be at times almost wholly blackish. The eyes, bill, and legs are yellow. The plumage of the adult female is paler, being grayish brown or buffy where that of the male is black. The breast of the female is buffy-cinnamon and the collar on her hindneck is rather indistinct. Immature birds of both sexes have streaked and spotted plumage, as is true of most young thrushes. The male apparently does not acquire his deepest, richest coloration until he is several years old.

If not the most common, this thrush is at least the most conspicuous and familiar of the numerous members of the thrush family which occur in the highlands of Guatemala. It is known also in adjoining regions of El Salvador and in the Mexican state of Chiapas. Its extreme altitudinal range is from about 5000 feet, where it is comparatively rare, up to at least 12,000 feet on the summits of some of the volcanoes. It is a hardy bird, tolerant of cold. In early December, 1930, I slept with two companions in a grass-thatched shack situated in the long-extinct crater of the Volcán de Agua. The unceasing wind drove a chilling cloud-mist into the rock-rimmed bowl, and several heavy Indian blankets did not keep us warm. I arose at daybreak and, wrapping a blanket around me, climbed up to the crater's rim on the eastern side to watch the sun rise. As the sun rose, its horizontal rays began to dispel the nocturnal chill, and I saw a flock of Rufous-collared Thrushes fly up the outer slope and pause in the pine trees on the rim, where they called to each other for a while and then dived down into the crater. They had probably passed the night in the scattered low pines close to the summit of the twelve-thousand-foot volcano, for in the evening twilight I had seen them dimly in the mist-filled crater. Aside from the yellow-eyed Guatemalan Juncos, these were the only birds that I saw near the top of the peak.

In mid-September, 1934, when crystals of frost were sparkling on the low herbage of the open glades, I found these thrushes on the high tableland of the Sierra Cuchumatanes in western Guatemala. In this area they were numerous in the open pine woods up to at least 11,000 feet above sea level. At the other extreme, I saw a few Rufous-collared Thrushes in October near the shore of Lake Atitlán at an elevation of about 5000 feet.

VOICE

During the year which I spent on the Sierra de Tecpán in western Guatemala, I saw and heard much of these thrushes, but my preoccupation with birds of less familiar types prevented my making a careful study of them. On January evenings they settled by scores on the open pastures near the summit of the 10,000-foot mountain. They reminded me of American Robins as they hopped over the close-cropped turf, but their breasts were browner than those of the northern species. Their call, a sharp *whip whip whip*, closely resembled that of the American Robin. When they flew they uttered another note very different in character—low, weak, and lisping—unlike anything that I could recall having heard from an American Robin. At times this softer utterance bore considerable resemblance to the call of the Cedar Waxwing which winters in these



Fig. 10. Rufous-collared Thrush.

mountains; and more than once I scanned the treetops looking in vain for the wax-wings that I so distinctly heard, only to discover at last that the author of these misleading sounds was a thrush well concealed in the foliage.

On the evening of January 25, as I was walking in the dusk across the pasture where the thrushes had been foraging, I heard their song for the first time. The strains seemed to come from a single bird in a cypress tree on the border of the pasture, and they were continued for several minutes, while the earliest stars twinkled in the darkening sky. The refrain was disappointing in itself, but I welcomed it as a harbinger of returning song, for few birds of any kind were tuneful at this season. The following evening several thrushes sang from their roosting places; again this occurred after the stars had begun to shine. To judge by their voices, the birds did not sleep in a compact assemblage but scattered themselves through the tops of the cypress trees that grew around the edges of the clearings. Each succeeding evening more voices joined the vesper chorus in the cypress trees. Their strains were rather weak and halting, running off into chaffy chattering at the end; but I hesitated to pass judgment on their ability as songsters, hoping that they would improve with practice.

Do thrushes always deliver their first song of the season in the evening rather than in the morning? I have too few observations to hazard a generalization; but in a number of years I have heard the season's earliest song of Gray's Thrush of the lowlands as the day waned, and these Rufous-collared Thrushes certainly sang in the evening

before they did in the morning. In early February, however, they began their morning chorus, carolling as the waxing daylight revealed the frost which whitened the open spaces. They were among the very first birds to become active in the morning, and in April they sang in full chorus by the light of the moon, before it had begun to pale in the face of the rising sun. Now they were in full song, and their many voices flooded the mountains with melody, even as the matutinal choir of the Gray's Thrushes saturates the cleared lands at lower altitudes. In the evening, before retiring to roost, they chose by preference the topmost spike of some tall pine as a singing perch and carolled far into the dusk, mingling their cheery music with the calls of the Whip-poor-will long after other diurnal birds were asleep. Their song much resembled that of the American Robin and was pleasant to hear, but it lacked the fullness and depth of feeling of the song of Gray's Thrush, and it also lacked the variety of such versatile minstrels as the Black Thrush and the White-throated Thrush.

NESTING

Like practically all the other birds of the region except the nectar-sipping humming-birds and flower-piercers, the Rufous-collared Thrushes on the Sierra de Tecpán raised their single brood in the brief interval of favorable weather between the last of the nocturnal frosts at the beginning of April and the advent of cold, hard rains in mid-May. This was a very dry period, when pastures and open fields were brown and scarcely any flowers were blooming. But most of the trees were in full foliage, the dominant oaks having somehow managed, despite the long-continued drought, to obtain enough moisture to renew their leaves a month or two earlier.

I found three nests, which were situated in trees growing in clearings and open woods in the zone of mixed dicotyledonous trees and pines at about 8500 feet above sea level. The first nest was 11 feet above the ground far out on a horizontal limb of a tree hawthorn (*Crataegus pubescens*). The second was 14 feet up on a horizontal bough of an alder tree (*Alnus arguta*), and the third was 15 feet above the ground in one of the many kinds of oaks that grow in these mountains. These nests were roomy, open cups. The first was the most attractive, for its outer wall was composed largely of gray lichens, with the admixture of a few sticks and pieces of weed stem that imparted strength to the structure. Within this was a thick layer, in both the bottom and the side walls, of a sort of plaster made by mixing bits of moss and fibrous materials with mud. This hard material was well covered by an inner lining of fine grasses. The outer part of the wall of the second nest was composed of sticks, weed stems, and straws, with a little green moss, but otherwise it resembled the first nest in construction.

The first nest contained 2 eggs on April 25, 1933, the second had 3 eggs on April 26, and the third held 3 feathered nestlings when found on May 13. The eggs were bright blue, unmarked. Those of the first set measured 32.5 by 20.6, and 30.2 by 20.6 millimeters. Those of the second set measured 27.0 by 20.6, 26.6 by 20.6, and 26.6 by 20.2 millimeters.

The young thrushes in the third nest were brooded through the night of May 13-14. When I visited them the next day, one jumped out and flew well. The other two left on the following day, May 15. Such maternal coverage of well-feathered nestlings seemed rather necessary in a region where the thin atmosphere became very cold every night, even at a season when the midday sun was at times oppressively warm. The young thrushes in their juvenal plumage were very different from either of their parents. Their grayish brown upper parts were conspicuously streaked and spotted with buff, the buffy breast bore conspicuous dusky spots, and there was no trace of the rufous collar.

When the wet season arrived in mid-May and their single brood was on the wing, the

male Rufous-collared Thrushes gradually became silent. In late May they still sang at dawn, but through the remainder of the day I rarely heard them, and they went silently to rest in the rainy or misty twilight. In June they ceased to sing even at daybreak. They had entered their long period of silence, which lasted until the end of the year.



Fig. 11. Crater of El Volcán de Agua, Guatemala. Here Rufous-collared Thrushes and Guatemalan Juncos were found at dawn, having apparently roosted in the pine trees near the summit of the 12,000-foot peak.

SUMMARY

The Rufous-collared Thrush inhabits the highlands of Guatemala, El Salvador, and Chiapas; it is found chiefly in the zone between 5000 and 12,000 feet above sea level. It occurs where the dominant trees are pines, cypresses, oaks, or other broad-leaved trees with an admixture of pine. This thrush is found, however, in open stands of trees, about the edges of woodland and in clearings with scattered trees rather than in the midst of heavy forest. When not breeding it travels in straggling flocks. It moves over open ground in search of food as does the American Robin. In December it was encountered at the summit of the Volcán de Agua at 12,100 feet, where apparently it roosted in the scattered pine trees; in January it was found roosting in cypress trees near the summit of the Sierra de Tecpán, at about 9600 feet.

On this mountain in 1933, the song of this thrush was first heard late in January, when the birds sang as they went to roost. Their song was not noticed in the morning until early February. At the height of their song period in April, they began singing with the first traces of approaching day, or even by moonlight, and in the evening twilight they continued to sing long after other diurnal birds had become silent. In late May they sang only at daybreak, and by June they had entered the long songless period which lasted until the end of the year. Their song resembles that of the American Robin.

In April and May, three nests were found in clearings and open woods, at heights ranging from 11 to 15 feet above the ground. The substantial open bowls contained a middle layer composed of a sort of plaster made by mixing mud with fragments of vegetation. They contained, respectively, 2 eggs, 3 eggs, and 3 nestlings. The eggs were bright blue, unmarked. At 8500 feet only a single brood seemed to be reared. This was accomplished in the interval of most favorable weather between the cessation of nocturnal frosts at the beginning of April and the advent of hard, cold rains in mid-May.

ORANGE-BILLED NIGHTINGALE-THRUSH

Catharus aurantiirostris

The genus *Catharus* comprises a number of small, long-legged thrushes, chiefly brown, olive, gray or blackish in color, that pass their lives on or near the ground in the more elevated portions of tropical America. These thrushes are found from the upper levels of the Tropical Zone to the high mountains of the Temperate Zone, but they are seldom seen near sea level. Some species are gifted songsters, but their music is quietly restrained rather than effusive and, as far as I know, is produced solely by day. The name "nightingale-thrush" appears to have been applied to these birds because a few of them, including the Orange-billed Nightingale-Thrush resemble in appearance the renowned nocturnal minstrel of the Old World and not because of their qualities as songsters.

The Orange-billed Nightingale-Thrush ranges from central México to Colombia, Venezuela, and Trinidad. This account deals chiefly with the well-marked Chiriquí race, once considered a distinct species (*C. griseiceps*), which is confined to the Pacific slope of southern Costa Rica and extreme western Panamá. This bird is about six inches long and has fairly bright brown upper plumage and light gray under parts, becoming white on the abdomen and under tail-coverts. From the forms of *C. aurantiirostris* that inhabit more northerly parts of Central America and southern México, it is distinguished by its dark gray rather than brown head. The bill, interior of the mouth, and bare orbital rings are bright orange, the long legs are orange-yellow, and the eyes are brown. The sexes are similar in appearance but, in at least some pairs, the female may be distinguished by the black ridge of her upper mandible. At the tip of the bill this black band is narrow, but at the base it extends below the nostrils, almost to the edge of the mandible. Elsewhere her bill is as bright orange as that of the male, which has at most a suggestion of black at the base of the culmen.

On the Pacific slope of southern Costa Rica the Orange-billed Nightingale-Thrush is abundant at elevations between 1400 and 4000 feet and possibly ranges somewhat higher, for in adjacent parts of Panamá it has been found up to 4800 feet (Ridgway, 1907:32) and in the Santa Marta region of Colombia a related race occurs up to 5000 feet (Todd and Carriker, 1922:405). It lurks on or near the ground beneath the densest of the thickets that spring up in abandoned fields and clearings; it avoids both open land and the undergrowth of the adjacent forest. The species as a whole differs from its congeners in its preference for bushy growth in cultivated districts rather than the cool depths of the mountain forests. In 1936 and 1937, I found Orange-billed Nightingale-Thrushes especially numerous in the extensive areas of low thickets that covered abandoned agricultural lands in the vicinity of Rivas. This village is in the lower part of the valley of the Río Buena Vista, an affluent of the Río Grande de Térraba, at an altitude of about 3000 feet above sea level. At all times most difficult to see, their presence was usually revealed by their notes issuing from the depths of the tangled vegetation. I was unable to discover whether these secretive birds live singly or in pairs during the portion of the year when they are not engaged in nesting. At least, they do not flock. Such birds as these must be constantly changing their area of residence; when the thickets where they live are cut and burned for the purposes of agriculture, they find fresh havens in neighboring fields which meanwhile have been overgrown with bushes and vines.



Fig. 12. Orange-billed Nightingale-Thrush.

VOICE

Although a more persistent songster than most other thrushes, the Orange-billed Nightingale-Thrush lacks the fluency and fervor of many of his relatives. Its quaint little song is short, simple, prosaic, decidedly un-thrush-like, and pleasant but not inspiring. The bird seems to sing in a talking voice. Its repertoire contains a variety of brief phrases which are repeated tirelessly over and over. *Thanks very much, that's very nice*, and *Will Shakespeare* are some of the paraphrases that have suggested themselves to me; but the shortness of some of the bird's syllables makes them difficult to represent by human words. One male sang *che-what ch-r-r-r*, ending its verse with a slight trill. The Orange-billed Nightingale-Thrush compensates for the plainness of its song by the regularity with which it utters it. While the Central American thrushes of the genus *Turdus* rarely sing except during their season of reproduction, the little nightingale-thrush is songful throughout the year. During my long sojourn at Rivas, I heard it at dawn and again in the evening throughout the twelve months. On chill December mornings these thrushes raised a chorus of their own amid the tangled thickets, for scarcely any other bird sang at this season. In the wet and gloomy months of September and October, the nadir of the song-birds' year, they sang less than at other times, but even then they were not entirely silent. They were at all seasons among the very first of the birds to lift their voices at dawn, and they were the last to become silent at night-fall. I took their music as the signal for the beginning of the birds' day.

The song of the Chiriqui race of the Orange-billed Nightingale-Thrush closely resembles that of its brown-headed relatives to the north. It utters the same sharp, mew-ing call which is rather similar to that of the Catbird. The similarity in voice, general habits and nesting of the gray-headed and brown-headed nightingale-thrushes of Central America, so far as known to me, gives added weight to the decision of Zimmer (1944), based on morphological characters and geographic distribution, to unite in a single species the forms earlier designated as *C. melpomene* and *C. griseiceps*.

NEST BUILDING

In two breeding seasons at Rivas, I made records of 29 nests of the Orange-billed Nightingale-Thrush, but in 15 subsequent seasons in the same general region, I recorded only three additional nests. The earliest of these 32 nests was newly begun when discovered on March 22, 1937. Two days later I found a second nest, already nearing completion, and a third that was half finished. An egg was laid in the second nest on March 30, and one was laid in the third nest on April 1. Numerous other nests with eggs were found in April of both 1936 and 1937. The latest nest was discovered on August 5, 1936, when it contained two eggs. Thus the breeding season covers about five months, a period sufficiently long for the rearing of two or even three broods. One pair, whose nestlings were fledged on April 28, began a new nest seven feet away from their first on May 20. But this structure was never completed, and aside from this I have no evidence for a second brood.

The nest is usually built in thickets and weedy fields where the birds occur. Although some nests are placed in the midst of dense, impenetrable tangles of vegetation, the birds often select a site somewhat more exposed than one would expect from their retiring habits. Their nests have been found at the edge or in a more open part of the thicket, as beside a cowpath. One nest was built in the axil of a leaf of a sugar cane, another in a coffee bush; both these plants were in small plantations. Still another nest was placed in a *Piper* bush beneath the deep shade of the sotacaballo (*Pithecolobium*) trees beside the river, in a situation with heavier leafage above but more open on the sides than that

usually preferred by this thrush. The lowest of the nests was only $3\frac{1}{2}$ inches above the ground. However, so low a position seems exceptional, for the next lowest (three in number) were 3 feet up. From that point the heights ranged up to 10 feet, which was the elevation above the ground of two of the nests. Half of the nests were built between 4 and 6 feet above the ground.

On March 25 and 26, 1937, I watched the construction of a nest situated $5\frac{1}{2}$ feet above the ground in the trifurcation at the top of a young targuá (*Croton draco*) tree growing in a low thicket. As far as I could determine, the female worked without help from her mate. Between 6:00 and 7:00 a.m. on March 26, she brought material 11 times, and she brought material 6 times in the following hour. On each visit to the nest, she usually brought a large billful of material, consisting of many pieces, which it must have taken her considerable time to collect. After laying her load in the interior of the half-finished cup, she would sit in it and shape it with her whole body. Her mate did not follow her back and forth on her visits to the nest, but while she worked he sang much of the time in the neighboring thicket. Now and then he came to perch for a moment on the rim of the nest and inspect his partner's work, and once he sang while he did so.

The completed nest of the Orange-billed Nightingale-Thrush is a bulky, thick-walled, open cup, measuring about $2\frac{1}{2}$ inches in internal diameter by $1\frac{5}{8}$ inches in depth. The outer walls are composed of coarse herbaceous stems, straws, and grass blades, intermixed with which is a variable amount of green moss. The interior is thickly lined with fine tendrils, rootlets, fine dry grass stems or inflorescences, dry secondary rachises of acacia leaves, or plant fibers. Some structures are untidy with the dangling ends of weeds hanging beneath them, whereas others are more neatly finished.

THE EGGS

The Chiriquí race of the Orange-billed Nightingale-Thrush appears invariably to lay two eggs in a set, and these may be deposited with an interval of either 24 or 48 hours. One egg was laid between 4:35 p.m. and 6:35 a.m., probably just before the latter hour. The shells are blue or pale blue; they are marked all over, but most heavily on the thicker end, with speckles and irregular blotches of cinnamon, brown, rufous-brown or pale lilac. The measurements of 25 eggs average 23.7 by 17.5 millimeters. Those showing the four extremes measured by 26.2 by 17.9, 25.0 by 18.3, 21.8 by 17.5, and 24.2 by 16.7 millimeters.

In 30 nests in the valley of El General, 2500 to 3000 feet above sea level, eggs were laid as follows: March, 1; April, 15; May, 4; June, 5; July, 4; and August, 1.

Two nests of *Catharus aurantiirostris costaricensis* found by Cherrie (1891:272) on the central plateau of Costa Rica contained 2 eggs each. These were pea-green rather than blue in color. A nest of this brown-headed race found by me near Cartago, Costa Rica, 4500 feet above sea level, on April 29, 1951, was situated $5\frac{1}{2}$ feet up in a bush in the dense shrubbery of a flower garden. The bulky open cup was composed of mosses and fibrous materials and contained 2 eggs which were pale gray, finely flecked with bright cinnamon-rufous which on the thick end nearly concealed the ground color. They measured 24.6 by 17.5 and 25.0 by 17.5 millimeters. Another nest found in the same locality on July 1, 1952, held 3 feathered nestlings. Aside from an occasional larger set, there is a close similarity between the eggs and the nests of the brown-headed and gray-headed forms of the Orange-billed Nightingale-Thrush.

INCUBATION

I have watched five nests that contained eggs or newly hatched nestlings, and in no instance did I see the male cover the eggs or young. At two nests of the Russet

Nightingale-Thrush I likewise saw only the female sit; incubation by the female alone seems to be the rule in the thrush family.

The nest in the young *targuá* tree which I had watched the female build on March 26 was completed two days later, and it contained two eggs on April 1. To learn some of the details of incubation, I watched this nest from my blind during the morning of April 12 and most of the following afternoon—a total of more than eleven hours. I could distinguish the male by his song and the female by the black stripe along the culmen of the bill. This female nightingale-thrush was one of the most impatient sitters among birds that I have watched. Her sessions on the nest through the day ranged from 5 to 56 minutes; the very long session was taken during a light shower in the late afternoon, and, excluding this session, her longest period on the nest was 21 minutes. The average of her 26 sessions in the course of 11 hours was only 12.6 minutes. Her 25 recesses varied from 5 to 24 minutes, with an average for the day of 13.2 minutes. She was away from her eggs slightly more than she covered them, for her total time off the nest was 329 minutes and her total time devoted to incubation was 328 minutes. Making allowance for the fact that the record included one more completed session than recess, she incubated only 48.8 per cent of the time. Very sensitive to heat, in the warmer hours of the day she panted much, with gaping mouth, even when she was not directly beneath the sun's rays. The nightingale-thrushes as a group are typically denizens of cool mountain forests, and they seem unable to endure a warm climate.

More interesting than the foregoing was the behavior of the male nightingale-thrush. During every recess of his mate, he kept guard over the nest. He had no one particular perch from which he watched it, but he moved around among the bushes close to the nest, usually within two or three yards of it. Most of the time he rested low in the tangled vegetation at the foot of the bank above which the nest was situated, and when in this position he was below the level of the nest. While he watched he repeated tirelessly his sweet, simple song. Only in the hottest middle hours of the day did his music lag, but during no watch was he completely silent. Although in his position below the nest he could not see what was within it, during many of the female's recesses he came to perch upon the rim and he attentively examined the eggs. If I approached the nest, he remained a few yards away from me and showed his displeasure by uttering loud, nasal mews, but he never dared to attack.

The behavior of the male was the more striking because, while his mate incubated, he rarely stayed for many minutes in the vicinity of the nest. There was a regular alternation in attendance by the male and the female, just as there is by the two sexes when both take turns at incubation; the male nightingale-thrush, however, passed his turn guarding instead of covering the eggs. Often the female flew from the nest just as she heard the song of her approaching mate. At other times he came and sang near her while she sat, but he soon left when he found that she was not yet ready to leave. Sometimes the female flew off before the presence of the male near the nest was evident to me, but almost always when this happened he appeared soon after her departure. Rarely did he wander off before his mate returned to take charge of the nest.

On June 8 of the same year, I devoted five hours of the morning to watching a second nest of the Orange-billed Nightingale-Thrush. In this nest the second egg had been laid on May 31. This female sat somewhat more constantly than her neighbor. Her 9 sessions ranged from 7 to 32 minutes, averaging 17.2 minutes. An equal number of recesses ranged from 11 to 19 minutes, averaging 15.1 minutes. The female sat a total of 155 minutes and was absent from the nest a total of 136 minutes, thus keeping the eggs covered 53.3 per cent of the time. Possibly this thrush sat for longer periods than the other because she was cooler. The tall thicket beneath which her nest was built provided

better shade; the morning was lightly overcast and the air cool. This thrush did not pant once during the entire morning, as her neighbor had often done. She always sat in the same position, with her tail toward me. Early in the morning, she uttered many a nasal mew as she approached the nest at the end of each recess, and sometimes she also gave a high, thin whistle. Later, she returned in silence.

Possibly, too, the more constant incubation of this second nightingale-thrush resulted from the fact that she was never called from the nest by her mate. Although he sang much through the morning, he rarely came within sight of the blind in which I sat. Yet, because this thicket was taller and more open beneath the canopy of foliage, I could see considerably farther than I could at the first nest. I could detect no relation at all between the singing of the male and the movements of the female. Sometimes he sang within hearing of the nest while she sat, and sometimes he sang while she was away. He did not once come to stand on the rim of the nest and look at the eggs, as the other male had done. Once he passed through the bushes above the nest, but apparently he paid no attention to it. Much of the morning I heard two nightingale-thrushes singing in different parts of the thicket. Although the males of some species of relatively large and powerful birds, like the jays and the Boat-billed Flycatcher, appear to guard the eggs regularly during the mate's absences from incubation, in birds as small and weak as the nightingale-thrush, standing guard is likely to be an individual trait rather than a habit of the species as a whole.

On August 4 and 5, 1947, I spent six and a half hours watching a nest situated about 10 miles from the foregoing nests, in the shady undergrowth of tall second-growth woods near the Río Peña Blanca. The set of two eggs had been completed on July 27. This late-nesting female sat more constantly than those which I had watched a decade earlier. Her 10 completed sessions ranged from 11 to 39 minutes and averaged 25.6 minutes, whereas 10 recesses varied from 8 to 19 and averaged 11.9 minutes. She spent 68.3 per cent of the time on her eggs, sitting always in perfect silence. On leaving she darted sharply downward from her nest, which was eight feet up in a slender bush. Her mate sang much, especially in the early morning, and sometimes his singing near the nest was the signal for her departure; but there was not the regular alternation between sitting by the female and guarding by the male which I had witnessed at my first nest. Thrice while the female was away the male went to look at the eggs; on two of these visits he brought a particle of food which he swallowed as he alighted on the nest's rim. But I did not see him feed his mate or coax the eggs to receive food, as some male birds do. Although this seemed to be a case of anticipatory food-bringing, it was not a well-marked example of this behavior (see Skutch, 1953a:10-12).

I passed much of May 1, 1936, seated in my blind in the midst of a low thicket near the Río Buena Vista. The purpose of my vigil was to learn something of the mode of incubation of a Bran-colored Flycatcher. But nearer to my hiding place than the flycatcher's nest was a nest of the nightingale-thrush. The latter was only three feet above the ground and contained two newly laid eggs. Although the set was complete, the thrush had not yet settled down to the task of incubation, for she left her eggs uncovered more than she sat on them. Upon approaching her nest, flitting through the bushes and tangled vines, she would utter nasal mews, and sometimes her mate would answer from the depths of the thicket. Then she would alight on the rim of her neat cup, ruffle out her feathers, hop into the hollow and snuggle down on her eggs.

During one of the nightingale-thrush's absences from her nest, a Slaty Castle-builder, foraging through the thicket, chanced to find the nest. The wren-like little bird pecked at the side of the nest, then it alighted upon the rim and looked down for a moment at the blue, brown-flecked eggs. Then, suddenly, it drew back its head and brought its

sharp, black bill down hard against the nearer egg, piercing the shell. The damage done, it at once continued its course through the thicket. I do not know why the castle-builder behaved in this fashion. It was certainly not done for the purpose of eating the egg, for the bird scarcely could have tasted the contents, and no member of the ovenbird family is known to be a nest robber. I believe that this was a young castle-builder which, when its eye was caught by the shiny blue objects in the nest, chose this method to investigate their properties.

Soon after the departure of the castle-builder, the owner of the nest returned. Alighting upon the rim, she appeared to notice at once that her egg had been damaged, but she gave no indication of disturbance. She bent her head down into the nest, where I could not see what she did, then she raised it again, mincingly opening and closing her bill, as though drinking. For several minutes she continued these motions; apparently she was sampling the contents of her egg and finding them not unpalatable. Finally, she settled down in the nest to warm the broken egg along with the sound one. After sitting for nearly twenty minutes, she rose up, tasted the egg a few times more, then grasped it with her lower mandible in the hole and flew out of sight with it. In three minutes she returned and alighted on the rim of the nest, pecked at the spot where the broken egg had lain, and made little mincing movements with her bill as before. Then she jumped down into the hollow of the nest to incubate the remaining egg.

I was able to determine the incubation period at six nests of the Orange-billed Nightingale-Thrush. At two nests it was 13 days, at one nest between 13½ and 14 days, and at three nests 15 days. This may be compared with the incubation period of the Russet Nightingale-Thrush, which was 15 days at one nest and 15 or 16 days at another.

THE NESTLINGS

Soon after daybreak on April 29, 1937, I entered my blind in front of a nest of the nightingale-thrush which was situated in a low bush beneath a great, leaning sotacaballo tree growing close beside the loudly rushing current of the Buena Vista River. When found a week earlier, the mossy cup already held two blue eggs. Before slipping into the blind, I glanced into the nest to assure myself that all was well with the eggs, and I picked one up to feel whether it was warm. But although I failed to notice that the other egg was on the point of hatching, I soon inferred from the behavior of the birds that it was. I had expected merely to learn something about the routine of incubation at this nest, but what I actually witnessed was far more interesting. My four-hour vigil at the nightingale-thrushes' nest on the morning the first egg hatched proved to be one of my most memorable experiences in bird-watching.

It was 6:10 a.m. when I began to watch the nest. At 6:14 the female nightingale-thrush returned to it, but instead of sitting on the eggs she rested on the rim and much of the time kept her head down in the bowl, where, unfortunately, I could not see what she did. She evidently watched, and possibly assisted, the young bird to escape from the shell. She continued to rest on the nest's rim for seven minutes.

At 6:21 the male came with an insect in his bill, and the female flew away. He looked into the nest, then swallowed the insect. Probably he saw that the nestling, whose hatching he had anticipated, was not yet out of the shell. He remained perching on the rim, guarding the nest, until his mate returned, at 6:29; she also had an insect in her bill. For a minute she stood on the rim, putting the insect down into the nest and apparently trying to make the nestling take it, but evidently it was not yet able to do so. Then she settled down in the nest with the insect still in her bill. For ten minutes she continued to hold it; then suddenly she swallowed it. At 7:03, after sitting for 33 minutes, she heard her mate singing nearby and left the nest, carrying off half of the empty

eggshell. The male alighted on the rim, but he left in a minute. At 7:09 he returned to resume his guard on the rim; but he had been there only a minute when the mother bird came back and he went off.

At 7:10 the female came to the nest with a tiny particle of food in her bill. She rested on the rim and during five minutes tried in vain to make the nestling swallow the morsel. While she was so engaged, the male also came with a very small insect. He wanted to give it to his mate, but, busy with her own offering, she could not take it. After a short delay, he swallowed his insect and went off. Then the female settled down to brood, still holding in her bill the morsel which the nestling did not take. Soon the male brought another insect, but, finding his mate's bill still occupied, he again ate the object himself. When he had gone, the female rose up, and after another minute's effort succeeded, at 7:21, in giving the nestling its first meal.

The female nightingale-thrush continued on the nest for an hour, during which her mate brought food seven times more, making a total of nine times in this session. The female herself ate all of the tiny insects which he delivered to her, but once she tried earnestly for five minutes to make the nestling take one of them. While she was engaged in this vain effort, her mate came with another insect, whereupon she swallowed the one she had been trying to make the nestling take; then she ate that which he had just brought. When, at 8:09, the male brought the ninth insect, the female took it in her bill and carried it off. The male remained standing on the rim of the nest for two minutes.

At 8:11 the female returned, bringing an insect, and after two minutes of coaxing succeeded in inducing the nestling to eat it. Then she resumed brooding. She remained sitting for 57 minutes; during this period her mate brought food seven times. She ate all of this, but once she tried for several minutes to give one of the insects to the nestling before she swallowed it herself. After eating an insect brought to her by the male, she usually stood up to look down into the nest, the while making the motions of swallowing.

At 9:08, when the male brought food the seventh time, the female took it and went off. The male stayed on the rim of the nest, guarding it, until his mate's return thirteen minutes later.

At 9:21 the female returned, bringing no food, and settled down to brood. Soon the male brought a small insect which she delivered to the nestling. Next he came with a larva as long as his bill. The female strove long and diligently to make the nestling swallow this, but in the end she was obliged to devour it herself. While she was busy trying to feed the nestling, the male came with yet another insect, but, as she was not just then ready to receive it, he swallowed it and went away.

At 10:01 the female left, after sitting 40 minutes, as the male approached with a tiny insect. He delivered this to the nestling, then remained standing guard on the rim until, at 10:07, his mate reappeared. A minute later she returned to the nest but brought no food. At this point I left the blind.

When I approached the nest, both parents flitted nervously through the bushes a few yards away and protested with loud mewling cries, as nightingale-thrushes almost always do when they feel that their nest is in danger. One of the pair also uttered a peculiar whistle, high in pitch and not very loud. I found the nestling dry, but the filaments of the down for the most part cohered in coarse gray strands which were just beginning to fray out at the ends into delicate single threads. When I bent over the nest, the little, pink-skinned, sightless creature raised up its head with an effort and opened wide its tiny yellowish orange mouth for food. The second egg showed no indication of hatching.

I was indeed sorry that I had not watched this nest before the egg hatched. Rewarding as the morning had been, it would have been still more interesting had I been able

to compare the parents' behavior on this day with that on previous days. The female's periods of brooding were, respectively, 34, 59, 57, and 40 minutes; her absences 7, 2, 13, and 7 minutes. Thus she brooded (or stood on the rim presenting food to the nestling) for 86.7 per cent of the time. It is probable that she had not sat on the eggs for periods as long as those she devoted to brooding the newly hatched nestling. Her long sessions and short recesses were made possible by the food that the male brought and she ate. Although her mate may have intended this food for the nestling and not for her, indirectly it was nevertheless of benefit to the nestling, for it enabled the female to brood it almost constantly during the critical first hours of its life outside the shell.

In the nest which I had studied most attentively during the period of incubation (on April 12 and 13, 1937) the first egg hatched on April 14; the second egg hatched on the following day. From 5:45 to 7:45 on the morning of April 17 I watched the parent nightingale-thrushes attend their two nestlings. The female alone brooded, as was to be expected from the fact that she alone had incubated. In the two hours, she covered the nest 5 times, for 19, 6, 7, 5, and 13 minutes, a total of 50 minutes, as compared with 60 minutes devoted to incubation in the same hours of April 12. The male was the chief provider, bringing food to the nest 11 times, while the female did so only 4 times. Her portions were, however, larger than those he brought. If the female happened to be covering the nest when the male arrived with food, he surrendered it to her. The first time that he did so, she ate the insects herself. The nestlings had been sluggish in swallowing the larvae which she had offered them on her arrival a few minutes earlier, and it was evident that they did not require nourishment just then. But when, during another session of brooding an hour later, the male brought food to her as she sat in the nest, she backed onto the rim and placed it in a nestling's mouth, then resumed brooding. While sitting, she would from time to time rise up to look down attentively at the nestlings beneath her, and so she kept herself informed of their needs.

The male nightingale-thrush was now too busy hunting food to keep guard near the nest in the absence of his mate, and he sang very little. Now and then he went to look into the cup without bringing food. On one of these visits of inspection, the nestlings hungrily stretched up their open mouths as he alighted on the rim. Immediately he flew off to find something for them, and in a minute returned with an insect which he gave to one of the young. On one occasion, after feeding the nestlings, he delayed for five minutes on the rim of the nest, plucking off minute objects, probably ants. He drove away a Rufous-breasted Wren which came to hunt insects in the bushes ten feet from the nest.

At the age of 11 days these nestlings were well feathered, and when 13 and 14 days old, respectively, they left their nest. In all, I have determined the approximate nestling period of 13 nestlings in 7 nests. In one instance it was 13 days, in five instances it was 14 days, in two instances it was 14 or 15 days, in three instances it was 15 days, and in two instances it was 17 days. The fledglings have dark olive-brown dorsal plumage. Their bill is black with a light tip rather than orange as in the adults, and they lack the conspicuous orange orbital rings of the latter. Their feet are yellow. They can usually fly fairly well as soon as they leave the nest, and they promptly vanish in the dense thickets where their parents lurk. For this reason it is almost impossible to follow their subsequent history.

SUMMARY

The Orange-billed Nightingale-Thrush lives on or near the ground in dense secondary vegetation in the higher parts of the Humid Tropical Zone. It is found from about 1400 to 5000 feet above sea level. This thrush is a most retiring bird and is very difficult to see.

The male's short, simple song is delivered throughout the year. He sings from a low, inconspicuous post, and he is among the first birds to become vocal at daybreak. He is also one of the last birds to become silent at nightfall.

The bulky, open nest, usually containing some green moss mixed with the dry, herbaceous vegetation that composes it, is placed from 3 to 10 feet above the ground (rarely lower) in dense thickets or tall, crowded weeds, or sometimes in a more open, well-shaded site. Only the female was seen to build.

In the valley of El General in Costa Rica the nesting season extends from March to August; but of 30 sets of eggs, 15 were found in April. In this region the full set consists regularly of 2 eggs, but in another part of Costa Rica a set of 3 eggs was laid by a female of another race.

Only the female incubates, usually sitting most inconstantly. One female incubated 48.8 per cent of 11 hours; another incubated 53.3 per cent of 5 hours; but a third, nesting very late, sat for 68.3 per cent of 6 hours.

One male regularly guarded the nest during his mate's recesses; another did so sporadically; but a third was not seen to do so. The first male sometimes went to examine the eggs, but he did so without bringing food. The second male twice brought food on his visits of inspection and he ate it as he alighted on the nest's rim.

When her egg was punctured by a Slaty Castle-builder, a female first sampled its contents, then, after covering it for 20 minutes, carried it off in her bill.

At six nests the incubation period varied from 13 to 15 days.

A nest was observed from concealment while the first egg hatched. The female stood on the rim watching, and possibly assisting, the nestling's emergence from the shell. The male brought food before he saw the chick and possibly this was before the young had escaped from the egg. The parents, especially the female, tried patiently to make the nestling receive food before it was able to do so; but it swallowed the first morsel within an hour of its emergence. The male then brought food very frequently, and he brought much more than the chick could consume. Most of the food was eaten by the female, which brooded far more constantly than nightingale-thrushes ordinarily incubate. Some items of food were swallowed by the male when he found his mate's bill full.

The nestlings are feathered at the age of 11 days. They leave the nest when they are from 13 to 17 days of age and can fly well.

RUSSET NIGHTINGALE-THRUSH

Catharus occidentalis

This small brown Russet Nightingale-Thrush dwells in the high mountains from northwestern México to western Panamá. In Guatemala and Chiapas, the race *Catharus occidentalis alticola* is found from 6000 to 10,500 feet above sea level. In Costa Rica and adjacent parts of Panamá, *Catharus occidentalis frantzii* is resident between 5000 and 7000 feet or higher. Why the species should not occur as high in Costa Rica as in Guatemala I cannot explain, unless it be that at high altitudes in the former country it would have to compete with the Slender-billed Nightingale-Thrush, whereas in Guatemala no other species of *Catharus* extends upward into the Temperate Zone. The Russet Nightingale-Thrush lurks obscurely in the dim undergrowth of the wet mountain forests; it is found either in forests made up of broad-leaved trees or in ones composed of pines, cypresses or other conifers. These types of forest occur in many parts of the Guatemalan mountains. Clearings in these same forests, densely covered with sapling conifers, are also attractive to this bird.

The highest point at which I discovered this nightingale-thrush was in the dense thickets of junipers in a ravine on the high plateau of the Sierra Cuchumatanes in Guatemala, which is about 10,500 feet above sea level. Except when singing, the bird is so quiet and unobtrusive that it is seldom seen and hence it is likely to be considered rare. It is only after its beautiful song has become familiar, or the bird-watcher begins to find its nests, that its real abundance in suitable localities becomes apparent. Unlike many thrushes of the genus *Turdus*, the species of *Catharus* appear never to flock.

I like to recall the Russet Nightingale-Thrush as I saw it years ago on a high mountaintop in Guatemala. Although I had several times caught fleeting glimpses of the retiring bird, I had been watching birds in this locality for more than a month before I had a really satisfying encounter with one. It stood on a moss-overgrown, fallen log in the moss-draped cloud forest, and I was able to study it at my leisure. It was a very plainly clad little thrush, about six and a half inches long, olive-brown above and gray below, with a bright russet crown and hindneck as its most distinctive feature. Long of leg, short of bill, with large, brown eyes, it seemed well fitted for life on the dimly lighted floor of the heavy mountain forests. After a while it hopped down from the mossy log to the ground, which was covered with mosses and the delicate trailing stems of *Nertera depressa*, and began to eat the little, bright orange berries of the latter. With its short black bill, it picked up one after another of these berries. Much of the time it was in full sight of me and hardly five yards away. At intervals the bird was seized with a fit of trembling, and the tail, feet, and whole body quivered as though it suffered from the cold. When it had gone, I sampled some of the orange berries, which evidently were edible, and found them rather insipid, although they had in very mild form the flavor of water-cress.

VOICE

Between 7000 and 10,000 feet on the Sierra de Tecpán in western Guatemala, I heard the song of the Russet Nightingale-Thrush very rarely in the severely dry months of the early part of the year. It was not until past the middle of May, when the weather had become very wet and the song of most other birds was beginning to wane, that the nightingale-thrushes began to sing freely. June was their month of fullest song; with

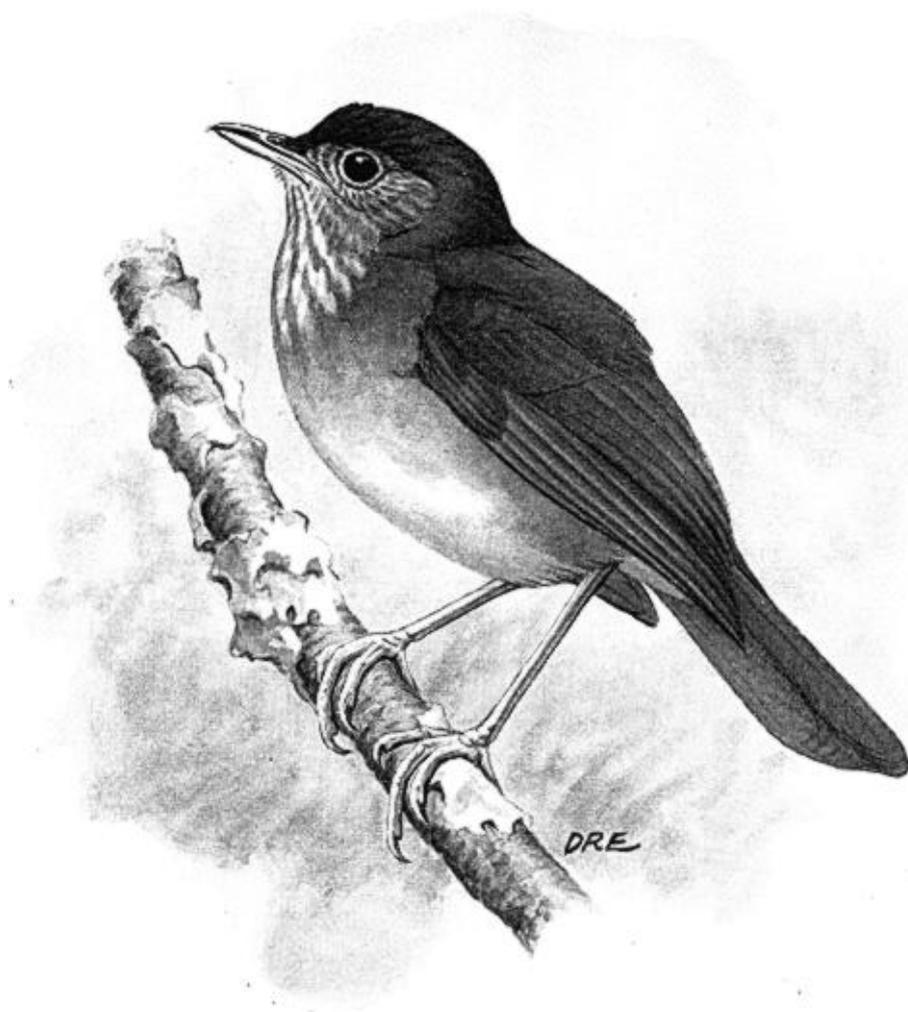


Fig. 13. Russet Nightingale-Thrush.

the advent of July they sang less, and after the middle of that month I rarely heard them except at daybreak. By early August they had ceased to sing even at dawn and had entered a long period of silence. On the northern face of the Cordillera Central of Costa Rica, between 5000 and 6000 feet above sea level, there was a very short dry season in 1938, and there Russet Nightingale-Thrushes sang from mid-March until early June. This was followed by a little sporadic singing in the following weeks. Thus, in this far wetter region, this nightingale-thrush's period of song came much earlier than in western Guatemala which has a long dry season. The interval of full song of the Costa Rican birds coincided with that of the majority of the passerine birds, instead of falling considerably later, as in the Guatemalan representatives of the species. Corresponding differences were found in the time of nesting of the two races.

This nightingale-thrush both lives and sings near the ground, sometimes performing as it stands on a fallen log in the damp undergrowth of the mountain forest. The songs of the Costa Rican and the Guatemalan races are similar in their dreamy,



Fig. 14. Remnants of cypress forest (*Cupressus Benthamii*) standing in dense lower growth near the summit of the Sierra de Tecpán, Guatemala, at about 9500 feet. Russet Nightingale-Thrushes and Rufous-browed Wrens were found in the lower vegetation, and Rufous-collared Thrushes sang in the trees.

unsubstantial quality. At the season when it sings, the Costa Rican bird must compete with many a more brilliant minstrel. Hence the Guatemalan nightingale-thrush impressed me the more deeply because it delivered its ethereal notes in the months when most of the other songsters were lapsing into silence, and much of the time the sweet voice of this bird alone sounded in the dripping forests. At dawn, on misty July mornings, when I stood beside the burrows of the Blue-throated Green Motmots, this nightingale-thrush's song was almost the only music to greet the day. It was the true "storm-thrush" of these mountains, the lover of gray and mist-dimmed, even rainy, weather. It was then, and in the sullen wet dawn of an unpromising day, that I most often heard its inspired music. How can written words convey any notion of its character, except by comparing it with another and better-known bird song, that of the Wood Thrush, for the two are of the same type. But the voice of the nightingale-thrush is less forceful, less substantial and more ethereal than that of the Wood Thrush. It seems afraid to sing loudly, and the song, instead of reaching a definite end, dies gradually away as though it came from a region far remote.

Female nightingale-thrushes deliver little ghosts of songs in an undertone, while approaching or leaving their nests, contemplating their nestlings, or in the midst of scolding intruders with a churring note.

The mellow querulous whistle of the Russet Nightingale-Thrush is very different from the sharp, mewing call of the orange-billed species. On a certain steep slope on the Sierra de Tecpán overgrown with head-high cypress saplings, I often heard this whistle as the day ended. The nightingale-thrushes were numerous in the young cypresses, but they were so retiring that I rarely glimpsed them. As dusk deepened, their soft whistles sounded from all sides with increasing frequency, and they continued, although becoming fewer, after the first stars shone out and other diurnal birds had fallen silent for the night. The nightingale-thrushes uttered this call, too, in damp and cloudy weather, but they rarely gave it while the sun shone brightly.

THE NEST

On the Sierra de Tecpán in Guatemala, I found nine nests between May 20 and July 13, 1933. Seven of these were among the mixed forests of dicotyledonous trees and pine trees about 8500 feet above sea level. These nests were all in deep valleys, usually above or near a stream, either in the forest itself or in bushy, tangled thickets not far beyond its edge. In addition to choosing the wettest part of the year for their nesting, these nightingale-thrushes seemed to prefer to place their nests in the most humid situations available to them. A thousand feet higher up the mountain two nests were discovered in the dense stand of young cypresses which covered a steep slope that had been logged not many years before. Here they were somewhat more exposed to the winds and to the sun that shone infrequently at this wet season. In height these nine nests ranged from 3 to 13 feet above the ground, but only one was above 7 feet.

Two nests found near Vara Blanca, Costa Rica, 5500 feet above sea level, were in very different situations. The first was built in the tall, dense *gigante* grass of a pasture surrounded by forest, not far from the edge of the woodland. It was not discovered until it had been cut down by a man cleaning the pasture; this was on April 18, 1938. On June 25 of the same year I found a nest 4 feet above the ground in the close-set hedge of introduced cypress trees that surrounded the cottage I was occupying. This was situated in the midst of the same pasture, and it was separated from the woodland by about a hundred feet of open grassland. The parent nightingale-thrushes were so discreet in approaching their nest through the tall grass outside the hedge that I did not suspect the presence of the nest so near me until I happened to see one of the birds fly out of the hedge with a white dropping in its bill. The nestlings were then completely feathered and were ready to leave the nest. These parent nightingale-thrushes sometimes hopped around on the bare soil of the neighboring flower garden searching for food.

Two nests found by Carriker (1910:747) on Volcán Irazú, Costa Rica, on April 13 and 14, 1902, "were both placed on sprays of bamboo hanging over the side of a deep ravine, and about seven feet from the ground."

Nests found in Guatemala and Costa Rica were similar in construction. All were bulky, open cups, with very thick walls composed chiefly of green mosses and liverworts, with an admixture of weed stems, pieces of vine, straws, bast fibers, or a few pine needles where these were available. The lining was composed of fine brown or black fibrous rootlets, and sometimes a few horsehairs or leaf-skeletons were used; these were all closely matted. Unlike the nests of species of *Turdus*, those of the nightingale-thrushes contained no middle layer of mud. Some of these birds were untidy builders, allowing weed stems and slender vines up to a foot in length to dangle below their nests, while many pieces of fallen material littered the foliage beneath. The nests measured from 5½ to 6 inches in over-all diameter, and they were about 3½ inches in height. The interior hollow was from 2¼ to 3 inches in diameter by 1⅞ to 2¼ inches deep.



Fig. 15. Eggs and moss-covered nest of the Russet Nightingale-Thrush on the Sierra de Tecpán, Guatemala, July 14, 1933.

THE EGGS

In the excessively humid Costa Rican mountains, eggs were found by Carriker on April 13 and 14. I found eggs in this area on April 18, but in western Guatemala, where the dry season did not end until mid-May, the earliest egg, newly laid, was discovered on May 20. As calculated from the date of hatching or the condition of the nestlings in three other nests, found at later stages, egg laying must have begun quite generally about May 18 to 20. Eight nests from Guatemala and four nests from Costa Rica, including two recorded by Carriker, each contained 2 eggs or nestlings. In one Guatemalan

nest the second egg was laid after 10:30 a.m. In this late laying the nightingale-thrush agrees with other members of the Turdidae for which information is available.

The eggs are pale blue, pale grayish blue or greenish blue, mottled all over with brown, rufous-brown or cinnamon; the markings on the thicker end are often so heavy and crowded that they almost conceal the blue ground color. These eggs resemble those of Gray's Thrush, but they are smaller. The measurements of 12 eggs, of both the Guatemalan and Costa Rican races, average 23.9 by 18.2 millimeters. Those showing the four extremes measured 24.6 by 19.1 and 23.4 by 17.5 millimeters.

INCUBATION

Incubation is performed only by the female. I found these nightingale-thrushes strongly attached to their nests at all times. One female with newly laid eggs would remain sitting until I approached openly to within a few yards; then she would jump from the nest and bustle through the bushes close at hand, scolding with churring notes as long as I remained. Once she darted within a yard of me when I touched the eggs. The far larger Gray's Thrushes are much more shy at the nest.

I cut a little niche into the steep slope of the ravine above my first Guatemalan nest of this nightingale-thrush. This niche was just large enough to hold my camp stool; over the stool I set an umbrella blind, and from this concealment I watched most of the stormy afternoon of May 28 and from 6:10 a.m. until 2:16 p.m. on May 30. Attempts to make one member of the pair acquire a mark by rubbing against a paintbrush set above the nest having failed, I had perforce to depend upon the voices of the male and female to distinguish the sexes. The sweetly singing male did not once come near the nest, and the almost silent female alone incubated. In eight hours on May 30 I timed 12 completed sessions ranging from 13 to 42 minutes and averaging 26.6 minutes; an equal number of recesses varied from 8 to 21 minutes and averaged 12.4 minutes. Thus the female kept the eggs covered 68.2 per cent of the time.

On approaching the nest, sometimes by hopping over the ground until near the sapling that supported it, she at times repeated in an undertone a few phrases of the song which her mate was singing out of sight in the undergrowth; more rarely she voiced a few musical notes upon leaving the eggs. On other days when I looked into the nest, she flitted around within a foot of me, and at intervals she interrupted her complaints to utter brief phrases suggestive of the male's song. She sat very still upon her eggs, rarely moving even her head, and almost always she maintained, until she left the nest, the same position she had assumed on her arrival. She was, despite her lack of bright colors, a beautiful bird. One exclaims immediately upon beholding a brilliantly colored bird that it is beautiful; but after passing many hours in quiet contemplation of this thrush, clad in softly blended shades of brown, the conviction was gradually borne upon me that she was no less beautiful than many a more gaily adorned bird, although her beauty was of a more sober order.

It rained hard during much of the afternoon. When the heavy showers fell, the thrush spread her wings slightly over the rim of the nest, where they served to throw the water outward, and she seemed perfectly comfortable and at ease despite the downpour. The drops which settled upon her had a silvery appearance, as drops of any colorless liquid do when they rest upon a nonabsorbent surface. The shining droplets rolled down her back or wings and off the nest; or if they delayed, she shook her head or body to hasten their descent. At the end of the afternoon she seemed far drier than I, for the umbrella above my head had developed several leaks. Then I began to understand how the nightingale-thrushes managed to breed in the course of the grueling wet season of the high mountains.

While I watched in the pouring rain on May 28, the female nightingale-thrush did a very curious thing, altogether unique in my experience with birds. Although she had built her actual nest neatly and well, she had been most careless about its surroundings and had left considerable dropped material sprawling over the supporting branches, with much more littering the boughs and foliage below the structure. This excess material formed a little shelf just outside the nest proper, and on this the nightingale-thrush



Fig. 16. Russet Nightingale-Thrush incubating eggs; Sierra de Tecpán, Guatemala, July 14, 1933.

settled down as though incubating. Here she remained for three-quarters of an hour, patiently brooding nothing while her eggs, two or three inches distant but apparently screened from her view by the rim of the nest, were exposed to the hard, chilling rain. At the end of that period I happened to shake the blind slightly and she darted away. Possibly she had settled outside rather than within the nest because the supporting branch, in sinking somewhat as it grew heavy under the weight of accumulated rain drops, had brought the little shelf nearer to the actual point in space previously occupied by the eggs. Or perhaps, on returning to the nest, her attention was taken by the blind which had so suddenly invaded her domain, and she failed to pay strict attention

to what she was doing. On all subsequent returns, the thrush sat on her eggs in the proper fashion. Her behavior was suggestive of that sometimes witnessed among gulls and other sea birds whose nests and eggs have been shifted about experimentally by students of bird behavior (Noble and Lehrman, 1940).

The rain was accompanied by infrequent but loud peals of thunder. The nightingale-thrush appeared not to notice a moderately loud report, but one detonation which was close and extremely intense caused her to look quickly around. Beyond this, she seemed indifferent to the noise. So, protecting her eggs at times and leaving them exposed to the rain and the cold mountain air at other times, while she went off to seek food, this nightingale-thrush hatched her eggs after 15 or 16 days of incubation. In a neighboring nest both eggs hatched after 15 days of incubation.

THE NESTLINGS

On June 5 I devoted four hours to watching another nest containing 2 nearly naked, 3-day-old nestlings. Most of the time I could recognize the female of this nest by her white under tail-coverts, which projected above the base of her tail in abnormal fashion and were unusually conspicuous. The female alone brooded, for 10 periods ranging from 1 to 32 minutes in length and averaging 16.7 minutes. Her 9 absences varied from 3 to 15 minutes and averaged 7.4 minutes. She kept the nestlings covered for 69.3 per cent of the time, which seemed to be none too much; for the morning, like most in early June, was so chilly that I was most uncomfortable sitting in the blind in the deep, damp, sunless ravine. During the four hours the male brought food 10 times, and he usually brought bigger billfuls than the female, who fed the nestlings only 8 times. White grubs were often conspicuous in the parents' bills. When the male found his mate brooding, he sometimes delivered all his food to her, or at times he gave her only a part. When the female rose to put this portion into the nestlings' mouths, the male then gave the rest of the food directly to the young. If the young were slow in stretching up for their meals, they were aroused by a single low note from the parents. The male, unlike many songsters, did not sing as he approached the nest with food in his bill. Once the female rose up, stepped backward to the rim of the nest, and, while looking down at the nestlings, sang a few strains in a low but very clear voice; then she flew away. It may be recalled that the other female, too, sometimes uttered a few songful notes in an undertone.

At this same nest I watched again from 7:00 to 9:08 a.m. on June 10, when the 2 nestlings were 8 days old. Although the air was cool and the young birds not yet completely covered by their sprouting feathers, they were brooded very little. The female covered them only 3 times, for 4, 2, and 13 minutes, or a total of 19 minutes out of the 128. She ended her first two turns on the nest as her mate approached with food for the nestlings; this behavior was very different from that of six days earlier. At that time she usually had taken the food from the male and delivered it to the nestlings. During her third and longest session, however, she merely rose up on the nest, helped the male to deliver what he had brought, and then resumed brooding. Both parents together fed the two nestlings 10 times in the 128 minutes. Again white or yellowish larvae, apparently found beneath the leaf litter on the ground, were an important component in the diet. Twice the male sang in a low voice as he came toward the nest with laden bill.

Since I had at this season relatively few nests to watch, I thought that it might prove interesting to vary the routine by giving the nightingale-thrushes some simple "intelligence tests." Taking advantage of the absence of the parents from the nest when the nestlings were eight days old, I completely covered the bowl with a piece of light blue paper. As the male approached, the nestlings stretched up their heads, lifting one edge

of the paper. He fed them beneath it, then he took it in his bill and carried it away. Next I placed a white handkerchief over the nest. The female approached before I had finished arranging it, and she pulled it off the nest as soon as I retired into the blind. Then she attempted to fly away with the handkerchief; but it was too heavy for her and bore her to the ground, where after giving it a few ineffectual tugs she left it and went to brood. I waited an interval, to give the parents an opportunity to feed and warm their nestlings, then covered them over with a green leaf. This thoroughly confused both parents; they hopped all around and even upon it, but they made no attempt to remove it. During the next three-quarters of an hour they returned again and again to the nest, but they seemed to be completely baffled; I believe that if I had not removed the leaf at the end of this time the nestlings would have succumbed to cold and hunger. The parents, although perturbed, did not seem able to solve the problem. I think the parents removed the blue paper and the white handkerchief, but not the green leaf, because they were accustomed to carry the white excrement of the nestlings from the nest. The blue paper was apparently light enough to evoke the same behavior; but they had never been called upon to take away green objects.

Later I made the same tests at the nest of a second pair of nightingale-thrushes with two week-old nestlings, and I found these birds more easily confused than the first pair. When one of the parents arrived with a billful of grubs and found the handkerchief covering the nest, he scolded with half-raised wings; then he sang in an undertone, still holding the grubs; then he scolded again. Twice he went off and returned; then he flew away with the undelivered food. The mate was confused in the same manner. One of the pair made a motion as though it were about to tug at the handkerchief; but neither actually did so, and the handkerchief remained over the nestlings until, after half an hour, I uncovered them. The thrushes' failure to remove the handkerchief could not have been because they feared it; for later, when I moulded it into the bowl of the nest and put the nestlings upon it, the parents, after some scolding and vacillation, came and fed them there. I also covered this nest with a leaf, and the results were the same as at the first nest.

Similar differences in the temperament of individual nightingale-thrushes were encountered in the course of my attempts to photograph them. At one nest with eggs, the female fidgeted about at a distance of a few yards while I focused the camera and changed films. She was so eager to resume incubation that she was ready to be photographed before I could reach the point a few yards up the slope to which I had led the thread which released the shutter. I made six exposures, and each time she was posed before I was ready to take the picture. So quietly did she sit that the negatives of exposures up to five seconds revealed not the slightest movement. I have rarely taken the portrait of a more cooperative bird. Quite in contrast to this willing subject of photography was a neighbor who would not return to her eggs in front of the camera even after it had been in place for forty minutes. Yet at this nest I waited in a blind to which I had led the thread to release the shutter, whereas at the first I worked without concealment.

When 13 days old the nestling nightingale-thrushes were well feathered. However, the female still brooded them through the cold wet nights, although they so completely filled the nest that she had to sit above rather than in it. During their last night in the nest I found the young unattended. The two young of one brood, which had been handled, left when 14 and 15 days old, respectively. The nestling period for the two young of another brood was 15 to 16 days.

The young nightingale-thrushes lacked the russet crown of the adults, and their upper plumage, from forehead to rump, was everywhere nearly the same shade, a brown

slightly darker and more olive than that on the backs of the adults. The young of my latest Guatemalan brood left the nest about August 1, after which I found no further evidence of breeding. The males now ceased to sing. Apparently in the high mountains of Guatemala only a single brood is reared.

SUMMARY

The Russet Nightingale-Thrush inhabits the highlands from about 6000 to 10,500 feet in Guatemala, although apparently it does not ascend so high in Costa Rica. The reason for this difference may be that at high altitudes in Guatemala it is the only member of its genus, whereas in Costa Rica another species occurs on the high mountain tops. The Russet Nightingale-Thrush dwells in the dim undergrowth of the damp highland forests and in the dense, low growth of adjacent clearings. It is never seen in flocks.

This nightingale-thrush spends most of its time on or near the ground, where it feeds on small berries and insect larvae.

The Russet Nightingale-Thrush sings and breeds in the wet season. On the excessively wet Cordillera Central of Costa Rica the period of song extended from mid-March until June, but in the drier mountains of the Guatemalan highlands full song was heard from mid-May into July. The male's beautiful song is low and dreamy, seeming to fade gradually away rather than to reach a definite end. The female has a whisper song.

The nest is a bulky open cup, containing much green moss and liverworts but no stiff layer of mud as in the case of *Turdus*. It is built in a bush or bamboo in the undergrowth of the forest or among dense vegetation in a clearing. The nest is usually placed from 3 to 13 feet up. Building was not observed.

In wet Costa Rica laying begins about the middle of April and continues until at least the end of May, whereas in the drier regions of western Guatemala it does not begin until the rains return in mid-May and continues until about the end of June. The set regularly consists of 2 eggs, which are pale blue or grayish blue, mottled with shades of brown.

Only the female was seen to incubate. In eight hours a female took 12 completed sessions ranging from 13 to 42 minutes and averaging 26.6 minutes; 12 recesses ranged from 8 to 21 and averaged 12.4 minutes. She kept the eggs covered 68.2 per cent of the time. This female once sat for three-quarters of an hour beside rather than in her nest, while hard rain fell on her exposed eggs.

At two nests the incubation period was 15 or 16 days.

The nestlings were brooded by the female alone but they were fed by both parents. The chief food was white or yellowish grubs apparently found beneath the ground litter.

At one nest the parents promptly removed a white handkerchief and a pale blue paper which covered their nestlings, but they were baffled by a green leaf. A neighboring pair failed even to remove a white handkerchief which prevented their feeding their nestlings. Similar individual differences were found in the course of photography, one female settling in front of the camera almost as soon as it was arranged, another remaining away a long while.

The nestling period is 14 to 16 days. Apparently only one brood is reared each year.

GENERAL SUMMARY OF INFORMATION ON THE TURDIDAE

The thrushes, solitaires, nightingales, and their allies form a nearly cosmopolitan family, or, according to some systematists, merely a subfamily of the Muscicapidae. The group consists of small or middle-sized passeriform birds totaling 304 species (Mayr, 1946:67). Although thrushes are most numerous in the temperate regions of Eurasia, many species are found in the New World, and the family is abundantly represented in tropical America, especially in the highlands. Brilliant plumage is rare in this family; most of the members are clad in shades of brown, gray or black. But some are remarkably handsome birds in their dress of chestnut and black or white and black, and a few are prettily attired in subdued shades of blue and red. Young thrushes often have the plumage conspicuously spotted, especially on the under parts, and this character is retained by the adults of many species. The sexes are frequently alike and where differences occur they are rarely as pronounced as in many finches and wood warblers. Seasonal changes in coloration are typically slight or absent. The thrushes which breed at high latitudes are usually more or less migratory, but some pass the winter amid snow and ice. In winter Blackbirds form temporary pairs which break up at the approach of the breeding season (Snow, 1956:443).

The food of some species, especially that of the genus *Turdus*, contains a high proportion of fruits, whereas species of *Sialia*, *Catharus*, and others take a preponderance of animal matter; but in most members of the family the diet is highly varied. Many thrushes forage on the ground, where they may push fallen leaves and litter aside with their bills, or they may dig little holes in search of small prey. European Robins sometime feed at the feet of a man who obligingly scrapes away the frozen topsoil in the winter woods (Lack, 1953:195).

In voice this is one of the most highly endowed of all avian families. For fullness and range of voice, variety of phrasing, smoothness and continuity of flow, few other birds can match the thrushes; the finest dawn choruses are those in which they take a leading rôle. Among the most renowned songsters of nearly every land are members of this family: in Europe, the Song Thrush and the Nightingale; in North America, the Veery, Wood Thrush, and Hermit Thrush; in Guatemala, the *guarda barranca* or Brown-backed Solitaire; in Costa Rica, the *jilguero* or Black-faced Solitaire. Each of these is very different from the others in the character of its music. As a rule, thrushes do not copy the songs of their neighbors, yet numerous instances of mimicry have been observed. The Guatemalan Black Thrush is a superb imitator of the notes of other birds; the Red-spotted Bluethroat and the European Wheatear have considerable talent in this direction; and in Great Britain the Song Thrush is at times a mimic. Although Blackbirds compose many original phrases or tunes, less gifted individuals copy others of their kind; and the European Robin's sub-song contains many imitations of the calls and songs of other species (Howard, 1952:178-180). Flight songs are not usual in the family, yet they have been reported for the Gray-cheeked Thrush, the Red-spotted Bluethroat, and the Townsend Solitaire (Bent, 1949:201, 307, 325); this type of song likewise has been reported for the Wheatear which rises into the air to indulge in a "little lyric frenzy" (Selous, 1927:331).

In Central America, thrushes of the genus *Turdus* rarely sing outside their breeding season, whereas species of *Catharus* (nightingale-thrushes) and *Myadestes* (solitaires) are songful through much of the year. The Townsend Solitaire of western North America sings much in fall and winter, even in snowstorms (Bent, 1949:326). Many thrushes sing more or less in their winter home which is far from their breeding ground. Thus

the Swainson Thrush is tuneful during its last month or two in Central America, from late March to early May, and it produces more music than any other bird in the undergrowth of the heavy forests where it sojourns. I have also heard the migratory Wood Thrush sing in the forests of Panamá, and Hermit Thrushes likewise sing in their winter quarters farther north (Bent, 1949:159). In Africa, European Robins, perhaps chiefly females, hold territories and sing while they winter in the region around the Mediterranean (Lack, 1953:112); and the Nightingale sings finely in its winter home in equatorial regions (Moreau, 1937:19). Similarly, the Red-spotted Bluethroat sings occasionally while wintering in both Egypt and India (Bent, 1949: 311-312).

In the family as a whole, song seems to be largely restricted to the males, and in most species I have heard at best only a little shadow of song from the female. But the female Gray-cheeked Thrush often sings while incubating eggs or brooding young (Bent, 1949:212); and in the Eastern Bluebird, whose song is charming but not brilliant, the voices of the two sexes are indistinguishable (Thomas, 1946:178). Female European Robins which claim winter territory sing loudly in autumn, but song by this sex is rare at other seasons (Lack, 1953:35). In a group so excellently endowed with music, it is strange to find so poor a songster as the Mountain Thrush of the Costa Rican highlands, whose two or three weak notes are so monotonously reiterated that, when I first heard them coming from the mist that shrouded the dripping mountain forests, I mistook them for the utterance of a hummingbird. The colonial-nesting Fieldfare also has a poor reputation as a songster.

Nuptial feeding was reported by Lack (1940:176) for the European Robin, Townsend Solitaire, and Eastern Bluebird. A Western Bluebird fed his mate while she built, and the male Mountain Bluebird feeds the female while she incubates (Bent, 1949:267, 279). The male Hermit Thrush feeds his incubating mate (Bent, 1949:148), and so, too, does the European Wheatear (Mildenberger, 1943). Nuptial feeding appears not to occur in *Saxicola*, *Catharus*, and most species of *Turdus*, although on rare occasions it has been seen in the Mistle Thrush and Blackbird (Tucker, 1946) and in the American Robin (Common, 1947:240; Kendeigh, 1952:128).

Monogamy is certainly the rule in the family, although polygamy has been reported for the Whinchat (Nice, 1943:206), and an apparent case of polyandry has been reported for the Eastern Bluebird (Laskey, 1947:314). Also, two female European Robins, mated to the same male, each had a separate territory from which she drove the other (Lack, 1953:71).

The nest is most often placed in trees or bushes, but many members of the family build on the ground; among these are species of *Myadestes*, *Hylocichla*, *Luscinia*, and *Saxicola*. Cavities in trees or bird boxes are used by bluebirds (*Sialia*); while redstarts (*Phoenicurus*) and European Robins (*Erithacus*) nest in holes of the most varied sorts, including crannies in stone walls, hollows in trees, holes in the ground, or within the shelter of a house or other building. Fieldfares breed in colonies, but solitary nesting is usual in the family. Nests of the members of the Turdidae are typically open cups, usually thick-walled and often bulky, composed of sticks, grass, weeds, leaves, moss, and often paper, rags, and string. In *Turdus*, an inner plastering of mud is often present. Exceptional in this family is the domed nest of the Kamchatka Nightingale (Bent, 1949:314).

The nest is built by the female usually without assistance from the male, although in a few species the male gives some help. This is often true of bluebirds, and the male has been reported as helping to build both in the Eastern Bluebird (Kendeigh, 1952:140) and in the Mountain Bluebird (Bent, 1949:279). The male American Robin may on rare occasions take a subordinate part in building the nest (Bent, 1949:20; Ken-

deigh, 1952:125). Among the Old World thrushes, both sexes of the Ring-Ouzel are reported to build, while the male of the Mistle Thrush, European Blackbird, and Wheat-ear may give more or less help in nest construction (Witherby, *et al.*, 2, 1938:104-204).

The eggs of thrushes are laid at almost any hour of the forenoon and sometimes in the afternoon. Even in a single set the hour of laying is most variable (Skutch, 1952a: 53). The American Robin usually deposits its eggs rather late in the morning (Kendeigh, 1952:130). The eggs of thrushes are sometimes white but more often are greenish blue or blue; at times they are olive-brown, or at least they are tinged with these colors. They may be immaculate or more or less heavily spotted or blotched with shades of brown, red, purple or gray. Both unmarked and mottled eggs may be found in different species of the same genus, as, for example, in *Turdus* and *Hyllocichla*. Among the Central American members of the family, species of *Catharus* nearly always lay 2 eggs in a set; species of *Turdus* lay 2, 3 or, exceptionally, 4. The Eastern Bluebird of the Guatemalan highlands produces sets of 4. As in other families, northern species lay larger sets, consisting usually of from 3 to 6 eggs, rarely more.

Incubation is carried on chiefly or wholly by the female. Witherby's "Handbook" records incubation by both sexes in the Ring-Ouzel, and it states that in a number of other species the male sits "at times," but the amount of incubation performed by him may not be great. Male Eastern Bluebirds have on rare occasions been found incubating, but this is unusual in the species (Laskey, 1939:26-27; Thomas, 1946:156; Bent, 1949: 243). Likewise the males of Mountain Bluebirds, European Wheatears, and Red-winged Thrushes cover the eggs at times (Bent, 1949:279, 293, 3). In the European Blackbird, although the male at times sits, he apparently cannot fully warm the eggs because he lacks a bare incubation patch (Bent, 1949:77). Careful studies of the Wood Thrush (Brackbill, 1943:75; Bent, 1949:108) and of the American Robin (Schantz, 1944:118) revealed that the female alone incubated; and I found this to be true of Gray's Thrush, the Russet Nightingale-Thrush, and the Orange-billed Nightingale-Thrush. The nightingale-thrushes are rather inconstant sitters; at four nests of the two species the longest session observed lasted only 56 minutes, and the averages of sessions ranged from 13 to 27 minutes. The sessions of the Wood Thrush studied by Brackbill (1943) varied from 7 to 59 minutes, with an average of 31 minutes for the first brood and 27 minutes for the second brood. The larger Gray's Thrush sits more steadily, rarely for less than half an hour at a stretch; sometimes it incubates for 2 or 3 hours continuously. At one nest the average of the sessions was 59 minutes, at another nest the average was 74 minutes. The percentage of time devoted to incubation by day was 49 to 68 for the Orange-billed Nightingale-Thrush, 68 for the Russet Nightingale-Thrush, 78 to 80 for the Wood Thrush, and 74 to 86 for Gray's Thrush. Kendeigh (1952:128) found that the percentage of the day which the American Robin spends on the nest is 78.1 when the temperature is at 58°F., but he also found that the bird's constancy in sitting falls to 60.7 per cent as the temperature rises to 83°F. Lack (1953:201) found surprisingly great individual variation in the European Robin's pattern of incubation.

The incubation periods of a number of European, North American, and Central American thrushes range from 12 to 14 or rarely to 15 days. The European Robin's eggs hatch in 13, 14, and sometimes 15 days, the longer period being more frequent in the cool weather of March and April than later in the summer (Lack, 1953:200). The incubation period for Gray's Thrush is rather consistently 12 days, but for the smaller nightingale-thrushes it is from 13 to 15 days, more often the latter. Perhaps this is a result of the less constant incubation of the nightingale-thrushes. At a single nest of the Eastern Bluebird in the Guatemalan highlands, the incubation period was 14 days. This is in accord with the period of 13 or 14 days found for another race of the same species

in Tennessee by Laskey (1940:188). The incubation period of *Sheppardia cyornithopsis*, $16\pm\frac{1}{2}$ days as determined at one nest in Tanganyika Territory by the Moreaus (1940:320), is unusually long for the family.

Nestling thrushes, when newly hatched, have tightly closed eyes, bear sparse but sometimes long natal down, and usually have the interior of the mouth yellow or orange-yellow. Nearly always they are brooded by the female alone, but Howard (1952:83) states that an aberrant male Blackbird often brooded. As far as I know, the nestlings in this family are fed by both parents; the food is carried in the bill rather than regurgitated. Some males start to bring food much more promptly after the nestlings hatch than do others, but this is probably an individual rather than a specific variation. Injury simulation has been recorded for several European species of *Turdus* and for the Wheat-ear (Nice, 1943:284), and also for the American Robin and the Wood Thrush, in which it was successfully employed against a snake (Hebard, MS). However, distraction displays of any sort are rare in this family, and I have never had a thrush attempt to lure me from its nest. As a rule, members of this family are prudent rather than bold when their nests are visited by man; but the braver of them may dart or flit close to the intruder, protest vocally, and at times snap their bills in a threatening manner.

Nestling periods fall chiefly between 12 and 15 days; species that nest in holes may have a nestling period of 16 days. Nestling Eastern Bluebirds remained in their boxes "from 14 to 16 days, usually the latter period" (Laskey, 1940:188); but periods of 17 and 18 days are recorded for this species by Thomas (1946:158). The Black Redstart stays in its nest in a cavity for 16 to 18 days. Brackbill (1943:80-81) noted that young Wood Thrushes began to find some food for themselves at ages of from 20 to 23 days, and when they were from 28 to 32 days old they seemed to be independent of their parents.

Helpers at the nest have been reported for a number of species, especially in the genus *Sialia*. Laskey (1939:28) describes how five Eastern Bluebirds of the first brood, less than two months old, "diligently cared for the four nestlings of the second brood. This group of immature birds began bringing food into the box when the young were three days old." In the same paragraph she cites additional instances, reported by other observers, of similar helpfulness by young Eastern Bluebirds. Young Mountain Bluebirds (Mills, 1931) and Western Bluebirds (Finley, 1907) may assist in similar fashion to attend young of the following brood. An adult male Eastern Bluebird busied himself feeding the nestlings of a pair of House Wrens, much to the distress of the latter, until his mate hatched his own offspring, when he turned his attention to them (Forbush, 1929). A six-week-old female Eastern Bluebird in the aviary of Ivor (1944) began to feed young Wood Thrushes, Veeries, Bobolinks, orioles, and cardinals which were being hand-reared in the same compartment. When this female was slightly older, she helped both to feed and to brood a nestful of young Eastern Bluebirds, sometimes sitting on the nest side by side with the female parent. A mature, unmated female Wood Thrush in the same aviary joined the young bluebird in feeding the hand-reared chicks of various species.

Three adult Gray-cheeked Thrushes fed the young in one nest (Bent, 1949:205). A Swainson Thrush helped to feed nestling American Robins (Bent, 1949:167). Wynne-Edwards (1952:378) found several juvenal Wheatears bringing food to nestlings of a later brood, and he cites a second example of such behavior in this species discovered earlier by E. M. Nicholson. Sutton and Parmelee (1954:298) watched two adult male Wheatears attending the young in one nest. A second adult Black Redstart, in better plumage than the male parent, helped the parents to nourish nestlings and clean their nest (Nice, 1943:243). After raising her own young, a female Blackbird continued for two

or three weeks to offer food to any bird that came near, and among others she fed an adult European Robin (Lack, 1953:99). Armstrong (1947:168) saw a European Robin feed nestling thrushes, and he (1955:233, pl. 7) published a photograph of another robin bringing food to nestling Winter Wrens. A male European Robin fed a rival with whom he had been fighting in a cage, after the latter broke his leg (Lack, 1953:82). The same author (1953:98-99) has also collected many other instances of similar behavior by the European Robin.

The sleeping habits of thrushes are very inadequately known. Perhaps most often they roost in trees or bushes which are screened by foliage. The communal roosts of the American Robin, in which many thousands of birds may gather from a wide surrounding area, have been often described. In the highlands of Guatemala, numerous Rufous-collared Thrushes congregate to sleep in tall cypress and pine trees; at lower altitudes in Central America I have found Gray's Thrushes roosting in small numbers in compact clumps of tall bamboo, in company with various other small birds. Sometimes thrushes sleep in an enclosed space, but they seem reluctant to do so unless the weather is severe. Thomas (1946:174) found Eastern Bluebirds sleeping in nest boxes only in the coldest weather. At temperatures approaching zero on the Fahrenheit scale, two pairs overcame their usual enmity and took refuge in the same box on snowy nights. Ordinarily three or four Eastern Bluebirds snuggle within a terminal cluster of dead leaves. Armstrong (1940:7) relates how a European Robin slept on winter nights in a eucalyptus tree in an enclosed porch, where he waited until the door was opened the following morning; but such behavior is exceptional in the species. In Nigeria, a fledgling Red-breasted Chat went to roost in the underground hole where it had been reared. The female parent had tried earlier in the evening to lead the young bird back to this hole (Macgregor, 1950:383).

FAMILY TROGLODYTIDAE

RUFOUS-BREASTED WREN

Thryothorus rutilus

Some of the wrens of tropical America grade in coloration in such a fashion that, by arranging them in a series of slightly differing forms, one may constitute a "species" whose extreme members differ greatly in appearance. Among the wrens about which taxonomic judgment is much at variance is the subject of the present account. Some ornithologists regard the Rufous-breasted Wren as a distinct species, while Hellmayr included it in an extremely polymorphic "species" which embraces forms so diverse as a rufous-breasted bird in Trinidad and one with a spotted, white breast in northern Central America. We need not at present attempt to solve this perplexing problem; the final decision requires field observations of the behavior of the several forms, especially in regions where two of them meet. In the present chapter we shall deal solely with the form *Thryothorus rutilus hyperythrus*, which figures as a separate species in most of the older faunal works, and which extends along the Pacific slope from the Isthmus of Panamá to somewhat beyond the Gulf of Nicoya in Costa Rica.

The Rufous-breasted Wren is about five inches in length. The sexes are alike in appearance. In this form, the crown is russet or rich chestnut with a narrow black border. A narrow white line arches above each eye. The entire cheek area, the auricular region, the sides of the neck, the chin, and the throat are black, heavily streaked or spotted with white. The back, rump, and wings are plain olive-brown, and the tail is grayish brown, broadly barred with black. The breast and belly are bright orange-tawny, which becomes paler in the center of the abdomen. The under tail-coverts are grayish with broad dusky bars. The slender bill is black, the eyes are deep brown, and the legs and feet are dark.

Avoiding the somber depths of the heavy forest as well as the bright light of the clearings, these wrens frequent low, dense, vine-smothered second-growth thickets and the lighter, more open secondary woods. The latter shelters an undergrowth more dense and tangled than is usually found beneath mature forest. They also forage along the vine-festooned edge of the rain forest, although they avoid its interior, and they even work their way along compact hedges which lead out from a dense thicket into an area with more scattered vegetation. It is usually difficult to see them well, but this is due to their restless nature and the heaviness of the foliage where they forage rather than because they are particularly shy or distrustful of man. Much of their insect food is found among the curled, dead leaves caught up in the vine tangles. They remain in pairs at all seasons, as one can ascertain by paying attention to their responsive songs, although it might be difficult to prove this point by visual observations alone. In altitude, this species extends from sea level up to at least 4000 feet. It is very abundant between 2000 and 3500 feet in the basin of El General in Costa Rica where I have studied its habits.

VOICE

As they forage through close-set vegetation, where visibility is very restricted, these constantly mated wrens keep in touch with each other by their voices. As is true of a number of other wrens, they use song for this purpose rather than tuneless calls. It is not surprising that song so constantly employed should acquire special modifications.



Fig. 17. Rufous-breasted Wren.

Male and female, answering each other over and over as they move restlessly through the bushes and vines, often make some attempt to coordinate their verses, which are sweet and pleasing although in power and brilliance they fail to equal the songs of some other wrens. Sometimes the two sing in unison, but more often their song is antiphonal. Pairs seem to vary in their skill in blending their voices together; but those which are expert at antiphonal singing do it so well that, except in favorable conditions, the human listener may not suspect that the continuously flowing song emanates from two throats rather than one.

Once while I sat in a blind, placed in second-growth thickets, I enjoyed an excellent opportunity to study the Rufous-breasted Wren's mode of singing. When the male and female of a pair were on opposite sides of me, one of them, probably the male, sang an engaging song of five clear notes, then his mate immediately responded with a refrain of

four slightly weaker notes. No sooner had she concluded her reply than the male sang his five notes again, whereupon she added her four; the whole formed a very fine example of antiphonal singing. Later, when both of these wrens were on the same side of me, they continued to sing in precisely the same manner. Now, however, the refrains of the two were so well timed, and they blended so perfectly together that, if I had not just heard them singing from opposite quarters, I should never have suspected that I had been listening to more than one songster. In another pair, the parts of the male and female consisted of six and three notes rather than of five and four. The males often sing, alone, phrases of five or six notes.

The songs of these wrens do not, like those of so many other birds, serve chiefly to advertise the possession of territory and to attract a mate. Their main purpose is to keep constantly mated individuals together; hence the songs are not restricted to the season of pair formation and reproduction but are heard throughout the twelve months, including the wettest and gloomiest periods of the year. Song is most profuse, however, during and just before the nesting season. When angry or distressed, this wren scolds with a sharp *churr*. Another utterance is a long-drawn, questioning *reeep* or *ch'reeep*, delivered with a rising inflection of the voice. Both this note and the song of the Rufous-breasted Wren are rather similar to the corresponding utterances of the Spotted-breasted Wren of northern Central America, which lends support to those who would place these two forms in the same species. On the other hand, the birds differ greatly in appearance.

SLEEPING

I have thrice found these retiring wrens of the thickets sleeping in dormitory nests, and each time a single bird occupied the lodging. The nests differed greatly in site and construction. The first, situated $5\frac{1}{2}$ feet up in a tangle of vines in a brake of tall wild cane (*Gynerium sagittatum*), was a compact, well-made, spherical structure about $4\frac{1}{2}$ inches in diameter, with a round doorway facing directly sideward. It closely resembled the breeding nest, to be described later, and possibly it had been used earlier for rearing a brood. Here, on February 28, 1937, I found an adult sleeping alone. It rested at the back of the ample chamber rather than with its breast in the doorway. A few days later the cane brake was cut down for planting maize and the nest was deserted.

The second dormitory, found on January 1, 1948, was situated about ten feet up in the clustering foliage of an outjutting twig of a calabash tree in front of our house. It was a frail, slight structure composed of dry grass blades mixed with a few tendrils and rootlets and a little green moss. The doorway faced obliquely downward rather than sideward. There were small holes in the thin roof and at the back there was a round hole almost big enough for the wren to pass through. The nest measured about $3\frac{1}{2}$ inches from front to back and $2\frac{1}{2}$ inches in transverse diameter. The interior was too shallow to have held an egg. Although the nest was in a surprisingly exposed situation, the wren could reach it from the edge of the woodland, 50 yards away, without flying more than a yard or two across an open space. This was accomplished by working along a privet hedge, and then passing through the compact crown of the calabash tree.

The solitary occupant of the lodging usually slept with its tawny breast in the doorway, just as Bananaquits slumber in nests of the same shape. But once, when I had frightened it forth by an evening visit and it returned as the light was failing, it fell asleep with its head inward and its barred tail projecting into the doorway, and it remained all night in this position. It was a sound sleeper, not easily awakened by the beam of a flashlight, noises, or even the shaking of the nest. At dawn it continued to slumber after many birds of other kinds had become active. The wren lodged in this flimsy nest for about ten days after I found it. After this, the structure remained

deserted for some days, but it was later occupied at night by a Bananaquit. Probably this or another Bananaquit had built it; for in form and situation this nest resembled those of the honeycreeper far more than the other nests of the Rufous-breasted Wren that I have seen.

In mid-July of 1956, I discovered the third dormitory in a guava tree close by the site of the second dormitory. It was situated about twenty-five feet above the ground on a slender, horizontal twig, beneath a little spray of leaves. Here it was completely visible from below, although its size and height made it inconspicuous, but it was protected above by the canopy of the tree. It was composed, as far as I could see, chiefly of grass and a few tufts of green moss, and it was even smaller, frailer, and more loosely constructed than the second dormitory. In this respect it resembled one of the flimsier sleeping nests of the Bananaquit. In this skimpy, exposed structure a single Rufous-breasted Wren slept through wet July nights. By August the nest had so deteriorated that it no longer afforded even a modicum of shelter and it was abandoned. Curiously enough, in June I had watched this wren and its mate build a fine, substantial nest, of the sort they use for breeding, in a neighboring calabash tree; but repeated visits failed to disclose that they either slept or laid an egg in it. A week or so after its completion some small animal, possibly a mouse or rat, closed off the doorway.

I watched two nests from which a brood of young had just departed, without seeing parents or fledglings return to sleep in them. I am not sure that the young are led to lodge in dormitories or even that adults consistently use them. The fact that they are among the first birds to sing at dawn suggests that they do not, for birds with comfortable quarters usually arise rather late.

NEST BUILDING

On February 26, 1937, I found a pair of Rufous-breasted Wrens which were feeding two stubby-tailed fledglings. The eggs from which they had hatched were probably laid in January. However, the height of the breeding season is later, from March to May. The globular nest is placed in a variety of situations. Those in which I found eggs or nestlings ranged from 4 inches to 15 feet above the ground. Once I came upon a bird building 40 or 50 feet above the ground in the midst of a dense vine tangle at the forest's edge. However, I could not see the structure or learn whether eggs were laid in it, and it might have been intended merely for a dormitory. The lowest nest, almost on the ground, was situated in a tangle of dead vines and bracken stipes in a fairly open spot in the midst of a tall second-growth thicket. The highest of the nests that were definitely occupied was 15 feet up among climbing bamboo (*Lasiacis*) and vines which hung like a green arras at the edge of the woods. This nest faced a shady pasture close by our house. Most of the nests that were at intermediate heights were in tangles of vines, usually at the edge of woodland or beside an opening in a thicket rather than in the impenetrable depths, where they would be likely to escape observation by humans. One nest was eight feet up in a slender composite bush standing alone in a small clear space in the midst of a thicket. Three were from four to six feet up in compact coffee bushes growing in a small plantation. These bushes were close by a ravine filled with tangled shrubs, vines, and climbing bamboo.

On March 31 and April 1, 1940, I watched a pair of wrens build twelve feet up in a tangle of climbing bamboo growing among the trees lining the bank of the Río San Antonio. At this point the river flowed between open pastures. Male and female shared the labor of building and both worked diligently, but the one which sang most, and which I took to be the male, did the greater share, sometimes coming first and building while his mate was absent. Their material was chiefly small, papery, light-colored dead leaves

of the bamboo, but they also gathered larger fragments of the darker dead leaves of dicotyledonous plants and long, slender, flexible strips of vegetation. Sometimes they carried several pieces at once. Most of this material was collected among the crowded, slender stems of the scrambling bamboo which were at no great distance from the nest. They reached these by hopping and flitting through the tangle rather than by flying. Since their source of supply was so close at hand, they could make very frequent trips to the nest, and for an hour and a quarter in the early morning sunshine both wrens worked with great energy and almost without intermission, coming and going so frequently that I lost count of their journeys through the clustered foliage. While his mate worked with him, the male rarely sang, and if he did sing he was answered by the weaker song of the female. But when she left him alone at his task he sang frequently, sometimes, in a subdued voice, while carrying a billful of leaves. As far as I could learn, this nest was never used for breeding or sleeping.

On March 5 and 6, 1956, I watched a pair of wrens at work on a bulky nest situated about thirty feet up, far out on a projecting leafy spray of the big timber bamboo at the end of our garden. It appeared to be composed almost wholly of the long, slender leaves of the bamboo. The wrens brought more dead leaves of the same kind, which they gathered high up in the bamboo clump. If one member of the pair arrived with a contribution in its bill and found the other inside, it did not pass the leaf in to its partner but waited in front until the other emerged, then it went in to place what it had brought. As at the earlier nest, much of the time male and female worked together, seldom singing; but at intervals the female went off leaving her mate to build alone, and then he sang often. For example, from 7:15 to 7:39 a.m. on March 6 the male worked by himself, bringing 15 billfuls of material and singing 26 times. Then the female returned, and in the next hour, from 7:39 to 8:39, both sexes labored steadily, bringing material 59 times. In this hour the male sang only twice, but from time to time the wrens voiced their questioning call, *ch'reeep*. This nest also was apparently not used for breeding.

At two additional nests I have seen both sexes take active parts in building. One of these nests was accessible, and after it was completed I made periodic visits without ever finding an egg. This made me suspect that, although these wrens continue to build without seeming to notice a human watcher, they will not lay in a nest which they have built so publicly. At the very high nest, already mentioned, I found a single individual at work; from its silence I inferred that it was a female.

The completed breeding nest is a bulky, globular structure measuring from $4\frac{1}{2}$ to 6 inches in diameter, with a round doorway of about $1\frac{1}{2}$ inches diameter in the side. The thick walls and roof are composed of the dry leaves of bamboos, grass blades, dicotyledonous leaves, straws, weed stems, and the like. The bottom of the snug chamber is softly lined with down from seeds.

THE EGGS

Each of four nests contained 3 eggs or nestlings, and there was one nest with 2 nestlings. The eggs are white with a heavy wreath of brown spots around the thickest part and a sprinkling of the same over the remaining surface. Those of one set measured 18.3 by 13.9, 18.3 by 13.9, and 17.9 by 13.5 millimeters.

In eight nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: March, 3; April, 2; May, 1; and July, 2. The presence of fledglings in February, as mentioned earlier, shows that the breeding season is longer than these records indicate and that laying may sometimes take place in January. The latest nest held young well into August.

THE NESTLINGS

As I approached the nest situated near the ground in a fairly clear space in the midst of a thicket, the parent which had been incubating jumped from her eggs and fluttered over the ground for a distance of several yards, with spread tail and beating wings, in a fairly convincing distraction display. This is the only time I ever saw a wren of any species give such a display or attempt in any way to lure me from its nest.

This low nest was discovered by Dr. and Mrs. Darwin E. Norby on April 28, 1949, when it contained three eggs. Two days later, when the eggs were hatching, they took turns in watching from a blind and made a record of activities from daybreak until nightfall. As far as they could tell, only the female brooded, and she brought most if not all of the food, although the male several times looked into the nest while the female was close by. The female first left the nest at 6:03 a.m. and finally returned for the night at 5:37 p.m., making an active day of 11 hours and 34 minutes. In this period she brooded 19 times ranging from 2 to 33 minutes and averaging 17.1 minutes. Her 20 absences ranged from 3 to 42 minutes and averaged 18.5 minutes. She spent 48 per cent of her active day in the nest. On leaving she usually alighted on a perch near the doorway and gently fluttered her wings before she flew away. On most of her returns she brought something in her bill. This was usually too minute to be distinguished, but on several occasions a small insect was recognized. The premature loss of this nest prevented further studies.

The male of this nest would without much doubt have begun to bring food in a day or so, for, as I have seen at several other nests, he takes an important share in feeding the naked, pink-skinned young. Their food appears to consist entirely of insects. In April, 1955, I watched a pair of Rufous-breasted Wrens attend their nestlings under difficulties. Their nest was situated fifteen feet up in the curtain of vines which draped the woodland's edge, and about a dozen feet away, at a somewhat higher level, a Striped Brush-finch had a nest. The finch resented the presence of the far smaller wrens and tried hard to keep them away from their nest. Whenever she saw one of them approaching with food for the nestlings, she would drive at it and chase it back into the shelter of the dense vegetation. The wrens were accordingly obliged to skulk in the protecting vine tangles until they saw an opportunity to steal up to their nest when their quarrelsome neighbor was not looking. In such circumstances the nestlings' meals were infrequent, and one morning when I watched for two hours the two parents together succeeded in feeding the young only three times. Once when I touched the wrens' nest with the tip of a stick used for measuring its height, the parent which had been brooding fell straight downward from the doorway almost to my feet. Immediately the finch darted out from the bushes upon the wren, passing close in front of me and causing the smaller bird to flee with a squeak of alarm. Sometimes the finch would pursue the wren for fifty feet.

The brush-finch's enmity seemed to be directed specifically toward the wrens rather than toward trespassers in general, for she rarely paid attention to birds of other kinds. Once when a female Yellow-faced Grassquit alighted near the wrens' nest, the finch darted toward it as though to chase it away. Apparently she had mistaken this bird of about the same size for a wren, but she discovered her error in time and perched close to the smaller bird without molesting it. For at least a week the brush-finch continued to persecute the parent wrens. After this I no longer saw them at the nest, which the young had apparently left.

From one nest three young departed when 16 days old, and their nest was thenceforth deserted by night as well as by day. As stated earlier, there is no evidence that the parents lead their young to sleep in dormitories.

SUMMARY

The Rufous-breasted Wren inhabits dense thickets and vine tangles at the forest's edge, from sea level up to about 4000 feet in Costa Rica. It lives in pairs throughout the year.

As they forage out of sight of each other in dense vegetation, the members of a mated pair keep in contact by means of song rather than by call notes. Both sexes sing, and their singing is often antiphonal. Sometimes the alternating phrases of the two performers are so skillfully articulated into a continuous song that only when standing between them is the observer aware that he hears two songsters rather than a single one.

On three occasions, one of these wrens was found sleeping alone in a dormitory nest. The first of these nests closely resembled the breeding nest of this species. The second was probably built by a Bananaquit and was later occupied by one of these honey-creepers. The third nest resembled the second.

In the valley of El General, the breeding season extends from January to August but it is at its height from March to May. The compact, globular nest, with a doorway in the side, may be placed in a variety of situations from a few inches above the ground to 40 or 50 feet up in vine tangles, but it is usually from 4 to 15 feet up in a bush or a tangle of vines. Both sexes build the nest. The males of two pairs worked more constantly than the females, singing much when alone but working mostly in silence when the mate shared the task.

Three eggs form the set. The period of incubation is unknown. A distraction display was given by the female of the lowest nest when her eggs were on the point of hatching.

Newly hatched nestlings are quite devoid of down. They are brooded by the female but they are fed by both parents. One pair attended their nestlings under the persistent persecution of a Striped Brush-finch, whose nest was nearby. In one instance the nestling period was 16 days. There is no evidence that fledglings are led by their parents to sleep in a nest.

CHINCHIRIGÜÍ WREN

Thryothorus modestus

This small, plainly attired wren frequents low, dense vegetation from Chiapas to the Canal Zone, and its distinctive voice is heard from sea level well up into the highlands. The upper plumage of the Chinchirigüí Wren is brown; it is brightest on the rump and tail, which, like the wings, is indistinctly barred with dusky. A narrow white stripe arches over the eye and this is bordered below by a dark streak passing from the base of the bill through the eye. The cheeks, chin, throat, breast, and upper abdomen are white; the sides of the head are somewhat dull and grayish. The sides, flanks, lower abdomen, and under tail-coverts are buffy cinnamon. The eye is brown or, in some individuals, reddish in a bright light. The bill is black, and the feet are bluish-gray. The sexes are alike in appearance and both are about five inches in length.

A variety of English names has been given to the several races of this retiring wren, and recently Eisenmann (1955:77) has proposed the name "Plain Wren" for the species as a whole. But the imitative name Chinchirigüí (pronounced *Chin-cheery-gwée*, with the accent on the final syllable) given to it by the natives in Costa Rica so well paraphrases its song that we shall retain this designation for the species.

Avoiding the warmest and wettest regions of the Caribbean littoral, this wren first appears on the eastern side of Central America in inland districts where protecting mountains intercept some of the excessive rainfall. It is found in the middle reaches of the Motagua Valley in Guatemala, or at elevations of a few thousand feet, as in the Reventazón Valley of Costa Rica, where resting fields bear a vegetation less vigorous than that of the lowlands. From there it extends over the central highlands up to about 5000 feet in Guatemala and, according to Carriker (1910:756), to 6500 or even 7000 feet in Costa Rica, and it is found over the whole Pacific slope down to sea level. Everywhere it avoids not only woodland with a closed canopy but also the higher and denser second-growth thickets. It is at home in weedy fields, bushy roadsides, and scrubby pastures where the cattle keep open a network of trails through the tangled growth. It sometimes settles down in neglected orchards and quiet gardens.

A bird which prefers such habitats is inevitably driven from area to area by the shifting agriculture of the tropics. If the resting field where it dwells remains undisturbed until the vegetation becomes too high and heavy, it moves to a more recently abandoned clearing where the weedy growth is of the height and density it prefers. If it is displaced from such a field by laborers cutting down the vegetation with their long machetes, it can often find a neighboring area where the rapidly growing herbs and bushes provide a favorable habitat. In such concealing vegetation these wrens dwell in pairs throughout the year, as one can tell by listening to their voices. The birds themselves are seldom glimpsed, for they always forage near the ground and rarely rise on wing above the tops of the low bushes. One of the few occasions when I have seen one of these wrens make an extended flight was when it was driven by fire from the thicket where it dwelt. It delayed until the crackling flames came close to the corner where it had taken refuge, along with a variety of other birds of similarly retiring habits, then at last it flew slowly and laboriously over the adjoining open field.

Sometimes a Chinchirigüí Wren will live temporarily in an area where the vegetation is more open than it usually selects. In July, 1943, a lone wren appeared in my dooryard and hunted through the scattered shrubbery, a small patch of pineapple

plants, and even through the open crowns of some guava trees. Sometimes it ascended to a height of 25 feet where it was far higher and more exposed than one often sees this species. But chiefly it frequented the hedge of *Stackytarpheta* along the western side of the enclosure in which the house stands. The hedge had been allowed to grow high and spread widely until it had formed a long, narrow thicket quite to the taste of a

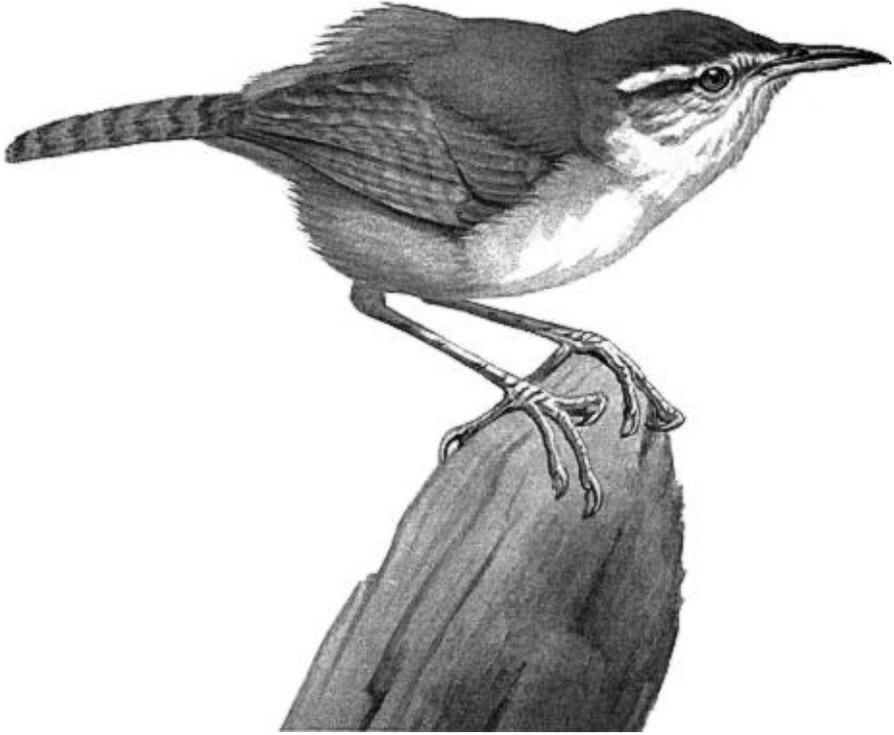


Fig. 18. Chinchirigüí Wren.

Chinchirigüí. The lone bird would work along this hedge from end to end, and I heard its pleasant notes issuing now from one part, now from another. At times it visited a neighboring coffee grove and hunted among the coffee bushes. Sometimes it disappeared, apparently having ventured farther afield. For about two months this wren dwelt about my house; it seemed to be always alone, although Chinchirigüí Wrens generally live in pairs. The softness and sweetness of its voice suggested that it was a young, still unmated individual. But apparently the area it had chosen contained too much open lawn to satisfy another Chinchirigüí, hence no mate would join it here. In late September the bird vanished.

VOICE

The Costa Rican name of this wren, Chinchirigüí, is a good paraphrase of its song. As I hear it, however, the song consists of three syllables rather than four: *chin-cheer-gwee*. The third short *i* appears to have been supplied for the purpose of making the word more easily pronounceable by Spanish-speaking people. This same trisyllabic phrase may be uttered by the wren in several contrasting tones; at times it is clearly whistled and again it is given either in a dry and chaffy or in a screechy voice. If the

unmusical renderings may be considered the wrens' call, then their call and song are of the same form but differ in tone. Sometimes they call three times in a rather screechy voice *chin-cheer-gwee*, *chin-cheer-gwee*, *chin-cheer-gwee*, followed by *chin-cheer-gwee* in loud, clear notes. But even at its best the song of the Chinchirigüí is a pallid performance when it is compared with that of many other wrens. In voice as in plumage, this wren of the bushy fields and pastures lacks the charm and beauty of many of its relatives of the unspoiled woodlands.

Although the trisyllabic phrase is sometimes uttered by a single individual, at other times it is clearly the product of two excellently coordinated voices. Like other constantly mated wrens, which much of the time forage in dense vegetation where visibility is poor, the male and female Chinchirigüís keep in touch with each other by songful notes rather than unmelodious calls. Once at dawn two of these wrens, which had apparently just left their sleeping nests in the weedy clearing where I stood, greeted each other from opposite sides of the field. One whistled two clear notes, then it paused a moment while the mate, probably the female, voiced a single note. The first bird then added two more notes and the second bird answered with one. They sang back and forth in this fashion a number of times, each wren fitting its notes perfectly into the momentary interval allowed by the other, to make one continuous, harmonious song. Had they both been on the same side of me, I should have thought I was listening to a single wren calling its name. But actually one sang:

Chin-cheer *chin-cheer* *chin-cheer*,

and the other sang: *gwee* *gwee* *gwee*.

Thus the very name of this wren is proof that it lives in pairs!

Once, when I watched a nest from concealment, the male sang a triple whistle in the distance, while the female on the eggs answered with a single whistle repeated at intervals. This time they did not produce the effect of one continuous song. When leaving the nest the female once uttered double whistles. It appears that her song is the slighter part in the antiphonal duet.

As with the short, stereotyped songs of some other wrens, that of the Chinchirigüí is not the first musical utterance of the young wren, but it is preceded by a song of quite different character. Sometimes, in low, dense vegetation, I have heard the first efforts at singing of a young bird, which has usually kept well hidden. This juvenal song was low, sweet, diffuse, and rambling; it was without set phrasing, much like the subdued music of a Catbird. One afternoon in early April, I heard a young bird attempt to achieve the typical *chin-cheer-gwee* song in the midst of such a pleasant monologue. Soon after he had ended his pretty, artless song a parent arrived and gave him a berry, thereby furnishing an indication of the early age at which the young wren begins to sing.

A later stage in the development of the adult song seems to be represented by the lone Chinchirigüí, mentioned previously, which lived from July to September, 1943, in the shrubbery about my house. This wren called much, at times uttering dry, rattling notes, at times soft, mellow whistles. It often delivered a version of the typical *chin-cheer-gwee* song, but this was given in tones far softer and more caressing than those of mated adults when they perform antiphonally. Its rattling notes were also less sharp and dry than those of breeding birds. Apparently this was a juvenile which had not yet found a partner and was advertising its single state by repeated calls and songs. In voice it had advanced somewhat beyond the warbling, diffuse song of very young birds, and with a soft, juvenal voice it had begun to speak the adult's language. It is evident that for recognition and maintenance of the bond between the members of a pair, the sharp, distinctive adult song is more useful than the soft, juvenal medley, which is hardly to be distinguished from the first warblings of young birds of a number of other

kinds. Yet in certain moods we regret that force and distinctiveness must be purchased by the sacrifice of so much spontaneous sweetness and charm.

When annoyed, the Chinchirigüí utters its trisyllabic phrase in a dry, harsh voice, or it may protest with *churr*'s and rasping notes in the manner of other wrens.

SLEEPING

The Chinchirigüí Wrens build nests of two kinds. Some of these are carefully made and serve for reproduction and at times for sleeping as well, but others are built which can be used only for sleeping. The dormitory nest is a flimsy, thin-walled, roughly cylindrical pocket placed horizontally, with the round entrance at one end. It has no lining and is composed of grasses, tendrils, straws, and inflorescences with small flowers attached. An egg, if laid within this structure, would be in great danger of rolling out, for the hollow barely extends below the level of the doorway. The interior of the nest measures about $2\frac{1}{2}$ inches in diameter and from $3\frac{1}{2}$ to 6 inches in length. The walls are scarcely contracted about the ample doorway. I have seen a number of these nests in both Guatemala and Costa Rica; nocturnal visits to them always revealed a single occupant, which slept either with its tail inward and the puffed-out feathers of its breast filling the doorway with a fluff of pale gray down, or in the reverse position with its tail toward the outside. The wall closing off the end of the nest opposite the doorway is often so thin and frail that one can see the surrounding vegetation through its meshes. Twice I have known a Chinchirigüí to awake when visited before daybreak, gaze a moment into the flashlight beam with dull red eyes, then turn around and push out through the flimsy wall at the rear of its bedchamber. Could it be that the wall at this point is deliberately left thin to serve as a safety exit in the event of a nocturnal attack?

Usually the dormitories of the Chinchirigüí are situated among grass or bushes, in the dense vegetation these wrens frequent, at heights varying from one to seven feet above the ground. But once, while harvesting, we discovered one in an unusual position. A large, ripe ear of maize had nodded forward, leaving a dry, loosened husk to form a broad hood above it. In the space between the husk and the ear were a number of long, finely branched pieces of dry grass inflorescences; these were arranged to form a sort of low rim around the shoulder of the ear, but they projected far downward over its sides and upward under the cowl. Feeling sure that this was a snug bedchamber where some inventive Chinchirigüí slept dry and warm through cold September rains, I left this maize plant untouched in the midst of the harvested field, where the quickly springing weeds were already forming the sort of low thicket that these wrens love. Returning before daylight the next morning, I found the Chinchirigüí slumbering on the shoulder of the maize ear. Its breast was against the base of the husk that formed the rear wall of the chamber; its long, dusky-barred tail was turned outward, its brown feathers were all ruffed out so as to reveal much of their gray basal portions, and its head was buried out of sight amid this loose, roundish mass of down. The grass that it had carried up, more from custom than of necessity, outlined rather than enclosed the bedroom, which would have served equally well without this addition. On awaking at dawn, the wren's first action was to lift up its head from the loose plumage amid which it was buried. Then it smoothed down its ruffled feathers and looked around. For a few moments it lingered motionless, then it saw me, darted down into the weeds, and scolded sharply.

Another unusual dormitory had a globular rather than an elongate form, and a round doorway could be seen in the side that faced out from the low supporting bush. This dormitory was composed almost wholly of finely branched, dry inflorescences of a grass, which gave it a very light and dainty appearance. The loose, frail walls were far different from the solid, compact walls of the breeding nest. A single wren, perhaps a

female, slept in this beautiful, unsubstantial structure, her fluffed breast feathers quite filling the round entrance. A few days after we discovered this nest, it vanished; perhaps it was either blown away by a puff of wind or devoured by a hungry cow.

It is usually impossible to decide to which sex these dormitory nests of the Chinchirigüí belong. But one February I found the lodgings of both members of a pair close together, and repeated visits left little doubt as to the sex of the respective occupants. The male's dormitory was an elongate, loose-walled pocket of the usual form (fig. 21a). About ten feet away in the same low thicket, on the opposite side of a little-used roadway, was a well-constructed nest of the type commonly used for breeding. However, when I found it, and for some days thereafter, the female wren slept in it without having any eggs. One morning, in dim light, as I stood quietly beneath this nest waiting for the sleeper to awake and come forth, her mate, which I had aroused somewhat prematurely, began to call in his driest, chaffiest tones. After repeating his harsh *chin-cheer-gwee* a number of times, at intervals of a few minutes, without receiving a response from the female, the irritated wren flew up and alighted on the roof of the nest beneath which I quietly waited. He apparently had not noticed me in the faint light. There was a low *churr*, but I could not decide which member of the pair had uttered it. The male then flew off through the thicket. Ignoring the protests of her mate, the female did not fly out of her well-made nest until at least a quarter of an hour after the early birds had begun to sing. Seeing me at once, she scolded harshly. Later, the female laid two eggs in this nest and started to incubate. But when one of these eggs was destroyed, she continued to sleep in the nest along with the remaining egg, which she had ceased to incubate by day. I also found a second breeding nest with the male's dormitory nearby.

I have gathered no evidence that young newly emerged from the nest are led by their parents to sleep in the same nest or in a neighboring structure. One nest from which the young departed, possibly prematurely, at the age of thirteen days was thereafter occupied for sleeping by a single adult, probably the female parent, unaccompanied by fledglings. Once I found a young Chinchirigüí roosting in an old nest of a Bananaquit, a chamber rather small for the larger wren. This discovery, and my failure to encounter more than a single sleeper in any of the occupied dormitories that I have visited by night, leads me to believe that young Chinchirigüís, like young Bananaquits, sleep in the open until they can either build or find shelters for themselves.

NESTING

On the Pacific side of southern Costa Rica the Chinchirigüí has a long breeding season. In El General, I have met fledglings already beginning to feed themselves as early as mid-February. These young birds were probably hatched from eggs laid no later than the first days of January. Several occupied nests were discovered in February, one of which held well-feathered young by the end of the month. My latest nest in El General contained eggs on August 24, and in the lowlands near the Golfo Dulce I found nestlings on September 23.

The breeding nest is usually placed in a bush, a tangle of vines, or a tussock of grass in the low, dense, weedy growth which these wrens prefer. Often a more open part of the thicket is chosen by them, or they may build at its edge or even beyond it, as in the case of a pair which placed their nest ten feet up in an orange tree growing in a dooryard where there was closely trimmed grass and scattered shrubs. This was at a distance from thickets—a most exposed site for so retiring a bird. One nest was built in an aloe in a rock garden close beside a house on a coffee plantation near Cartago. Here the nest was well concealed by close-set vegetation. The 11 occupied breeding nests that I have seen varied in height from 2 to 10 feet, but only three of them were higher than 4 feet.

The highest was, strangely enough, the one in the most open situation, but the orange tree that supported it had compact foliage for its concealment. In form the nest is globular or somewhat elongated, with its long axis vertical or at times inclined at an angle of about 45 degrees. The rounded doorway faces sideward or obliquely downward and is shaded by a visor-like extension of the roof. The substantial walls are composed of the blades and inflorescences of grasses and similar materials, while the bottom of the chamber is lined with the down from seeds or other soft stuff. I have never succeeded in watching the shy Chinchirigüís at work on their nest.

As already related, the female may sleep in the breeding nest for some nights before she begins to lay in it. Seven nests each contained two eggs or nestlings, one held a single egg, and one of the very late nests had three eggs ready to hatch on August 24. The rather elongate eggs are pure white, with no markings. The measurements of 8 eggs average 21.9 by 15.3 millimeters. Those showing the 4 extremes measured 23.8 by 16.3, 20.2 by 15.1, and 20.6 by 14.3 millimeters. Nine sets in the valley of El General, 2000 to 3000 feet above sea level, were laid as follows: January, 1; February, 2; April, 2; May, 2; June, 1; and August, 1.

I spent most of the morning of May 30, 1943, watching a nest in which the eggs were near the point of hatching, but the female wren was somewhat distrustful of my blind and the record I made was not quite satisfactory. Three completed sessions lasted 55, 31, and 21 minutes in this order, suggesting a decline in steadfastness as the sun rose higher. Twice when the wren returned to the nest without much hesitation her excursions had lasted 39 and 33 minutes. Her other two recesses were prolonged while she flitted through the surrounding bushes and scolded. During the first of these two recesses she apparently scolded at the brown wigwam in which I was sitting, but during the second recess, which came near noon, she seemed to see something in the vegetation which perturbed her. I did not see the male once in the nearly six hours that I watched. From time to time, however, I heard his triple whistle coming from the distance, and the female replied with single whistles while sitting unseen in her well-enclosed nest.

At one nest the incubation period was 18 days. At another nest the nestlings were well feathered when 11 and 12 days old, and a day later one, probably the older, jumped out when I looked into the nest. The second fledgling left the following day, when it was 13 days old. Probably if I had not disturbed this nest the young ones would have stayed in their chamber a few days longer. For at least 10 days after their departure an adult continued to lodge in this nest, but I could not discover where the fledglings roosted or whether they survived.

SUMMARY

The Chinchirigüí Wren inhabits weedy fields, scrubby pastures, and bushy roadsides from sea level up to about 7000 feet. It skulks in low, dense vegetation and rarely exposes itself. It is found in pairs throughout the year.

The most characteristic utterance of this wren is a trisyllabic phrase which suggests its vernacular name. This may be delivered in a dry or harsh voice or in a clear, melodious tone. A single individual may utter this phrase, but often it is produced by the antiphonal singing of a mated pair. One member, probably the male, sings two notes while the other replies with one, and the responses are so well timed that unless the observer stands between the two songsters he seems to hear a single bird rapidly repeating a trisyllabic verse. This song is heard throughout the year. The earliest song of the young wren has a very different character, being a soft, long-continued medley rather than a short, stereotyped phrase. But youngsters still fed by their parents may practice the trisyllabic song.

Adults sleep singly in dormitory nests built from one to seven feet above the ground in low thickets or on weedy roadside banks. The dormitory, a loosely constructed pocket with its long axis horizontal and the doorway at one end, is easily distinguished from the well-made breeding nest. If the sleeping wren is disturbed, it may escape by bursting through the rear wall of this flimsy chamber. Females may build a breeding nest and lodge in it for some time before laying begins, and they may also continue to sleep in such a nest after the young have left or if their eggs fail to hatch. The slighter dormitory of the male is sometimes found near the well-made structure in which his mate lodges and attends her eggs. One Chinchirigiú slept on a nodding ear of maize, beneath a loosened husk, where it had placed a few straws to form a rudimentary nest. Young birds are apparently not led to roost in a dormitory but must find lodgings for themselves. One juvenile slept for a time in an old nest of a Bananaquit.

In southern Costa Rica the breeding season extends from early January to September. The breeding nest, a globular or somewhat elongated structure with the entrance in the side, is placed from two to 10 feet up, but usually within four feet of the ground, in a bush, tussock of grass or tangle of vines, or even in a fruit tree or flower garden. Two white, unmarked eggs form the usual set, but one nest contained 3 eggs. At one nest the period of incubation was 18 days.

At one nest the nestling period was 13 days, but the young might have remained a few days longer if they had not been disturbed.

RIVERSIDE WREN

Thryothorus semibadius

This beautiful wren is confined to the Pacific slope of Costa Rica and of Panamá west of the Canal Zone. It is slightly over five inches in length, and the sexes are alike in appearance. The whole upper plumage, from forehead to rump, is a uniform bright chestnut. The tail is largely black with narrow, widely spaced bars of buff or rusty brown. The wings are blackish, conspicuously marked with narrow bars of buff and white on the coverts and with some white spots on the primaries. There is a white superciliary streak which is bordered next to the crown with black. The cheeks, auricular region and sides of the neck are black, boldly and irregularly streaked with white, and there is a white orbital ring. The chin and part of the throat are white, faintly spotted with black. Contrasting sharply with the plain, bright brown upper plumage, the ventral plumage is nearly everywhere, including the breast, belly, sides, and flanks, covered with fine transverse bars of black and white. The under tail-coverts are barred with black and buff. The bill and feet are black, and the eyes are brown.

In the valley of El General, where these wrens are abundant up to at least 3000 feet above sea level, they are largely confined to the vegetation along the many turbulent rivers and their larger tributaries which tumble noisily down rocky channels from the high Cordillera de Talamanca. Here the wrens forage among the varied epiphytes which form aerial gardens on the massive boughs of the sotacaballo trees (*Pithecolobium*), in the tangles of vines which hang from their branches, and in damp thickets at no great distance from the streamside. Sometimes they work along the edge of the forest, where it borders a clearing, well up on the ridges, but they are most likely to do this in prolonged wet weather. It is then that we see them chiefly in the shrubbery about our house which is a hundred feet from a wide brook. In the coastal lowlands between the Golfo Dulce and the mouth of the Río Térraba they were not, however, so closely associated with watercourses as in the valley of El General. Here I found them along the edges of the forest in low, swampy areas, and well up on the hills, where they seemed to be confined to precipices too steep for large trees. A situation such as this favors the development of dense vegetation somewhat similar to that found along the banks of rivers.

Although in some regions these wrens clearly display a preference for watercourses, the rivers themselves yield them no food; for they forage in tangled vegetation much as many other species of *Thryothorus* which show no predilection for rivers. Perhaps their partiality for the streamside was acquired in a region that was largely covered with heavy forest, as was true of El General at the beginning of the present century. In an almost uniformly forested district, the tangled vegetation which these wrens prefer would occur chiefly where the woodland is interrupted by a watercourse. But that these wrens have for many generations dwelt close beside sonorous streams appears to be attested by their voices, which possess a ringing quality common among birds which frequent mountain streams.

I most often meet Riverside Wrens in family groups composed of three or four individuals; rarely have I seen them in pairs. Probably, like so many other tropical wrens, they are constantly mated; but since they have a long breeding season and the young appear to remain for months with their parents, the mated pair is rarely unaccompanied by offspring.

Once while I sat in a blind close beside a stream, watching a nest of the Buff-rumped



Fig. 19. Riverside Wren

Warbler, a family of Riverside Wrens foraged close about me, unaware of my presence. They hunted chiefly in the curled dead leaves of the banana, the cecropia tree, and other plants, clinging to them in all sorts of positions and attitudes while they probed the folds in the leaf tissue with their sharp, black bills. Presently one of the wrens discovered a sluggish, brown orthopterous insect, almost as long as itself, which was crawling slowly over the ground. With a few nips and shakes the bird quieted its relatively huge prey, then proceeded to devour it by picking off tidbits and savoring them

with the air of a gourmet. The repast lasted for many minutes, the wren all the while standing on the bare surface of the steeply sloping bank.

In poorly drained forest near the coast, I several times saw Riverside Wrens foraging on the outskirts of a swarm of army ants. However they did not definitely take advantage of the insects stirred up by the ants as was true of the antbirds and other professional followers of the ecitons.

Late one afternoon I bathed in a rocky, tree-shaded stream in the valley of El General. As I emerged from the water I noticed a black snake, five or six feet in length, lying on the stones in the shallow water upstream from me. The anterior foot or so of its body was held nearly erect, as though to see me better. When I threw a stone to send it on its way, it climbed up into a leafy tangle of bushes and vines overhanging the water. A pair of Riverside Wrens happened to be foraging along the watercourse at this time and they soon spied the reptile, which they scolded with harsh *churr*'s. Becoming bolder, they advanced close to it and bit or pecked it twice on the tail, once near the middle of its length. After each attack by the birds, the snake shifted its position slightly, while they retreated promptly. So far as I could see, the serpent did not strike at them. Soon the wrens went off, leaving the snake among the bushes. I suspected that they might have a nest in the vicinity, but I could not find it.

VOICE

As has been noted, the song of the Riverside Wren has that clear, ringing quality present in the voices of a number of birds, such as the Buff-rumped Warbler and the American Dipper, which must make themselves heard above the roar of rushing streams. The necessity to be audible in a noisy environment has resulted in the sacrifice of the exquisite modulations and sweetness of the songs of some wrens found in forest and thicket. That their voice successfully meets the competition of a clamorous mountain torrent is attested by the fact that I have often heard these wrens singing at the riverside two hundred feet away, their voice ringing out above the babble of falling water. Sometimes their loud, commanding, trisyllabic song sounds like *victory, victory, or mil veces, mil veces*; or they seem to proclaim *River Wrén, River Wrén*. At other times their basic refrain consists of only two notes, repeated several times: *checker, checker, checker*. In addition to these songs, which are heard throughout the year, they call back and forth with clear, tinkling notes which are softer and sweeter than their song, and similar bell-like notes are sounded as they fly. When annoyed, they utter the harsh, rasping *churr* so typical of wrens.

The short, stereotyped song of the adult Riverside Wren develops from a juvenal song of very different character. On a sunny November morning I found a young wren, whose breast was spotted rather than barred as in the adults. It was foraging alone in low herbage at the edge of wet forest in the Pacific lowlands, and it was singing to itself. Its song was a long-drawn medley of sweet, low notes strung out in leisurely sequence and without definite phrasing. It contrasted sharply with the short, powerful ringing song of the mature Riverside Wren, but it was much like the first songs of the Southern House Wren and the Chinchirigüí Wren. The young bird continued its rambling song for many minutes, and it was later joined by adults of its kind.

SLEEPING

The Riverside Wrens sleep in globular nests, with a downward-facing doorway, which resemble the breeding nest to be described in detail in the following section, but they are often more carelessly constructed. Like the breeding nests, the dormitories are placed in trees and bushes along the banks of wide, rushing mountain torrents or along

the courses of more gently flowing streams. They are built either above the current itself or over the shore, at heights varying from about five to twenty feet. I have often found one, and sometimes two or three, grown birds sleeping in a dormitory, but I am not sure of the significance of these variations. I believe that the members of a mated pair often sleep in separate nests, even when they are without eggs or young. Possibly the female continues for some weeks to sleep with her fledglings, while the male takes shelter apart. This would explain the observed variations in the number of occupants of nests, but I



Fig. 20. Río Chirripó, with Cerro Chirripó (12,580 feet) in the background, in the valley of El General, Costa Rica. Riverside Wrens and White-throated Thrushes foraged and nested along the shores; Torrent Flycatchers frequented the rocky channel.

am not certain that other considerations do not influence the wrens in making their dispositions for the night. Both of the nests I watched, in which nestlings were reared, remained deserted after their departure, but it is not improbable that the female parent led her fledglings to sleep in another dormitory. Since these wrens build their nests now on one side, now on the other, of a rushing river difficult to cross, it is hard to follow their history for long periods.

Along the banks of the creek that enters the Río Peña Blanca almost in front of our house, I found in late December, 1943, and January, 1944, two dormitory nests of the Riverside Wren, situated about 250 feet apart. Each was occupied nightly by a single wren, but I believe that the two wrens were mated, as I sometimes found them together in the evening before they retired, and they would sing responsively. Both wrens went early to rest and arose late. On clear evenings they would enter the dormitories between 5:15 and 5:30, but on cloudy or rainy afternoons they might be found in their lodgings before five o'clock, a whole hour before most other birds went to rest. At the time when these Riverside Wrens went to their dormitories, the valley where they lived was already in the shadow of the western ridge, but the forest-crowned slope to the east, and the whole great range to the northeast, were often gloriously aglow in the last beams of

the setting sun. An afternoon shower would advance the hour of their entering the nest, even when the rain had ceased and the sun was struggling through the clouds before they actually retired. On various mornings they left their lodgings between 5:26 and 5:38, although by five o'clock or a few minutes later many of the early birds were at this season in full song.

One of these nests was more carefully formed and was concealed better than the other, and the wren which slept in it generally retired earlier in the evening and left later in the morning than its supposed mate. The difference at times might be as much as six minutes in the morning and sixteen minutes in the evening, but on some evenings the difference was less than the minute or two that I required to make my way from this nest to the other nest which was higher up the stream and on the opposite shore. The wren which took the slightly longer periods of rest was, I thought, the female. However, her nest collapsed in the course of the first hard showers in March, and it was abandoned before it contained the eggs for which I looked to support my conjecture as to the sex of the occupant. At about the same time, the other nest vanished, perhaps having been carried off by a building flycatcher. This nest had been used as a lodging for at least two and a half months after I found it; the nest of the supposed female had been used for a month and a half.

In February of the same year I found, several hundred yards upstream from these dormitories, a third sleeping nest. This was composed almost wholly of light-colored bast fibers and was situated in a tangle of vines hanging about fifteen feet above the water. Singing brightly, three full-grown Riverside Wrens flew downstream in the evening and entered this nest. The next morning, as they flew upstream, they sang back and forth with a variety of ringing verses. A few days later, this nest was, for some unknown reason, deserted, but two wrens, apparently survivors from the larger group, now slept in an old, dilapidated nest situated in the top of a sapling a hundred feet downstream. Seven years earlier, I had found another nest with two occupants, apparently adults, but, aside from these three instances, all the Riverside Wrens that I have followed to their dormitories have slept alone.

In the evening, after retiring early, Riverside Wrens are often reluctant to return to the open although daylight has scarcely begun to fade and most other birds are still active. Despite the lowness of their dormitories, they will remain within, and, with their boldly marked black and white faces prettily framed in the doorway, look down upon the human visitor who might be standing with his head only a yard away from their nest. Sometimes even a gentle shaking of the nest fails to drive them out, but if the nest is shaken more vigorously, they will dart forth and skulk among the surrounding bushes, protesting harshly. Usually the watcher has only to retire a short distance and stand quietly for a few minutes in order to witness their return to the nest. If they are shy at first, repeated evening visits quickly accustom them to their observer.

NESTING

Although for many years I have seen and heard much of the Riverside Wren along the streams which flowed close by the various dwellings I have occupied in the valley of El General, I have found even fewer of its occupied breeding nests than I have of its neighbors, the Lowland Wood Wren, the Rufous-breasted Wren, and the Chinchirigüí. This is due in part to the inaccessibility of the nests of the Riverside Wren which are often hung above a turbulent stream, and apparently also in part to this wren's shyness at its breeding nest, which contrasts with its fearlessness of man at its dormitories. Nests apparently intended for breeding, that I have found under construction, have always been abandoned unfinished. For example, on February 22, 1946, I found a pair

of Riverside Wrens carrying material to an uncompleted nest situated four and a half feet above the brook in front of our house. While I stood on a rock in the stream bed in full view of them, each of the birds took a billful of material into the structure. Later, one of the pair carried in another load, but after that they worked no more in my presence. The nest was finally abandoned when less than half finished. On October 26, 1947, I watched a solitary wren building actively in a bush at the edge of a clearing near the Río Esquinas in the Pacific lowlands, but apparently it was engaged in constructing a dormitory rather than a breeding nest.

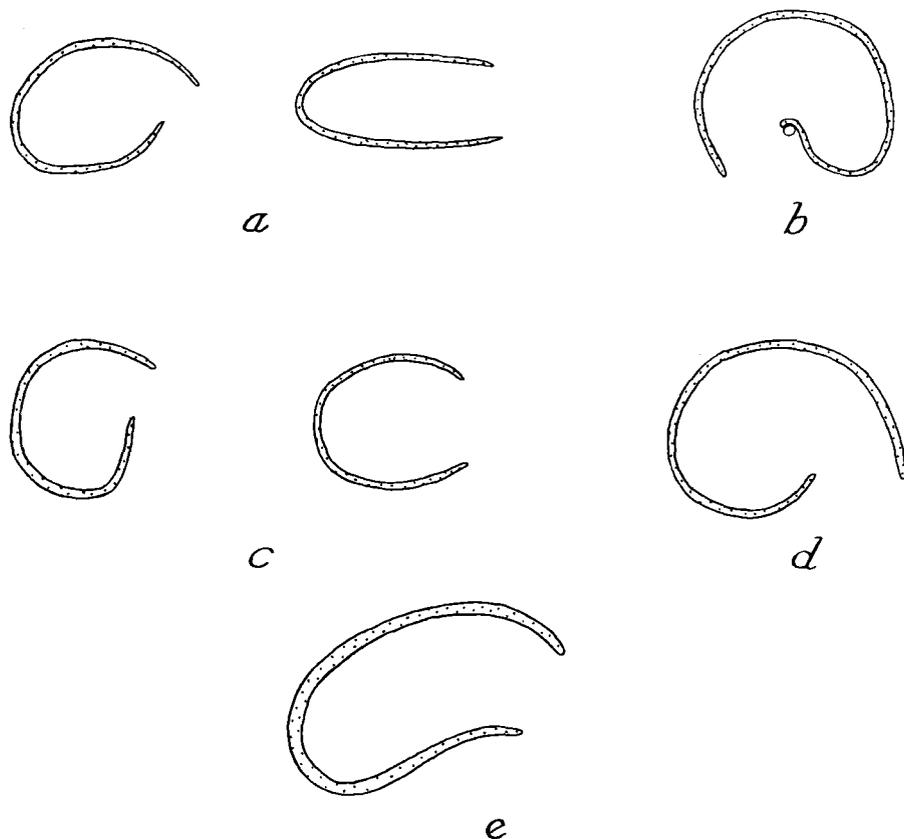


Fig. 21. Schematic sections through nests of wrens. *a.* Chinchirigüi Wren; left, breeding nest; right, sleeping nest of male. *b.* Riverside Wren, breeding and sleeping nest. *c.* Lowland Wood Wren; left, breeding nest; right, sleeping nest. *d.* Highland Wood Wren, breeding and sleeping nest. *e.* Rufous-naped Wren, breeding nest.

The two occupied breeding nests which I have seen were both placed six feet above the shady shore of a rushing mountain stream; one was alongside the Río Buena Vista, the other was beside the Peña Blanca. The unfinished nest mentioned above was lower than these nests, while others, which might have contained eggs, were considerably higher and were above the water rather than above the shore. The two occupied nests were found in January and July, and the first of these, which was more carefully constructed, will be described in detail. In form it was roughly a globe with a deep indentation stretching across the lower side, which fitted over the single, slender, horizontal

twig that supported the structure. This supporting twig divided the nest into two nearly equal parts. On one side was the well-enclosed nest chamber, on the other was the vestibule or antechamber. The doorway was in the bottom of this vestibule, facing downward and inward, so that whenever the wren entered it had to fly straight upward and then pass through the spacious antechamber and over the sill formed by the supporting twig to gain the rounded chamber. A second twig, parallel to the first, passed through the upper part of the nest and served to prevent its pivoting around on the single support, although it did little to uphold the structure. The walls were composed of fine fibrous materials with a few bits of green moss on the roof, which was thin and admitted light. The outside dimensions of the nest were 6 inches from front to back, 5 inches in height, and 5 inches from side to side. The doorway measured $3\frac{1}{4}$ inches parallel to the supporting twig and 2 inches at right angles to this. This nest somewhat resembled that of the Highland Wood Wren, but the doorway of the latter faces downward rather than obliquely inward. The Riverside Wren's nest seems to be one of the most highly evolved structures made by this family of skillful builders. It might have been derived from the apparently more primitive "elbow-shaped" nests of the Song Wren or the Banded Wren by drawing the two ends together to give a more globular form (see fig. 21*b*).

The second breeding nest resembled the first, but it had a less spacious antechamber. Dormitory nests are often smaller and more loosely constructed than these breeding nests. A twig penetrating the top is not an invariable feature of the Riverside Wrens' nests. Some are adequately supported by the branchlets on which they rest.

When found on January 28, 1937, the first nest contained one egg and one nearly feathered nestling, which left two days later. This set of eggs was probably laid at the end of December. The second nest contained two eggs on July 22, 1942. Since I have found young birds still fed by their parents as late as October 7, I have concluded that the breeding season of the Riverside Wrens covers most of the year.

The eggs are white with fine, faint speckles of pale brown that are most numerous in a wreath or cap on the thick end. The three which I have seen measured 22.2 by 15.9, 21.8 by 15.1, and 20.6 by 15.1 millimeters.

On July 26, 1942, I spent nearly 4 hours of the morning watching the late nest from a blind. In this period I timed two completed sessions on the eggs lasting 67 and 69 minutes and two recesses lasting 35 and 37 minutes. At no time did I see more than one wren in the vicinity of the nest, and I believe that only the female incubated. One of the eggs hatched later that same day, thereby putting an end to my study of behavior during the period of incubation. This female would remain in her nest, looking down, while I stood below within reach of her.

At this, as at the earlier nest, only one parent slept with the nestling. When fifteen days old the single young bird flew out while I was trying to see into its well-enclosed chamber with a mirror. It alighted on my left arm, but, when I made a move to catch it, it fluttered to the ground and crept far under a rock by the shore. With difficulty I extracted it, returned it to the nest, and finally persuaded it to remain. But by the next day it had departed, at the age of sixteen days. Probably it would have delayed a day or two longer but for its premature experience in the outside world. At the earlier nest, I found that the nestling was brooded by night as long as it remained within the nest. After the departure of the young, neither parent nor fledgling slept in either of these breeding nests. The young birds keep company with their parents for at least several months after they become self-sufficient. A party of three, apparently consisting of parents with a well-grown youngster which was indistinguishable from them, was first noticed along the river in front of our house in mid-November, and the three roamed about together at

least until the middle of the following January. Because of their protracted breeding season and the long period they stay with their young, a pair of Riverside Wrens is seen alone far more seldom than are those of some other species of birds.

SUMMARY

The Riverside Wren is confined to the Pacific slope of southern Costa Rica and Panamá west of the Canal Zone, where it ranges from sea level to somewhat above 3000 feet. In the valley of El General it lives chiefly along the shores of the wider streams, but in the lowlands it is to be found along the edges of the forest in low, swampy areas and on slopes of the foothills too steep to support trees.

They forage in tangled vegetation and investigate curled dead leaves for the insects and spiders lurking within, sometimes capturing very large ones.

The song is loud and ringing, of such a quality that it sounds above the constant roar of clamorous mountain torrents. There is also a clear, bell-like call note, softer and sweeter than the song. Juvenal wrens sing a protracted rambling medley, very different from the short, stereotyped phrases of the adults.

These wrens sleep in covered nests, usually above the banks of streams. As a rule they lodge singly, but sometimes two or three, possibly a female with full-grown young, occupy the same dormitory. The lodgings of the male and female of one pair were about 250 feet apart. One of these nests was used for over 2½ months. Compared with other birds, Riverside Wrens retire early, often before sunset, and they rise late. At their dormitories they are not shy of humans.

The nesting season is long, extending from at least late December into September, but nests are difficult to find. The breeding nest resembles the sleeping nest but it is often more carefully constructed. It is a globular structure saddled over a horizontal twig, on one side of which is a well-enclosed chamber and on the other a wide vestibule or antechamber entered through a doorway that faces downward and inward. Fragmentary observations indicate that both sexes build.

Two nests each contained 2 eggs or nestlings. The eggs are white with faint brown speckles. One wren took long incubation sessions of over an hour and recesses of more than half an hour in length.

One young wren left the nest when 16 days old. At another nest the parent continued to sleep with the nestling as long as it remained inside, but neither of the nests under observation was used for sleeping after the nestling left.

The young continue to accompany their parents for some months, until long after they have become indistinguishable from them. Because of the extended breeding season and the long period they remain with their young, a pair of Riverside Wrens is rarely found alone.

LOWLAND WOOD WREN

Henicorhina leucosticta

The humid lowland forests of tropical America, from southern México to Perú and the Guianas, are the home of a very small, stubby-tailed, brown wren with a voice all out of proportion to its size. Exhibiting considerable variation over so extensive a range, this wren has been classified in a confusing number of species and even genera, but modern taxonomic judgment tends to place all the lowland wood wrens in one species and the forms inhabiting the highlands in another. The Lowland or White-breasted Wood Wren is about four inches in length and has rich brown upper plumage. The wings and tail are more or less conspicuously barred with black. The crown may be black, brown, or sooty gray, but the sides of the head and neck are, in all forms, black conspicuously streaked with white, and there is a white superciliary stripe which extends down the side of the neck. The throat and breast are pure white whereas the sides of the breast are gray. The flanks and under tail-coverts are russet or cinnamon. The bill is black, the eyes are brown, and the legs are dark. The pure white rather than gray breast distinguishes the Lowland Wood Wren from its highland relative.

These wood wrens pass their lives on or near the ground in the dim undergrowth of the rain forest, scarcely ever ascending as high as a man's head. They forage among the tangles of fallen branches and vines, the decaying fronds dropped from lofty palm trees, bushes, ferns, and low herbs of the forest floor. These wrens are often difficult to see, but this is due to the dimness of the light and the abundance of cover rather than because they are especially shy. At times they are bold and inquisitive, advancing to the trail's edge to scrutinize the rare human intruder into their woodland solitude. Then they hop over the low bushes or palm fronds, often clinging antbird-like to upright stems, sometimes with the head downward, while they complain with harsh *churr's*—a habit which is most pronounced in the gray-breasted young not long out of the nest. Old and young hold their short tails tilted jauntily upward. Their curiosity satisfied, they seem to melt into the dim underwood and vanish. Except when accompanied by one or two dependent young, the adults are usually found in pairs; they are never encountered in flocks of their own kind. Sometimes I have seen them accompanying the motley crowd of small birds which follow and forage with the army ants, but they are occasional rather than habitual attendants of the myrmecine army.

The upper limit of the range of this wren of the lowland forests varies considerably from place to place. At 3000 feet in both Costa Rica and eastern Ecuador I found it the sole representative of its genus. Bangs (Ridgway, 1904:612) recorded it at 5700 feet on Volcán Chiriquí in western Panamá, and in southern Costa Rica, Carriker (1910:764) saw several individuals at about 7000 feet above Ujarrás, where it mingled with its relative, the Highland Wood Wren. However, on the stormier northern face of the Cordillera Central of Costa Rica, I did not see the lowland species at 5500 feet, although in this area the gray-breasted Highland Wood Wren was very abundant.

VOICE

Many have commented on the brilliance and power of the Lowland Wood Wren's song, which seems to be the utterance of a much larger bird. Its phrases are usually short, consisting of a few loud, clear, melodious whistles. On Barro Colorado Island in the Panamá Canal Zone, Chapman (1929:266) heard songs which sounded like *Alas poor*

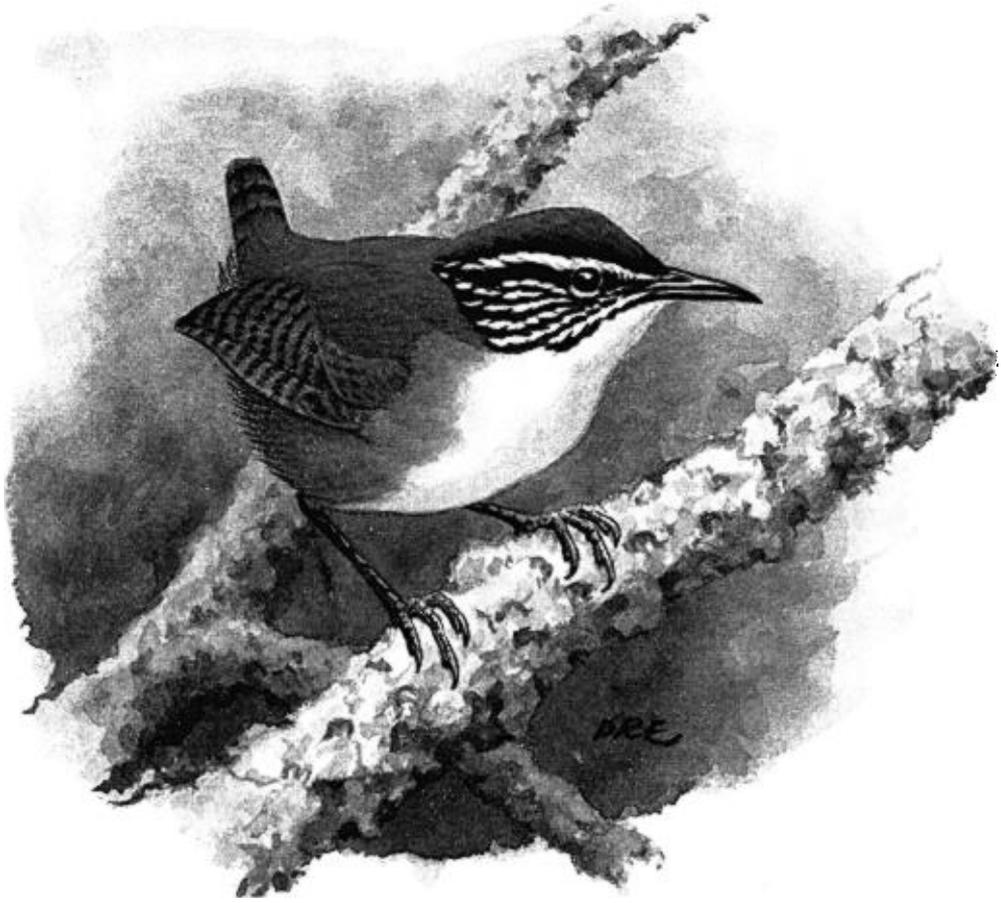


Fig. 22. Lowland Wood Wren.

Yorick, and *William, William, Willow*. In another key a bird sang "*Cheero-cheero-cheero*, interspersed with a thin, sibilant *spee-spee* and a metallic *ter-leek*." As is true of many wrens, both sexes sing. In one Guatemalan pair, in which I could momentarily distinguish the sexes, the male's song consisted of three rich, full whistles ascending in pitch; his mate answered with a pretty verse of five notes which were not quite so full and mellow as the song of the male. A Costa Rican wood wren uttered a loud, clear song while sitting in her nest and was answered by her mate in the distance. A Lowland Wood Wren which I heard in the forest near Puyo in the Oriente of Ecuador gave a variety of beautiful, ringing, forceful songs, one of which consisted of a prelude of trilled notes followed by three clear, powerful whistles. Although, like so many other members of their family, the Lowland Wood Wrens sing throughout the year, they are not so generous with their music as some other species, and they sing far less than their highland relative. The sparing use of their brilliant verses makes them the more effective. In the dry early months of the year in southern Costa Rica, when there is little song to compete with the monotonous chirring of the cicadas which is so constant that one soon ceases to be aware of it, the reigning quietness is suddenly broken by the clear, sweet notes of a wood wren which calls out *cheery weather, cheery weather*, then as suddenly falls silent

again. In the vast stillness of the wilderness, this small bright voice is marvellously effective; it is like an exquisite miniature framed in the middle of a broad white sheet.

In addition to their many musical phrases, the wood wrens scold with prolonged *churr*'s and *chitter*'s. They also utter a full, throaty call, a loud, explosive *tuck*, a sharp *teleet*, a harsh monosyllable, and a single, flute-like whistle.

SLEEPING

Although the Highland Wood Wren uses the same kind of nest for both breeding and roosting, the Lowland Wood Wren builds two kinds of nests which contrast sharply in construction and location. The compact breeding nest (fig. 21c), described in the following section, is placed in low, inconspicuous situations where it is rarely found. The rather flimsy dormitory is, on the contrary, placed at just the height where it is most likely to attract a man's attention, hence it is among the most frequently found of all the avian constructions in the lowland forests. Many persons who have noticed these nests have surmised that they are built as "dummies" to mislead predators that might take the birds' eggs or nestlings, but this view makes unproved assumptions about the psychology of both the wrens and their mammalian or reptilian enemies.

The sleeping nest is built in the midst of the forest, in a crotch of a slender sapling or in a tangled strand of thin vines. It is usually found at heights ranging from about 2 to 10 feet above the ground, but it is most often encountered between 3 and 6 feet. Little effort is made to conceal it. The structure is more or less globular or cylindrical, with its longer axis placed horizontally and the round opening occupying almost the whole of one end. A Costa Rican nest measured 5 inches from front to back and 4 inches in height. In one of these nests that I found in Ecuador, the chamber was $2\frac{3}{4}$ inches from front to back, $2\frac{5}{8}$ inches in height, and $2\frac{1}{8}$ inches from side to side. Some nests are composed largely of the lacy skeletons of partially decayed leaves, with perhaps a few fibers and tendrils mixed with them. Although leaf skeletons are included in most of these structures, some nests contain a preponderance of other materials including rootlets, liverworts, mosses, small brown leaves, and various fibrous stuffs. Most of them have some green moss or liverwort on the outside. In some the walls are thick and opaque, whereas in others, especially those in which lacy leaf skeletons predominate, one can see the light through both side walls. The rounded inner end of the pocket is sometimes loosely closed. Since the doorway extends to the level of the floor and there is no sill, an egg placed in one of these nests would be in great danger of rolling out. The slender sapling or vine which supports this structure would move under the weight of any snake or mammal large enough to capture the wren; thus it might give the sleeper warning of the approach of an enemy.

In Costa Rica I have visited a number of these nests under cover of darkness, or I have watched for the occupants to enter at the day's end or to leave at dawn. Most nests prove to be untenanted, which suggests that each wren has a number of lodges scattered over its territory, so that if disturbed at one it can retire into another. Of four nests in fairly good condition which I examined in the forest near my house on two mornings in early March, only one sheltered a sleeper. Whenever the nest was occupied, it held only a single adult wren, which invariably slept with its tail toward the back and its head at the doorway. If one approaches quietly in the dark, he will see only the white breast gleaming in the opening in the beam of his light, for the bird's head is turned back and buried in its feathers. In eastern Ecuador as in Costa Rica, I found only a single adult occupant of a dormitory.

Although two adult Lowland Wood Wrens apparently never roost together, young birds, still dependent on their parents, sleep with one of them, probably the female

parent, in a dormitory nest. In 1942, the wood wrens in the forest near my house appeared to have a particularly successful breeding season; by June many pairs had two youngsters, the latter easily distinguished from their parents by the conspicuous yellow corners of their mouths and their light gray rather than white breasts. I found two families, in widely separated parts of the forest, in which two young wrens slept with an adult in a typical dormitory nest about four feet above the ground. These nests were far higher and more exposed than the nests in which the young had, in all probability, been hatched. About fifty feet from one of these nests, which had three occupants, was another similar nest with a single sleeper, which I took to be the male parent. After July, I no longer found nests occupied by more than one wren.

Although I have found scores, or more probably hundreds, of the dormitories of the Lowland Wood Wren, only once have I had the good fortune to watch their construction. While wandering through the forest near my house on May 30, 1945, I came upon a wren building such a nest in the crotch of a small sapling, about two feet above the ground. Instead of scolding loudly and then slipping away through the undergrowth, as these wrens usually do when they see a man, this bird continued at its task while I stood in plain view of it, only twenty feet away. It worked with great zeal, picking up fibrous vegetable materials from the ground or the lowest stratum of the vegetation and carrying them in rapid succession to the half-finished nest. I found the bird at 7:40 a.m., and in the next 35 minutes it went to the nest 46 times, usually if not always taking a contribution to it. It flitted from bush to bush or hopped over the ground, never walking, and it frequently voiced full, throaty notes. It was alone. At the end of this period of concentrated activity the wren flitted away, and from the distance I heard its song or that of its mate. Although I waited three-quarters of an hour, or until nine o'clock, the wren did not return to resume its labor. After an interval of half an hour I returned, but it was still absent.

NEST BUILDING

In contrast to the numerous dormitories that I have seen, I have, in the course of many seasons' work in the forests where the wood wren dwells, found only five occupied breeding nests; four of these were in the valley of El General in Costa Rica and one was in eastern Perú. In addition, I have watched in El General the building of two nests, which were of the type used for breeding but which did not later contain eggs. Of the six Costa Rican nests, the lowest rested on the ground, while the bottom of the highest was only nine inches above it. The sites of these nests were rather diverse. The first was situated in a patch of newly felled forest among the chaotic tangle of still unburned trunks, boughs, and vines that made my progress across the opening slow and exceedingly difficult. In the midst of this sun-flooded clearing, about fifty feet from the wall of standing trees that formed the edge of the undisturbed forest, the nest was placed among slender dead branches between prostrate trunks, and it was shaded by a few low, green shoots of the ground vegetation. The second nest was on a steep hillside in remote, undisturbed forest, beside an obscure path, where it was supported against the base of a small sapling and largely concealed by the fronds of ferns and the leaves of aroids. The third nest was eight inches up on a small stump; it was well hidden by the stump sprouts, in the midst of which it was placed, and by some clustering fronds of a hart's-tongue fern. The fourth nest was also in the forest, in a little opening where some heavy boughs had fallen from far above, and it was placed among the brown dead branches and leaves, with scarcely any green vegetation near it. The fifth nest, which never contained eggs, was being built beneath the great, brown, fallen frond of a chonta palm in the forest near our house. The sixth nest, which likewise was never used, was not in primary forest

but in a patch of old second growth continuous with it, close by the entrance to our farm. It was being built among low herbage inside a great coil of fallen vines. A nest found by Huber (1932:238) at Eden, Nicaragua, was higher than any of these; it was in a crevice of a fallen log about 18 inches above the ground. The occupied nest which I discovered at Tingo María in the Department of Huánuco in eastern Perú was in a situation quite different from that of any of the Costa Rican nests. It was 23 inches above the ground and was placed among the foliage of ferns and aroids that covered over the low, slender trunk of a tree fern which was growing beside a path in the undergrowth of the forest. The Peruvian and the Central American wood wrens are, of course, racially distinct; they were formerly classified as different species.

Shortly before eight o'clock on the morning of April 14, 1955, I came upon a wren building the nest beneath the fallen frond of a chonta palm on the ridge in the forest close by our house. Two wrens were then in the vicinity, but so far as I could tell only one built while I sat watching on a log fifteen feet away. My presence did not seem to disturb this bird which remained absorbed in its task. From 8:00 to 8:15 a.m. it brought material 10 times, and in the next quarter-hour 9 times; but in the half-hour from 8:30 to 9:00 the wrens stayed out of sight and no work was done. Apparently only one member of the pair had been in the neighborhood of the nest during the period of active building from 8:00 to 8:30. This bird was silent except for the low, throaty notes it constantly repeated. It spent very little time in the nest arranging the materials it had so actively brought; it kept always near the ground as it went back and forth through the low herbage, and it often alighted on the ground. Subsequent watching failed to reveal further building, and the nest was never finished.

On April 25 of the same year, I found a pair of wrens building the nest, already mentioned, within the coil of vines near the gateway to our farm. My attention was drawn to this nest when both birds passed near me bearing material in their bills. Soon I discovered that they would continue to build while I stood beside a tree only two yards from the nest; in this position the birds were almost at my feet. Although at first they hesitated a little and scolded when they saw me towering so close above them, these retiring birds were presently busily at work, seeming to disregard my presence. From 7:40 to 8:30 a.m. both sexes took substantial shares in the task and were often at the nest together, each bearing its contribution. They brought rootlets which they laboriously pulled from a patch of bare ground, going again and again to the same spot, and also skeins of fibrous materials from decaying stems and an occasional tuft of moss. When they met at the nest, they uttered snatches of low song and pleasant, rapid twitters. Each took into the nest the billful it brought, and I did not see one pass its burden to the other, although this might at times have occurred unseen by me, since the entrance faced away from me. I could not watch the birds arranging their materials inside the closed nest, but I often saw its roof shake while they were at work in it.

At 8:30 a.m. the period of energetic building by both sexes ended. The pair vanished for 5 minutes, then one returned and continued to work alone. Between 8:35 and 9:00 this bird brought 15 billfuls of material. Now there was no song, except at first from the mate off in the distance, and there was no contented twittering while the builder was in the nest. Instead, it uttered a number of full, throaty notes each time it approached the structure, hopping over the ground and the fallen vegetation for the last foot or two of its way. At nine o'clock the lone builder went off, apparently in search of its mate, and, although I waited a quarter-hour longer, neither member of the pair returned. These observations show that both members of a pair sometimes take fairly equal shares in building, or, at the same nest, one may do a considerable amount of work alone. Although this nest was completed, as was the one beneath the palm frond, it never held eggs.

Although the lightly constructed dormitory has its long axis horizontal, the substantial breeding nest is usually considerably higher than wide. This ovoid structure has a thick bottom, firm walls and roof, and a round, sideways-facing entrance, the lower edge of which is well above the bottom and which is protected above by a visor-like projection of the roof. In some nests this projection extends far forward and makes it exceedingly difficult to see the contents of a structure situated almost at ground level in dense vegetation. This is true even when one uses a mirror and a small electric bulb as aids to vision. These nests are composed of fibrous rootlets which may be fine or coarse, skeletons of decayed leaves, and plant fibers; sometimes also there are many finely branched stems of mosses and liverworts from which the leaves have mostly decayed. There is more or less green moss on the outside, especially at the top. The nest among the brown fallen branches, however, had scarcely any green moss, which, in this exceptional situation, would have made it more rather than less conspicuous. One nest contained in the bottom a pad of very fine material, dark brown and blackish in color, consisting of fine, many-branched moss or liverwort stems, and thread-like rootlets. There is often also a lining of downy feathers, which in one nest consisted of vermilion-tipped feathers from the under plumage of the White-tailed Trogon, barred feathers from the Marbled Wood Quail, some buffy and whitish feathers, and also a green-tipped feather of a trogon. These nests measure about 6 inches in height by $3\frac{1}{2}$ to 4 inches in transverse diameter. The doorway is about 2 inches in diameter and the chamber extends about an equal distance below its lower edge. The Peruvian nest resembled the Costa Rican nests in construction.

THE EGGS

Four Costa Rican nests each contained two eggs or nestlings, and this was the number in the Peruvian nest found by me and in the Nicaraguan nest recorded by Huber. All of the eggs which I have seen were elongate, glossy, and pure white, but the eggs found by Huber had a very few light brown specks. The measurements of five Costa Rican eggs average 21.9 by 14.7 millimeters. Those showing the extremes measured 23.0 by 15.1 and 20.6 by 14.3 millimeters.

In the valley of El General, Costa Rica, 2500 to 3500 feet above sea level, two sets were laid in February and two in May. But on March 10, 1940, I found a pair of wrens followed by well grown young which had probably hatched from eggs laid no later than January.

The nest at Tingo María, Perú, at latitude 9° S and 2300 feet above sea level, contained 2 eggs well advanced in incubation on August 31, 1940.

INCUBATION

On June 5, 1949, I watched a nest from daybreak until 1:14 p.m. in which the second egg was laid on May 28. As far as I could tell, only the female incubated. She took three long sessions which lasted 86, 70, and 98 minutes, and three recesses of 43, 75, and 53 minutes' duration. Despite her long sessions, she spent only 59.8 per cent of the 7 hours on her eggs. On leaving her low doorway, she would hop over the ground, sometimes passing beneath a fallen log, and proceed silently in this inconspicuous fashion for from a few feet to as much as five or six yards. Then she would rise into some low bushes and perhaps utter her throaty call before she flew away. At the end of her outing, the last few yards of her approach to the nest were also covered by hopping over the ground; but now she repeated her full, harsh call note over and over, sometimes continuing even after entering her nest. Once while sitting on the eggs she sang in a loud, musical voice and was answered by her mate unseen in the distance. On one return to the nest, she

brought material for it. I did not see the male near the nest, although I heard him sing, especially in the early morning. The morning was cloudy, with a little sunshine in its latter part, and soon after noon rain began to fall.

At this nest the second egg was laid on May 28 and both eggs hatched between the afternoon of June 14 and early morning on June 15, giving an incubation period of approximately 18 days.

THE YOUNG

When her eggs were pipped, this wren sat most steadfastly, not leaving the nest until I vigorously shook a sprout growing close beside it. Then she hopped slowly and reluctantly away over the ground. Next morning even shaking the sprout which touched the nest did not make her leave. She stuck to her newly hatched nestlings until I bent down to look into her doorway, and I might easily have caught her in the nest had I wished to. Then, instead of vanishing, as on past days, she hopped around me in the undergrowth, where I had occasional glimpses of her, churring in protest at my intrusion and from time to time voicing a few musical notes. After completing my examination of the nestlings, I stood watching unconcealed about three yards away from the nest. Almost at once the wren came hopping back over the ground with a small insect in the tip of her bill. With scarcely any hesitation, she entered the nest and apparently fed one of the nestlings, uttering a few musical notes, while they produced a chorus of weak *chip*'s. Then she went off again. The nestlings had pink skin with sparse gray down.

Another female with recently hatched young *walked* away from her nest when I visited it. She continued this for a yard or so, then voiced a loud *teleet teleet*, followed by harsh *churr*'s, as she flitted away through the undergrowth.

At another nest, the male began to bring food on the day the nestlings hatched. Sometimes he passed it to the female while she brooded, but once he gave it to her while the two stood in front of the nest. Two days later, the male gave the two nestlings their first meal at 5:41 a.m. In the next six hours, he and his mate brought food 13 times, but one billful was carried away when the nestlings failed to take it. The parents always approached the nest by hopping over the ground from the farthest point at which they were visible, and at times they crept, mouse-like, through the divisions of a fallen palm frond. Frequently they sang a little with food in their bills. Practically all the food taken to the nest was white, and apparently it consisted of the larvae and pupae of insects. When a week old, these nestlings were carried off by a predator in the forenoon. In the early afternoon of the same day, I thrice saw the parents bring food to the empty nest, then carry it away. On the following morning, a parent brought food for the vanished nestlings at least once.

Because of the loss of nests, I have been unable to determine the nestling period. After fledging, the young are apparently not led back to sleep in the low nest in which they were reared, because, as mentioned earlier, I have twice found them roosting with a parent in a higher dormitory.

SUMMARY

The Lowland or White-breasted Wood Wren lives on or near the ground in the heavy rain forests at low elevations from tropical México to Perú and the Guianas. In particularly favorable situations, it may extend as high as 7000 feet above sea level, but, at altitudes greater than 5000 feet, it is more often replaced by the Highland Wood Wren. These wrens hunt among fallen branches and dense ground vegetation. They remain in pairs throughout the year.

The beautiful, loud, clear, whistled song is generally short and delivered more sparingly than that of many other wrens. Both sexes sing, but the male's voice is stronger.

These wrens build two kinds of nests: low, substantial, well concealed nests for breeding, and higher, slighter, more exposed nests for sleeping. The dormitory nest is usually from two to ten feet up in slender saplings or in vines. It is a roughly globular or cylindrical pocket with the long axis horizontal and the opening facing sideward. A single adult occupies a nest, sleeping with its tail at the rear and its white breast in the doorway. Young still dependent on their parents sleep with one of them, probably the female, in a typical dormitory nest.

The breeding nest is usually placed within a few inches of the ground, rarely on it, and usually not more than one foot up. Unlike the dormitory, its long axis is vertical and the chamber extends about two inches below the lower edge of the sideward-facing doorway. It is made of leaf skeletons, rootlets, and fibrous materials, with usually some green moss on the outside, and it often has a lining of feathers in the bottom. Male and female may share the task of building, but sometimes one works alone.

On the Pacific slope of southern Costa Rica, breeding may begin in January, but of the four sets of eggs actually found, two were laid in February and two in May. The set consists of two white eggs, usually immaculate but sometimes sparingly speckled with brown.

Apparently all the incubation is done by the female. One wren took very long sessions, lasting 86, 70, and 98 minutes, with recesses of 43, 75, and 53 minutes. In the course of seven hours she kept her eggs covered only 60 per cent of the time. These eggs hatched in 18 days.

Newly hatched nestlings are pink-skinned with sparse natal down. The nestling period is unknown. Fledglings are led to sleep in a dormitory nest rather than in the low breeding nest.

HIGHLAND WOOD WREN

Henicorhina leucophrys

In the dense undergrowth of the humid mountain forests of tropical America, from México to Bolivia, lurks a small, short-tailed wren with retiring habits and an unforgettable song. Naturally, over so great a range, the continuity of which is broken by intervening valleys and transcontinental gaps in the mountain system, the species has become diversified into a considerable number of geographic races that have received a long and confusing array of names. Yet everywhere the Highland or Gray-breasted Wood Wren is a distinctively marked bird with a character of its own, and one who has made its acquaintance in México will have no difficulty in recognizing it when he meets it again in the mountains of Perú. I have before me two descriptions of this species set down in my notebooks while I watched the living birds in the mountains of Guatemala and in the upper Pastaza Valley of Ecuador, and these two delineations, written at an interval of six years and at points separated by fifteen degrees of latitude, show close correspondence. Since this wren, restless like most of its tribe, does not long expose itself to view, these field descriptions are not complete in all details. But both mention the following: the rich brown upper plumage; the conspicuous white line that begins at the base of the black bill and arches above each dark eye and continues down the side of the neck; the broader black band which borders this on the lower side, passing across the eye; the heavy black streaks on the white cheeks and sides of the head; the light gray on the center of the chest and breast; and the pale cinnamon or buffy-brown on the flanks, abdomen and under tail-coverts. This bird is only about four inches in length. The Highland Wood Wren is to be distinguished from its lowland counterpart, *Henicorhina leucosticta*, by its gray rather than white breast. These two related species may be separated even more readily by their very different songs.

I first made the acquaintance of the Highland Wood Wren in the mountains above Tecpán, in the western cordillera of Guatemala. Here I found the bird both in the mixed forests of pine, oak, and other broad-leafed trees about 8000 feet above sea level and among the magnificent forests of cypress (*Cupressus Benthamii*) on the highest portions of the range, up almost to 10,000 feet. This is a region of pronounced seasonal contrasts. There is a long dry season lasting from about the middle of October to the middle of May and becoming quite severe toward its end; the remaining five months of the year may be excessively wet. During the dry season the wood wrens appeared to be rare, and they were confined to deep, bush-choked ravines, whence I heard their loud, somewhat explosive *tuc tuc tuc* or their clear ringing song. This last sounded wildly beautiful as it rose from the banks of some unseen mountain rill murmuring gently along the bottom of its deeply cut, fern-draped channel. It was a long time before I caught a glimpse of the retiring creatures and traced these compelling utterances to their source. The wrens were very active birds, moving restlessly through the dense vegetation of the barrancas and often disappearing beneath the overhanging banks of the streams. But after the wet season was well established, they left the deep shade of the ever-humid ravines and not infrequently hunted through low and tangled thickets far up on the mountainsides in places where I had never seen them in the course of the drier months. In July they seemed to become more numerous than they had been earlier in the year. However, I am not sure whether this apparently greater abundance resulted merely from the shift from more secluded to more exposed habitats or whether the birds had migrated from a

greater distance. Except when accompanied by young, I almost always saw the wood wrens in pairs.

The following year, in early August, I found the wood wren present in great numbers in the undergrowth of the stately subtropical forest on the seaward slopes of the Volcán Zunil in western Guatemala. This seemed to be the most abundant bird of the woodland between 5000 and 6000 feet above sea level. The wrens' loud, explosive clucking issued from the dense undergrowth on every hand, and frequently one would burst into sweet song, in which he was joined by his mate which was foraging a short distance away.

At Vara Blanca, on the northern slope of the Cordillera Central of Costa Rica, the wood wrens were no less numerous, between 5000 and 6000 feet above sea level, than they had been at a similar altitude in the Pacific Cordillera of Guatemala. In these almost constantly wet forests, they lived among the lush undergrowth of ferns, brightly flowering shrubs, and tangles of slender-stemmed bamboos which grew beneath tall trees heavily burdened with epiphytes of many kinds. As in Guatemala, I found them nearly always in pairs, except during the months immediately following the nesting season, at which time they were often seen in family groups of three or four. These groups consisted of parents with their full-grown offspring. Here at last, during the year I spent in these storm-beaten forests, I discovered the nests in which they slept and reared their young, and the birds then became to me something more than a challenging voice and a fleeting vision.

VOICE

In a species so far-ranging as the Highland Wood Wren, separated into numerous more or less isolated races, there is considerable variation in song and notes. The song also seems to change in character with the season of the year and doubtless, too, with the age of the bird. In the Costa Rican highlands, I heard these wrens sing far more than anywhere else. Here they sang much throughout the year and in all kinds of weather. They sang even at the height of those seemingly interminable storms of wind, rain, and driving cloud-mist when for weeks the sun would be only a memory and a hope and most species of birds rarely lifted their voices. But now and again the sweet music of the wood wren would break the mist-shrouded silence, bringing a note of cheer and good hope into the midst of so much gloom and despondency.

As I most frequently heard it in the Costa Rican mountains, the song of the Highland Wood Wren was a long-continued series of clear, sweet, tinkling notes which might run on almost indefinitely, for the music lacked the set pattern and formal phrasing of that of the majority of wrens. It was a rambling, juvenal type of song, contrasting sharply with that of the wood wrens of the lowlands, whose exquisite phrases, brief and sharply cut, are perfect cameos of song. But as though to compensate for his technical inferiority as a musician, the highland wren sings far more profusely than his lowland relative; not only are his separate songs many times longer, but it also seems that he delivers them more often. The wood wren of the lowlands can be likened to the professional musician who for a price gives a brief performance of incomparable quality; the highland bird is like the inspired amateur, who must release the melody constantly welling up in him whether or not he has an audience.

One day in March, while I sat in a pasture close by the woodland, watching the birds of many kinds that flocked to feast upon the seeds of a lagartillo tree, a pair of Highland Wood Wrens foraging among the bushes at the woods' edge entertained me with their songs. Now and again they sang together in their full voices, but most of the time one of the two, probably the male, kept up a singing monologue in a voice some-

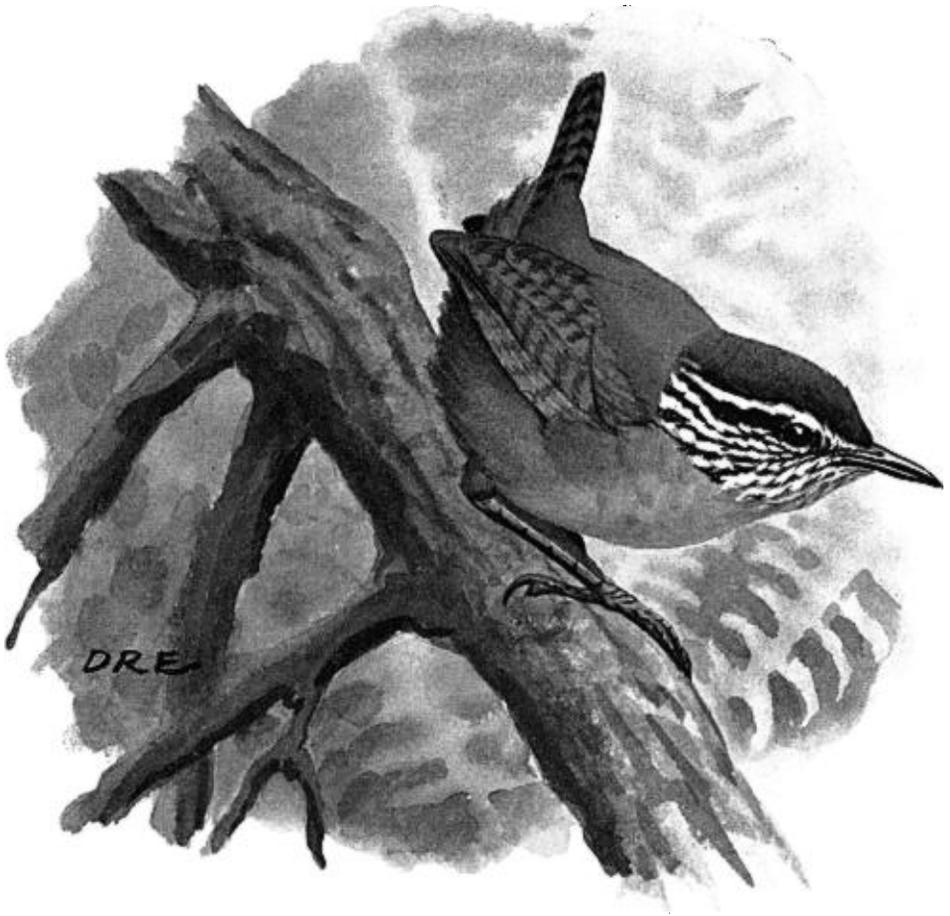


Fig. 23. Highland Wood Wren.

what lower than that used for the duet, yet it was still too loud to be called a whisper-song. Rarely have I heard a bird, never another kind of wren, sing for such long periods without a pause. For nearly an hour he poured forth a constant succession of clear, sweet, tinkling notes, rising and falling in pleasant cadences, but there was no set phrasing and no recognizable musical pattern. While I listened to this delightful soliloquy, it occurred to me that the Highland Wood Wren had, as a songster, never grown up. Other songbirds, like the Southern House Wren, Chinchirigüi Wren, and the Song Sparrow, begin to sing some weeks after they depart from the nest. This song is a long-drawn, diffuse, somewhat warbled melody, very sweet to hear, but it is without set phrasing and has little specific character. As these juveniles approach maturity, they exchange this "childhood" song for others that are shorter, often musically more brilliant, and more distinctive of the species. Probably the Lowland Wood Wren also goes through a similar transition in its mode of singing. But the increase in technical brilliancy which the bird achieves as he changes from his juvenal to his adult song is sometimes dearly bought with loss of quantity. Whenever I heard the Highland Wood Wren, I was grateful that one bird, at least, had preserved through life the artless simplicity and the exuberant abundance of its early song.

But this difference between the character of the song of the Highland Wood Wrens and that of other members of the family is only relative. In April, as they began to nest, their singing became more brilliant. Clearness and sweetness of tone they had possessed at all seasons, but their songs had hitherto lacked rhythm and character. Now, because they varied their performances by the use of emphasis and stronger modulations, some of them, at least, became notable musicians. Their songs now lost something of the rambling, diffuse style that had been so pronounced only a few weeks before, and they acquired more definite phrasing. Yet even now the wrens would sing at times in the discursive fashion of earlier months. It seemed likely, although I never quite satisfied myself on this point, that the long-drawn, rambling songs were those in which male and female joined together, whereas the more finely executed, finished pieces were the compositions of the males alone. These latter songs were music as delightful as I have heard from any wren; for, if they fell somewhat short of the performances of the Lowland Wood Wren and the Black-bellied Wren in brilliance of technique and exquisite mellowness of tone, they amply compensated for slight shortcomings in these directions by their greater length.

When disturbed or alarmed, the wood wrens voice their displeasure with harsh *churr*'s. The sharp, almost explosive *tuc*, so prominent in the vocabulary of the Guatemalan wood wrens, is replaced by a softer note in the Costa Rican race.

SLEEPING

Like most wrens, the Highland Wood Wrens do not roost in the open exposed to the elements but sleep in snug shelters. Their dormitory nests are thin-walled, globular structures (fig. 21*d*) which are entered through a downwardly directed doorway. Although the dormitories of the Lowland Wood Wrens are of much frailer construction and are placed in higher, more exposed positions than the breeding nests, the nests of the highland species exhibit no constant differences correlated with their use for sleeping and for breeding. Some, indeed, may be employed at different times both as dormitories and as receptacles for the eggs. Two of the dormitory nests that I found at Vara Blanca were in higher, more exposed positions than any I saw with eggs or young, but, since I did not discover a large number of either kind of nest, I am not certain that breeding nests are always better concealed than dormitory nests.

Adult Highland Wood Wrens were found sleeping in pairs throughout the year. After the close of the breeding season, the pair might be accompanied by their fledglings, thus making three or four wrens in a nest. At the end of January, I found a nest situated in a most unexpected position. It was at the end of a slender, horizontal branch of a small dead tree which was in the midst of a pasture of tall *gigante* grass more than head high. The nest was about ten feet above the ground and at least a hundred yards from the edge of the forest. In this exposed crotch of a leafless tree, it was conspicuous from afar. As the day ended with the usual drizzle, a pair of wood wrens approached the nest slowly through the tall grass, apparently foraging on the way and singing back and forth to each other in their customary fashion. As the light grew dim, one wren flew up into the dead tree and entered the nest. The mate lingered in the grass to hunt a few more morsels, and whenever it sang, the other bird replied with song from within the nest. Presently the second bird flew up from the grass into the dead tree; as it alighted, shaking the branch, the one that had been within the nest hopped out again. Then both birds entered and stayed for the night.

In mid-March I watched a pair of wrens build a nest above a roadside bank. After it was completed both birds slept in it. In the evening, when the second wren joined the first inside, they uttered low, sweet whisperings of contentment. This nest was

destined for the rearing of a brood, and soon after the second egg was laid I found only a single wren, doubtless the female, passing the night in it. But after a few days, the male resumed the habit of sleeping in the nest, and he continued to do so during the remainder of the incubation period as well as during the whole time that there were nestlings within the nest. But it appears to be unusual for the male to sleep with his mate while she incubates and broods the nestlings, for at two other nests only a single adult passed the night with the eggs or young. The male most probably takes shelter during this period in a separate dormitory of his own.

The fledglings from two nests were not led back to pass the night in the snug chambers they had just departed. But apparently they went to sleep with their parents in some other shelter, for in the months following the breeding season, I twice found four wrens occupying the same dormitory. On June 22, I watched four wrens retire at nightfall into a nest situated about fifteen feet above the ground in a small dead tree standing in the same pasture where earlier I had found the other high, exposed nest. This nest had apparently been built by this same pair of birds which were now accompanied by full-grown young. In mid-September of the preceding year, I had found four wrens sleeping in a nest situated eight feet above the ground in a slender bush in the forest. These were also without much doubt parents with their full-grown young which were too wary to permit me to detect lingering traces of immaturity, if any remained.

Earlier in the same month, I had surprised a pair of wrens building a nest among the lower branches of a small, compact bush growing out from the top of a high, vertical roadside bank, at a height of eight feet above the roadway. After the structure had been completed, I went out at dawn to look up into it with a flashlight. Two wrens, which had been slumbering side by side, peered down at me with their boldly patterned, black and white heads projecting over the sill of the doorway. This was apparently a pair which had either separated from their young-of-the-year or possibly had been unsuccessful in rearing a family.

THE NEST

The use of the nest as a dormitory for the wrens has been considered briefly; now let us examine the nest more closely as a receptacle for the eggs and as a shelter for the nestlings. In form it is roughly globular. The roof which covers the rounded chamber is projected far forward and downward, forming an antechamber or vestibule in front of the nest chamber. The entrance to this vestibule is from below, so that the bird must fly sharply upward to gain the interior of its well-enclosed nest. The walls and roof are composed largely of fine, black, fibrous rootlets, with more or less green moss attached to the exterior on the top and sides. The walls and roof are thin and permit much light to penetrate their meshes, yet they are thick enough to shed the rain that falls so abundantly in the mountain forests, for at the end of a steady shower that lasted two hours, I found the interior of one nest perfectly dry.

A favorite location for the breeding as well as the sleeping nest is among the vegetation that overhangs a bank beside a roadway, a path, or the edge of a ravine. Of the three occupied nests found at Vara Blanca in 1938, two were above wayside banks; one rested upon two slender branches of a shrub, the other was upon fallen dead branches projecting over the edge of the bank. Both had woodland on one side, pasture on the other. Carriker (1910:762) reports two nests that were placed on sprays of bamboo hanging over the sides of deep ravines on the Volcán Irazú. The third breeding nest which I found at Vara Blanca was built among rank weeds in a pasture surrounded by forest. A boy cleaning the pasture chopped down the supporting vegetation before he noticed the nest, so it was no longer possible to determine its original height above the

ground. After inadvertently knocking it down, the lad propped the nest up on some sticks in approximately its former position, about a yard above the ground. It was now a most conspicuous object in the midst of the freshly cleaned pasture, but both parents continued faithfully to attend the two still unfeathered nestlings.

On March 17, I watched a pair of wood wrens build their nest in a bush that overhung the edge of the high bank beside the Sarapiquí trail. The nest was already half finished, and both sexes were actively carrying fibrous rootlets into the spacious interior. When they met inside, they uttered low sweet notes which seemed to express contentment. Four days later the structure appeared to be completed, and both birds slept in it. Soon two eggs were laid there.

THE EGGS

Two of the nests that I found at Vara Blanca contained two eggs each; the third nest held two nestlings. Carriker's two Costa Rican nests also contained sets of two eggs; as is true of the Lowland Wood Wren, this appears to be the usual number of eggs for this species. The eggs are pure white, with no pigmentation. Carriker gives the dimensions of one set as 21.5 by 15 and 22 by 15 millimeters. In one of the sets at Vara Blanca, both eggs measured 22.2 by 15.5 millimeters. The earliest of my nests contained fresh eggs on March 28; the latest held nestlings a few days old on June 14. Both of Carriker's nests contained eggs in mid-April. It is not known whether more than one brood is raised in a year.

INCUBATION

Early in June, I spent nine hours watching from a blind a nest that contained two eggs within a few days of hatching. Since the sexes of the wood wren are nearly identical in appearance and have rather similar songs, it was not possible to prove definitely whether one or both members of the pair sat in the nest. But everything that I saw during my long vigil pointed to the conclusion that a single bird incubated; and analogy with other species of wrens, of which the sexes may be distinguished by their songs or otherwise, leads us to believe that this duty was performed by the female. Not only did I fail to witness a single exchange of places in the nest, but I never saw a second bird come near the nest. However, I frequently heard the male wren's song issuing from the dense undergrowth of the woods below the path above which the nest hung. He appeared to spend most of his time in this place. When his cheerful notes reached the incubating female she sometimes sang in reply; but more often she flew out to join him. The female incubated most inconstantly, spending slightly more time away from the eggs than upon them. Fifteen sessions in the nest ranged from 8 to 28 minutes, averaging 16.4 minutes. Fourteen recesses varied from 7 to 40 minutes in length, averaging 16.8 minutes. Accordingly, the female covered the eggs only 49.4 per cent of the time—a very poor record.

My nine hours of watching at this nest was divided between six hours on a sunny morning and an additional three hours during an almost steady downpour on the afternoon of the following day. It was interesting to find that both the sessions and recesses of the wren were shorter on the rainy afternoon than they were on the clear morning. In the morning her 8 sessions averaged 19 minutes and her 8 recesses averaged 20.1 minutes; in the afternoon her 7 sessions averaged 13.4 minutes and her 6 recesses averaged 12.3 minutes. She came and went more frequently in the rain.

In this nest a single bird, beyond much doubt the female, slept with the eggs; in the earlier nest, which I had watched while it was being built, both sexes slept in the nest except at the very beginning of the incubation period.

In this early nest, two eggs were laid between March 25 and 28. One egg hatched on the afternoon of April 15 and the second hatched on the following day. If we make the

probable assumption that the eggs hatched in the order of laying, then the second, which was laid not earlier than March 27 nor later than March 28, hatched after 19 or 20 days of incubation. The Lowland Wood Wren has a similarly long period of incubation.

THE NESTLINGS

In the nest above the pathway at the edge of the forest, where I had watched the female incubate, one egg hatched during the afternoon of June 6; the second probably hatched during the following afternoon—at all events, by the morning of June 8 there were two nestlings. Because I had not seen the male wren come near the nest in the course of nine hours toward the end of the incubation period, I was eager to learn how soon after the eggs hatched he would bring food to the nestlings and, if possible, how he would discover that they had hatched. With these questions in mind, I watched the nest from 6:20 to 9:40 on the morning of June 7; the nest at this time contained one newly hatched nestling and one egg barely pipped. Usually the female, upon returning to the nest, hopped into it so rapidly that I could not make certain whether she brought food, but three times I definitely noticed morsels in her bill. Except in a single instance, each time a wren entered the nest it stayed to brood. Since it is almost axiomatic that if the male bird does not incubate he does not brood the nestlings (I know of no exception to this rule) it is a fair conclusion that the male wren did not go into the nest more than once during my watch. But the time when the wren did not remain to brood the nestlings, it entered in a direct, unhesitating manner, as though well accustomed to the act; so that I believe that this time, also, the female brought food but broke her rule of lingering after each feeding to brood her newly hatched nestling. Once, however, one of the pair came with a morsel in its bill, hopped about among the branches near the nest, then carried off the food. I believe that this was the male wren, which had come with food but did not yet know what was to be done with it; I have noted this in male birds of other kinds.

In spite of the fact that the female now provided for a nestling in addition to hunting food for herself, she stayed in the nest more constantly on the morning of June 7 than she had done on June 3 while incubating her eggs. Considering only corresponding hours of the two days, which leads to averages somewhat different from those already given under incubation, we find that from 6:39 to 9:44 a.m. on June 3, three days before her eggs hatched, the female's periods in the nest averaged 15.6 minutes and her recesses averaged 17.8 minutes. From 6:33 to 9:35 a.m. on June 7, when she had one nestling and one pipped egg, her periods in the nest averaged 11.9 minutes and her recesses averaged 8.3 minutes. Hence, although the female came and went with considerably greater frequency, as is usual with birds after they begin to feed their nestlings, she cut the length of her recesses in half with only a relatively slight reduction in her sessions, thereby increasing her total time in the nest from 46.7 to 58.9 per cent. Five times she flew from the nest as she heard her mate's song issuing from the forest down the mountain side; once she answered him from the edge of the woods before vanishing into its depths. Accordingly the female continued to maintain close contact with the male, although she was apparently unable to inform him of recent happenings at the nest.

The following morning, June 8, when the second egg had hatched, I watched from ten to eleven o'clock, and saw the male bring food three times and pass it to his mate as she brooded in the nest. On two occasions he brought larvae. How had he learned that his nestlings had hatched? Since he apparently had not possessed the habit of going from time to time to look into the nest and acquaint himself with what was happening there, as many male birds do, I believe that he must have been led to bring food by seeing his mate with morsels in her bill.

As these nestlings grew older, I watched their nest at odd times and saw the parents bring a great variety of insects and larvae, but they never brought any fruit or berries. At the age of nine or ten days the young were feathered. From time to time I visited the nest at daybreak, but I never found more than a single parent sleeping in it. The young wrens departed on June 24, aged 17 and 18 days, respectively. From the earlier nest, where both parents kept the young birds company through the night, the first made its exit on April 29 when (assuming it to have been the older by a day) it was 14 days old. That evening both parents slept with the remaining nestling, but the one that had left did not return to the nest. The next day the second young wren left the nest. Possibly the earlier departure of these nestlings was caused by the upsetting of their nest, which a few days before I had found hanging precariously below the supporting branches; at this time I had tied the nest up in its original position. After the last nestling had left this nest, it, like the other nest, was no longer used as a dormitory. The density of the vegetation in which the wrens now hid made it impossible to learn what provision was made for the shelter of the fledglings during the night, but, from evidence presented earlier, it seems likely that they were led to sleep with their parents in some other nest.

SUMMARY

The Highland or Gray-breasted Wood Wren dwells in the dense undergrowth of humid forests at high altitudes from México to Bolivia; in Central America it is found chiefly from 5000 to 10,000 feet above sea level. In the long dry season in the highlands of western Guatemala, these wrens lurk in deep ravines and along watercourses, but in the wet season they hunt in tangled thickets far up on the mountain slopes. Except when accompanied by dependent young, they are nearly always found in pairs.

Geographical races differ somewhat in song. In the Costa Rican highlands the wood wrens sang much throughout the year, even at the height of storms which for weeks at a time shrouded the mountains in chill, sunless gloom and silenced most other birds. As usually heard, the song is of a diffuse, rambling, juvenal type, lacking the short, definite, stereotyped phrases of so many other wrens. Rising and falling in pitch, the clear, sweet, tinkling notes may run on with hardly a break for nearly an hour. In the breeding season the song acquires more definite phrases, set off by stronger emphasis, but it never quite loses its diffuse, rambling character. Male and female sing responsively; sometimes this occurs while the latter sits in the nest.

These wrens sleep at all seasons in covered nests which in form and site cannot be distinguished from the breeding nests. The nests are built and occupied by both sexes together. During the period while the full grown young accompany their parents they all sleep in the dormitory, which may then shelter as many as four individuals. A larger number of occupants was never found.

The globular breeding nest is usually decorated with green moss, and it is often placed on a spray of vegetation which overhangs the bank of a ravine or roadway. In front of the closed chamber is an antechamber or vestibule with a downward-facing doorway. Although thin, the roof and walls of dark, fibrous rootlets are adequate to shed a long-continued rain. Both sexes build this nest.

In Costa Rica, the set consists of two pure white eggs which are laid from late March until May.

Incubation seems to be performed by the female only. In nine hours the sessions of one bird ranged from 8 to 28 minutes, averaging 16.4 minutes. Her recesses varied from 7 to 40 minutes, averaging 16.8 minutes. The female was in the nest only 49.4 per cent of the nine hours. On a rainy afternoon both sessions and recesses were shorter than on

a sunny morning. At one nest the female slept alone with the eggs and nestlings, but another breeding nest was occupied at night by both parents.

At one nest the period of incubation was 19 or 20 days.

At a nest in which the first egg hatched in the afternoon, only the female was seen to take in food the following morning, but by the second morning the male was also seen feeding the nestlings. Apparently he was led to bring food by seeing his mate do so. The female brooded a newly hatched nestling more constantly than she had incubated the eggs. The young were fed on insects and larvae.

At one nest the nestling period was 17 or 18 days. In two cases the breeding nest was not used for sleeping after the departure of the young. Apparently in these instances the young wrens were led to some other dormitory.

SOUTHERN HOUSE WREN¹

Troglodytes musculus

The Southern House Wren inhabits dooryards, plantations, and deforested lands of all sorts in both arid and humid regions. It is found from sea level up to about 9000 feet in both northern and southern Central America. These wrens remain in pairs on their territories throughout the year. They subsist on insects, spiders, and the like, which they find in low herbage, in piles of brush, in rustic buildings, and in crevices in the bark of trees up which they climb. They seem never to eat vegetable food.

The male has a variety of brilliant songs which he sings more or less freely in all months except while molting toward the end of the year. The female has a far simpler, twittering song which she sings chiefly in response to her mate. At times she adds a slight, clear trill to her performance.

Adults when not nesting sleep singly in a great variety of nooks and crannies in trees, earthen banks, human dwellings, bunches of bananas, and the like. The male usually arises a little earlier and retires a little later than his mate.

At lower altitudes in Costa Rica the onset of the breeding season is sometimes as early as the end of December but more usually it begins in February or March; it continues until August or September. Thus it involves both the dry and wet seasons, but chiefly the latter.

The cavities chosen for nesting are of the same great variety as those used for sleeping. Male and female together fill the chamber with many coarse sticks and straws; the former sings profusely even while carrying things in his bill. The lining, which consists of fine fibrous materials and finally of feathers, is applied chiefly by the female. The male sometimes helps with this, but perhaps more often he continues to bring sticks which get in his mate's way and are at times removed from the nest by her. Nest building occupies 4 to 8 days.

The eggs are laid from a short while before sunrise to a short while after sunrise on consecutive days. Thirty-eight sets from Costa Rica, Guatemala, and Panamá consisted of 2 eggs in one instance (this may have been incomplete), 3 eggs in 13 instances, 4 eggs in 22 instances, and 5 eggs in two instances (probably both sets were laid by the same female in consecutive years). The size of the set bears no relation to its order among the season's broods, sets of 4 may follow sets of 3, and the two sets of 5 were both in late nests. The short, blunt eggs have a whitish ground color, which is densely flecked all over with fine markings of brown, reddish brown, cinnamon, or pinkish cinnamon. The pigmentation may be heaviest on the thick end or nearly uniform over the whole surface, and at times it almost obscures the ground color. The measurements of 39 eggs average 17.8 by 13.4 millimeters.

The female sometimes sleeps in the nest cavity before she begins to build. In nine cases she slept in the completed nest before she laid her first egg; in four instances she began to sleep there in the evening after she laid the first egg; and in one instance she did not sleep in the nest until she had two eggs.

Only the female incubates, taking sessions which in the observed cases ranged from 5 to 44 minutes in length and recesses which varied from 6 to 29 minutes. In six hours a female incubating her first set of eggs took 12 sessions which averaged 14.1 minutes and 12 recesses which averaged 15.7 minutes; thus her eggs were covered 47.3 per cent of the

¹ This life history is a résumé of an account first published in *The Condor*, 55, 1953:121-149.



Fig. 24. Southern House Wren.

time. In 9.5 hours, while incubating the eggs of her third brood, this same female took 14 sessions averaging 25.8 minutes and 14 recesses averaging 14.4 minutes; thus she incubated her eggs for 64.2 per cent of the time. In 6 hours another female took 11 sessions averaging 19.6 minutes and 11 recesses averaging 11.4 minutes; she sat for 63.3 per cent of the observation period. Many females continue to bring feathers and fragments of snake skin to the nest during the period of incubation. The male comes from time to time to look into the nest.

At a nest situated at an altitude of 8500 feet in the Guatemalan highlands, the incubation period was 17 days. At 13 nests situated between 2500 and 3000 feet above sea level in Costa Rica, the incubation period varied from 14 days and 9 hours \pm 3 hours to 16 days and 2 hours \pm 2 hours. At 8 of these nests the period fell between 14.5 and 15.5 days, so that the average length of the incubation period might be stated as 15 days. Eggs hatch at all hours of the day. Those of the same set often hatch on 2 consecutive days and sometimes their hatching is spread over 3 days. The empty shells are promptly carried away by the female.

Newly hatched nestlings have pink skin with sparse gray down; the interior of the mouth is orange-yellow. They are nourished with small insects, spiders, and other invertebrates. The male may bring food within half an hour after the first egg hatches. Thereafter the two parents take about equal shares in feeding, especially after the female has ceased to devote much time to brooding. Nestlings 9 to 18 days of age were fed at rates varying from 4.3 to 8.4 times per capita per hour, in broods consisting of 3 or 4 young and over observation periods of 3 or 4 hours. Higher rates of feeding are sometimes observed, and a lone nestling 13 days old was fed by 3 attendants 31 times in 2.5 hours, or at the rate of 12.4 times per hour.

Arriving at the nest with food, the parent gives it to the nestling which first stretches

up its open mouth. Since the promptness of the youngster's gaping response seems to be determined by the degree of its hunger, this method of feeding ensures that the meal goes to the one most in need of it. When all the nestlings are equally hungry and stretch up simultaneously, the one nearest to the parent is likely to be favored. But the constant shifting of positions by the nestlings makes it impossible for any one of them to remain for long in the preferred place nearest the doorway.

Only the female broods. Diurnal brooding continues, gradually decreasing in amount, until the nestlings are 9 or 10 days old and their feathering is well advanced. Often the mother continues to sleep with the nestlings until they leave the nest.

One nestling left the nest when about 17 days old; 26 nestlings in 11 broods left the nest when 18 days old; 12 nestlings in 7 broods departed when 19 days old; 1 nestling remained in the nest until 20 days old. Usually they emerge before 8:00 a.m., and only rarely do they leave spontaneously after midday. Nine broods which were watched from a distance as they left their box or gourd came forth in obedience to an inner impulse, without any urging or suggestion from their parents. In one instance, the parents caused a newly emerged fledgling to return into the box it had just left, although the time was morning and the young bird was old enough to leave. Fledglings just out of the nest fly fairly well but lack control.

As night approaches, the newly emerged young are led by their parents to a safe sleeping place, which is sometimes the nest itself but often some sheltering cranny that is easier to reach. Exceptionally the parents take their fledglings to roost in the open nest of some other bird or even in the crotch of a tree, where they are exposed to rain. The parents go in and out of the chosen dormitory many times, showing the youngsters what they must do, until at last they succeed in following the parental example. After the young enter, the parents may feed them in the dormitory and remove their droppings. The fledglings may also receive food before they leave in the morning. The mother bird may sleep with her young family or apart from it.

Young wrens find at least some of their food ten days after they leave the nest, but some of them, especially the season's last brood, may receive occasional food from their parents five weeks after leaving.

When the young are taken back to sleep in the nest space, they may continue to pass their nights there while the female hatches out her next brood in the same cavity. From one nest they were forcibly evicted by their parents about the time the eggs hatched, and from another they were put out soon after the next brood hatched. At one nest, however, two young of the first brood persisted in sleeping with the nestlings in the face of parental opposition. After their parents began to tolerate them at the nest by day, these young birds brought much food to their younger sibling in the nest.

When only 73 days old, the young female which was feeding the nestling became antagonistic to her mother. After a day of fierce fighting, in which only the two females took active parts, the young wren was vanquished and disappeared from the vicinity. The young male, more pacific, continued to attend his younger relative until the latter was fledged. Later this young bird of the second brood helped to feed and otherwise attend the nestlings of the third brood, beginning this activity at the age of 54 days.

With two young birds helping to feed a single nestling, the parents built a new nest, in which the female started to lay the season's third set of eggs six days after the nestling left the second nest.

At 8500 feet in the mountains of Guatemala, observations were made on a pair of wrens which reared a single brood of four in a niche in a roadside bank. Although they started a second nest, the female did not lay again. After the young left the nest, they and their parents slept in neighboring crannies in the bank, where they were not difficult

to find. At first all four youngsters roosted together, sometimes with their mother, but nine days after leaving the nest they began to sleep in two or more groups. Three were found slumbering in the same niche a month after they left the nest, but after this they rested singly in niches scattered along 50 yards of roadway. Although now each member of the family lodged alone, the young were permitted to dwell in the parental domain for at least half a year longer.

One young male was first heard singing when 34 days old, another was heard singing when 46 days old. The diffuse, rambling juvenal song differs greatly from the adult's song.

At lower altitudes in Costa Rica, a single pair of house wrens may rear three or four broods in a year. One pair attempted six broods but raised only one. Excluding the extreme case of the pair which built their third nest before their second brood was fledged, 15 intervals between the emergence from the nest of one brood and the resumption of laying ranged from 14 to 36 days, with an average of 24.5 days.

In 26 nests, 90 eggs were laid and 51 young were fledged, giving a nesting efficiency of 57 per cent. Ants were the only known cause of loss of nests.

The incubation period, nestling period, and interval between broods are substantially longer for the Southern House Wren than for the Northern House Wren in the United States; but at lower altitudes the nesting season of the former is so much longer that the species produces three or four broods instead of the latter's two. This is exceptional for birds of the humid tropics, which if they suffer no losses from predators or otherwise usually lay fewer eggs in a season than closely related species that breed at high latitudes. The Southern House Wren has the highest reproductive potential of any passerine bird of Central America for which we possess adequate information.

RUFOUS-BROWED WREN

Troglodytes rufociliatus

From southern México to Argentina, the mountains of America are inhabited by a group of wrens which are placed in the genus *Troglodytes*. These are readily distinguished from the even more widely distributed house wrens (*T. aëdon*, *T. musculus* and their allies) by their conspicuous buffy or rufous superciliary stripes and by the usually bright cinnamon or tawny color of the throat and breast. Each isolated highland area has its own distinct form of these small wrens. *Troglodytes rufociliatus* is found in the highland area embracing the mountains and plateaus of Chiapas, Guatemala, Honduras, and El Salvador. In southern Nicaragua and northern Costa Rica the highlands are interrupted by transcontinental lowlands, and beyond this region in Costa Rica and western Panamá is another elevated region which is the home of *T. ochraceus*, which will be treated in the following chapter. Then in central and eastern Panamá is a long stretch of territory which does not rise above the Tropical Zone and from which wrens of this type are accordingly absent. In northern Colombia, the isolated Santa Marta range has its own peculiar form, *T. monticola*; while the main chain of the Andes, which stretches unbroken from Colombia and western Venezuela to Argentina and Chile, is the home of *T. solstitialis*. This latter wren is compared with the Ochraceous Wren at the end of the next chapter. Far in the east, the isolated summits of Mount Roraima and Mount Duida are each inhabited by an endemic species of *Troglodytes*, which, as Chapman (1931:108) suggests, may be local representatives of *T. solstitialis*. The wrens of all these widely separated highland areas have obviously been isolated from each other for many thousands of years, and whether they have in some or in all cases diverged far enough from their nearest neighbors to be distinct species is a question which we still lack sufficient information to answer. For the present, it seems safest to treat as specifically distinct each form which exhibits easily recognizable differences in size and coloration and is at the same time widely separated in space from the nearest related form. Further remarks on this matter are given at the end of the following chapter.

The sexes of the Rufous-browed Wren are similar in appearance. These wrens are small, slender-billed birds about four inches in length. The upper plumage is deep brown, indistinctly barred with dusky except on the pileum, which is plain. There is a conspicuous superciliary stripe of ochraceous-buff, partly separated by a deep brown postocular streak from the bright ochraceous-buff or tawny which covers the cheeks, sides of the neck, throat, and chest, and which becomes paler on the lower breast and abdomen. The sides, flanks, and under tail-coverts are narrowly barred with blackish on a light brown or buffy ground. The eyes, bill, and feet are dark.

In Guatemala I found this wren in the highlands from 7000 to 11,000 feet above sea level, so that it is practically confined to the altitudinal Temperate Zone; whereas the Ochraceous Wren in Costa Rica and *solstitialis* in Ecuador are abundant in the Subtropical Zone. In the mountains above Tecpán, in the Department of Chimaltenango, the Rufous-browed Wren was fairly abundant in the forests of pines mixed with oaks, alders, and many other kinds of broad-leaved trees which occupied the slopes between 8000 and 9000 feet, and it was perhaps equally numerous in the heavy stands of huge, moss-burdened cypress trees from 9000 feet to the summit of the range at about 10,000 feet. Higher still, I saw it on the Sierra Cuchumatanes in the Department of Huehuetenango, where it was of course absent from the extensive open meadows of grasses and



Fig. 25. Rufous-browed Wren.

flowering herbs which occupied so much of the high plateau, as well as from the rocky ridges which bore an open stand of pines. But it was present up to about 11,000 feet in the more sheltered ravines and glens, where there was a bushy undergrowth beneath the pines and alders, and in the dense stands of low junipers.

In my experience, the Rufous-browed Wrens forage more in the dense undergrowth of the woodland and less among the epiphytes high in the trees than do the Ochraceous Wrens of the wetter Costa Rican forests, and their preference for tangled, low vegetation makes them difficult to see. They often creep beneath fallen logs and explore the depths of brush piles, more like chipmunks than birds. But they also hunt in the massed epiphytes on the trees, and they are even more expert in climbing over upright trunks than is the Brown Creeper which dwells in the same woodlands, for they can hang equally well with head up, down or sideward. I gathered abundant evidence, both from their answering calls and from the occasional discovery of two individuals sleeping together, that they live in pairs throughout the year.

VOICE

The call of the Rufous-browed Wren is loud and nasal. I heard its song, which is delivered by both sexes, from early January until November. It is seldom heard, however, in the last months of the year. The song of the Rufous-browed Wren, like that of

its southern relatives the Ochraceous and the Equatorial wrens, is usually a disappointing performance, which fails to convey the impression of abounding vitality and blitheness which emanates in fullest measure from the Southern House Wren. Since in Guatemala the Southern House Wren's range extends far up into that of the Rufous-browed Wren, I sometimes have heard the two species almost simultaneously and I have always been impressed by the contrast between them. The rapid outpouring of the house wren seemed so light-hearted and carefree, whereas the slow, halting notes of the Rufous-browed Wren often gave a feeling of oppression and sorrow. As I listened to the Rufous-browed Wren, I sometimes imagined that I was hearing a gifted singer whose once fine voice had broken with age. Yet sometimes this highland wren sang a more animated strain. One evening, as I tried to follow a pair to their roost, I heard them singing, and one, beginning with the usual slow drawl, worked up to a cheerful trill which much resembled that of the Southern House Wren.

NESTING

Just as the Rufous-browed Wren forages on the whole nearer the ground than the related Ochraceous Wren, so, too, it selects lower sites for its nests. I found three nests during my year on the Sierra de Tecpán, the first in April and the last in June, and all were in the mixed broad-leaved woods at about 8500 feet elevation. The first of these nests was so excellently concealed that I should not have found it had I not happened to set my blind close beside it in order to watch a neighboring nest of the Mexican Trogon. While I was engaged in placing the brown tent close in front of their nest, the wrens kept discreetly away, raising no protest, but later, while I sat quietly within the blind studying the trogons through a long day, the wrens revealed their nest and I learned a little of their customs. My blind was situated beneath a great old oak tree whose spreading boughs, far above my head, bore a luxuriant aerial garden of orchids, bromeliads, and other epiphytes. One side of the massive trunk had been hollowed out by fire and decay, and in a narrow cranny opening upon the hollow, only two and a half feet above the ground, the wrens had hidden their nest. By looking through the side window of the blind, I could see something of their home life without interrupting my study of the trogons. On leaving her eggs the female wren would climb up the length of the hollow, which extended far up the trunk, and often after emerging from its upper end she would continue to creep up the bark. Thus she finally took wing from a point so far above the nest that her sudden movement was not likely to reveal its situation. Often the male brought offerings of insects and larvae to his mate while she sat in the cranny. Once, while she was clinging to the opposite wall of the hollow, ready to fly across it to her nest, the male clung above her and gave her a green caterpillar, which she accepted with a sweet little warble; she swallowed it and then went back to her eggs. This is the only nest at which I have seen a male wren, of any species, give food to his mate before the pair began to feed nestlings.

Since that day was dedicated wholly to the trogons, I had to wait until the following day, April 20, to learn what was within the cranny into which I had so often seen the wrens disappear. I found the fissure through which they entered so narrow that I could not reach the nest without paring away a little of the surrounding wood with my knife. The nest was a well made cup, composed principally of pine needles but with many small, dry, papery leaves, chiefly those of a grass which resembled *Zeugites*, mixed with them. It was lined with downy feathers, and it held three eggs, which were white, speckled all over with pale cinnamon-brown; the pigmentation was especially heavy in a wreath around the thicker end. The eggs measured 18.3 by 13.5, 17.9 by 13.5, and 17.9 by 13.5 millimeters. When I returned to the nest on April 25, there were three nestlings, but on



Fig. 26. Moss-draped trunks in secondary forest near the summit of the Sierra de Tecpán, Guatemala, at 10,000 feet, home of the Rufous-browed Wren.

my next visit, a week later, I found one of the young wrens lying dead on the ground, while the other two had vanished. I then removed the nest for closer examination and learned that the cavity behind it had been stuffed by the wrens with a great quantity of green moss, evidently to reduce the space and make the structure fit more snugly.

The second nest was no less well concealed than the first. On May 23, as I walked along a roadway through the woods of pine and oak, I met a small Indian boy who spontaneously handed to me two well-feathered young Rufous-browed Wrens. Then his older companion gave me another. When I requested them to show me where they had found these nestlings, they led me to a point where the bank above the road was strongly undercut, leaving at the top an eave-like projection of root-bound soil that stood out at least two feet beyond the earthen wall beneath it. I had passed this bank almost daily, and on some days several times, without suspecting the presence of a nest, but the boys had happened to go by just as one of the parent wrens flew in or, more probably, out. The structure, which I found lying on the road, was a shallow cup composed of grass blades, pine needles and slender stems, and it was well lined with feathers. With some difficulty I fastened the nest in what appeared to be its original position, and then I placed the young birds in it, for they could still scarcely fly. The following night, and again before daybreak on May 25, I found a parent brooding them. But

later in the day the nest was again pulled from the bank and destroyed, although, as I afterward learned, the fledglings were unharmed.

The third nest, which I found on June 18, was 32 inches above the ground in a slender, rotting stub standing in heavy mixed forest. The cavity was just large enough to accommodate the nest, and the opening which led to it, $1\frac{1}{4}$ inches in diameter, was so narrow that I could not reach the three eggs for measurement. All these eggs hatched on June 26, but by July 7 the three nestlings, still unfeathered, lay dead in their nest. I could detect no external lesions and believe that they died of malnutrition or exposure, or of the two in combination. The rainy season had begun in mid-May, and for a number of weeks long-continued cold rains had drenched these mountains almost daily, making it difficult for parent birds to find adequate nourishment for their nestlings. In several other nests, including those of a Chestnut-capped Brush-finch and a Russet Nightingale-Thrush, I found dead nestlings which appeared to have succumbed from the same cause, whereas other late nesters succeeded in rearing only part of their brood.

SLEEPING

I found the Rufous-browed Wrens sleeping in situations even more diverse than those in which they placed their nests. One evening toward the end of February, as the chill, which swiftly follows the sun's setting, fell upon a bushy clearing in the cypress forest near the mountain top, I heard a pair of Rufous-browed Wrens in the undergrowth join in their slow, deliberate song. Presently I saw a small, obscure bird work its way from branch to branch up the great trunk of a tall cypress tree, until, at a point about sixty feet up, its dim form was lost to view in the moss-enswathed boughs. Since colors could no longer be distinguished in the twilight, only the bird's size and mode of progression convinced me that it was a wren. I could not tell whether it went to roost in a special nest, or to a snug pocket in one of the great cushions of moss that burdened the tree, or whether it crawled into a cranny in the trunk itself. The night turned very cold; at dawn heavy frost whitened the roadway and other bare ground in the clearings. Hence it was understandable why small birds, at an altitude of nearly 10,000 feet, should seek snug lodgings.

A month later, when I again watched this great tree as dusk descended, I heard the same slow song issuing from the dense vegetation beneath it. Then I watched the small, dark figure ascend toilfully into the branches far above me until it vanished. Presently a second wren followed upward in the same manner. When it reached the point where the first had passed from view, the two came flying sharply downward, one evidently chasing the other. Then, after a further interval, a single dark figure worked upward again in the gathering gloom. I inferred from this shadow-show that the female wren had her habitual lodging high up in the cypress tree and that her mate had followed her, hoping to share her snug retreat, but was repulsed and driven downward. The female had then returned alone to her nook.

Meanwhile, on March 13, I had discovered a single Rufous-browed Wren sleeping alone in a little niche or short tunnel, about eight inches deep, in a cut bank beside a road at an altitude of about 9000 feet. Four Southern House Wrens occupied as many similar holes along the same stretch of roadway, and in another hole in this same bank the flashlight revealed a great, hairy bird spider that seemed larger than the wrens. As already related, the nest beneath the overhang at the top of the roadside bank was carried off by somebody on May 25, when the nestlings it contained were barely able to fly. The following night I found all three of the young sleeping high up on the sloping bank beneath the sheltering overhang. They were near the site of their vanished nest,

to which they evidently had tried to return, doubtless under parental guidance. Each young wren rested on a little shelf with its head inward toward the bank, just as adult Rufous-browed and Southern House wrens sleep in more secure niches. But the following night they were absent, probably having been led by their parents to a more secluded lodging.

Eight days later I discovered where these wrens slept. I found them in a niche in a neighboring part of the bank, well concealed by the vegetation which draped down in front of it from the top of the bank. The three young slumbered with an adult, doubtless the female parent. All rested with heads inward and tails toward the opening, three of them pressed closely side by side while the fourth was crowded into the end of the short tunnel. I stood admiring them in the glow of the flashlight a little too long, for the female finally awoke and flew out, fluttering directly against me. Her movement aroused the fledglings and all three took flight. I caught one, held it for a minute, and then I released it to join its companions in the thicket across the road. Since dawn was almost at hand, they suffered no harm. The following night a single young bird occupied this niche, and after that it was deserted. But, at the end of June, I found two of these wrens sleeping together in a neighboring niche. On July 29 I found a single bird sleeping in the little tunnel where the four had slept. Then, after a long interval in which I lost track of these wrens, I discovered two of them on November 18 slumbering side by side in this same tunnel in the bank. It was now no longer possible to distinguish old from young, but I surmised that these two birds were a mated pair.

My confidence that I was correct in calling these two wrens a mated pair was strengthened by another discovery that I made two evenings later. As the day waned I watched a nest of the Banded-backed Wren, situated about twenty feet up in a pine tree. In the failing light a Rufous-browed Wren, hidden among the herbage beneath the pines, called innumerable times in a loud, nasal voice, continuing even after it was answered by its mate which was foraging some distance away. At last both birds became quiet, and I waited several minutes more before two small birds flew silently up from the ground vegetation and entered the Banded-backed Wrens' nest, which was still fairly sound. In order to make quite certain of their identity, I threw a stick lightly against the supporting branch and they darted out, protesting loudly in the peculiar nasal tones which alone identified them in the dim light. After I hid behind some bushes, they returned to their borrowed dormitory. That same night I again found the other pair of Rufous-browed Wrens sleeping in the roadside bank not far away. Yet in March I had seen a wren, which I supposed to be a female, repulse her mate when he tried to join her in her unseen lodging high up in the cypress tree. Probably in November, when reproductive urges are at their lowest ebb, mated individuals sleep together like young Rufous-browed Wrens, whereas in March, as the nesting season approaches, the female insists on passing the night alone. I assume from my studies of the congeneric Southern House Wren that she will do so in her breeding nest.

SUMMARY

The Rufous-browed Wren inhabits Temperate Zone woodlands in the highlands of Guatemala and neighboring countries, chiefly from 7000 to 11,000 feet above sea level. It forages mainly in low, dense vegetation, in brush piles, and beneath fallen logs, but it also hunts among the epiphytes on trees and it is expert in creeping over upright trunks in any direction. It lives in pairs throughout the year.

Its call is loud and nasal. Its song, usually slow and halting, only rarely becomes animated and conveys an impression of cheerfulness. It is heard at all seasons, but in the last months of the year there is a marked decrease in song.

Three nests were found at an altitude of about 8500 feet in mixed woodland of pine and oak in the Guatemalan mountains, in April, May, and June. They were open cups composed of pine needles, grass leaves, and slender stalks, and they were lined with feathers. Two were in cavities in trunks near the ground, while the third was beneath an overhang at the top of a cut bank. Each contained either three white eggs speckled with cinnamon or three nestlings. In one pair, the male repeatedly fed his mate during incubation. In the latest nest, the nestlings died in July, apparently as a result of the cold, rainy weather.

These wrens slept in niches in banks, in an old nest of the Banded-backed Wren, or high up in a great cypress tree where the actual lodging could not be discovered. In March they slept singly, and a supposed female repulsed her mate when he tried to join her in the evening. In June, three fledglings, which earlier had tried to return to their nest, slept in a niche in a bank with a parent; but the family soon dispersed. In November, two individuals, apparently a mated pair, were found lodging together in two instances.

OCHRACEOUS WREN

Troglodytes ochraceus

The genus *Troglodytes* contains not only enterprising, adaptable species which have colonized major areas of the earth's surface and learned to live in close association with man, like the Winter Wren and the Northern and Southern House wrens, but also retiring, inconspicuous species which are confined to mountain forests and limited in range. Among the latter is the Ochraceous Wren, which Ridgway called the Irazú Wren. Males and females are alike in coloration. They are brownish birds about four inches in length. The upper parts are tawny-brown, inclining to russet on the crown. This is bordered on each side by a prominent superciliary stripe of ochraceous-buff, which in turn is margined below by a broad tawny-brown postocular streak that expands on the ear coverts. The wings and tail are prominently barred with dusky. The cheeks, chin, and throat are ochraceous-buff, which pales to buffy-white on the abdomen. The bill is blackish.

The Ochraceous Wren is confined to the humid mountain forests of Costa Rica and western Panamá where it resides chiefly between 4000 and 8000 feet above sea level, although it has been recorded as low as 2000 feet (Carriker, 1910:766). In 1937 and 1938, I found it abundant, between 4700 and 5500 feet, in the tall, epiphyte-laden forests on the northern slopes of the Cordillera Central of Costa Rica. Although primarily an inhabitant of the woodland, it not infrequently ventured forth into adjoining pastures where there were scattered large trees and many stumps laden with moss, ferns, orchids, and a variety of other epiphytes. It foraged chiefly on mossy trunks and branches, up which it climbed with ease, even when they were vertical, and sought small invertebrates among the matted roots and clustered stems of the air plants which burdened them. At times it was seen hunting in the midst of tangled vines. Because of their retiring habits, I am not sure that the Ochraceous Wrens remain mated throughout the year as do most of the tropical wrens.

The song is heard chiefly from early March to late June, and I had long been familiar with this wren's notes before I succeeded in tracing them to their source. But one morning in March I watched one of these wrens creeping up a mossy trunk in a pasture and voicing a low, weak, dragging *churr*. This long-drawn, plaintive, churring call was followed by a modest little song, rising and falling in a quiet way, which was pleasant to hear. It conveyed no suggestion, however, of the overflowing joyousness which seems to inspire the music of the Southern House Wren, which also was to be found in clearings in these humid forests.

NESTING

Nesting began in April, 1938, if not earlier; for on May 7 I found a pair of these wrens carrying food into an inaccessible nest, whence issued the cries of nestlings. On May 10 I found another pair feeding nestlings, and on May 23 I watched a pair building. The sites chosen for these three nests were unlike those of any other bird I know. In the epiphyte-laden mountain forests, the ends of decaying branches sometimes break off but are prevented from falling by stout aerial roots which bind them to sounder portions of the tree. The segment of the dead branch then swings free in the air at the end of one or more rope-like roots, the length of which may vary from a few inches to more than a yard. This detached length of branch often bears a luxuriant growth of

epiphytes, including various flowering shrubs and herbs, ferns and much moss, and it might be compared to a basket hung high in a tree. At times the pendent mass is composed largely of the blackish, matted roots and rootlets of epiphytes which have died, together with the humus which has accumulated among them. All three of the nests that I found at Vara Blanca were among such masses of aerial vegetation; these latter were suspended from a tall tree by one or a few stout roots and were swinging free in the air from 40 to 50 feet above the ground. In one case the wrens were nesting in a



Fig. 27. Ochraceous Wren.

cavity in a blackish mass of fibrous roots and humus, but the other two nests were supported by segments of dead branches covered with living epiphytes. Of these last two nests, one was in a cavity in the branch itself, the other was in a niche among the mosses and roots of epiphytes which mantled the hanging segment. Two of the nests were in forest trees which had been allowed to remain standing in new clearings, while the third nest was at the edge of the forest. Other birds of epiphyte-burdened forests, including the Golden-bellied Flycatcher in Costa Rica and the White-eyed Starling in the Solomon Islands (Cain and Galbraith, 1956:281), place their nests in nooks and tunnels amid the massed air plants, but only the Ochraceous Wren, as far as I know, builds in a dangling mass of epiphytes. Its nest site reminds one somewhat of that of the Parula and Pitiayumi warblers, which often build among *Tillandsia usneoides*, cacti, or other aerial

vegetation hanging below the limb of a tree. The wren's nest, however, is far more effectively isolated from the tree itself.

At the nest which was under construction on May 23, the female wren did most of the work, bringing fibrous materials, fragments of dead leaves, and an occasional twig or feather. At times her mate brought a small contribution, but mostly he sang and followed her while she gathered materials. I did not succeed in learning the form of this or the other nests, as none conveniently fell after the birds no longer needed them.

I discovered the other two nests by watching the parents carry in food for their nestlings. At the higher of these nests, the parents were in the habit of flying up to a part of the tall trunk that was well below the hanging structure; from there they worked their way up the epiphyte-laden bole until they were level with the pendent mass in which their young were concealed, and then they flew across to the nest. Southern House Wrens at times lodge in a high woodpecker's hole. They reach their dormitory by working their way up the trunk in a number of hops and short vertical flights, much as the Ochraceous Wrens ascend to their swinging nests.

The fledgling Ochraceous Wrens left this high nest toward the end of May, but for several weeks the exceedingly wet weather prevented my watching in the evening to see whether they would return to it. On June 14, however, I was present as the day ended. Soon after six o'clock two wrens, uttering incessantly their slow, plaintive *churr*, made their way gradually up the tall trunk and then flew across to the dangling segment of branch and entered the cavity at its lower end which contained the nest. About twenty minutes later, a third wren joined them, and all three stayed for the night. Because of the height and distance, I could not distinguish old from young, but probably the first two were young birds and the last to enter was the female parent. This dangling nest used for sleeping swayed like a pendulum in every slightest breeze.

At the nest which the wrens were building on May 23, they fed nestlings from June 25 or somewhat earlier until at least July 6. By the morning of July 9, the nest was empty, and that same evening I watched the parents lead a single fledgling back to sleep in it. The mist which shrouded the mountain made observation difficult, but as far as I could see only one young bird entered. After putting it to bed, the parents went elsewhere for the night. Three evenings later none of the family came near this nest.

SUPPLEMENTARY OBSERVATIONS ON THE EQUATORIAL WREN

The Ochraceous Wren, first given specific status by Ridgway, has been classified by various authors as a race of the Equatorial Wren, *Troglodytes solstitialis*, of the Andes. This latter is a bird of similar appearance, but it has darker, more olive-brown dorsal plumage and slightly barred flanks. In view of the close affinity of these two forms, it may be of interest to record here the little I learned about the habits of the Equatorial Wren on my visit to Ecuador in 1939. I saw it on the wet eastern slopes of the Andes at altitudes ranging from about 4000 to 8500 feet above sea level. Its song was weak and plaintive, reminding me much of that of the Ochraceous Wren which I had heard not long before. On October 7, I found, at an altitude of about 8500 feet on a spur of the Volcán Tungurahua above Baños, a nest which was situated on a precipitous slope planted with cabbages and Windsor beans, at the edge of a tremendous gorge. When the little vegetable patch was cleared, weeds, sticks, and leaves were thrown over a crotch of a small leaning tree so that they would not litter the field. In the midst of this mass of dry brush, the wrens had built their nest about seven feet above the ground. The bulky structure was composed chiefly of fibrous rootlets and was lined with narrow, dry leaves

of a bamboo. The entrance was in the side, but the nest itself was not roofed, for it was sufficiently covered above by the trash among which it was placed. It contained two nestlings, already well feathered. The parents were not shy and fed their family while I watched on the slope not far above them. Sometimes they entered the brush pile on one side and left on the other.

On October 17, I discovered a second nest of the Equatorial Wren, situated in a natural cavity 30 feet up in the trunk of a slender tree standing in a new clearing in the forest in the Pastaza Valley, at an altitude of about 4200 feet. Here, too, the wrens were feeding nestlings.

Thus, although in appearance and voice the Equatorial Wren of Ecuador rather closely resembles the Ochraceous Wren of Costa Rica, these two birds choose quite different sites for their nests. In the case of races separated by a wide gap in which no closely related forms occur (*T. solstitialis* and *T. ochraceus* are separated by the low country of central and eastern Panamá), it is impossible to employ the one irrefutable criterion of specific sameness—intergradation where the two races come into contact. In the absence of such interbreeding, we cannot be sure that two races belong to the same species, even though they resemble each other, for it is well known that in many instances birds confusingly similar in appearance are specifically distinct. All that we can do is to speculate whether they would or would not interbreed if they should come into contact. The more that we know about these forms of somewhat similar aspect but widely separated ranges, not merely as museum skins but as living organisms, the more ground we have for speculating as to whether they would or would not behave as distinct species if they should happen to come together. In our present dense ignorance of the details of the lives of most tropical birds, to lump together forms with a wide geographical separation merely because of a superficial resemblance is taxonomic dogmatism, which is as unbecoming a form of human fallibility as any other form of dogmatism.

SUMMARY

The Ochraceous Wren inhabits heavy, humid mountain forests of Costa Rica and western Panamá, chiefly from 4000 to 8000 feet above sea level. It hunts its food on mossy trunks and branches and among the epiphytes which encumber them, climbing with ease even up vertical surfaces.

Its call is a low, weak, drawled *churr*, and its simple song lacks the ebullience of the music of many other wrens.

Three nests, found at about 5500 feet above sea level in the Costa Rican mountains, indicated a breeding season extending at least from April to July. These nests were built among masses of epiphytic vegetation which had broken away from tall trees and swung free in the air from one or more stout roots, at heights of 40 to 50 feet above the ground. At one nest the female built while the male followed her, sang, and from time to time helped a little.

Three birds, probably two juveniles and a parent, slept in a swinging nest from which the young had departed several weeks earlier. A single fledgling was led back to sleep in another nest which it had just left, but its parents roosted elsewhere. Three nights later this nest was deserted.

In voice the Equatorial Wren of Ecuador resembles the Ochraceous Wren, but two nests of the former were in situations quite distinct from those chosen by the latter. One was in a pile of brush in the low crotch of a tree, the other was in a natural cavity in a trunk. We need to know more about the habits of these two forms before we can decide whether they should be classified in the same or in different species.

SONG WREN

Leucolepis phaeocephalus

The Song Wren is clad wholly in shades of brown which blend into the shadows of the woodland floor where it dwells. This wren is about five inches in length. It lacks the prominent head markings of so many of the Central American wrens, and its upper plumage is nearly everywhere a rich sepia-brown. The wing and tail feathers are somewhat lighter brown, narrowly barred with black. The cheeks, auricular region, throat and upper breast are bright reddish chestnut. The sides of the neck and the breast are brown of a shade lighter than the upper parts, but the flanks are darker and the center of the breast and abdomen are brownish gray. The under tail-coverts are deep russet-brown. The eyes are brown, the strong bill is largely black, and the legs are dark. The sexes are similar in appearance, but sometimes the upper plumage of the female is lighter than that of the male.

This wren, which differs so strongly from any other Central American representative of the family, is confined to the Caribbean lowlands and foothills where it ranges up to about 2500 feet above sea level. It is found from Honduras to western Panamá, but in central Panamá it crosses the low continental divide to the Pacific side. Thence it extends southward into Colombia and Ecuador. It dwells in the undergrowth of the heavy forest and in the taller and denser secondary woodland. I believe that I can best convey to the reader something of its peculiar charm by departing from the usual form of these life histories and tracing the growth of my acquaintance with it more or less as it is recorded in my notes and journals. Perhaps the biographer of birds should be grateful that he does not have for every species such a mass of information that only by generalizing can he reduce it to a manageable form.

DISCOVERY OF THE NEST IN COSTA RICA

As with a number of other elusive birds of the woodland, I first became aware of the Song Wren through the discovery of its nests. The first of these was found on February 7, 1934, in the densely tangled understory of second-growth woods on a steep slope far above the Pejivalle River in Costa Rica, at an altitude of about 2500 feet above sea level. It was situated eight feet above the ground in the trifurcation of a young sapling. The structure had the form of a retort, or of a bent human elbow, with a rather wide, tubular entrance or antechamber on one side of the bend and a well-enclosed nest chamber on the other. Its total length was 10 inches, its height was 6 inches, and its width from side to side was 5 inches. Resting on a foundation of coarse pieces of vine draped across the crotch, it was constructed, rather bulkily, chiefly of rather coarse fibrous roots, with an admixture of leaf skeletons and lengths of vine reduced by decay to their fibrous constituents. The bottom of the chamber was lined almost exclusively with the lacy skeletons of leaves and a few other leaves less thoroughly decayed, which formed a very thick layer. This nest already held two newly hatched nestlings.

The parent birds did not come in sight while I examined and made notes on the nest, so that in order to identify them I was obliged to watch from a blind, set in the thick undergrowth, from 6:45 to 9:49 on the following morning. In this period of slightly over three hours, the nest was entered only four times by the parent or parents, presumably with food. They approached through the underbrush, hidden from view, then darted so rapidly into the nest that I could not see them well. After feeding, and some-

times brooding for from three to eighteen minutes, the parent shot out and away, again giving me only a fleeting glimpse of itself. If I revealed myself or touched the nest, the parents stayed out of sight and made no protest. Hence, despite my long vigil, I had only one really good look at one of these wrens, and that was but momentary.

On February 19, before the nestlings were old enough to fly, I found the nest empty. In the roof above the chamber, there was a round hole, such as I have found in similar circumstances in many other enclosed nests in the forest, which had apparently been made by the marauder that took the nestlings.



Fig. 28. Song Wren.

In the surrounding woodland, I encountered a number of other nests of similar form, but all were empty except the one that I found on February 26. This closely resembled the first nest in site, construction, and the type of vegetation among which it was situated; it was, however, only three feet above the ground. It contained two eggs which were white, with brown speckles forming a wreath about the thick end. Although I could view the eggs by inserting a small mirror, it seemed impossible to remove them for measurement without damaging the nest. On two occasions I waited half an hour for a glimpse of the owners of this nest, but they never came within sight. Thus the identification of this structure rests upon its resemblance to the first nest, which contained nestlings.

The only other occupied nest of this species of *Leucolepis* which has come to my attention is that found by Jewel (Stone, 1918) in low, wet forest in the Canal Zone on May 7, 1911. It was situated two feet above the ground and "consisted of a long tube or tunnel with the nest proper at the far end." It was composed of sticks, twigs, and

dead leaves, and it was lined with grasses. It contained two eggs, of which one was almost without spots on its white surface.

SOCIAL HABITS, VOICE, AND SLEEPING

Although I failed to find an occupied breeding nest during my sojourn on Barro Colorado Island from early February to June, 1935, I became far more familiar with the Song Wrens themselves than I had in Costa Rica where I found them nesting. My first intimate encounter with them occurred in the middle of the afternoon on February 20, when I met a family of four or five in open woods near the main building. They were part of a loose mixed flock of small birds which included a Spotted Antbird, some White-flanked Antwrens, two White-whiskered Soft-wings, and a woodhewer. When they saw me, the Song Wrens withdrew in the opposite direction, always keeping on or near the ground. They continually uttered a low, full throaty *chuck*, which, coming from the whole family at once, reminded me of the croakings of green frogs (*Rana clamitans*) in a marsh. When I glimpsed one through the scattered ferns and sparse herbage of the lowest layer of the forest vegetation, it bobbed up and down on its feet before taking flight. As long as I followed, four of them remained together. They circled around through the woodland instead of travelling in a straight course, and before long they came to an unusual natural bird bath with which they were doubtless already familiar. A small tree had been cut or broken off about three feet above the ground, and from the top of the stump two vigorous upright sprouts had sprung and thickened into sturdy branches. Between these branches, the interior of the stump had decayed away, leaving a hollow in which rain water had collected and formed a little pool. It was this clear water which the wrens used for their bath, in preference to the rock pools in the narrow rill just down the slope from this tree. All four of the wrens crowded into the narrow basin at once, and they formed a delightful picture. It was the clearest view of these elusive birds that I had succeeded in obtaining.

After I found this group of wrens, I tried to discover where they slept, but I was unsuccessful until March 6. In the evening of this day, I came upon four wrens which I was fairly certain were the same ones I had watched bathe earlier, for they were only a few hundred feet from the scene of that memorable encounter and the species was far from abundant in this woodland. They were then foraging among the tangled vines in an opening in the forest made by the fall of a great tree. Soon they began to move away, continually uttering the throaty clucks which first betrayed their presence among the vines, and which guided me as I strove to follow them through the underwood in the failing light. They were not as shy as I had found them in full daylight, and if one happened to see me it bowed deeply many times, always clucking to its fellows; at length it dived again into the concealing foliage. They remained very near the ground, travelling one behind another rather than in a compact flock. As it grew darker, they gave the most curious song that I have ever heard from any wren. It was delivered so rapidly that it was impossible to paraphrase it syllable by syllable, but its effect may be reproduced if one reads as fast as he can the following line: *pic a puc a puc a puc a pic a puc a puc*. The notes which composed this refrain were all full and throaty, except the last, or sometimes the last two, which were clear and whistled in startling contrast to all the others.

Thus singing, or croaking, the wrens made their way down the hillside to a small stream, beside which, six feet up in the crotch of a slender sapling, was one of their elbow-shaped nests which I had first noticed many days earlier. I believe that they would have gone directly into it, but the light had by now grown so dim that I could scarcely distinguish their brown bodies from the brown dead leaves of the forest floor,

and in my eagerness to see I approached too near. They fled up the steep forested slope on the other side of the stream. I followed but soon lost them, for it was hard for me to move through the tangled undergrowth. When I returned to the nest the wrens were not in sight, and I could not tell whether they had entered or not. Accordingly I gently shook the sapling, whereupon several dusky figures darted out and began to croak in the inimitable fashion of the Song Wren. I at once retreated up the slope and stood partially concealed by the foliage. It was impossible to distinguish the wrens



Fig. 29. Dormitory nest of the Song Wren in the undergrowth of the forest on Barro Colorado Island, Canal Zone, March, 1935. The entrance is on the right.

in the dusk, but I was delighted to see the slender sapling shake repeatedly as each in turn went back into the nest. I was not certain just how many sleepers it finally contained.

At the end of that same night, I stationed myself on some rocks at the side of the rill near the nest. The forest was still dripping from the showers which had fallen after midnight, and clouds veiled the sky. With the first lightening of the sky the Great Rufous Motmots began to hoot in the treetops, and soon the woods resounded with the varied voices of many birds. At 6:27 a.m. the first wren shot out of the nest; it was followed within the next three minutes by four more wrens. As the family gathered among the undergrowth before proceeding on their wanderings in quest of food, they began the throaty cluckings which seem inseparable from their sociable existence. But

soon clear whistles began to intrude among their guttural notes, and presently I heard, issuing from the obscurity which still prevailed in the depths of the forest, a whole song composed of low, clear, distinct staccato whistles, conjoined into a beautiful and moving melody. And as I listened delightedly, I understood at last why these clucking birds should be called Song or Musician Wrens.

The nest in which these wrens slept was similar to those in which I had found the species breeding in the Costa Rican mountains a year earlier. I discovered four such nests, still in fairly good condition. These were scattered through the area of the woods where this family roamed, and in addition there were some old, decaying structures of the same kind. All were in slender saplings, six to nine feet above the ground. Apparently Song Wrens provide themselves with a number of lodgings, placed at various points within their territory, and change their sleeping quarters from time to time, just as do Banded-backed Wrens. I had first noted the particular nest in which the family now lodged about a month earlier. Some time after this, I found a small round hole, made in the wall at the back; this was similar to the perforation that I had found in my first Costa Rican nest after the nestlings had vanished from it. This opening had been closed off by the wrens before I found them sleeping in this nest.

At daybreak on March 11, I again watched this group of wrens begin their day. One by one, the five birds left the dormitory beside the woodland stream between 6:22 and 6:25 a.m. They rejoined each other in the undergrowth on the other side of the rivulet and again sang sweetly as they had on the previous morning. But when I watched in the evening of March 21, they did not come near this dormitory. Although I failed to discover where they were lodging, a fortnight later I again met what I took to be this same family, now apparently reduced to four members, not far from their deserted dormitory. These four wrens, together with two Spotted Antbirds, had gathered around a swarm of small black ants and were snatching up the insects and spiders which the ants drove from their places of concealment beneath fallen leaves. The two kinds of birds foraged in much the same manner, except that the wrens usually rested on perches nearer the ground than did the antbirds while they watched for some small creature to be driven out of the litter by the ants. Although the antbirds were content to rely solely upon the ants to discover their food for them, the more enterprising wrens foraged for themselves under the fallen leaves. Instead of flicking the leaves aside, as do many species of terrestrial birds, they merely pushed their bills under the edges of the dead leaves, raised them just high enough to look beneath, then dropped them almost in their original position if they discovered nothing of interest there. The four Song Wrens displayed their strong mutual attachment by foraging quite close to each other.

Meanwhile I had met another family of Song Wrens in a rocky area in another part of the forest on Barro Colorado. Far from shy, one or two of them flew up into a nest with pieces of dead leaf while I watched. This structure, which was situated about six feet above the ground in a slender young tree, was of the usual type and appeared to be completed, although the wrens were carrying more material into it. I sat on a nearby rock, partly screened by foliage, hoping to see them take more leaves into the nest; for I wished to learn how many individuals shared the work of building and maintaining these structures. But the wrens perversely drifted off through the undergrowth, voicing their usual throaty chorus. In the neighborhood of this nest, as was true of the other occupied dormitory, I found a number of other nests. Some of these were in good repair; others were in various stages of decay. At 6:20 on the evening of March 20, I watched four wrens retire into the structure into which I had seen some of them carry leaves.

A month later, I met this family of wrens about fifteen or twenty feet above the

ground in a dense tangle of vines, where they were calling in great excitement. The cause of this commotion was a large brown owl that was resting quietly in the thickest part of the tangle, where I could scarcely see it. I had never before found Song Wrens so far above the ground, and apparently it had required an exciting discovery to make them ascend so high.

The circumstances in which I had heard the mingled clear and guttural notes at daybreak on March 7 and 11 were such that I could not learn from how many throats they issued. The observations of Chapman (1929:266–269) on Barro Colorado Island make it seem probable that while the male delivers beautiful clear whistles the female accompanies him with less musical notes. On December 26, 1926, he heard “two full-throated whistles, so loud, so clear, so perfectly spaced that I thought at first someone was calling. . . . In singing, the bird seemed to stand on tip-toe, with neck stretched up to the utmost, like that of a crowing cock. . . . Two days later I heard the species again. On this occasion he added to the long-drawn couplets a phrase of four notes of the same rich, vibrant quality. There was no suggestion of the yodeling of the Carolina Wren and some of its allies. The following day, while one bird, probably the female, uttered continuously a chuckling *cúttá, cúttá, cúttá*, the male sang a winding whistle of seven or eight notes, the first low and throaty but full-toned and musical, with a vibrant, harp-like quality and rising to a clear, sweet pipe.”

Harrower (MS), who found the Song Wren in pairs in the thick undergrowth of second-growth woods near Gatún in the Canal Zone, was also deeply impressed by its unique musical performances and believed that its singing was antiphonal, although the density of the vegetation prevented his proving this point and learning how the sweet and the guttural notes were distributed between the supposed duettists. Carriker (1910:753) appraised this wren's song as he heard it in the Caribbean lowlands of Costa Rica, as “very fine, almost rivalling that of *Henicorhina protheleuca* in its clearness and sweetness.” Although many other wrens have voices that equal and possibly surpass that of the Song Wren in power and mellowness, no other wren that I have heard gives a performance so startlingly unexpected as does this wren with its melodious whistles set against a background of guttural croaks. The Song Wren is a musician who strives for bizarre effects.

The Central American Song Wren has not won the fame, among natives of its homeland or among foreigners, of the related Organ Bird or Quadrille Wren (*Leucolepis arada*) of the Guianas and the northern part of the Amazonian basin. This remarkable bird has been praised by many naturalists and travellers as being one of the most excellent of all feathered songsters. A few of these encomiums are quoted at length by Armstrong (1955:82–83). Whether the elusive Song Wren lacks renown because no appreciative writer has heard it at its best, or because its music is intrinsically inferior to that of its relative of the South American forests, is a question on which we must refrain from passing judgment until we have more observations.

SUMMARY

The Song Wren lives in the undergrowth of humid primary forest and second-growth woodland from Honduras to Ecuador. On the Caribbean side of Costa Rica, it ranges from the coastal plain to at least 2500 feet above sea level in the foothills. In the early part of the year, these wrens were found in the Canal Zone in close-knit family groups consisting of four or five individuals. They bathed in rain water that collected in hollow trunks, and once they ascended to the unusual height of 20 feet to scold an owl.

Song Wrens seek insects and spiders on or near the ground, sometimes in company

with other small birds. They peer beneath fallen leaves, lifting them up by inserting their bills under the edges. At times they depend on swarming ants to drive their invertebrate prey from concealment.

As they wander through the forest, they keep up a constant chatter of guttural, clucking notes, which remind one of the croaking of frogs. The song, which consists of clear, loud, well-spaced whistles, is usually heard against a background of similar throaty notes that contrast strongly with it. Apparently the female utters these clucking sounds while her mate whistles, but more observations on this point are needed.

The nest, which has the form of a bent tube closed at one end and open at the other, is hung in the crotch of a slender, erect sapling in the undergrowth of the woodland at heights ranging from about 2 to 8 feet. In February, one nest was found with two nestlings and another with two eggs at about 2500 feet above sea level in Costa Rica, while another nest with two eggs was reported from the Canal Zone in May. This wren is exceedingly shy and difficult to observe at its nest.

The four or five individuals which keep close company by day retire at nightfall into a dormitory which has the same form as the breeding nest and is situated about 6 feet up in a sapling. In the vicinity of each occupied dormitory, as was true of each occupied breeding nest, one finds a number of similar structures. Some of these are in good repair; others may be in various stages of decay.

RUFOUS-NAPED WREN

Campylorhynchus rufinucha

Like others of this genus, the Rufous-naped Wren is among the largest of the representatives of its family, a member of the so-called cactus wren group. It measures nearly seven inches in length. Its black forehead and crown are bordered on each side by a broad, whitish superciliary stripe, and this in turn is margined below by a black line that extends from the base of the bill around the eyes to the back of the head. The hindneck, back, and rump are cinnamon-rufous, rather inconspicuously marked with blackish spots and whitish streaks on the back and rump. The graduated tail is largely black, with the long central feathers barred with gray and the shorter lateral ones prominently tipped with white. The blackish wings are broadly barred with cinnamon and buff. The sides of the head below the black loreal and postocular stripes and all of the under plumage are pale buff or nearly white, with deeper buff on the flanks and under tail-coverts. The fairly long and somewhat curved bill is black on the upper mandible and lighter on the lower mandible. This description refers to the Central American forms, which until recently were considered to be a distinct species, *Campylorhynchus capistratus*. Typical *C. rufinucha* of southern México has a darker, less reddish back that is conspicuously variegated, and its underparts are speckled.

The species is found in more or less arid country from the Mexican states of Colima and Veracruz to northwestern Costa Rica. Along the Pacific coast of Central America, it is rather uniformly distributed from the Mexican border to the Gulf of Nicoya, but farther to the south the heavier rainfall and more luxuriant vegetation exclude it, as it does not tolerate the rain forest or the lush second-growth clearings. On the Caribbean side it is found chiefly in inland districts of Guatemala and Honduras where intervening mountain ranges intercept the rain-laden winds from the sea. In suitable localities it extends upward to about 4000 feet above sea level, but it is most abundant in the hot, dry lowlands. Here it lives in light woods where many of the low trees are thorny and shed their foliage in the long rainless months of the early part of the year. But it is most in evidence in semi-desert regions where tall organ cacti and opuntias abound, where the courses of the smaller streams are much of the time dry, rocky or sandy channels winding through the parched land, and where hedgerows of close-set, spiny plants replace the wire fences of the humid regions. Country of this description is found in the middle reaches of the Motagua Valley of Guatemala, especially between Zacapa and Progreso. Here the Rufous-naped Wren is one of the most abundant birds and I learned most of what I have to record of its habits.

VOICE

The calls of these cactus wrens are usually loud and harsh, but their song, at its best, is beautifully clear and liquid. Its tone is full and mellow, its phrasing intricate and varied; the sweet, melodious notes often reminded me pleasantly of those of that superb songster, the Yellow-tailed Oriole. Although able to produce pure melody, the wrens all too often mix their harsh and liquid notes together in a manner which exasperates one who wishes to hear them at their best. For a bird capable of such glorious music to mar its performance with an admixture of harsh and trivial notes seems a perverse waste of natural talent. In this strange medley of contrasting sounds, now the harsh, now the liquid notes predominate, and writers have praised or spoken disparagingly of

this wren's song according to whether more or less of the pleasing notes were incorporated in the particular version they happened to hear. As in other wrens, the two sexes are about equally endowed with song and frequently they sing in unison, keeping perfect time in their most intricate musical figures. On such occasions, one must stand between the duettists in order to be convinced that two individuals are performing, for if both are on the same side and are only a short distance apart, the two voices blend into one.



Fig. 30. Rufous-naped Wren.

NESTING

The nest, which has the form of a deep pocket, is generally placed from six to fifteen feet up in a thorny bush or tree. A favored site is a large opuntia, in which the structure is suspended between two of the flat segments of branches which have their broad faces vertical, parallel, and a few inches apart. The many slender spines prevent the nest's slipping out of the space between the branches. Thorny acacia trees are also frequently chosen as the nest site, especially the *cornezuolo* or bull's-horn acacia, the paired hollow thorns of which are inhabited by small ants that administer memorable stings to the person who carelessly touches their tree. At the end of June, 1932, the cactus wrens in the middle Motagua Valley were occupied with breeding, and their bulky nests were easily found in the thorny plants where the sparse foliage or leafless branches did little to conceal them. Many of these nests were in various stages of neglect and decay, and at the same time a number of new ones were being built. On June 24 I watched a pair of wrens just beginning a nest in an opuntia. Both sexes built and seemed to be taking fairly equal shares in the work. They went about their task while I stood in plain view a few paces from them, for they were not at all shy. They brought lengths of vine, fibers, and some of the long, silky, white hairs which densely clothed the tips of the branches of an organ cactus that was abundant in the vicinity,

mixing these diverse materials without any order in their nest's foundation. Sometimes the wrens busied themselves breaking off the sharp opuntia spines nearest their nest, grasping each in the tip of the bill and giving it a sharp twist. It was marvelous how these, as well as other birds of the region, could dart through the thorniest plants and alight on the branches yet never seem to suffer injury.

A little later that same morning, I found a second nest under construction; it was also in an opuntia tree. This nest was nearly completed, and a wren was engaged in



Fig. 31. Cactus fence near Zacapa, in the Motagua Valley of Guatemala, in the range of the Rufous-naped Wren, White-throated Magpie-Jay, Rufous-crowned Motmot and Lesser Ground Cuckoo.

carrying into it great fluffy billfuls of down from the tips of the branches of the organ cactus. Occasionally it varied this procedure by fetching a piece of vine or other coarser material. The following day I again watched this same nest without finding evidence that both members of the pair cooperated in its construction. The inactive partner, however, remained nearby and often joined the active one in a melodious duet. In the same tree that held this nearly finished nest were the remains of three old structures.

On July 15 I watched still another pair building in the lower part of a *Peireskia* tree which had clusters of needle-like thorns and large orange-colored blossoms. As at the first nest, male and female shared the work. In mid-July many of these cactus wrens were still building, and in three days I came upon three pairs engaged in this work.

The completed nest is an elongated structure curved so that the entrance at one end faces obliquely downward, while the opposite side forms a deep, descending pocket for the eggs (fig. 21e). The length from end to end is about nine inches. The thick

walls are composed of pieces of dead vine, straws, fibers, rootlets, and the like, and the chamber is copiously lined with the long, silky, whitish hairs from the organ cactus. One nest was made, outside as well as inside, almost wholly of the cactus silk, with just enough stalks, vines and fibers to hold the fluffy down together and preserve the structure's shape. In a region so dry and hot, one might suppose that the wrens would find it unbearable to stay for long inside such a thick and stuffy nest. If this is true, perhaps their eggs require very little incubation in order to remain sufficiently warm for the development of the embryo to proceed.

On June 26, I found a set of four eggs near El Rancho in the Motagua Valley. These eggs were white, very heavily spotted with brown, rusty brown, olive-brown and gray. They measured 22.6 by 16.7, 22.2 by 16.3, 21.8 by 16.7, and 21.0 by 15.9 millimeters. In the same locality, I discovered on July 14 a nest with two nestlings a few days old and one egg, and on July 20 I found a nest with three newly hatched nestlings and one egg.

On August 15, 1935, I found Rufous-naped Wrens very abundant in the vicinity of Zacapa, which is somewhat lower in the Motagua Valley. At this date they were in pairs or in larger family groups. I watched one pair carry fine material into an old nest of an oriole. This nest had been built by either the Spotted-breasted Oriole or the Black-throated Oriole, both of which were present in the region. It hung from the tip of a slender twig about twenty feet above the ground and was near the river. The male and female wrens collaborated in lining this borrowed nest. Since the season now seemed late for further breeding, I thought that the wrens might be fixing up this long, swinging pouch as a safe lodging, but on two evenings I watched in vain for them to enter it.

On July 11 and 12, 1934, in the dry, hot country around San Gerónimo Ixtepec, on the Pacific side of the Isthmus of Tehuantepec, I made the acquaintance of another form of the Rufous-naped Wren. It struck me at once as being different from the race present in the Motagua Valley not only in coloration but also in song and nidification. This form, which is confined to southwestern México, was once considered a distinct species, *Campylorhynchus humilis*. It was abundant among the low, thorny trees and bushes, interspersed with cacti, which occupied that portion of the plain not devoted to cultivation. In two days I discovered four nests. Two were in bull's-horn acacias, and the other two were in other kinds of thorny trees. Three were about 5 feet above the ground, and the fourth was 25 feet up. Three of these nests were still unfinished, and at two of them I saw that both sexes shared in building, as had the Guatemalan cactus wrens. The fourth nest, already completed, was not as long and deep as those I had found in the Motagua Valley; it might be described as oven-shaped or domed rather than pocketlike. It was built of straws and weed stems and lined with soft white down. The unfinished nests, too, promised to be more open and less deep than those of the Guatemalan birds. The shape of the nests appeared to constitute a constant difference between the two races. The completed nest held three nestlings and one egg which was buffy and curiously mottled with tan and brown.

In Costa Rica, the Rufous-naped Wren lays sets of 4 eggs, according to Alfaro (1927). In El Salvador, Dickey and van Rossem (1938) found that the sets ranged from 3 to 6 eggs, with 4 or 5 being the most frequent number.

SLEEPING

In November, 1938, I saw many of these birds in the Province of Guanacaste in northwestern Costa Rica, and they were very common in the vicinity of Las Cañas and Nicoya. At this season, when I saw no indication of breeding, they were either in

pairs or three or four together, and they sang occasionally. The local name for them, *salta piñuela*, is a tribute to their ability to move about in thorny vegetation without impaling themselves. The piñuela (*Bromelia Pinguin*) is a bromeliad or wild pineapple with long, stiff, narrow leaves that stand almost upright in a close cluster. Each leaf is armed along the margins with sharp, recurved spines. These formidable plants, frequently planted close together for hedges, make a barrier far less penetrable by man than a fence composed of four strands of barbed wire. In other parts of Costa Rica, according to Alfaro, this wren is known as *Chico piojo*.

One evening at Las Cañas, I watched three of the *salta piñuelas* enter a bulky nest situated nine feet above the ground in a bull's-horn acacia standing by the roadside. Two different birds went to rest in another nest twelve feet above the ground which was likewise in a bull's-horn acacia by the roadside. These nests were pocketlike structures with an opening in the side, such as the cactus wrens use for breeding. On the Hacienda Tenorio, a family of four wrens lived about the house in a most familiar fashion, sometimes hopping over the porches to search for insects and spiders. They frequently entered, for the same purpose, a small, ruined hut situated close by the big house. A dovecote with four rooms stood on a tall pole in the yard, and in the two lower compartments the wrens had built nests, in one of which all four of them slept. One evening, after only three of them had retired, I shook them out, whereupon they flew across the yard and entered a nest which they had built in the lower branches of an orange tree. When, after considerable shaking, I persuaded them to leave this nest, they flew back to the dovecote and joined the fourth wren, which meanwhile had entered the nest in the lower left compartment. All four then passed the night without further molestation. In addition to their two nests in the dovecote and the one in the orange tree, these industrious wrens were engaged in the construction of a fourth nest in another orange tree close beside the house.

SUMMARY

The Rufous-naped Wren inhabits the drier regions of southern México and of Central America as far south as northwestern Costa Rica. It is abundant in low deciduous woodland and thorny thickets as well as in semi-desert regions where tall cacti are numerous.

Its calls are loud and harsh. Its song is varied, including mellow liquid notes which frequently are mixed with harsh ones that mar the total effect of the performance. Male and female often join in a duet, keeping perfect time in their most intricate phrases.

In the arid middle reaches of the Motagua Valley in Guatemala, there was much breeding activity in late June and July. The nest, placed 6 to 15 feet up in an opuntia or some other thorny plant, is a deep pocket, made of straws, rootlets, and fibrous materials, and is copiously lined with down from the organ cactus, which sometimes is the chief component of the structure. It is usually built by both sexes, although at one nest only a single individual was seen at work. Two nests contained four eggs or nestlings, whereas a third nest held two nestlings and one egg.

On the Pacific side of the Isthmus of Tehuantepec, breeding seemed to be at its height in mid-July; at that time I found, in two days, three nests under construction and a fourth which contained three nestlings and one egg. These nests were from 5 to 25 feet up in thorny plants and differed from those built in the Motagua Valley by being shorter and more open; they were domed rather than pocket-shaped. In two instances the work of building was shared by both sexes. These birds are racially distinct from those in the Motagua Valley.

In Guanacaste, northwestern Costa Rica, Rufous-naped Wrens were found in pairs or in family groups of three or four individuals in November, when apparently they were not breeding. Each pair or group retired at nightfall into a dormitory nest which was usually situated in a tree, although one family had built two nests in a dovecote, in one of which they slept. This family had three nests; two of these were being used as lodgings, yet they were engaged in building a fourth structure in the vicinity.

CHIAPAS WREN

Campylorhynchus chiapensis

This large wren, seven to eight inches in length, is not as strongly barred or spotted as are many other members of its genus, and the clear, contrasting colors of its upper and under plumage impart to it an elegant appearance. The sexes are similar in coloration. The forehead, crown, and nape are black, bordered on each side by a fairly wide white superciliary band, which in turn is margined by a black loreal and postocular streak. The back and rump are rich chestnut-brown. The wings are blackish and chestnut lightly barred with black. The tail is dusky and chestnut barred with black and it has a narrow subterminal band of white. The cheeks and all the under plumage are immaculate white. The species appears to be confined to the Pacific lowlands of Chiapas, México.

In mid-July, 1934, I found the Chiapas Wren abundant in the vicinity of Tonalá, a small town in the Mexican state for which the species is named. Here the trees were taller and the vegetation was more lush than farther west along this same coast, where on the plains around San Gerónimo Ixtepec I had found the Rufous-naped Wren very numerous. This smaller wren was rare at Tonalá, and in four days I saw only a single individual, in contrast to the many pairs of the Chiapas Wren which I saw as I wandered along the pleasant shady roads. I found them chiefly in the hedgerows and in the bushy pastures where scattered bull's-horn acacias grew. They were active and noisy like other cactus wrens. Their song was deep and full, but it was essentially the repetition of a single mellow note. Male and female sang in unison in the manner of the Banded-backed Wren and the Rufous-naped Wren.

I noticed many of their nests, which were bulky, somewhat globular structures that resembled those of the Banded-backed Wren far more than the smaller pockets of the Rufous-naped Wren. They were placed by preference in bull's-horn acacias, where they could be reached only with a ladder and by one willing to endure the sharp stings of the ants which inhabited the hollow thorns. On my second evening at Tonalá, I watched two of these cactus wrens go to rest, one in each of two nests which were situated 10 or 12 feet above the ground in acacias growing about 100 feet apart in the midst of a pasture covered with tall grass. In order to make quite sure that only one individual went into each nest, I shook them out while there was still enough light to see clearly and watched each one, after a little scolding, return to its solitary lodging. The next day I managed to borrow a ladder from a neighboring farmer and with his help climbed up to examine these nests. The first that I visited was a very bulky structure, composed of straws, weed stems, bits of vine, and the like. It measured about 14 inches in height by 11 inches in horizontal diameter. Most of the nest's height was accounted for by that portion above the chamber, and this thick pile of coarse materials must have been effective as a thatch to shed the rain, for the wet season was now at hand. Unlike any other wren's nest that I have seen, but similar to an unusual nest of the Slaty Castle-builder that I once found, this bulky construction was provided with *two* doorways, one facing north and the other facing east. When I reached inside through one of them, my fingers encountered two fat nestlings, whose eyes were not yet fully open, and one addled egg. This was light buff in color and was very heavily mottled with brown, especially in a wreath around the larger end where the brown was practically solid. It measured 26.2 by 17.5 millimeters.



Fig. 32. Chiapas Wren.

Although the tree was swarming with ants from the hollow thorns, thoroughly aroused by all the shaking incident to setting up and climbing the ladder, and although the ants were marching up and down the branches in search of whatever had disturbed their peace, it is noteworthy that while I was present not a single one attacked the nestlings, and none crawled on my hand from the nest. Yet if I had touched any part of the tree itself for as long as my hand was in contact with the nest, I should have paid dearly for my temerity. Apparently the ants respected the wrens' nest, or rather were indifferent to it, even at times of great excitement. Indeed, if it were otherwise, no bird could rear its progeny in the bull's-horn acacias. While the angry ants rushed wildly about, the parent birds, after the manner of cactus wrens, remained at a safe distance and showed little concern beyond uttering a few harsh notes of protest.

After replacing the nestlings, we turned our attention to the second of the nests into which a wren had retired on the preceding evening. I examined it at the price of more painful stings than I had received while visiting the first nest. This empty structure was somewhat smaller than the one which held the nestlings, and it had only one doorway. It was evidently the dormitory where the male slept alone while his mate covered eggs or nestlings in the neighboring larger nest. This procedure is also followed by the Banded-backed Wren.

SUMMARY

The Chiapas Wren inhabits hedgerows and bushy pastures in the Pacific lowlands of the Mexican state for which the species is named.

Its song consists of the repetition of a single deep, full note and is delivered by male and female in unison.

These wrens were breeding in mid-July, when their bulky nests were prominent in the bull's-horn acacias growing in bushy pastures. Most were inaccessible, but the single breeding nest that could be reached contained two nestlings and one spoiled egg. This nest was unusual in having two doorways in the sides. Not far from it was a smaller, empty nest with a single doorway, in which one wren spent the night. It appeared to be the mate of the female which was brooding the nestlings in the neighboring nest.

BANDED-BACKED WREN

Campylorhynchus zonatus

Possibly because the earliest known northern members of the family are tiny and inconspicuous, we generally think of wrens as small, skulking birds more readily heard than seen. But the so-called cactus wrens of the genus *Campylorhynchus* are neither small nor shy. One of the largest is the Banded-backed Wren, which measures nearly eight inches from the sharp tip of its slender, slightly curved, blackish bill to the end of its long tail. It is as large as many a thrush or oriole. As in other wrens, the sexes are alike in appearance and both are clad in modest colors. The back, wings, and tail are heavily barred with black or dusky bands alternating with white, gray or buff. The white breast of the adults is heavily spotted with black, whereas the sides, flanks, and abdomen are tawny-ochraceous. There is a white or buffy-white superciliary stripe, separated from the white cheeks by a dusky streak through the eye. The long, slender form, strongly barred upper plumage, and spotted white breast of this wren make it easy to recognize wherever it is found.

Most of the numerous species of cactus wrens dwell in hot, arid regions where cacti and other thorny plants abound. One lives in the desert regions of the southwestern United States, and in tropical America there are many kinds. Generally the cactus wrens have full, mellow voices, and in another family would be accounted good songsters; but their music pales in comparison with the exquisite melodies of some of the smaller wrens of the tropics.

The Banded-backed Wrens are the eccentrics of the group. I found them in almost all kinds of habitats except among cacti, for they as a rule prefer regions too humid for these plants. The members of this species have a wide geographical range from southeastern México to northwestern Ecuador, and they have an altitudinal range equalled by that of few other birds. In my wanderings through tropical America, I have encountered them among the shade trees near cottages by the seashore in Costa Rica, and I have found them in clearings in the cypress forest on the Sierra de Tecpán in Guatemala, nearly 10,000 feet above sea level. At intermediate altitudes, I have found them in heavy, humid forest which has been thinned by lumbering, in bushy lowland pastures where only scattered trees remained, and in thickets along the banks of lowland rivers. On the Cordillera Central of Costa Rica, 5000 feet above sea level, they live about openings in one of the wettest forests in all Central America. In the mountains of Guatemala they are fairly abundant in open and relatively dry woods of pine, oak, and alder. But despite the wide variety of habitats in which they seem to be at home, they are, in most parts of their range, neither common nor uniformly distributed. Thus I should not like to predict where one would or would not find these curious birds.

Banded-backed Wrens travel through the woods and bushy clearings in noisy family groups consisting usually of from six to a dozen individuals, and they are as versatile in their manner of foraging as they are in their choice of habitat. In the course of their daily rounds, they neglect to investigate no possible hiding place of their insect food. They search among the fallen leaves on the ground. They remind one of overgrown nut-hatches as they crawl over the trunks and branches of trees, usually in an upright position, but on occasion they hang with either back or head downward while they peer into the crevices and pry up loose scales of bark. They pull the gray lichens from the boughs to see what may be lurking beneath, like the Guatemalan Steller Jays, and they hunt among the foliage like wood warblers.

VOICE

When the family spreads out to forage, its several members keep in contact either by their constantly reiterated calls of *tsú-ka*, *tsú-ka* or by their harsh cries of *zoro-chuc*, which last has given them their name among the Cakchiquel Indians. If interrupted by a human intruder, they scatter in all directions and scold in loud, rasping tones. Of all the wrens I know, they are the only ones that almost never utter sweet and musical



Fig. 33. Banded-backed Wren.

notes. I heard low, soft sounds only once, from a pair building their nest. Yet despite the harshness of their voices, male and female sing duets in unison, in the manner of wrens which are more vocally gifted, and what they lack in sweetness of tone they make up in animated, rollicking tempo.

SLEEPING

As evening falls, the whole family approaches its sleeping nest, in the vicinity of which the members continue to search for a few final bits of food. Then, one by one, they fly quietly through the wide entrance and settle down in silence for the night, at a time when most of their neighbors are still awake and active. The dormitory is a roughly

globular structure, nearly a foot in greatest diameter, with the thick roof and walls composed of straws, weeds, pine needles, moss, lichens, sheep's wool, and in fact anything available in the locality which may help shed water and make the sleeping quarters dry and cozy. The entrance is on the side, wide enough to admit a man's hand freely, and it usually faces outward from the tree in which the nest is placed. A forward projection of the roof shades the doorway and keeps out driving rain. These dormitories are usually high in the trees, at the ends of slender branches where it is difficult or more often impossible for the bird-watcher to reach them, but sometimes they are placed as low as twelve feet above the ground. At times members of a single pair occupy a nest to themselves, but I have seen up to eleven birds sleeping together.

On the Sierra de Tecpán, among the woods of oak and pine, at 8000 to 9000 feet above sea level, I located, at various times in 1933, the sleeping quarters of nine different groups of these cactus wrens, and I followed the vicissitudes of their occupants as long as I could. At intervals through the year, each family would build a new nest and move into it. Since it was not always easy to discover the site of the new dormitory, at times several hundred feet distant from the old, I gradually lost track of some of these families, but there were two that I followed through most of the year (see pp. 199-200).

THE APPROACH OF THE BREEDING SEASON: COURTSHIP

Banded-backed Wrens were habitually late risers, lingering in their snug nests from several minutes to more than an hour after their neighbors were up and about. One frosty morning in February, I was on hand at dawn to watch a family of seven take their departure from a nest in the top of a small oak tree growing in the open woods behind the house. At this season the Blue-throated Green Motmots, which were among the first of the local birds to become active in the morning, flew out of their burrows at about 6:05 a.m. Finally, at 6:47 a.m., long after most other species had begun to forage, the first of the seven Banded-backed Wrens suddenly darted from its comfortable dormitory. Four others followed at short intervals, and then the sixth wren stuck its head through the doorway; it lingered in this attitude, as though reluctant to venture forth into the chilly morning air. When finally it had gathered enough courage to leave, the last of the sleepers peeped out of the round entrance, but it immediately drew back again. For a full minute more it enjoyed its retreat before at last it joined its foraging comrades.

After leaving their nest, the seven wrens foraged in the immediate vicinity for about a quarter of an hour among the low bushes and herbage wet with dew. Then, one by one, they flew down the slope for about a hundred feet to search for food in a pile of oak branches with the dead leaves still attached. From this point the main party continued down the slope, leaving behind a single bird which had separated from the rest and gone along the hill to the north. The lone bird, perched in the top of a low oak tree, called continuously *tsú-ka tsú-ka*, wagging its long tail as it uttered each call, until it heard the voices of its companions far down the hill, whereupon it flew off to join them.

An hour after they left their nest, the party was foraging among the lichen-covered boughs of the oak and pine trees above a spring, about a thousand feet from their starting point. When their hunger had been satisfied, to a large extent by insects plucked from the bark, they began to give attention to their feathers. Two birds, perching among the topmost twigs of an oak tree, mutually nibbled each other's plumage, alternating these friendly offices with the preening of their own feathers. One raised a wing while the other preened or searched for vermin on the under surface. One does not often see a

wild bird preen the plumage of another. The birds that I have watched exchanging this service most often are the black anis. These are among the most sociable and affectionate of feathered creatures and they raise their families in communal nests. After watching the cactus wrens preen each other, I felt certain that they must possess nesting habits that would be interestingly different.

At eight o'clock the wrens began to take their baths. Although there was a spring of



Fig. 34. Alder trees (*Alnus arguta*) on the Sierra de Tecpán, Guatemala, at about 8500 feet. In this mixed woodland lived Banded-backed Wrens, Rufous-browed Wrens, Rufous-collared Thrushes and Tufted Flycatchers.

pure water beneath them, they preferred to bathe in the dew which still clug heavily to the foliage and was dripping from the oak trees in a continuous shower of small drops. They fluttered among the densest clusters of the foliage until they looked quite wet and bedraggled. Then they shook out their feathers and put them in order once more. A numbers of birds, from the small hummingbirds, honeycreepers, and wood warblers to the big Brown Jays, seem to prefer these aerial dew baths to bathing in pools or streams.

After their ablutions, the family seemed to separate. At least four of the wrens continued down the long slope as far as the road from Tecpán to Paquep, where apparently they fell in with a few wrens from another group. Standing on the bluff above the road,

I had an excellent opportunity to watch the courtship which now began among the boughs of the low oak and hawthorn trees below me. One bird, apparently a male, pursued another, apparently a female, through the branches, the latter fleeing always upward by hops and short flights until she reached the top of the tree, where, since she could retreat no higher, she was joined by her wooer. Then the two, perching close together, sang over and over again their harsh duet, just as the Rufous-naped Wrens join in duets of far sweeter music. I found it a charming performance, for, despite the harshness of their rattling notes, they at least had a lively, spirited cadence.

At one time there were four wrens on the scene, pursuing each other two by two, and for a while it even seemed as though a triangle might be formed, with disagreeable consequences. But soon one pair withdrew and left the other to occupy the stage alone. Time and time again the one whose actions appeared to proclaim him the male pursued the other through the boughs. It was evident that he tried to get as close as possible to his partner as they sang the duet, but she, although not unwilling to sing, did not desire to sing at such close quarters. Her objections were not, however, strenuous; for often, especially if driven to the treetop, she allowed him to perch close beside or even touching her as they poured forth their harsh notes with great gusto. With their barred backs and black-spotted white breasts side by side, they made an attractive picture. When the supposed female took flight, the male pursued through the air, keeping very close and uttering a rattling sound or even singing on the wing. This lively play went on in the chill morning air, for even at nine o'clock my fingers were so cold and numb that I could scarcely form the letters in my notebook.

Finally the pair reached the top of a tall pine tree which was more than a hundred feet high. From this great height the female glided down on set wings, while her ardent wooer fluttered just behind and a little above her, singing. This form of play was repeated from the lower tree in which they alighted, and then the birds went off across the stream and I lost sight of the last of the flock. They had wandered more than a third of a mile from their dormitory.

Two weeks later, I watched before the sleeping nest of this same family on a very different kind of morning. It was the first day of March, and it was cold and misty. But notwithstanding the unpleasant beginning of the day, other birds, not so fortunate in the possession of warm sleeping quarters, were active when I arrived at the wrens' nest at 6:20 a.m. There was no sign of movement on the part of the wrens for nearly half an hour, when one of them stuck its head through the entrance. One glimpse at the cold, wet, gray morning was sufficient to convince the bird that it was not yet time to come forth; for it withdrew into the nest, and there was no further sign of life for twenty minutes more. Then a wren again came to the doorway, where it stood many minutes with only its head and breast visible to me, as it looked out upon the driving mist and the dripping world. At length, perhaps driven by hunger, it crept into the open, but instead of flying down as usual to forage in the undergrowth, it moved only a few inches to a perch beside the nest, where it waited quietly with outfluffed feathers for its less venturesome companions to appear. It was several minutes before they began to follow. Finally at 7:15 a.m., two wrens perched quietly beside the first, while two more flew directly to the ground. One even ventured to sing a snatch, a harsh refrain exactly fitted to the mood of that harsh day. The sixth and last did not emerge until its companions had begun to break their fast among the wet bushes, where it flew at once to join them. I could not make sure what had happened to the seventh member of the family.

The ancestors of the Banded-backed Wrens probably lived in hot, dry regions of the lowlands, where their nearest relatives still remain. Their habitual reluctance to face

the cold and dampness of these elevated regions in which they have established themselves, reveals that they have not entirely lost that love of warmth and dryness which is characteristic of their branch of the wren family.

With the approach of the vernal equinox the season of courtship reached its height, and this makes birds sleep lightly. Toward the end of a clear, starry night, in the latter part of February, I went out across fields, in which the frost-encrusted grass crunched sharply under foot, to visit a nest in which three wrens slept. It was in the vicinity of this nest in a hawthorn tree that I witnessed the spirited courtship already described. As I neared the dormitory, I heard loud song coming from the interior; this was at an hour when most cactus wrens were sleeping soundly. In a few minutes one of the wrens emerged, hopped about among the twigs near the nest, and then returned to its dormitory. But very soon it came out once more, singing wholeheartedly as it flew forth. As soon as there was sufficient light, I noticed one of the nest mates perching motionless in front of the entrance, and it remained there perfectly quiescent for about half an hour more. Evidently its restless bedfellow had driven it prematurely from the nest, and, becoming chilled in the penetratingly cold early morning air, it remained still and dejected until the sun rose higher and began to warm the earth.

A few mornings later a slightly different scene was enacted at this nest. As before, harsh song floated down from it at the first peep of day. Soon the restless bird stuck forth its head and continued to chant. Next it emerged from the nest and crept about among the surrounding foliage. A minute later a second wren followed it forth, and this was of course the signal for much loud singing. But in a very short time one of the two—the female, I believe—went inside again. Whereupon the male came to the nest, stuck his head into the doorway, and made a clicking sound. Despite these protests, she and her companion remained inside a few minutes longer before venturing out. On this same morning the six wrens in the little oak tree, which apparently had not yet begun to feel the restlessness of the reproductive urge, were still reposing in their dormitory when I visited them half an hour after the last of the three birds had left the hawthorn-tree nest.

Although usually the cactus wrens were among the earliest birds to retire, the advent of the mating season changed this, too. Sometimes, in the evening twilight, I found a pair of them pursuing each other among the boughs and through the air, singing their spirited duets after their usual time for going to bed. In the dusk I once saw a wren, probably a male, display with spread tail and drooping wings as he sang in company with his mate among the branches of a tree. The old, well-established routine which had prevailed through so many months was broken, and dormitories which had long been occupied were temporarily or permanently deserted. The flocks seemed to wander about a good deal and to retire at nightfall into any nest (and there were many scattered over the farm) which happened to be nearest at hand. One evening I saw ten cactus wrens pile into a nest which had been unoccupied for some time. Apparently they found the quarters too narrow to contain them all, for presently six came flying out again. Then some of these decided to return, and for the next few minutes there was so much going in and coming out, in the waning light, that I was wholly bewildered. Finally the trouble was settled by three birds going to sleep in a very old and dilapidated nest, with a gaping hole in the roof, situated in an oak tree a short distance from the first. The remaining seven then became quiet in the nest which had been their original choice. The following evening this scene of excitement and unrest was repeated, but a few nights later not a wren came near these nests.

Out of so much confusion, which was difficult to interpret because of the impossibility of recognizing individual wrens or even of being certain of their sexes, emerged

mated pairs, which took themselves off to quiet nests of their own where they could raise their families. These nests, selected for the purpose of reproduction, had long been in place and showed their age by their weathered appearance, but they were still sound and serviceable. Sometimes the new (or were they returning?) occupants added a few bits of material to the structures, but since it is the habit of the cactus wrens to do this from time to time throughout the year, this action had no particular significance in relation to breeding.

Toward the end of February, one such pair of wrens took possession of an old and weathered, but perfectly sound, nest (no. 5) situated about forty feet above the ground in an oak that grew in a bushy pasture. Here they retired together every evening until, in the latter part of March, the female laid her five pure white eggs in this nest. Then the male found other sleeping quarters and left her to incubate the eggs alone through the night.

NEST BUILDING

The pair just mentioned demonstrated that the same structure may serve both as dormitory and breeding nest. Whether or not some of the very highest nests, such as the one a hundred feet above the ground in a tall forest tree in Costa Rica where seven wrens slept, were also used to shelter eggs and young was not learned. The highest nest definitely known to have contained eggs was forty feet up. The lowest nest employed for reproduction was far nearer the ground than any which I found in use as a dormitory, and it was in an unusual situation. It was placed only six feet up in a small *Dracaena* tree standing in the dooryard of a farmhouse in the Pejivalle Valley of Costa Rica. Rather small for a cactus wren's nest, it measured only about eight inches in diameter and was well concealed in the broad red leaves of the unbranched little tree. After the nestlings were taken from this nest by a snake, the parents built another exceptionally low nest, about fifteen feet up in a small *Erythrina* tree growing beside a rivulet, between another dooryard and open pasture. It was in this same locality that the hundred-foot-high dormitory nest was found.

The nest of the Banded-backed Wren may be built by both sexes, or it may be built by the male alone. It seems probable that when a nest is constructed to serve as a dormitory for a number of individuals, all share in the task of building it; but at all such nests which I watched in the period of construction, the work was carried on in such a desultory fashion—the wrens arriving one or two together, bringing a few pieces of material, then drifting away and neglecting the nest for many minutes—that I never could learn how many individuals took a share in the work.

In June a cactus wren, whose previous nests had been cut down by destructive people, tried to rear a belated brood in a hawthorn tree beside a road through a pasture on the Sierra de Tecpán. While she incubated her eggs, her mate, which had lost his dormitory through the same agents, worked in a desultory fashion at building a new sleeping nest for himself on the other side of the same tree. On a rainy night, while the roof was still hardly more than open lattice-work, he tried sleeping in it, but apparently he was not comfortable, for he passed the following night in the breeding nest with the female and the eggs. This was a rare privilege, accorded to him only for a single night, and the next evening he returned to his new nest, which meanwhile had progressed a trifle farther. After the nestlings hatched, the relentless persecutors cut down the breeding nest in order to take them; then the female wren joined her mate in sleeping in the nest which he had built while she incubated. This was their nightly shelter for several months.



Fig. 35. Nest of Banded-backed Wren in hawthorn tree (*Crataegus stipulosa*) on the Sierra de Tecpán, Guatemala, June 14, 1933.

In the middle of June, I found that another pair of cactus wrens had moved into new territory, where until then I had discovered none of their kind in residence. These wrens were building a nest in the top of an oak tree, about fifty feet above the ground. Both male and female brought materials, consisting of dead pine needles, lichens, moss, and an occasional slender stick. I watched one of the pair tug at a lichen growing on a branch, pulling with both wings spread and exerting its utmost effort, but the plant was attached too firmly to be removed. When the two wrens met inside the nest they uttered low, soft notes, very different from their usual harsh chatter. These were the only notes of this character that I ever heard from any of their kind. When the nest was still scarcely completed, the pair began to sleep in it. Two weeks after it seemed finished, they had another burst of energy and brought more pine needles to the structure.

Since a description has already been given of the nests used as dormitories (pp. 187-188), it will be unnecessary to describe the breeding nest, which does not differ from the former. Indeed, the same structure may be used for both purposes.

THE EGGS

On the Sierra de Tecpán, at about 8500 feet above sea level, I managed on April 4 to climb to a set of five eggs, well advanced in incubation. A neighboring nest held 5 nestlings, four or five days old, on May 6. Late in June I found a cactus wren incubating, but the nest was inaccessible. In the same locality, on October 11, I discovered a set of five eggs in a nest which had been built in August. They were already addled and contained no traces of embryos. In addition to these nests belonging to the nominate race, *zonatus*, I have a single record of a breeding nest of *costaricensis*. This was found in the Pejivalle Valley at an altitude of 2000 feet on the Caribbean slope of Costa Rica, and on April 5, 1941, it contained three nestlings a few days old. These few, scattered records indicate that the breeding season of the Banded-backed Wren in Central America extends from late March until July; eggs may be laid in September or October, but such late sets are apparently not incubated. One nest contained three eggs or nestlings, and there were three sets of five. The eggs are white, either immaculate or faintly marked with few or numerous pale brown speckles, especially in a wreath about the thicker end. The measurements of ten eggs average 22.0 by 15.8 millimeters. Those showing the four extremes measured 23.8 by 16.3, 23.0 by 16.7, and 20.6 by 15.1 millimeters.

INCUBATION

To study incubation we return to the nest in the oak tree (no. 5) from which our attention was diverted to make a wider survey of nests and eggs. I had been expecting that the cactus wrens would build new nests for their eggs, and incubation had been going on for a number of days in this old and weathered structure before, to my surprise, I learned that it was in use as a breeding nest. By bracing with ropes the slender ends of the branches in the crown of the oak, I managed to reach this nest and found the five eggs nearly ready to hatch. Then, with considerable difficulty, I made one of the wrens, evidently the female, rub against a wad of cotton soaked in vermilion paint which was held on a stick above the eggs. Thus she acquired a distinguishing mark that helped greatly in subsequent studies.

On April 8, the last day before the eggs hatched, I watched this nest from 5:45 to 10:49 a.m. In the five hours the marked wren, without much doubt the female, took 10 completed sessions on the eggs which ranged from 4 to 46 minutes in no regular order and averaged 16.3 minutes. Her 11 recesses varied from 3 to 26 minutes and averaged 10.7 minutes. She spent 60.4 per cent of the time in the nest. While she warmed the eggs her mate usually remained close by, foraging in the oak which supported the nest, where the dense clusters of staminate catkins harbored small insects for which he assiduously searched. At times he hunted in some other tree or bush not far distant. As he hopped about among the boughs he seemed to keep an eye on the nest in which his mate sat, and it was remarkable how often he spied her the moment that she came out for a recess. He flew at once to greet her with a song, in which she as usual joined. Upon the conclusion of the duet, they flew off close together to forage in the neighboring woods. Often the male accompanied his mate back to the nest; but on other occasions she returned without him, and he came later to the oak tree. He was not always alone, even while the female remained within the nest, for at times a third cactus wren kept him company among the boughs of the nest tree. This third bird, whose sex I could not determine, did not appear to be particularly interested in the female, but it showed considerable interest in the nest itself. Both the male and his unmated companion went occasionally to look into the doorway while the female incubated, and once one of them (I could not tell which) went inside and stayed for a minute with her. At the close of the day, the male and the third wren went off together, but I did not learn where they slept.

THE NESTLINGS

The nestlings, when first hatched, were very small and delicate. Their eyes were tightly closed, and their few sparse tufts of gray down did little to cover their pink skin. When I climbed up into the tree to look at them, the parents seemed no more concerned than they had been when I went to examine the eggs. They coolly flew off to hunt among the neighboring trees, and as likely as not would sing a duet while I was at the nest.

The male parent and the unmated bird which kept him company brought insects and larvae to the nestlings, but the female seemed to feel that the extent of her duty was to keep the young well brooded. This was a most unexpected division of labor, and one which I have never witnessed in any other species. Even upon returning to her nest from a recess, in which she found her own food, she brought nothing in her bill for the nestlings. At least, I could never detect anything in her bill whereas it was easy to see that the father and the helper carried something when they came to the nest. In four hours of the morning when the three nestlings were three and four days old, they were fed 13 times by the male and the helper. The female brooded them for 7 periods ranging from 13 to 40 minutes in length, a total of 146 minutes.

As the nestlings grew bigger, their attendants showed more solicitude for their safety. When they were five days old, and their eyes had opened and the pinfeathers were beginning to push from beneath the pink skin, one of the adult birds—the female, I believe—protested almost continuously with harsh notes while I was at the nest. Two days later, when I again climbed up to visit the little birds, the conduct of their guardians was exceedingly odd. The one that I supposed to be the female parent remained in some trees a little distance away, where she flew excitedly back and forth and called her harsh protests almost incessantly, yet she never attempted to come near me. But the male parent and the helper came into the treetop with me and foraged unconcernedly not many feet away, approaching far closer in their apparent indifference than the demonstrative female dared to approach in her anguish.

When the nestlings were two weeks old and well feathered, the female no longer brooded them by day. She seldom visited the nest and brought food to it rarely, if at all. She spent much time feeding among the boughs of the nest tree, where she hunted insects on the lichen-covered branches, or pulled apart the tassels of catkins, now dead, on the chance of finding small creatures among them. To the male and the helper fell the duty of providing for the young. The helper brought food somewhat more frequently than the male, which devoted much time to singing duets with his mate, or else to pursuing her in courtship flight. I could now distinguish the birds more readily, for both the female and the helper had rubbed against a tuft of paint-soaked cotton, which I had stuck in the entrance of the nest, and they had both acquired vermilion marks on their breasts, the female on the left side, the helper in the middle. The female continued to sleep with her young every night, as long as they remained in the nest.

Early in May I turned my attention to a newly found nest (no. 6) that held five young nestlings. The female alone slept with them during the night, but by day she had several assistants to bring them food. These assistants were so numerous that I could not make sure just how many there were. The parent birds and the helpers could not be distinguished by their plumage, and my attempts to mark them with paint, as at nest 5, were unsuccessful. Once, while the female was inside brooding the nestlings, I saw three wrens bring food to the nest at the same time. Since it is possible that one of these was the male parent, two were with certainty helpers. Although I devoted much time to watching this nest, I never could find positive proof that the parents had more than two helpers; yet I had good reason to believe that there were five helpers. The wrens which attended this nest, with the exception of the female parent, went to rest

every evening in a dormitory in a pine tree about four hundred feet distant from the breeding nest. It was easy to count them as they entered in the evening or came out in the morning; there were six wrens in this group. One of these was in all probability the male parent; the other five were possible helpers. Naturally, they were under no compulsion to bring food to the nest all at the same time, yet unless they did this I could not prove that all fed the nestlings. Nor was I able to learn at this busy nest whether the female parent fed the nestlings, or whether, as at nest 5, she only brooded them.



Fig. 36. Nestling Banded-backed Wren, 16 days old, Sierra de Tecpán, Guatemala, April 26, 1933.

At nest 5, only four of the eggs hatched, and three of the nestlings lived to leave the nest. They flew forth when the oldest was 19 days old and the other two were a day younger. Their backs, wings, and tails were marked with buffy and dusky bars, which did not contrast so strongly as the blackish and gray bars on their parents. Their under parts were light buff, with the feathers of the breast edged with dusky, but without the bold black spots which covered the breast of the adults. Their upper mandibles were blackish and the lower ones were largely yellow; their eyes were dark brown; and their feet were grayish yellow.

My low nest of the Costa Rican Banded-backed Wren had a tragic end. One afternoon before the nestlings could fly, I heard the parents scolding loudly and harshly in the yard. Rushing out of the house, I found at the nest a grayish snake about five feet long. One of the wrens was above the serpent, only a few inches from it if not actually attacking it. Since there still seemed to be a chance of saving the nestlings, I knocked the snake to the ground without waiting to see what the parents would do. While it lay dying on the bare roadway, the wrens stood only a few inches away from its still moving coils and scolded. The nestlings had already been swallowed by the snake.

THE FLEDGLINGS' RETURN TO THE NEST

On the evening after the departure of the young cactus wrens from nest 5, I watched for them to return for the night. The whole family, including adults and fledglings, flew into the nest tree after sunset, but after hopping among the boughs for a time they vanished in the foliage on the side of the tree opposite the nest from which they had just taken wing. On that side of the tree there was another nest which, to judge by its old and weathered appearance, was even older than that in which the young birds had been hatched and reared. But it was still, as I afterward learned, in a good state of preservation, and it was even more spacious than the breeding nest. Apparently it was into this dormitory that the family had vanished.

To make certain whether the cactus wrens really had slept in this old structure which appeared so unpromising, I was present next morning to watch for them to come forth. At a quarter to six the three adults suddenly burst from the entrance and raised their harsh voices in animated song. I could not see whether the fledglings were within, but presently one of the attendants (in the dim light I could not distinguish which) came to the entrance with an insect in its bill and flew away bearing a fecal sac. This was sufficient evidence that the fledglings were inside, but soon their lisping cries of *tsip tsip* told even more unmistakably where they were. They were hungry and were being neglected, for by seven o'clock only two insects had been taken into the nest, and one of its three occupants could not have received a bite of breakfast. No wonder they complained as loudly as their small voices would permit! But despite their continued calls for nourishment, they were fed only three times more in the next forty-five minutes. At length one of them stuck its head through the entrance, and at 7:45 a.m., two hours after the adults had left the dormitory, it flew forth. The other two fledglings soon followed. They hopped and flew with agility among the branches of the nest tree, then they launched forth and easily traversed the fifty feet which separated them from a grove of oaks on the edge of the pasture where the old birds were foraging. Here it was principally the helper which heeded their hungry *tsips*, for their parents were too absorbed in a renewed courtship, singing together and pursuing each other through the air, to give much attention to their offspring. But to give the female parent her due, I must record that before the fledglings left the dormitory that morning she brought them an insect, which she delivered while hanging back downward from a convenient twig in front of the entrance.

In the evening I watched this family go to rest. When I arrived at the nest, the adults were foraging for food and feeding the fledglings in the grove on the edge of the pasture. Then the old birds flew across to the nest tree and were followed by the youngsters. After hopping and creeping among the branches, the adults flew back to the grove again, and the young wrens easily followed them. Thus they winged back and forth several times. Finally the helper, which apparently had taken the young wrens in charge, seemed to decide that it was time for them to retire, and it led them to the nest where they had slept on the previous night. But entering this nest was no easy matter for young birds that still were rather shaky on the wing. There was no twig directly in front of the entrance on which they could alight, and the perch which promised the easiest approach was almost a foot below. To jump up to the nest from this was beyond their power, and as they could not yet fly straight upward, they tried the alternative of alighting on the roof and climbing down to the doorway. This, too, was by no means a simple feat, for the edge of the roof projected well forward of the entrance, and when they clung to it, they found nothing below to which they could drop. While they tried again and again these two equally difficult modes of approach, the helper showed them over and over how easy it was to fly up to the doorway from below; but what was easy for an adult bird was quite a different matter for fledglings two days out of the nest.

One of the three young wrens, doubtless the oldest by a day, soon succeeded in effecting its entrance by way of the roof, clinging precariously and almost losing its hold as it came over the edge. The others tried in vain to follow the leader. The helper encouraged them, and it entered the nest at least a score of times, only to come out again at once, teaching them by example how it was done. Several times a fledgling, rising from the lower perch, just managed to grasp a fiber or a stick at the sill by one foot, but it found its forces too far spent to raise itself over the obstacle, and in a moment it lost its hold and went fluttering down among the branches, only to return in a minute for another attempt. Several times, too, one flew up while the helper was in the entrance and clung to its back. With more presence of mind their guardian might have pulled them into the nest in this manner; but each time it dropped down with the youngster holding on to it, and the struggle began anew. The efforts of the little, short-tailed, pale-breasted fledglings to imitate their long-tailed instructor formed a delightful scene. Their attempts and failures were most amusing, and at times I so shook with silent laughter that I could no longer hold my field glasses steady.

At length, after ten minutes of repeated failures, the last two fledglings gained entrance to the nest. One accomplished this by cutting around the corner from the side of the nest and almost losing its hold; the other entered the nest by flying up from below and also almost losing its footing on the sill. There still remained a little daylight, so the helper, after looking into the nest to see that all was well, flew off to join the parents and forage a bit more before retiring. After ten minutes the first of the adults came to the nest, followed at short intervals by the other two. As each in turn darkened the entrance, the fledglings greeted it with their lisping hunger calls, associating the appearance of a bird at the doorway with the bringing of food. When the last of the adult wrens had disappeared into the interior, the nest became quiet.

The next morning, before six o'clock, the adult cactus wrens left the dormitory in their usual noisy fashion. The little ones remained behind and called for food. After uttering their weak *tsip*'s in vain for half an hour, the fledglings came out and flew across to the grove where their elders were foraging, and there they were fed. On the preceding morning they had left the dormitory an hour and a half later.

In the evening of the following day, the helper led the young birds to sleep in the nest where they had been hatched, going in and out several times to show them what to do. Since this nest was much easier to enter than the other, and the little wrens were fast acquiring skill in their movements, they did not require nearly so much instruction as they had two evenings before. After all the young had entered, they hopped out again, and the patient helper was obliged to lead them into the nest once more. The young slept alone; for the three adults, after foraging in the nest tree for 15 or 20 minutes more, retired into the other nest. But the following night all six wrens slept together again, this time in the breeding nest. It seemed to be of little concern to them in which of the two nests they spent the night, and if I happened to be watching on one side of the tree they would vanish into the nest on the other side. Yet if the second dormitory had not been there, I feel sure, from having observed so many nests, that they would not have hesitated to enter the one that I was watching.

AFTER THE BREEDING SEASON

When the five young cactus wrens left nest 6 in May, they, their parents, and all the helpers slept in a dormitory nest about a hundred yards away. This made a family of eleven (one of the group had disappeared), the greatest number of wrens I have ever found sleeping together. This was their nightly shelter until August, when they con-

structed and moved into a new nest, which served them as a dormitory until October. Then the family, which had been reduced to nine individuals, returned to the old nest in the pine tree, where the male parent and the helpers had slept while they fed the nestlings in May. They retired into this nest every evening until I left the vicinity at the end of the year. Upon looking into the nest which this family abandoned in October, I was not a little surprised to find the five addled eggs of which mention has already been made.

The family of six wrens, which has received most of our attention, changed their dormitory far more often than the larger family with eleven members. The former built so many nests in the last eight months of the year that I found it convenient to designate each by a letter, numbers having been earlier used to designate the family groups or the nests used by them for reproduction. The nest (no. 5), in which the nestlings had been hatched and reared, I now called A, and the nest on the other side of the same tree, into which the youngsters had been led by the helper, was nest B. At the beginning of May, we left these wrens alternating between A and B in a manner which showed no definite preference for either. In the middle of that month they moved into a new nest, C, which they had built forty feet up in an alder tree, two hundred feet from nests A and B. They slept in the alder-tree nest for nearly four months. In July the young birds, now in their fourth month, began to acquire the adult plumage, with spotted breasts and more conspicuous barring on their backs. The whole family had become exceedingly shy, and it was difficult to come close to or to watch them.

In the latter part of August the family built a new nest, D, in the same oak which already held nests A and B. They worked at its construction in such a desultory fashion that I could not learn how many of the six participated in the task, but by the beginning of September it was completed and the entire family moved in. They remained in that nest for a little more than two months, until, in the middle of November, they deserted it in favor of nest A. However, in less than a month they changed their habitation again, and this time they moved so far away that I had difficulty in learning where they had gone. Finally I discovered that they had made a fifth nest, E, in the top of a hawthorn tree over five hundred feet from nests A, B, and D and three hundred and fifty feet from nest C. The family had been reduced to four members during the preceding week, and it is possible (although I found no proof) that they moved so far away because they had been attacked in the tree where they had been sleeping. After about a fortnight in the hawthorn tree nest, they returned to nest D, in the first week of December. By Christmas they were sleeping in nest A once more, but when I last visited them, at the end of December, the four wrens were sleeping again in nest D. The cactus wrens' periodic removal to new quarters is probably made in the interest of sanitation, but I am unable to explain why this particular family changed their sleeping place so often.

The pair of wrens, which in mid-June built a nest fifty feet up in the top of an oak tree, was kept under observation for somewhat over five months. On a cold, damp morning in July, one of the pair left this nest, stretched a wing, preened its feathers a little, then called harshly for its mate to come out and join it. When the latter failed to respond, the earlier riser returned to the doorway and either nipped or tugged at the laggard inside. The second then came out, but its first care, before flying away, was to rearrange some loose material at the entrance of the nest.

For three months this pair of wrens slept alone in the oak tree nest, but in October they were joined by a third bird, which remained with them until, at the end of November, I learned that the nest had been abandoned. I could never discover what had become of its occupants. The appearance of the third tenant at this nest, which originally sheltered only two, helps to account for the gradual reduction in the number of occupants of the more populous nests.

A number of instances of the cactus wrens' reluctance to arise on cold and wet mornings have been given, but there is one more that seems to deserve mention. It was the only occasion on which I witnessed any discord among these sociable birds. Despite their harsh voices, they are good natured and peace loving. But one morning in September, when the mountain was darkly enveloped in a dense cloud, I waited to see the wrens emerge from a dormitory which I had just discovered. While the light was still quite dim, one of the birds stepped forth from the nest, paused on a branch in front of the doorway, turned around, and sang loudly at its sleeping comrades. Thereupon a second wren came forth and bumped directly into the singing bird. It was apparently greatly annoyed by the loud singing at a time when there was scarcely sufficient light to begin the day. The two wrens clinched, paused a moment with bill clasping bill, then fluttered downward, sparring, until they struck the foliage of the bushes beneath the tree, where I lost sight of them. Relieved of this disturber, the other seven birds emerged slowly, one by one, and the last did not appear until a quarter of an hour after the earliest riser had broken the peace of the nest. As often happens on such unpleasant mornings, some of the wrens turned around and re-entered the nest for brief periods.

These capacious sleeping nests are not the peculiar possession of those Banded-backed Wrens which reside in the high mountains where nights are frosty; they are built by the wrens wherever they happen to live. Upon leaving the Sierra de Tecpán I went to Costa Rica, and there I discovered two more dormitory nests. One, on the mountain slopes above the Pejivalle River at an altitude of about 2500 feet, was a hundred feet above the ground in a tall forest tree and was the loftiest of all that I found. It was occupied at night by seven wrens. The other was in the top of a slender acacia, amid a grove of balsa trees beside a small stream in the Caribbean lowlands, less than a hundred feet above sea level. Into this nest, two cactus wrens retired as the hot day came to an end. Perhaps the Banded-backed Wrens could not survive in such varied climates if they did not construct these cozy nests to shelter themselves from the extremes of weather.

SUMMARY

In Central America, Banded-backed Wrens reside in an amazing variety of habitats. They are found from openings in the Caribbean rain forest at sea level to clearings in the cypress forest 10,000 feet up, and they have been recorded from the wettest mountain forests of Costa Rica to the relatively dry woodlands of western Guatemala. Yet despite this great tolerance of climatic conditions, they are of unpredictable occurrence and are far from uniformly distributed over their extensive range.

Social at all seasons, they roam about usually in parties of six to twelve individuals, exhibiting as much latitude in their method of foraging as in their choice of habitat. They search in the ground litter, creep over the bark of trees prying up scales of bark and pulling off lichens, and glean amid the foliage. As far as observed, they subsist wholly upon small invertebrates.

They have a variety of notes which are mostly harsh. Like other wrens, male and female join in singing gay, animated duets. Their songs, however, are devoid of melody.

At nightfall the whole party retires into a bulky, globular dormitory nest. Usually there are a number of these nests scattered over an extensive territory, and they are situated as a rule from 12 to 100 feet up. From two to eleven individuals sleep together. Except in the period of excitement at the beginning of the breeding season, the Banded-backed Wrens retire early and arise late, especially on wet or frosty mornings.

They bathe amid wet foliage and engage in mutual preening.

Courtship consists of animated pursuits through the boughs of trees, often culminating in a loud duet delivered from the topmost twigs. There is also chasing on the wing, in which the pursuing bird (the male?) sometimes sings harshly.

As the breeding season approaches the wrens are restless; they have difficulty in settling down for the night and often change their lodging. Out of this confusion emerge mated pairs, which finally select breeding nests. These may be old dormitories to which a few pieces of material are added; but this renovation is without special significance, as it is done to sleeping nests at odd times through the year.

Nests used for breeding ranged in height from 6 feet in a Costa Rican garden up to 40 feet in a Guatemalan oak tree. Since there is no distinction between breeding and dormitory nests, observations on building must be taken to refer to both sorts. Both sexes seem ordinarily to share the work of construction. A male, which had lost his dormitory, built alone while his mate incubated in a neighboring nest.

The eggs are white, sometimes immaculate and sometimes faintly speckled with brown. In Guatemala, three sets of five eggs were found; the first had been laid in March, the second in April, and the third in August or September. The late set was apparently never incubated and the eggs seemed to be infertile. In Costa Rica a nest with three nestlings was found in April.

At a nest where the female was marked, she alone incubated, sitting for 4 to 46 minutes at a stretch and keeping her eggs covered 60 per cent of five hours. The incubation period is unknown.

The nestlings are apparently brooded by their mother alone, but they are fed by both parents and by one or two, and possibly by as many as five unmated helpers. At one nest the marked female left most of the feeding to the other attendants, but she alone brooded.

As a rule, the female alone spends the night in a nest which contains eggs or nestlings, but on one occasion a male which had lost his dormitory and was building another passed a night with his mate and her eggs. The male parent and helpers sleep in another nest, which may be near the breeding nest or somewhat distant. The attendants at one nest slept in a lodge with six occupants, but it was impossible to prove that all of them fed the nestlings.

The nestlings of one brood left spontaneously when 18 or 19 days old.

After emerging from the nest, the young wrens, which can already fly well, are led in the evening to the nest in which they were reared or to some other dormitory. Sometimes they experience great difficulty in gaining the doorway, trying again and again while an attendant encourages them by going in and out many times over. The adults join them later in the evening.

In the high mountains of Guatemala apparently a single brood was reared. After the young-of-the-year can fly well, young and old roam about together and at nightfall retire into a dormitory. One family occupied only three dormitories from May to the end of December. In the same period, another family used five lodges and moved frequently from one to another. Two wrens which built a new nest in June occupied it for the next five months. In this period they were joined by a third individual.

Banded-backed Wrens sleep in dormitories in the warm lowlands as well as in the cold highlands, and the possession of these snug shelters perhaps explains their ability to endure climatic extremes.

Young birds lack the spotted breast of the adults but begin to acquire this, along with other features of the adult plumage, in their fourth month.

GENERAL SUMMARY OF INFORMATION ON THE TROGLODYTIDAE

The wrens are a family of small or, exceptionally, middle-sized passeriform birds containing, according to Mayr (1946:67), 63 species. Although several genera of wren-like birds inhabiting the Himalayas and East Indies have in the past been included in this family, they are probably not true wrens, and their removal from the Troglodytidae leaves this an almost exclusively New World group, with only a single species, the Winter or Holarctic Wren, in the Eastern Hemisphere. This latter is one of the very few species of birds which the New World has beyond much doubt contributed to the Old. The family is richest in species in the tropical portion of the Americas and it is especially well represented in México and Central America.

Wrens are restless, slender-billed birds which lack brilliant spectral colors. Shades of brown prevail in their plumage, which is often variegated with black, white, and gray. Some wrens are remarkably handsome with their rich shades of chestnut or boldly contrasting areas of black and white. The sexes are always alike in appearance, and seasonal changes in coloration do not occur in the family. Wrens have become adapted to a wide variety of habitats, including tropical forest, tangled second-growth thickets, grasslands, marshlands, thorny scrub, cliffs and rocky wastes, and semi-deserts where cacti abound. Others are at home on the high, bleak summits of tropical mountains. But whatever their habitat, they prefer low, dense vegetation and rarely take long flights. Only a few species of wrens are migratory, and these do not perform such long annual journeys as do many other small birds. Of the species which breed in the United States, for example, none migrates as far south as Guatemala. Family ties are strong in the non-migratory wrens of milder regions and they remain in pairs or family parties throughout the year. Even the Carolina Wrens, which live through winters of frost and snow, remain in pairs in this inclement season. In central California, Bewick Wrens may be found in pairs at all times of the year (Miller, 1941:89).

The food of wrens is almost wholly animal. Northern Cactus Wrens seem to include more vegetable material in their diet than most other species, yet even with them fruit pulp, seeds, and other vegetable matter account for only 17 per cent of the food taken (Bent, 1948:227). Most wrens forage inconspicuously in dense vegetation, such as tangles of vines, crowded growths of bushes or weeds, and close-set stands of grass or marsh vegetation. Many species explore piles of stones or brush and some hunt insects in houses and sheds, whereas others forage amid the crevices of rocky outcrops in arid regions. Song Wrens hunt over the dark floor of the tropical forest, pushing up fallen leaves with their bills to see what may be lurking beneath them. Banded-backed Wrens not infrequently peer beneath fallen leaves in similar fashion, and in their search for food Northern Cactus Wrens overturn stones that may weigh more than themselves (Jaeger, 1947). Winter Wrens at times immerse their heads in water to secure prey, or they even walk wholly beneath the surface at the shallow margin of a brook—a habit which suggests that dippers and wrens may be closely related (Armstrong, 1955:25).

Wrens are superb musicians, and the songs of many are unforgettably beautiful. In perhaps the majority of the tropical wrens the female sings, and in some species the female's voice is scarcely inferior to the male's. The female Southern House Wren, however, has only a simple twitter or at best a little trill to answer her mate's brilliant song. In some species, males and females sing in unison. In others, they sing in antiphonal fashion: the male delivers a few notes, then the female sings a phrase which is followed by a phrase from the male. The contributions of the two are so perfectly articulated

that the whole performance seems to be the outpouring of a single gifted songster. Usually one must stand between the two performers, so that the musical notes reach him now from one side and now from the other, in order to convince himself that he is hearing two voices instead of one. In some species these antiphonal songs or duets serve, in place of the simpler call notes which most birds use for the purpose, to keep the mated pair in mutual contact as they forage out of sight of each other in dense vegetation. Perhaps for this reason, as well as because of the great length of the breeding season of many species, wrens sing more constantly throughout the year than nearly all other birds of tropical America. The gloomiest wet weather seems not to quench their ardor for song, and northern species, like the Winter Wren and the Carolina Wren, may sing cheerily on cold winter days.

The songfulness of wrens is further manifested by the nocturnal singing of some species. Notable among these are the Marsh Wren and the Sedge Wren, which at the height of the breeding season sing through much of the night. Winter Wrens have on rare occasions been heard singing at night in both America and Europe (Armstrong, 1955:87). The Marsh Wren often sings while flying. The Carolina Wren has so varied a repertoire that it is reputed to be somewhat of a mimic and is sometimes called the "Mocking Wren." The Bewick Wren is also credited with a certain talent as a mimic. Song interspersed with harsh notes replaces physical combat as a means of settling territorial disputes, either by itself, as in the Bewick Wren (Miller, 1941:91), or when fortified by posturing, as in the Winter Wren, in which grappling encounters rarely occur (Armstrong, 1955:47-49).

The first song of young wrens is usually a low, diffuse, often sweet warble, which bears hardly any resemblance to the loud, clear, stereotyped song of the adult of the same species. Such indefinite, rambling juvenal songs have been recorded for the Winter Wren, Northern Cactus Wren, and Marsh Wren (Armstrong, 1955:85), and also for the Riverside Wren, Chinchirigüí Wren and Southern House Wren. The last mentioned may begin to practice this juvenal song when only 34 days old.

Nuptial feeding seems to be of infrequent occurrence in the family, yet there is a growing number of records. The female is fed by her mate during the periods of egg laying and incubation in the Bewick Wren (Miller, 1941:96; Laskey, 1948:118); she is fed at least during incubation in both American and European races of the Winter or Holarctic Wren (Bent, 1948:152; Armstrong, 1955:128), in the Rock Wren (Bent, 1948:288), Carolina Wren (Laskey, 1948:118; Nice and Thomas, 1948:143), Northern Cactus Wren (Anderson, *in* Nice and Thomas, 1948:143), and the Rufous-browed Wren according to my own observations.

Polygamy is frequent among wrens in the migratory northern species. In his study of the Marsh Wren, Welter (1935) found that from a quarter to a third of the territories held one male and two females. The consorts of the same male were intolerant of each other; they occupied opposite ends of his territory and fought when they met. Welter also discovered one instance of probable polyandry. In the Winter Wren, Kluijver and his colleagues, according to Kendeigh (1941:47), found that almost 50 per cent of the males were polygynous, a few even having three mates at once. Armstrong (1955:103) found that three of eight males at Cambridge, England, were bigamists, and one had virtually three mates. In the Northern House Wren a plurality of mates has been recorded by a number of observers (Bent, 1948:126), and Kendeigh (1941:47) found that about 6 per cent of the matings were polygynous. A male Northern House Wren carried food to both of his mates which were incubating simultaneously and later he assisted in feeding the broods of both of them (Bent, 1948:126). Males of this

species often change mates between the rearing of the first and second broods of the same season. I have found no evidence of departure from strict monogamy among the Central American wrens, which unlike many northern species appear to preserve the bond between the members of the pair throughout the year.

The nests of wrens are in nearly all species either closed, roofed structures, or they are placed in a cavity of some sort, so that the eggs and young are almost invariably protected from the elements. Closed constructions placed in bushes or trees are preferred by most species, especially in the tropics. The largest nests are built by the big cactus wrens; those of the Banded-backed Wren of this group may be a foot in diameter. The walls and roof of these large structures are thickly felted of a variety of materials, and there is an ample doorway in the side. The wren's nest is sometimes roughly globular in form, with a round entrance in one side, as in the Sedge Wren and the Rufous-breasted Wren. In other species the roof of the nest is extended more or less forward over the doorway; in some cases it extends so far that it forms a vestibule or antechamber, which is sometimes almost equal to the nest chamber in size and is entered from below. Nests of this type are found in the Riverside Wren and in the Highland Wood Wren. A nest in the shape of a deep, elongated pocket is built by the Rufous-naped Wren. The Banded Wren and the Song Wren build nests slung over a branch or crotch in the shape of a bent tube or human elbow; the downwardly directed antechamber on one side balances the nest chamber on the other side. Species of *Troglodytes*, including the Northern House Wren, Southern House Wren, Rufous-browed Wren, and Ochraceous Wren, are especially addicted to the use of cavities of the most diverse sorts for hiding away their cup-shaped nests. The Winter Wren, and less commonly individuals of other species of this genus, build a round, roofed nest, which is usually tucked into a cranny of some sort, but at times it is situated in a bush or amid grass. Northern and Southern House wrens, Bewick Wrens, Carolina Wrens, and Marsh Wrens often place fragments of cast reptile skins in their nests, a habit which has given rise to much speculation. Some naturalists regard these exuviae as a sort of talisman to ward off the attacks of snakes, although in my opinion they are collected merely because such soft, papery material is intrinsically attractive to nesting birds. The Rock Wren makes its nest in a cleft in a rock or in a hole in a bank, paving the approach as well as the spot on which the structure rests with small pebbles, fragments of glass, bits of iron or miscellaneous rubbish, sometimes collected in amazing profusion.

Nest building is carried on by both sexes in all species for which we have information. In many tropical wrens male and female work together, taking rather equal parts in the construction of the nest. This appears to be true of the Banded-backed Wren, Rufous-naped Wren, Rufous-breasted Wren, Coraya Wren, Highland Wood Wren, and at least some pairs of the Lowland Wood Wren. In the Southern House Wren, male and female toil side by side to fill with coarse sticks the superfluous space in the cavity chosen for the nest. When this has been accomplished to the female's satisfaction, she gathers fine rootlets, horsehairs and fibers to line the hollow left in the darkest corner for the reception of the nest proper; but her mate, although he may at times bring material suitable for the lining, often continues stupidly to bring superfluous sticks which get in her way. Or he may accumulate a little heap of sticks on his own account somewhere close by.

The male Northern House Wren chooses a territory which includes a variable number of nest boxes or other cavities suitable for nesting. These may number from one to seven, but most often there are but two or three. Into each of these he carries one or more sticks to show his possession, and in some he may lay the substantial founda-

tion of a nest. The female on her arrival is attracted to these cavities which the male has begun to fill with material, and if one meets her approval she brings the lining and completes the nest (Kendeigh, 1941:23-25), or she may throw out the sticks brought by the male and refill the cavity in her own fashion. Similarly, in the Winter Wren, the male builds the shell or foundation of a number of nests (6.2 on the average in the Netherlands); he works by preference in wet or even rainy weather when materials are soft and can be readily molded into the globular nest (Armstrong, 1955:145). The female later selects one of these shells, lines it herself, and here she lays her eggs. On rare occasions, however, the female takes a small or even large part in helping the male to build the outer shell, and the male may even bring some material for the lining (Armstrong, 1955:154-159). The female Carolina Wren may also complete a nest begun by the male, while he takes no part in the final stages of construction. But if no mate arrives, the male may finish the nest alone; in other cases, both sexes begin the nest and then the female completes it alone (Laskey, 1948:116; Nice and Thomas, 1948:139-141). In the Marsh Wren, the situation is somewhat different. Before the arrival of the female, the male begins to build, and before the first brood has taken wing, he may complete as many as ten nests, although five is the average number. He takes about two days to build a nest and may have several under construction at the same time, but some are never finished. When the female arrives, she may add a few straws to one of the male's nests, but the amount she adds is negligible. Soon she sets about building a new nest on her own account, the male taking at best an inappreciable part in the work. This breeding nest is completed in from five to eight days and differs from the male's nests in its thicker walls and its soft downy lining. The brood is reared in this nest (Welter, 1935).

The eggs of wrens are usually white or nearly so. More rarely the ground color is pale blue, as in the Banded Wren, or dull brownish, as in the Marsh Wren. Usually the eggs are speckled or blotched with shades of brown or lilac, sometimes so thickly as almost to obscure the ground color. In a number of species the eggs are immaculate. A number of tropical species lay only 2 or 3 eggs in a set, but even at low latitudes sets of 4 or 5 are not uncommon. Northern wrens lay from 4 to 8 eggs, rarely 9 or 10. The eggs are laid before or soon after sunrise in the Bewick Wren (Miller, 1941:96), the Carolina Wren (Laskey, 1948:117; Nice and Thomas, 1948:142) and the Southern House Wren. In the Marsh Wren they are deposited between 5:00 and 8:00 a.m. (Welter, 1935).

Incubation is performed by the female alone in all species that have been carefully studied. I found Southern House Wrens, Highland Wood Wrens, and Banded-backed Wrens to be impatient sitters, their sessions averaging between 14 and 26 minutes. Seldom did one of these wrens sit as long as 45 minutes continuously by day. A Riverside Wren and a Chinchirigüí Wren, each of which was watched for 3.5 hours, were less restless; the former sat twice for slightly more than an hour, the latter sat once for 55 minutes. A Lowland Wood Wren, which I watched for 7 hours, took sessions ranging from 70 to 98 minutes. These six kinds of tropical wrens kept their eggs covered for from 47 to 65 per cent of the time, which is much less than that of most finches, tanagers, and wood warblers. Among northern species, some are hardly more constant at incubation than these tropical wrens. Kendeigh's (1952:40) vast bulk of data on the Northern House Wren, obtained on 30 females over a total of 332 days, shows that the average length of their sessions is 12.1 minutes, that of their recesses 8.5 minutes, and that their eggs are covered, on the average, 58.2 per cent of the period of diurnal activity. The Winter Wren studied by Armstrong (1955:176-177) took sessions rang-

ing from 16 to 67 minutes and averaging 31 minutes. Her recesses ranged from 6 to 20 minutes and averaged 12.5 minutes, and she covered her eggs for 71 per cent of the two days during which she was observed. The Carolina Wren, however, incubates far more steadily. In 92 hours of observation, Nice and Thomas (1948:145) found that one female's sessions ranged from 31 to 174 minutes and averaged 86 minutes; her recesses ranged from 8 to 84 minutes and averaged 31 minutes. Thus she spent 73 per cent of the time on her eggs. Another Carolina Wren watched by Laskey (1948:105) for 66.6 hours took sessions ranging from 11.5 to 136.5 minutes and averaging 57.5 minutes; her recesses ranged from 9 to 70 minutes, and averaged 33.5 minutes. Thus she spent 63 per cent of the time on her eggs. In all of these northern wrens, the percentage of the day which the female spends on the nest varies inversely with the temperature of the air. The female of the Southern House Wren and the Winter Wren sometimes brings a feather to the nest as she returns to resume incubation, and the female Carolina Wren may add various materials to her nest's lining in the same way.

The period of incubation is 13 days for the Marsh Wren (Welter, 1935), 12 to 14 days for the Sedge Wren (Walkinshaw, 1935:369), 13 to 16 days for the Northern House Wren (Kendeigh, 1952:43), usually 15 to 17 days for the Winter Wren (Armstrong, 1955:169), and 14 to 15.5 days for the Carolina Wren (Laskey, 1948:103; Nice and Thomas, 1948:142). The eggs of some of the tropical wrens take longer to hatch. Repeated determinations of the incubation period of the Southern House Wren gave 14.5 to 15.5 days as usual; 16 days was not uncommon, but 17 days was exceptional. Eggs of the Highland Wood Wren took 19 or 20 days to hatch, those of the Lowland Wood Wren and the Chinchirigüi Wren 18 days; but only a single determination is available for each of these three species.

The nestlings are hatched blind and helpless. Those of the Winter Wren (Armstrong, 1955:212), Southern House Wren, Lowland Wood Wren, and Banded-backed Wren bear sparse natal down, but newly hatched Rufous-breasted Wrens are completely naked. In the family as a whole, the nestlings are brooded by the female only, so far as known. In some species, as the Marsh Wren with its thick-walled nest, they are brooded surprisingly little even in the first days after hatching. The part taken by the male in feeding the young varies in remarkable fashion from species to species and even from race to race of the same species. In the Carolina Wren, Southern House Wren, Banded-backed Wren, Highland Wood Wren, and Rufous-breasted Wren the male shares in feeding the nestlings soon after they hatch and apparently continues to feed the fledglings until they become self-supporting. In the European race of the Winter Wren, the male feeds the chicks at about 40 per cent of the nests and is only very exceptionally more active in bringing food to them than is the female. After they leave the nest he may never attend them, or he may do so sporadically. Sometimes, however, he takes full charge of them and he may feed them after the female has ceased to do so (Armstrong, 1955:192, 224, 226). Some of the northern, insular races of the Winter Wren, such as that inhabiting the Shetland Islands, seem to be normally monogamous rather than polygamous as in the European race. In these races the male appears to take a large part in feeding the young, an arrangement made necessary by the greater difficulty in finding food on these bleak northern islands (Armstrong, 1952). In the Northern House Wren, the male as a rule aids the female in nourishing the young while they are still in the nest, but after they leave he continues to attend them only about half the time (Kendeigh, 1941:47, 53). In the Marsh Wren, Welter (1935) never saw a male bring food to the nest. Perhaps this is not surprising when it is recalled that if he comes near the nest while his mate is incubating she drives him away.

After the young Marsh Wrens leave the nest, the male begins to feed them, gradually warming up to the work until, toward the end of their second week in the open, he seems to feed them more than the female. Walkinshaw (1935:364) says of the Sedge Wren that the young "are fed by the female almost entirely but the male occasionally will stop to feed them." Wrens apparently always carry food to the nest in the bill rather than in the throat.

Injury simulation is very rare in the family. When I approached a low nest of the Rufous-breasted Wren whose eggs were on the point of hatching, she fluttered over the ground in a fairly convincing display; this was the only performance of this character that I have witnessed in the family. Nice and Thomas (1948:152) on one occasion saw "a mild form of 'distraction-display'" given by a male Carolina Wren whose fledgling screamed as it was caught for banding. Hebard (MS) records instances of injury simulation by the Northern House Wren and the Marsh Wren privately communicated to him by the observers. In all of these species, distraction displays appear to be exceptional. Usually wrens keep discreetly at a distance when one visits their nest. Yet Banded-backed Wrens, which seemed indifferent when I came to see their nestlings, ventured within a few inches of a large snake which was swallowing the young. A family of Riverside Wrens attacked a big snake which was not even near a nest.

The nestling period of the Sedge Wren is 12 to 14 days, of the Marsh Wren 14 days, of the Northern House Wren 15 or 16 days, of the Carolina Wren 12 to 15 days, of American races of the Winter Wren 17 to 21 days, and of the European race of the same species 12 to 17, usually 15 days. Most Central American wrens remain in the nest considerably longer than most northern wrens—from 16 to 18 or rarely 19 days in the species I have studied. Great care and patience are needed in the determination of the true nestling period of wrens; it is difficult to see the young in their well-enclosed nests, and if they are disturbed by the ornithologist's visit, they will rush out prematurely.

The young of the Winter Wren find some of their food only four or five days after leaving the nest (Armstrong, 1955:224), whereas those of the Marsh Wren and the Southern House Wren may begin to feed themselves ten days after leaving, if not sooner.

Multiple nesting is an unusual acceleration of the reproductive process which has been observed in wrens and in a few birds of other families (Skutch, 1953c:143). Both the Northern House Wren (Kendeigh, 1941:46) and the Southern House Wren may at times begin to build a new nest before the young of the previous brood have taken wing. The female of both these species on rare occasions may start to lay another set of eggs before she has finished taking care of her earlier brood.

Helpers at the nest have been discovered in several species of wrens. At one nest of the Banded-backed Wren at least two additional individuals assisted the parents in feeding the young, and at a second nest there was a single helper. On the rare occasions when their parents permit them to sleep in the nest space after the subsequent brood hatches, young Southern House Wrens may take a large share in nourishing their still younger siblings. In one family, young of the first brood attended nestlings of the second brood, and one of the latter, when older, helped to take care of the third brood. A pair of Winter Wrens took over the care of fledglings of their own kind which had been hatched and partially reared by a pair of Great Tits (Armstrong, 1955:104-105). These are the only instances that have come to my attention of wrens attending young of their own species other than their own offspring, but there are a number of records of wrens feeding birds of other families. A Winter Wren nourished two fledgling Spotted Flycatchers after they had left their nest which was close to that of the wren. A

male Winter Wren fed nestling Great Tits while his mate was incubating, and he continued his attentions to the neighbors' brood for at least four days. Winter Wrens have also been known to feed young Willow Warblers and Linnets and to help Hedge Sparrows to nourish a European Cuckoo reared by the sparrows (Armstrong, 1955: 233-234, 242). A Northern House Wren fed parent grosbeaks of both sexes while they sat brooding their nestlings, and the grosbeaks passed some of this food to their young. After the young grosbeaks left the nest, the wren persisted in nourishing them, and a few days later it brought food to a family of House Sparrows (Bent, 1948:125-126). A male Carolina Wren whose mate was incubating in a nest box not only fed her but also fed young Crested Flycatchers in a neighboring box (Wight, cited by Laskey, 1948:118).

The sleeping habits of wrens are of special interest. Unlike most birds, wrens as a rule do not roost in the foliage but retire at nightfall into some snug, well protected shelter. Probably the majority of species, especially in the tropics, sleep in nests which they have built. These may be essentially similar to the breeding nest in form and situation, or they may differ markedly in both particulars. In the Riverside Wren, Highland Wood Wren, Song Wren, and Banded-backed Wren, differences between the breeding nests and dormitory nests are slight or none. But the dormitory nest of the Lowland Wood Wren, a thin-walled, roughly globular structure with a wide opening in the side, situated from two to ten feet up in the undergrowth of the forest with little attempt at concealment, is very different from the thick-walled breeding nest. This last is built much nearer the ground and so cunningly concealed that it is rarely found by man. Likewise the flimsy horizontal pocket of straws which the Chinchirigüí Wren builds for a dormitory is much less substantial than the breeding nest of the same species, and the Rufous-breasted Wren at times roosts in a structure far slighter than that which it builds for its eggs. The dormitory nests of both the Chinchirigüí and the Lowland Wood wrens could not be used for rearing a family because they are so shallowly cupped that eggs would probably roll out. Similarly, dormitory nests of the Northern Cactus Wren, especially those that are presumably built by young individuals, are much slighter than the breeding nests and have scarcely any entrance tunnel (Bent, 1948:229).

Species of *Troglodytes*, including the Southern House Wren and the Rufous-browed Wren, sleep in natural cavities rather than in nests of their own construction. The roosting places of the former are most varied, including holes in trees, niches in banks, a nook in a thatched roof or beneath roof tiles, and a space in a bunch of bananas. Some individuals even pass the night in an old, open nest of another bird or in closely clustered foliage, where they are not shielded from rain. The Winter Wren, which builds a more elaborate nest than these congeneric species, not infrequently roosts in the unlined shells of nests built by the males, or it may sleep in a finished nest in which a brood was not reared. But in the coldest weather it also seeks warmth in any quiet, snug niche that it can find. The Bewick Wren has been discovered roosting in a variety of situations, including holes in trees, nest boxes, crannies in the sides of buildings, the bough of a pine tree beneath a thick canopy of fallen dead needles caught upon it (Williams, 1941:277-281), and in an open nest of a Western Flycatcher built beneath the eaves of a garage (Williams, 1942:243-244). Carolina Wrens have been found sleeping by pairs in old hornets' nests on cold winter nights (Brooks, 1932) and in a fold of an old portiere hanging in a garage (Laskey, 1943:2). Others have reported Carolina Wrens sleeping singly in a pocket of an old coat hanging on a porch, between two timbers on the inner wall of a garage, and in a pile of cedar boughs (Ganier, 1943:4).

The number of individuals which sleep in the same dormitory varies with the species. Adults roost singly in the Southern House Wren, Rufous-browed Wren, Lowland Wood

Wren, Chinchirigüí Wren, Rufous-breasted Wren, Bewick Wren, Northern Cactus Wren, and others. Pairs, or family groups consisting of parents and young no longer dependent on parental care, sleep together in the Highland Wood Wren, Banded-backed Wren, Rufous-naped Wren, and Song Wren, and at times this is true of the Riverside Wren, the Rufous-browed Wren, and the Carolina Wren. In wrens as in other avian groups, extreme cold may cause birds usually found solitary to sleep in dense masses for mutual protection. Armstrong (1955:275-282) believes that the combination of high humidity and low temperature is most effective in causing Winter Wrens to roost socially. In cold, damp weather these wrens, which most of the time sleep singly, may congregate from a wide area to huddle together in any protected nook, where if sufficiently numerous they sleep in tiers, with their heads toward the center of the cluster and their tails outward. As many as 46 of these diminutive wrens have been found sleeping together in a nest box in the British Isles, while in western Washington in the United States 31 individuals of another race of this same species crowded together in a bird box that measured only 6 inches in each dimension (Bent, 1948:175-176). As soon as milder weather returns, the territorial exclusiveness of the Winter Wren reasserts itself and the groups disperse. Thus, paradoxically, in wrens, as in other organisms, a harsh environment may cause greater apparent sociability in animals intrinsically unsocial than is ever witnessed in tropical species which have actually a more highly developed social structure and preserve their family bonds for longer periods. In the tropics, the greatest number of wrens I ever found sleeping in one nest was eleven; the species in this instance was the highly sociable Banded-backed Wren.

Wrens of a number of species lead their newly-emerged fledglings to sleep in some suitable shelter, either the nest which they have just departed or some neighboring dormitory. This is true of the Winter Wren (Armstrong, 1955:228-233), the Bewick Wren, Northern Cactus Wren, and, at least occasionally, the Northern House Wren (Bent, 1948:178, 226, 126), and, according to my own observations, this also occurs in the Banded-backed Wren, Lowland Wood Wren, Highland Wood Wren, Southern House Wren, and Ochraceous Wren. In some and possibly all of these species, the adults show the fledglings what is expected of them by going in and out of the nest several times in their presence, until the youngsters still shaky on the wing succeed in following. The parents, or one of them, may or may not sleep in the same dormitory with the fledglings. In the solitary sleepers such as the Southern House Wren, Lowland Wood Wren, and Northern Cactus Wren, the several members of the family seek separate lodgings as the young cease to be dependent on parental care. In the gregarious sleepers such as the Banded-backed Wrens, the youngsters use the same dormitory as the adults long after they have become self-supporting. This leads to interesting forms of cooperation in the following nesting season.

Exceptionally, male wrens sleep in the nest where their mate is incubating eggs or brooding young. This has been observed in the Banded-backed Wren, Highland Wood Wren, and Southern House Wren, but in all of them it appears to be a temporary arrangement caused by unusual circumstances. Rarely, too, young Southern House Wrens and juvenal Winter Wrens (Armstrong, 1955:230) are permitted to sleep in the nest space where the female is incubating a subsequent set of eggs or attending the nestlings of the following brood. Then the young, at least in the case of the Southern House Wren, may help to feed their younger brothers and sisters.

Welter (1935) could find no evidence that male Marsh Wrens ever slept in any of the many nests that they built with such tireless energy, or that the fledglings took shelter in the nests, which, at the season when they emerge, are so abundant in the

marshes; on the contrary, they roosted on the flags. Yet in another race of the Marsh Wren the young may lodge in these extra nests (Bent, 1948:263). Likewise Kendeigh (1941) failed to discover Northern House Wrens using as dormitories any of the nest boxes with which they were so liberally supplied, and into which the males had carried sticks. Other observers, however, have seen the parent House Wrens lead a newly emerged brood to sleep in a nest box near that in which they were reared. Sometimes young of this species have been led to open nests of other species of birds or to the dense foliage of a pine tree or shrub (Bent, 1948:126). The supernumerary nests built by the males of Marsh Wrens and other species have long been known as "dummy nests," and it has been assumed by numerous ornithologists that their function is to confuse predators and thereby diminish the frequency of their devastating visits to occupied breeding nests. But in the non-migratory species of the tropics, which greatly outnumber the migratory species of wrens, there is no longer room to doubt that these always eggless nests are built primarily as dormitories; the readiness of the canny occupants, if disturbed as they retire in the evening or during the night, to desert their old lodging and build another, explains the multiplication of these structures.

The building of far more nests than are ever used by Marsh Wrens, Winter Wrens and other migratory or far northern species doubtless represents the survival of an ancestral custom by wrens that have adopted a wandering mode of life in which the usefulness of a regular abode in the form of a dormitory nest is greatly diminished. Yet in these species the habit of building a plurality of nests has acquired a new and most important function. They are now an integral part of the pattern of activities by which the male wins a mate; for only if he possesses at least the foundation of a nest that gains the approval of a female which comes to inspect his territory, will she stay with him. Even the males of species in families not known to use nests as dormitories, as, for example, the Whitethroat and the Phainopepla, build nests in advance of the arrival of the female. But whatever other functions the building activities of wrens may serve, we can hardly doubt that they provide a convenient outlet for the excessive energy of these dynamic little birds, which must find some avenue of escape whether useful or not.

FAMILY PARIDAE

BLACK-EARED BUSH-TIT

Psaltriparus melanotis

Although many of the birds of the Guatemalan highlands are of kinds which a bird-watcher from the North Temperate Zone would expect to find in a region of pines and oaks, there are no chickadees or other species of *Parus* present in Central America. Their place is partly taken by a close relative, the Black-eared Bush-tit, a tiny grayish bird about four inches in length. In the male the top of the head is slate-gray, and the sides of the head are covered by a black patch that extends around the hindneck as a narrow collar; the remaining upper plumage is olive-brown; the throat is white, and the breast is pale buffy-gray deepening to cinnamon-buff on the abdomen. The bill and feet are black and the eyes are dark. The female resembles the male except that her cheeks are light brown instead of black, which color is confined to a patch behind the ears, and her eyes are pale yellow. The species ranges through the mountains from the southwestern United States to the Guatemalan highlands. Van Tyne and Sutton (1937:65-67) found this species and the Common Bush-tit breeding in the same area in Brewster County, Texas, where they behaved like distinct species. These observations make it unlikely that Hellmayr and others were correct in considering *P. minimus* and *P. melanotis* as conspecific.

Through most of the year these lively little birds roam through the more open woods and bushy fields and pastures of the Guatemalan *altos* in flocks of from a dozen to a score of individuals. They maintain a constant low, lispng conversation and exhibit all the agility of a chickadee in clinging to the tips of the twigs in every conceivable position while they pluck from the bark and foliage the small insects upon which they subsist. Most of the time they stay well concealed in the crowns of trees or bushes, from the midst of which they emerge only long enough to pluck food from the exposed extremities of the branches. Sometimes the flock of bush-tits joins a large party of migrant and resident wood warblers and other small birds, such as form during the months of the northern winter, but more often they keep to themselves. It is noteworthy that in these flocks the black-faced, dark-eyed males far outnumber the brown-cheeked, yellow-eyed females by four or six to one. Usually it is impossible to count them accurately as they move restlessly among the foliage, but once a flock foraged in the low herbage of a garden, where it was easy to make an enumeration, and I counted eleven males and only one female. Among the Black-eared Bush-tits in Texas, Van Tyne and Sutton found a ratio of five males to one female.

On the Sierra de Tecpán, in the Guatemalan department of Chimaltenango, the Black-eared Bush-tits are confined to the region where oak trees grow, and I did not meet them above 9000 feet, the upper limit of the oaks. I never saw a bush-tit among the cypress forests on the mountain top. The lowest point at which I encountered the bird was at about 5000 feet above sea level, in the scrubby oak woods on the slopes above Lake Atitlán. Farther north, on the Sierra del Carmen in the state of Coahuila, México, Miller (1955:168-169) found Black-eared Bush-tits between 4800 and 8000 feet above sea level.

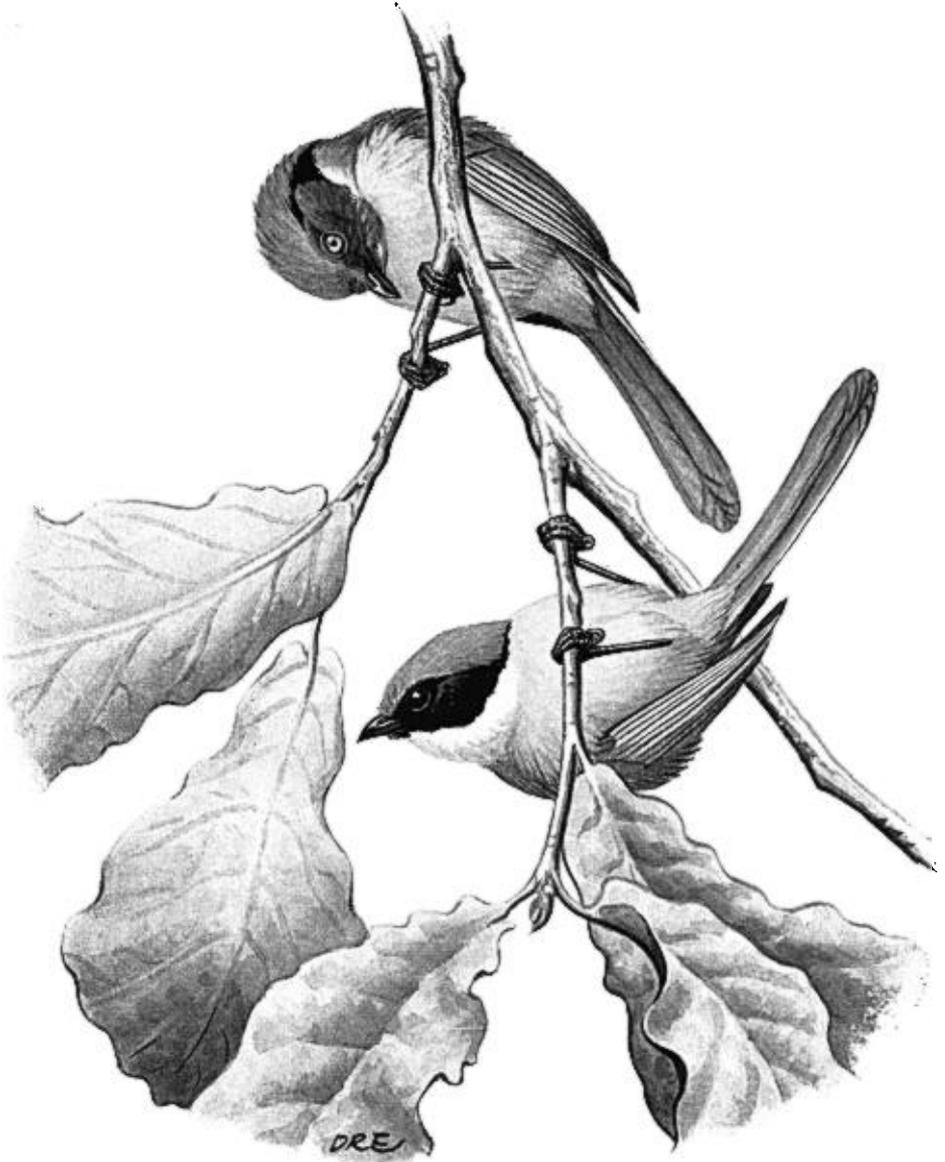


Fig. 37. Black-eared Bush-tit. Female above, male below.

FOOD

Although the bush-tit of California is reported to consume about 19 per cent vegetable matter (Bent, 1946:445), I never noticed the Black-eared Bush-tits take anything but the small invertebrates they were constantly gleaning from the finer twigs and foliage of trees and bushes. Nestlings were fed on minute insects and green larvae, with rarely a small moth or butterfly.

VOICE

Apparently the Black-eared Bush-tit has no true song. While foraging it keeps up a constant chatter of low, lisping notes, and at times it utters fine, wiry or sibilant twitters. The strongest and most musical notes which I heard were, oddly enough, full and somewhat mellow chirpings voiced by parents alarmed for the safety of their nestlings.

NEST BUILDING

On my first visit to the Sierra de Tecpán, in November, 1930, I found the remains of an old nest, which even in its ruins was a marvelous structure, quite unlike any other nest I had ever seen. I wondered greatly what species had made the delicate fabric, but it was impossible to find the answer at that season. All that the people whom I questioned could tell me was that the nest belonged to a *gorrión*, which is a name applied to any small bird from a hummingbird to a sparrow.

My question was finally answered early in March, 1933, when I found the recently begun nest of a pair of bush-tits on the open, bushy mountainside, just below the main entrance road to the hacienda "Chichavac." It was suspended eight feet above the ground from a fork of the thorny, downy-leafed *Solanum mitlense*, in a scarcely penetrable little thicket of this odd, coarsely branched shrub. A prettier location would have been hard for the birds to find; for just above the nest, on the roof of the thicket, clustered the big, pale lavender blossoms of the shrub. The nest itself, a delicate, pear-shaped pouch, 6½ inches long, hung beneath the fork, with its round entrance at the top, between the arms. It was still a very open, extremely frail fabric, composed of finely branched, gray foliaceous lichens and held together by cobweb, aided no doubt by the fine, ciliate projections from the lichen itself. Only one kind of lichen, a species abundant on the bark of trees, had been employed. Mixed with the lichens were tiny pellets of down and bits of the cocoon cases of spiders.

The nest had still practically no lining, and the birds were busy adding to it. I found a little hollow on the slope above the nest where I could lie, partly concealed by the herbage, and watch the pair of bush-tits at their work. Looking over the tops of the bushes in which the nest was building, I could see spread out before me all the great tableland of Chimaltenango, stretching in misty vastness to the great volcanic cones which towered far above the intervening ridges. Only the small, black, biting flies, which were out in force that fine morning, interfered with my complete enjoyment of the situation.

Both the male and female bush-tits joined in the arduous task of finding enough downy material to line their ample pouch. Usually they came and went together, but each occasionally brought material to the nest in the absence of its mate. When the two arrived together with down in their bills, sometimes it was the male, sometimes the female, which first entered the pouch. After attaching the material on the inside, the bird made vigorous movements to work it into the fabric and shape the structure. These movements were revealed to me by the swaying of the nest and the vibrations of its walls which were so vigorous that one might imagine they would tear asunder the frail fabric. The work of shaping the structure was largely undertaken by the female, and once I slowly counted ninety while she was so employed. The male generally stayed inside for a shorter period, but once he kept the walls in motion for thirty counts. Sometimes he compensated for his partner's greater activity in this branch of the work by finding, while she was occupied within, some trifle to be added to the structure. He had a habit, upon leaving the nest after having deposited his contribution, of flying back to it immediately with empty bill. He would sometimes repeat this useless activity three or four times in succession.

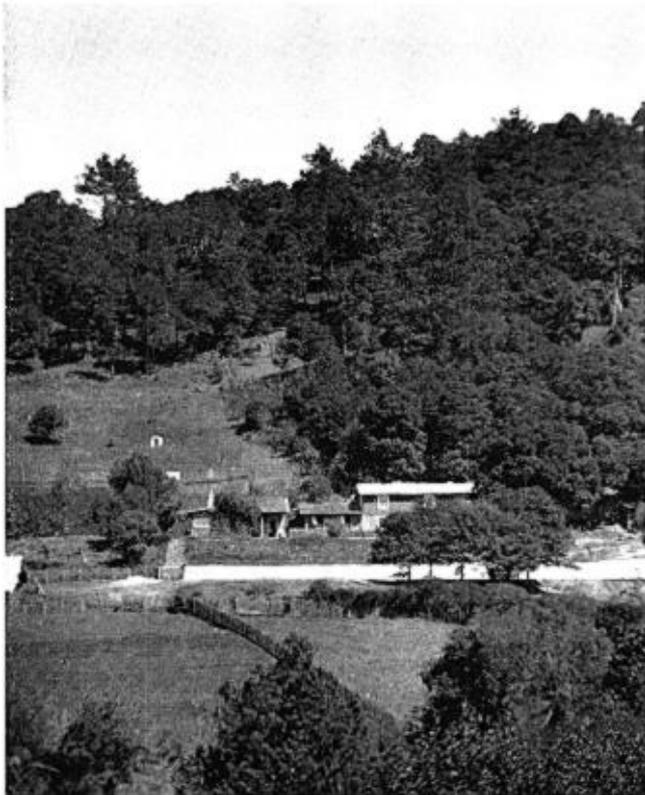


Fig. 38. Mixed woods of pines and broad-leaved trees, including many oaks, surrounding pastures on the Sierra de Tecpán, Guatemala, at about 8500 feet. Here lived Black-eared Bush-tits, Banded-backed Wrens, Rufous-collared Thrushes, Steller Jays, and Mexican Trogons.

The male was always the more wary and circumspect in his approach to the nest. If I left my imperfect concealment and advanced a little closer to the scene of activity, the male, upon arriving with a billful of down, fluttered and fidgeted around, uttering fine little chirps of alarm. He would not go near the pouch at all, or, at best, he would go to it only after considerable delay and excitement. The female, under the same conditions, would go directly to the nest and unconcernedly add her material, then she would make the necessary adjustments. Even when I stood only ten feet away and fully exposed, the female, after hesitating a brief interval and making several false starts, entered the nest with her contribution; but the male fluttered to and fro in the background, calling in the greatest excitement, and would not come near it.

At another nest, which I watched later, this situation was reversed. Here the female was very timid, and it was long before she would enter in my presence; but her mate went right in, apparently unmindful of me. This pair also differed from the first in another respect, for instead of each waiting its turn to take the down into the pouch, they sometimes entered together and worked simultaneously. Although in this pair, too, both shaped the nest, again it was principally the female which attended to this part of the work.

I was eager to learn the origin of the down which the bush-tits were using to line their nest, so I carefully removed little bits and examined them with my pocket lens. Those samples which were not cobweb consisted largely of the star-shaped hairs, each with from four to eight arms, which so profusely covered the leaves of the *Solanum* bushes among which the nest was suspended. Some fragments contained only white hairs from the lower side of the leaf; while others, which came from the margin of the leaf, showed on one side the dense white down from the lower surface of the leaf, and on the other the sparse, rust-colored hairs from the upper surface. Examining my samples more closely, I discovered that the little pieces from the margins of the leaf could be readily unfolded, for the central tissue had been wholly removed. I could not at first understand how the birds had extracted that central tissue, but I admired their elegance in using only such light material instead of pieces containing the entire thickness of the downy leaf. Nor did I comprehend how they obtained the fragments consisting of the lower epidermis and its attached hairs alone. I could not pluck off such fragments with my fingernails or pocket knife, and the average first-year student of botany is unable to prepare such neat samples of epidermis even when using a razor.

After pondering the problem at some length, it occurred to me that perhaps the bush-tits had taken advantage of the work of a leaf-mining insect which eats away the central tissue from the epidermis of the leaf. The following morning I made a search among the foliage of the *Solanum* bushes and found the creature that I sought, a slender white larva (greenish from the leaf tissue it had eaten), about a quarter of an inch in length. Like other leaf-miners, it lived in the interior of the leaf, consuming the soft central tissue but leaving the epidermis as covering and protection for itself. The bush-tits had sought out these bits of epidermis which had been cleaned by the larva, torn them from the leaf, and added them to the nest, doubtless at the same time eating the larva. At times the leaf-miner left its tunnel, and biting the hairs from an area on the lower surface of the leaf, fastened them to the outer side of a close-spun fabric that it wove. Beneath this coverlet, which usually lay along a vein, the larva took refuge. These long, narrow, little strips were also used by the birds, for I found one in the nest. The larvae were not abundant, and it was necessary to examine numbers of leaves to find traces of their work. Like the White-eared Hummingbirds (see Skutch, *in* Bent, 1940: 456-457), the bush-tits were dependent upon the activities of insects to make available to them the plant down so necessary for the construction of their nests.

It was no easy matter for the diminutive birds to obtain the cobweb that they needed as binding for their pouch. One morning I watched a pair of bush-tits struggling to loosen a spider cocoon from the end of a fine, low twig. The male first tackled it, clinging beneath the twig, back downward, while he tugged at it with his bill; but the tough material was obdurate. Failing to achieve his purpose so, he released his grasp on the twig and, still holding the stuff in his bill, hung for a moment beneath it, as I have seen Montezuma Oropendolas do when striving to pull a fiber from another's nest or bill. This method, too, was unsuccessful; so he relinquished the cobweb and the female made a trial at it, using identical tactics, and likewise failing. Then the male, now rested from his previous exertions, tried again, and this time he secured a portion of the web, a long white shred very conspicuous in his bill. Again the female made an attack upon the remainder, hanging first back downward, then pivoting backward until her head pointed to the ground, as she stretched out the elastic fabric. Next, still holding the cobweb in her bill, she released her grasp on the twig and fell on the strand, which parted under the impact. Then the pair flew off toward their nest with their hard-earned prizes in their bills.

The bush-tits seemed to know the best places for finding feathers. One day at the

end of March, while I watched a pair of White-winged Doves incubate their two eggs, a pair of bush-tits discovered, on the branches below the shallow nest, some downy feathers that doubtless had been shed by the doves. They proceeded to collect these with much twittering. The black-faced male was the more active and gathered the larger billful. The male dove covering the eggs was quite indifferent to these tiny visitors which were very active within a foot of where he sat.

Two other nests, one finished and the other nearing completion, were found in the same locality at the beginning of April. Both were in shrubby composites growing in bushy openings with scattered trees. The three nests were, respectively, 8, 10, and 13 feet above the ground. Unfortunately, I did not find any nest at the very beginning of its construction, and accordingly I did not learn how the delicate fabric of lichens was put together or how many days were required for the entire work of building the nest. One pair was occupied nearly three weeks merely in applying the lining (before the eggs were laid); from this it would appear that the building of the nest takes a month or more. Addicott (1938) found that in California the Common Bush-tit may take from 13 to 51 days (average 33.2) to build a similar nest; the work proceeds more rapidly as the season advances. Like the Black-eared Bush-tit, the male and female of this species share in building the nest. Owen (1945) states that the Long-tailed Tit of Great Britain spends about 21 days in building its almost equally elaborate nest, which is stuffed with innumerable feathers. In this species also both sexes work at the nest.

Completed nests of the Black-eared Bush-tit measured from 6 to 6½ inches in length by 2½ inches in greatest diameter, a point a short way above the rounded bottom. In the bottom there was an ample cushion of vegetable down, about three-quarters of an inch thick, and over this was laid a thick, soft coverlet of downy feathers upon which the eggs reposed. The soft, delicate fabric of the walls admitted both light and air, but from the outside the nest appeared entirely opaque. The top was hooded, with the circular doorway in the vertical plane, facing sideways, and between the arms of the supporting crotch. The complexity of these nests, coupled with their marvelous delicateness, make them one of the most wonderful examples of bird architecture that I know. As exquisitely finished as are the nests of hummingbirds and gnatcatchers, they far surpass these in size and in the degree of comfort they afford the occupants. The construction also demands far more skill.

THE EGGS

On the Sierra de Tecpán, between 8000 and 9000 feet above sea level, the eggs were laid in two nests in the first week of April; in the third nest they were laid in mid-April. In two of these nests the eggs were deposited on consecutive days. In each of three Guatemalan nests, the set consisted of four pure white eggs, which I could see by carefully pushing back the hooded top and peering down with one eye. For fear of injuring nest or eggs, I never removed the contents of occupied nests; but a single egg from an abandoned nest measured 13.5 by 9.5 millimeters.

INCUBATION

Incubation is performed by both sexes. Even before the eggs were laid, male and female slept together in the nest, taking advantage of it to shield them from the nocturnal cold of the high mountains where frost whitened the open fields on every clear and starry night until the beginning of April.

Because there were so many more males than females, all of the former, of course, could not find mates. These attached themselves to the mated pairs, which they aided

in the duties of the nest and the care of the young. It was not, as far as I could learn, a case of polyandry. While I watched the construction of the two nests, I detected the presence of a single male and female at each. Later, when more than one male took an interest in the nest, there was a difference in their behavior which seemed to indicate that one alone was the female's mate and the others merely unmated helpers. Thus it did not appear to be the custom for more than one male (the mate) to sleep with the female in the nest while it contained eggs. In one nest (no. 3), I found two males passing the night with the female just after the set of eggs had been completed, but this arrangement did not last, and later only the mated male spent the night with the female and her eggs. According to the number of helpers and the part they played, there were slight differences in the histories of the three nests which I studied.

During the period of incubation, it was customary for the male bush-tit to emerge first from the nest in the morning, leaving the female to keep the eggs warm while he sought his breakfast. After snatching a hasty meal amid the dew-spangled foliage, he returned to relieve his partner. Sometimes she seemed to be a trifle reluctant to quit the nest, and he was obliged to go inside and urge her to depart. At other times she came forth when she heard his returning voice, and he entered at once to cover the eggs. She then flew off among the trees to forage, and when her hunger had been satisfied, she came back to take another turn on the eggs and give her mate an opportunity to augment his hastily gathered repast. So they replaced each other, many times, in the course of the day. When the bird which was warming the eggs heard the voices of its companions in the vicinity of the nest, it called in fine, sibilant or wiry twitters, which were sometimes kept up continuously for minutes at a time. On other occasions the bird's desire for companionship was so strong that it left the eggs unattended while it went off to join its mate and the helpers. Flocks consisting almost wholly of males wandered about at the height of the nesting season.

In the early morning, while the air was still cool, the bush-tits sat fairly constantly on their eggs, at times for a quarter to half an hour continuously. But as the rising sun warmed the air, they became most impatient sitters, and many times they were hardly well settled in the nest before they were ready to leave it again. They were, in fact, among the least constant on their eggs of all the birds I have watched. During three hours in the middle of the day (10:30 a.m. to 1:30 p.m.), one pair, male and female together, kept the eggs covered exactly one-half of the time. In the early part of the afternoon, the bush-tits sometimes went away and neglected the nest entirely for considerable periods. Addicott found that in California the bush-tits incubated fairly constantly in cool weather, but that they were most inattentive to their eggs when the air was warm. In many other species of birds of which both sexes incubate, the eggs are almost continuously covered no matter how warm the day. But as the sun sank low and the thin mountain air rapidly cooled, the bush-tits gave increasing attention to their eggs; the male and female retired early to sleep in their snug pouch, while many other diurnal birds still foraged and sang.

I watched nest 2 from 5:30 to 11:30 a.m. on April 10, six days after the last egg was laid, and from 6:05 a.m. to 1:30 p.m. on April 18, when the eggs were nearly ready to hatch. Combining the two records and disregarding that portion before the beginning of activity at 6:07 on the morning of April 10, in the course of nearly 13 hours the male covered the eggs for 30 periods ranging from one to 31 minutes and averaging 8.5 minutes. The female was in the nest 22 times for periods ranging from one to 22 minutes and averaging 8.8 minutes. The eggs were left unattended for 37 periods ranging from one to 34 minutes and averaging 8.3 minutes. Thus they were incubated only 59.5 per cent of the 13 hours. This was the nest to which one male helper brought

material during the period of incubation, although he was not seen to take a turn on the eggs. Nest 3 was watched from 5:30 to 10:30 a.m. on May 5, near the end of the period of incubation. The male first left the nest at 5:53, and from then until 10:30 he incubated for 11 periods ranging from 2 to 23 minutes and averaging 10.8 minutes. The female took 8 sessions varying from one to 18 minutes in length and averaging 10.6 minutes. The eggs were neglected for 11 periods varying from 2 to 13 minutes and averaging 6.4 minutes. They were covered 74.5 per cent of the 4½ hours. In comparing this record with that for nest 2, it should be remembered that it does not, like the latter, cover the midday hours when incubation is least constant. At each nest, the average lengths of the sessions of the male and female were very nearly the same, but the male took more and longer sessions. By day he covered the eggs considerably more than his mate. At nest 2 the male was in the nest 255 minutes and the female was in it 194 minutes; at nest 3 the male spent 119 minutes in the nest, whereas the female spent 85 minutes.

Apparently the bush-tits felt about their warm, downy nest much as I did about my woolen coat; it was far too hot to remain on the inside of it during the middle of a bright, sunny day, yet after sunset I would gladly have had it a little thicker. So, trusting that the thick bed of down and feathers would keep the eggs warm during their absences, they devoted much time to seeking more material to add to the lining or hunting for downy feathers to lay beneath the eggs. They tucked the cottony material chiefly into the inner wall of the upper part of the pouch, around the doorway, or inside the hood. This latter became greatly thickened and at one nest was extended forward during the period of incubation. In addition to fetching more building stuff, there was a certain amount of repair work to be done. Little tufts of down were constantly coming loose, and it was necessary to attach them more securely. At intervals both male and female left the eggs momentarily to climb up to the top of the nest and tuck in a loose tuft here and there. Undoubtedly they performed the same office in the interior portions of the nest which were not visible through the entrance. This would account for much of the mysterious and rather vigorous shaking of the structure that I noticed while a bush-tit was within, presumably incubating. The exterior of the nest was scarcely ever touched; I never saw any new material added there after the eggs were laid, and its durable covering of lichen and cobweb seemed to require no repair work.

At nest 2, a bachelor male took an active part in bringing material during the period of incubation. I fixed a fine twiglet transversely across the entrance and placed a few drops of red paint upon it, hoping that one of the males would rub against it on entering or leaving and so acquire a distinguishing mark. But the wary birds would not attempt to push past the obstruction, and my efforts to mark them were in vain. There was, however, a difference in behavior between the males. One was often extremely careless in attaching the tuft of down which he brought, merely placing it against the wall and not taking the trouble to tuck it in carefully, with the result that it might be brushed out by the next bird that passed through the entrance. The other male took pains to attach his material securely before he left it, and in addition he made himself responsible for putting in order the slipshod work of the first. The careful male also warmed the eggs, and I could not doubt that he was the mate of the female. He gave the helper so many opportunities to replace him on the eggs, of which the latter always failed to take advantage, that it is unlikely that the helper ever incubated.

At times the careful male, upon leaving the nest after a turn on the eggs, emerged with a little tuft of down in his bill and carried it away. This seemed to be pure absent-

mindfulness, but it illustrated well the bush-tits' absorption in the materials of the nest at a time when most incubating birds devote themselves wholeheartedly to their eggs. Sometimes the bush-tit, as he was about to fly away, remembered that he was carrying off a portion of the nest and turned around to replace it before going off. The habit of holding a fragment of material in the bill when leaving the nest is well developed among Rufous-breasted Castlebuilders, and more rarely the Rose-throated Becards do the same thing. Both of these species build very large and elaborate nests.

A few figures may help to convey a more adequate notion of the assiduity which the bush-tits displayed in bringing material to nests where incubation was going on. They did not begin this activity until seven o'clock in the morning or a little later, about an hour after they first left the pouch to hunt food. At nest 2, between 7:11 and 11:30 a.m. on April 10, two or possibly more males brought material 25 times, the female 7 times, making a total of 32 billfuls in about 4½ hours. At the same nest, from 7:07 a.m. to 1:30 p.m. on April 18, the males brought material 33 times, the female 8 times, making a total of 41 billfuls in about 6½ hours. At nest 3, from 7:00 to 10:30 a.m. on May 5, one or possibly more males brought material 17 times, the female 4 times, making a total of 21 billfuls in 3½ hours. The bush-tits continued industriously to add to the lining of their nests until the nestlings were hatched.

At nest 1 the fourth and last egg was laid on April 7; there were two nestlings on April 21 and four on April 22, giving an incubation period of 15 days. At nest 2 the period of incubation was 15 or 16 days.

THE NESTLINGS

After the nestlings hatched, their constant demand for food left their attendants little time for finding down and feathers. Thus only rarely was a bit of material added to the nest. But the maintenance of the elaborate pouch was not neglected, and often while feeding nestlings the adults took time to tuck in bits of down or other materials that were coming loose. The bachelor males which had attached themselves to the mated pairs now gave active assistance in feeding the nestlings, and at two nests they even took turns brooding them. The number of these male helpers differed at the several nests. I carefully watched all three of my nests during this period, and at nests 1 and 3 I found only a single assistant. At night these helpers were permitted to sleep in the nests along with the mated pair and the nestlings—no small reward for their services, for the nights were always chilly at these high altitudes. I wondered how the tiny nestlings fared with three full-grown birds sleeping above them, but they seemed to suffer no ill effects, and there was not a single mortality.

Nest 2 was indeed fascinating to watch. This was the nest to which the helper brought material while there were eggs. This helper now aided in feeding the nestlings, but at first he did not take advantage of the privilege of sleeping with them at night. When the nestlings were twelve days old, however, I paid them an early morning visit and watched two males come out of the nest, and five minutes later the female followed. Two mornings later, I was surprised to see three males emerge from the nest where they had evidently passed the night. The nestlings were now well feathered, and the four of them, with their parents and the two helpers, made a total of eight sleepers in the little pouch. They undoubtedly were packed away in tiers, some on top of the others. It was noteworthy that the adults, now that they had hungry mouths to fill, arose considerably earlier than they had while there were only eggs in the nest.

A male gave the nestlings their first food at 5:55 a.m., and for the next three hours I watched a scene of ceaseless activity. Although only three males had slept in the nest, at least four were bringing food to its occupants. Three of these were helpers, the

fourth was the male parent. With the female parent, the nest had five attendants in all, and the attendants outnumbered the nestlings. It is a pity that the bush-tits are not, like the Brown Jays of the lowlands, naturally provided with marks which serve to distinguish individuals. If they were, I might have found that more than four males fed the nestlings in the course of the morning. But I am sure there were four, for once I saw them all come to the nest together, bearing food. A little later a male, then a female, then three more males entered the nest in continuous succession, each going through the entrance immediately after the preceding one had emerged. It was only the well-marked, but by no means invariable, habit of the bush-tits of foraging together and flocking together to the nest with food in their bills which made it possible to determine that as many as four males attended the nestlings. Often one male, after giving his offering to a nestling, waited in the bush near the nest until his companion had delivered his, then both flew away together. At times two attendants were inside the pouch at once. During the first three hours of the morning (5:55 to 8:55) the four fourteen-day-old nestlings received food 115 times, 83 times from the males, 32 from the female. This made 9.6 feedings per nestling per hour, which was the maximum rate observed during a three-hour period.

Table 2

Rates of Feeding Nestling Black-eared Bush-tits

Nest no.	Age of nestlings in days	Hours, a.m.	Attendants	Feedings		Total
				Males	Females	
1	1	7:45-10:45	2 M, 1 F	18	8	26
3	3	6:00- 9:00	2 M, 1 F	25	10	35
2	5-6	6:14- 9:14	2 M, 1 F	44	13	57
3	10	6:25- 9:25	2 M, 1 F	36	13	49
2	12-13	5:50- 8:50	3 M, 1 F	53	20	73
2	14-15	5:55- 8:55	4 M, 1 F	83	32	115
2	16-17	6:04- 9:04	3 M, 1 F	70	29	99
3	15	6:07- 7:07	2 M, 1 F	30	6	36

Each nest held four nestlings. The number of attendants definitely recognized is indicated in Column 4, but possibly additional helpers escaped detection.

Rates of feeding at three nests with nestlings of various ages and different numbers of attendants are given in table 2. During the nestlings' first week, at least, the rate of bringing food increased with their age, and it appeared also to be greater with a larger number of attendants. The diet of the nestlings consisted of minute insects and green larvae; rarely a small moth or butterfly with the wings still attached was brought to the nest. As a rule, each parent delivered directly to the nestlings the food it brought. At nest 3 the female sometimes took the insects from the males to pass them to the nestlings; but at times with open mouth she begged for the food in vain, the males preferring to give it directly to the little ones. At nest 2, the male which brooded and was apparently the father of the nestlings was most insistent upon taking food from his mate and the male helpers. Usually this was duly passed on to the nestlings, but once he flew away with the insect he had received from a helper.

For the first few days after they hatched, the nestlings were brooded most of the time through the cool hours of the early morning and late afternoon, but even day-old bush-tits were covered very little during the middle of a sunny day when the air was warm. At nests 1 and 3 the single male helper assisted the parents in brooding the nestlings, but at nest 2, where the helpers were more numerous, I could find no evidence that more than one male brooded. At the age of ten days, the nestlings were still

brooded in the early morning for brief, widely separated periods, but when twelve days old and clothed with feathers they were no longer covered by day.

The parent bush-tits seemed to have no particular notes for scolding or signifying alarm. Yet when I approached a nest while an adult was within and others happened to be in the vicinity, the latter uttered rapid twitters which were understood well enough as a warning by the bird in the nest and it lost no time in slipping out. When I climbed the ladder to peep into the nest, the parents and their helpers fluttered around in the bushes at a discreet distance, twittering most excitedly. Occasionally one of them began to chirrup in a tone deeper, fuller and more mellow than is ordinarily heard from these birds. It was a querulous utterance, but at the same time it was very pleasing in quality. Yet this strain was not reserved entirely for occasions which probably appeared alarming to the parents, for at times I heard the female utter it while in the nest, talking to her mate through the wall.

Although I found only unmated males acting as helpers, once I saw a female bush-tit take an interest in a nest not her own. One morning while from a blind I watched the bush-tits incubate in nest 3, I was surprised to see a second female accompany the female parent as the latter returned from a recess. The stranger followed into the nest, but a minute later it climbed up to arrange the down in the top; then it emerged and perched in the bush close beside the nest. Soon the male, returning with a tuft of down in his bill, discovered her and drove her away. But she circled around and, after the departure of the aggressive master of the nest, rejoined the mistress inside. A minute later both females emerged and flew away. When the strange female reappeared later in the morning, the male again pursued and drove her from the bush. He continued the chase among the boughs of a neighboring tree, but the persistent intruder returned a third time despite her two rebuffs. However, after the eggs hatched, I watched in vain to see her assist the parents and their single male helper in feeding the nestlings. For a few days after the hatching of the nestlings, she frequented the vicinity and shared the excitement of the attendants when I looked into the nest, but soon she left the neighborhood and I saw her no more. I do not know why this female stranger was not busy with her own nest at the time; it could not have been because of the scarcity of potential husbands! Possibly she was barren and, unable to raise a brood of her own, might have assisted in the care of the others' nestlings had she been given a more courteous reception.

Because it was impossible to remove the nestlings from the bottom of their deep pouch without grave risk of injuring both the nest and its occupants, I learned no more about their appearance and early development than could be seen by peering down into the dimly lighted cradle with one eye applied to the orifice at the top. When newly hatched, the nestlings were very tiny and nearly naked. At the age of 12 or 13 days they were fairly well feathered, and the most conspicuous thing about them, as I peeped into the pouch from above, was the wide yellow corners of their mouths. When food was brought to them, nestlings of this age called together with high, thin, rapid twitters, much like those I had previously heard from the parents while they incubated. At times the young birds vigorously shook the swinging nest.

When the young in nest 2 were 14 and 15 days old, I tried for the first time to remove them for closer scrutiny. It was a delicate undertaking to coax them upward inside the flexible pouch and get them through the doorway, which was just wide enough for one of my fingers to pass through. While I worked at this, the parents and two other males flitted excitedly about the vicinity and sometimes ventured very close to me. After I had laboriously extracted one of the nestlings, the other three eased my task by escaping with a rush. Although completely feathered, they could at best fly only a

few feet. Three were captured without much difficulty and returned to the nest, but the fourth had hidden himself so well on the ground that an hour's search failed to disclose his position. Reluctantly I departed leaving him in the open.

Returning at four o'clock in the afternoon, I found that the escaped bush-tit had risen from the ground and was resting in a shrub behind the nest. He could hop with agility from twig to twig and fly between perches separated by less than a yard. He preened his feathers and begged food from the adults with very good results. At about a quarter

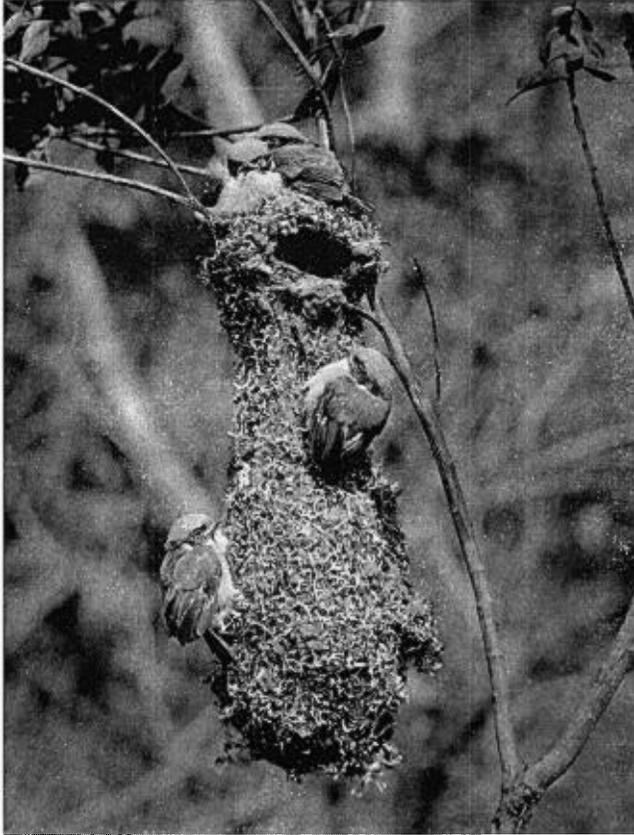


Fig. 39. Four nestlings of the Black-eared Bush-tit, 15 days old, posed on the outside of their nest on the Sierra de Tecpán, Guatemala, May 23, 1933.

past five, when the sun was sinking low and the air becoming cool, he seemed to remember the other three young snugly cradled in the warm pouch and gradually made his way toward them. When almost at the nest he lost his hold and fluttered to the ground, but he promptly ascended again, hopping and flying from branch to branch by easy stages. The female parent flew down to encourage him, and the upward journey was rewarded by more than one insect that the males brought down to the youngster. On reaching his goal he was at a loss to find the entrance and crawled all over the outside of the pouch without encountering the opening. Several times he almost reached the doorway, but the flaring lip always diverted the young bird from the entrance. Failing

to find any other means of ingress, he rested on top of the nest and tried to force his way through the fabric where the wall was thinnest. Naturally the nestling did not make any headway. At last he was content to rest quietly on the roof, where he intercepted much of the food supply and recuperated his small forces. While here, the adults, whose contributions he did not claim, passed in and out beneath him, bearing food to the young birds in the nest. From this activity the escaped nestling seemed to learn how to enter the nest. But he was not yet strong and agile enough to climb over the rim from above, head downward, and when he crawled down the sides of the pouch he lost his bearings and wandered aimlessly. After several more fruitless attempts he again rested from his exertions on top of the nest, where he was fed to repletion.

After the young bush-tit had spent more than an hour in vain efforts to re-enter the nest, the sun set and the air rapidly became so cool that I shivered. Although the adults had fed the young bird liberally, they had failed to give him instruction and encouragement, as wrens will do in similar circumstances. It was already past the hour when bush-tits retire to rest, and I felt certain that without aid the young bird could not regain the shelter of the nest. So in the failing light I emerged from the blind whence I watched, easily caught the bird, and stuck his head into the doorway of the pouch. He promptly climbed down to join the other three nestlings, and soon the female came to brood the four for the night.

All twelve of the nestlings in the three nests over which I watched were black-faced like the adult males. When 16 or 17 days old, they sometimes showed their heads in the doorway, woodpecker-fashion, for a few seconds at a time. Previously they had stayed out of sight in the bottom of the pouch. From nests 1 and 2 the nestlings departed when 17 or 18 days old, but all four of those reared in nest 3 remained until 19 days of age, despite their temporary removal for photography four days earlier. The nestlings in nest 1 had not been touched. As the young bush-tits became bigger and occupied more space in the pouch, the helpers which had slept with them when they were younger began to pass the night elsewhere. At nest 3 the parent birds and helper slept with the young to the very last. At nest 1 only the parent birds remained with the young during their final night in the pouch. But at nest 2, which had been most crowded, with two helpers sleeping in it, the female parent alone kept the little ones company during their final nights as nestlings.

ROOSTING

From the behavior of the young bush-tit that I had prematurely driven into the open, I fully expected that the fledglings would return in the evening to pass the night in the warm cradle from which they had just departed. I waited at the close of the day to see them fly into it, hoping to be present at a lively and engaging scene such as I had not long before witnessed at a nest of the Banded-backed Wren. But I waited in vain. After the nestlings took wing, the bush-tits' nests remained lone and deserted. They were used neither as sleeping quarters nor for a second brood since only one brood was raised. The downy pouch was an admirable protection against the cold nights of the dry season when the bush-tits nested, but it soaked up water like a sponge and would have made a poor dormitory during the wet season, which began about the time the fledglings took wing. The young were reared in the brief interval of most favorable weather, a scant six or seven weeks, which intervened between the last nocturnal frost and the beginning of the rains. From May or early June onward the bush-tits, young and old together, travelled through the bushy fields and open woodlands in small flocks, and as evening fell they went to roost in the tops of trees growing in open woods or at the edge of the woodland. The flock sometimes divided itself between several neighbor-

ing trees, and the birds did not always use the same ones for roosting on successive nights. Here they had naught but the dripping foliage for shelter. Small wonder that they must forage so ceaselessly and restlessly through the day in order to store up enough fuel to keep them warm through the long, cold highland night!

SUMMARY

In Guatemala the Black-eared Bush-tit is confined to the zone of oak trees approximately 5000 to 9000 feet above sea level. Here they roam through open woods and bushy fields in small flocks of about 12 to 20 individuals, the great majority of which are black-faced males. They subsist on small invertebrates which they glean from the finer twigs and foliage. Their usual notes are low and lisping, and they appear to have no song.

Between 8000 and 9000 feet in western Guatemala nest building began early in March. The bush-tits' exquisite, lichen-covered, downy pouches were suspended in bushes at heights ranging, in three instances, from 8 to 13 feet. The sideward-facing doorway was at the top of the hooded pouch, between the supporting twigs. Male and female shared the work of construction, but the latter was somewhat more assiduous in arranging the materials. Much of the down used for the lining was taken from downy leaves whose epidermis had been loosened by leaf-mining larvae. Above a very thick pad of vegetable down in the bottom of the pouch the birds placed a layer of downy feathers. At one nest the bush-tits occupied three weeks merely in applying the lining.

Three sets of eggs were laid in the first half of April. Each set consisted of four pure white eggs. Only a single brood was reared, in the brief period of most favorable weather between the cessation of nocturnal frosts in early April and the beginning of the rainy season in mid-May.

Incubation was performed by both sexes, with the male somewhat more attentive by day. Although in the cooler hours of the day the birds sat with fair constancy, they were most neglectful of their eggs while the sun was high and the air warm. In nearly 13 hours the male of one pair took 30 sessions ranging from 1 to 31 minutes and averaging 8.5 minutes; his mate took 22 sessions ranging from 1 to 22 minutes and averaging 8.8 minutes. The nest was unattended for 37 periods ranging from 1 to 34 minutes and averaging 8.3 minutes. These eggs were covered for only 59.5 per cent of the 13 hours. In the early morning, however, the bush-tits might incubate as much as 75 per cent of the time, whereas around midday their attentiveness fell to 50 per cent or less.

Throughout the period of incubation the bush-tits continued to bring much downy material, which was attached inside the pouch. At one nest a second male also brought such material, but he fastened it with less care than did the mated male.

Before the eggs were laid, male and female slept together in their downy pouch which protected them from the nocturnal chill of the high mountains, and they continued this habit throughout the period of incubation. The male left first in the morning, and the female kept the eggs covered until his return. At one nest an extra male was found sleeping with the mated pair soon after the eggs were laid, but this arrangement was not continued.

At two nests the incubation period was 15 to 16 days.

The nestlings were fed by both parents and by from one to three extra males. At a nest containing four 14-day-old nestlings, five attendants brought food 115 times in three hours, or at the rate of 9.6 visits per nestling per hour. The young were brooded by both parents and sometimes by a male helper. After they were 12 days old and well feathered they were no longer covered by day.

Both parents continued to sleep in the pouch while it held young, and they were

joined at this time by some of the male helpers. One nest was occupied for some nights by the parents and two helpers in addition to the four nestlings, making eight occupants in all. When the nestlings were about ready to leave, there was a decline in the number of adults which slept with them, but at each of the three nests at least one parent, the female, stayed with the young during their final nights in the pouch.

As was to be expected from the relative paucity of the sex, no female helper was observed. But at one nest a second female appeared during incubation and was tolerated in the pouch by the breeding female. The male of this pair, however, repeatedly drove the female stranger away.

A two-week-old bush-tit driven prematurely from the nest made valiant efforts to re-enter it, but he received no instruction from the adults and was unsuccessful.

All of the 12 eggs in three nests produced fledglings, every one of which had a black face and closely resembled the adult males. They left the nest spontaneously when from 17 to 19 days old.

After the departure of the fledglings neither the old birds nor the young ones used the pouch as a dormitory, but all roosted amid the foliage during the cold rains which now began to fall. Although it provided warmth in dry weather, the sodden pouch would have made an unsatisfactory dormitory in the wet season.

GENERAL SUMMARY OF INFORMATION ON THE PARIDAE

The titmice, chickadees, bush-tits, and verdins belong to a family of very small birds containing, according to Mayr (1946:67), 65 species. The family is far better represented in the Old World than in the New, and in the Americas it is almost confined to the region from México northward. Only a single species is found in Central America, and that has been recorded no farther south than Guatemala. In plumage these little birds are plain, nearly always lacking brilliant colors. For the most part, they are clad in shades of gray, brown, and olive. In a number of species there are conspicuous and distinctive markings, usually of black, on the head. A few species are distinguished by high crests or remarkably long tails, and one species has a yellow head. The sexes are usually alike in plumage, but at times they may be distinguished by their head markings. They are rather sedentary birds whose migrations, if they occur, tend to be short. Those which breed at high latitudes pass the winter amid snow and chilling winds, displaying a hardihood altogether amazing in birds so small. In winter they usually travel in flocks, sometimes in company with other small birds. But the sedentary Plain Titmice, which form pairs soon after becoming independent of their parents, remain mated and on their territories at all seasons (Dixon, 1949). Other species which in some regions mate permanently and hold territory throughout the year are the Marsh Tit (Morley, 1950), Coal Tit (Ruttledge, 1946), and Willow Tit (Gibb, 1956:422). In the Great Tit most individuals have the same partner in successive years, but this seems to result from remating with the former mate rather than from preserving the bond between the two through the winter months (Kluijver, 1951:11). The same appears to be true of the Black-capped Chickadee (Odum, 1942:526).

The food of the Paridae consists chiefly of small insects, their eggs and larvae, spiders, and other diminutive invertebrates. These are painstakingly hunted in winter in the crevices of bark or in the scales of buds where they lurk. Some species vary their diet with small seeds and fruit pulp, such vegetable matter accounting for about three-tenths of the food of the Black-capped Chickadee (Bent, 1946:327). Gibb (1954) found that in titmice the proportion of the day spent in finding food varies inversely with the body weight of the species. Food is stored for future use by several species, including the Black-capped Chickadee (Odum, 1942:514) and the Tufted Titmouse (Bent, 1946:401).

In song the Paridae is one of the least gifted of oscine families. The members of this family are almost as deficient in music as they are in bright feathers. Although the notes of some are clear, ringing, and melodious and are most appealing when heard in the still winter woods, the performance is usually brief and lacking in variety. On the other hand, the best utterances of other species in this family have so little musical quality that one is in doubt whether to consider them call notes or song. Yet an exceptional female Great Tit "had the originality to sing a charming song during the nesting season" (Howard, 1952:24).

Nuptial feeding was recorded by Lack (1940:176) "in most West European species of *Parus* (*major*, *caeruleus*, *atricapillus*, *ater*, *cristatus*) also *Penthestes* [*Parus*] *a. atricapillus* in North America during incubation." In the Great Tit the male feeds his mate both before and during incubation (Kluijver, 1950:122). In the Black-capped Chickadee (Odum, 1943), the Carolina Chickadee (Brackbill, 1949), and the Plain Titmouse (Dixon, 1949:125-126), the male feeds the female during the period of nest construction and incubation. In the Boreal Chickadee (Bent, 1946:377) and the

Tufted Titmouse (Brackbill, 1949), the feeding of the female seems to have been observed only before incubation began, but doubtless as in other tits it continues through the period of incubation. In the Long-tailed Tit, Lack (1958:13) has recently shown that the male feeds his incubating mate.

Polygamy is rare in the family. The only instance that has come to my attention is a case of a male Great Tit with two mates, both of which he dutifully fed until the eggs of one of them hatched. After this he deserted one of the females, despite her efforts to regain his attention (Howard, 1952:26-28).

Nests of this family are often in a cavity in a tree, stump or post. Usually the birds make use of an abandoned woodpeckers' hole, a bird box, or some other hollow they find ready made for them, but if the wood is soft some species enlarge a too-narrow cavity or even excavate a new one for themselves. Holes in the ground, crevices in masonry, crannies in walls, old nests of magpies or squirrels, or almost any enclosed space are occupied by some species for their nests. The cavity is lined with shredded bark, moss, fur, hair, feathers or other soft materials to form the nest proper. During the period of incubation, titmice often continue to bring material to their nest. Great and Blue tits sometimes "decorate" their nests by laying around the edge of the nest cup bits of green vegetation, such as leafbuds, fragments of leaves, and fern fronds (Gibb, 1950:512). A few members of the family display great architectural skill, and scarcely any birds' nests excite greater admiration than the exquisite, pensile, lichen-covered pouch of the bush-tits (*Psaltriparus*) or the Long-tailed Tit's felted oval nest with doorway in the side. The big, retort-shaped nest of the Verdin, constructed of interlaced thorny twigs and petioles, with the entrance in the side, is likewise a noteworthy structure, reminding one of the work of the castle-builders (*Synallaxis*) and other members of the tropical American Furnariidae. All the Paridae which build in the open hold fast to the family tradition of ample soft linings of feathers or other downy materials. They may devote weeks to the construction of their elaborate nests. Very different is the open nest of the Bearded Tit (a species sometimes placed in a separate family) which is built of blades of sedge or reed and lined with reed flowers or feathers.

The nest is built by both sexes in numerous species of *Parus* (Witherby, *et al.*, 1938:1, 244-277; Odum, 1942:526); in the Long-tailed Tit, *Aegithalos* (Witherby, *et al.*); in the bush-tits, *Psaltriparus* (Addicott, 1938, and my own observations); in the Bearded Tit, *Panurus* (Witherby, *et al.*, 1938:275); and in the Verdin, *Auriparus* (Bent, 1946:430). The Crested Tit is exceptional in that the male takes little or no part in nest building. Likewise Howard (1952:26) never saw a male Great Tit or Blue Tit help with building; nor did Dixon (1949:125) find the male Plain Titmouse taking a share in this labor, although he reports that others have seen the male help to build. The male Bearded Tit, however, performs more than his due share, adding the lining himself. In excavating the nest cavity, titmice often, but not always, carry the loosened particles of wood a considerable distance away before dropping them, in the manner of the Prong-billed Barbet. Probably the discrepant reports on the participation of the sexes in nest building in titmice that breed in holes are to be ascribed to the fact that the male may help to carve out the cavity yet take no part in bringing material to line it, as is true of the Black-capped Chickadee (Odum, 1942:524). Thus if the pair of titmice used a bird box or some other chamber that they found already made, the male would take no part in building; if they carved a hole for themselves, he would help to prepare the nest.

The eggs of the Paridae are white, creamy, bluish white or greenish white. They are usually more or less heavily spotted with reddish brown or chestnut, but in *Psaltriparus* and sometimes in *Parus* they are immaculate. These diminutive birds lay large sets of eggs. The Black-eared Bush-tit in the Guatemalan highlands generally lays 4, whereas

northern members of the family have sets of from 4 to 15 and sometimes considerably more. Nests containing as many as 24 eggs have been recorded for the British Blue Tit, but such big nestfuls are possibly produced by two females laying together. Titmice which nest in cavities often cover their eggs with the lining of the nest during the absences of the female. Apparently this is done chiefly or only before the set is completed and incubation begun.

Incubation is performed principally by the female in the genus *Parus*, including the west European species and in America the Black-capped Chickadee, Carolina Chickadee, and Plain Titmouse (Witherby, *et al.*, 1938:244-277; Odum, 1942:527; Brackbill, 1949:291; Dixon, 1949:126). In the bush-tits and Bearded Tit both sexes incubate; in the Long-tailed Tit the evidence is conflicting, but apparently the female does most if not all of the sitting. Although the male bush-tit incubates, he does not, like the female, develop a bare brood patch (Addicott, 1938). Titmice rarely cover the eggs for long periods continuously. Odum (*op. cit.*) found that for three female Black-capped Chickadees the average length of the sessions on the eggs was 24 minutes. As the temperature rises, the Great Tit takes shorter sessions and longer recesses. Thus in the case of the first brood, her total time on the eggs decreases by eight minutes per day for each rise in temperature of one degree Centigrade, whereas with the second brood it decreases by fifteen minutes per day for each rise in temperature of one degree Centigrade (Kluijver, 1950:120). Similarly, the length of the sessions of both Common Bush-tits and Black-eared Bush-tits, in their thickly padded swinging pouches, varies inversely with the temperature of the outer air; it is very short in the warmer part of the day.

Incubation periods in the Paridae fall chiefly within the range of 13 to 15 days.

The young are hatched with sparse natal down and are fed, usually at a rapid rate, by both parents with food carried in the bill. Injury simulation has been recorded for the Black-capped Chickadee (Odum, 1941:531), the Carolina Chickadee and the Tufted Titmouse (Grimes, 1936:479), but it is rare in the family and apparently even in these species. More often than they give a distraction display, titmice sit firmly on their eggs or nestlings and hiss at the intruder, usually at the same time opening the mouth widely and swaying from side to side. These displays, which are stereotyped and in some species quite elaborate, have been described in detail by Sibley (1955), who views them as examples of behavioral mimicry, serving to frighten small mammalian predators by their resemblance to a hissing, puffing snake. Even humans may find them alarming. At times parent titmice peck intruding fingers and even allow themselves to be lifted from the nest. If undisturbed, nestlings of the typical members of the family, which are reared in closed nests, rarely leave when less than 15 days old, and in various species of *Parus* the young may remain in the nest for 21 or even 22 days. If the female dies or deserts the nest, the male Great Tit may assume all responsibility for the care of the nestlings and fledglings (Gibb, 1950:530, 536). Young Bearded Tits, however, leave their open nests when only 9 to 12 days old. The incubation period of 12 days and nestling period of 14 days given by Addicott (1938) for the bush-tit both seem unusually short.

Helpers at the nest are of widespread occurrence in *Psaltriparus* and *Aegithalos*, but, as far as known, they are rare in other genera. In the Common Bush-tit, a third individual may assist in incubating the eggs and in feeding and brooding the young (Addicott, 1938). In the Guatemalan highlands, males of the Black-eared Bush-tit greatly outnumber the females. Many perch remain without mates, and these unmated males may bring material to a nest in which a mated pair are incubating, and later they may feed and even at times brood the nestlings. At one nest, three unmated males assisted the parents, making five attendants for the four nestlings. At each of two

other nests, there was a single male helper. In the Long-tailed Tit, three birds are often interested in a single nest (Owen, 1945). At one nest of this species, the attendants were two males and one female, all of which fed the ten young in perfect harmony (Robertson and Porter, 1952). A male Great Tit fed the nestlings of a widowed female of his own kind, and a pair of these tits adopted eight fledglings which were offspring of another pair. A young Great Tit placed food within reach of a nest mate with a broken leg (Howard, 1952:25, 31, 102). A Blue Tit took a nest from a European Robin and laid her own eggs among those of the robin; she eventually reared a mixed brood of both species (Lack, 1953:86). A pair of Mountain Chickadees fed nestling Williamson Sapsuckers, probably having been led to do this by the collapse of the partition which separated their hole in a rotting trunk from that of the woodpeckers (Russell, 1947).

The sleeping habits of the Paridae are of great interest. Like many other birds which lay their eggs in cavities or well enclosed nests, they sometimes take advantage of the same or similar structures for protection during the night. The male sleeps in the nest with the female and the eggs or nestlings in several species, including the Long-tailed Tit (Witherby, *et al.*; Owen, 1945), the Common Bush-tit (Bent, 1946:442), and the Black-eared Bush-tit. In the last mentioned species, not only does the female's mate sleep with her while she incubates the eggs and broods the nestlings, but the unmated males which help to feed the young may at the end of the day enter the warm pouch for protection against the nocturnal chill of the high mountains. At one nest I found four adults (three males and a female) passing the night with four nestlings. Four adult Common Bush-tits have also been found sleeping in a nest in which incubation was in progress (Bent, 1946:449). Although Witherby, *et al.* (1945) states that the male British Great Tit roosts in the nest at night, the observations of Howard (1952:59, 63) indicate that only exceptionally is he permitted to sleep in the nest box with his mate, a privilege which he must win by dint of great persistence. Kluijver (1950:102) states that in the Netherlands the female Great Tit sleeps alone in the nest.

Unlike certain species of wrens, barbets and woodpeckers, and the Verdin among the titmice (Bent, 1946:432), the Black-eared Bush-tits which I studied in the Guatemalan highlands did not lead their newly emerged fledglings at nightfall to roost in the swinging pouch where they had been hatched and reared. Apparently this was because the rains had begun and the softly padded walls of the nest were so continuously soaked with water that it would not have made a healthful dormitory. With the exception of the Verdin, I have found no mention of any species in this family whose fledglings return to sleep in the nest.¹ Kluijver (1950:101) states that the young Great Tits never return to the nest, but at first they sleep together amid the foliage and after they grow older they roost in solitude. Howard (1952:66) watched parent Great Tits install their fledglings on safe branches for the night.

When not engaged in breeding, members of this family may sleep either in enclosed spaces of various sorts or among foliage, and, as we should expect, the more severe the weather becomes the more inclined they are to seek snug dormitories. In the winter months from November to March, the Great Tits of the Netherlands roost alone in a natural cavity in a tree or in a bird box. In spring and summer they select a sheltered place against a tree trunk or among the foliage (Kluijver, 1950:101). Miss Howard's Great Tits slept singly in the bird boxes she put up for them; many individuals of both this species and the Blue Tit found accommodation in nooks and cardboard boxes inside her cottage, each in its separate space (1952:21, 35, 112-117). Coal Tits roost

¹Another exception has recently come to my attention. The Highland White-bellied Pied Tit of tropical East Africa sleeps in holes and crevices in trees, usually high above the ground, and it leads its fledglings back to the nest space at nightfall (Van Someren, *Fieldiana: Zoology*, 38, 1956: 407-411).

in holes in rotting trees usually pecked out by themselves, or they may retire in the dense cover afforded by ivy (Ruttledge, 1946). Blue Tits, which usually roost in ivy or evergreens, will in bad weather seek protection in a hole or in such miscellaneous hollow objects as an empty coconut or a large-mouthed bottle (Coward, 1928:143). The Long-tailed Tit, although it builds a cozy nest for its eggs and young, may in cold weather take shelter in a hole, where a number cuddle together in a ball (Coward, 1928:147). The Bearded Tit, however, roosts in groups among reeds, where each male rests close beside his mate, sheltering her beneath an outstretched wing.

Turning to the American species, we find that the Plain Titmouse roosts either in natural cavities or in densely clustered foliage (Dixon, 1949:113). The Tufted Titmouse sleeps in woodpeckers' holes and in natural cavities in posts and stubs and even spends dark, inclement days in such retreats (Bent, 1946:405). Black-capped Chickadees may take shelter on winter nights in cavities in trees, in gourds, in old nests of the Wood Pewee on porches, and in other nooks, but more often they roost among dense conifer branches (Odum, 1942:529; Laskey, 1943:3; Bent, 1946:330). In California, Williams (1941:275-277) discovered Chestnut-backed Chickadees roosting singly on wires and ivy vines against the walls of a house close beneath the protecting eaves, and he found them sleeping in a cavity in the side of an old hornets' nest. He also refers to a Mountain Chickadee which slept in the abandoned nest of an American Robin. In winter, Verdins roost singly in their bulky nests of interwoven sticks, those of the female being larger and more adequately lined than those of the male.

FAMILY CORVIDAE

WHITE-TIPPED BROWN JAY

Psilorhinus mexicanus

As long as the Brown Jay remains silent and inactive, the bird-watcher familiar only with the jays of northern lands might find difficulty, from appearance alone, in placing it in the proper family. However, the bird itself does not leave one long in doubt as to its lineage, for one seldom finds it silent and at rest, and by actions and voice it proclaims itself immediately and unmistakably a jay.

Exceeding the Blue Jay and even the larger European Jay in size, it is about seventeen inches in length and is nearly as big as the American Crow. Although not so beautiful as the Blue Jay, or those numerous jays of celestial hues which dwell in the highlands of Central America, there is a certain distinction in its plain attire. Both male and female are clad in brown, except for the white lower breast and belly and the broad white tips of the outer tail feathers. The latter are visible when the tail is spread in flight. The Brown Jay wears no crest. In the color of the bill, the rings bare of feathers which surround the eyes, the legs, and the feet, there is considerable individual variation. In some birds, fully adult, these are wholly black; in others, not yet old enough to breed, these regions are entirely bright yellow; but in perhaps the majority of full-grown individuals they are variously and irregularly marked with black and yellow. This enables the bird-watcher to distinguish individual birds easily.

Brown Jays range along the eastern side of the continent from southeastern México to the Almirante Bay region of western Panamá; the Central American race (*Psilorhinus mexicanus cyanogenys*) occurs from Guatemala southward. In Guatemala it is confined to the wet Caribbean lowlands, chiefly below 2000 feet, and is quite unknown in the highlands and on the Pacific slope. In Costa Rica its distribution is curiously different. Not only is it common in the Caribbean lowlands, but from the coast it extends upward over all the cleared lands of the central plateau and the surrounding mountains, where it is frequently found at 6500 feet and occasionally at 8300 feet, at which altitude I have seen it in the pastures on Volcán Irazú. Since this is far higher than the continental divide in the northern and central parts of the country, the jay, like the Montezuma Oropendola with which it so often associates, "spills over" to the Pacific slope in these regions, where it is not uncommon at many points on the western declivities; occasionally it reaches the lowlands of Guanacaste and the Peninsula of Nicoya. But in southern Costa Rica, where the Cordillera is much higher, it is unknown from the Pacific side.

In the humid Caribbean lowlands of Guatemala, Honduras, Costa Rica, and Panamá, where I first became familiar with them, the Brown Jays are both abundant and conspicuous. Avoiding heavy forest, they frequent the cleared and bushy lands. Doubtless the comparatively recent advent of railroads and large banana plantations in the region, with the consequent destruction of primeval forest, has been responsible for a considerable increase in their numbers. Their homelands include bushy pastures on the steep foothills of the coastal mountains, where scattered trees and vine tangles have been allowed to remain standing amid the tall, coarse grass, and where in the dry season the sun, beating down all day into deep and narrow valleys bereft of most of their shade, produces an almost insufferable heat. They also frequent the larger streams whose shores are bordered by willows, cecropia trees, and brakes of giant cane. They



Fig. 40. White-tipped Brown Jay.

are found in the banana plantations themselves and on all the waste and abandoned lands, once covered by magnificent forest, but now impassable tangles of low vegetation, with cecropia, balsa, and inga trees standing above them, and perhaps lone and blasted relics of the original forest towering over all.

In the highlands of Costa Rica, the Brown Jay dwells in a climate and in vegetation amazingly different from that found in the lowland portion of its range. Here the human population, far denser than in the thinly peopled coastlands, has long since destroyed the original forest, and the land is taken up with pastures, plantations of coffee and cane, and low thickets. The low, pruned shade trees of the coffee groves form a perfect habitat for the Brown Jay, which wanders also through pastures with scattered trees and along the shady courses of the waterways.



Fig. 41. Edge of secondary woods near Almirante in western Panamá; typical habitat of the White-tipped Brown Jay, Boat-billed Flycatcher, and Black-fronted Tody-Flycatcher.

Brown Jays are restless, active birds. Their calls are heard in the morning almost before the human eye can detect the lifting of the night, except perhaps the faintest brightening of the sky low in the east. In the hot middle of the day, when other lowland birds are resting silent and unseen in the shade, they seem to go out of their way to protest a man's passage through their haunts. They are among the last of the diurnal birds to settle to roost in the evening. They forage usually in small, loose flocks of from six to ten individuals, and it is difficult to elude so many keen eyes and to watch these birds unobserved. One of the party is sure to spy you, and his persistent *chaa chaa* of alarm sends off the whole flock with loud protesting cries. I have sometimes had the annoying experience, while sitting quietly in my blind before the nest of a pair of birds of another species which were oblivious of my presence, of having a Brown Jay perch somewhere above me and scold persistently in raucous tones. At times this action would arouse the suspicions of the birds I was watching, and I longed to emerge from my hiding place and throw something at the inconsiderate alarmist. Whether its restless eyes caught mine through the peephole, or whether the blind itself was the cause of its scolding, I could not always decide. Bird collectors wax eloquent when describing the annoyance which the jay causes them, for it is keen to detect their approach and broadcasts the news to all the feathered world.

While walking through the banana groves, I often encountered Brown Jays. They either fled away with harsh complaints or one would linger upon the petiole of a banana leaf, watching me approach as it bowed excitedly first to the right and then to the left. With each forward movement of its body, it uttered a noisy scold with the utmost vehemence and with such rapidity that its loud *chaa*'s seemed to stumble over each other in its windpipe and to choke it. The scolds were punctuated by a note somewhat resembling the sound made by pulling a cork from a vial. At length, as I pushed closer than the jay deemed safe, it would take wing, and in a moment it would be hidden by the huge foliage.

FOOD

Only rarely did I surprise one of the jays sipping the nectar so richly secreted by the staminate flowers of the banana, of which they are extremely fond. Clinging to the knotty axis of the inflorescence, above the great, dull red, pendent bud swollen with the still unopened flowers, it bent its head to probe one of the white blossoms in the compact cluster beneath the latest upturned red bract. Its beak filled with the delicious fluid, it raised its head and worked its mandibles with a rapid, mincing movement; and through the binoculars I could discern the vibrations of its throat—the characteristic actions of a bird drinking. After sucking the richest flow from the blossoms of the top-most rank, it tore them off and allowed them to fall to the ground, exposing fresh sources of bounty in the lower tier. Sometimes it plucked a flower to hold beneath a foot while it probed the depths; often, when disturbed, it flew away with a single flower held in its bill. In the banana groves, and out of them, the Brown Jays often associate with the Montezuma Oropendolas, with which they share a taste for many foods, including the banana nectar. The oropendola is as alert as the jay and much more shy, and when the two species flock together among the banana trees it is indeed difficult to surprise them and learn what they are doing.

Brown Jay's are fond of a variety of fruits, which seem to make up the greater portion of the food of the adults. In season they feed much upon the orange disks of the Central American rubber tree (*Castilla elastica*). The green, finger-like fruiting catkins of the guarumo or trumpet tree (*Cecropia* sp.), which they break off and hold with a foot against a branch as they tear them apart with the bill, are an unfailing food which they like. They peck a hole in the green side of a pendent granadilla (the fruit of the passionflower, *Passiflora*) and remove big chunks of the orange-colored pulp. In the banana plantations they appear to prefer the nectar to the ripe fruit. Like other jays, they sometimes forage on the ground, but a watcher who can surprise them there is indeed a good stalker. They pull curled brown leaves from the vine tangles and, holding them beneath a foot, investigate the interior for insects and spiders. For their young, they catch lizards and dragonflies, which doubtless they also sometimes consume themselves. I am happy to record that in the lowlands I never discovered them robbing nests or in any way persecuting the smaller birds, although they boldly attacked the biggest hawks. But in the central plateau of Costa Rica, where the sparser and often stunted vegetation supplies far less food, the jays have become arrant nest robbers. During a week in June on the beautiful hacienda "Las Cónavas" near Cartago, I saw Brown Jays eat two newly hatched nestlings of the Grayish Saltator and carry off a fully feathered nestling Gray's Thrush. Whenever the jays came into the garden where the thrushes nested, the latter complained with anxious cries.

VOICE

The call or alarm note of the Brown Jay, a loud harsh *chaa* or *chay*, lacks the steely coldness, as Thoreau characterized it, of that of the Blue Jay of North America. Although louder, as befits the bigger bird, it is softer in tone, more nasal and drawled.

As for most bird notes, it is difficult to convey the sound by means of written syllables, but it bears so much resemblance to the calls of other jays that the bird-watcher can hardly fail to recognize it as the utterance of a member of the tribe. The Brown Jay seems to possess no liquid or ringing notes, like the *willica* with which the Blue Jay heralds the approach of a sudden shower, or like the soft, liquid, even somewhat plaintive cries of the Magpie-Jay, a bird whose alarm note is excessively harsh. I have never heard from the Brown Jay any utterance which even in an expansive moment I might call melodious. The mating call is a complaining *pee-ah*, sometimes low but more often loud, and the hunger call is similar. Indeed, the various utterances of the Brown Jay are all rather similar in form and differ chiefly in loudness and intonation. In Costa Rica the bird is given the name *piá-piá* (the *a*'s broad and strongly accented), which is a good imitation of one of its calls. In Guatemala it bears an Iberian name, *urraca* (magpie).

FLIGHT, BATHING, PLAY

The wing beats of the Brown Jay, when it has a distance to cover and is at its leisure, are regular and corvine. When descending a steep hillside, or fleeing from real or imagined danger with loud cries of alarm, it flies in quite a different manner. At such times it closes its wings after every stroke and constantly expands and folds its tail, which gives its body a rocking motion and makes its progress appear headlong and reckless. Its flight then seems quite in keeping with its bold, restless, active nature.

One morning in early March, after a damp and misty night, I was sitting quietly in sight of a tall umbrella-topped tree rising alone in the midst of a banana plantation, waiting for the Montezuma Oropendolas to return and continue work on some nests they had begun a few days earlier. As the mists cleared, a Brown Jay flew into the tree and plunged into the midst of the leaves clustered at the ends of the branches, where it fluttered around and rubbed into its plumage the drops that had condensed there during the night. At the same time it shook loose many of the dying leaflets, which fluttered slowly to the ground, for the tree was then in the process of its annual defoliation. Then it perched on a limb, fluffed all its feathers, shook its wings, and wagged its white-tipped brown tail rapidly from side to side. It flew into another leaf cluster to sop up more water, then shook itself again, at the same time expressing its joy in uncouth corvine sounds. After it had repeated this performance several times, a male oropéndola which had returned to the tree tried to drive the jay away, but the jay merely crossed to the other side of the crown and took another dip into the foliage. At length it flew away with its plumage appearing very wet and bedraggled.

The Brown Jays have a game that I have sometimes watched, especially in the early morning and late afternoon. This game seems to be entered in a spirit of fun; possibly it is a courtship ceremony, but young, nonbreeding individuals engage in it. One jay, perching beside or in front of a second jay, stretches up on its legs and makes feints with its bill at the other, now here, now there, bobbing up and down, twisting and turning from side to side in a spirited manner, until it appears a feathered clown. The bird so assailed with mock thrusts turns its beak toward the other and erects the feathers of its head and upstretched neck, looking very bizarre as it silently endures the mock attack. Later the roles of the two participants may be reversed, the "attacker" now assuming the passive attitude.

NEST BUILDING

On my arrival in the lower Motagua Valley in Guatemala in the middle of February, 1932, the first nest which I found was a nearly completed one of the Brown Jay. Few species of birds had begun to breed so early in the season, so I had considerable

time to devote to a search for Brown Jays' nests. Nearly a month passed, however, before, on March 12, I discovered a second nest, a finished structure which, like the first, was in the crown of a banana plant. Two days later I encountered a third nest, in which the female was already incubating. This nest was forty feet up in a bamboo armed with murderous spines, and it was utterly inaccessible. A single additional nest rewarded my searches for the remainder of the month of March, but in the first week of April I discovered the secret of locating Brown Jays' nests and began to find them in abundance. They were either under construction or still contained eggs. The breeding season seemed to be just beginning for the majority of the jays; the single February nest was unusually early. April was the month of incubation. When the rains commenced early in June, a few pairs, the earlier broods of which had suffered misfortunes, were still feeding their young in the nest; but by the end of that month the young were all on the wing and the nesting period had terminated. In Guatemala, a single brood each year appears to be customary; but if the eggs or helpless young of the first are destroyed, the jays are prompt to begin another nest.

In Costa Rica, my experience with the Brown Jays has been less extensive. In the Pejivalle Valley at about 2000 feet above sea level, I found them starting their nests in the last week of February, 1934. A nest with eggs was discovered in the same locality on April 15, 1941, and another on May 7 of the same year.

The site chosen for the nest is usually high and inaccessible. A tree of moderate height standing alone in a pasture, or rising above the bushes and vine tangles of recent second growth, is most often favored. Here the nest is almost always supported among the twigs at the end of a long, slender branch, too limber to sustain the weight of a man, at a height of from 25 to 50 feet above the ground. In such a position, the nest is inaccessible, and the jays know it. An unusually high Costa Rican nest was situated about 75 feet up in the crotch of a tall tree. Other nests are placed in the crowns of banana plants. A fruiting plant is almost invariably chosen; for the stem, where it emerges from between the leaf sheaths at the top of the apparent trunk and bends sharply over to support the huge, pendent bunch of fruit, forms a convenient horizontal base for the structure, and the petioles radiating in all directions from this point prevent the nest from slipping sideways. Certainly this is an attractive home site, ensconced in the midst of fresh green foliage from 12 to 20 feet above the ground; but a more ill-advised location could hardly be imagined. In the first place, the youngest leaves, which alone rise above the nest, stand almost vertically and afford slight protection from sun and rain to the sitting jay and her nestlings. Indeed it is questionable whether there ever are nestlings in these nests, for the birds generally choose to build above a bunch of fruit which will be ready to market before the eggs hatch, and the fruit cutter does not spare the nest.

In the Brown Jay, nest building, like most other activities, is a noisy performance. As soon as the site has been selected, or at least as soon as the first stick is laid, the birds sit in it and continually utter loud, mournful cries which carry for long distances. This loud, sad *pee-ah*, very different in quality from the ordinary calls of the jay, is heard almost exclusively from nesting birds and from fledglings begging for food. Following it to its source, I found all the nests of which I watched the construction. Male and female unite in the labor, as is usual in the Corvidae. In some pairs they share the work nearly equally, while in other pairs the female seems to perform the larger part of the task of building. After adding a stick to the growing pile and shaping it with depressed breast and active feet, she remains sitting in the incipient structure, uttering her plaintive calls, until her mate comes near with his contribution. Then she makes way for him, perhaps going off to find another stick, while he deposits his and sits in

the nest to shape it, often crying, but usually he does not sit as long or cry as loudly as his mate. Sometimes, however, either member of the pair may work in the complete absence of the other. At this stage, nest building involves much labor, for the sticks employed are often from 12 to 30 inches in length. The jays break them with their bills from dead limbs, or from the vine tangles, rather than search on the ground for them. On the way to the nest these long pieces sometimes become entangled among the twigs and foliage of the nest tree, and the birds must exert much effort to extricate them. Their proper disposition in the foundation also requires much strenuous tugging with the bill and pushing with the breast and feet.

In the method of nest building just described, male and female come to the nest alternately with material. At times they vary this mode of work and come to the nest together. Then the first to deposit its contribution of material waits until the other has done likewise, and they go off together for more pieces. Other pairs seem unable to cooperate closely, with the result that the bird which desires to build remains at the nest and calls long and loudly for its partner.

On a cloudy morning at the beginning of April, my attention was arrested by loud, oft-repeated calls of *pee-ah pee-ah*, which I followed through a banana grove to a tall wild fig tree standing in a hedge row which separated two sections of the plantation. A pair of Brown Jays was building a nest far out on a horizontal branch, about forty feet above the ground. The coarse sticks of the foundation formed an open ring, with so little material in the center that I could readily see through it, and the birds were filling in this framework with finer sticks to support the lining of fibrous roots. One member of the pair did practically all of the work; the other rested on the bough beside the nest uttering loud plaintive cries while the mate was arranging the sticks. When the latter flew off for another twig, the more vociferous bird tugged at the nest as though testing whether the sticks were well placed. It also entered the nest and shaped it with feet and wings, remaining there, constantly crying, until the mate returned with another contribution. Then it climbed out to the bough, where it continued to utter the melancholy calls until the nest was again vacant.

For the next two days, I continued to watch at this nest. Sometimes both jays were in sight. One broke off a twig in the vine tangle beneath the tree and brought it to the nest in which the other sat. This bird then flew down to fetch a twig, so it was certain that both jays helped to build. Usually, however, a single bird flew alone to the nest, sometimes bringing a stick and sometimes not, and sat in it to call plaintively for many minutes on end, most often without drawing the absent partner. It happened that male and female were identical in appearance, both with bills, orbital rings, and feet entirely black, so that it was impossible to distinguish the sexes. But from watching other nests, where the sexes were different and I could identify the female after incubation began, I believe that the crying jay in the fig tree was the female.

The bulky foundation of sticks completed, the nest is ready for the lining of long, coarsely fibrous roots, often between two and three feet in length, which the jays pull with their bills from the ground, choosing for this purpose, when possible, a steep bank of bare soil where the roots are exposed. After tearing away a root they double it in the bill and carry it to the nest, where it is molded with others to form a neat, rather shallow cup.

Many nesting jays have the bill, orbital rings and feet entirely black. As already noted, others have more or less yellow on the bill, and the orbital rings and feet are largely yellow; but I have never seen sitting on the nest, or recognized as the mate of an incubating female, a jay with much more than the basal half of the bill yellow. While the mated birds are building, other Brown Jays, with yellow feet and eye rings, and the

bill perhaps merely tipped with black, often remain in the vicinity. These birds, which are apparently yearlings, may accompany one of the mates, as it flies up to the nest with a stick or a root in its bill, and perch close by while the other adds the material and shapes the nest. They manifest much interest in the operations and often alight on the rim of the nest to examine it. The breeding birds do not in the least resent these liberties, as would the adults of many species; and since the yellow-bills are less absorbed in the work than the builders, they are usually the first to notice the approach of an intruder and to give the alarm. Indeed, they seem to be more concerned over the arrival of a person at the nest tree than the owners themselves, which, if their nest is high, continue with their building operations unmindful of the watcher standing in full sight below it.

Accordingly, I was not inordinately surprised one day, while watching a pair of Brown Jays at work on their nest, to see a young bird fly up to the structure bearing in its bill a stick; the bill of this bird was bright yellow marked with a small black spot at the tip. More excitable than the adults, which had added many sticks while I stood quietly not far off, it caught sight of me just as it was about to enter the nest and dropped its burden to scream loudly. Neither at this nest nor at any other which I watched did I again see a young jay bring material. I believe, however, that it is the mercurial nature of the young which prevented my seeing them help with the building more often, for at a later period their attachment to the nest becomes very firm.

When eggs or nestlings were taken by predators, the jays tore apart their ill-fated nest to use its materials in the construction of a new one which was built at no great distance from the previous nest. In one instance the replacement nest was built in five or six days and was completed a week after eggs, on the point of hatching, had vanished from the earlier structure. Another nest seemed to be finished nine or ten days after young nestlings had disappeared from an earlier nest of the same pair, which was about 100 yards distant. These replacement nests were probably built more rapidly than first nests, but unfortunately I have no information as to the time required to construct initial nests.

The completed nest of the Brown Jay is a very bulky structure. The foundation is made up of a great pile of coarse sticks, most of which are over a foot in length and some are as long as $2\frac{1}{2}$ feet. The longest and coarsest sticks are on the bottom and outside; toward the center of the nest they become finer. Many of the sticks are armed with thorns. In some nests, a network composed of long pieces of vines lies within the sticks and supports the broad, shallow basin of loosely matted fibrous roots. The latter vary from about one foot to three feet in length. There is no softer lining, and the whole structure is so open that, standing beneath it, one can glimpse the sky through the interstices in the fabric. The internal diameter of one nest was $5\frac{1}{2}$ inches; its depth was 3 inches.

THE EGGS

The earliest set of eggs actually seen by me was completed on March 19, 1932, in a nest near Los Amates in the Motagua Valley of Guatemala. Although I have records of twelve nests and saw a good many more, only three nests were accessible to me. From one of these the eggs began to disappear before the set was completed; each of the other two nests contained 3 eggs. In three inaccessible nests, it was possible to count the nestlings when they stretched up their heads for food. One of these contained 3 nestlings; each of the others held 2 nestlings. In all, I have records of three nests with 3 eggs or nestlings and of two nests with 2 nestlings. The eggs are laid on consecutive days. The Brown Jay's egg is pale, chalky bluish gray, thickly covered with fine brown speckles, which on the thicker end nearly obscure the ground color. The measurements

of seven eggs average 34.5 by 24.6 millimeters. Those showing the four extremes measured 36.5 by 24.6, 32.5 by 25.4 and 33.3 by 23.8 millimeters.

INCUBATION

The female alone incubates, closely and patiently. She sits for long periods in the nest after it is completed and before the first egg is laid. After the first egg is laid, she begins to incubate, during the day at least. She seems to know when her nest is safe and inaccessible, and then it is sometimes impossible, by any fair means, to drive her from it; fortunately the Brown Jays in the wilder parts of the lowlands have not yet learned to fear man as a creature with a gun. I recall one bird which I tried to frighten from her nest, forty feet up in a cruelly armed bamboo shoot. She looked imperturbably down from her high eyrie while I whistled, shouted, clapped my hands, hammered on the resounding haulm, and threw up sticks as close as I dared without endangering the nest. At the end of a quarter of an hour's violent exercise, I was sure that she saw through my bluff. During the whole ludicrous performance the male did not arrive to protest; he usually maintains a discreet distance when the eggs seem to be in peril, from man at least. Even a jay incubating in one of the nests in banana plants, which were the lowest I found, would usually allow me to approach openly and to stand or even move about quietly beneath her for several minutes, while she looked down with bright black eyes, sheathed at intervals by the white film drawn rapidly across them. If I persisted in remaining too near, she would at length seize an opportune moment to steal quietly away and gain a safe distance before she perched on a banana leaf and turned to express her indignation in no uncertain terms. She did not flee her nest in panic, like some small, shy, timid bird. If frequently molested, she became more wary and slipped from her nest at an earlier moment.

Often one or more of the young jays with much yellow on bill and feet lingered near the nest and called loudly when I approached. They were more likely to do this than the male himself, for he was far less excitable and generally remained at a distance from the nest unless he came on business. Even if his mate at length fled the nest and called, he was often slow in arriving, if indeed he came at all. Sometimes it was only by means of a prolonged watch that I could determine which of the several individuals in the vicinity was the mate of the incubating female; usually, although not always, he could be recognized by his blacker bill.

As she covers her eggs, the female jay frequently utters the peculiar cries, sounding half melancholy, half vexed, which she uses while building the nest. As her session on the nest lengthens, her *pee-ah pee-ah* increases in loudness and frequency, and if the watcher sits quietly, in a position not too exposed, he may see her mate arrive, sometimes with a morsel projecting from his bill, more often bearing nothing outwardly visible but with his throat clearly outswollen with the offering of food that he brings. The female jay has already spied him; her cries redouble in number and volume. As he advances to the edge of the nest, she rises and spreads her wings, which she vibrates in the manner of a nestling begging for food, while the wide-open position of her mouth changes her cries to a low whine, and she eagerly swallows her mate's gift. Sometimes he lays the food before her on the nest instead of placing it in her open mouth. Then, if she has not grown tired of long sitting, she remains and her mate promptly departs. However if she has covered the eggs continuously for several hours and desires a recess, she flies from the nest as soon as she has swallowed the morsel, leaving him to stand guard on the rim. There he remains like a sentinel until she returns to resume incubation, after an absence of from ten to fifteen minutes. Twenty minutes is the longest period I have seen a male Brown Jay stand guard; when at the end of this interval his

mate had not returned to relieve him, he flew away leaving the nest unattended. His duty is to guard, not to incubate; only once have I seen a male jay warm the eggs, and that was for a brief period at a nest which was otherwise abnormal. It seems strange that he should not cover the eggs, since he often sits in the nest while helping to build it. It is true that the males of many other species of birds take a share in building the nest yet never incubate. Usually, however, these males do not stand guard at the nest during the period of incubation, and so they do not have the same provocation to sit.

A well conducted nest of the Brown Jay is, then, practically never left unattended, save when the birds are driven from it by man or by some other enemy too powerful for them. Since these jays fear neither hawk nor eagle, and they are ready to rush to each other's assistance when danger threatens, their eggs are fairly secure. The period of danger to their nests begins after the young have hatched and when they are left unguarded while both parents forage for food. Both of the pairs to which I devoted most attention lost the young of the first brood soon after they hatched.

Sometimes the male jay is negligent in his duty to his mate and does not come to relieve her with sufficient frequency. He is, I believe, more easily upset in his routine than the female. One Guatemalan nest was situated in a slender tree at the edge of a banana plantation. During the period of incubation, laborers were putting up a wire fence that passed beneath this tree; there was much cutting of posts in the thicket beyond, digging of post holes, hammering of staples, and talking; yet the female jay did not desert her eggs in the face of all this but continued to incubate except when the disturbance was almost beneath her. In the course of fence construction the male jay became rather inattentive to the nest, and for long periods he failed to come for his spells of sentry duty. Thus the female was forced to leave the nest unguarded while she foraged for food; her absences, lasting from four to twelve minutes, were even shorter than is customary when the male guards the nest while the female is away. I noticed the same behavior one morning at another nest at which the male, usually more attentive, was for some reason very tardy in appearing. The female was obliged to leave twice, but she reduced her absences to five minutes. When her mate stood sentinel, she remained away fifteen minutes; she was ill at ease away from the nest when her eggs were unguarded.

In addition to the mate of the incubating female Brown Jay, unmated birds may bring food to her while she covers the eggs. At two of the four Guatemalan nests which I studied in the period of incubation, unmated birds fed the female. At one nest, one or possibly two of these helpers brought food four times in five hours one morning; at another nest, a single helper fed the female twice in the same period. At a Costa Rican nest, five individuals, in addition to the female, were recognized in the vicinity of the nest; at least three of them, including the male, fed the incubating female. One morning they gave her food five times in four hours.

On "Alsacia" Plantation in the Motagua Valley, in April and early May when the Brown Jays' season of incubation was at its height, I heard their peculiar loud cries arising from all the bushy hillsides and vine-entangled bottom lands, where isolated trees remained to support the nests. Following these sounds, it was easy to locate them; there are few birds whose nests are found more readily than those of the Brown Jay. Individual hens differed in their noisiness, some being exceedingly vociferous, others comparatively silent. I counted the calls of an unusually clamorous female which was incubating in a tall tree beside a brook. In two minutes she called from the nest thirty times, and when hungry she continued at this rate for many minutes together, until at last her negligent mate came to give her food and stand guard while she hunted more.

One morning toward the end of April, I sat down quietly on the steep hillside above a Brown Jays' nest of which I had watched the construction. This nest was situated at a height of twenty-five feet in a handsome *Bursera* tree, whose reddish cinnamon, papery bark was peeling off like that of the pale birch of the North. So steep was the slope that, fifty feet above the base of the tree on the hillside, I was only slightly below the level of the nest, and I could watch most of the movements of the incubating bird. The female, which was on the nest when I began my vigil at 7:05 a.m., had a black bill and black orbital rings; whereas her mate had some yellow at the base of his bill and his orbital rings were largely yellow. Thus it was not difficult to distinguish the two. Soon after my arrival a young bird, with much yellow on its bill, flew up and drove a noisy pair of Sulphur-bellied Flycatchers from the nest tree. At 7:30 the sitting jay began to call. Two minutes later her mate came with food. She took it, flew off, and left him standing on the rim of the nest. He remained there like a sentinel for fifteen minutes, until she returned to resume incubation. Sitting again on the nest, she was silent for the better part of an hour, but at 8:32 she cried out again, and she repeated her calls at intervals until, at 9:43, her mate arrived with some pieces of orange-colored fruit in his bill. As he drew near, she stood up and fluttered her spread wings, merely whining now. Again she flew away after having swallowed the male's offering and left him on guard.

On her way back to the nest she paused in an acacia tree standing down the hillside from it, drew toward her a ripe granadilla hanging from the dying vine that had scrambled over the topmost branches of the tree, pecked a hole in the green rind, and extracted large billfuls of the bright orange pulp. She ate more in two minutes than her mate had brought to her all morning. Then she relieved him of his guard at the nest, which he had maintained for eleven minutes. Soon after returning to her eggs she began to pant, although she was shaded by a rather thin canopy of foliage and the sky was hazy. At 11:03, hearing a jay in the distance, she began to call once more. Finally, at 11:25 her mate approached with food, and again she spread and fluttered her wings as he came to her. This time he did not stay to guard but went off at once and left her calling him. At 11:31 she rose up to preen her feathers in the nest. Five minutes after noon I went for lunch. The nest had not been left unattended for a single minute during the five hours of my vigil. The male stood guard only; he never incubated.

At this nest the female jay kept the eggs covered for 91.3 per cent of the 5-hour observation period. A neighboring nest was equally well attended; the female was sitting when I arrived at 7:00 a.m., took a 15-minute recess while her mate stood guard from 8:15 to 8:30, then returned and incubated continuously for more than 3 hours and 45 minutes. She showed no inclination to leave when I ended my vigil at 12:15 p.m. and she had kept the eggs covered for 95.2 per cent of the $5\frac{1}{4}$ hours. At a third Guatemalan nest which I watched for 5 hours, the female sat for 94.7 per cent of the time. At a Costa Rican nest the female incubated continuously from 6:05 to 10:05 a.m., except for a single absence of 14 minutes, from 8:17 to 8:31, at which time her nest was left unguarded; she sat for 94.2 per cent of the 4 hours. Additional records for a somewhat abnormal nest are given beyond (p. 243).

At one Guatemalan nest, the period of incubation was 18 days. At an earlier nest of this same pair, the female sat inconstantly and the incubation period was about 20 days.

THE NESTLINGS

Although I watched many pairs of Brown Jays, there were two with which I became more familiar than all the others. They revealed to me so many new and unexpected details of behavior, so many idyllic pictures of bird life, that I feel that their histories

are worthy of separate chronicle. It was at the nests of these two pairs that I chiefly studied the care and development of the nestlings. These two pairs of jays differed in so many ways that for the sake of clarity, and at the risk of a certain amount of repetition, I shall give their stories one by one.

History of the willow-tree family.—In mid-March I found a nest in the crown of a tall banana plant near the edge of a plantation which bordered a small lagoon. On the bright, warm spring days Boat-billed Herons and Yellow-crowned Night Herons dozed in the willows which grew beside the water. When I came upon the nest, it was occupied by a jay with a black bill and black orbital rings. The head and tail of this jay were readily visible above the rim of the nest as I stood below it. The bird looked quietly down upon me, while a jay which I then mistook for the mate called in great excitement. The eighteen-foot trunk of the plant, soft and succulent and draped in brown dead leaves, would hardly have been scalable even if the roots, already straining under the great bunch of half-full fruit, could have borne the additional burden. The next day I made a tall bamboo ladder and climbed up to the nest, where I found two brown-speckled eggs resting in the neat cup of fibrous roots. The following day there were three eggs in the nest and the set was complete. I tore away most of the fruit from the bunch, both to remove from the cutters all temptation to harvest it and to make it less likely that the plant would share the fate of many others in the plantation and sink uprooted by the weight of its ponderous burden.

I waited ten days before setting up a blind near the nesting tree so that the jays might become more attached to their nest. The young birds which roamed in the vicinity materially increased the caution it was necessary to observe; for if the cloth on the blind were not drawn tight, their keen eyes would spy me through a chink in the back of the blind and their loud scolding would then alarm the bird on the nest. Although I at first suspected that the mate of the jay on the nest was a bird with only a little yellow at the base of the bill and yellow eye rings, which always protested most vociferously at my approach and whom I came to call "black-bill," my first morning's watch convinced me of the error of this assumption. Neither member of the mated pair displayed the slightest trace of yellow, and I found it desirable to mark one of the birds in order to tell them apart. Taking advantage of their absence, I stuck a small brush, dipped in vermilion enamel, between the sticks of the nest in such a manner that the end projected slightly above the eggs. I had hoped that when the female returned to the nest she would rub against it; but, more observant than some other birds that I have tried to mark by this stratagem, she noticed it at once, pulled it from between the sticks, and flew out of sight with it. Foiled in this attempt to mark her, I poured some paint on the rim of the nest in the evening. This is an ill-advised procedure, but the following morning the jay's breast was conspicuously stained with vermilion. I named her "vermilion-breast," and I continued to call her by that name long after the pigment had vanished from her feathers.

Had I studied only this nest, I should have carried away a very wrong idea of the Brown Jay's customary mode of incubation. Whether because the passage of the laborers through the plantation and my own frequent visits had made her shy and restless, or because of some temperamental quirk, "vermilion-breast" was very inconstant in her attention to her eggs. Her periods on the nest were usually short, often of less than half an hour's duration, and her absences were frequent and often prolonged. On the second morning that I watched, she left the eggs uncovered for more than two hours, without having been frightened, so far as I could see, and without giving any evidence of mistrust in the blind. Often while incubating she cried out, but she did this no more than other jays which were more faithful sitters. Sometimes, too, she called in

the vicinity of the nest. Her mate at times stood guard; but twenty minutes was his limit of endurance, although the absences of the female were often more prolonged. Sometimes he would come to the unoccupied nest and stand on the rim for a period, pecking most of the time at the paint in the cup. Once he relieved "vermilion-breast" on the nest and actually covered the eggs for twenty minutes; this was the only time I ever saw a male Brown Jay cover the eggs. Rarely he fed his mate, sometimes on the nest, once while perching beside her on a banana leaf.

So passed the first two days, which were bright and sunny; but on the third and fourth days, which were overcast and misty with frequent showers, "vermilion-breast" gave much more time to her nest. My watch on the fourth morning was enlivened by the male's pursuit of a squirrel which had ventured too close to the nest. The jay darted at the fleeing animal again and again as it scrambled noisily over the slippery banana leaves. Later a pair of lovely Gray-necked Wood-Rails walked with stately strides just in front of the blind, making loud noises like a man coughing. Again the male jay waited until "vermilion-breast" had been absent from the nest for several minutes before he came to guard it, and he left before her return. As the rain fell harder, the female called mournfully from the nest and was answered by the voice of another jay unseen among the banana plants.

When I had finished my fourth day's watch, I added up "vermilion-breast's" total time on the eggs for the past three days. Disregarding the first day of my vigil because I had disturbed her by placing the paintbrush in the nest, I found that on the second morning she sat 81 minutes out of 240; on the second afternoon, 132 out of 240; third morning, 201 out of 240; fourth morning, 192 out of 240. On the two wet, cool mornings, she spent more than twice as much time on her eggs as she had on the bright, sunny morning, and she spent a considerably longer time on the eggs than she had on the sunny afternoon. She seemed to know that her eggs would chill more quickly in the wet weather, and she avoided the danger by sitting more constantly.

Nineteen days after the set was complete, I heard tapping in the first two eggs. The next day I returned, confident that at last I would see Brown Jay nestlings, but I was greeted by an empty nest.

"Vermilion-breast" and her mate were not discouraged by their loss. The following evening, wandering through the plantation near the deserted nest, I heard continued cries of *pee-ah* and followed them to a willow tree growing beside the lagoon, where I found the male resting on a branch halfway up the trunk. These nest calls proclaimed that the pair had selected this as the site of their new nest, although there was still nothing tangible to indicate this. While I stood below, "vermilion-breast" and "black-bill" flew up and added their voices to the male's scolds.

The jays worked apace at building and within six days the structure was completed. The old nest in the banana plant, two hundred feet distant, was torn apart to furnish sticks and roots for the new nest. Four more days elapsed before the first egg was laid; the second and third followed on successive days. I remained away as much as possible during the period of incubation; for this nest, supported between a small branch and the main trunk of the willow tree, twenty-five feet above the ground, was the most readily accessible of all the nests that I found, and I wanted very much to learn the true length of incubation from a study of the jays at this place. This nest was also less subject to disturbance by the plantation laborers than the former nest of the pair had been, and "vermilion-breast" sat more constantly. The first egg disappeared; but the other two hatched eighteen days after the last was laid. The more secluded position of the nest had reduced the length of the incubation period by two or three days.

Thus three months after I had found my first Brown Jay's nest, I held nestling Brown Jays in my hand. They were blind and naked, without a trace of natal down. The entire skin of one was pale yellow; but the upper parts of the second were suffused with a peculiar dark olivaceous tint, while elsewhere it was yellow, too. The feet and the short, thick bills of both were yellow, and the interior of the mouth was red. While I clung below the nest, a bird with yellow orbital rings and bill half yellow, which I had sometimes seen in the vicinity, perched close above me to scold. It ventured as near to me as either of the parents. As time passed, I became familiar with this jay and called him "pied-bill."

Hidden in a wigwam of green cloth set beneath the banana plants, I watched the care and development of the two nestling Brown Jays in the willow tree. The dainty, graceful foliage of this tree and its light green color contrasted pleasantly with the dark, heavy foliage of so many of the surrounding trees. Beyond was the narrow lagoon, an old bed of the Río Morjá, where kingfishers of three kinds, nesting in the banks of the neighboring river, came to fish in the quieter waters, which were beclouded by giant turtles as they moved along the muddy bottom. Here, too, a pair of Green Herons and a pair of Boat-billed Herons each brought their brood of three, which had apparently been reared in the concealment of the cane brake on the opposite shore. In the dense stand of giant canes lived Limpkins, which often came to hunt in the banana plantation, walking over the ground sedately with an undulatory movement of the body that began at the head and flowed back to the tail. Occasionally I watched a scarlet-eyed Gray-necked Wood-Rail as it emerged from the canes to forage at the muddy brink of the lagoon. Here, too, on rare occasions I glimpsed a glorious Agami Heron resplendent in deep blue and maroon plumage, a supreme delight which was always too transient.

My vigil began before sunrise on the nestlings' third day. I had not waited long before the helper called "black-bill" flew up to the nest, looked down on the nestlings, then brooded them, remaining no more than a minute. This was the first and only time that I ever saw one of the helpers actually brood the young, although they frequently stand guard and shade them. When it had gone, "pied-bill" came up and looked into the nest with evident interest, then rested on a branch very close by. A little later "vermillion-breast" (her breast no longer stained) flew up with "brownie," a third helper whose bill was more than half black and accordingly considerably darker than "pied-bill's." Both perched on the rim and fed a nestling at the same time. The others drew off while "vermillion-breast" settled down to brood. She warmed the nestlings for twenty minutes, when her mate arrived with food and she left them exposed that he might feed them. Next "pied-bill" returned, its throat outswollen with food which it delivered to the nestlings. Then it cleaned the nest, swallowing the droppings. Next the male parent returned, fed the nestlings and took his stand on the branch just above the nest, where he uttered the hunger call in a low voice. Seeing a yellow, fallen willow leaf in the nest, he picked it up and tried to swallow it, but it would not go down, so he held it against the branch with a foot, plucking at it, and at length he allowed it to flutter to the ground. As one of the other jays flew by, he repeated his low hunger call and was answered in kind. This call, then, as I afterward repeatedly observed, was used not only by the nestlings and the incubating females to tell that they were hungry, but it was used also by the attendants of the nest to communicate to the others that the young required food. The next to feed the nestlings was "black-bill." Before it left, the female returned and fed and then brooded the young. When her mate next brought food she did not, as usual, leave the nest but merely rose up to allow the nestlings to stretch forth their heads and receive what he had brought. During 2½ hours the two three-day-old nest-

lings were fed 13 times, 5 times by the father, 3 times by the mother, and 5 times by the helpers.

That afternoon I saw one of the parents replace the other in brooding. Since the parent had worn off "vermilion-breast," I could distinguish her only when her behavior differed from that of her mate. At all events, I am certain that the father of these nestlings did on occasion warm them. He was the only male Brown Jay that I saw incubate and the only one that I ever saw brood.

Thus five grown jays attended the two nestlings from the first, and they continued to do so until the young left the nest and I could follow them no longer. The actions of each jay were characteristic and revealed a high degree of individuality among these birds. "Brownie" always took less interest in the nestlings than the others, feeding them but seldom. "Black-bill" often outdid the parents in bringing food, but I saw it brood only once. "Pied-bill" was the zealous protector of the nestlings. It far surpassed both the parents and the other helpers not only in the loudness and persistence of its alarm calls but also in its boldness in approaching what it considered the source of danger, usually myself. When I climbed the willow tree to view the nestlings, it darted to within a few inches of my head, and often it perched only a yard above me to deliver noisy screams. I expected that at length it would gather enough courage to strike my head or peck my hand, but it never did. I have found Groove-billed Anis, Slaty Antshrikes, and Catbirds more daring in this respect. After the parents and "black-bill," tiring sooner of their demonstrations, flew to a safer distance, "pied-bill" lingered close to me and relieved its feelings, as Boat-tailed Grackles sometimes do, by pecking vigorously at the willow branch on which it perched, or tearing to shreds a banana leaf nearby. Sometimes "black-bill" joined in punishing the willow tree, but "pied-bill" alone ripped the banana leaves. Usually, if I remained long at the nest, the other birds would withdraw to the branches of a bamboo farther along the shore of the lagoon, where two or three of them would perch close together and make the feathers of their heads and necks stand on end in a ludicrous manner. "Pied-bill" always stayed by the nest until I went away.

Although I left the blind in place over night and tried to slip into it as unobtrusively as possible, the jays always seemed to know when I was inside. Perhaps they vaguely distinguished my outline through the cloth, perhaps they caught my eye in the narrow slit through which I peered, or perhaps they remembered my comings and goings. I could not open the observation window more than an inch without causing serious disturbance to their routine. When perturbed they would come and scold instead of delivering the food which they had brought for the nestlings. It was usually "pied-bill" that worried about the blind after the others had forgotten their suspicions and gone off to forage. It was chiefly for this reason, I think, that it fed the nestlings less often than did the other jays. It would fly from leaf to leaf above me, angrily scolding. There was something peculiarly disagreeable to me in its notes, especially when drawled in an undertone as they usually were while I was in the blind. The only bird note which has annoyed me more is the Meadowlark's alarm note, a sharp *zzzt* which rubs my auditory nerves the wrong way, like the scratching of linen with the finger nails. When the jays came with their throats distended with food, their voices were somewhat softened and mellowed, but often they hurried to swallow the food in order to get the utmost from the syrinx. One day as I walked past the nest, "pied-bill" approached with its throat crammed with food and an additional item, which I took to be a portion of a lizard, carried athwart its bill. The bird placed this morsel under its toes and held it against the perch while it expressed displeasure at my intrusion. Then, having relieved

its feelings vocally, it again took the food in its bill and carried it to the nestlings.

It was difficult to learn the nature of the food given to the nestlings, for this food was usually brought concealed in the grown bird's throat and fed to the young in pieces. When the attendants caught a lizard or a large insect, they held it down against the perch with a foot and used the bill to tear it into pieces. These pieces were then crammed into the throat until it bulged out conspicuously. This preparation of the food was done at a distance from the nest, where I could watch it only by chance. The final morsel was often carried to the nest in the jay's bill. Once I identified a dragonfly, once a small



Fig. 42. Nestling White-tipped Brown Jay, 21 days old; Motagua Valley, Guatemala, May 30, 1932.

spider, and a green caterpillar, and sometimes the bright orange pulp of a fruit, probably that of the passionflower or the Central American rubber tree.

The nestlings developed slowly. At the age of nine days their flabby bodies were still naked, but the sheaths of the remiges were long and conspicuous and those of some of the wing coverts only slightly shorter. Their eyes were still less than half-way open. At the age of two weeks their bodies were still nearly naked; but during the next two days the contour feathers expanded rapidly, and the sixteen-day-old nestlings began to appear clothed. As I looked over the nest's rim at the young birds, their heads bristled with the erected pinfeathers; they now began to take notice of me. They clung so tightly to the fibrous roots of the nest lining that once I cut the toe of one in trying to lift it from the nest. It was extremely difficult to make them loosen their grasp. While they sat in the nest, they sometimes flapped their wings, on which only the tips of the plumes protruded from the sheaths. These were their earliest exercises in flight.

At the age of twenty days, the nestlings were well feathered and began at last to

look like Brown Jays. They resembled their parents except that the bill, feet, and orbital rings of one were bright yellow, while the second, which had darker skin at birth, was rather dusky in these regions. They now felt their growing strength, moved around more in the nest, stretched their limbs, preened their sprouting feathers, stood up to flap their wings for a fraction of a minute at a time, and sometimes ventured to perch on the rim. They were very silent and rarely called for food except on the approach of a grown bird to feed them, at which time they stretched up their necks, opened wide their yellow bills, and emitted hoarse cries of hunger, which resembled those of the adults except that they were weaker.

On the morning of the nestlings' twenty-first day I watched for three hours at the nest, keeping a record of how many times each attendant brought food to them, with these results: both parents together, 6; "black-bill," 6; "pied-bill," 4; "brownie," 2. Thus the three helpers together fed the two nestlings twice as often as the parents (which I could no longer tell apart), and "black-bill" alone equalled their joint record. "Pied-bill" doubtless would have fed the young more often had it not been so anxious for their safety.

On my approach to the nest on the following day, all five of the attendants flew about me with greater excitement than ever before. As I started to climb the tree, one of the nestlings, catching the excitement, jumped from the nest. However, its flight was weak and it came down in the lagoon. Spreading its wings on the surface of the water, it flapped across the few feet of open water which separated it from the shore and crawled under the marginal weeds, where I readily caught it. I wanted to photograph the young birds and this promised to be my last opportunity. Amid ear-splitting protests, I climbed to the nest and with difficulty loosened the other nestling's grasp on the lining of rootlets. With one young jay on each shoulder, I set off for the plantation house, where I intended to take the pictures, expecting a noisy escort of Brown Jays on the journey. But they were less constant in their guardianship of the young than I had found Montezuma Oropendolas to be under similar circumstances; when I reached the tramline, a hundred feet from our starting point, I turned to look back and saw that only "pied-bill" and "black-bill" still followed. Here they stopped short, leaving the young jays to their fate, which consisted of a long journey clinging to my shoulders, facing the camera a number of times, a meal of pineapple and cooked plantain, and in the afternoon a return journey to the nest, where they were welcomed by a pandemonium of excited cries.

Late in the afternoon of their twenty-fourth day, I found the two nestlings perching side by side on the nest's rim. They were restless, stretched and preened, moved from one side to the other, and panted at times as the rays of the declining sun, finding pathways through the light foliage of the willow, happened to fall upon them. Finally the one with the clear yellow bill, which had earlier flown into the lagoon, flew to a slender branch about a foot distant from the nest; then it hopped to a thicker limb along which it climbed. Here it was fed by "pied-bill" and one of the parents. Impelled by waxing strength, the young jay flapped its wings, launched forth into the air, easily cleared the narrow lagoon, and alighted on the far side in a vine-overgrown willow at a place somewhat lower than the starting point. The moment it took to the air several of the attendants, which had been resting not far off, rushed after the young one and escorted it closely on its first flight.

Then the dark-billed nestling hopped out to a branch about a foot from the nest. After perching there for a few minutes it lost its balance, and in attempting to regain it, clinging by one foot and madly flapping its wings, it made a wild and desperate jump,

just succeeded in catching a toehold on the side of the nest, and pulled itself up into the nest. The spirit of adventure quite quenched by this narrow escape from a tumble into the lagoon, the young jay was content to lie quietly in the bottom of the nest for the remainder of the day. I saw it only when it raised its head to take food. The parents fed the young one six times, "pied-bill" fed it five times, and "black-bill" four times. In the deepening twilight the adult birds continued to fly up to the nest with their offerings. "Pied-bill" came with a morsel a minute before the first call of the Pauraque, which is the signal for the cessation of activities by all strictly diurnal birds, and just after the goatsucker began his soft-voiced calling another attendant brought food to the young jay. By this time the light was too dim to distinguish which attendant it was. Then all the adults went off to their unfound sleeping quarters, leaving the fledgling alone for the first time in its brief span of life. Meanwhile, where its nest mate had gone, and what attentions were being given to it, I could not determine.

When I returned next morning before sunrise, the dark-billed young bird was still lying prone in the nest, to which its parents and their two most faithful assistants brought food. As the rays of the rising sun brightened the foliage of the willow, the young jay became more active and stood quietly on the rim of the nest, where it preened and stretched. Then it climbed out and perched on a branch, stretched both wings, preened, and shook itself. There "black-bill" brought it food, but it was already sated and showed no interest. The helper seemed distressed by this refusal, and at intervals of a few minutes returned five times more with the same offering, each time to meet with the same rebuff from the young one, which continued contentedly to preen. Three minutes after the last refusal of "black-bill's" morsel, a parent brought food which the nestling accepted; but when "pied-bill" came shortly afterward, its offering was also disdained. "Pied-bill," however, was insistent and a few minutes later won acceptance of its gift. The fledgling was being stuffed at such a rate that it could not assimilate all the food that was brought. In two hours, the fledgling took food from the parents eleven times, and it took food four times each from "pied-bill" and "black-bill." "Brownie" was not seen, but possibly it was taking care of the other young bird, which stayed out of sight.

Later that morning the dark-billed fledgling left the nest tree, and I never knowingly saw it again. It had been in the nest 24 days; its nest mate had remained in the nest 23 days.

History of the hilltop family.—One morning late in April, as I followed a cattle path along the back of a sharp ridge on "Alsacia" plantation, I noticed a Brown Jay sitting in her nest in the topmost boughs of a slender tree which stood above the scrubby, vine-choked growth on the steep hillside below me. She had yellow orbital rings, but these were narrower and less conspicuous than in nonbreeding birds, and her bill was at least half yellow. As is frequently true, the two sides of her bill were not colored alike and there was far more black on the left side than on the right; seeing her from opposite sides at different times, one might take her for two different birds. While I stood looking over the tree, considering the possibility of an ascent to the nest, a jay arrived which had a bright yellow bill, merely black-tipped, and bright yellow orbital rings. It protested my presence rather mildly for a young Brown Jay; then it perched on the rim of the nest and gave the sitting bird something to eat. A few minutes later, the same jay (or, in the light of subsequent observations, more probably another with a very similar bill) arrived with another morsel for the bird on the nest. This was before I had seen any nestlings, and at the two nests which I had earlier studied during incubation I had seen the female fed only by her mate. I felt sure, however, from the large amount of yellow on the head of this attendant that it was not the mate of the jay which it had fed on the nest, and I decided to put this opinion to test by a prolonged

watch. I found a grassy slope near the crest of the ridge, where I was slightly higher than the nest and could look over the top of the vine-draped bushes which surrounded the nest tree. Here I sat quietly all morning and although I was in full sight, at a distance of fifty feet, my presence was mostly ignored by the jays.

Almost an hour passed before the sitting female began to utter the nest call; two minutes later a jay arrived which had only a small patch of yellow at the base of the black bill and yellow rings surrounding the eyes. There was nothing visible in the bill of this jay, but it gave the bird on the nest something which had caused its throat to bulge out, and then it flew away. Twenty minutes later it returned. The female cried out at its approach, rose from the nest to greet it, took the proffered food in her bill and flew off with it, leaving this jay standing on a twig beside the nest. Here it remained guarding the eggs until the female silently returned after an absence of fifteen minutes, when it as silently departed. The behavior of this jay indicated that it was the mate of the incubating female.

When the mate had gone, I decided to see how long the female would stay continuously on the nest. Soon the young yellow-bill brought food again and after it had been delivered *chaa*-ed at me, which the owners of the nest had so far failed to do. About the middle of the morning, the sun pierced the clouds which had veiled the sky since dawn, and the female began to pant on the nest, which was very poorly shaded, for the tree was shedding its foliage. Another hour passed and she became restless, preened her feathers much, and often bent down her head to turn her eggs. Two hours after she had gone back to the nest she began to call for the first time on her long shift; she was the most silent of all the incubating jays that I had watched. I climbed into the top of a neighboring tree from which I could look into the nest, hoping that when she went off again I could see and count the eggs. But when her mate returned to feed her once more she showed no desire to leave; she merely turned her eggs and settled back to incubate, while he promptly flew away. Then the yellow-billed jay or jays fed her for the fourth time, although her mate had brought food only thrice. The sun passed the zenith and still she showed no inclination to leave; her patience outwore mine. She had sat without interruption for three hours and forty-five minutes. The nest had not been left unguarded for a minute all morning, and I was not given an opportunity to see the eggs.

The relations between the incubating female and the two yellow-bills which helped to attend her were, as I afterward learned, most intimate. One day at noon I found one of them resting on the rim of the nest beside her while she incubated. The day was devastatingly hot, and both birds were gaping in the full sunshine in the treetop. The next evening, while passing along the ridge which ran to the east of the nest, I saw the male standing guard, a silent and motionless sentinel silhouetted blackly against the blaze of light in the western sky. Presently the female returned, followed by the two yellow-bills doubling and twisting in pursuit of each other, apparently all in fun. She settled down on her eggs for the night; the other three jays withdrew together.

The female jay hatched out two nestlings; there had been at least one additional egg which was broken. The continuous watch which the parents had kept over the nest in the period of incubation was relaxed while they hunted food for their young. The young birds, because of their conspicuous position in the unshaded treetop, attracted the eye of some wandering predator and met their doom. The parents then lost no time in beginning a new nest, about a hundred yards from the first. It was in the top of a small tree, which like the former nest tree had lost its leaves, but it was screened above by a canopy of vines. The old structure was torn apart to furnish material for the new nest.

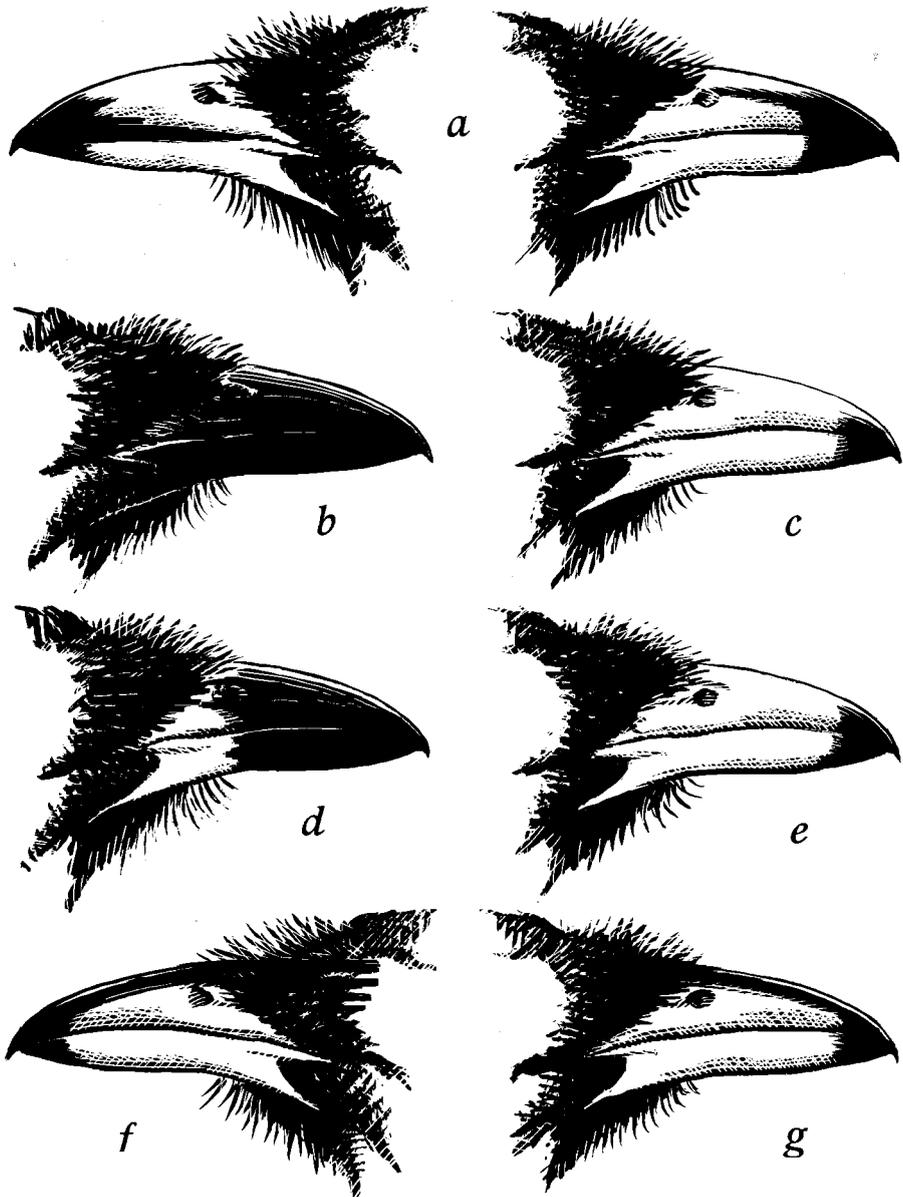


Fig. 43. Bills of White-tipped Brown Jays of the hilltop family; the light areas represent yellow. *a*, left and right aspects of bill of female, showing unusual variation between sides. *b*, male, the apparent mate of the female. *c*, *d*, *e*, *f*, *g*, bills of the five nest helpers.

As soon as the platform of sticks had been laid, the breeding female sat on it most of the time, crying incessantly and without end, sometimes beating her wings ever so slightly against her sides as she cried. From the most silent of incubating Brown Jays she had become by far the noisiest of her kind that I encountered. At times she left the nest to perch in some tree close by, still continuing to call. During the period of nest construction, two yellow-bills brought her food, sometimes placing it in her open mouth,

at other times depositing it in front of her on the rim of the nest. In $2\frac{1}{2}$ hours one morning, these attendants fed the female four times. But the male had become inured to the complaints of the female and brought her nothing as far as I saw. Nine or ten days after the disappearance of the first brood the new nest seemed to be finished.

In due course the eggs were laid, and the female hatched out three nestlings. At first I was confused by the diversity of markings on the bills of the birds which came to feed the young; but by making sketches to show the distribution of black and yellow, I at length became familiar with these jays individually. There were five helpers in all: "yellow-bill" (fig. 43*c*), whose bright bill was yellowest of all, merely tipped with black; "black-tip" (fig. 43*e*), the end of whose bill was more conspicuously black; "rhynie" (fig. 43*d*), whose bill was blacker than that of the breeding female and almost as black as that of her mate, showing but little yellow at the base; "urraca I" and "urraca II" (fig. 43*g* and *f*), both with the tip and culmen or ridge of the bill entirely black, and so similar in appearance that I realized there were two birds with this marking only when, after I had watched for nearly eleven hours, they stood side by side on the rim of the nest. When I saw one alone I could never be quite certain which it was. All of these helpers had yellow orbital rings, but those of "rhynie" were turning black. The jays which attended the same nest often foraged together. "Black-tip," "yellow-bill" and at least one of the "urracas" had fed the breeding female while she built or incubated. These same five jays, together with the parents, continued to attend the young at least as long as they remained in the nest.

While the nestlings were unfeathered and still required occasional brooding, the attendants maintained an almost constant guard over them, as though to prevent a repetition of the tragedy which had deprived them of the first brood. Each attendant when it came with food, remained perched on the side of the nest, or on a branch quite near the nest, until it saw another attendant approaching. The latter, after delivering the food it had brought, remained on guard until a third attendant arrived, and so on. Only the female spent her turn at the nest brooding the nestlings; the others, although they might stay at the nest as long as she or even longer—sometimes for nearly an hour—merely stood guard, or at times when necessary shaded the nestlings from the sun. Sometimes one jay continued on sentinel duty while another fed the nestlings and left again. This was particularly true when the male parent brought food, for now that he had many helpers he seldom served as guard. Sometimes two of the attendants lingered on opposite sides of the nest, at which time the guard was double. The chief flaw in this admirable system of watching was "rhynie"; this jay never took a turn as sentinel. When "rhynie" approached, the bird on guard generally considered itself relieved and went off to forage; but "rhynie" never stayed to carry on the watch, and so the nest was left unattended. The male parent himself was sometimes remiss in this respect. While guarding, the jays spent much time pecking at the bottom of the nest; and the female parent did the same while brooding. After the nestlings were well feathered and did not need to be brooded, the guard was no longer maintained.

At the nest in the willow tree no regular guard had been kept, although the attendants sometimes stood by the nest at irregular intervals. It must be said in extenuation of "vermillion-breast" and her helpers that one or more of them was usually in sight of the nestlings, for they as a rule foraged near the nest and I could rarely approach it without being seen by them. The assistants at the hilltop, on the other hand, usually ranged farther off on the bushy hillsides, and for this reason a guard was more necessary. At another nest, where the parents were only rarely aided by a third bird, no guarding was attempted; apparently they could ill afford to devote the time to it. At all nests, however, the jays from time to time lingered for brief periods on the rim of the

nest after feeding the nestlings. This is a practice by no means confined to Brown Jays. However, only at the nest on the hilltop, of those that I studied, was the habit of guarding developed into an efficient system of watch. This was not merely a result of the large number of attendants, for several of them individually would remain guarding for longer periods than I observed at other nests.

This, thanks to the precipitous slope of the hillside, was the only nest at which I could watch the nestlings from a point actually on a level with them. When an adult alighted on the rim of the nest, the three occupants stretched up their skinny necks to their utmost and opened wide their yellow bills. All appeared equally in need of nourishment, although this was not actually the case. The attendant would place a particle of food in the throat of one, but if it was not swallowed immediately would pick it up again and put it into the throat of another of the young birds, or sometimes into that of the same bird again, until at length the food disappeared with sufficient rapidity. The removal of the food from the mouth of a sluggish nestling, when the adult took it entirely into his own and seemed to eat it, was a more conspicuous act than placing it there; it often appeared as though the nestling in some mysterious manner supplied food to the grown jay.

Frequently, when a sentinel saw a forager approach the nest with food, it uttered a faint hunger cry and vibrated its half-spread wings, begging for some of it. Often its plea was freely granted, and the newly arrived jay gave the other a portion or the whole of what it had brought. The sentinel would then deliver to the nestlings what it had received. Sometimes the bird arriving with food would refuse to entrust it to the sentinel, insisting on feeding the nestlings itself. More rarely the sentinel would try to take the food forcibly from the reluctant forager, but no fights ever arose from this cause. Frequently one of the parents received food from a helper and gave it to a nestling, but at other times a helper intermediated between the parent and the nestlings. Sometimes one parent took it from the other. Then it was usually the female, who spent most time at the nest, who was given the morsel for the nestlings by her mate. This was very much like the behavior of the Moorhens of England as described by Grey (1927:156), who saw the parent birds pick up bread crumbs and pass them to the young of the first brood born in May, which in turn would put them into the mouths of their tiny downy brothers and sisters of the second brood, hatched in July. In the Moorhens, however, the food regularly passed from older to younger birds, whereas in the Brown Jays a parent sometimes intermediated between a young helper and the nestlings, so that the food passed from a younger to an older individual, and from this to one of the nestlings.

Rarely did a jay abuse his privilege of giving to the nestlings the food which another had brought. "Yellow-bill" was most often guilty of this breach of trust. Sometimes, after carrying the pilfered morsel out of sight, "yellow-bill" returned so promptly to feed the nestlings that I believe it gave them what it had taken. Once, when one of the "urracas" brought a whole, big, green caterpillar to the nestlings, "yellow-bill" snatched it from the other and fled with it. "Urraca" showed not the slightest resentment of this display of bad manners. The caterpillar was perhaps the largest single piece that I ever saw brought to a nestling. Doubtless "yellow-bill" acted wisely and saved one of the young from choking. Once when "yellow-bill" was guarding and "urraca I," arriving with a morsel, refused to relinquish it, the former placed its empty bill into the gaping mouth of a nestling, as though to feed it.

I am not sure whether, in all the annals of bird-watching, there is another record of seven birds feeding three nestlings. A copy of the notes made in the blind during a

part of one morning's watch will, I believe, give a truer picture of what the jays did than many pages of generalization.

June 7, 1932, 5:30 a.m. I arrive at the nest on a cloudy morning after a rainy night. The female broods.

5:35. The female gives the hunger call.

5:36. She leaves as "black-tip" comes to feed (?) and assume guard.

5:44. "Black-tip" leaves as I make a necessary adjustment to the blind.

6:00. The male parent comes to feed and guard the nestlings.

6:02. He leaves as "black-tip" arrives. After feeding the nestlings, "black-tip" remains to guard but goes off, as another bird calls in the distance, leaving the nest unguarded.

6:06. "Yellow-bill" feeds the nestlings.

6:07. The female and "rhynie" arrive and feed the nestlings at the same time, then both go off and leave the nest unguarded.

6:12. "Yellow-bill" feeds and guards.

6:23. It goes off as the female returns, without food, to brood the nestlings.

6:24. "Black-tip" brings food and gives it to the brooding female for delivery to the nestlings.

6:45. "Rhynie" feeds while the female remains on the nest, merely rising to allow the nestlings to stick out their heads.

6:52. The female gives the hunger call as she continues to brood.

6:53. "Black-tip" gives food to the nestlings, while the female remains on the nest and calls more loudly.

6:54. The male brings food. The female remains on the nest and takes a portion from him to deliver to the nestlings; he gives them the remainder directly.

6:59. The female again calls from the nest.

7:01. She leaves as "yellow-bill" feeds the nestlings and assumes the guard.

7:05. "Urraca I" arrives, feeds the nestlings, and takes over the guard as "yellow-bill" leaves.

7:13. Seeing the nestlings stretch up their mouths for food, "urraca I," standing on the rim of the nest, gives the hunger call.

7:14. "Urraca II" (now for the first time distinguished) feeds the nestlings, then remains standing on the rim of the nest beside "urraca I," which is its double.

7:16. They both go off as the female comes to feed and brood the nestlings. It begins to rain.

7:28. One of the "urracas" feeds the nestlings. The female merely rises on the nest to uncover them.

7:34. The female gives the hunger call.

7:39. She leaves as "yellow-bill" feeds the nestlings. "Yellow-bill" then departs and leaves the nest unguarded.

7:41. "Urraca I" feeds the nestlings and resumes the guard.

7:46. "Urraca I" leaves as the female returns to feed and then brood the nestlings.

7:54. "Black-tip" feeds the nestlings and leaves the female brooding.

7:56. "Yellow-bill" feeds the nestlings, then goes off leaving the female on the nest.

8:07. The female leaves as "urraca II" brings food to the nestlings. "Urraca I" comes to feed the nestlings while "urraca II" is at the nest. They perch side by side on the rim for a minute, then "urraca I" leaves the other on guard.

8:13. "Rhynie" feeds the nestlings and departs while "urraca II" continues to guard.

8:14. "Urraca II" drives away a Chachalaca which has alighted in the nest tree.

8:20. The female returns to the unguarded nest, feeds, then broods.

8:30. The female stands on the rim of the nest while "rhynie" feeds the nestlings, then she settles back to brood.

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9:35. I leave while "yellow-bill" guards the nestlings.

In a total of 13½ hours, on June 5, 6, and 7, the three naked nestlings were fed 91 times, or at the rate of 2.2 feedings per nestling per hour. In 6 hours on June 7 (5:30 to 9:35 a.m. and 4:20 to 6:15 p.m.), after I had learned to recognize all the helpers individually, they brought food as follows: The male, 6; the female, 9; "yellow-bill," 10; "urraca I," 4; "urraca II," 8; "rhynie," 6; "black-tip," 9; unrecognized, 1. Total visits, 53.

By June 18, when the nestlings were feathered and no longer brooded, swiftly growing vines had so covered over the nest that I could catch only glimpses of the young jays

through their leafy screen when they stretched up their heads to receive food. Because the nest was now so unsatisfactory to watch, I limited my vigil to the three hours between 5:55 and 9:00 a.m. At this time I saw only the same seven attendants, which brought food as follows: The male, 6; the female, 4; "yellow-bill," 2; "urraca I," 4; "urraca II," 1; "rhynie," 7; "black-tip," 3; unrecognized, 3. Total visits, 30. Hence the feathered young were fed at the rate of 3.3 times per nestling per hour in the early morning. Their attendants no longer guarded them but remained at the nest only long enough to deliver the food and remove the droppings.

Other nests.—At each of the four nests which I watched while they held nestlings, at least one unmated bird helped the parents to care for them. We have already given sufficient attention to the nests in the willow tree and on the hilltop. The third nest was situated in a *Bursera* tree growing in the midst of a cane brake. Two young birds regularly helped the parents attend the two nestlings. In five hours on two mornings, the helpers together brought food to the young 15 times, the parents together brought food 23 times. At a fourth nest a single yellow-bill fed one of the three nestlings only once during many hours of watching. These parents took care of their offspring almost alone.

RELATIONSHIP OF THE HELPERS TO THE BREEDING BIRDS

What is the relationship between the helpers and the mated pairs which they assist? At one time a suspicion crossed my mind that perhaps several Brown Jays deposit their eggs in the same nest, as anis do; but inasmuch as there were from one to five helpers and the number of nestlings did not exceed three, this can hardly be true. In anis the number of eggs varies with the number of birds interested in the nest; in Groove-billed Anis there are usually four eggs for each pair. Moreover, with very rare exceptions, only one jay, without much doubt the mother of the brood, is ever seen sitting in the nest. The color of the bills, orbital rings, legs and feet of the jays furnishes a clue to our problem, but it is to be used with caution. The only generalization that it is possible to make is that the parents *average* much blacker in these parts than do their helpers. With two exceptions, the breeding jays which I have seen had bills which were black except at the very base. Their orbital rings were often largely yellow, yet these orbital rings were not so completely of this color as in young birds. The female on the hilltop had the most yellow on her bill of all the breeding birds I found (see fig. 43*a*), but another, a male, had only slightly more black on his bill. Many nesting birds have the bills, feet, and orbital rings entirely black. Two of the helpers, on the other hand, had bills as black as many breeding birds, and the orbital rings of one were more than half black. The legs and feet are of less value in distinguishing the birds because they are more difficult to see clearly, and the areas of black and yellow are not so sharply defined as on the bills.

I believe that Brown Jays begin to breed in the second year after they hatch or perhaps even later, and that the pied-billed individuals are with few exceptions non-breeding yearlings. There appears to be much variation in the rate of blackening of the bills. It may be recalled that one of "vermillion-breast's" two nestlings had a dusky, or dirty yellow, bill at the time of its departure from the nest, while the bill of the other was pure yellow. I have never seen a full-grown bird with a dusky bill; their bills are either pure yellow, pure black, or with sharply defined areas of each color. I believe that this fledgling's bill had already begun to turn black, at least in its greater portion. Unfortunately, after leaving the nest it went off into the cane brake, where I lost track of it. In July I saw a young Brown Jay with the bill black except at the very base clamoring for food, although its feet and orbital rings were bright yellow. Presently

another jay flew up and placed something in its bill, which hardly left room for doubt that it had recently left the nest.

In addition to individual differences in the rate of blackening of the parts bare of feathers, there appear also to be regional differences. Whereas in the Motagua Valley of Guatemala most of the Brown Jays displayed conspicuous areas of yellow in the nesting season, in the Pejivalle Valley of Costa Rica, in April and May, individuals marked with yellow were exceptional. Of three birds which brought food to an incubating female, two of which were presumably helpers, only one had yellow on the orbital rings, which even on this one were partly black. None had yellow on the bills, except at the gape. It is not at all unlikely that some of the helpers with nearly black bills are only yearlings; but it is possible that others are older birds which have failed to mate, and so they assist at another's nest. This may happen on rare occasions in American Robins and other species which do not normally receive outside help in caring for their progeny.

Perhaps most often the young jays, held by the ties of family and the associations of the home territory, remain with their parents until the year following their hatching, in which period they help to attend their younger brothers and sisters. Yet this is not necessarily true, for the Brown Jays are gregarious. It may well be that before the following breeding season the youngsters separate from their parents and attach themselves to another nesting pair. This would explain the presence of five helpers at a single nest; for when it is recalled that my Brown Jays laid only two or three eggs and reared a single brood, it appears unlikely that they would produce so many offspring in one year. Some of the youngsters must lose their parents through death between breeding seasons, and these would be left free to join other mated pairs. Most nesting pairs seem to have at least one nonbreeding bird attached to them.

SUMMARY

In Guatemala and Honduras, Brown Jays were found only in the lush vegetation of the humid Caribbean lowlands, up to about 2000 feet. In Costa Rica, however, they spread over the central plateau and up the slopes of the volcanoes to at least 8300 feet. In the latter country, they cross the lower parts of the continental divide and occur on the Pacific slope.

Avoiding heavy forest, these jays live in second-growth thickets with scattered trees, shady pastures, banana plantations in the lowlands, and coffee plantations in the highlands. They roam about in wary, noisy flocks consisting usually of six to ten individuals. When they see a human being, they protest loudly, alarming birds of other kinds.

The Brown Jays' food is quite varied. They eat a variety of fruits, sip nectar from banana flowers, and probe curled dead leaves for the insects and spiders which hide within them. Their vertebrate prey includes lizards and nestlings of other birds. Although in cultivated districts of the Costa Rican highlands, they were frequently seen to pillage nests, more extended watching in the richer vegetation of the lowlands failed to reveal a single instance of such predation.

Their calls are loud and raucous, and they seem to lack the liquid notes and pleasant whisper song of other jays whose calls are equally harsh. Of special interest is the drawled *pee-ah*, which is used chiefly by building and incubating birds and seems to be a call to the mate for assistance in building or for food.

Brown Jays take dew baths amid the foliage, sometimes in high treetops.

They have a peculiar play, possibly a courtship ceremony, in which one bird makes repeated feints at a second, which stands passively with upstretched neck and erected head and neck feathers. Later the roles of the two may be reversed.

In Caribbean Guatemala one nest was built in February, yet the height of the breeding season did not occur until April, at which time many pairs had eggs. The few pairs still feeding nestlings in June had apparently lost earlier broods. Evidently a single brood is reared each year.

The bulky nest is placed far out on a slender bough of a tree, or more rarely against the trunk, usually from 25 to 75 feet up. Lower nests, from 12 to 20 feet up, are situated in the center of the crown of a banana plant, which is an attractive but dangerous position. Building is a strenuous occupation; coarse sticks for the foundation are broken from trees and long roots for the lining are pulled from bare ground. Male and female share the work of building, coming to the nest separately or more rarely together, and each takes a part in shaping the structure. One of the building birds, probably the female, often spends much time sitting in or near the nest and calling plaintively. Once a young, unmated jay brought a stick to the nest of a mated pair but dropped it on seeing the observer. A replacement nest was built in 5 or 6 days.

In Guatemala the first set of eggs was completed on March 19. The full set consists of 2 or 3 bluish gray eggs which are thickly speckled with brown.

Although one male once sat briefly on the eggs, the female normally does all the incubation. She sits very steadily, from about two to nearly four hours at a stretch, and when hungry she repeats a loud, far-carrying, plaintive cry. Food is brought to her not only by her mate but also by young, unmated birds, which can be distinguished by the distinctive markings of their pied, black and yellow bills. One female was fed a total of 5 times in 4 hours by three or more attendants. Sometimes after receiving food from her mate the female flies off, leaving him standing guard over the eggs while she takes a recess rarely exceeding 15 minutes. During this time she probably eats more food than her attendants have brought to her in a morning. If she does not return in 20 minutes, the male may go off, leaving the nest alone. If because of her mate's negligence she is driven by hunger to begin her recess in his absence, she returns more promptly to the unguarded nest, sometimes after an absence of only 5 minutes. Observations at four nests, each of which was watched for four to five hours, showed that the female incubated from 91 to 95 per cent of the time.

One female hatched her eggs in about 20 days in a low nest where she was often disturbed. At a higher and more secluded nest of this same jay, the incubation period was 18 days.

Newly hatched Brown Jays have yellow skin, sometimes tinged with olive on the dorsal surface, and they are wholly devoid of down. Their eyes are tightly closed; their feet and bills are yellow; and the interior of the mouth is red. Their feathers sprout so slowly that they are mostly naked until they are about 16 days of age. By their twentieth day they are well feathered and resemble their parents in plumage, but their bills, orbital rings, and feet are bright yellow or yellow clouded with dusky rather than black or largely so. They leave the nest spontaneously when 23 or 24 days old.

The nestlings are brooded by the female parent and on rare occasions by the male parent. They are fed not only by both parents but by helpers. At four nests, 1, 2, 3, and 5 helpers were distinguished. At the nest with 5 helpers, each of the 7 attendants would, after feeding the young, remain on guard until another arrived. Thus while the nestlings were still naked they were rarely left alone, although they were brooded only by the female. Instead of giving food directly to a nestling, one of the attendants would often pass it to another attendant for delivery. A helper might pass food either to a parent or to another helper, and a parent might pass it to a helper or to the other parent. At another nest, a helper was more excited by the observer's visits than either of the parents and would sometimes peck its perch or tear up a leaf to relieve its feelings. Nests with few attendants were not well guarded after the nestlings hatched.

The food of the nestlings was usually torn in pieces at a distance from the nest and carried in the attendant's bulging throat, with perhaps the last fragment held visibly in the bill. If a nestling did not swallow its food rapidly, it was removed by the attendant and placed in another gaping mouth, until at last it went down quickly. In $13\frac{1}{2}$ hours, three naked nestlings were fed by seven attendants a total of 91 times, or at the rate of 2.2 feedings per nestling per hour. When feathered, these same nestlings were fed by the same attendants 30 times in 3 hours, or at the rate of 3.3 times per nestling per hour. Two feathered nestlings with five attendants were fed at approximately the same rate.

The bills of Brown Jays darken gradually as they grow older; apparently they darken more slowly in Guatemala than in Costa Rica. After attaining full growth the young jays seem to pass one or more seasons without breeding, but they assist mated pairs at the nest.

WHITE-THROATED MAGPIE-JAY¹

Calocitta formosa

The White-throated Magpie-Jay is found chiefly in the drier areas of the lowlands of Central America and southern México, but in the western part of the Pacific slope of Guatemala it inhabits a region of higher rainfall which was once covered with heavy forests but is now largely occupied by coffee plantations. Here this magpie-jay extends upward to at least 3700 feet above sea level. It wanders through low, thorny woodland,

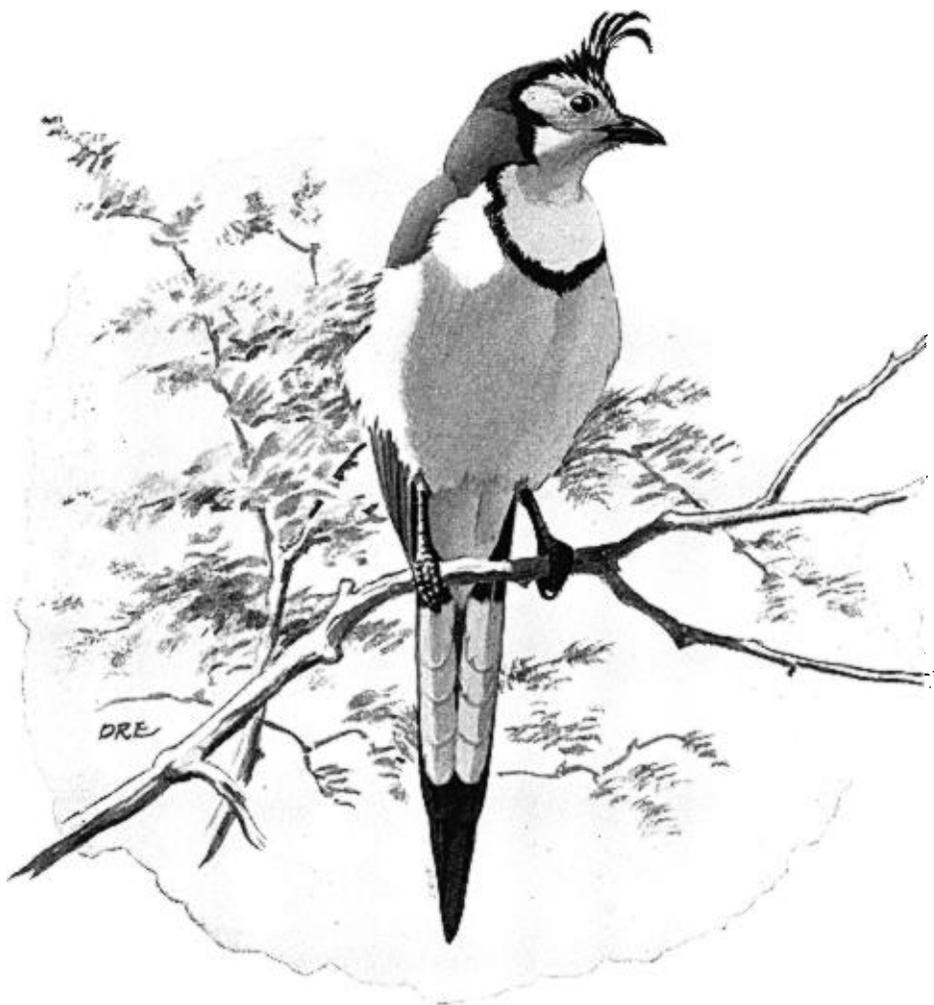


Fig. 44. White-throated Magpie-Jay.

¹ Résumé of the author's paper in the *Wilson Bulletin*, 65, 1953:68-74.

clearings with scattered trees, or tree-shaded coffee plantations in small, straggling flocks, which scold harshly whenever they see a human.

This species has been seen to eat maize and berries, but probably it subsists chiefly on animal food.

Although its alarm notes are painfully loud and harsh, it also utters a variety of mellow, liquid notes. Sometimes, resting inconspicuously in the foliage, it sings a medley in an undertone. The incubating female frequently repeats a harsh call that carries a long distance.

The breeding season is extended, nests with eggs having been found in various parts of Central America from December to July. The nest is placed in a tree or clump of bamboos at heights ranging, in seven instances, from 20 to about 100 feet above the ground. It consists of a pile of coarse sticks which supports a neatly finished cup composed of wiry roots and other fibrous materials, measuring about 5 inches in diameter.

One nest contained 4 gray eggs, finely, densely, and evenly flecked with brown. They measured 35.7 by 23.8, 35.7 by 23.8, 34.1 by 23.0, and 34.1 by 24.2 millimeters.

Apparently only the female incubates. While engaged in this occupation she is fed not only by her mate but by other individuals which seem to be unmated. On the Pacific slope of Guatemala, one female was nourished by two and probably three or more other jays, which fed her 47 times in 13.75 hours. In this period she took 10 sessions on the eggs which ranged from 25 to 88 minutes and averaged 54.6 minutes. Her 13 recesses varied from 1 to 21 minutes and averaged 8.6 minutes. She covered her eggs for 86.4 per cent of the observation period. So much food was brought to her that she found it unnecessary to hunt for herself but devoted her short absences from the eggs largely to preening and stretching her limbs.

The incubation and nestling periods of this jay are unknown.

GENERAL SUMMARY OF INFORMATION ON THE CORVIDAE

The ravens, crows, rooks, magpies, jays, nutcrackers, and their allies constitute a nearly cosmopolitan family containing, according to Mayr (1946:67), 100 species. They are middle-sized to large passeriform birds and include some of the biggest members of the entire order. The family is best represented in the North Temperate Zone. Tropical America has numerous jays, but the other divisions of the family are lacking south of Nicaragua and the Greater Antilles, the southernmost outposts of the ravens. In coloration, the ravens, crows, and rooks are mostly black, or gray and black; the magpies are chiefly black and white; the jays are mostly shades of blue, but at times they are brown, gray, or green and yellow, and often of great beauty; the nutcrackers are gray or brown and white. The sexes are alike in this family and seasonal changes in coloration are absent, at least in the better-known species. Wandering in inclement weather, rather than true migration, best describes most of the annual movements performed by members of the Corvidae, which fail to make such long journeys as many of their smaller neighbors. But in a few species, including the American Crow and Blue Jay, and in Europe, the Rook and Hooded Crow, many of the individuals which breed farthest in the north migrate southward in the autumn. Their journeys may cover a thousand miles or more but rarely take them beyond the breeding range of their species as a whole. No member of the family which breeds farther north is known to reach Central America as a winter visitor. The intelligence of the Corvidae, and the fairly complex social organization of many species, make this family peculiarly interesting to the student of bird behavior. Jackdaws (Lorenz, 1952:163), Thick-billed Nutcrackers (Swanberg, 1956:413), and probably other species remain paired for life.

The food of these big birds is so varied that they are correctly termed omnivorous. The larger members of the family are to a considerable extent carnivorous, eating a variety of small animals such as mice, turtles, lizards, frogs and toads, as well as many insects, worms, spiders, and other small invertebrates. Some are not averse to carrion, and a number of jays and magpies have an unenviable reputation as devourers of the eggs and young of their feathered neighbors. Jays of numerous species are fond of acorns, which they open and break into edible portions by vigorous hammering with their strong bills. Nutcrackers extract the seeds from the cones of pines and other conifers. The larger northern members of the family forage a great deal on the ground, over which they progress by walking rather than by hopping, and they sometimes follow the plow; but the jays of tropical America seem to be largely if not wholly arboreal. The habit of storing excess food for future consumption is well developed in the jays, magpies, and nutcrackers. The bird places the food either in a shallow hole which it opens in the ground or in a crevice in the bark of a tree and covers it with soil, dead leaves, lichens or moss. Later it may hunt for its cache and consume the stored food. Thick-billed Nutcrackers, whose survival over the winter and early breeding while snow still covers the ground are dependent on caches of food, exhibit amazing proficiency in retrieving long-buried hazelnuts from beneath a thick layer of snow (Thorpe, 1951:277). Likewise the European Jay remembers and defends its hidden food (Goodwin, 1956:211-213). The Steller Jays of the Guatemalan highlands hide away edible particles as do their relatives farther north; but I have never seen the White-tipped Brown Jays or the White-throated Magpie-Jays of the warm lowlands do this. Apparently related to the habit of storing food is the habit of crows and magpies of hiding away such bright and glittering small objects as they can acquire and carry off.

The voices of the majority of the Corvidae are for the most part loud and unmusical,

often harsh and discordant. Some display considerable powers of mimicry, especially when held in captivity. European Jays when strongly excited tend to repeat sounds which they heard on earlier occasions when the same emotions were stirred (Goodwin, 1956:213-214). Such singing as the corvids do is largely performed in quiet seclusion and is given in an undertone, so that it is not often heard by the bird-watcher. This suggests that these birds do not sing in advertisement of territory or for the acquisition of a mate. At times the *sotto voce* songs of crows and jays are truly delightful performances, sweet and pleasantly varied, often amounting to a medley, and are continued for many minutes together. Soft warbles form part of the whisper songs of crows and jays, surprising as this may seem coming from birds generally so harsh voiced. Amadon (1944) discovered that both sexes of the Scrub Jay deliver the whisper song.

Nuptial feeding is of frequent and perhaps regular occurrence in the Corvidae. Most often the male feeds the female while she incubates, but for a few species there are records of feeding during courtship. Among these latter are the Scrub Jay (Amadon, 1944), Blue Jay (Bent, 1946:34), European Jay (Goodwin, 1951:429-432), Jackdaw and Chough (Lack, 1940:176). The male brings food to the female while she incubates in the foregoing species and this is also true of the Raven, Carrion Crow, Rook, magpies (Linsdale, 1937:108-114), Thick-billed Nutcracker (Witherby *et al.*, 1938, 1:29), and Blue Jay (Forbush, 1927:379). While incubating, the female White-tipped Brown Jay cries out loudly when hungry and food is brought to her on or near the nest not only by her mate but also by one or more unmated helpers. The same is true of the White-throated Magpie-Jay.

The nests of jays and crows are usually placed in a tree or bush, but ravens build on cliffs, Jackdaws on cliffs or old towers or trees, the Hooded Crow occasionally on the ground, and the Chough in crevices in the walls or roof of a cave. Jays as a rule build their nests in solitude. However, the Piñon Jay nests in colonies, and colonial nesting is well developed in Rooks, Jackdaws, crows, and other species. The nest is usually a bulky open structure composed of coarse sticks; it has a lining of fibrous roots, strips of bark, grass, weed stems, pine needles, wool, feathers, hair, or other fine material. Mud is used to plaster the inside of the cup by magpies and the White-winged Chough, an Australian bird which some systematists would place in a separate family. The nests of magpies are often huge, bulky structures, which are roofed over with coarse twigs and entered through an opening in the side. The remarkable nest of the Black Crow of South Africa consists of an upright cylindrical "basket" of interlaced coarse sticks which is about two feet in height and two feet in diameter and is open at the top and bottom. Its central hollow is surrounded by grass stems and roots, while the core is filled almost to the top with coarse sedge and an admixture of other materials (Skead, 1952:440). Magpies, Rooks, Jackdaws, White-winged Choughs, and other members of the family may use the same nest year after year, adding some fresh material to it each spring until it becomes a very massive structure.

The nest is built by both sexes in practically all of the species of the Corvidae for which we have information. This is true of the Raven, Hooded Crow, Carrion Crow, Rook, Jackdaw (Witherby *et al.*, 1938, 1:9-28), European Jay (Goodwin, 1951:432), Scrub Jay (Amadon, 1944), Blue Jay (Forbush, 1927:378), White-tipped Brown Jay, and others. At times more than two individuals join in building the nest. Three American Crows were watched building one nest (Forbush, *op. cit.*, 395). In the White-winged Chough, the whole flock assists in nest building (Mathews, 1925, 12:414-420). Gross (1949:242) watched a company of seven or eight Mexican Jays at work on a nest, and when the White-tipped Brown Jays are building a helper may from time to time bring a stick to the nest. The usual procedure in nest building in crows and jays appears

to be that the female sits in the growing structure while the male fetches material and gives it to her to arrange, but in the European Jay, according to Goodwin, the sexes work rather independently of each other and both arrange what they bring. Sticks are often laboriously broken from trees rather than gathered from the ground, and colonial-nesters, such as Rooks, are not above stealing material from the unguarded nests of their neighbors.

The eggs are often greenish or bluish green, or they may be grayish, buff, creamy, or dull olive. Usually they are rather heavily blotched, or thickly and finely spotted, with varying shades of brown, pale lilac, or, more rarely, black. Exceptionally, as in the robin-blue eggs of the Mexican Jay, the shells are without spots or blotches. The jays of Central America lay 2 to 4 eggs in a set. Northern members of the family have sets of from 3 to 7, and rarely there may be 9 or 10 eggs to the set.

Incubation is carried on by the female alone in the majority of the species which have been most carefully studied. This is true of the Rook (Yeates, 1934:43-44), Raven (Gilbert and Brook, 1924), Carrion Crow, Jackdaw, European Magpie, Thick-billed Nutcracker, and Chough (Witherby *et al.*, 1938, 1:9-38), Scrub Jay (Amadon, 1944), and White-throated Magpie-Jay. In some species of the Corvidae, however, incubation by both sexes appears to be customary, while in other species the male may sometimes sit on the eggs. Among the former we may tentatively place the Black Crow (Skead, 1952:441), and with greater confidence the Clark Nutcracker, at one nest of which the female was on the eggs for 79.5 per cent of 20 hours of observation in the daytime and the male was on for 20 per cent. Since this species nests when temperatures are near or below the freezing point, the utility of this arrangement is apparent; it is noteworthy that the male nutcracker, unlike some other male passerines which take turns on the eggs, develops a bare brood patch like that of the female, which enables him effectively to apply heat to the eggs (Mewaldt, 1956:15). At a nest of the Canada Jay which she watched in snowy weather, Lawrence (1947) saw two individuals sitting simultaneously, one above the other, and taking turns at being bottom bird in contact with the eggs. This, however, is unusual behavior in any family of birds, and it is at variance with the earlier observations of Warren (1899), who saw only the female incubate while snow lay deep in Michigan. We need more observations on this species. In the European Jay the female usually performs all the incubation, but the male may occasionally take a turn at incubating and at brooding the young (Goodwin, 1951:434; 1956:206). In the White-tipped Brown Jay, too, I once saw a male sit briefly on the eggs, but this was most exceptional behavior.

In the family as a whole, incubation seems usually to begin with the laying of the first egg of the set. However, the American Crows studied by Emlen (1942:150) did not start to incubate until the set was complete. The males of some of the Corvidae keep the incubating female so well supplied with food that she rarely finds it necessary to leave the eggs and forage for herself; if the male brings less food and the female takes brief recesses to go off and hunt for more food, he often stands guard over the eggs until her return. This last is the method of the White-tipped Brown Jay. In part because they are so well attended by the males, female jays incubate more constantly than most other oscine birds. Brown Jays usually take sessions lasting from 1½ to nearly 4 hours without interruption, and they keep their eggs covered for from 90 to 95 per cent of the day. The sessions of a White-throated Magpie-Jay ranged from 25 to 88 minutes and averaged 55 minutes; she kept the eggs covered 86 per cent of the day. The European Jay leaves her eggs about once in 3 hours and stays away from 5 to 15 minutes, rarely more (Goodwin, 1956:206). The Scrub Jays studied by Amadon were on the nest for 80 to 90 per cent of the time. Female Scrub Jays and Blue Jays sometimes cover their nests so

steadfastly that they may be lifted off the nest by human hands and then returned to it without causing them to fly away. Gilbert White (1789, letter II) wrote of a Raven that continued to sit bravely in her nest in the top of an oak tree, which woodsmen were cutting down, until she was caught by the branches of the falling tree and killed.

Incubation periods in the Corvidae range from 16 to 18 days for the smaller members of the family, 19 to 20 days for the Carrion Crow, and 20 to 21 days for the Raven.

The nestlings are hatched sightless and helpless. The newly hatched young of the White-tipped Brown Jay, Blue Jay, Scrub Jay, Mexican Jay, and the magpies are wholly devoid of down; but those of crows, ravens, and Clark Nutcrackers bear sparse natal down. The interior of the mouth is red in the Black Crow (Skead, 1952:442), Clark Nutcracker (Mewaldt, 1956:20), White-tipped Brown Jay, and probably in most other species. In the family as a whole, the young are brooded by the female, although male European Jays (Tutt, 1952; Goodwin, 1956:206) and White-tipped Brown Jays may on rare occasions cover the young briefly. The male appears regularly to brood in the nutcrackers.

The young are fed by both parents with food carried largely in the throat pouch; sometimes, as in Brown Jays, after the pouch has been filled to capacity, a final item may be carried conspicuously in the bill. Of the Rook, it is said that until the nestlings are about nine or ten days old the male provides all the food not only for the young but also for the female parent, which remains almost constantly on or near the nest brooding or guarding them. After the young are older she goes off to hunt and brings some food to the nest, but the male is still the chief food-gatherer (Yeates, 1934:58-59). So, too, the female Raven stays almost constantly on the nest until the nestlings are about a week old, and the male brings food for all the family (Gilbert and Brook, 1924). If a nestling jay does not promptly swallow the food that has been given it, the attendant at once plucks the food from its throat and offers it to another or to the same young bird. This has been observed in the European Jay (Goodwin, 1956:207) and in the White-tipped Brown Jay.

Members of the Corvidae apparently never simulate injury or otherwise give distraction displays. They are powerful enough to drive away many predators which would be formidable to smaller birds, and when their nest is visited by man they often work themselves into a rage. But they usually do not dare to attack the human intruder and instead shower blows on some unoffending object nearby. In these circumstances, Ravens hammer away at a dead limb (Tyrrell, 1945:7) or tear up grass by the roots; one frenzied parent settled on a sheep's back and pulled out wool (Gilbert and Brook, 1924). While I visited a nest of the White-tipped Brown Jay in a willow tree, the adult jays would rip neighboring banana leaves into shreds. When Grimes (1940:435) removed young Scrub Jays from their nest, a parent pecked so vigorously at the empty receptacle that he "thought the structure would fall to pieces." Once when he placed a hand on the nest, he was attacked by three adults which pecked his hand and ears, drawing blood from the former.

Young of the Corvidae develop slowly and remain in the nest until they can fly. Nestling periods are 20 days for the Clark Nutcracker, 20 to 22 days for the European Jay, 22 to 27 days for the magpies, 23 or 24 days for the White-tipped Brown Jay, 29 or 30 days for the Rook, 38 days for the Chough and the Black Crow, and 5 or 6 weeks for the Raven. Young Thick-billed Nutcrackers are fed by their parents until they are at least 105 days old (Swanberg, 1956:414).

Helpers at the nest have been noted in several species of the Corvidae. A pair of White-tipped Brown Jays may be assisted in their nesting operations by from one to five unmated helpers. These are apparently yearling birds which will not breed until

they are two years old. These helpers may occasionally bring a stick to the nest during construction and they may feed the female while she builds or incubates, but they are chiefly in evidence after the young hatch. At this time they bring food and guard the nest as zealously as the parents. An incubating White-throated Magpie-Jay was fed by one or two helpers in addition to her mate. Grimes (1940:433-435) found three grown birds bringing food to a nestful of young Scrub Jays, and at least two of them took turns at brooding. Bent's (1946:118-122) brief account of the nesting habits of the Mexican Jay suggested interesting modes of cooperation between a number of individuals; and later Gross (1949:242-244) watched seven or eight of these jays, including two yearlings, take part in building a single nest. Three American Crows fed the young at a nest in Connecticut (Forbush, 1927:395). It would be valuable to know more details of the nest life of the Australian White-winged Chough, of which it is said that a whole flock assists in building the nest. At one nest of the Tufted Jay, Moore (1938:238-239) found three individuals whose relations were most intimate. Two of these jays even sat side by side on the eggs for a short while. The statement of Forbush (1927:380) that Blue Jays "are said to care for the aged and infirm" is wholly in keeping with what we know of the social habits of the Corvidae. According to Darwin (1871) Indian Crows fed two or three blind adults of their kind; and Kropotkin (1902:59) cites an observation of Brehm, who saw two crows feeding, in a hollow tree, a third crow that was wounded. Davis (1952) watched a captive Raven pass food to a free Black Vulture through the bars of its cage in freezing weather. A tame Blue Jay whose bill was broken off short in a washing machine was fed by hand and grew a new bill in a year (Fluck, 1947). It is not impossible that a free jay or crow with such a mutilation would be nourished by its companions until it had regenerated its bill.

FAMILY HIRUNDINIDAE

ROUGH-WINGED SWALLOW

Stelgidopteryx ruficollis

Rough-winged Swallows are plain-colored birds, grayish brown on the upper plumage and on the under parts paler grayish brown, becoming white on the abdomen and under tail-coverts. Over their immense breeding range, extending from southern Canada to northern Argentina, these swallows exhibit variations in color and size, on the basis of which a number of forms have been named. Those inhabiting southern Central America and northern South America are readily distinguished by their light gray or whitish rumps, which contrast strongly with the remaining upper plumage. Their throats are cinnamon or rufous instead of gray as in the more northern races. In eastern Costa Rica I have seen light-rumped and dark-rumped individuals flocking together. The recognition in the field of the several forms of Rough-winged Swallows inhabiting Central America is further complicated by the presence, during the northern winter, of migrant races from the United States and Canada and also by local migratory movements of birds which breed within our area.

In its several races, this is the most common swallow of Central America. It is abundant in clearings and along the waterways over much of the lowlands, especially on the Caribbean side, and it nests upward to about 6000 feet above sea level in Costa Rica. In mid-September, 1934, I saw many Rough-winged Swallows circling over the alpine meadows on the high plateau of the Sierra Cuchumatanes of Guatemala, 10,500 feet above sea level; but these were probably migrants from farther north. Like other swallows, Rough-wings are sociable, flying in loose flocks over open fields and waterways as they collect small insects from the air. When tired they rest together in a dead tree or on telegraph and electric wires. In the evening they gather in great compact flocks to go to their roost. Many of their notes are harsh chirps, but in El General, Costa Rica, I have heard them utter soft, clear, singing notes, and rarely a brief, musical trill.

PAIRING AND CHOOSING THE NEST SITE

Beginning in mid-November, 1942, a lone Rough-winged Swallow was often seen resting on the leafless tips of long, slender branches of the calabash trees in front of my house in El General. From time to time he sang briefly, whence I inferred that he was a male. At first he was usually alone, but after mid-December a second Rough-winged Swallow was often with him and appeared to be his mate. When other swallows of the same species flew over the terrace in front of the house, I saw brief aerial contacts between them and heard harsh notes seemingly uttered in anger. Apparently the swallows not only had mated but also were making some attempt to defend a territory far in advance of the nesting season. This was at a time when they were gathering by hundreds to roost in a neighboring cane field. The following year, 1943, a lone swallow began to rest in the same trees, occasionally singing, as early as October, and it was joined by a mate before the end of November. I believe this was the pair that later nested in an abandoned burrow of the Amazon Kingfisher, which was situated in the bank of the river about a hundred yards away.

At Vara Blanca, between 5500 and 6000 feet above sea level in the Costa Rican highlands, I first noticed Rough-winged Swallows, both light-rumped and dark-rumped

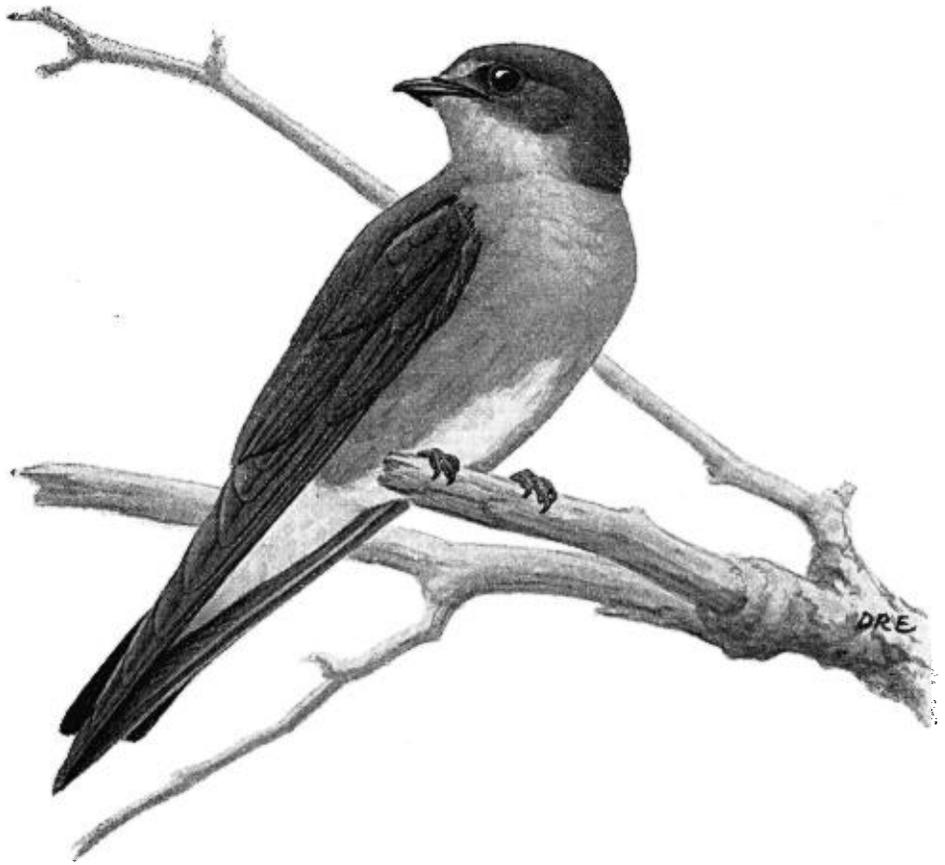


Fig. 45. Rough-winged Swallow.

forms, in mid-March, and they at once took an interest in old burrows in the roadside banks.

In 1932, while studying the habits of the Ringed Kingfishers, Amazon Kingfishers, Green Kingfishers, and Turquoise-browed Motmots which bred in burrows in the low, sandy banks of the Río Morjá, a small tributary of the Río Motagua in Guatemala, I saw much of the Rough-winged Swallows. Of the five species of birds which nested in these banks, four were related to each other. Greatly as the motmot differed in appearance from the three kingfishers, both in structure and habits, there were unmistakable signs that it had sprung from the same branch of the family tree. The fifth of these neighbors was phylogenetically as far removed from the other four as its restless, aerial spirit differed from their calm, phlegmatic natures. It was an intruder ready to take advantage of the others' toil, who waited until a burrow already made was free for use.

In February, while the kingfishers were still engaged in the excavation of their burrows, the Rough-winged Swallows began to take an interest in them, returning again and again to alight in the entrance or perch on a root jutting out from the bank close beside it. Three swallows were sometimes attracted to the same burrow. Two of these were evidently rivals for the favor of the third; but since all wore the same coat of

grayish brown, and constantly changed their positions, I found it impossible to tell which were the rivals and which the courted. After resting a few moments at the mouth of a tunnel obviously too wide to have been made by them, all three would fly up together above the water, with many twistings and turnings and harsh chirpings.

One pair of the swallows took great interest in a burrow of the Ringed Kingfishers, and they repeatedly perched in or near the entrance. Once for ten minutes one of the pair stood just inside the mouth of the tunnel, talking in harsh chirps to its mate which clung to the bank outside, as though, lacking courage to explore alone the dark interior, it was trying to persuade the other to accompany it on the adventure. It moved slowly inward until its white thighs alone were visible in the darkness, chirping the while; but since the mate disdained to enter, it emerged at length without having penetrated deeply. This performance was repeated several times.

Through March the swallows continued to pair and select sites for their nests. Often, pursuing each other, they clashed, two by two, high in the air. Doubtless for them this was a grim affair of mates and homes; but as they doubled and twisted and dodged to escape each other, then for an instant fluttered together as lightly as butterflies, uttering the while their hoarse chirps, it all seemed like a fairy dance. Then they separated and continued their pursuit of minute insects, and often, as they flew across the river, dipped prettily into the surface of the water to snatch up some drowning insect, sending up a glittering spray. They seemed to be less interested in the kingfishers' burrows at this time than earlier in the season. Perhaps they had already decided which pair would have a certain burrow when the proper time arrived.

It was early April before the Rough-winged Swallows began to build their nests. After much watching at the entrances of the tunnels of other birds, they at last had found some free for their own use. Into kingfishers' burrows from which an early brood had departed, into shafts which were abandoned unfinished because the excavators had struck a root or a rock or for other reasons, into last year's kingfisher and motmot burrows which had come through the rainy season in fair condition, they at length started to carry dead leaves and rootlets and bits of straw to make their thick but shallow nests. Fine, scattered toe-scratches in the entrance of the burrow, in place of the deep parallel ruts made by the kingfishers and motmots, betrayed the fact that the swallows had taken possession. When they discovered that a suitable burrow had been deserted by its builders, they often claimed it with surprising promptness. Within five days after four young Amazon Kingfishers had left the tunnel where they were hatched, the swallows had begun to carry in material for their own nest.

Unlike the birds which originally dug these burrows, the swallows preferred to sit on their eggs where they could look out upon at least a narrow circle of daylight. Hence, if theirs was a completed burrow of kingfisher or motmot, they neglected the darker but more spacious nest chamber at the end and built their nest on the outer side of the curve in the tunnel, which was quite wide enough for their smaller bodies. Here I could see the nests and by baring my arm sometimes I could just manage to reach them from the front.

Throughout Central America, as in other parts of their range, tunnels in banks are the preferred nest sites of the Rough-winged Swallows. A narrow hole only 11 or 12 inches long may be accepted by them. In the long tunnels of Ringed Kingfishers and Amazon Kingfishers, the nest may be placed as much as 3 or 4 feet from the entrance, but it is still well forward of the enlarged chamber at the end. One nest which I discovered in El General was placed in a thick, upright wall, 8 feet high, formed by the clay adhering to the roots of a great charred tree that lay uprooted in a new clearing in the forest. The swallow's nest was in a tunnel penetrating what had been the lower side of the root system. The tunnel was situated 4 feet above the ground; it was 12 inches long,

and at the mouth it was $2\frac{1}{2}$ inches wide by $1\frac{3}{4}$ inches high. In Trinidad, Belcher and Smooker (1937:506) found Rough-winged Swallows nesting in old burrows of kingfishers and jacamars, in an accidental break in a bank, or in holes left for drainage in masonry walls. Although I have no knowledge of Rough-winged Swallows digging tunnels for themselves in Central America, they are reported to do so in the United States (Bent, 1942:426). Here they also nest in crevices in walls of masonry or wood, in wharves, bridges, culverts, and other works of man, and rarely even in hollow trees or travelling river steamers.

The nest itself is a well-made, shallow cup composed of grass, dry leaves, rootlets and similar material. I was not able to learn whether it is built by one or both members of the pair.

THE EGGS

Throughout Central America, the Rough-winged Swallows begin to lay in April. In the Pejivalle Valley of Costa Rica, a dark-rumped individual started to lay on April 16, and at Vara Blanca a nest with one egg was found on April 28. Along the Río Morjá in Guatemala, two completed sets were discovered on April 21 and a third female began to lay on this date. Two other females started laying before the end of the month. A sixth nest, built upon an earlier one that had been deserted, had fresh eggs on May 18. This is my latest record of newly laid eggs, whence it appears that a single brood is raised each year. Four of the nests along the Río Morjá contained sets of 5 eggs; two nests had sets of 4 eggs. At Pejivalle two nests each held a set of 5 eggs. In Trinidad, Belcher and Smooker (1937:507) found sets of the race *S. ruficollis aequalis* ranging from 4 to 6 eggs. In the United States, *S. ruficollis serripennis* lays from 4 to 8 eggs in a set, but usually the set consists of 6 or 7 eggs (Bent, 1942:428). The eggs are deposited on consecutive days and are pure, immaculate white. The measurements of 27 eggs in Guatemala average 19.8 by 13.6 millimeters. Those showing the four extremes measured 20.6 by 14.3, 19.8 by 14.7, and 19.1 by 12.7 millimeters.

INCUBATION

As far as I could learn, incubation is performed by the female alone. Nothing reveals better the temperament of a bird than the way it incubates. Of the birds which made the burrows in the banks of the Río Morjá that were afterward claimed by the swallows, the phlegmatic Ringed Kingfisher could sit on the eggs all day with only a single break; Amazon Kingfishers, Green Kingfishers, and Turquoise-browed Motmots measured their turns on the nest in hours; but the mercurial swallow found ten or fifteen minutes, or at best half an hour, the longest period of inactivity that her spirit could endure. Furthermore she required a recess of almost equal duration before going back to sit again. The kingfishers entered and left their nests so infrequently that, when studying their mode of incubation, I found it advisable to set up a twig in the mouth of the burrow to assist my wavering attention, but the situation was quite different in the swallows. Although I at first employed twigs to indicate the movements of the birds when eyesight wandered, I soon grew weary of wading back and forth across the river to set up the little stick each time a swallow pushed it over on entering or leaving. Their periods both on and off the nest were so short that, without feeling the strain, I could keep my eyes glued on the burrow's entrance and see all their goings and comings without any mechanical aid. The vigil demanded strict and undeviating attention, for the swallow's sudden dives out and swift darts in were over in an instant.

On April 28, I sat on the sandy shore opposite an abandoned burrow of the Amazon Kingfisher which was occupied by a pair of Rough-winged Swallows. The female

swallow had been incubating her five eggs for three days. In an hour her movements were as follows: entered at 9:47, on 10 minutes; away 7; on 7; away 9; on 13; away 14.

Leaving this nest (number 1), I went to watch another swallow's nest a few paces upstream which was in an abandoned Ringed Kingfishers' working. Here incubation had already been in progress for eight days. I thought that with longer practice the swallows might sit more constantly, but the following record shows that this bird stayed in the nest for periods even shorter than those of her neighbor which had more recently begun to incubate: beginning at 10:52, away 5 minutes; on 6; away 7; on 8; away 9; on 12; away 7; on 9.

The same restlessness continued in the afternoon, when kingfishers, jacamars, woodpeckers and other birds take longer sessions on their eggs than in the morning, as this record made on April 28 at the first nest shows: beginning at 3:57, on 8 minutes; away 9; on 12; away 17; on 13; away 13.

The male of this pair of swallows, in the intervals when he was not circling and darting above the river in quest of insects, rested on the end of a piece of dead cane which stood upright in a pile of driftwood stranded in front of the burrow. His mate, upon leaving, perversely desired to perch in this position, although there was a slightly lower branch which might have served her equally well. The male would make way for her as she darted down upon him, and he would either take the lower branch himself or go circling above the river. Then, after a brief period of perching, the female swallow would take wing, double and turn and loop tirelessly back and forth above the water, now and then dipping into its surface to pick up some floating insect. At times, too, she gave chase to some other swallow, voicing harsh twitters as she pursued it. When her hunger and desire for exercise had been satisfied, she rested once more on the end of the cane, then took wing and circled around and around in front of her burrow, hesitating to enter; but suddenly she turned, shot into the burrow, and disappeared for ten or fifteen minutes. Of course, by this time, with all her flying around and mingling with other swallows on the river, I could never be sure that this was the same individual that I had seen dart out of the burrow. But since the male never went into the burrow when he saw the female come out, and since the eggs were uncovered nearly half the time, I doubted whether he shared in the task of incubation. Interpreted on the assumption that one bird alone sat in the nest, my records showed a simple, rhythmic alternation of incubation and flight. However, if both sexes took turns on the eggs they must have followed a most complicated arrangement, far more intricate than the incubation pattern of any species of which I could distinguish the sexes.

In an effort to make quite certain whether both sexes of the Rough-winged Swallow warmed the eggs, I caught another female on her nest and marked both wings with white paint before releasing her. It was essential to give her large, conspicuous white wing-patches which could be seen plainly as she darted rapidly into or out of the tunnel. This nest remained unattended all day, as I could tell by the absence of toe-scratches in the entrance to the burrow where I had carefully smoothed the ground. Had it been the custom of the male swallow to incubate, he probably would have gone into the burrow even if the female did not, since I had not frightened him. The white-winged swallow often fluttered before the entrance on that day, but she never resumed incubation of her eggs. Three weeks later, however, I discovered that this nest had been covered over, eggs and all, with fresh material, and a new set of five eggs—the latest that I found—had been laid there.

On May 4, I again watched before the two nests that I had studied on April 28 and I also watched a third nest in which incubation had been in progress only four days. All three female swallows sat on their eggs for considerably longer periods than they had on

the earlier date, but the record of one will suffice as an example: left nest at 7:09, away 5 minutes; on 12; away 14; on 34; away 10; on 15.

On April 28, which was dry and excessively warm, the longest session that I timed lasted thirteen minutes. On May 4, which was a cool, cloudy day, following heavy rains which had freshened the air and dampened the burrows, all three of the swallows remained on their eggs for longer periods; each of them sat at least once for more than half an hour continuously. On the cooler day, when the soil was wetter, the eggs apparently required more constant coverage to keep them warm.

At nest 1, in four hours of observation on both the warm and cool days, I timed 9 completed sessions which ranged from 7 to 34 minutes in length and averaged 13.8 minutes. The 9 recesses varied from 5 to 17 minutes and averaged 10.9 minutes. Thus the swallow incubated for 55.9 per cent of the four hours. At nest 2, in two hours of observation, I timed 5 sessions which varied from 6 to 31 minutes in length and averaged 13.2 minutes, and 6 recesses which ranged from 5 to 12 minutes and averaged 7.8 minutes. At this nest the swallow covered her eggs for 62.9 per cent of the two hours.

Twelve minutes after a swallow had left her eggs I found them warm to the touch. This was more than the average period during which they were left uncovered. The thick nest of insulating materials prevented the rapid conduction of their heat into the soil. By improving on the primitive methods of the original occupants of these burrows, whose larger eggs, lying directly upon the soil, cooled quickly when left unincubated, the Rough-winged Swallows were able greatly to reduce the time they spent on the nest.

I did not give attention to the sleeping habits of these Guatemalan Rough-winged Swallows: but later in Costa Rica I paid nocturnal visits to nesting burrows and in each instance I found only a single individual present with the eggs. The male did not sleep close beside his incubating mate, as the male does in the Blue-and-White Swallow, the Barn Swallow, the Wire-tailed Swallow of Africa, and other species of the family.

At one Guatemalan nest three of the five eggs hatched 16 days after the last egg was laid. At a Costa Rican nest where the set of five eggs was completed on April 21, there were three nestlings on May 7, four on May 8, and five on May 9, giving an incubation period for the last of 18 days.

THE NESTLINGS

When newly hatched, the Rough-winged Swallows were tiny, blind creatures with pink skin and sparse, but long and plumose, whitish down on the crown, shoulders and back. Now two birds could be seen darting in and out of the burrow, for the male cooperated with the female in feeding them. Often both parents were in the tunnel at the same time. It was impossible to distinguish what they brought to the nestlings, for they caught insects so minute that they were entirely concealed in their bills. Often before entering the burrow they circled around in front of it, then they suddenly swerved aside and glided in. Did they capture additional insects on these gyrations, or merely procrastinate?

When the nestlings were 13 days old, they were well feathered, but they remained in the burrow a full week longer, gaining strength to fly. In the beam of a flashlight, the pupils of their eyes shone with a ruby light framed by the black iris. The one nearest the front sometimes opened its bill widely and hissed, just as the females did when I looked in to see them on the nest. When I tried to reach the young ones, they slipped from the nest into the back of the burrow, where they were safely beyond my grasp. This, too, was a habit of the female when I looked in at her or threw in the beam of the flashlight.

Balked in my attempt to take one of the young swallows from this burrow into my hands, I remembered another burrow farther upstream which I had occasionally seen a

swallow enter or leave, but which I had not visited because it was so difficult to reach. Slithering along in the soft, oozy mud at the foot of a vertical river bank, I finally reached my objective, a Ringed Kingfishers' burrow abandoned because the diggers had come upon a large root only two feet from the entrance. Looking in, I was amazed to behold a big toad in the front of the tunnel, and at its feet, lying prone and trembling, a fully feathered young swallow. The bird lay just beneath the huge mouth of the amphibian, which seemed wide enough to engulf it whole. When I prodded the toad with a stick, the swallow slipped past it to join its two nest mates at the back of the tunnel. Then I pulled out the intruder and cast it into the swift current of the river.

I believed that I could reach one of these nestlings, but, as I was rolling up my sleeve, one bird slipped past me and easily flew across the river, which was forty feet broad. By extending my bared arm to the utmost and enlarging the entrance, I was able to reach a nestling's leg, by which I gently drew the bird from its retreat. It was fully feathered and struggled to escape me. Its throat was distinctly tinged with rufous, as its specific name implies, a detail which is difficult to see when the adults are viewed in flight. Its wing-coverts were also broadly edged with rufous; the outermost primary was without any trace of the recurved hooklets on the outer margin which make this feather of the adult male rough to the touch. Remembering the example of this swallow's nest mate, I wished to witness its prowess on the wing, so I released the young bird. I was prepared to rush into the water and rescue the fledgling should it fail in its effort to traverse the stream, but my fears for its safety were unfounded, for it flew across the channel with ease and continued an equal distance over the stony flood plain on the farther side. Here several other swallows, which had been circling around in the vicinity, rushed after it; and one flew for several feet apparently in contact with it, gradually forcing it down. I have witnessed similar behavior by the parents of fledglings of other species; apparently the adult tries to force the fledgling taking its first flight down into the cover of the vegetation, where it will be less likely to draw the attention of a hawk (Skutch, 1955:129).

The Rough-winged Swallow's nestling period of 20 or 21 days is long for a small passerine bird, but it is not as long as that of other members of the family. Young Rough-wings, like their neighbors the kingfishers and motmots, must wait until their powers of flight are well developed before they leave the burrow. Often the tunnel is situated in a steep bank which drops down to a broad expanse of water, and the fledglings, upon emerging, may need to fly far before they reach a place of rest.

Some days after the last young swallow had departed, I returned to look once more into the burrow where I had encountered the toad and found it or another of its kind gazing out at me. I was surprised that it had been able to climb up the almost vertical bank. Perhaps the toad had selected the burrow merely as a shelter and did not have designs on the nestlings. The young swallow that I had found, on my first visit, at the feet of a toad may have been at the mouth of the burrow when I approached and, retreating precipitately when I came in sight, it might have struck against the toad and fallen in confusion in front of it. But what a strange companion for the swallows the toad made! Later I found another toad which had chosen a deserted motmots' burrow as its residence. These, then, were the last inmates of the tunnels in the banks of the Río Morjá.

ROOSTING

At one burrow in El General where I watched, the newly emerged fledglings did not return to sleep on or near the nest, in the manner of Blue-and-White Swallows, Barn Swallows, and other species, but they apparently flew off to roost with the adults at a distance from their birthplace.

Extensive marshlands covered with reeds, cattails or osiers, or small islands are

attractive to those swallows, especially the migratory species, which roost in the open and often congregate in enormous numbers at nightfall. In El Salvador, Dickey and van Rossem (1938:403) found Rough-winged Swallows roosting in a group of small mangrove islands in a bay; in this country the Rough-wings winter in the lowlands and nest in the foothills and mountains. In the hilly, mountain-rimmed basin of El General, where I have dwelt for many years, there are neither marshlands nor islands to provide the roosting places that swallows prefer. Our little patches of sugar cane offer conditions which most nearly approach those supplied by reeds and other marsh grasses of regions less thoroughly drained. In these patches of sugar cane the Rough-winged Swallows sleep; this species is locally the most abundant member of the family. After the Blue-and-White Swallows have gone to rest in pairs or family groups in their sheltered nooks beneath the roof tiles, the more numerous Rough-wings, lacking such inviting bedrooms, continue to hawk for small insects in the evening air. Sometimes they wheel around at a considerable height; again, they skim low over the hilltop pasture.

Their formation is at first loose and open, each swallow going its own way. But after the rose, orange, and lavender tints of sunset have faded from the clouds, leaving them gray, the birds draw together into a more compact flock, which swings back and forth over the valley and the enclosing hills. As the light wanes, they contract into a still denser mass and rise higher, forming a dark cloud, constantly changing in shape, while each component particle, a mere speck in the sky, ceaselessly shifts its position as in a gigantic aerial amoeba with its internal granules in more than usual agitation. This cloud moves hither and thither high over the darkening valley, dipping and rising again. Sometimes the "amoeba" sends out a protrusion on the lower side but at once retracts it—the swallows in that portion of the body have made a false start toward their roost. At last the huge "amoeba" begins to stream earthward, each included particle shooting rapidly downward, as though the ectoplasm had ruptured and, violently contracting, shot the contained granules toward the ground. Some of the swallows trace complex spirals and loops as they rush downward, others go more directly. At times the earthward movement of the whole flock takes two minutes, but often it is less.

Twice I watched this rapid down-streaming of the swallows, from elevations on opposite sides of the valley, without being able to detect exactly where it ended; for the light was already so dim that the birds, easily distinguished as dark specks against the sky, vanished from sight the moment their background became the dusky foliage of the trees. But at last I traced the downward movement to our little cane field, where, entering, I found a number of the birds resting upon the broad cane leaves. Here they passed the night.

When I watched from a distance, it appeared that the swallows shot directly down to their destination, and so great was their velocity that I wondered how they avoided dashing themselves against the ground. But one evening I hid myself among the canes and saw that, instead of streaming down directly above me, they flowed earthward some distance to one side, where I temporarily lost sight of them. Then they as suddenly reappeared, shooting in among the tall canes all around me, flying a nearly horizontal course, and alighting easily upon the nodding cane leaves.

The compact mass of swallows, drifting back and forth high above the valley, reached its best development on clear evenings, when there were only a few rose-tinted clouds. On cloudy or rainy evenings, the swallows entered the cane field from a more open formation, with greater independence of movement, and they made their approach from a low altitude rather than by darting down from high in the air. On evenings when the sky was only partly overcast, an intermediate type of behavior was witnessed. Thus on January 22, 1944, there were light showers during the afternoon. At sunset the sky was

half overcast, and there was a broad segment of a rainbow. The swallows began to drop into the cane field at 5:16 p.m., darting down one or a few at a time while the flock still flew in very open formation at no great height. But after about half had gone to rest, the remainder drew more closely together; and the compact flock rose higher—but not, I believe, as high as on less clouded evenings—to stream down in more spectacular fashion from the greater altitude. The last swallow entered the cane at 5:21, five minutes after the first.

On January 28, when at sunset the southwestern half of the sky was clear but clouds banked heavily against the lofty mountains covered the northeastern half, a somewhat similar display was witnessed. At five o'clock there were only three resident Rough-winged Swallows resting on a calabash tree in the corral. At 5:10 a small flock appeared overhead, flying low. Five minutes later the air was full of swallows. At 5:16 they began to drop down into the sugar cane as they flew over it in open formation at no great height. First a few darted down, but soon there was a stream of these early roosters. When possibly half had gone to rest, the others rose higher, drew together, and swung back and forth in close formation at a good height. Thence they streamed down in the headlong fashion characteristic of clear evenings. Five lingered in the air, darting about, for a good fraction of a minute after all the others had disappeared amid the sugar cane. The last of these went to roost at 5:26, so that the flock entered the field over an interval of ten minutes. After retiring, the hundred or more swallows rested in silence upon the cane leaves, in contrast to the noisy Gray-capped Flycatchers and the chattering Variable Seedeaters that roosted with them.

On clear mornings, the departure of the Rough-winged Swallows from the cane field was hardly less spectacular than their entry on clear evenings. As day broke they would rest in perfect silence among the sugar canes. Possibly a few might shift their positions, revealing themselves momentarily above the crests of the canes; and rarely one or two impatient individuals would leave the roost a few minutes in advance of the main body. Then, all of a sudden, they would begin to twitter from a hundred throats, and at the same time all would rise together. Movement and sound started so nearly at the same instant that I could not tell whether the swallows began first to fly or to chatter. Within the space of a few seconds after the first bird soared above the nodding cane leaves, the whole flock, with the exception of a straggler or two, was on the wing. In compact formation, and all twittering softly in unison, they rose up and up until they were mere specks in the sky, then they vanished. Although individual birds milled around in the flock as it ascended, and at times one bird gave brief chase to another, the cloud of swallows as a whole had so little horizontal movement that on some mornings it was still almost directly above the quarter-acre of cane when it passed from view long before sunrise.

On cloudy mornings, the swallows departed in the same manner as they arrived on cloudy evenings, in looser formation than in clear weather. Then, instead of passing too high to be seen before they spread out to forage, they would separate at a much lower altitude. So far as I could learn from repeated observations, there was no signal to set the swallows all in movement at the same instant. It seemed that when a number started to leave simultaneously, the rest immediately followed and the movement became general. On some mornings the birds were seen to drift off toward the northwest when they were mere specks in the sky. Then they would be absent all day; only a few resident individuals lingered about the house until the main body returned in the late afternoon.

The big flock of Rough-winged Swallows roosted in our cane field only at the beginning of the dry season, in January and February of 1943, and in January of 1944. These birds were certainly not all residents of the immediate vicinity. If not migrants from

another region, they had at least gathered from a wide expanse of surrounding territory. After March, only a few individuals, apparently those which nested in the neighborhood, roosted among the sugar canes.

SUMMARY

The Rough-winged Swallow is abundant in Central America in open country from sea level far up into the mountains. It nests up to at least 6000 feet.

This swallow has a short, melodious song and utters a variety of harsh calls.

Certain observations suggest that the male may claim territory as early as October or November and win a mate shortly thereafter.

The nest is placed in a tunnel, which may be in the wall of clay adhering to the root system of a great uprooted tree but more often is in a bank above a road or beside a river. Often a burrow dug by kingfishers or motmots is chosen as the nest site.

In the Caribbean lowlands of Guatemala, these swallows took great interest in burrows which kingfishers were digging in February, although in the normal course of events they would not become available to the swallows until the young kingfishers left several months later.

Nest building began in early April, often in a burrow which had been vacated by kingfishers only a few days earlier. The nest was not placed in the chamber at the inner end of the burrow but much nearer the entrance, at a point whence the incubating swallow could look out over the river. The nest is a compact, shallow cup, composed of dry leaves, grass, rootlets and the like.

In Central America, laying begins in April and continues into May. The set consists of four, or more frequently five, pure white eggs, which are laid on consecutive days.

Incubation is performed by the female alone. In six hours of observation at two nests, the longest session lasted 34 minutes and the shortest 6 minutes. The longest recess lasted 17 minutes and the shortest 5 minutes. One female incubated 56 per cent of four hours and another 63 per cent of two hours. The swallows sat more constantly in cool, cloudy weather than in warm, dry weather. At a nest in Guatemala, the incubation period was at least 16 days, and at a nest in Costa Rica it was 18 days.

Both parents feed the nestlings. The food consists largely of winged insects. Bearing only sparse down at hatching, the young are feathered when 13 days old but remain in the burrow until 20 or 21 days old. On leaving, they fly well, as is necessary when their burrow faces a wide expanse of open water. On its first flight, one young swallow was followed closely by several adults, one of which flew above it and seemed to force it earthward.

The second parent did not sleep on or beside the nest, nor did young swallows return to lodge in the burrows where they were reared.

At the beginning of the dry season in January and February, a large flock of Rough-winged Swallows roosted in a small patch of sugar cane in El General. When they first appeared in the evening they foraged in very open formation, but as daylight waned they drew into a compact flock which swung back and forth high in the air. From the bottom of this flock the swallows streamed almost straight down, so that from a distance they appeared to strike the ground, although actually they turned in time to fly horizontally into the cane field. This behavior was more spectacular on clear evenings than it was on cloudy ones. The swallows roosted on the broad cane leaves. In the twilight of clear mornings, the roosting swallows would suddenly begin to chatter and at the same moment rise up all at once in a compact mass, which ascended rapidly and almost vertically until the birds were lost from view. These swallows congregated from a considerable distance to roost, for during the day few were seen in the vicinity of this cane field.

BLACK-CAPPED SWALLOW

Notiochelidon pileata

The Black-capped or Cobán Swallow is a very distinct species, the only representative of its genus, and it is confined to the highlands of Guatemala, the state of Chiapas in México, and El Salvador, where it occurs from about 4000 to 10,000 feet above sea level. It is difficult to confuse with any other swallow in this area, resident or migratory. This species is about four and three-quarters inches in length, and male and female have a glossy black hood which covers the top and sides of the head to below the eyes and the hindneck. The back is grayish brown. The wings and conspicuously forked tail are sooty or blackish. The under plumage is largely white, with grayish brown sides and flanks and sooty brown flecks on the throat.

Black-capped Swallows lead the restless aerial life typical of their family, and each appears to cover scores of miles every day as it wheels and circles tirelessly over mountain and plateau in quest of the small flying insects on which it subsists. They utter harsh chirps much like those of the Rough-winged Swallow. These swallows are a familiar sight about the highland towns, where apparently they nest in nooks and crevices in the buildings, and on the Sierra de Tecpán in Guatemala they were abundant residents. One morning I watched a score of them circling in the air above a high ridge; possibly there were more, but who can count swallows on the wing? They settled, one or a few together, on the topmost twigs of a tall pine, until almost all of those in sight had gathered there. Then, when the air was nearly clear of swallows, by a sudden impulse all took wing again, spreading out from the top of the tree as ripples spread from the point where a stone strikes the surface of a pond. They did this over and over.

NESTING

Anthony (Griscom, 1932:284) found Black-capped Swallows breeding in April and May; several pairs apparently had nests in a cave too small for him to enter and investigate. On the Sierra de Tecpán, in 1933, I found this swallow breeding in the burrows of the Blue-throated Green Motmots, as in the preceding year I had discovered the Rough-winged Swallows nesting in the tunnels made by kingfishers and Turquoise-browed Motmots in the banks of lowland rivers in the same country. In early April, the Black-capped Swallows began to take great interest in the motmots' burrows in the roadside banks, both those still occupied by the motmots and others which had been abandoned. Sometimes, when I looked into the entrance of a burrow where the motmots had just begun to incubate their eggs, a pair of the swallows flew out, almost brushing my face in their hurry to escape. When they discovered a suitable burrow no longer occupied by the makers, they carried in dead leaves and pine needles for their nest; but if the motmots were breeding in the burrow, the swallows were obliged to wait until the young had flown, before they could take possession.

In early June, when others of their kind were already feeding nestlings, a pair of Black-capped Swallows claimed a burrow from which the young motmots had just departed. Both were discovered sleeping there only two nights after the parent motmots, which often continue to use the burrows as dormitories for a brief period after the departure of their young, had been seen to leave the tunnel at dawn. Within a day or two the swallows began to build their nest in the burrow. Both male and female carried into the burrow dead pine needles and small, dry leaves, all of which they picked up from

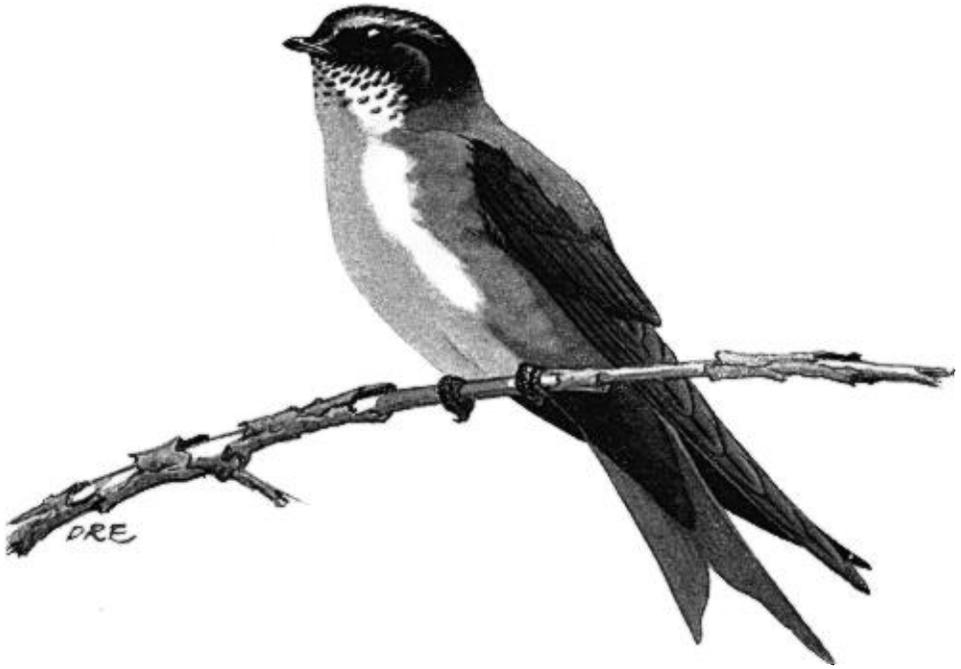


Fig. 46. Black-capped Swallow.

the road that passed in front of the nesting site. With boundless energy, they gyrated around and around with their burdens in their bills, then they swerved suddenly and darted into the burrow. Only the biggest and heaviest leaves and bundles of pine needles were carried in a fairly direct course to the nest. Several times one of the birds grasped a large, green alder leaf, just fallen from one of the trees that shaded the road, and attempted to bear it to the nest. The swallow rose into the air without difficulty, but the leaf that it had seized in its bill always stayed behind, for the swallow's wings are stronger than its bill. Other kinds of birds, with relatively stronger bills and weaker wings, fail to rise when they attempt to lift an object too heavy for them. After working industriously for a period, the pair would go spiralling high into the air, hawking for insects, and presently disappear over the treetops. Soon they would return to continue their labors; and so through the morning they alternated between building and foraging, but almost always they were on the wing.

Rough-winged Swallows, when they breed in old kingfishers' or motmots' burrows, place their nests where they can be seen from the mouth of the tunnel, and where the female can look out upon a small circle of the world while she incubates her eggs. But the Black-capped Swallows were more secretive and built their shallow cups of pine needles and leaves at the very end of the burrow, where I could not see them from the front. When they first took possession of the burrow, and while building the nest, male and female slept together in it. In the morning they darted forth nearly an hour later than the original occupants had been accustomed to emerge and about forty minutes after their neighbors, the Southern House Wrens, became active.

The construction of the nest took the pair about five days. After its completion the female alone slept in the burrow, while her mate sought a separate shelter from the cold

nocturnal rains. Although the nest seemed to be finished by June 14, it was June 19 before the female swallow laid the first of her four white eggs. The others followed on consecutive days. Apparently because of the lateness of the season, this nest was abandoned before the eggs hatched; it had been built to replace an earlier one in a nearby burrow that had been destroyed. At another burrow, into which the parents were carrying food, but which I did not attempt to open, I found that both parents slept with the nestlings. Still another pair slept for a night or two in early June in a recently deserted motmots' burrow, then they abandoned it without starting a nest. Apparently it was only while the female was laying and incubating her eggs that the male was exiled from the burrow.

SLEEPING

In October I discovered that seven or eight Black-capped Swallows slept in a deep burrow, doubtless an old one of the motmots, at the top of a ten-foot bank beside the highway over the Sierra, at an altitude of about 9000 feet. It was most difficult to count the birds as they entered their tunnel for the night. Arriving in the vicinity as the light began to wane, they would circle again and again in front of the burrow, delaying to go in with typical hirundine procrastination. Often they would fly directly toward the tunnel as though they intended to enter, but they would veer off at the last moment and continue to gyrate about; sometimes they would actually fly up under the foliage which draped in front of the entrance, or strike one of the leaves with a resounding *plop*, only to dart out again and continue to wheel about with their comrades. At times two or three together, all rushing about in the vicinity, would converge toward the entrance as though moved by a single impulse. Since it was physically impossible for all to enter simultaneously, they solved the difficulty by all turning away to continue their circlings. By this time the light had become dim, and I never felt quite certain whether one of the swiftly moving, shadowy forms had actually gone into the earth. Rarely one or two of the swallows would fly up the mountainside and go directly into the burrow without the usual procrastination. The last of the swallows entered for the night from ten to twenty minutes after the first had gone into the tunnel.

The burrow in which these swallows slept was situated on a particularly cold and windy shoulder of the mountain. On October 16 I arrived at dawn, after a long, hard climb by moonlight, feeling quite warm from the exercise. But as I sat atop the bank on the opposite side of the road, to watch the birds leave their dormitory, the cold, brisk wind blowing across the ridge cooled me off rapidly. A few minutes after seven o'clock I heard other Black-capped Swallows twittering down the slope behind me; but those for which I waited did not appear. The rays of the rising sun had penetrated to the foot of the bank when, at eight o'clock, three swallows darted from the burrow, twittering, and at once flew out of sight. Another hour and a half dragged by before, at half-past nine, the remaining five birds shot out in rapid succession and followed down the mountainside. They had slept, or at least remained in the warmth and obscurity of the burrow, for more than half of that beautiful and sunny but unpleasantly cold morning, over three and a half hours after most other birds had arisen with the dawn, and a full hour and a half later than their bedfellows.

Seven swallows continued to sleep in this burrow at least until early December. During the day, until they arrived in the evening to go to rest, I never saw Black-capped Swallows in the vicinity, and at this season I rarely met them even on parts of the mountain a thousand feet lower. Apparently they foraged at a considerable distance from their dormitory, probably in lower and warmer regions; and upon their return in the evening they promptly—for swallows—sought shelter from the cold breezes in their snug retreat. On December 4 they retired between 5:43 and 5:51 p.m. Next morning

four came out at 8:20 a.m. and the other three at 8:27, after having enjoyed more than 14½ hours of repose. Meanwhile the burrows along a slightly lower roadway, where I had found swallows nesting earlier in the year, were not used by them as dormitories.

It occurred to me while making these studies that the swallows' habit of remaining late in their burrows on cold mornings, if widespread in the family, may possibly have given rise to the old myth that these birds hibernate. Doubtless now and then through the centuries, in the older and more densely populated countries where the belief arose, some peasant happened to dig into a swallow burrow during the early half of a brisk autumnal morning before the birds left on their southward migration and surprised them drowsing late. While the birds would without doubt dart away at once if they saw a ready channel of escape, if they found themselves trapped they might shrink back into the end of the burrow in an attitude which suggested torpidity. Or if the weather had turned unseasonably cold, they might be weak and helpless from starvation, as has been described for some species. And it is certainly not inconceivable that in the course of centuries, over thousands of square miles of territory inhabited by millions of men and millions of swallows, an occasional falling bank might reveal to a passer-by a knot of swallows snugly enconced in the earth in broad daylight. Such rare and accidental occurrences, if repeated now and then through the years, and handed down by oral or written tradition, might well have given rise to the belief that swallows hibernate.

SUMMARY

The Black-capped or Cobán Swallow, the only species of the genus *Notiochelidon*, is confined to the highlands of Guatemala, Chiapas, and El Salvador, from about 4000 to 10,000 feet above sea level. It frequents the highland towns as well as open country and forages in the air in loose flocks like other swallows.

It has been reported to nest in caves, but the only nests actually examined were placed in burrows which Blue-throated Green Motmots had dug into roadside banks, between 8000 and 9000 feet above sea level.

In early April, while these burrows were still occupied by the motmots, the swallows investigated them and sometimes rested by day in the entrance; but only after the motmots' brood had flown were they able to nest in them.

Having found a suitable unoccupied burrow, the pair of swallows slept in it and then began to build their nest, placing it far back, where it could not be seen from the entrance. The shallow cup of pine needles and leaves was built by both sexes. The parent birds picked up materials from bare ground and bore them by a circuitous course to the burrow. In one instance the construction of the nest required about five days.

A set of four white eggs was laid in late June but it was abandoned before hatching, apparently because of the lateness of the season.

The male, which had slept with his mate in the burrow during the period of construction, roosted elsewhere after the nest was finished and during the period of laying and incubation. But at another nest both parents slept with the nestlings.

In October, November, and December, seven or eight swallows slept in a deep burrow in a bank at an altitude of 9000 feet. Although in the evening they entered over a period of from 10 to 20 minutes, in the morning some left as much as 1½ hours before their companions. On bright but cold and windy mornings some of the swallows would linger in their lodging until well past nine o'clock; then they would fly rapidly down the mountainside. In December, they sometimes took 14½ hours of repose.

It is suggested that the habit of swallows of remaining in their sleeping place in full daylight in cool weather may have given rise to the myth that members of this family hibernate.

BLUE-AND-WHITE SWALLOW¹

Pygochelidon cyanoleuca

The Blue-and-White Swallow is an exceptionally adaptable species. Its range stretches from Costa Rica to Argentina, and within this vast area it is at home in habitats as diverse as the open pampas, the Amazon and its tributaries, the high Andes, the desert guano islands of Perú, and the rain-drenched Costa Rican mountains. In the latter country, it nests in clearings in the heavy forest up to at least 6000 feet above sea level; it appears to be absent from the coastal lowlands below 1000 feet.

In its habits of catching insects on the wing and resting on exposed twigs or wires, it differs but little from other swallows. In Costa Rica, its song, a thin, weak, long-continued trill, is delivered more or less frequently throughout the year.

Building may begin in at least a desultory fashion in mid-February in Costa Rica. Almost any covered nook or cranny is acceptable as a nest site. Nests have been found in cavities in trees, holes in earthen banks, niches in masonry bridges, crevices in house walls, and beneath roofs of thatch, tile, or sheet iron. Both sexes join in building the shallow structure of straws and the like which are gathered from bare ground, such as a roadway or path, rather than from grassy fields where such material is more plentiful. Finally, the loosely made bowl is warmly lined with downy feathers, often those of the domestic chicken. A pair which began to build in February took nearly a month of dilatory activity to complete their structure, but another pair which started later finished the nest in about a week.

In Costa Rica laying begins in March and second broods are started in June. Two sets contained 2 eggs, four sets contained 3 eggs, and one set consisted of 4 eggs. The eggs are usually deposited on consecutive days. They are pure white, without markings. The measurements of 6 eggs averaged 16.6 by 12.2 millimeters.

Incubation is performed by both sexes. The adults replace each other frequently on the eggs, but, because of the difficulty of distinguishing the sexes, the respective shares of the male and female could not be determined. In nine hours of watching at one nest, 25 sessions of both sexes varied from 3 to 50 minutes in length and averaged 18.6 minutes. The eggs were left unattended for 11 periods which ranged from 1 to 14 minutes and averaged 6.9 minutes. Thus the eggs were covered for 85.9 per cent of the nine hours. At another nest which was watched for four hours, the swallows took 4 sessions which ranged from 34 to 81 minutes and averaged 55.5 minutes. They neglected the eggs for only 2 periods of 1 and 14 minutes' duration. Thus the eggs at this nest were covered for 93.7 per cent of the four hours. At two nests the incubation period was 15 days. One pair of swallows attended infertile eggs for at least 26 days.

Newly hatched nestlings bear sparse, light gray down on their pink skin, and the interior of the mouth is pale flesh color. They are fed and brooded by both parents and remain in the nest space until they can fly well. Those of one brood took wing when 26 and 27 days of age. They were then dark gray instead of deep blue above, and their under parts were clouded with gray instead of pure white as in the adults. At about 40 days of age they became independent of parental care, but they continued to roost in the nest space with their parents.

The roosting habits of one family were followed for more than six months, and the roosting habits of a second family were followed for over two years. Less extended observations were made on other pairs. The mated male and female remain together through-

¹ This life history is a résumé of an account first published in *The Auk*, 69, 1952:392-406.

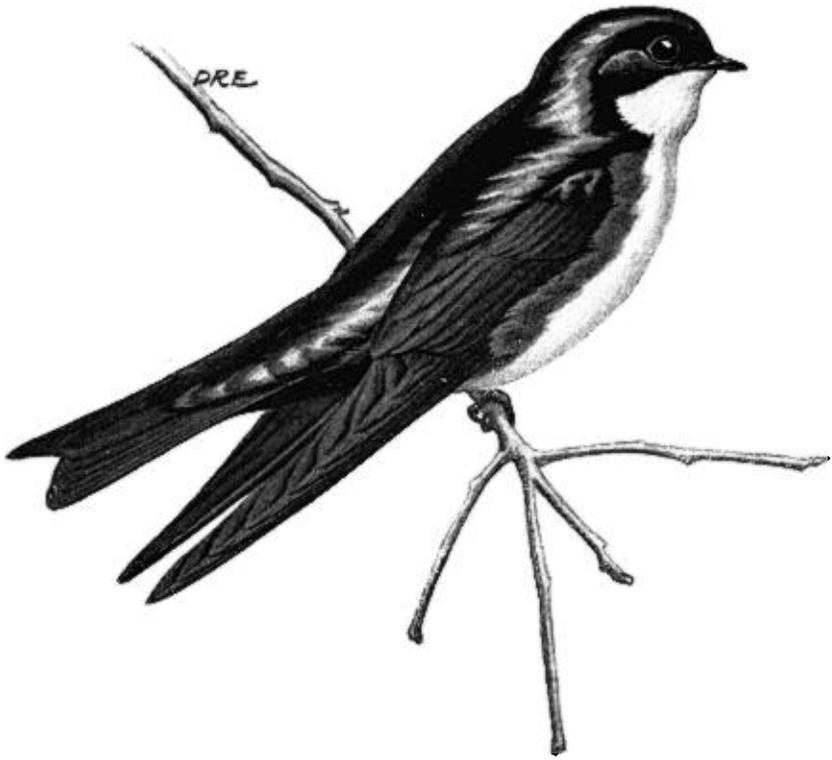


Fig. 47. Blue-and-White Swallow.

out the year and use the cranny in which they nest as a fixed abode. The two sleep in the nesting place each night, and sometimes they enter it by day to take shelter from hard rain. While incubation is in progress one adult, probably the female, sleeps on the eggs, while the other roosts on the rim of the nest, in contact with its partner. The fledglings return to sleep in the nest space with the parents, and they may continue this habit until two months of age, although the old birds no longer attend them and may proceed to rear a second brood.

Within this general pattern, individual variations were observed. In one pair, only one swallow slept in the nest space before incubation began, and this one not consistently. In the course of incubation, and while the nestlings required brooding, the parents slept together at the nest. But after the nestlings were older, one and then the other parent chose a distant roost. During their second nesting, this pair followed the normal pattern and always slept together on or by the nest.

GENERAL SUMMARY OF INFORMATION ON THE HIRUNDINIDAE

The swallows and martins constitute a homogeneous, well-defined family of cosmopolitan distribution, containing, according to Mayr (1946:67), 75 species. Their plumage is varied in color, containing red, green, blue, and violet, but seldom of the brightest shades; many species are very plainly attired in grays and browns. The outer tail feathers of some species are slender and greatly elongated. The sexes may be alike or different in plumage, but the differences are as a rule not pronounced. Swallows molt only once a year and adults wear the same colors at all seasons. Those which nest at higher latitudes perform very long migrations, travelling by day, catching insects in the air as they go, and gathering at nightfall into populous roosts to pass the hours of darkness. Although the gregarious tendencies and migratory habits of many swallows are not favorable to the maintenance of the pair bond between the male and female, some of the resident species of the tropics, such as the Blue-and-White Swallow, remain mated throughout the year.

The food of swallows consists almost wholly of insects captured in the air as the birds fly tirelessly back, forth and around over the countryside. Tree Swallows are exceptional in that they eat many seeds and berries, which amount to about 20 per cent of their total food (Bent, 1942:391). This peculiarity in their diet enables them to pass the winter months in regions too cool for other members of the family.

The voices of swallows are generally weak. The song of numerous species is sweetly varied but nearly always lacking in range and force. Usually it is best described as "twittering." Often swallows sing in flight; some species, including the White-rumped Swallow of Argentina, soar up in flocks in the early dawn to sing high above the earth, where they catch the first rays of the rising sun (Hudson, 1920, 1:37-38). The notes of martins are deeper and fuller than those of the smaller swallows; their song often has an oily, rolling character.

The courtship of swallows is to a large extent performed in the air, where it is difficult to follow the actions or even to recognize the sex of individuals.

Nuptial feeding has been reported for several species. Before and during incubation the male Barn Swallow feeds his mate, either in the air or on the nest (Coward, 1928:250). Male Tree Swallows frequently carry food to their mates on the nest (Bent, 1942:389). The male House Martin sometimes feeds the female (Niethammer, *in* Allen and Nice, 1952:631).

The question of polygamy among swallows requires further elucidation. In several species, three or more adults have been discovered building or attending the same nest. These may be merely instances of mutual helpfulness and not irregularities in the relationship of the pairs. More details on this subject will be found under the discussion of "helpers at the nest."

The nests of swallows are rarely exposed to the elements; they are nearly always placed in some sheltered position, as on a cliff or bank, in a hollow in a tree, or on some edifice constructed by man. Mayr and Bond (1943:335) recognized three principal types of nesting arrangements in the family: 1, natural hollows are used; 2, new nesting holes are excavated in banks or in level ground; 3, mud nests are constructed. The "natural," or perhaps better "preformed" hollows used for nesting are of the most diverse sorts. They include burrows in banks, which may be dug by kingfishers, motmots or other birds, or they may result from the decay of a stout root; crevices in cliffs; holes in trees, either made by woodpeckers or other birds or resulting from decay; positions

beneath the eaves or in the interior of houses, barns and other edifices; crevices in bridges; and bird boxes. The degree to which the swallow confines itself to one particular kind of nest site varies with the species, but in the absence of the preferred nest location another type of hollow may be used. Rough-winged Swallows undoubtedly prefer burrows in banks, but they have also been known to use "holes in masonry, sides of wooden buildings, adobe walls, quarries and caves; crannies and ledges under bridges, culverts and wharfs" (Bent, 1942:426). The Blue-and-White Swallow uses indifferently a cranny beneath a roof, a hollow in a tree, or a burrow in a bank. Bank Swallows excavate their own burrows in sand banks, and so at times do Rough-winged Swallows, but the latter appear to prefer a preformed cavity if they can find it. The nests of the foregoing swallows are usually shallow, loosely constructed, open cups of grass, leaves, pine needles, rootlets, or weed stems, and they are often softly lined with feathers.

Greater skill in nest construction is displayed by those swallows which build with mud. Their nests may be either open and cup-shaped like those of the Barn Swallow, or they may be closed, with a round, sometimes spout-like, entrance in the side, like those of the Cliff Swallow. These nests are plastered to some solid surface, preferably in places where they are sheltered from the rain. The Barn Swallow builds whenever possible in a barn, shed or other partly open building. Cliff Swallows' nests are attached in compact clusters to the outer wall of a building where they are sheltered by the eaves, or to the face of an overhanging cliff. Although these swallows build their clay nests in contact in crowded colonies, they are not wholly tolerant of their neighbors. Each nesting bird defends the area it can reach from its doorway, and as a result of this antagonism the spout-like entrances of contiguous nests diverge from each other. Emlen (1952) believes that the peculiar form of the Cliff Swallow's nest is an adaptation to screen the nesting birds from their immediate neighbors, thereby permitting closer crowding than they would otherwise tolerate and the maximum utilization of the restricted localities on sheltered cliffs where alone these birds found adequate nest sites before man-made buildings were introduced to North America. Among the colonial nesters so frequent in the family are also the Bank Swallows or Sand Martins, whose burrows honeycomb suitable vertical exposures of soil, and the Purple Martins, which occupy many-roomed bird houses in localities where these are provided for them. Although the nest of the latter is built largely of vegetable materials in a preformed cavity, if the entrance to the chamber is so wide that the cup is exposed to wind and rain, the Purple Martin may construct between the doorway and the nest a wall of mud which may weigh as much as eight ounces. Another peculiar feature of the household arrangements of the martin is the green leaves which both sexes bring and lay loosely on the nest, both during the period of laying and after incubation has begun (Allen and Nice, 1952:622).

The nest is as a rule built by both sexes. This is true of the Barn Swallow, House Martin, and Bank Swallow in Great Britain (Witherby *et al.*, 1938, 2:226-241), of the Bank Swallow, Barn Swallow, and Purple Martin in the United States (Bent, 1942: 371-516), and of the Blue-and-White Swallow and the Black-capped Swallow in Central America. In the Tree Swallow, the female apparently does most of the work of building (Bent, *op. cit.*: 389). In the Cliff Swallow, however, the male performs most or all the work at the beginning of construction, but as the nest nears completion the female helps. As in other birds that breed in crowded colonies, these swallows may steal material from the nest of their neighbors (Emlen, 1954: 23, 29). At times more than two individuals lend their bills to the work of construction. Fourteen House Martins were watched as they helped to finish a single nest, and at times three Cliff Swallows may work at one structure (Bent, *op. cit.*:435, 474). Swallows differ from most other birds in making repairs to their nests after incubation has begun, or even while they feed the nestlings. Cliff

Swallows, whose young had fallen from the nest and were placed by men in a box or a can for protection, built a covering of mud over the open receptacle.

The eggs of swallows are usually immaculate white, but in the genera *Hirundo*, *Petrochelidon*, and *Ptyonoprogne*, all of which build nests containing mud, they are variously spotted with shades of red, brown, and lilac on a white ground. Even within the tropics sets are often large, the Gray-breasted Martin laying from 3 to 5 eggs, the Rough-winged Swallow from 3 to 6 eggs, the Blue-and-White Swallow 2 to 4 eggs, and the Black-capped Swallow 4 eggs in one instance. Northern species produce only slightly larger sets, which usually contain from 3 to 7 eggs and rarely more.

As to the sex which incubates, there is considerable variability within the family and even within a single genus, if published accounts may be trusted. In the Barn Swallow, incubation is carried on apparently by the female only or the share of the male is small (Witherby, *et al.*, 1938, 2:226). That the male of this swallow helps his mate to incubate is affirmed also by Moreau and Moreau (1939) and by Hosking and Newberry, 1946: 31). For the Barn Swallow in North America, there is abundant evidence that both sexes cover the eggs, at least in some pairs, although it is doubtful whether the male's incubation patch is sufficiently well developed to permit him to incubate effectively (Bent, 1942:448; Kendeigh, 1952:113). Yet of the congeneric Wire-tailed Swallow of Central Africa, Moreau (1939:111) states that "all the effective sitting was done by the females"—a statement based on long-continued observations of a species whose sexes are readily distinguishable by the more elongated tail feathers of the male. Both sexes participate in incubation in the Bank Swallow (Stoner, 1942:133; Witherby *et al.*, 1938, 2:240), House Martin (*ibid.*: 235), Tree Swallow (at least occasionally by male, Bent, 1942: 389), and Blue-and-White Swallow, as I have convinced myself at several nests. In the Purple Martin (Allen and Nice, 1952:625) and the Gray-breasted Martin, the female alone incubates. Although it is stated that in the United States both sexes of the Rough-winged Swallow take turns on the eggs (Bent, 1942:428), in Guatemala I could find no evidence that more than one parent, doubtless the female, sat in the nest. The similarity in appearance of the sexes and the fact that the nest itself was out of sight in a burrow made observation and its interpretation difficult in this species. In the Rough-wing Bank Martin of Africa, Moreau (1940:247), reporting on 800 hours of watching at seven nests, found no proof that both members of the pair shared the work of brooding or feeding. Even when the male swallow does not incubate, he may spend much time perching close beside his sitting mate, frequently singing, or he may guard the nest as in the Purple Martin (Allen and Nice, 1952:629). In a number of species, the male sleeps close by his incubating partner, either within or close beside the nest.

As in most small insectivorous birds, the swallows' sessions on their eggs are usually short, although there are exceptions to this rule. Automatic recordings, covering 24 complete days, at the nests of two different Barn Swallows, showed that the sessions on the eggs averaged 15.8 minutes and the recesses 10.6 minutes. One female, however, was more constant in incubation than the other, and even at the same nest there was pronounced variation from day to day in this respect. The percentage of the daylight period that was spent on the eggs varied inversely with the temperature and ranged from 31.6 per cent when the temperature was above 85° F. to 80.5 per cent when it was less than 70° F. In the far heavier Purple Martin, similar recordings with a thermocouple, continued for six days, showed that the sessions averaged 32.0 minutes, the recesses averaged 9.3 minutes, and the eggs were covered for 76.7 per cent of the day (Kendeigh, 1952: 111-119). In the Wire-tailed Swallow, many hours of watching showed that 70 per cent of the sessions lasted only from 2 to 7 minutes, while 70 per cent of the recesses lasted from 2 to 5 minutes. The percentage of time spent on the eggs during the period of diur-

nal activity varied from 43 to 66, with no tendency to rise at lower air temperatures or as the eggs neared the point of hatching (Moreau, 1939). In the Rough-wing Bank Martin, most of the sessions and most of the recesses fell between 8 and 20 minutes, and the birds were in the nest from 31 to 66 per cent of the day (Moreau, 1940). Blue-and-White Swallows, in which male and female alternate on the nest, often sit for well over an hour at a stretch, and they may keep the eggs covered about 90 per cent of the time during the day. (For a tabulation of data on the behavior of swallows during incubation, see Allen and Nice, 1952:630-631; Kendeigh, 1952:244-245).

The normal incubation period of swallows is apparently rarely less than 13 days, and for the majority of species that have been studied it varies from 14 to 16 days. The Rough-wing Bank Martin requires the exceptionally long period of 19 days to hatch its eggs (Moreau, 1940:247), the Red-throated Rock Martin 17 or 18 days (Moreau and Moreau, 1940:320).

The nestlings at hatching are very small and helpless, sightless, and bear sparse natal down in the Barn Swallow, Rough-winged Swallow, and Blue-and-White Swallow, but in the Purple Martin they are normally wholly naked (Allen and Nice, 1952:632). With the apparent exception of the Rough-wing Bank Martin, the young are fed by both parents in all species for which we have adequate information, including the Barn Swallow, Wire-tailed Swallow, Tree Swallow, Bank Swallow, Rough-winged Swallow, Blue-and-White Swallow, Purple Martin, Gray-breasted Martin, and House Martin. In the Violet-green Swallow, the female seems to bring most of the food, but the male helps (Bent, 1942:378). The food, consisting of small insects, is generally carried in the parent's throat, if not in deeper regions of the alimentary tract, and is regurgitated to the nestlings. Gray-breasted Martins and Purple Martins bring to the nest dragonflies and other large insects held conspicuously in the bill. Food is brought at a fairly rapid rate, the brood as a whole often receiving from 30 to 40 feedings per hour (Kendeigh, 1952:245). In the Wire-tailed Swallow, Moreau (1939:122) recorded maximum rates of 89 feeding visits per hour by both parents to three nestlings, 41 visits per hour when there were two nestlings, and 34 visits to a single nestling. The nestlings are brooded by the female alone, or by the male also if he helped to incubate the eggs. The parents, in common with most birds that nest in enclosed spaces, do not simulate injury or give any form of distraction display if their offspring appear to be in peril.

The feathering of the nestlings proceeds at about the normal rate for young passerines; but, after they are completely feathered, the young, if undisturbed, remain in the nest until they have acquired sufficient strength and expanse of wing to fly for considerable distances. During their last week or so in the nest their weight, after increasing steadily until it equals or even exceeds that of the adults, declines slightly. This is a peculiarity of development which has been noted in the Barn Swallow (Stoner, 1935) and the Purple Martin (Allen and Nice, 1952:632) and which is probably widespread in the family.

The nestling period of swallows is rather variable and appears to depend to a certain extent on the site of the nest, whether there are convenient perches in front of the nest or whether, perhaps, it is in a high bank with nothing but a broad expanse of water before it. If undisturbed, few swallows leave the nest when they are less than 18 days of age. Usually they leave the nest when they are about three weeks old. Rough-wing Bank Martins remain in the nest for from 24 to 27 days (Moreau, 1940:236); Purple Martins remain in the nest from 24 to 28 days according to Bent (1942:495) or 28 to 35 days according to Allen and Nice (1952:630), and Blue-and-White Swallows for 26 or 27 days. Longer periods have been recorded for several species, but an error in the determination of the true nestling period may occur because the young, after their first excursions, return to their nest to rest or to sleep.

Helpers at the nest seem to be not uncommon among swallows. That the mated pair may receive help from other individuals while building their nest has already been mentioned. More often, young of early broods bring food to later broods, as in the House Martin and Barn Swallow, in which such precocious performance of parental offices has been repeatedly witnessed (Witherby *et al.*, 1938, 2:236; Forbush, 1929:152; Nice, 1943:79). In captivity, a female Purple Martin when 54 days old fed and tried to brood hand reared nestlings (Richmond, 1953:245). At times more than two adults attend a single nest. A. E. Shirling watched nests of the Violet-green Swallow where two or three females brought food to the young (Bent, 1942:378-379). In the Tree Swallow, from four to six adults, at least three of which were males and at least one of which was a female, fed the nestlings in a single nest. In such instances, the helpers are sometimes parents of neighboring broods which have come to grief (Bent, 1942:387). There is, however, a suggestion of polygamy in the reports of three Cliff Swallows which joined in building a nest and took turns at incubating the eggs—apparently a frequent occurrence in this highly gregarious species.

The sleeping habits of swallows are of great interest. The more gregarious species, and especially those which are migratory, often gather in countless numbers to share a common roost, which is often in a grove of trees but may be in a stand of cattails, reeds, osiers, or some other form of marsh vegetation. The roosting swallows may belong to a single species or to several species intermingled. The evening gatherings of swallows are most spectacular at the time of the fall migration; but Purple Martins, especially the males, sometimes gather from miles around to roost in one particular grove of trees even in the nesting season (Cater, 1944). In the fall, 100,000 martins may congregate in a single roost (Allen and Nice, 1952:613).

One of the greatest aggregations of birds on record is that of an estimated one million European Barn Swallows, which, together with thousands of birds of other kinds, roosted among reeds in a marsh in the Transvaal, on their northward migration (Rudebeck, 1955). Even those swallows which congregate in immense numbers to sleep in the vegetation in the course of migration may take advantage of shelters when they reach their journey's end, at least when northwardbound. In a cold spell in late spring, such protection may be necessary for their survival. Thus Cliff Swallows sleep in their last year's nests on the side of a barn (Buss, 1942) or even in hollow limbs of trees, Violet-green Swallows sleep under the eaves of a building (Edson, 1943:403), Purple Martins sleep in their rooms in the bird house, and Barn Swallows roost on the rafters of the barn where they will soon build nests. Once the new nest is ready, the male swallow of some species roosts in or beside it. The male Barn Swallow slumbers on the rim of the open cup beside his incubating mate, or on the rafter close by. Likewise, the male Wire-tailed Swallow of tropical Africa sleeps beside his mate on the half-cup of mud attached to a vertical wall, close below some overhead cover (Moreau, 1939:122). Both sexes of the House Martin retire at nightfall into the cozy, clay-walled nest they have built with so much labor. The male Purple Martin sleeps in the box with his mate until the nestlings are about 12 days old, when both parents change their sleeping place and roost in trees (Allen and Nice, 1952:632). I have invariably found the male Blue-and-White Swallow sleeping on the rim of the nest where his mate incubates, whether this be in a burrow, a hollow tree, or on a rafter beneath the roof. But in the Rough-winged Swallow and the Gray-breasted Martin I found the female sleeping alone with her eggs, although in regions where the martin nests about houses her mate may spend the night close by. A male Violet-green Swallow did not sleep in his mate's nest box or in the same vicinity (Combella, 1954:437), and male Tree Swallows did not at any time roost in the houses with their mates (Bent, 1942:389).

In a number of species, especially those in which both male and female sleep in or

on the nest, the fledglings, after their first excursions into the outer world, return to sleep in the nest with their parents for a variable number of nights. Such behavior has been reported for the Barn Swallow and House Martin (Witherby *et al.*, 1938, 2:226-238; Hosking and Newberry, 1946:41; Bent, 1942:449), Purple Martin (Bent, 1942:495; Cater, 1944:16), Red-throated Rock Martin (Moreau, 1947:206), and Gray-breasted Martin (Bent, 1942:514). I have myself witnessed the return of the fledglings of the Blue-and-White Swallow and the Gray-breasted Martin. For the Tree Swallow, the evidence is contradictory; some observers state that the fledglings sleep in the nest box for a few nights after their earliest flights, but others report that once they have left the box they never return (Bent, 1942:390). Possibly the Tree Swallows' behavior in this respect varies from family to family or from region to region. The fledglings of the Violet-green Swallows studied by Edson (1943:400) did not as a rule return to the nest once they had vacated it, yet some went back for a night or two. Newly fledged Bank Swallows are as likely to enter a neighboring burrow at nightfall as that in which they were reared (Stoner, 1942:133). This author found young of three different families sleeping in the same burrow, and he concluded that family bonds were more or less severed after the fledglings' first flight.

In the House Martin, family ties are much more enduring. In Switzerland, Haller and Hüber frequently found from 10 to 12 individuals sleeping in the same nest, and once he discovered 13 sleeping together, including the parents, two fledged broods of 4 each, and 3 nestlings of the third brood (Witherby *et al.*, 1938, 2:235). One rainy afternoon, I watched a female Gray-breasted Martin which had reared a single fledgling lead the latter to sleep in the high woodpecker hole from which it had taken its first flight that same morning. She went to the doorway a number of times until the young martin succeeded in following her there.

After their young separate from them, the members of a mated pair of Blue-and-White Swallows still sleep side by side in a niche of the sort they use for nesting, and they continue to do so until the following breeding season. In the winter months, Black-capped Swallows roost more gregariously in deep burrows in banks. One October, I found a burrow in the high mountains of Guatemala in which 7 or 8 individuals passed the night. When the day dawned cold and frosty, they would linger in the burrow for more than half the morning, despite the brightness of the sunshine on the flowery mountain side. It occurred to me then that similar inactivity in the middle of a bright, cold morning might have given rise to the old myth that swallows hibernate.

FAMILY TYRANNIDAE¹

YELLOW-BELLIED ELAENIA

Elaenia flavogaster

In appearance and language, the Yellow-bellied Elaenia is a distinctive bird, easily recognized and not soon forgotten. It is a flycatcher of medium size, about six and a quarter inches in length, with a long tail, short black bill, and blackish legs. Its upper plumage is plain olive and on its wing-coverts are two conspicuous whitish bars. Its throat is pale gray and the remainder of its under parts are pale sulphur yellow. The outstanding physical characteristic of this elaenia is its crest, composed of stiff gray feathers of rather unequal length, which stand upright on both sides of the crown and expose a small patch of white in its center. Although the bird may lay these feathers flat at will, when it finds itself observed it generally holds its crest fully expanded and has a wild, reckless aspect. In Costa Rica, this crest earns for the elaenia the name *copetoncillo*, "the little big-crested one." With crest laid back, the Yellow-bellied Elaenia might be mistaken for one of its congeners, or even for a flycatcher of a different genus, but with crest erect its identification is unmistakable. Male and female are alike in plumage and have equally conspicuous crests.

The Yellow-bellied Elaenia ranges over an immense territory stretching from southern México to northern Argentina and the more southerly of the Lesser Antilles. It occurs over the whole length of Central America on both sides of the Cordillera. In Costa Rica, it is found from sea level on both coasts to an elevation of at least 6000 feet in the mountains, and it appears to be resident and to breed wherever it is found. It is a very abundant bird in all of the agricultural districts between 2000 and 5000 feet above sea level, that is, in the part of the country which supports the densest human population. In Guatemala, where it is perhaps less abundant, its distribution is similar; here likewise it ranges from the lowlands of both coasts well up into the mountains. Apparently, however, it does not occur quite as high, for I can find no record of its presence at points above 5000 feet. Everywhere it is an inhabitant of open country, frequenting shady pastures, hedgerows, the shade trees about dwellings, city parks, and plantations. It does not occur in densely forested country. It never flocks but lives in pairs at all seasons.

FOOD

The elaenias catch small insects on the wing, but their aerial sallies are rarely so spectacular as are those of the larger flycatchers such as *Tyrannus* and *Myiozetetes*. They also eat many small berries. When the lead-blue fruits of the aguacatillo (*Persea Skutchii*), each as large as a pea and with a single big seed at its center, ripen in May and June, the elaenias devour a multitude of them, and they feed them to their young. They also eat the seeds of *Alchornea latifolia*, a small tree common in the clearings in El General. When the green pod splits into four valves and exposes its two seeds, each enclosed in a bright red aril, many birds flock to feast on them.

¹ In this family, the life histories are arranged to point out certain trends in breeding behavior: from the use of simple open nests to the construction of various types of closed and pensile structures; and from fairly full participation in nesting activities by the male to his complete aloofness from the nest. A natural arrangement must take into account behavioral no less than morphological characters; and since the habits of many genera of flycatchers are scarcely known, all present classifications of the Tyrannidae must be regarded as provisional.



Fig. 48. Yellow-bellied Elaenia.

ROOSTING

On the evening of October 15, 1949, a Yellow-bellied Elaenia flew into a guava tree in front of my window and seemed to settle down for the night. Its roost was a dead twig about fifteen feet above the ground. In this position, the bird was wholly exposed below but well shielded above by clustered foliage. Going out with a flashlight after nightfall, I found the elaenia in the same spot; its head was tucked back into its plumage and completely concealed. In the neighboring rose-apple tree, about ten feet away and slightly lower, I discovered its mate. It also rested on a slender twig where it was exposed below but screened by foliage above, and its head was equally well concealed in its plumage. Next morning the pair slept late, not becoming active until after many other birds had begun to call and fly about. The following evening, while a drizzle fell, the elaenia went to rest in the guava tree more than half an hour before dusk. It settled down in the same spot, while the mate in the rose-apple tree chose a twig near its former position. For the next week, one of these birds continued to roost every night in the rose-apple tree, but I could not discover where the other roosted. Then the elaenia in the rose-apple also changed its roost and could no longer be found. In roosting close to but not in

contact with its mate, the Yellow-bellied Elaenia is like most of the other adult flycatchers whose sleeping places I have discovered.

VOICE

The voice of the Yellow-bellied Elaenia is as distinctive as its crest. Its most frequent utterance is a drawled, slightly harsh, whistled *wheel*. Another call that is often repeated, especially in the nesting season, is *wheel-chup*, *wheel-chú* or *well-chip*, as it has sounded to me at various times and places. The first syllable is drawled, the second is shorter, sometimes clipped and brisk.

The elaenias have also a long, polysyllabic utterance like that of no other bird I know. For a long while I wondered how any bird could deliver notes so intricately jumbled. The truth of the matter did not occur to me until one day when I happened to stand between the two birds of a pair when they called to each other from neighboring trees. One elaenia, it may be either the male or female, gives as a signal a single harsh whistle of a peculiar quality. The mate, if attentive, repeats a somewhat similar but slightly more mellow note a number of times, with an undulatory effect. The elaenia who delivered the signal joins in with similar notes, and since the two make no attempt to keep time, their duet is both harsh and confused. Yet if the male and female are close together when they unite their voices in this fashion, the listener might never suspect that he was hearing more than a single bird with a most bizarre and jumbled "song." The preliminary call is often given when the mate is too distant to respond, or feels indisposed to do so, and then the performance is rarely carried on by one bird alone. Like so many other non-migratory flycatchers of tropical America, the Yellow-bellied Elaenias remain in pairs throughout the year. The garbled duet in which male and female join is an indication of their mated state.

I had been familiar with the Yellow-bellied Elaenia for nearly a decade before I discovered its remarkable dawn song. In the nesting season, it is one of the earliest birds to sing. Before dawn, while the stars are still twinkling brightly overhead and only a paleness above the eastern horizon announces the approach of the new day, or even by moonlight, the elaenias sound their long-drawn, harsh *wheel*. This note may be repeated after a short interval, and soon it is followed by a harsh, assertive *we do*, which is repeated over and over for many minutes. Although the elaenia possesses a fairly varied vocabulary, his other notes are reserved for later in the day. In his twilight singing he limits himself strictly to these two notes, *we do*, and the only latitude he allows himself is to pronounce them from time to time in a tone more fiercely insistent than usual. *We do, we do, we do, we do, WE DO, we do, we do* he calls interminably, until the listener, however skeptical at first, is quite browbeaten into conceding that *they do*.

Although some flycatchers mount high in the trees for their dawn singing, the elaenia is often content to sing from a low perch, probably from the same one where he has slept amid the bushes. One May morning, beside a stream at the border of a pasture, I watched two birds alternate between low bushes in the pasture and the lower boughs of the streamside trees which were not more than 20 or 30 feet high. These two elaenias, not far apart, were apparently trying to out-sing each other, and they obligingly continued to asseverate *we do* until the light grew strong enough to permit me to distinguish their colors and identify them without a doubt. Usually most of their kind cease singing while the light is still so dim that is difficult to recognize them. While singing, they kept their crests laid back, a circumstance that prevented their identification in the dim early light. After more than half an hour of almost uninterrupted effort, they ceased the monotonous dawn song, erected their crests, and joined in the garbled duet with their mates.

The place from which the elaenia sings at dawn is not necessarily near the nest site. The male of the pair which in 1944 nested close in front of my house, and to which I devoted much attention, was not once heard singing in the vicinity; apparently he roosted and sang his dawn song at a distance from the nest tree. After the sun has risen, the elaenias repeat the dawn song only with extreme rarity, even less than do some of the other flycatchers which under stress of excitement give voice to this song later in the day.

About my house in El General, I have for several years heard the first dawn song of the elaenia toward the end of January. January 18, 1947, is my earliest date. Dawn singing, however, does not become regular and prolonged until late in February or in March. It continues into June, but by July it has usually ceased. In 1953, an elaenia sang the dawn song at the end of August, after a long period of silence, but early in September it discontinued this unseasonable singing.

NEST BUILDING

Early in March I have sometimes seen elaenias with cobweb or a fiber in their bills, but I have not actually found them building until late March or early April. The site of the nest is a tree or bush growing in a dooryard, hedgerow, plantation, or low and open thicket. Fifty-four nests in Costa Rica, Honduras, and Guatemala ranged in height from $4\frac{1}{2}$ to 60 feet above the ground. The great majority of these nests were rather low, and 41 of them were situated between 6 and 15 feet up. Of those above 20 feet, two were at estimated heights of 25 feet, two at 35, and one exceptional nest at 60 feet. The beautiful, compact, cupped nest is built in a bifurcation or trifurcation of a horizontal, ascending, or erect branch, which may be either thin or thick. Sometimes the nest is saddled over a fairly thick horizontal branch. One exceptional nest was supported on a big, shrivelled leaf caught up among vines that grew over a small cecropia tree in a pasture; another was situated in the midst of a whorl of five slender branchlets springing from the end of an ascending branch of a tree of *Croton draco*.

The nest is built by both male and female. But, because the sexes cannot be distinguished by either appearance or voice, it is usually impossible to decide with certainty which sex does the greater share of the work. At one nest, however, I marked one member of the pair, and this individual, which I strongly suspect was the female, brought far more material than its mate. The first nest of which I watched the construction was situated 18 feet above the ground in a lemon tree in the garden of a Guatemalan plantation house. I watched it through most of the morning of April 27, 1932, when the fabric was still thin enough to see through. The pair of elaenias worked diligently all morning. Both male and female were building actively, but each went its own way, flying off to seek material and returning with it alone. Hence it was exceptional to see both near the nest at the same time, yet there were eight occasions in the course of my vigil when I was sure that both brought contributions. Each bird placed and arranged in the nest what it had brought. They fetched much cobweb, which they wiped from their bills to the side of the nest, and sometimes they brought fibers for the interior. At intervals, they called and answered each other with their harsh whistles, keeping in touch even though they did not work side by side as do trogons, tanagers, and many other birds. One pulled away some fibers dangling beneath a Blue Tanagers' nest in a neighboring avocado tree and flew to its own nest with the plunder.

The second nest I observed in construction was situated six feet above the ground in an ascending crotch of a thorny "berenjena" (*Solanum*) bush growing in a pasture beside a winding, sluggish Costa Rican stream. By attaching a bit of cotton soaked in India ink

to the end of a fine twiglet placed over the nest, I hoped to cause one member of the pair to brush against it and acquire a distinguishing stain. But on returning and finding the foreign object above the nest, the bird that I took to be the female promptly pulled it out and carried it away. Thereupon I repeated my experiment, this time choosing a fine forked twiglet and covering both arms with cotton soaked in ink. Now the elaeia, on arriving with material in its bill, sat on the cotton and became boldly splotched with black on head and neck. I believe that this was the female of the pair; at any rate, it was the marked bird which did most of the work.

This bird brought short, fine fibers, bits of lichen, and much cobweb, which last she carefully wiped on the outside of the nest. She shaped the slowly growing structure with vigorous movements of her feet and body, at the same time strongly depressing her long tail that stuck out far beyond the little cup so that it pressed against the outer edge of the rim and forced it inward. Her head and neck, bent down over the opposite side of the nest, performed the same function there. While at work she laid flat her mobile, expressive crest. She was careful to recover and incorporate in the nest bits of fallen material that stuck to the downy leaves below. She gave the open structure a roof by bending down the apex of a big, downy leaf from above and binding it with cobweb to the rim of her nest. I am not sure whether this was by accident or by design; I cannot recall another nest of this or any other kind of bird that was roofed in just the same manner. Despite the fact that this nest was built to replace another that had been begun in a very similar location 50 feet away and had mysteriously vanished after a week's work, the female elaeia worked slowly. In two and one-half hours, she brought material only 25 times.

The unmarked "male" elaeia gave very little help. Once he came to the "berenjena" bush with a large billful of material. He perched on the far side of the bush, looked at the blind suspiciously, hesitated, then flew across the brook with his load. His distrust of the blind was in itself evidence that he came infrequently to the nest, for the brown wigwam had been in place since the previous afternoon, and the female had already become so accustomed to it that she no longer gave it any attention. After some procrastination, the male returned to the "berenjena" bush with the same material. But just as he seemed to be on the point of entering the nest, his mate arrived with more cobweb and he flew away, apparently somewhat afraid of her. Most of the time he stayed at a distance from the nest, voicing now and again his harsh whistle, and more rarely his quaint, garbled "song." Two mornings later, when the nest was nearing completion, the female elaeia worked still more slowly, bringing material only nine times between 8:30 and 10:00. In this period, the male came once with material, and this time he placed it in the nest.

At a nest built in 1944 in a calabash tree in front of my house, both sexes also worked, sharing the task somewhat more equally. In an hour one morning, material was brought 11 times by both sexes together. Three times both birds were in sight at once with material in their bills. Thus the male brought at least three contributions to eight by the female, and possibly he did an even greater part of the work. When this pair built a nest for a second brood in a neighboring tree, both again shared the task.

Late in the morning of April 1, 1946, I had the good fortune to notice a pair of elaeias just beginning a nest in a guava tree beside my house. In an initial spurt of activity, this pair brought materials at a rate faster than I had hitherto observed, the two together making 24 visits to the nest site in the hour from 11:40 a.m. to 12:40 p.m. I repeatedly saw both at or near the nest site at the same time, each with a contribution in its bill. They continued to work, at least sporadically, through the afternoon. Between 4:30 and 4:35, they came twice more to the nest, but from 4:35 to 5:00 they remained away, apparently having ended their day's work. Both male and female were bringing cobweb, tufts of lichen, and short fibers and trying to attach them to the chosen branch

or the branchlets which sprang from it, but because of the smoothness of the bark of the guava tree the heavier pieces fell to the ground. On the following day, I failed to see the elaenias in the guava tree. Apparently they had promptly discovered that it was unsatisfactory as a nest site. While building, these elaenias also kept their crests laid flat. But a pair which I watched building a very high nest in 1956 sometimes raised their crests while working. The two often came together to the nest with material.

Because of the loss of the few nests which I found when barely begun, I do not know exactly how long it takes to build them. But observations made on nests found in a somewhat more advanced stage lead me to believe that the elaenias, working in a leisurely fashion, take a week or ten days to complete their small but elaborately wrought edifice. Thus a nest found on April 19, 1945, when the foundation had already been placed, did not appear to be finished until April 26. The first egg was laid on the next day.

The nest of the Yellow-bellied Elaenia has often been said to resemble that of the Wood Pewee. It is a compact, shallow cup whose firm, soft walls are composed of fine rootlets, vegetable fibers, bits of herbaceous stems and other fragments of vegetation, all closely matted and bound together with the liberal use of cobweb. The exterior is ornamented with green and gray lichens, less frequently with green moss, bits of string, or the like, all attached with cobweb. It is lined with fine fibers and downy feathers, some of which are large in relation to the cup and project well above its rim. The habit of using feathers is widespread in the species; in Trinidad the Yellow-bellied Elaenia invariably lines its nest with feathers (Belcher and Smooker, 1937:243). The first egg is sometimes laid before any feathers have been brought, and their number is usually increased during incubation. Often there are also a few lichens in the interior of the cup. A typical structure measured $2\frac{1}{4}$ inches in inside diameter by $1\frac{1}{4}$ inches in depth. An unusually flat nest was only $\frac{7}{8}$ of an inch in depth.

Many nests of this elaenia are almost completely covered with lichens and are structures of rare beauty. When placed in a crotch of a thick, upright stem, or saddled on a massive horizontal bough, they often blend so well with the lichen-covered bark that they appear to be part of the tree itself and are difficult to distinguish. However the elaenias are not always careful to build in a setting with which their nest will blend. Sometimes, neglecting better opportunities for concealment, they attach their nests to slender stems devoid of lichens or moss, often those with brown or green bark, and then the exquisite encrustation of these cryptogamic plants seems to have been placed on the walls all in vain. When the female is sitting, with her head and most of her body projecting above the shallow cup, her long tail sticking out beyond the side, she is, for all her obscure colors, and despite the fact that her crest is then laid flat, a fairly conspicuous object.

THE EGGS

In El General, my earliest nest contained a complete set of eggs when found on March 21, 1949, while other early nests held their first eggs on March 28, 1937, March 31, 1939, and April 3, 1936. Although finches, tanagers and wood warblers, as far as my experience goes, lay their eggs early in the morning, flycatchers often lay later in the day, about the middle of the forenoon or even toward noon. The approximate time of the laying of ten eggs of the Yellow-bellied Elaenia was as follows:

Nest number	First egg	Second egg
3	10:10 a.m. - 10:30 a.m.	10:35 a.m. - 11:10 a.m.
42		8:30 a.m. - 9:10 a.m.
43		9:00 a.m. - 10:05 a.m.
44	9:05 a.m. - 5:00 p.m.	8:30 a.m. - 9:15 a.m.
48	8:30 a.m. - 9:55 a.m.	
50		10:35 a.m. - 5:20 p.m.
54	9:45 a.m. - 1:05 p.m.	before 8:30 a.m.

The first of these nests was in Guatemala in 1932, while the remaining observations were made in Costa Rica in later years. *Elaenia*s appear usually to lay between 8:30 and 11:00 a.m., rarely earlier. At 11 nests, an interval of two days separated the laying of the first and second eggs. In Central America, the full set appears invariably to consist of two eggs, and I have 39 records of nests with this number of eggs or nestlings. But in Trinidad, according to Belcher and Smooker, there may exceptionally be three eggs in a set.

The eggs of the Yellow-bellied *Elaenia* are short, broad and very blunt. They are whitish, creamy-white or pale buffy in color and are marked with irregular blotches and spots of bright or dull brown, pale lilac or ash-color. On some eggs, the pale lilac spots are lacking. These markings are usually aggregated into a wreath about the broadest part of the egg, with a few thinly scattered over the remaining surface. The measurements of 23 eggs average 20.7 by 16.2 millimeters. Those showing the four extremes measured 22.2 by 16.7, 19.1 by 15.9, and 21.4 by 15.5 millimeters. It is of interest that in Trinidad this species lays a decidedly longer and relatively narrower egg. The average of 14 eggs measured by Belcher and Smooker was 22.2 by 16.1 millimeters.

In 44 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: March, 4; April, 18; May, 14; June, 5; July, 2; August, 1.

INCUBATION

The lowest of all of the 55 nests of the Yellow-bellied *Elaenia* that I have seen was situated atop a fence post which had rooted and sprouted a wreath of branches at its upper end. The nest was placed in the midst of these branches on the sawed-off end of the post, only 4½ feet above the ground. On April 12, 1932, I spent the morning in sight of this nest while I watched a pair of Citreoline Trogons excavate their nest chamber in a big, black termitarium attached to a neighboring post. At about 10:10 the female *elaenia* entered her still eggless nest, sat about 20 minutes, then gave a long, harsh whistle and left to join her mate. Going up to the nest, I found that she had just laid an egg and that it was already cool. Apparently she had not placed it in contact with her bare incubation patch while she continued to sit after depositing it.

Because I did not yet know that the *elaenia*'s second egg is normally laid two days after the first, I came the following morning to watch for it. My first act on arriving at 9:30 was to fasten a small paintbrush dipped in white paint to the twigs surrounding the nest. At 10:05, the *elaenia* flew up to enter the nest but was deterred by the sight of the brush. She flew off, but returned after a few minutes and tried to pull it away with her bill, succeeding only in getting paint on her tongue. She did not like the taste and perched on a strand of the wire fence, against which she tried to rub the disagreeable stuff from her bill. She returned several times, stood on the rim of the nest and fumbled with the brush, but she would not enter the nest. At last she succeeded in getting a prominent white mark on her forehead, and as soon as she left I removed the offending brush. Soon she returned to sit on her single egg, uttering her long, harsh whistle while in the nest. After only seven minutes, she flew off, "singing," to join her mate, without having laid the second egg.

The next day at 9:30 a.m., I again concealed myself in the vine tangle near the nest. At 9:46 the marked *elaenia* entered the nest, but she flew off at the end of 10 minutes. Between 10:00 and 10:30 this same bird sat twice more, for periods of 12 and then 10 minutes, calling to her mate from time to time while she incubated. At 10:35 she again entered the nest and stayed until 11:12, laying her second egg in this interval. There could now no longer be any doubt that I had marked the female. Too often, in our studies of birds of which the sexes are alike in appearance, we assume that one member of the pair is the female because it incubates, or perhaps because it is more zealous in defending

the nest, whereas the only infallible criterion for the identification of the female is the laying of an egg.

I continued to watch this nest on the fence post until 2:30 p.m., thereby obtaining a record of the behavior of a female *elaenia* during the first three hours after her second egg was laid. The female alone incubated. Her six periods on the nest were of 9, 23, 2, 31, 22, and 61 minutes duration, her recesses 8, 3, 1, 2, 11, and 13 minutes. She covered the eggs for 80 per cent of the time—a far better record than that made by two other *elaenias* which I watched for longer periods after they had been incubating for several days. But her periods on and off the nest showed a greater range in length than those of the two other birds which I watched for a total of 22 hours in dry weather. She had not yet fallen into a steady rhythm of incubation. While sitting in the nest, this female often called to and answered her mate, and once she joined him in a harsh duet. To my great regret, her eggs disappeared a few days later, before I could resume observations. But a few conclusions may be drawn from my study of this ill-fated nest: (1) the female incubates her single egg for at least short periods before she lays the second; (2) after laying her second egg and completing the set, she may begin to incubate at once, with more than normal assiduity, but in an erratic manner; and (3) the male apparently does not incubate.

In May of that same year, I marked with vermilion paint, in the manner already described, the female *elaenia* of the pair that I had watched building in the lemon tree behind the plantation house. I did not see this female lay an egg, but since subsequent watching demonstrated that the marked bird alone incubated, and I had already proved conclusively that the female *elaenia* incubates, I felt confident that I was correct in calling the vermilion-spotted bird the female. I watched her nest from 5:10 to 11:35 a.m. and from 4:30 to 6:45 p.m. on the twelfth day after she laid her second egg. Her 19 sessions ranged from 8 to 22 minutes and averaged 13.2 minutes. Her 17 recesses varied from 4 to 12 minutes and averaged 8.2 minutes. She was a restless sitter and spent only 61.7 per cent of the time on her eggs.

Through much of the day, the male was within hearing of the nest, but his near approach appeared to be objectionable to his mate. In the early morning, his single whistles, the usual signal for the birds' duet, almost always elicited her half of the performance, although often he failed to join in himself. As the female uttered her little whistles while sitting in the nest, her tail, which projected far beyond the cup's rim, was jerked vigorously up and down, while her crest, usually laid flat while she incubated, was raised to its full extent. As the day wore on, the male's whistles failed to win a response from her, save that at times she left the nest on hearing them and joined him in foraging. He frequently called *wheer chup, wheer chup* all through the day, but this seemed to have no particular meaning for his mate. At 5:53 in the evening, the female returned to her eggs from her last absence of the day and sat quietly as the light faded from the sky. When I left at 6:45, she was still sitting on the nest.

In early May, 1939, I found a Yellow-bellied *Elaenia's* nest 25 feet above the ground in a tree of *Cassia spectabilis* in a pasture. The shallow cup, situated in a crotch between thick branches, was well covered on the exterior with gray lichens which camouflaged it so perfectly that from a short distance it looked as though the incubating bird sat in the naked crotch without any nest. The male of this pair had somehow lost all his tail feathers, but despite this deficiency he could fly well. I did not make a continuous watch of this nest, but I spent much time observing neighboring nests of other species that then engaged my attention, and thus incidentally I saw a good deal of these *elaenias*. Here again I found no evidence that the male incubated since I never found the tailless *elaenia* on the nest. The sitting bird was always the female, whose long tail projected far beyond the shallow rim. One morning the tailless one found a downy white feather, probably of a

domestic chicken. He held it in his bill until his mate returned to her nest and then, while she sat, he flew up and presented it to her. She accepted it and rose up to place it beneath the eggs. Incidentally, this male, quite tailless when I made his acquaintance about May 4, had a full-feathered new tail of nearly normal length by May 24, when he was helping to feed the nestlings. Thus it would seem that three weeks or a little longer is sufficient time for an *elaenia* to replace a lost tail.

The pair of *elaenias* to which I devoted the most attention nested in the calabash trees in front of my house in 1944. Here I could watch them from the porch without the necessity of concealing myself. I did not attempt to mark one of the pair for identification, because such interference with a nest seems to diminish its chances of escaping predators. In the course of 23 hours of watching while incubation was in progress, I did not once see a change-over on the nest, which makes it seem most unlikely that the male took turns at warming the eggs. As at the other nests, this was the duty of the female alone. Ten hours of my watching was done while the female incubated her first set of eggs in dry weather; the rest of the time the weather was mostly wet. In the 10 rainless hours, I timed 27 sessions which ranged from 4 to 49 minutes and averaged 15.6 minutes. The *elaenia's* 28 recesses varied from 4 to 13 minutes and averaged 6.9 minutes. She spent 69.3 per cent of the 10 hours on the nest.

In dry weather, the female *elaenia's* longest sessions on the eggs occurred in the early afternoon, when the sun beat down fiercely upon the imperfectly shaded nest in the calabash tree. Then the panting bird stood rather than sat in the nest, protecting the eggs from the hot sunshine rather than incubating them. Under such conditions, the female once was at the nest for 49 minutes and once for 41 minutes continuously, whereas in the bright but milder sunshine of the forenoon she took no session longer than 25 minutes. However, her most protracted periods of continuous sitting by day were during the afternoon rains, so frequent in the breeding season, when she incubated once for 116 minutes (nearly 2 hours) beneath a long, steady shower, and again for 55 minutes during a lighter, intermittent rain. Between 2:00 p.m. and nightfall on a rainy afternoon, she was absent from her nest for a total of only 34 minutes: once for 12, once for 13, and once for 9 minutes when frightened by a passerby. On rainy afternoons, she took her brief recesses during intermissions in the showers. Since she employed them chiefly in preening, she appeared to require little food in the afternoons. Apparently she satisfied her hunger during her frequent brief absences from the nest in the mornings, which at this season were rainless if not sunny.

This female *elaenia*, like the others I watched, would lay her crest flat the moment she reached her nest and hold it so the whole time she sat there. With her white crown patch flattened, she was a different and far less conspicuous little gray bird. But although she took the precaution of folding up her revealing headgear, she was by no means silent while incubating. On the contrary, she frequently replied in kind to the harsh whistle of her mate. After the start of incubation, she modified this note into something very much like a trill—a resonant but somewhat harsh trill, dying rapidly away. I heard this note from no other *elaenia*, and from this individual only while she actually engaged in incubation.

Occasionally, while on her outings, this female *elaenia* found a white chicken feather and brought it to her nest. When she laid her first egg, there were only a few downy feathers in the lining, but after a week of incubation, the interior of the nest was amply and softly padded with them. Some were so large that they stretched quite across the bottom of the nest. In a similar manner, the Southern House Wren gradually increases the feather lining of her nest while she incubates.

The male of this pair of *elaenias* had a tendency to guard the nest during his mate's

frequent brief absences from the eggs. After she flew off, he often came to rest on a low branch within two or three feet of the nest; or sometimes his arrival was the signal for her departure. Rarely he stood patiently guarding the eggs until she returned; more often he became bored with this duty and flew off before she came back, frequently after he had served as sentry for only a minute or two. In this sporadic guarding, he differed from the male of the pair that I had watched in Guatemala twelve years earlier, for the Guatemalan male did not guard the nest at all. The present male did not utter the disyllabic *wheer chup* that the northern bird of earlier years had so often voiced; he gave only the long, harsh *wheer* and his part of the polysyllabic duet. Unlike the Guatemalan female *elaenia*, the female nesting in front of my house in Costa Rica did not sing in duet while she incubated, although she often did so as she flew from the nest. The Guatemalan female, however, did not utter the trilled note.

A few more observations were made on incubation while this same female attended her second set of eggs, in a nest in a calabash tree 50 feet from that which held her first nest. The April morning on which I had watched her incubate her first set of eggs had been fair, but the June morning when I watched her incubate her second set was damp and cloudy, with only intermittent sunshine, after a rainy night. Perhaps the greater dampness and cloudiness were responsible for her more constant sitting in June. Possibly also the fact that she was now incubating a second brood and was somewhat tired by her labors in rearing the first brood accounted for her increased time on the nest. At any rate, the increase both in the length of her sessions and in the percentage of time she spent on the eggs was well marked, as shown in table 3, where comparison is made of corresponding periods of four hours on the two mornings. Early on a rainy morning, I watched this female *elaenia* sit continuously for 51 minutes, which is twice as long as her longest session on a clear morning while she incubated her first set of eggs. As a rule, birds incubate more constantly in rainy weather than they do in fair weather. However, if continued hard rain makes food difficult to procure, they may be forced by hunger to decrease the time they can devote to sitting.

Table 3
Comparison of Incubation of a Yellow-bellied *Elaenia* on
Clear and Cloudy Mornings

	April 21, 1944 (7:19-11:16 a.m., clear)	June 11, 1944 (7:16-11:10 a.m., cloudy, threatening)
Sessions:		
Number	13	10
Shortest	5 minutes	6 minutes
Longest	25	30
Average	11.8	16.7
Recesses:		
Number	13	10
Shortest	4 minutes	4 minutes
Longest	9	8
Average	6.5	6.7
Per cent of time on the eggs	64.5	71.4

At two nests the incubation period was 15 days, at one 15 or 16 days, at one 16 days, and at two 17 days. The first of these nests in which the eggs took 17 days to hatch was situated above a path where the incubating bird was subject to considerable interruption by people passing beneath her. The second, built the following year in a neighboring tree, probably by the same pair of *elaenias*, was only six feet up in a fairly exposed situation. In the evening of the day on which the female laid her second egg, she was frightened from the nest by a colt grazing close by. I removed the horses from the enclosure but the *elaenia* did not return, although there was still sufficient daylight to see well. She

incubated more or less on the following day, but for no apparent reason she left her two eggs exposed for a second night, covering them only during the third night after her set was complete. Hence the long incubation period at this nest.

THE NESTLINGS

First morning.—At dawn on May 1, the second egg in the low nest in the calabash tree was pipped. By noon the fracture in the shell had not been extended appreciably. Placing the egg to my ear, I could hear the chick peeping within, but it was not hammering at the shell. Whenever I visited the nest, the parents became greatly excited, looking on from higher perches with raised crests and calling much but making no feint of attack. I have never known an elaenia to fly close to a human intruder, snapping its bill, as do many other flycatchers; their protests are merely vocal. By nightfall on May 1, the egg had not hatched.

At daybreak of the following morning, May 2, I took my place on the porch to watch the events attending and immediately following the hatching of the nestlings. At 5:19, as it was growing light, the female elaenia flew from the nest for her first recess of the day. Going then to the nest, I found that the second egg had hatched. The short, whitish down of the tiny, blind, pink-skinned nestling had almost dried and its filaments were spreading out. The first egg of the set was not even pipped, and when opened later it was found to be infertile. Returning at once to my post on the porch, I resumed my vigil. At 5:28 the male alighted on the branch above the nest from which he often guarded, but he remained only a moment and apparently did not notice the nestling. After his departure, the nestling raised its head above the rim, and within a minute the female returned and resumed brooding. While sitting she called much and gave her part of the duet, which I had not heard while she covered the unhatched eggs. After sitting for half an hour, she flew from the nest. A minute after her departure, the male went again to the branch above the nest. Now the nestling evidently caught his eye, for he flew at once to the nest's rim, where he stood for about twenty seconds, looking intently in. Then he picked up a white feather of the lining that stuck up above the rim and carried it off. At 6:05 the female brought a rather big insect and offered the nestling its first meal. But the insect was too large to be easily swallowed. For a minute she continued to place it in the nestling's mouth, and in the end it vanished. However, I am not sure that she did not eat it herself when she found that the nestling could not do so. Then she resumed brooding.

While she sat, the male, at 6:08, came with a tiny insect and stood on the rim of the nest. His mate neither took it from him nor rose up to permit him to give it to the nestling. He flew up to a branch beside the nest and after a few minutes flew to a higher limb of the calabash tree. At 6:15 the female left the nest. Five minutes later she returned, fed the nestling, picked up the cap of the empty shell and carried it away. Less than a minute after her departure, the male fed the nestling for the first time.

The male elaenia apparently did not notice the nestling on his first brief visit to the nest tree that morning, but he undoubtedly did so on his second visit 40 minutes later. He brought food 9 minutes later, but was unable to give it to the nestling. The female brought the first food 46 minutes after becoming active that morning. She removed the cap of the empty shell an hour after she first left the nest in the dawn. The large part of the shell had not been removed by 8:28, when I went to the nest and found that the unhatched egg had slipped into it, fitting snugly. I separated the two, and 7 minutes later the female carried off the shell.

I continued to watch until 9:15. The female alone brooded the nestling. She sat more constantly now than she had done while incubating during the same hours on April 21, a week after laying her second egg. Her sessions on the nest were longer, her absences

shorter, and her total time on the nest increased from 62.5 to 68.5 per cent (see table 4). The male, perching on one of several low branches within a yard of the nest, now guarded in the female's absences much more consistently than he had done before the egg hatched. The nestling was left both unguarded and unbrooded only about 40 minutes in the four hours, and that chiefly before the male discovered that it had hatched.

Table 4

Comparison between Incubation and Brooding at Various Ages of a Nestling Yellow-bellied Elaenia during the First Four Hours of the Day

	April 21 7th day of incubation	May 2 Nestling just hatched	May 8 Nestling 6 days old	May 12 Nestling 10 days old	May 18 Nestling 16 days old
Sessions in minutes					
Shortest	4	5	2	1	0
Longest	19	30	21	25	0
Average	10.5	11.0	7.0	7.3	0
Total	147	164	146	44	0
Absences in minutes					
Shortest	4	2	2	10	240
Longest	9	9	9	86	240
Average	6.3	5.1	4.5	32.7	240
Total	93	76	94	196	240
Per cent of time on nest	62.5	68.5	60.9	18.3	0.0

Table 5

Rate of Feeding a Nestling Yellow-bellied Elaenia at Various Ages during First Four Hours of the Day

Hour a.m.	Date and age of nestling				
	May 2 Newly hatched	May 8 6 days	May 12 10 days	May 18 16 days	May 19 17 days out of nest
5:15-6:15	1	9	8	13	16
6:15-7:15	8	9	8	14	20
7:15-8:15	10	10	10	19	16
8:15-9:15	5	14	20	13	out of sight
Totals	24	42	46	59	52*

* For 3 hours only.

The female fed the nestling 15 times, the male 9, making a total of 24 feedings in the first four hours of the morning period (table 5). The male flycatcher would have fed the nestling more often had his mate cooperated more closely. If he came while she brooded, she never took the morsel from him to pass it on to the nestling, as do many female birds. She did not rise to permit him to slip the food to the young one beneath her, and often she did not fly off to leave the nest open for him. In these circumstances, he could only wait on a neighboring bough, holding in his bill the food he had brought, and going again and again to rest on the rim of the nest beside his unresponsive brooding mate. Sometimes she would finally make way for him, but often he would grow tired of holding the food and swallow it before it could be delivered at the nest. Once, after the male had fed the nestling and risen to a neighboring twig to guard it, the chick, still hungry, lifted its head with its mouth open, exposing the bright orange-yellow interior. The male went again to the nest's rim, uttered a low, soft note, plucked or appeared to pluck a minute insect from the adjacent branch, and placed it in the nestling's mouth. A little later, when again the nestling gave tokens of being hungry after the male had fed it, he darted out to capture a passing insect and fed the young bird again. Once, after he had delivered food, he carried off a dark feather from the lining of the nest.

Six days old.—On May 8, when the nestling was six days old, I again watched the nest through the first four hours of the morning. The female now brooded less than on the morning when the nestling hatched, but she still covered the nest about as constantly as she had done while I watched her incubate (table 4). Her sessions on the nest were, on the average, shorter, because she often flew off to permit her mate to deliver food to the nestling. Now she had become more cooperative in this respect, rarely keeping him waiting when he arrived with food, but still she never took a particle from him to pass it to the nestling. Her absences were shorter, too, because she often returned very promptly to feed the nestling, after which she brooded it.

After feeding the nestling, the male often lingered on a perch within a yard of the nest, guarding it. Sometimes he stayed at his post until the female's return, leaving as she approached. But often he flew away before she arrived. He was not at all consistent in keeping guard.

At noon on May 8, the sun shone hotly between gathering storm clouds and the air was oppressively warm. The female elenia, panting with open mouth, stood on the nest's rim to shade her six-day-old nestling. When the sun went behind a cloud, she brooded, but when it shone out strongly again she rose and merely shaded the nestling. The little bird pushed its head out from beneath the female's breast, and when the male came with food he was able to deliver it while the female remained on the nest. After his departure, the female plucked two bright red berries from the nestling's throat and ate them. Apparently they were too big to go down, or the young bird was too full to swallow them.

In the afternoon of the following day, I watched the nest while rain fell. During the hardest downpour, the female brooded for 37 minutes continuously. Just as her longest sessions on the eggs were taken while it rained, so were her longest spells of brooding. The male continued to bring food during the lighter showers. Sometimes the nestling would push its head out from beneath the female's breast to take the nourishment, and sometimes the female would rise up to make it possible for her mate to deliver the food. More rarely she would fly from the nest when he came, but she only remained away a few minutes.

In eight hours on May 8 and 9, four hours in the morning and four hours in the afternoon, the nestling received food 77 times. Now that the female did not brood after each feeding, it was not always possible to distinguish her from her mate. The male, however, was recognized as he fed 33 times and the female 28 times, leaving 16 feedings for which I was uncertain which parent to credit. The parents were accordingly taking fairly equal parts in providing for the nestling. On approaching the nest with food, both invariably laid their crests flat.

Ten days old.—On May 12, when the nestling was ten days old, I watched it for the first five hours of the forenoon. The early morning was darkly overcast and so cool that I found it comfortable to wear a jacket while sitting inactive on the porch. After eight o'clock, the sun began to penetrate the high ceiling of clouds and the air became warmer. Despite the chilliness of the morning, the nestling, now thinly covered nearly everywhere with whitish down, was brooded very little—once for 25 minutes before the hour of sunrise, then only for 5 short periods ranging from 1 to 7 minutes. Now that the female rarely brooded, it was usually impossible to distinguish the parents when they came with food; but I believe that it was the male which after feeding often remained on one of the slender branches close by the nest, as he had so often done before the egg hatched and while the nestling was younger. The arrival of his mate always sent him away, but he was by no means consistent in awaiting her coming. Thus the nest was not constantly guarded. Although the parents did not maintain a continuous, sentry-like watch over their nestling, one or the other was almost always in sight, and I could not approach the

Table 6

Some Rates of Feeding and Brooding a Nestling Yellow-bellied Elaenia in Midday and Afternoon

Date	Hour	Times fed	Minutes brooded	Weather
May 8	12:00-1:00 p.m.	11	19	Gathering storm clouds, warm
May 8	1:00-2:00 p.m.	12	15	
May 9	2:32-3:32 p.m.	4	49	Rain until 4:05 p.m.
May 9	3:32-4:32 p.m.	8	32	
May 12	11:15 a.m.-12:15 p.m.	8	0	Cloudy, warm
May 18	2:43-3:43 p.m.	8	43	Rain, mostly hard
May 18	3:43-4:43 p.m.*	17	30	Steady rain

* At 4:43, the young bird left the nest.

nest without being greeted by their angry, protesting whistles. Nor could any other bird come near the nest without being chased away.

Between 5:15 and 9:15 a.m., the nestling was fed 46 times by both parents (table 5). Its food consisted of minute insects and a variety of small berries, of which some were white, some bright red, and others black. One white berry was so big that for all its efforts the young bird could not gulp it down. The parent placed it in the nestling's mouth and removed it half a dozen times, until finally, convinced that the young bird could not swallow it, the old one did so. It was difficult to make certain how many articles were brought on each visit, but there were often at least two. If the nestling kept its mouth open after receiving the food, the parent continued to put its bill into it, without, as far as I could see, delivering additional particles. On its part, the young bird did not, on the arrival of a parent, rise in the nest with neck stretched upward to its limit, after the strenuous fashion of so many nestling birds. It merely lifted its head slightly and opened its mouth, revealing the bright yellowish-orange interior. The low-rimmed cup, which the nestling already nearly filled, and the absence of all competition from nest mates, rendered such vigorous upward stretching superfluous. Compared with most nestling birds, the young elaenia gave the impression of being languid and almost indifferent when food arrived. The parents swallowed all droppings, at times appearing to gulp them down with an effort. I did not see them carry any away in their bills.

Sixteen days old.—The female elaenia brooded the nestling through the night of May 15-16, but it did not brood during the young bird's last two nights in the nest, although on the next-to-last night a light rain fell. In the first four hours of May 18, the young bird's sixteenth and final morning in the nest, it received food 59 times. This was considerably more food than it had received when it was 10 days old, but it was not brooded. However on the afternoon of the same day rain fell steadily and hard, and the mother brooded her well-feathered nestling, already on the point of departure from the nest, as though it were a tender, newly hatched bird. In two rainy hours (2:36 to 4:36 p.m.), she covered it for periods of 21+, 15, 18, and 26 minutes, or a total of 80 minutes. Her absences from brooding were brief, for periods of 7, 10, 8, and 15+ minutes. Thus the young bird was brooded for 66.7 per cent of the time which was about as much brooding as it had received on the morning it hatched! But toward the end of its last long period of being brooded it became restless and pushed out from beneath the female to move around in the rain.

In two rainy hours, the young elaenia received food 25 times. In the first hour (2:43-3:43) it was fed 8 times, in the second (3:43-4:43) 17 times. All of these meals were brought in the rain, yet this compares favorably with the rate of feeding on clear mornings. There was a difference, however, in the distribution of the meals. In clear weather, food was brought at a fairly uniform rate. In the rainy afternoon, the parents took ad-

vantage of brief spells of lighter rainfall to bring food at a rapid rate, compensating for the long periods of harder rain when the female brooded and no food was brought. Thus, after 44 minutes in which it received only 2 meals, the nestling was fed 6 times in as many minutes. Then, after 21 minutes, it was fed 7 times in 10 minutes. There followed 26 minutes without a meal, at the end of which 10 meals were brought in 20 minutes, all in a steady rain. The parents appeared to regulate the amount of food they brought by the nestling's needs, not by the weather, and since its digestion proceeded at about the same rate whether it rained or shone, the young elaenia required about the same amount of nourishment each hour.

Departure from the nest.—By May 18, the young elaenia had already made some short excursions beyond the walls of its narrow abode. On the preceding day, when it was only 15 days old, I found it a little before noon resting on the thick, mossy branch close beside the nest. An hour later it was sitting on the rim, and soon afterward it was back inside once more. The following morning, May 18, the young bird rested quietly in the nest until after sunrise, when it became very active, preening, stretching its wings and legs, flapping its wings rapidly, and moving about much in the nest. At 6:40, it climbed out upon the thick, gently inclined mossy branch to the right of the nest and worked along it for a distance of possibly eight inches, among the close-set, clustered leaves. Three minutes later it returned inside the nest, where it rested quietly for a while after this venturesome excursion. After half an hour of repose, it became active and restless once more. Then, after another hour of relative quiescence, it again hopped up to the rim, thence out along the branch to the right for a few inches. But two minutes later it reversed its direction, went to the upright branch that formed the other arm of the crotch that held the nest, and hopped up to a leaf that stood above it. After a minute or two there, it returned home and began to preen. Then it continued to rest quietly in the nest.

Accordingly, by the afternoon of May 18, the young elaenia was not without previous experience in the world beyond the narrow confines of the nest. Yet its final departure came as a complete surprise, for it was made at a time and under conditions I have observed in no other fledgling. After being brooded like a helpless nestling through much of the rainy afternoon, then receiving 10 meals in 20 minutes as already recounted, the young elaenia, thus strongly sustained, began to climb the leafy upright branch that rose beside its nest. It was then 4:43 on a dark and stormy evening, with the rain coming down in a steady deluge. Since, in my experience, most young birds choose the sunny hours of the morning for their departure, I was unprepared to see this elaenia, so lately treated like a newborn chick, leave its nest in this independent manner, and I was even more amazed to behold a flycatcher walk off into the world in scansional fashion. But probably, despite recent maternal coverage, the downy nest beneath it was thoroughly waterlogged and most uncomfortable, whereas the branch that rose upright so close beside it was more enticing. So the fledgling elaenia went climbing upward through the rain, surprising the parents which brought food to the so recently abandoned nest, and with precocious independence and infantile aplomb settled down to sleep out the wet night amid the sheltering foliage of the calabash tree, five or six feet above its former abode.

The young elaenia did not lack parental ministrations as it climbed the main branch of the calabash tree. One of the parents, on arriving with food, went twice to the empty nest before it found the fledgling, already a foot higher up. Here it tried to feed the youngster, but stiff leaves interfered. Finally it gave up and carried off the food. Soon, however, this parent or its mate fed the fledgling while hovering on beating wings above it. But the next morsel was also taken to the empty nest before it was taken to the youngster who already was three or four feet higher. The young bird was fed twice more; then

its mother sat in the nest as though brooding, while rain fell very hard. Her offspring was far above, not beneath her! After two minutes, she appeared to discover her error and flew off. As dusk settled gloomily over the drenched valley, the parents made several more attempts to feed the young bird. But they could not reach it in the clustered stiff leaves where it had finally settled, and in the end they carried their offerings away.

At dawn next morning, I found the fledgling elaenia in the same crotch in the top of the calabash tree where it had settled down at nightfall. For half an hour it remained motionless in the spot where it had slept, while attentive parents brought food that with considerable difficulty they pushed in to it through the sheltering foliage. At 5:45 the young bird bestirred itself and began climbing over the neighboring branches and taking short flights from one to another. Meanwhile it received many additional mouthfuls. Soon the sun shone forth and still further raised its spirits. At 6:38 it flew two feet to a nearby branch. Encouraged by this successful journey, the young bird soon flew to the nearest bough of a neighboring calabash tree, six feet away. Its next flight covered about eight feet and took it to the opposite side of the same open crown. Then, after a few short flits from twig to twig, it found a perch quite to its taste, on a short, horizontal, leafless branch at the top of the tree and fully exposed to the morning sunshine. Here it settled down to await the small berries and tiny insects that tireless parents brought. It took them in its bright yellowish-orange mouth like a king receiving tribute from his vassals, and while waiting for more to come it preened, exercised its wings, or merely rested motionless in the sunshine.

The fledgling stayed in this same spot for the next hour and a half. In all, I had it in sight for the first three hours of the morning. The number of feedings it received is recorded in the last column of table 5. In the three hours, it was fed a total of 52 times. In the corresponding hours of the preceding morning, the young elaenia, still in the nest, had been fed only 46 times. There is one other record of the same maximum rate of feeding of 20 times per hour (8:15 to 9:15 on May 12), but none of 52 meals in 3 hours. The young elaenia was fed slightly more often as a fledgling than as a nestling.

The parents brought alternately insects and berries, as on previous days. When alighting beside the fledgling to pass food to it, they always laid their crests quite flat, just as they had done when approaching the nest. They also did their best to remove the droppings by swallowing them, as they had earlier done. While the fledgling still rested in the foliage early in the morning, they were careful to pick off and eat any excreta that had lodged on the leaves. Sometimes, arriving with food for the young bird, they would spy a blob of excrement on a leaf and promptly swallow the particle of food in order to be able to swallow the bit of waste matter. In this fashion, the young bird was deprived of a few meals. Later, while it rested on the naked twig with a clear space below, the parents behaved still more queerly. After feeding the young bird, they would face in the opposite direction to watch for its dropping to appear, just as they had waited for it after feeding at the nest. But then it was the nestling that turned around, or else the parents reached over it. The fledgling, still preserving the habit of all the past days of its life, would evacuate chiefly just after receiving food. As the dropping appeared, the parents would dart earthward in pursuit of it, and they often succeeded in overtaking it before it struck the ground. Did it possess an agreeable taste to stir them to such strenuous efforts to retrieve it?

Observations at a nest with two nestlings.—For comparison with the record of attendance of a single nestling, I watched, on the morning of June 5, 1946, a nest with two nestlings. These had hatched on May 19 and 20 and were accordingly about 16 and 17 days old. The mother had brooded the well-feathered young through the preceding night, sitting above rather than in the nest, for they completely filled its concavity. The

first meal was brought to them at 5:31 a.m., and in the next four hours they were fed as follows:

5:31-6:31 a.m.	32 times
6:31-7:31	11
7:31-8:31	30
8:31-9:31	34
Totals: 4 hours	107 times

In the first four hours of the morning, food was brought to the nest 107 times, or 53.5 times per capita, as compared with 59 times for the single nestling in the calabash tree in a corresponding period of the morning of May 18, when it was 16 days old (see table 5, column 5). Food was brought to the two nestlings far more often than it was to the single nestling, but it was not brought twice as often. Although the difference in the per capita rate at the two nests is small, it is in accord with many other recent studies, which have demonstrated that as the number of nestlings in a brood increases the rate of food bringing also increases, but not proportionally. Thus each member of a small brood receives more food than each one of a larger brood of the same species.

At this nest, too, both of the parent elaienias fed the nestlings, although I could not distinguish them nor determine their respective parts. They brought chiefly insects, but they also brought a good number of black and red berries. A number of insects, or several berries, were carried in the bill and mouth at one time. Often both nestlings were fed at a single visit of a parent, but more commonly only one received food. Although usually the parent laid its crest flat while at the nest, at times one of them delivered food with the crest partly raised. I could not tell whether this was always the same individual. All the nestlings' droppings were swallowed by the parents as soon as voided. Before excreting, the nestlings wagged their tail from side to side, and this seemed to be a signal of what was coming.

The morning was beautifully bright and clear, and the parents did not brood. When a third Yellow-bellied Elaenia came near the nest, it was at once driven away, but a Gray-capped Flycatcher was permitted to rest in the small nest tree without molestation. The nestlings alternated between periods of drowsy indolence and activity. During the latter, they preened busily, and standing up in the nest but apparently holding on with their toes, they flapped their wings with vigor. Once one of them climbed out of the nest to the bough beside it then promptly returned inside. Such exploratory excursions appear to be usual with elaienias about to quit their nest.

Development of plumage.—Unlike most passerine nestlings, and even unlike most nestling flycatchers that I have examined, the young elaienias bears down of two sorts. At hatching, it has short, whitish down in restricted linear tracts along the middle of the crown, above the eyes, across the hindhead, down the middle of the back, along the flanks, and on the wings and the outer side of the thighs. On the ventral surface, this down is restricted to a line on each side of the abdomen. This natal down fails to cover the chick's pink skin, and the young bird resembles a typical passerine nestling. Three or four days after hatching, short feather sheaths become visible beneath the transparent skin in the regions *between* the tracts of natal down. In another two or three days, these sheaths push out from the skin and ravel off, freeing a whitish secondary down which covers most of the skin that had been left bare by the sparse natal down. Thus at the age of six or seven days the nestling is well clothed on body, head, wings and thighs with whitish down in short, compact tufts and it has an appearance quite different from that of most passerine nestlings. It resembles an unfledged Lovely Cotinga but is of course much smaller. The single conspicuous area of bare skin on the nestling elaienias at this

stage is in the center of the abdomen whence it extends forward, rapidly narrowing, on the breast, so that it includes just that portion of the chick's lower surface that is in closest contact with the feather-lined nest.

When the nestlings are about ten days old, the tufts of *natal* down are pushed up on the ends of the sprouting pinfeathers, which, rapidly lengthening, soon split to release contour feathers of adult type. The elaeia's juvenal plumage, then, is developed only in the tracts which bore the natal down. The *secondary* down, which unlike the natal down undergoes no further development, is covered over by the contour feathers which spread out on either side of the feather tracts that supported down when the nestling hatched. At the age of 13 or 14 days the nestling is fairly well clothed with plumage, and when it leaves the nest a few days later it bears a fairly close resemblance to its parents. But it is still stubby-tailed and paler yellow on the breast, devoid of an erectile crest, and still adorned with tufts of nestling down on head and back, where it cannot reach to preen.

Nestling period.—At six nests containing in all ten nestlings, the period in the nest was 17 to 18 days. A very late brood, reared in El General in July, left their nest when 20 and 21 days old, respectively. These retarded nestlings were attended by their parent on their next to the last night but not on their last night in the nest. It would hardly be correct to say that the female brooded them, for they filled the nest's bowl to overflowing and she merely rested on the rim with her breast projecting above them. But at least she made an effort to cover them when they were at an age at which most young elaeias take flight and roost amid the usually dripping foliage, for in El General they leave the nest in the wet season. At other nests, which the nestlings abandoned at the usual age of 17 or 18 days, they slept alone on the last two or three nights before their departure, and in one instance for five nights.

After taking flight, the young elaeias follow their parents through the trees and bushes and are fed by them. All day long they repeat almost continuously a low, deep-toned, serious whistle, *weeer*, similar to the opening notes of the adults' call, but it is lower in pitch.

THE SECOND BROOD

On May 28, ten days after the departure of their nestling, the pair of elaeias whose history we have followed in most detail were building a new nest in a neighboring calabash tree, 50 feet distant from the first. As before, both male and female worked at the nest. Part of the material they used was torn from the old structure in which they had reared their first brood. Much of the time while they worked, the young bird, now 26 days old, was in sight or hearing. I saw it receive food from a parent only once, but most of the time it perched concealed in the foliage. It repeated incessantly its low whistle, which I first began to hear six days after it left the nest. I did not see it attempt to feed itself while its parents built the second nest. The female laid her first egg in this nest on May 31, her second on June 2, then she began to incubate. But nest and eggs vanished before the nestlings hatched. As far as I could tell, this pair did not build another nest that year.

In southern Costa Rica, most Yellow-bellied Elaeias appear to finish nesting in July. For this month I have only two records of nests with eggs in Costa Rica and two others in Honduras. For the following month, I have one record of a nest in El General which contained two newly hatched nestlings on August 2, and one of a nest in the same locality which on the exceptionally late date of August 24 held a single egg. In Trinidad and Tobago, the species has a far longer breeding season, for Belcher and Smoother (1937:243) found nests with eggs in every month from February to October.

After the conclusion of their breeding season, the elaeias remain in pairs until the

following year. In September and October they are especially noisy, repeating their whistles several times a minute through much of the day, from time to time dueting with their mates, and even singing the dawn song in broad daylight. Apparently this unwanted vocal activity is associated with pair formation by the birds hatched earlier in the year.

SUMMARY

The Yellow-bellied Elaenia inhabits dooryards, city parks, plantations, shady pastures, savannas and other areas with scattered trees, but it avoids closed woodland. In Costa Rica, it breeds from sea level up to at least 6000 feet. It never flocks but lives in pairs at all seasons. The members of one mated pair roosted on leafy twigs about ten feet apart.

Its diet consists of small insects, caught on the wing, and many berries.

It has a richly varied vocabulary, although none of its notes is musical. Among the more notable of its utterances is the duet, which consists of a series of rather harsh whistles uttered simultaneously by the two members of a mated pair. Since they make no attempt to keep time, the result is a bizarre, garbled performance. There is also a dawn song, probably delivered by the male alone, consisting of the repetition of a harsh, assertive bisyllable, *we do*, which is begun while the light of dawn is still very dim and which is continued for many minutes. In the valley of El General this dawn song is sometimes heard toward the end of January but it is more consistently delivered from late February or March into June. It is heard but rarely in July and August.

In El General, nest building usually begins from mid-March to early April. The nest is placed in a bush or tree at heights ranging from about $4\frac{1}{2}$ to 60 feet but usually it is placed between 6 and 15 feet up. The nest is situated in a fork or sometimes saddled over a horizontal limb. Both sexes build, the pair sometimes bringing material 24 times in an hour, although they usually work more slowly. The shallow, open nest is a beautiful structure, with soft but compact walls liberally covered with lichens and less often moss, which are attached by cobweb. It is well lined with feathers, many of which are brought after the eggs have been laid.

Although sets of 3 have been reported from other regions, in Central America 2 eggs are regularly laid. They are usually deposited between 8:30 and 11:00 a.m., and two days elapse between the laying of the first and second.

Only the female incubates. In seven hours in clear weather the sessions of one female ranged from 8 to 22 and averaged 13.2 minutes. Her recesses varied from 4 to 12 and averaged 8.2 minutes. Thus she spent 61.7 per cent of the period on the nest. In 10 rainless hours another female took sessions ranging from 4 to 49 and averaging 15.6 minutes, while her recesses ranged from 4 to 13 and averaged 6.9 minutes. She devoted 69.3 per cent of the 10 hours to incubation. In clear weather her longest sessions were taken in the early afternoon when the sun shone hotly upon the nest, but she sat continuously for far longer periods, up to 116 minutes, while rain fell steadily.

Some females duet with their mates while sitting in the nest. Most birds of both sexes keep their crests laid flat while building, incubating, or attending nestlings, but exceptions to this rule were noted. Some males guard the nest while the female is absent, but they do not perform this office consistently.

The incubation period is usually 15 or 16 days but it is sometimes prolonged to 17 days.

The nestlings are fed by both parents, the male sometimes beginning less than an hour after the first egg hatches, but only the female broods them. The diet of the nestlings includes small insects and berries, several of which are brought at one time. For a single nestling, feeding rates varied from 24 times in four hours when the chick was newly

hatched to 59 times in four hours when it was 16 days old. At a nest with two young 16 and 17 days old, food was brought 107 times in the same four hours of the morning.

Until the young are about six days old, they are brooded by day about as much as the eggs were incubated, but in the next few days the time the female devotes to brooding in rainless weather falls off rapidly. When hard showers fall, the female covers even well-feathered nestlings for long periods. Nocturnal brooding continues longer than diurnal brooding in clear weather, but the young are usually not attended by a parent during the last two, three or even five nights in the nest. One parent, however, attempted to cover a retarded brood through their next-to-last night in the nest.

At hatching, the elenia bears short, whitish natal down in narrow tracts which fail to cover the whole body. Within a few days, most of the body, wings, and thighs are covered by a fairly dense secondary down which pushes through the skin in the regions between the tracts of natal down. The contour feathers of adult type develop in the tracts of natal down, raising the downy tufts on their tips as they sprout out in the form of pinfeathers. On expansion, these contour feathers cover over and conceal the secondary down, while the primary down soon wears off their tips. On leaving the nest, the fledgling resembles its parents fairly closely, but its tail is still stubby and its crest undeveloped.

At six nests, the nestling period was 17 to 18 days, but at one unusually late nest the nestlings, raised in July, did not leave until 20 and 21 days old. When slightly under 17 days old, one nestling left its nest spontaneously late in the afternoon in a drenching rain. The female parent brooded the empty nest. Next day, as the fledgling perched in a tree, the parents tried to dispose of its droppings as though it were still in the nest.

In El General, a second brood is sometimes attempted. One pair started to build a second nest while they still attended a fledgling that had left their first nest ten days earlier.

BELLICOSE ELAENIA

Elaenia chiriquensis

The Bellicose Elaenia is a small, dull-colored flycatcher with few physical characteristics to aid in identifying it in the bush. Slightly more than five inches in length, its upper plumage is grayish olive. The middle and greater coverts of the wings have broad, pale gray tips which form two conspicuous light bars; the dark wing plumes have conspicuous light margins. The chest, sides, and flanks are pale gray, whereas the belly and center of the breast are pale yellowish or cream-color. The upper mandible of the short bill is largely black, and the lower is flesh-color becoming dark at the tip. The eyes are dark, and the legs and feet are blackish. The feathers of the crown are sometimes erected as a low crest, and in this position they reveal a small white area in their center. But the crest of the Bellicose Elaenia is by no means as high and prominent as that of the Yellow-bellied Elaenia; the white in it is not so conspicuous, and the crest is not raised so frequently. With their crests laid flat, these two flycatchers, which occur together in many places, may be readily confused, although the Yellow-bellied Elaenia is somewhat larger and has the bill more extensively black. With its high crest erected, it is impossible to confuse the Yellow-bellied Elaenia with its smaller congener. In voice and habits, too, these two species are quite distinct.

The Bellicose Elaenia ranges from Brazil through northern South America and Panamá to the Térraba Valley in southern Costa Rica. Here, at the northern limit of its range, it is an exceedingly abundant bird. Its favorite habitats are savannas and bushy pastures where there are plenty of shrubs intersected by a network of twisting cowpaths, with here and there a low tree. The extensive fields of bracken (*Pteridium aquilinum*), with small, fire-killed trees standing scattered above the head-high tangle of the fern fronds, are also attractive to the elaenias. These cover much of the sterile hills of the upper Térraba Valley. Pastures with tall shade trees and a clean sward beneath them are less attractive to this flycatcher, and so, too, are the denser thickets which take possession of abandoned fields where no cattle are permitted to wander. Yet in both these habitats this elaenia may be present in small numbers. But it is wholly absent from the primary forest and even from taller second-growth woodland with a closed canopy. It breeds from the lowlands upward to at least 3500 feet above sea level. In 1936 and 1937, I found this species very abundant, at an elevation of about 3000 feet, in the bushy growth which covered most of the lower end of the valley of the Río Buena Vista, a northern tributary of the Río Grande de Térraba. I estimated that in this locality it outnumbered the more widely distributed Yellow-bellied Elaenia by about three to one. Indeed, it seemed to me to be about the most numerous bird of the clearings, with the exception of the Yellow-faced Grassquit. On my farm beside the Río Peña Blanca, it is less abundant, but it is still a common bird.

FOOD

The Bellicose Elaenia subsists on small insects caught in the air and on a variety of small fruits and seeds, including fruits of mistletoes (Loranthaceae), seeds of *Bocconia frutescens*, a large-leaved shrub belonging to the poppy family, and seeds of the tree *Alchornea latifolia*, which are enclosed in bright red arils. For several years one of these flycatchers has from time to time visited my food shelf to eat bananas, and it is the only member of the flycatcher family that I have seen there.



Fig. 49. Bellicose Elaenia.

VOICE

The usual call of the Bellicose Elaenia is a low, short whistle, sometimes soft and sometimes harsh in tone, which is often repeated over and over at intervals of a few seconds. Some individuals tirelessly reiterate a short, thick disyllable which sounds like *tsé-be*. At daybreak in the breeding season, these flycatchers deliver an odd and distinctive dawn song. From the low bushes or trees in which they roost there issues, in the first gray light of the day, a quaint little phrase which sounds something like *a we d' de de*, *a we d' de de*, delivered very rapidly, over and over in endless sequence, in a small, dry, lustreless voice that is even more droll than harsh. This thin flow of queer notes is continued, with hardly a break or a pause, for from a quarter to half an hour, until it is silenced by the growing daylight. Presumably, it is only the male elaenias which sing in this fashion. After sunrise they may repeat this unmelodious phrase from time to time, but rarely, unless perhaps greatly excited by the presence of a rival, do they reiterate it for many minutes on end as they do in the dawn. A female brooding newly hatched nestlings once sang at daybreak a long-continued song which greatly resembled the male's dawn song, but this was somewhat lower in pitch and simpler in form. Other females, while sitting in the nest, have been heard to utter a *we-de* which sounds like a fragment of the dawn song. They have also a low, pleasant nest song.

In the evening twilight, the Bellicose Elaenia does not sing a long-continued refrain as it does at dawn. But in the gathering dusk, when the day's last songs have been sung

and all diurnal birds are sinking into drowsy silence, the elaenia suddenly shoots above his tangled thickets, rising up and up on a steep, irregularly twisted course until he has reached or even passed the level of the highest treetops of the tropics, and as he ascends he repeats over and over his inimitable *a we d' de de*. At the apex of his wild flight, the dim little bird at once turns and shoots recklessly earthward, continuing his dry ditty until swallowed up by the bushes where he roosts.

Although a few other flycatchers, including the Black Phoebe, the Vermilion Flycatcher, the Fork-tailed Flycatcher and the Least Flycatcher, have flight songs, and the last two rise up to sing in the evening twilight, the habit is rare in the family. Indeed, in Central America, few birds habitually rise high into the air to sing, so this little gray flycatcher is Costa Rica's best skylark. In localities where this elaenia is abundant, the flight and song may be seen and heard evening after evening over a period of several months each year, but only rarely does the bird soar up singing in the morning twilight. One evening in mid-April, I watched a pair of elaenias among the weeds at the foot of a high, rocky bank. When the light was failing fast, they perched low in the herbage and frequently repeated a curious little whistle that barely escaped harshness, turning from side to side as they called. Then, when the sky had faded to a dim gray, one of them suddenly rose into the air, ascending high in a most tortuous course and uttering the *a we d' de de* song as he flew. Then he darted to the ground near the point whence he rose, and both elaenias became silent for the night.

In the valley of El General, the dawn song and the evening flight song of the Bellicose Elaenia are delivered from early or mid-March through much of June. In the nesting season, I can count on seeing several birds rise up singing every evening from the hillside pasture, which has scattered guava trees, behind our house. Here the earliest date on which I have recorded the season's first flight song is February 28 in both 1950 and 1953, and the latest date is March 18, 1947. In the second half of the year, these birds are so rarely seen or heard that I have come to suspect that most or all of them withdraw from this region. This, however, awaits confirmation. Belcher and Smooker (1937:243) noticed similar seasonal fluctuations in abundance in this elaenia's breeding areas in Trinidad, and they were led to postulate local movements if not migrations over a longer distance. Toward the end of January the elaenias' queer whistles are heard with growing frequency in El General; and soon, by their songs, calls and frequent fights, they force themselves on the bird-watcher's notice.

TERRITORY

The Bellicose Elaenia is in my experience the most pugnacious bird of Central America. Real fights in which the contestants clinch and fall to the ground seem to be far less frequent among the birds of Central America than among those of northern regions. I have seen more such battles in this species than in any other, with the possible exception of the Gray's Thrush. A strong instinct to defend the area surrounding the nest, coupled with the proximity of nests in favorable areas, gives rise to many angry encounters. But there can be no doubt that the Bellicose Elaenia is intrinsically of a less placid temperament than most of its feathered neighbors—a fact which is amply demonstrated by the relations of the mated pair.

In April, 1937, there were three occupied nests in sight of the window of the thatched cabin I then occupied. Together they formed the apices of a rough isosceles triangle with a base of 70 feet and the equal sides each measuring about 90 feet. Naturally, with such quarrelsome birds nesting so close together, conflicts were of frequent occurrence. I began to see these fights about the beginning of February, and in March and April they became more numerous. Sometimes one elaenia would chase another about the

dooryard, until the two came to grips on the ground. Often, while one *elaenia* hotly pursued another, a third or even a fourth would join the chase. Unfortunately, it was impossible to distinguish the sexes of these birds. One morning in the first part of April, when I was sweeping out my cabin with the door ajar, one *elaenia*, closely pursued by a rival, fled across the edge of the porch and through the narrow opening left by the door. It alighted almost at my feet in a corner of the room, back down, and immediately its assailant was on top of it. But in an instant, before either had suffered any noticeable injury, they separated and flew out the way they had entered, going off in different directions as soon as they were in the open. Such was the usual outcome of these attacks; for, although the bird's onslaught was so fierce, its fury was soon spent. Of the many times that I saw two seize each other and tumble about on the ground, they always separated after a few seconds, apparently none the worse for their tussle.

Although the *elaenia*'s attacks are fiercest when directed against another of its own species that trespasses on its nesting territory, other birds, even of the most inoffensive kinds, cannot with impunity come near the nest. In the small tree where one nest was situated, I saw the pair of *Bellicose Elaenias* pounce upon intruding *Yellow-bellied Elaenias*, *Piratic Flycatchers*, and *Gray-capped Flycatchers*. All these trespassers were bigger than the *Bellicose Elaenia*, and the *Gray-cap*, which was the largest of all, was set upon with a ferocity rare among flycatchers. When the *Gray-cap*, intending no harm, came to rest in the side of the tree farthest from the nest, the *elaenia* darted from the nestling she had been brooding and attacked the intruder from below, turning deftly upside down in the air to use both bill and claws against its yellow belly, and causing the *Gray-cap*'s immediate retreat. Only a pair of *Blue Honeycreepers* and a *Variable Seed-eater* were considered too insignificant and harmless to be made the target of angry onslaughts. Another *elaenia*, which built her nest in a hibiscus bush in front of my cabin, drove off, with her mate's aid, every other bird that came near, except only the tiny grassquits and seedeaters, which seemed to be beneath her notice and were permitted to alight with impunity close by the nest. The pugnacious disposition of the *elaenias* contrasted sharply with the peaceable nature of the *Yellow-faced Grassquits* themselves, which were equally abundant about my cabin and had equal cause to quarrel with their neighbors if such had been their inclination.

Finally, the belligerent disposition of the *Bellicose Elaenia* is displayed by the females which drive their mates from the vicinity of the nest, as I have more than once witnessed. The female is often surprisingly touchy, and if her mate approaches with food for the nestlings while she is brooding, she quickly darts away.

NEST BUILDING

My earliest date for the beginning of nest building in El General is March 22, 1941. Other nests were found in various stages of construction in the last days of March, but building does not become general until April. The site chosen for the little open cup is the crotch or often the trifurcation of a usually slender branch of a bush or tree standing in a neglected pasture, a dooryard, hedgerow, coffee plantation, or in the more open part of a low thicket. Fifty-six nests, of which I have recorded the height, ranged from 15 inches to 35 feet above the ground. Half of these nests were between 5 and 10 feet above the ground. Often the nest is in a very exposed situation, with little screening foliage.

At three nests of which I watched the construction, the female worked alone, and she was not even closely attended by her mate. Indeed, two of these *elaenias* drove away others of their kind, which seemed to be their mates, whenever they came near the nest. In early April, 1947, I enjoyed a specially favorable opportunity to watch the process of

construction at the third of these nests, which was situated on a slender, leafy, horizontal branch of a rose-apple tree growing in front of one of the windows of our house. Through this window the construction of the nest could be watched from close at hand without disturbing the builder. I did not find this nest soon enough to observe the very first steps in its fabrication, but at an earlier nest I saw that this consists of the attachment of many tufts of cobweb in the crotch chosen for the nest's reception. These are wiped from the elaenia's bill onto the bark of the supporting twigs and serve to hold in place the materials subsequently brought. Then the bird brings fragments of dry grass inflorescences, bits of fibrous material, moss, and the like. It was at this stage that I found the nest in the rose-apple tree, at the end of the morning on April 5. The elaenia continued to work diligently through the middle of the day, bringing 27 billfuls of material from 11:45 a.m. to 12:45 p.m. and 25 more in the following hour. Her contributions consisted of fine straws, fibers, green moss, and much cobweb from conspicuous wefts of cocoon silk to tenuous strands that were invisible to me. These last were carefully wiped from the bill to the sides of the nest.

The next day, April 6, I devoted three and a half hours to watching the nest. From 6:18 to 7:18 a.m. the elaenia brought material 7 times, from 9:10 to 10:10 a.m. she brought material 26 times, from 12:35 to 1:35 p.m., 26 times, but from 2:45 to 3:05 p.m. she did not visit the nest.

In shaping her nest, the elaenia employed bill, feet, and body, and she had two principal procedures. In one she pressed down her breast and pushed the nest material outward by rapid backward movements of both feet, often turning with a vigorous motion to face in different directions while she did this. In the second procedure she used her bill to arrange the material, chiefly that on the outer surface of the nest, pulling the loose ends inward and upward and then tucking them down into the rim. Thus the wall was built up as its materials were pushed and pulled in contrary directions by feet and bill. Its height appeared to be regulated by the base of the builder's tail. At this stage of the nest's construction, there was very little material in its bottom, most of it having been pushed outward by the elaenia's feet. Twice she carried away pieces that, after being placed in the nest, were found to be too long and too thick to be molded into the desired shape. She drove away a Golden-masked Tanager and a Variable Seedeater which came close to the nest. Whenever her mate approached, there was a flurry of wings and a quick retreat. The two did not cooperate in the manner of the Yellow-bellied Elaenias. In the evening the male rose from the dooryard, singing.

On April 7, the female made 14 visits to her nest between 12:00 and 12:30 p.m. Neater than many birds, she twice flew up beneath the nest to pull away long strands that dangled untidily beneath it. On April 8, from 11:45 a.m. to 12:15 p.m., she made 6 visits to the nest, bringing mostly fine rootlets and similar materials for the lining. Early on the following morning, April 9, the nest appeared to be finished after about 4 days of work. Between 11:30 a.m. and 12:30 p.m. of that day the elaenia came twice to sit in the nest, devoting part of the time to shaping it with feet and breast or to tucking down materials into the rim with her bill, but I failed to see her bring anything more for it. She spent much time watching her completed nest from a neighboring bough, and any bird large or small that ventured near was attacked furiously with angry notes. Two more days elapsed before the first egg was laid on April 11.

The completed nest of the Bellicose Elaenia is a shallow, open cup. In form it is much like that of the Yellow-bellied Elaenia, but it is easily distinguished from the compact, well-made structures of the latter by its usually looser, flimsier construction, the absence of lichens from the outer wall, and the scantier lining of feathers, if indeed

these are present. It is composed of fine bits of grass and weed stems, tendrils, fragments of decaying leaves, bast fibers, slender rachises of acacia-like leaves, and the like. A single nest usually contains several of these ingredients but by no means all of them. The outside may be completely covered with green moss; it may have a few tufts of moss or perhaps a small green epiphytic fern attached to it; or it may be devoid of anything green. One exceptional nest was covered on the outside with tufts of white cotton and dark brown, branching liverworts. The interior may be lined with fine vegetable fibers, a few downy feathers, or the pappus of composites. Cobweb is freely used to bind the materials together and to hold the nest in place. Sometimes the walls are so thin that the sky may be seen through the gaps, but other nests are of fairly solid and compact construction. The internal dimensions of one nest were 2 inches in diameter by $1\frac{3}{8}$ inches in depth.

This species appears to be remarkably constant in its mode of building the nest. Belcher and Smooker (1937:244) say of the race (*E. chiriquensis albivertex*) inhabiting the island of Trinidad: "The nest is given concealment by being placed among leaves, usually within hand-reach, in a small upright fork of a *Byrsonima*; superficially it resembles that of *E. flavogaster*, but is more loosely and roughly built, is generally deeper, has no lichenous adornment, and while a stray feather or two may be used, it never has the pad of lining-feathers one finds in the nest of its congener." In Trinidad, where it nests only in orchard-bush savanna, the Bellicose Elaenia breeds in the same months as it does in Costa Rica, namely April, May, and June.

THE EGGS

In El General, the earliest eggs were found on April 20, 1936, April 3, 1937, April 14, 1939, April 17, 1940, April 11, 1947, and April 12, 1956.¹ In four instances, the first egg was laid 6, 6, 9, and 11 days, respectively, after the inception of nest building. In Costa Rica, as in Trinidad, the set usually consists of 2 eggs. In eight instances an interval of two days separated the laying of the first and second eggs, but at one nest this interval was only one day. In seven nests, six of which I kept under observation during the period of laying, I never found more than a single egg. I am always hesitant to admit that a single egg constitutes the full set of a species of bird that normally lays two. An egg is very easily knocked out of a nest as shallow as this. At one elaenia's nest, for example, I made daily visits during the period of laying and never found more than one egg in it, but later I found the broken remains of the second egg on the ground below. However, the number of nests of this species found with only a single egg makes it appear highly probable that at times one egg forms the complete set. The eggs are laid well after sunrise, but they are apparently rarely laid as late in the morning as are those of the Yellow-bellied Elaenia. At one nest the first egg was laid between 7:00 and 9:00 a.m., at another nest between 8:00 and 11:00 a.m., and at a third nest between 7:50 and 10:50 a.m. At a fourth nest, the first egg was laid before 9:50, and the second was laid before 8:10. I have additional records of second eggs laid between 7:20 and 9:00 and between 6:40 and 7:50 a.m.

The eggs of the Bellicose Elaenia are short-ovate and blunt, dull white, with a wreath about the thicker end of usually fine but sometimes heavy spots of brown, varying in shade on different eggs from pale brown to rufous brown. There is sometimes a sparse scattering of these spots over the remaining surface. Some eggs bear also flecks of pale lilac, and those in one exceptional set had a few faint blue dots and

¹ In 1958, when there were some good showers in early February, the Bellicose Elaenias bred exceptionally early. On the evening of February 14, one rose singing above the hillside behind our house; and here I found a nest with a newly laid egg on March 16.

scratches. The measurements of 15 eggs averaged 18.6 by 14.5 millimeters. Those showing the 4 extremes measured 19.8 by 14.3, 19.4 by 15.5 and 16.7 by 13.9 millimeters. Eight eggs in Trinidad averaged 19.2 by 15 millimeters (Belcher and Smooker, 1937: 244).

In 56 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: April, 31; May, 15; June, 10.

INCUBATION

The female alone incubates the eggs. Two female elaenias slept in their respective nests by night in the interval between the laying of the first and second eggs, but another did not begin to pass the night in the nest until after her set of two eggs was complete. On April 16, 1937, I devoted seven hours to watching, from a blind, a nest in which incubation had already been in progress for about 12 days. I timed 41 sessions on the single egg, which ranged from 2 to 21+ minutes, with an average of 5.6 minutes. But the long session of more than 21 minutes was taken just after the termination of a heavy downpour which fell in the middle of the afternoon, accompanied by boisterous gusts of wind that overturned my blind. As soon as the rain stopped, I set up the blind again, and by the time I had enclosed myself within it the elaenia had returned to her eggs. She continued to incubate for 21 minutes longer, while all the surrounding foliage was dripping. Undoubtedly, had I watched through the storm, I should have found that she sat uninterruptedly for a period much longer than any that I actually recorded. But aside from her sessions during and immediately after the rainstorm, her longest period of sitting was only 9 minutes; I recorded 5 sessions of this length. As soon as the declining sun began to break through the dissolving clouds and dry off the foliage, the elaenia returned to her former restless mode of incubation, and her sessions during two hours late in the afternoon were hardly longer than they had been in the early morning.

In the same seven hours, I timed 38 recesses from the nest, which ranged from 2 to 8 minutes and averaged 5 minutes. This elaenia devoted only 52.8 per cent of the seven hours to incubation, and had it not been for the storm she would doubtless have gone through the day spending no more time on the nest than she did away from it. Indeed, in the middle of the morning while the sun shone brightly, she was off the nest far more than she was on. From 7:59 to 9:43 a.m. she took 11 sessions ranging from 2 to 8 minutes and totalling only 43 minutes, but in the same period her 11 recesses, ranging from 4 to 8 minutes in length, added up to 61 minutes. The duty of incubation seemed to strain her small stock of patience to its limit, and through most of the day she seemed hardly to have comfortably settled on her egg before she jumped off again.

The small, cup-like nest was barely large enough to hold the elaenia's short body, so that while she sat her long tail projected far beyond the rim, and her head, back, and wings were exposed. So restless was she that even during her brief spells on the egg, lasting only a few minutes, she could not sit in motionless repose as many birds do, but was constantly moving her head about, hardly holding it in the same position for two consecutive seconds. In the early morning, she frequently uttered her slight, short whistle while she incubated. After seven o'clock she was more silent and passed many of her turns on the nest without making a sound, although during a few she whistled much. From time to time, while sitting on her egg, she continued for several minutes a low soliloquy of short notes rapidly repeated, forming a quaint little nest song that suggested perfect contentment. That she was as touchy as all of her kind there could be no doubt, for she suffered no other bird to come near, and even her mate was driven off if he dared approach too close to the nest.

On one of her recesses after the storm, this elaenia bathed in the raindrops which

still burdened one of the big leaves of a neighboring shrub of *Bocconia frutescens*. This was accomplished by sliding over the leaf with her breast pressed down to gather up the glittering drops in her plumage, then vigorously shaking her wings. This bush also supplied her with much food. On leaving her nest, she often visited it to pluck the black seeds from the little pods, each of which contained a single seed. She could avail herself only of those which had been exposed by the dehiscence of the pods, and she gathered these sometimes by making a short dart, sometimes while clinging to the inflorescence.

My most extended study of incubation was made at the nest conveniently situated in the rose-apple tree in front of the window. The first egg was laid in this nest on April 11, 1947, and the following night the female slept on it. The second egg was laid before 10:35 a.m. on April 13. From the window I watched this nest from 5:40 to 11:35 a.m. on April 21, from 11:50 a.m. to 4:55 p.m. on April 22, and from 4:58 to 6:00 p.m. on April 23, thus covering all parts of the period of daylight activity. In these 12 hours of watching I witnessed no change-over on the nest nor anything to suggest that more than one bird incubated. I timed 42 sessions which ranged from 2 to 60 minutes in length and averaged 13.3 minutes. An equal number of recesses varied from less than 1 to 7 minutes and averaged 3.3 minutes. But the two longest sessions, of 60 and 32 minutes duration, were taken while rain fell, as, at this season, it did almost every afternoon. The three longest sessions in rainless weather lasted 27, 24, and 23 minutes. Taking the three watches together, this elaenia incubated 80.1 per cent of the day.

Considering the clear morning separately, in six hours this elaenia took 26 sessions varying from 2 to 23 minutes in length and averaging 10.1 minutes. Her 26 recesses ranged from about 1 to 7 minutes and averaged 3.5 minutes. Accordingly she was at her post for 74 per cent of the elapsed time, which is an exceptionally good record for a small flycatcher and far better than that of the first Bellicose Elaenia which I had watched a decade earlier.

This female, too, sometimes sang a modest nest song in a low, pleasant voice, which was not as loud as that of the first elaenia. The rose-apple tree which sheltered her nest was parasitized by mistletoes, whose small green berries served her as food on her brief recesses. These berries were also attractive to other small birds, especially Variable Seed-eaters, which came close to the nest to gather them, causing the elaenia to jump from her eggs with a flurry of wings and little angry notes. Only in the rainy part of the afternoon, and afterward when the sky was darkly clouded, did she tolerate these harmless finches close at hand. The Song Tanagers which were numerous about the house, and the Southern House Wrens whose box was in a neighboring guava tree, also evoked self-assertive sallies from the nest. At times these birds refused to budge when the elaenia came upon them like a feathered fury; and then it was apparent that her ferocity was largely bluff, for she could do nothing to make them move. Although I often saw the male elaenia in the spreading rose-apple tree, he did not once come to look into the nest while I watched it. His approach to it was resented by his mate.

At this nest, in which the second egg was laid before 10:35 a.m. on April 13, the second nestling hatched between noon and 5:40 p.m. on April 26, giving an incubation period of somewhat over 13 days. Its shortness is to be attributed to the unusual constancy of sitting of this elaenia. At a nest which contained a single egg, laid between 8:00 and 11:00 a.m. on May 20, this marked egg hatched between noon and 6:00 p.m. on June 3, giving an incubation period of somewhat more than 14 days. In all, I found the incubation period to be about 13 days at one nest, about 14 days at four nests, and approximately 15 days at three nests.

I have never seen this or any other flycatcher "feign injury" in a convincing manner, but one elaenia left her egg in a fashion which might serve to lure an intruder away.

When I visited her nest, situated 12 feet up in a guava tree, she dropped almost straight down and fluttered along slowly only a few inches above the ground for at least ten yards, in an excellent distraction display.

THE NESTLINGS

The nestlings when newly hatched have pink skin with a sparse, light gray down, tightly closed eyes, and orange-yellow mouths. They are fed by both parents but brooded only by their mother. At the nest in the rose-apple tree in front of the window, where the first egg hatched on April 25, I began to watch at daybreak the following morning. To my great surprise, the female elaenia sang a dawn song as she sat on her nest in the dim early light. This song was somewhat lower in tone and simpler in form than that of the male, yet it was so similar to his dawn song that in the poor light I thought that the male was singing in the rose-apple tree, and I convinced myself that it was the bird in the nest which performed only by observing her moving bill through the fieldglasses from the window. *De-weet, de-weet* she repeated over and over countless times in her queer, dry voice. Although the male had never in my presence gone to inspect the nest while it contained eggs, somehow he had already learned that a nestling had hatched, and while the light was still very dim he came bringing a fairly big insect with gauzy wings that projected conspicuously from both sides of his bill. He gave this to the nestling when his mate rose up to expose it. The female took three short recesses; at the end of each she returned and continued singing while she brooded. She kept up her song for almost half an hour and did not cease until near sunrise. For the last few days, I had failed to hear the male sing his dawn song, and this morning the song from the nest was the only Bellicose Elaenia's dawn song in the garden. Hence for a while I suspected that the male might be sitting in the nest. But the silent member of the pair would come, deliver an insect to the mate or directly to the nestling if it happened to be uncovered, then go off without brooding. Hence it was necessary to suppose either that the male was doing all the brooding and singing in the nest, or that the female brooded and sang. The second assumption was more in accord with all my observations at this and other nests of the elaenia. But the case is unique in my experience. I have heard many flycatchers sing nest songs while sitting, but no other ever gave an imitation of the male's dawn song while she incubated or brooded.

In the afternoon of that same day, the second egg hatched in the rose-apple tree, and next morning, April 27, I again watched this nest as the day dawned. Although once the female sang her version of the dawn song for three minutes while sitting in the nest, she did so far less than on the preceding morning, when she had a single nestling. Now she sang chiefly when the male was nearby, and he answered with his low, thick note from the neighboring guava tree. He was far more negligent than on the previous morning, bringing food only once before sunrise, and delivering it while he and the female stood on opposite sides of the nest's rim.

I next watched this nest from 5:15 to 5:48, and again from 6:53 to 9:55 on April 29. One of the nestlings had already vanished; and since I do not know whether the survivor was the older or younger of the two, I am uncertain whether it was three or four days old. In the three hours and two minutes of the second part of my vigil, it was fed 19 times by its mother and 8 times by its father, making a total of 27 feedings or 9 per hour. The parents usually brought not a single insect or berry but a whole billful of them. The female brooded 16 times, for periods which ranged from 1 to 21 minutes and averaged 8.3 minutes. Although from time to time she darted from the nest to catch an insect flying close by, then returned at once to give the victim to the nestling and resume brooding, I counted such briefly interrupted sessions as a single one. Her 16 ab-

sences varied from 2 to 5 minutes in length and averaged 3.1 minutes. She kept the nestling covered for 73.1 per cent of the three hours, or with about the constancy with which she had incubated in the morning. Both before and after sunrise she uttered the *de-weet* notes of the dawn song, chiefly when her mate came near the nest, whether bringing food or otherwise. The significance of these utterances is not clear, although it seemed at times that she was trying to encourage him to feed the nestling. Usually she jumped from the nest as he approached with food, but once she stayed, took the insects from him and passed them to the nestling. But when again she tried to do this, he would not relinquish them, whereupon she stepped back upon the nest's rim and gave a little trill while he placed the food directly into the young bird's mouth. He often uttered a low, dull *weer*.

As I saw at this and other nests, the female elaenia, if brooding when her mate brings food, usually flies from the nest as he approaches. One female would bolt from the nest as soon as she saw the male coming. Sometimes, approaching from behind, he took her by surprise and alighted beside her before he was noticed, whereupon she jumped from the nest as though stung by a wasp. Once she seemed angry with her mate and flew at him when he came with food for the nestling. Another female, however, sometimes remained brooding when her mate came, took the morsel from him, and rose up to give it to the nestling beneath her. One female brought a large black berry which her naked nestling strove in vain to swallow. I doubted whether she herself could gulp it down; for when convinced that it was useless to continue to proffer the berry to the nestling, she carried it away instead of eating it on the spot. Nestlings are fed with fair frequency. In addition to the record of feeding given above, I have a few others. A lone three-day-old nestling was fed 10 times in one and a half hours—7 times by its mother and 3 times by its father. Another solitary nestling, 5 days old, was fed only 6 times in two hours, all by the female. But two days later this nestling was fed 10 times in the course of 67 minutes—7 times by the female and 3 times by the male.

As in the Yellow-bellied Elaenia, the nestling Bellicose Elaenia has down of two kinds. Loose tufts of fine, rather long, light gray natal down are borne in linear tracts along the center of the crown, above each eye, across the hindhead, along the middle of the back, and on the shoulders, the flanks, and the sides of the abdomen. Between these pterygiae, secondary or interpterylar down is developed in a number of regions, especially on the back and rump, the sides, the flanks, and the thighs. This secondary down does not expand until some days after the nestling hatches. On the back and rump it is gray and finally becomes fairly full and long; on the sides, flanks, and thighs it is whitish and more sparse. On the crown, this secondary down is represented by minute rudiments which hardly expand. In the Bellicose Elaenia the secondary down is not as abundant and dense as it is on the Yellow-bellied Elaenia, and before their juvenal plumage expands the nestlings of these two species differ greatly in appearance. The week-old Bellicose Elaenia more closely resembles a typical passerine nestling. The tufts of down in the feather tracts are pushed out on the ends of the sprouting contour feathers, which cover and conceal the secondary down.

The nestlings develop rather slowly and are 11 or 12 days old before they are completely clothed with feathers. Although perhaps not an affectionate mate, the elaenia is a devoted mother. Even after the nestlings are fully feathered and nearly as big as herself, she stands above them to shade them from the hot sunshine and she shelters them from the rain by brooding. In two instances I have known her to cover her nestling during the last night before it flew from the nest, while two other elaenias brooded through the next-to-last but not the last night that the young were in the nest.

It is difficult to learn the age of spontaneous departure of the young elaenia, for it

stays in the nest until it is well developed and very alert, then it may take flight while its human visitor is several yards distant. One 14-day-old nestling flew from its high nest when I raised up a mirror to look in. Two 15-day-old nestlings abandoned their low nest as I approached but while I was still some yards away. When I visited another low nest containing 15-day-olds, I found one of them resting on the rim, the other in the bottom. As I came nearer, the one on the rim flew off, travelling with ease. Revisiting this nest next morning, I was surprised to find that this young *elaenia* had returned to the nest, which again sheltered two. Again when it saw me coming, one of the two flew off, tracing a horizontal, curving course and displaying good command of its wings. That afternoon the nest was empty, the second fledgling having left at the age of 16 days. The return of the other to the nest from which it had flown was probably exceptional behavior. Another nestling that had been reared alone left, probably spontaneously, at the age of 15 days, and this was the age of departure from an additional nest in which two were reared. The full nestling period is, then, 15 or 16 days.

THE SECOND BROOD

The Bellicose *Elaenia* may produce two broods in a season. One female, whose single nestling departed on May 3, began a new nest on May 9, at a point 30 feet from her first nest. She laid the first egg of the second brood on May 15, 12 days after the departure of her first brood. Another female, whose nestling left about May 15, had a second nest with two eggs in a neighboring bush by May 28. In one instance, a nest in which two young were reared was renovated and re-lined with fresh feathers for a second set, which apparently consisted of a single egg, laid about four weeks after the departure of the first brood. In the valley of El General, the breeding season is practically over by the end of June. My latest records of nests are of one found with two eggs on June 21, and one with two well-feathered nestlings on July 1, both in 1936. Near sea level in the Canal Zone the species breeds well into July (Eisenmann, 1952:44).

SUMMARY

The Bellicose *Elaenia* inhabits savannas, bushy pastures, bracken fields, plantations, and in general open country with scattered trees and bushes. In southern Costa Rica, at the northern limit of its extensive range, it breeds from the lowlands up to at least 3500 feet above sea level.

Its diet includes small insects caught on the wing and a variety of berries and seeds. Unlike other flycatchers, it visits feeding shelves for bananas.

The male has a quaint, long-continued twilight song which at dawn he delivers from a perch. In the evening twilight, he rises steeply upward on an erratic course singing a similar song. In El General, these song flights occur from the end of February or early March until June.

The Bellicose *Elaenia* defends a small territory surrounding its nest; and where the population is somewhat dense, numerous and fierce encounters occur, usually without injury to the contestants. More territorial fighting was seen in this species than in any other Central American bird. These *elaenias* are also extraordinarily intolerant of the presence of other small, harmless birds near their nests, and the female seems often to resent the approach of her mate.

In El General, nest building begins in late March but does not become widespread until April. The nest, a small open cup with at times a few feathers in the lining, is placed in a bush or tree in a somewhat open situation, from 15 inches to 35 feet up, but most often it is found between 5 and 10 feet above the ground. It is built by the female alone. When working most actively, one female came with material 27 times in an hour. She shaped her nest with bill, feet, and breast and completed it in about four days.

The set consists of two or sometimes only a single egg. In the two-egg sets the second is usually laid two days after the first but rarely a single day intervenes. Eggs are deposited well after sunrise but usually long before noon. The female may or may not pass the night on the single egg before she lays the second.

Only the female incubates. She is usually a restless sitter and except while rain is falling rarely remains on the eggs for as long as 20 minutes. In seven hours, one female took 41 sessions which ranged from 2 to 21+ minutes and averaged 5.6 minutes. Her 38 recesses ranged from 2 to 8 and averaged 5 minutes. She devoted only 52.8 per cent of the seven hours to incubation. Another elaenia, watched for 12 hours including all parts of the day, took 42 sessions which ranged from 2 to 60 and averaged 13.3 minutes. Her 42 recesses varied from less than 1 to 7 minutes and averaged 3.3 minutes. She devoted 80.1 per cent of the day to incubation, which for a small flycatcher is unusual constancy. Both of these records included periods when rain fell.

While incubating, the female sometimes sings a low, pleasant nest song. On the morning after her first egg hatched, one female sang for many minutes a subdued version of the male's dawn song. She delivered this song more briefly on subsequent mornings.

The female which sat with unusual constancy hatched her eggs in somewhat over 13 days, but more often the incubation period is 14 or 15 days.

Newly hatched nestlings bear a sparse, light gray down and have the interior of the mouth orange-yellow. The female alone broods them, continuing for some days to sit no less assiduously than while she incubates. Both parents bring food, consisting of small insects and many small berries. Although sometimes the female takes food from her mate and delivers it to the nestlings, or stands on the nest's rim while he feeds them, more often she darts away at his approach.

The nestlings are feathered when 11 or 12 days old and leave the nest at the age of 15 or 16 days. One 15-day-old nestling, which had left before its nest mate, returned to stay in the nest with it, but this appears to be unusual.

Two broods are sometimes reared in a nesting season which in El General extends from late March or April through June. The old nest in which a family has been raised may be renovated for the second brood, but apparently more often a new nest is built near the site of the first.

YELLOW FLYCATCHER

Capsiempis flaveola

The Yellow Flycatcher is a small bird slightly over four inches in length, clad in olive-green and yellow. Its upper plumage is plain olive-green. The tail feathers are grayish brown with yellowish olive-green margins. Each dusky wing is marked with two very pale yellow bars on the coverts and light edges on the remiges. There is a yellowish white superciliary stripe set off by a narrow dusky band extending from the lores to behind the eye. The entire under parts, including the under wing-coverts, are bright canary yellow, somewhat clouded with olive on the sides. The eyes are brown, the short bill is black except at the base of the lower mandible, and the legs are slate-color. The sexes are alike in appearance.

The Yellow Flycatcher is found from Nicaragua through Costa Rica and Panamá to Bolivia, Paraguay, southern Brazil, and the Guianas. A lowland species, it ranges upward to somewhat above 3000 feet on the Pacific slope of southern Costa Rica. Here it is fairly abundant in parts of the basin of El General and exceedingly numerous about Buenos Aires lower in the Térraba Valley. As far as I know, it avoids closed woodland of every sort and inhabits low thickets and scrubby pastures where the shrubs and coarse herbs are higher than a man's head. In such tangled vegetation, one frequently hears low, soft, gentle, sweet-toned notes rapidly and rhythmically repeated in several keys. This pleasant chirruping, which is most difficult to describe, seems to be the utterance of some small bird with an amiable disposition, but the bird is not easy to glimpse amid the low, dense growth. Yet if one is patient and fortunate, he may finally catch a view of a small flycatcher with bright yellow under plumage. The glimpse is all too often fleeting, for the sprightly bird seldom delays long in one spot, but reveals itself momentarily as it darts into the air to capture a small insect, then vanishes promptly into the close-set foliage. Far more of its food appears to be plucked from the leaves, against which it flies, than caught in the open air in the manner of the larger members of its family. Of all the flycatchers I have watched, it is the most restless and difficult to observe as well as the most loquacious. Indeed, few wood warblers are in such constant and rapid agitation. It has been likened to a vireo, but vireos are far more deliberate in their movements.

Yellow Flycatchers are found in pairs throughout the year. Their rapid, pleasant chatter serves to keep the mates together as they circulate tirelessly through the low vegetation where visibility is restricted. One bright morning, I watched a pair emerge from a second-growth thicket into an adjoining pasture, where low trees, bushes, and tall weeds stood separated by considerable expanses of greensward. Here they flew restlessly from bush to bush, keeping together most of the time, but one following the other after an interval instead of accompanying its mate closely as do some tanagers. The two birds flew low above the open turf, but they generally remained between one and five yards up while they were in the bushes and trees where they remained a short time. Soon they reentered the thicket, where I could not follow them.

NESTING

I have seen six nests of the Yellow Flycatcher between 2400 and 3000 feet above sea level in the valley of El General. The breeding season of this species is peculiar and unlike that of any other flycatcher of the region. The great majority of the members of this family reproduce from March or April until June. Even the Paltry Tyranniscus, which has an exceptionally long breeding season, appears to nest only from February through September, but the Yellow Flycatcher breeds virtually throughout the year.

One nest contained a nestling bearing its first feathers on December 24. Another nest held nestlings on February 12. One contained eggs in May and another in June, in which month I also found a pair building. The sixth nest held well-feathered young on September 4.



Fig. 50. Yellow Flycatcher.

These six nests were situated from 9 to 20 feet above the ground. The lowest, discovered while we harvested a maize field in September, was placed in the axil of the uppermost leaf of the dry maize plant, attached in part to the branches of the tassel. It was at the edge of the milpa, near a field covered with low, bushy growth. The other nests were in shrubs or low trees growing in or at the edge of thickets or bushy pastures. All the nests were substantial open cups, composed of light-colored vegetable fibers, grass blades, shreds of plant epidermis and the like, with more or less green moss or selaginella attached to the outer wall. One nest measured $1\frac{1}{2}$ inches in internal diameter by $1\frac{1}{4}$ inches in depth. Of those whose contents I could determine accurately, two contained 2 eggs each, one contained 2 nestlings, and the fourth a single nestling. The eggs of one set were pure white and measured 17.1 by 13.1 and 17.5 by 13.1 millimeters.

Carriker (1910:710) describes a nest found at Guápiles in the Caribbean lowlands of Costa Rica on May 8, 1905, as follows: "It was a cup-shaped structure, made entirely of moss, lined with fine black and brown vegetable fibers and placed in a crevice in the side of a large tree, between two projecting spur-roots about four feet above the ground. The [two] eggs are deep cream-color, with a few markings of lilac and small blotches of bright cinnamon-rufous scattered over the whole surface, but thicker about the large end, forming a wreath." They measured 17 by 13 and 17 by 13.5 mm. While these eggs agreed closely in size with those that I had measured from the opposite side of Costa Rica, they differed in being spotted rather than immaculate white. The nest contained far more moss than did the nests that I found in El General, and it was in a different kind of site.

From 5:30 to 11:08 a.m. on June 20, 1936, and from 2:04 to 4:26 p.m. on the following day, I watched a Yellow Flycatchers' nest in which the second egg had been laid on June 11. Since I failed to witness a change-over on the eggs, I concluded that only the female incubated, as is true of other flycatchers. She first left the nest at 6:05 a.m. In slightly over seven hours of her active period, I timed 9 sessions ranging from 12 to 40 minutes and averaging 27.8 minutes and 8 recesses varying from 13 to 42 minutes and averaging 21.5 minutes. Both the longest sessions and the longest recesses were taken in the afternoon. This flycatcher covered her eggs 56.4 per cent of the time. Her mate was very attentive to her. Sometimes while she sat he called in the neighboring thicket and she answered him from the nest. Often the rapid notes which told of his approach were the signal for her departure from the eggs. Then she would join him and the two would chatter in soft, gentle tones as they went off to forage. Usually he would accompany her as she returned to her eggs, but like many male birds he came less often to the vicinity of the nest as the day wore on.

These eggs had not hatched by June 26, 15 days after the set was complete, and by the following day the nest had been destroyed by some predator. But, at a later nest, I saw that the male helps his mate to feed the young. I have always found Yellow Flycatchers very shy at their nest, and one must conceal himself well in order to see them approach it.

SUMMARY

The Yellow Flycatcher ranges from sea level up to somewhat above 3000 feet in Costa Rica. It inhabits low, tangled second growth and bushy pastures, where it catches insects amid the foliage, rarely darting conspicuously into the air. Male and female remain together throughout the year. As they move restlessly through the bushes, where they are difficult to see, they keep in touch by means of a constant, rapid chatter of low, pleasant notes.

Six nests found in El General indicate that unlike all other flycatchers of the region this species breeds practically throughout the year. The open, cup-shaped nest, with some green moss on the outside, is placed from 9 to 20 feet up in a low tree, a shrub, or a maize plant.

The set consists of 2 white eggs, which are incubated by the female alone. One female took sessions which ranged from 12 to 40 minutes and averaged 27.8 minutes, and her recesses varied from 13 to 42 and averaged 21.5 minutes. She covered her eggs 56.4 per cent of seven hours.

The male escorts his incubating partner to the nest and later helps her to feed the young.

TROPICAL PEWEE

Contopus cinereus

The Tropical Pewee is a small, olive and gray bird, five inches in length, without distinctive markings, and like many members of its genus it is rather difficult to recognize. The upper plumage is grayish olive, becoming darker on the top of the head. There are two not very conspicuous whitish bars on the coverts of each wing, and the secondaries have light edges. The throat, center of the breast, most of the abdomen and the under tail-coverts vary from dull whitish to palest yellow, which contrasts with the pale gray of the sides of the breast and the flanks. The upper mandible is blackish and the lower mandible is mostly yellow. The eyes are dark and the feet are nearly black. Male and female cannot be distinguished by their plumage.

The species has an enormous range extending from southeastern México to Trinidad, the Guianas, Perú, Paraguay, and Argentina. The short-legged race (*brachytarsus*) is found from southern México through the length of Central America on both coasts to Panamá. A lowland bird, it ranges upward to about 3000 feet above sea level in Guatemala and 4000 feet in Costa Rica, but in the upper Térraba Valley it apparently does not occur above 2000 feet. Despite the vast extent of its range, the pewee is by no means uniformly distributed in Central America. It is common in some regions such as the Pacific coast of Guatemala and the Canal Zone, but it is inexplicably rare in other areas, including most of Costa Rica.

In Central America, the Tropical Pewee inhabits open country with scattered trees, including coffee plantations with their light shade, pastures grown up with tall bushes, and shady dooryards. It avoids the primary rain forest and tall, closed second-growth woodland. From some exposed perch, often at no great height, it darts out rapidly to catch the flying insects which are its principal fare.

VOICE

In April and May, 1941, while residing on the hospitable "Río Humo" Plantation in the Pejivalle Valley on the Caribbean slope of Costa Rica, I awoke every morning in the dim light to hear the flycatchers singing. From the shade trees about the house on a ridge, and from the taller trees along the banks of the rivers on both sides, there arose a many-throated dawn chorus in which flycatchers of seven kinds participated. The smallest and least conspicuous of these dawn-choristers was the Tropical Pewee. The earliest to sing was the Tropical Kingbird, which raised its high-pitched twitter with the first brightening in the east. Then followed the cool, gentle *tre-le-re-re* of the Sulphur-bellied Flycatcher; the harsh, insistent *we-do* of the Yellow-bellied Elaenia; the loud, ringing *chee-er* of the big Boat-billed Flycatcher; the thick, throaty notes of the Gray-capped Flycatcher; and the clear *cheee* of the Chipsacheery Flycatcher, followed by a garbled version of the name which its relatives across the Cordillera pronounce more distinctly. With this medley of flycatcher voices filling the air along with the more musical strains of Gray's Thrushes, Black Variable Seedeaters, and other songbirds, I had to listen sharply to detect the weak, monotonous chant of the little pewee.

Each day at dawn a pewee perched in the *madera negra* tree just outside my bedroom window and, beginning in the early gray light, repeated his simple notes tirelessly for 15 or 20 minutes with scarcely an interruption. *Weet weet weet* he sang in a high, sharp voice. The monotony of this reiteration of a single note was relieved from time to time by a low and musical disyllable, for which *we-ye* was the best paraphrase I could invent,



Fig. 51. Tropical Pewee.

although it is scarcely an exact rendition. This more complex utterance was at times prolonged into a low, short warble. As the light grew stronger, the proportion of the more musical notes to the sharp *weet* gradually increased. At last the song was quenched by the growing flood of daylight, and I rarely heard it again until the following dawn.

Other notes of the Tropical Pewee, often heard at the nest, are a sharp *peet* and a little trilled *cheee*.

NEST BUILDING

Close by the Pejivalle River, 2000 feet above sea level, I found a nest nearing completion on April 19, 1941, and another, half finished, on the following day. The five nests I have seen were situated in fairly exposed situations, on a small horizontal branch supported laterally by ascending branchlets, or in a more or less upright fork, in a bush or tree growing in a pasture or plantation. The nests were at heights ranging from 7 to about 35 feet above the ground. In Trinidad this species often builds higher, from 10 to 60 feet up, according to Belcher and Smooker (1937:236). When a horizontal limb is used for support, the Tropical Pewee's little, open cup is saddled over the limb much in the style of a Wood Pewee's nest. The sites of all the nests that I have seen could be matched by those chosen by the Yellow-bellied Elaenia for its bigger but somewhat similar nest.

One afternoon I saw both male and female of a pair sitting side by side in a bare, unshaded crotch of a spiny *Xanthoxylum* tree. The following morning a new nest was begun in this crotch. This pair two days earlier had lost newly laid eggs. From this, it appears that the members of a pair choose the nest site together but, so far as I could learn by watching two nests, the work of construction is performed by the female alone. The first of the nests by the Pejivalle River, 13 feet up in a *madera negra* tree in a little grove in a pasture, was nearly finished when I discovered it on April 19. Watching for an hour the following morning, I saw only one individual, doubtless the female, at work on it. She was lining her little cup and always brought very small pieces of material. While engaged in building, she frequently voiced a sharp *peet* and more rarely a little trilled *cheee*. She was fearless and perched within six feet of me. I did not see her mate in the vicinity of the nest.

The following day, on the same plantation, I watched another Tropical Pewee at work on a half-finished nest, seven feet above the ground in a tuete (*Vernonia patens*) on a grassy slope below a roadway. The male was perching in the bush near his building mate when I found this nest, but later, when I settled down for a period of concentrated observation, he did not come near. In two hours (7:40 to 9:40 a.m.) the bird I thought was the female came 37 times with very small pieces of vegetation in her bill. Some of this material she pulled from an old nest of the same kind, already well weathered, situated in a crotch on the opposite side of the same bush. She brought bits of gray lichen, shreds of fibrous material, and much cobweb, in no definite order. After laying the new contribution in the nest, she sat in the structure to mold it with her whole body and her feet. While busily at work, she often voiced the slight, clear, trilled *cheee*, but I did not hear her utter the sharp *peet* that was repeated so often by her neighbor which I had watched build on the preceding day.

This nest when finished was a broad, shallow, compactly built cup, composed chiefly of finely branched gray lichens, with an admixture of slender bits of herbaceous stem, fine tendrils, fibrous stuff, seed down, green moss, and the like, all firmly bound together with much cobweb. The gray lichens gave the predominant tone to the exterior of the nest. It was lined with fine grass, especially pieces of the inflorescence of *Andropogon*. It measured 3 inches in diameter by $1\frac{1}{4}$ in height. The cavity was $1\frac{5}{8}$ inches in diameter by $\frac{7}{8}$ inch in depth.

THE EGGS

Each of the females which I watched build laid 2 eggs in the last week of April. In both instances, the eggs were deposited with an interval of two days, and from both nests they had vanished a day or two after the second egg was laid. Consequently I could not be sure that the sets were complete. Each of the birds promptly set to work to build a new nest about 100 feet from the pillaged structure. The first female laid the foundation of the replacement nest three days after she lost her eggs; the second female was found completing her nest nine days after the loss of her eggs. In both of the replacement nests, 3 eggs were laid. In the second of these nests, the first egg of the new set was deposited 11 days after the loss of the first set. The second egg of the new set was laid two days after the first, but the third egg was laid on the day after the second. Thus the interval between layings even in the same set may be one or two days.

The eggs of the Tropical Pewee are dull white, with a wreath of bright brown and pale lilac blotches about the thick end and a few small spots of the same colors scattered over the remaining surface. Two eggs measured 16.7 by 13.5 and 17.5 by 13.5 millimeters.

INCUBATION

Incubation was performed by the female alone. On the day intervening between the laying of the first and second egg, the female at one nest was twice seen sitting on the

single egg that had been laid. This was the replacement nest of the second female, situated nine feet above the ground in a small croton tree in a pasture. I watched this nest from 6:20 to 10:37 on the morning of May 20, five days after the set of 3 eggs was completed. The female took 12 sessions on the eggs, ranging from 2 to 45+ minutes in length and averaging 16 minutes. The longest session was taken early in the morning; the pewee was sitting when I arrived, an hour after birds had become active in the dawn, and she continued to sit without interruption for 45 minutes longer. After a recess of 8 minutes, she incubated for 34 minutes; but after that, when the air grew warmer, she sat for shorter periods. Her 12 recesses ranged from 2 to 9 minutes and averaged 5.4 minutes. She kept her eggs covered for 74.8 per cent of the time, which is unusually constant sitting for so small a flycatcher. I watched the other female, whose nest was 20 feet up in a thorny *Xanthoxylum* tree that forbade climbing, from 6:00 to 10:02 a.m. on May 21. In this period, the pewee took 12 sessions ranging from 3 to 29 minutes in length and averaging 12.3 minutes. This bird did not take longer sessions in the early morning than she did later in the day. Her 12 recesses ranged from 2 to 14 minutes and averaged 6.3 minutes. She kept the eggs covered for 66.1 per cent of the four hours.

I was surprised and delighted to see the males of both pairs feed their mates, both while they covered the eggs and while they were at recess; for although I had studied the nest life of more than a score of species of flycatchers, I had never known any male to give food to his mate except while she brooded nestlings. In the course of four and a quarter hours, I saw the male of the nest in the croton tree give food to the female 12 times, and it is not impossible that he fed her a few times more while they foraged together beyond my field of vision. The male of the nest in the *Xanthoxylum* tree fed his mate at least 10 times in four hours. The pewee with the nest in the croton tree was in every respect more attentive to his mate and their nest than was his neighbor in the *Xanthoxylum*. From time to time, while the female was off seeking food, he would go to stand on the rim and look attentively into the nest, as though to see whether the eggs were hatching. Sometimes he would remain there for a minute or two. At times he would bring a small insect and bend down his head into the nest, as though trying to deliver it to the unhatched eggs, "anticipating the nestlings," as I have called this curious behavior of many male birds. The female pewee sometimes arrived at the nest while her mate was in this attitude and took the food from him.

At other times, when the male pewee approached the nest with a larger and more conspicuous insect in his bill, the female, which had been absent, darted up to meet him there. Arriving simultaneously or nearly so, they would both perch on the rim while he gave the food to her. Then the male would fly off, while his mate swallowed his gift and settled down to warm her eggs. At times the male would bring her back to her task in this fashion sooner than she might otherwise have come. Usually she would then remain on the nest for a session of substantial length, but sometimes she would dart off and resume her recess after sitting for no more than a minute, or for only a few seconds. On other occasions, the female would go first to the nest, while her mate darted up just in time to place an insect in her mouth as she settled down. The morsel passed from bill to bill in the twinkling of an eye, and it was often difficult for me to be certain whether food had been given or not. Once the male merely darted over the nest as the female alighted on the rim preparatory to sitting. Had he given her food as he sped by? Chiefly, however, the male fed the female in less spectacular fashion while she sat quietly, sometimes bringing food twice or even three times during one of her longer sessions. Or he might pass her a morsel while she was off the nest.

At about the same time, I also watched a nest of the Black Phoebe, plastered beneath a projecting boulder beside the neighboring river. Here the mere presence of the male,

without food, was sufficient to encourage his mate to return to her eggs, especially when she hesitated because of a certain shyness in my presence. The male pewee, however, offered a more substantial inducement for his mate's return to her nest.

The female, like her mate, appeared to be impatient to begin feeding the nestlings. Once, returning from a recess, she brought an insect in her bill, lowered her head into the nest, and sang a pretty, low song that resembled the warbled part of the male's dawn song. Since the eggs could not swallow the food she offered them, at last she ate it herself and settled down to keep them warm. At times a small insect flying near tempted her to dart from her nest and catch it. Then she might return at once to her eggs, or, if she had already been sitting a good while, she might continue to catch insects among the neighboring trees. The nests were not well shaded, and when the sun shone down strongly on them, the incubating female stood up and panted, revealing the bright yellow interior of her mouth.

The males of both nests were more zealous than many larger flycatchers in driving intruders from the nest tree. With loudly snapping bill, they darted at all trespassing birds, including a pair of Gray's Thrushes, a Black-striped Sparrow, a Chipsacheery Flycatcher, a Yellow-bellied Elaenia, and even a Kiskadee, one of the biggest and most aggressive of the flycatchers, several times the pewee's size. Usually their sudden dart put the intruder to flight before it was hurt. Whenever I visited their nest, they swooped down at my head, or at the mirror that I raised up on the end of a stick to view their eggs, coming very close and clacking their bills as though attacking an intruding bird. Male and female joined in these demonstrations, at times protesting with their little trilled *cheee* in addition to trying to intimidate me with their bills.

At dawn I failed to hear a male pewee sing in the vicinity of either nest. One male proclaimed himself on the ridge about two hundred feet from the nest in the croton tree. Possibly this nest belonged to him. I did not succeed in locating the singing post of the second male.

In the nest in the croton tree, the third and last egg was laid on May 15. One egg hatched on May 29 and another on May 30. Unfortunately, I did not number the eggs as they were laid and so I am not certain whether one of those which hatched was the last laid. In view of this uncertainty, the incubation period must be stated as 15 or 16 days.

The newly hatched nestlings bore rather thick, whitish down. The interior of their mouths was bright yellow, like that of the adults. Because of my departure from the plantation soon after these pewees hatched, I did not follow their development. It can hardly be doubted that the male, which brought so much food to the nest before the eggs hatched, took his full share in nourishing the nestlings, although most probably he left all the brooding to the female.

On July 15, 1935, I found a Tropical Pewee completing a nest on the Finca "San Diego," near Colomba on the Pacific slope of Guatemala, at an altitude of about 3000 feet. Three days later the nest had been beaten down and ruined, apparently by the heavy rains of this season. This is a late date for a flycatcher's nest in Central America, but Hallinan (1924) found this species nesting in the Canal Zone on November 3, 1915.

SUMMARY

The Tropical Pewee inhabits open country with scattered trees. It rests on an exposed branch from which it darts out to catch flying insects.

In April and May, the male delivers a simple, monotonous dawn song, which is continued from 15 to 20 minutes with scarcely a break. Other notes are a sharp *peet* and a trilled *cheee*, often uttered at the nest.

Nests were found in April and May on the Caribbean slope of Costa Rica, and a late one was found under construction on the Pacific slope of Guatemala in mid-July. The open, lichen-covered nest is placed in a bush or tree from 7 to 35 feet up. Although the two sexes appear to select the nest site together, at two nests the female alone was engaged in building.

Two females which lost their first nests soon after, or possibly before, they had finished laying promptly built new nests, one beginning three days after her first set was lost. The other female laid the first egg of the new set 11 days after the loss of the first set. Each of these replacement sets contained 3 eggs. In one of them, the second egg was laid two days after the first, but the third was laid one day after the second.

The female alone incubated. In four hours and fifteen minutes one female took sessions which ranged from 2 to 45+ minutes and averaged 16 minutes. Her recesses varied from 2 to 9 minutes in length and averaged 5.4 minutes. She covered her eggs 74.8 per cent of the time. The other female incubated for 66.1 per cent of 4 hours.

In both pairs, the males fed their mates in the period of incubation, both on and off the nest. One male gave food to his mate at least 12 times in four hours and fifteen minutes and the other at least 10 times in four hours. One male took food to the nest in his mate's absences and seemed to offer it to the unhatched eggs. The female also at times presented food to the eggs while she uttered low, warbling notes.

The males were unusually zealous in driving birds of other species from the nest's vicinity, and both sexes darted with clacking bills at a human intruder.

At one nest the incubation period was 15 or 16 days.

TUFTED FLYCATCHER

Mitrephanes phaeocercus

In the high mountains of Central America, flycatchers are far less numerous in species and individuals than in lower and warmer regions where insects are more abundant. One of the most charming of the highland representatives of the family is the Tufted Flycatcher, which wears a permanently erect, peaked crest much like that of the Tufted Titmouse. I saw a good deal of these small flycatchers in both the Guatemalan and the Costa Rican highlands and found nests in both countries, although unfortunately all were out of reach. Since so little has been recorded of the habits of this genus, it seems well to give here the little I learned of them. The form inhabiting Costa Rica and western Panamá presents marked differences in coloration from Mexican and Guatemalan representatives of the genus, and Ridgway accorded it specific rank. In more recent taxonomic works, however, it is united with the northern species.

The Tufted Flycatcher is about five inches in length. The form which I knew in Guatemala has olive dorsal plumage and a grayish brown tail. Each dusky wing bears two narrow bars of light cinnamon buff, which appear almost white in the field. The cheeks, sides of the neck, throat, breast and part of the abdomen are plain russet or tawny-ochraceous, which fades on the lower abdomen and under tail-coverts to deep buff. The Costa Rican form, once known as *Mitrephanes aurantiiventris*, has brighter, more greenish upper plumage, and the light olive or buff wing bars are less conspicuous than in the northern form. The throat, the half-collar on the front and sides of the neck, and the breast are tawny cinnamon or dull orange, which fades into pale buffy yellow on the flanks, lower abdomen and under tail-coverts. Its eyes, bill, and legs are blackish.

In Guatemala, the Tufted Flycatcher is found from 5000 to 9500 feet above sea level. On the Sierra de Tecpán in the Department of Chimaltenango, it was the most abundant member of the family. A woodland bird, it lived in the heavy forests of oaks and other broad-leafed trees with an admixture of pines, as well as in lighter groves. More rarely I met it in isolated trees and along the hedgerows. It remained mated throughout the year, and in the winter months, when Townsend Warblers were present in great numbers in the highland forests, a pair of Tufted Flycatchers often attached themselves to the mixed parties of small birds which gathered about these warblers as a nucleus. By its pleasant voice and brisk, lively manners, this flycatcher endeared itself to me.

In Costa Rica, the Tufted Flycatcher occurs at a lower elevation than it does in Guatemala. It has been recorded at altitudes ranging from 1500 feet on the Caribbean slope up to about 10,000 feet in the Dota Mountains, but it is most abundant between 4000 and 8000 feet. Avoiding the intensively cultivated central plateau, it lives in the heavy mountain forests, where it is often seen about the edges of clearings or in openings made in the midst of the woodland by the fall of a great tree. It was common in the tall, epiphyte-laden forests around 5500 feet on the stormy northern slope of the Cordillera Central, where I found it in pairs throughout the year.

VOICE

The call of the Tufted Flycatcher in the western highlands of Guatemala is a pleasant, brisk *chee chee chee chee*. At the approach of the nesting season, the members of a mated pair utter low, soft notes as they rest close together in the treetops. When I first heard the Costa Rican Tufted Flycatchers, their call seemed to me to be sharper than that of the same species I had heard in Guatemala not long before, yet it had much the same character. I wrote it as *weet weet weet*. At daybreak in the breeding season, both

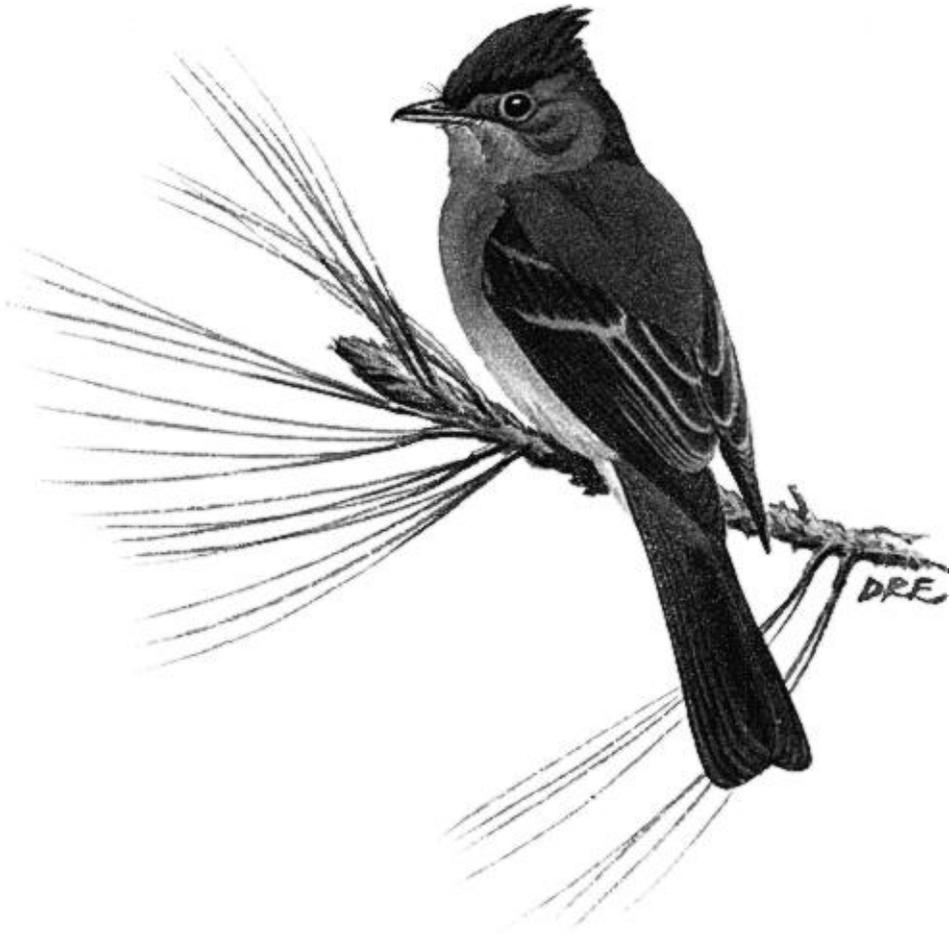


Fig. 52. Tufted Flycatcher.

forms of this species delivered one of the oddest and most whimsical songs that I had ever heard from any bird. In a high, thin voice, the Guatemalan Tufted Flycatcher sang insistently *de bee, de bee, de bic a de bee, de bic bee, de bee . . .*, continuing this for many minutes on end. This delightful ditty was delivered before sunrise, chiefly in May and June. In the hours of full daylight, I heard at most the opening notes of this refrain, but they were never continued to form a song.

One morning in May, while studying Quetzals in the Costa Rican highlands, I heard what seemed to be some small flycatcher singing his dawn song in the distance. On the following morning, I returned to this spot for the special purpose of tracing this distinctive utterance to its source. Just as the sky began to brighten, I heard this strange song issuing from the top of a tall tree at the forest's edge, but I could not catch a glimpse of the diminutive songster. The refrain was one of the quaintest and queerest, the voice one of the thinnest and highest, that I had ever heard from a bird. The whole song was delivered so rapidly that I strove fruitlessly to follow the sequence of the syllables. Yet I attempted to write a version that would convey at least a crude notion of the charac-

ter of the performance, and this is as near as I could come to it: *bip-bip-bip-didididup-bip-bip-bibibiseer*. This phrase should be read as fast as human lips can move and then allowance should be made for the more rapid utterance of the bird. The last syllable, *seer*, is abruptly ascending.

When this song had continued in unbroken flow for 18 minutes by my watch, the bird suddenly showed signs of tiring and then abruptly ceased. At the same moment, a Tufted Flycatcher alighted on a twig projecting from fallen brush beside the path in which I stood, not ten feet from me, and voiced the high, sharp *seer* which had occupied such a prominent place in the outpouring I had just heard. My identification of the unseen singer in the treetop rested upon this single note and the coincidence of his appearance beside me with the termination of the performance. But a few days later I watched a Tufted Flycatcher, probably under the stress of strong excitement, sing snatches of his dawn song in the middle of the afternoon—a most unusual occurrence.

NESTING

In Guatemala in 1933, I found two nests at an altitude of about 8500 feet. Both were small, neat cups attached to the upper sides of fairly slender horizontal boughs of alder trees, at heights of about 20 and 40 feet above the ground, and both were so far out from the trunk that it was impossible to reach them and learn of what materials they were constructed or what they contained. The first of these nests, still unfinished, was discovered on May 19. A single bird appeared to work at it, while the mate caught insects from a neighboring perch. In the heavy rains which came in late May, the nest flattened out before there was time for a brood to be reared in it. The second nest was found on June 25, at which time the parents were feeding nestlings. The alder tree that supported it stood on a steep slope near the edge of woods which bordered an open pasture. One of the parents flew down into the pasture and took its stand on a branch of a fallen limb only a foot or so above the ground. From this low observation post, it made sallies in pursuit of passing insects, often tracing intricate curves and loops in the air, and always returning to the same perch. At intervals it ascended into the woods to carry a portion of its harvest to the nestlings.

In the same locality, on July 24, I watched a pair of Tufted Flycatchers feeding their young, two or possibly three in number, already full grown and able to fly well. Their plumage, especially the rusty brown of their under parts, was far brighter than that of the parents, whose breasts and abdomens were faded and grayish, doubtless from wear. So great was the agility of these birds that at times they passed an insect to a young bird as they flew past it with hardly a break in their flight, although more often they alighted beside it on the perch.

On the morning of May 14, 1938, I watched a Tufted Flycatcher building about 80 or 90 feet up in a great tree which stood just within the edge of the forest in the Costa Rican mountains at an altitude of about 5400 feet. The site the bird had chosen was the angle between two diverging branchlets that sprang from a long, slender, nearly upright, dead shoot, which in turn arose far out on a horizontal bough. The branchlets which supported the nest were draped with brownish moss that hung in long tufts below them. The nest, as far as it could be distinguished at that great height, was a small cup composed largely of moss, and, like most birds' nests in this humid region, it blended so perfectly with its setting that I should never have found it save by happening to notice the builder as it entered the structure.

The bird presumed to be a female built without help from her mate. She made numerous trips in rapid succession, bringing moss which she pulled from neighboring trees. Then she suspended her work and caught insects for a while, after which she resumed

her active building as before. Her mate perched nearby on one or another of several exposed branchlets from which he darted forth to snatch up passing insects. He never tired of repeating the high, sharp *seer* which is so prominent in his dawn song, and sometimes he voiced his rapid, cheery *weet weet weet weet weet weet*, an utterance which he shared with his mate. From time to time, he went to visit the nest and see how it was progressing, but, as in the Guatemalan pair I had watched, I did not see him bring a contribution to it.

On May 25 incubation was in progress in this nest, which even the red spider monkeys that dwelt in these forests could hardly have reached. From June 10 to 24, if not longer, both parents fed the nestlings. On the latter date, I could see two nestlings above the nest's rim. They made a safe departure, and on July 5 I saw one of them receive food from a parent near the empty nest.

SUMMARY

The Tufted Flycatcher is a woodland bird which in Guatemala occurs from about 5000 to 9500 feet above sea level. It is found largely in the pine-oak forests of the Temperate Zone, while in Costa Rica it is found in the Subtropical and Temperate zones, chiefly between 4000 and 8000 feet above sea level. It lives in pairs throughout the year.

At dawn the male sings in an exceedingly high, thin voice and at an unusually rapid tempo. This bizarre dawn song was heard in both Guatemala and Costa Rica in May and June, and it was somewhat different in the two countries.

The nest, an open cup, is saddled over a horizontal limb or placed in an upright, mossy crotch high in a tree. In both Guatemala and Costa Rica, only one parent was seen to build.

Both parents attend the nestlings.

GOLDEN-CROWNED SPADEBILL

Platyrinchus coronatus

Scarcely over three inches in length, the Golden-crowned Spadebill is one of the smallest of the flycatchers. Yet unlike many of the diminutive members of this family, it is not difficult to recognize, even in the dimly lighted underwood of the high forest where it dwells. The peculiar markings of its head are its badge of identity. The russet or cinnamon-rufous band over the crown nearly or quite conceals the lemon yellow central feathers which give the bird its name. Bordering this on each side is a narrow stripe of black, which in turn is margined by a superciliary stripe of pale yellow. The yellowish olive sides of the head are marked with a black patch beneath each eye and another near the ear. The hind-neck, back, rump, upper tail-coverts, and lesser wing-coverts are plain olive. The wing and tail feathers are dusky with light brown margins. The under plumage is pale yellow, tinged with olive on the chest, sides, and flanks. The male and female are alike except that the latter has little or no concealed yellow in the center of her cinnamon-rufous crown; in the forest the sexes can be distinguished only when the male on rare occasions spreads his crown feathers and reveals his hidden gold. The short and relatively very broad bill is black on the upper mandible and light on the lower. Conspicuous rictal bristles spring from its base. The whole aspect of the bird is stubby—tiny stout body, short tail, and stout little head with short, broad, spade-like bill (see frontispiece).

The species ranges from Bolivia to Honduras. In southern Central America, it is found on both coasts and upward into the foothills and lower slopes of the Cordillera to at least 3500 feet on the Pacific side in the region of El General. It is an inhabitant of the heavy rain forest, where it forages among the bushes and subordinate trees of the lower levels. I cannot recall ever having seen it even a few yards beyond the forest in thickets or clearings, and if it ascends high into the trees, its dull coloration and minute size make its detection difficult for the observer. In the forests of El General, where they are not uncommon, the spadebills remain in pairs throughout the year. They do not, like many of the larger and more powerful flycatchers, have a favorite lookout perch from which they sally forth to catch flying insects, but they flit restlessly through the dimly lighted underwood, snapping up insects in their broad bills as they dart from perch to perch or plucking spiders and other minute creatures from the foliage against which they fly. Although at times a spadebill will join the motley feathered crowd that hovers about the army ants and may dart out from low perches to seize a tiny winged fugitive driven up by the swarm, this is an exceptional mode of foraging.

VOICE AND MECHANICAL SOUNDS

The spadebills' voices are in keeping with their size and retiring habits. A long-drawn little trill, low, weak and insect-like, with a rising, questioning inflection, is their most characteristic utterance, and at all seasons it is one of the common sounds of the forests where they dwell. They give voice also to an extremely low, cricket-like chirp, weaker than the usual chirping of this insect and scarcely audible at a distance of 20 feet.

On May 30, 1949, while I sat in a blind in the forest watching a nest of the Plain Antvireo, a Golden-crowned Spadebill spent much time among the small trees to my right and gave me a display which was unique in my years of familiarity with this species. Remaining most of the time from 15 to 30 feet above the ground, it tirelessly

repeated its long-drawn, weak trill. At intervals it flew from twig to twig with a jerky flight made with prominent wing beats; and while in the air it produced a peculiar sound somewhat like that which can be made by twanging a tightly stretched rubber band, but it was much louder. This sound seemed to be made by the bird's wings, after the fashion of certain manakins, but it was not nearly as loud and sharp as the snaps produced by the wings of the latter with their highly modified feathers. The flights on which the spadebill made the peculiar noise ranged from one or two up to about ten yards in length. The shorter flights were at times sharply inclined, but the longer ones were more nearly horizontal. The bird also beat its wings simultaneously while perching, but then I failed to hear the sharp twang. Likewise it continued the vocal trilling or buzzing while in flight. It seemed to be alone, for I saw no other of its kind.

The next time I watched a spadebill perform in this manner was early in the morning of April 25, 1959, when for about a quarter of an hour one of these birds continued to make twanging sounds as it flew back and forth between branches from 15 to 30 feet up in the forest. While performing, it drifted irregularly through a small area, demonstrating that it had no single preferred course for its display flight. Unlike the spadebill that I earlier watched, this performer was with another bird that seemed to be its mate. Only one individual performed at a time, but I could not tell whether it was always the same one. I have never known any other species of flycatcher to give a similar display.

NEST BUILDING

In the valley of El General, the Golden-crowned Spadebill begins to nest in April. As the site of its beautiful little nest it selects a fork in an upright stem of bush or sapling, or occasionally a trifurcation of such a stem. Fourteen occupied nests that I have seen were from 3½ to 13 feet above the ground, but the higher sites were exceptional. Eight of the nests were at 5 feet or lower, four were from 5 to 7 feet up, and only two were above 7 feet. Carriker (1910:729) gives the height of these nests as from 4 to 6 feet. With one exception, all the nests I saw were in the midst of extensive tracts of primary forest. The exceptional nest was in a narrow remnant of such forest fringing a stream and separated by broad pastures from the nearest large tract of woodland.

On May 2, 1948, I found a nest (number 5), about half finished, on the forested ridge behind my house, and on the two following mornings I watched a spadebill at work on it. The bird, which apparently was a female, built at a leisurely pace. Although on May 3 I began to watch at 6:35 a.m., she did not arrive until 6:58, when she sat in the nest to shape it. She first brought material at 7:05, and by 8:00 she had added 10 billfuls to her structure. From 8:00 to 8:28 she did not work, but from 8:28 to 9:00 she came with material 4 times. From 9:00 until I ended my watch at 9:35 the bird came only once more, making a total of 15 billfuls brought to the nest in 3 hours. The following morning the female labored a trifle more assiduously, bringing material 10 times from 6:38 to 7:38, none from 7:38 to 8:10, 10 times from 8:10 to 9:00, none from 9:00 to 9:38—a total of 20 billfuls in 3 hours. In the dim light beneath the forest, I could not distinguish the sexes of the pair, but I saw no evidence that more than one bird built. The presumed female brought liberal billfuls of brown scales from the fronds of tree ferns, bits of fibers, and cobweb which was wiped from the bill onto the outer surface of the nest. Often after adding her latest contribution she continued to sit for several minutes, patiently kneading the materials together and shaping the structure. The male sometimes followed as she flew to the nest, or he perched in a neighboring tree where he caught insects, but much of the time he was out of sight. This nest appeared to be finished by May 7, five days after I found it half built.

In its form and soft constituents, the Golden-crowned Spadebill's nest bears much

resemblance to that of a hummingbird, but it is somewhat bulkier and browner in color than most hummingbirds' nests. In shape it may be either hemispheric or conical with the apex downward, thus fitting snugly the V-shaped crotch that supports it. The thick walls contain fine, gray or brown bast fibers, skeletons of decayed leaves, fungal filaments from the trunks and branches of trees, and brown or rich chestnut-colored scales from tree fern fronds; the proportions of these several ingredients vary from nest to nest, but the fern scales are regularly present. One nest was composed chiefly of leaf skeletons and fine black fungal hyphae in alternate layers, and in addition it contained light-colored bast fibers and many large, chestnut-colored fern scales; these last were present especially at the bottom of the nest. Another minor ingredient of this nest was the fine, richly branched stems of mosses and liverworts from which the minute leaves had fallen. Fine, shining, black fungal hyphae are usually coiled down into the bottom of the nest to form the lining, but in one nest fragments of partly skeletonized leaves were used for this purpose. The outside is plastered with few or many shreds of white spiders' cocoons, although usually there are not enough to conceal the generally brownish color. Much cobweb is employed to bind the structure together and attach it to the arms of the supporting crotch. Although soft and downy, the neat little nest is at the same time tough, compact, and resilient. Three nests varied from $2\frac{1}{4}$ to $2\frac{3}{4}$ inches in total diameter and from 2 to $3\frac{1}{4}$ inches in height. The highest nest was shaped like an inverted cone. The interior cavity varied from $1\frac{1}{2}$ to $1\frac{3}{4}$ inches in diameter and was 1 inch deep. One nest had long streamers of half-decayed slender vines dangling loosely below it to a length of 15 inches.

THE EGGS

Although the nest which I found, half finished, on May 2 appeared to have been completed by the afternoon of May 7, the first egg was not laid in it until May 16. This is a long delay in laying, yet in two other instances at least 11 days intervened between the apparent completion of the nest and the deposition of the first egg. In two more nests, which seemed to be finished when I found them, no less than 6 and 8 days, respectively, elapsed before the first egg was laid. At four nests, the interval between the laying of the first and second eggs was 2 days; in some cases the interval was possibly greater. Thirteen of my 14 nests in El General contained 2 eggs or nestlings; the fourteenth nest contained a single nestling already feathered. Carriker (1910:729) discovered a nest with 2 eggs in the Caribbean lowlands.

The eggs are dull white, "old ivory," or creamy buff in ground color, and they are marked with spots and more or less sharply outlined blotches of pale brown, pale rufous, reddish lilac, or sometimes bright brown. These markings are usually aggregated into a definite belt around the thickest part of the egg, which is about midway between the two poles, and there is at times a thin sprinkling of spots outside this zone. In form, the eggs are short, broad, and unusually blunt at the small end. The measurements of 16 eggs average 16.4 by 13.4 millimeters. Those showing the 4 extremes measured 17.5 by 13.5 and 15.9 by 13.1 millimeters.

In 14 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: April, 5; May, 9. In only one of these nests were the eggs laid before the middle of April. Carriker's nest, found near Jiménez in the Caribbean lowlands of Costa Rica, held fresh eggs on May 11, 1905.

INCUBATION

The eggs are warmed by the female alone. She may begin to incubate on the day she lays her first egg; for at six o'clock in the evening I found the bird of nest 5 sitting on the single egg which she had deposited earlier that same day. On the mornings of May 21

and 22, 1940, I spent 5 hours watching a spadebill incubate her 2 eggs in nest 2, which was situated in a fringe of open woodland beside the Río San Antonio in the valley of El General. In this period, her 16 sessions on the nest ranged from 3 to 23 minutes and averaged 10.6 minutes. The 14 recesses separating these sessions varied in length from 2 to 19 minutes and averaged 8.3 minutes. She covered the eggs only 56.1 per cent of the five hours. While sitting, or sometimes as she flew from the nest, she voiced a very low, insect-like note, but otherwise she was silent. Thrice she ended her spells of incubation when an insect flew close by and tempted her to dart into the air and catch it. Only twice in the five hours did I see a second spadebill, apparently the sitting bird's mate, in the vicinity of the nest. However, he came no closer than twelve yards, and each time his appearance caused the sitter to fly from her eggs.

At their nests spadebills differ greatly in their reactions to the presence of man. The bird beside the stream would continue to cover her eggs while I approached to within a foot of her, and sometimes I could almost touch her with a finger before she flew off. Hence while watching her I did not deem it necessary to conceal myself, but simply sat down in the undergrowth about twenty feet away. That she was quite indifferent to my presence was proved by her flying about one foot above my head as she left her nest. But more often spadebills are shy, sometimes so wary that, approach through the forest undergrowth as stealthily as one can, it is almost impossible to surprise them on the nest. Such was the bird of nest 4, which I watched incubate on the morning of June 6, 1947. In this instance, I of course hid myself in a blind. From 5:30 to 10:52 a.m. she took 10 sessions which varied from 8 to 27 minutes in length and averaged 16.3 minutes. Her 10 recesses ranged from 9 to 20 minutes and averaged 12.3 minutes. She covered her two eggs for 57 per cent of the five hours, which compares closely with the 56.1 per cent of the other female whose rhythm of coming and going was faster. Spadebills, like other small flycatchers which eat few or no fruits, are inconstant sitters. While on the nest the shy spadebill repeatedly uttered a weak, high-pitched, insect-like trill, opening her mouth wide and revealing a blackish lining. From her mate she received even less attention than the female of the earlier year; I neither saw nor heard the male all morning.

At nest 5 the second egg was laid between 2:25 p.m. on May 17 and 8:20 a.m. on May 18. Egg number 1 hatched during the day of June 5 and egg number 2 hatched between 5:30 p.m. on June 5 and 7:30 a.m. on the next morning. Thus the incubation period was approximately 19 days. At another nest the period of incubation was at least 19 days, and at a third nest it was at least 18 days.

THE NESTLINGS

The tiny newly hatched spadebills have pink skin quite devoid of down. Their eyes are tightly closed and the interior and corners of their mouth are intense cadmium yellow. They never develop down, but within a day or two of hatching the rudiments of the pinfeathers are visible through the skin which rapidly becomes darker. When the nestlings are 7 or 8 days old, their feathers begin to break out of the horny sheaths and expand, and at the age of 10 or 11 days the young are fairly well covered with feathers.

Although the male spadebill at the streamside nest seemed to be inattentive during the period of incubation, he began to feed his nestlings within a few days after they hatched. At this nest the first egg hatched on May 27 and the second on the following day. On the morning of May 30 I watched for two hours, from 7:15 to 9:15 a.m. In this interval, the female brooded for 7 periods ranging from 2 to 13 and totalling 39

minutes. Each parent delivered directly to the nestlings the food that it brought, and four times the female flew from the nest as her mate arrived with something in his bill. He seemed reluctant to go to the nest if she was not there when he approached. Once, while she was away, he flew up with a small insect in his bill, and for five minutes or more flitted among the bushes near the nest, but he would not go up to it. At length his mate returned and without feeding settled on the nest to brood. Then at last the male advanced to the nest, and the female promptly darted away. The male then delivered the food that he had been holding so long and went off, too. I never saw him brood, which strengthened my conclusion that he had not earlier incubated. Three times the female fed and then brooded, and there were three more feedings which I believe should be credited to her, although I could not be certain of this because she did not stay to brood. Thus the two nestlings, 2 and 3 days old, were fed 10 times in the two hours. Sometimes while brooding the mother was lured from the nest by some incautious insect that blundered temptingly near.

For the care of somewhat older nestlings we turn to nest 4, which I watched from 7:30 to 11:10 a.m. on June 16, 1947, at which time the two nestlings were 7 or 8 days old and beginning to be feathered. Both parents took substantial parts in feeding the youngsters. In the dim light of the forest, I could not distinguish the male from the female, but 10 times one came with food while the other was brooding. Once the two birds fed the nestlings almost together, and many times the interval between two feedings was so short—a minute or less—as to leave little doubt that both parents had brought food. Although the male spadebill came 10 times while his mate brooded, he did not once replace her on the nest. Thus I gathered still further evidence that the male spadebill neither incubates nor broods.

In the hour from 7:30 to 8:30 a.m. the two nestlings were fed 19 times by both parents. In the following hour they were fed 16 times. In the third hour, from 9:30 to 10:30 a.m., they were fed only once. I was then absent from the blind for 10 minutes to investigate the cause of the reduced rate of feeding. Returning at 10:40 a.m., I watched for another half hour, in which the nestlings were fed 10 times, making a total of 46 feedings in $3\frac{1}{2}$ hours of watching. As far as I could see, the food consisted wholly of insects, which the parents brought in their short, broad bills. All the movements of these diminutive birds were sudden and brisk. They would dart up to the nest, thrust the food into a gaping yellow mouth, then usually dart away again in a trice, unless the mother stayed to brood.

The nestlings were brooded 14 times in the $3\frac{1}{2}$ hours. The periods of brooding ranged from a few seconds to 25 minutes, but this long session was taken in exceptional circumstances, soon to be related. The 14 turns of brooding totalled 63 and averaged $4\frac{1}{2}$ minutes. Nine of the sessions were terminated by the male's arrival with food; only 5 were ended spontaneously, and these lasted, respectively, a few seconds, 7, 1, 25, and 2 minutes. As at the earlier nest, the female never took food from her mate, but she nearly always left as he arrived so that he might feed the nestlings directly. Usually she darted away when she saw him coming, but once she was caught napping and he bumped into her as she left the nest. Once the male, arriving with food in the absence of the female, came to rest on a twig a yard or two from the nest and delayed there for a minute or two, repeating his weak trill and from time to time spreading the russet feathers of his crown to reveal the hidden gold. While he procrastinated here, the female arrived, fed the nestlings and covered them, only to dart off at once as the male at last advanced to deliver his billful of insects. This needlessly complicated behavior recalled the closely similar conduct of the pair at nest 2.

Early in my vigil at nest 4, the activities of other birds that I glimpsed more or less vaguely through the undergrowth led me to suspect that army ants were swarming through the forest not far from the spadebills' nest. A Tawny-winged Dendrocincla clung to trunks near the ground and darted out to catch insects in the air or to pluck them from the undersides of leaves. A Black-faced Antthrush passed and repassed. A Blue-crowned Motmot stayed long in one spot, and a Sulphur-rumped Myiobius flitted briskly about with spread tail and drooping wings. When the myiobius alighted only a foot away from the spadebills' nest while the female was brooding there, the latter sat calmly. Soon the male spadebill flew up with food and drove the bigger flycatcher away.

When this episode occurred, the swarm of ants was apparently only a short distance down the hillside from the nest. The dendrocincla was flycatching close by it, and the motmot's bright colors could be glimpsed through the leaves at no great distance. It was then that the female spadebill brooded continuously for 25 minutes—three times as long as her next longest session. After driving off the myiobius the male spadebill lingered with food in his bill close by the nest, waiting for his mate to make way for him in her usual fashion. When she had not done so at the end of five minutes, he flew off without having delivered the food that he carried. After the female terminated her long period of brooding, the pair stayed away for the next 42 minutes, with the exception of a single visit at 9:52 a.m. to deliver food. In the entire hour from 9:30 to 10:30, the nestlings were fed only once and brooded only once, in sharp contrast to the many feedings and broodings in the two preceding hours.

At 10:30 a.m. I emerged from the blind to investigate the cause of the parent spadebills' neglect of their nestlings. I found a swarm of small ants spread out over the leaf-strewn ground about 25 feet from the nest. My approach drove off the bird attendants of the ants, particularly the motmot, dendrocincla, and antthrush. At 10:40 I returned to the blind. At 10:45 a parent spadebill fed the nestlings, and in the following 21 minutes the pair together brought food 10 times, compensating for past neglect. Since my emergence from the blind had frightened away the birds that foraged about the ants but not the ants themselves, I concluded that these birds rather than the ants had been keeping the spadebills away from their nest. They were certainly not shy of the myiobius and did not seem afraid of the dendrocincla; apparently it was chiefly the motmot that they mistrusted. Yet I have never known a motmot of any kind to harm smaller birds or their nests.

For a glimpse at older nestlings, let us turn again to nest 2. On June 11, 1940, when these young spadebills were 14 and 15 days old, I watched them from 9:25 to 10:25 a.m. In this hour, they were fed 36 times. It was impossible to determine how many times each parent brought food individually, but on four occasions both came to feed the nestlings so nearly together that I had not lost sight of the first bird when the second arrived. Once they were on the nest's rim together. There was no brooding at this time, and the diminutive parents vanished in the foliage almost immediately after delivering food to the nestlings. I detected only insects in their bills.

The nestlings, which for several days had been well feathered, devoted considerable time to preening their plumage. Sometimes one would stand on the nest's rim and flap its wings for a few seconds at most. They tirelessly repeated slight, high-pitched trills, very much like the utterance of their father. They gave no sign of alarm when I watched them with my eyes less than a foot from theirs. In appearance, the spadebill nestlings differed considerably from their parents, for they quite lacked the russet crown bordered with black. They bore the same conspicuous dark marks on the face below the eyes

and on the ear-coverts, but these were not as black as on the adults. Their under plumage was light gray rather than pale yellow as on their parents and their cheeks were not so strongly tinged with yellow. In detail, their juvenal plumage may be described as follows: Forehead and crown brownish olive, slightly darker than the grayish olive with greenish tinge of the back and wings; no wing bars nor light margins on the wing feathers; superciliary stripe and cheeks buffy, with blackish patches on the cheeks below the eyes and on the ear-coverts, as in the adults; under parts light gray (or on some fledglings very pale yellow); upper mandible black; lower black at the tip, yellow at the base; eyes black; interior of mouth bright yellow.

These two nestlings left the nest the following morning, when respectively 15 and 16 days old. In all, I have determined the age of departure of nine young spadebills and found the nestling period to range from 14 to 16 days, with 15 days the most frequent length. Although the spadebills are slow in preparing their nest and laying and their incubation period is long, the development of the nestlings is by contrast fairly rapid. Since apparently each pair produces at most a single brood of two in the course of a year, there seems to be no reason why their reproduction should not proceed at a leisurely pace. Only in the case of the young in the nest, to which the parents' frequent visits are likely to draw the attention of the many predators that lurk in the tropical forest, has the reproductive process been somewhat accelerated.

A fledgling just out of the nest made the same lazy, long-drawn buzzing as the adults. While waiting for food, and again when a parent came to feed it, it spread its wings widely and beat them several times much in the manner of the male that made the twanging sound. This movement was quite different from the rapid quivering of drooping wings of most passerine fledglings.

SUMMARY

The Golden-crowned Spadebill is an extremely small bird which forages among the bushes and lower trees of heavy rain forest. It is found from sea level up to about 3500 feet in Costa Rica. It remains in pairs throughout the year. Food consists of insects and spiders caught on short darts between branches or plucked from foliage.

Its notes, which are low and weak, include a long-drawn, insect-like buzz or trill. It also makes a sharp, twanging note while in flight, apparently producing the sound with its wings.

In El General, nesting begins in April. The beautiful, cup-shaped nest, resembling a hummingbird's nest but bulkier, is placed in a fork of an upright stem in the forest, from 3½ to 13 feet above the ground but usually not above 6 feet. At one nest only a single bird, apparently the female, was seen to participate in building, which proceeded very slowly.

From 6 to 11 or more days elapse between the apparent completion of the nest and the laying of the first egg. The second egg follows in two days. The set regularly consists of 2 eggs, laid in late April or May, rarely in early April.

Only the female incubates, taking very short sessions in clear weather. In five hours one female took 16 sessions which ranged from 3 to 23 minutes and averaged 10.6 minutes. Her 14 recesses varied from 2 to 19 minutes and averaged 8.3 minutes. She spent 56.1 per cent of the time on the eggs. Another female's sessions averaged 16.3 minutes, her recesses 12.3 minutes, and she was in the nest 57 per cent of five hours. At three nests the incubation period was approximately 19 days.

The nestlings when hatched are devoid of down. Only the female broods them, but they are fed by both parents. The male was never seen to pass food to his brooding mate but always waited for her to leave so that he could give it directly to the young.

Two older nestlings received 36 meals in an hour. Their diet appeared to consist exclusively of small insects and spiders. When army ants with attendant birds foraged near a nest, the parents stayed away for nearly an hour; then they compensated for this long neglect by accelerated feeding.

The nestling period of nine young spadebills ranged from 14 to 16 days, with 15 days being the usual length. In their first plumage, the young bear the distinctive blackish facial marks of the adults but are otherwise of duller coloration.

Each pair appears to raise no more than a single brood of two in the course of a year.

BRAN-COLORED FLYCATCHER

Myiophobus fasciatus

The Bran-colored Flycatcher is widely spread over South America, from Colombia to Argentina and the Guianas, but in Central America it occurs only in Panamá and Costa Rica. In the latter country it appears to be restricted to the Térraba Valley, which lies between the Cordillera de Talamanca and the Pacific Ocean, and even here it is abundant only in restricted localities. This quiet and unobtrusive little flycatcher, about four and a quarter inches in length, differs from most of the smaller members of the Tyrannidae in having brown rather than olive or grayish upper plumage, and it is not difficult to recognize in places where it can be found. The sexes are similar in appearance. The forehead, crown, cheeks, hindneck, back and rump are cinnamon-brown; the center of the crown bears a concealed patch of yellow; the blackish wings display two conspicuous buffy bars on the coverts, and their flight feathers have lighter margins; the tail is dusky; the under plumage is pale yellowish buff, conspicuously streaked on the breast with grayish brown; the bill is blackish.

In the Térraba Valley, the Bran-colored Flycatcher inhabits the low, bushy growth that in this humid area quickly covers over abandoned grain fields and neglected pastures. Thickets through which cattle browse, keeping open an irregular network of ill-defined trails, seem more to its taste than those undisturbed growths where the low vegetation is so densely entangled that a man cannot pass without cutting his way with a machete. Here the diminutive birds remain well concealed, snatching small insects as they flit through the close-set branches rather than darting conspicuously into the air above.

At the lower end of the deep and narrow valley of the Río Buena Vista, about 3000 feet above sea level, I found the Bran-colored Flycatcher fairly abundant in the low, bushy growth that occupied so much of the valley floor. Here, in the breeding seasons of 1936 and 1937, I found 14 nests. These little structures were by no means conspicuous, yet they were almost easier to discover than the birds themselves. If I had not seen so many nests, I should certainly have called the flycatcher rare in the vicinity. Yet in many subsequent seasons of intensive bird study in other parts of the upper Térraba Valley, all less than 10 air miles from this first locality, and none more than 700 or 800 feet lower in altitude, I failed to discover a single nest of the Bran-colored Flycatcher and saw the bird only with extreme rarity. Evidently here at the northwestern limit of its vast range it has some very special requirements as to environment, but these are not clear to me. That the small difference in altitude cannot be the decisive factor is plain because the species was fairly abundant in the thickets around Buenos Aires in the lower valley, only 1200 feet above sea level; whereas in the Republic of Panamá it has often been recorded from the lowlands. In the Santa Marta region of Colombia, Todd and Carriker (1922:351) state that the nominate race of this species is "confined to the Piedmont belt of the Tropical Zone," where it has been encountered at points ranging from 2500 to 3500 feet above sea level. In the Pastaza Valley of eastern Ecuador, I found the Bran-colored Flycatcher extremely abundant at altitudes from 3000 to 4000 feet. Here it dwelt in just such bushy habitats as its Costa Rican cousin.

VOICE

The call of the Bran-colored Flycatcher is a deep, full, little whistle, grave and deliberate, and usually repeated over and over in slow, measured time. It also utters a slight, low trill, slow and weak, but clear in tone. While I watched one pair at the nest, the male

delivered the whistles and trill, but the female uttered only harsh, croaking notes of a weak character. These she delivered on several occasions as she alighted beside the male while he rested near the nest, and he replied with his serious little whistles.

In Costa Rica, I never heard the Bran-colored Flycatcher sing at dawn, but in the Pastaza Valley of Ecuador it sang freely from late August until past the middle of October. One bird which I watched near Puyo in the dawn of September 19, 1939, perched in a bush about six feet above the ground and about forty feet from his mate's nest and repeated tirelessly a low and soft but full and far-carrying monosyllable. This sounded like *chite* and was quite distinct from any of the notes this bird commonly utters during the hours of full daylight. Taking out my watch, I timed the utterance and found that



Fig. 53. Bran-colored Flycatcher.

the bird delivered this note at the rate of once a second, or sixty times in a minute; and he continued this for about twenty minutes. From the distance came the voices of others of his kind; indeed, this was the most characteristic dawn sound at this season, for no more forceful songsters raised their voices to drown the humble monologue of this little flycatcher. The slow, clear, little trills and measured, low, clear whistles which these Ecuadorian Bran-colored Flycatchers voiced later in the day were quite similar to utterances of their Costa Rican relatives. Hence I suspect that the latter also has a dawn song which I failed to discover because it was delivered at a season when many other birds sang at dawn, overwhelming these weak notes with their multitudinous chorus.

NEST BUILDING

In 1936, I found my first nest of the Bran-colored Flycatcher on April 13, when it was nearing completion. The following year a finished nest was discovered on April 3. Hence construction must have begun at the end of March. The nest is built in a thicket or field overgrown with tall weeds, usually beside a small open space or near the edge, and is placed in a shrub, a tall herb, a lower bough of a small tree, or more rarely near the

end of a dangling vine. Fourteen Costa Rican nests ranged in height from 4 to 12 feet above the ground. The lower sites were the more favored: 11 nests were situated between 4 and 7 feet, one at 8 feet, one at 11 feet, and one at 12 feet. The vireo-like nest is suspended by its rim between the arms of a forked twig horizontally spread at the end of a slender, often drooping branch or a free-swinging vine. Sometimes one side of the structure will be fastened to a thin twig and the other to the petiole of a leaf that springs from it. This latter is an unfortunate location, for often the leaf dies and becomes detached from the twig while the nest is still in use, allowing it to droop on one side and perhaps spill out the eggs or tender nestlings.

One pair of Bran-colored Flycatchers was so shy that they would not work at their nest while I watched from a blind, which I had set up on the preceding morning at a distance of 30 feet. Another pair was far more confiding and went ahead with their building while I sat only ten yards away, without so much as a bush to screen me from their view. This nest was supported, at a height of only 51 inches above the ground, at the end of a lower branch of a small aguacatillo (*Persea Skutchii*) tree. It was attached to a slender unbranched twig and the petiole of a leaf that sprang from it. The flycatchers did not seem to be entirely satisfied with this location; perhaps they were aware instinctively of its inherent instability. After beginning this nest, they abandoned it and looked about for another situation. For ten days they sought a more secure foundation, apparently without finding one that met their requirements, and in the end returned to complete their nest where they had first begun it, between the petiole and the twig. Possibly Bran-colored Flycatchers sometimes employ petioles for support because it is not always possible for them to find a satisfactory forked twig.

It was easy to distinguish the members of this pair. The one which I afterward decided was the female was the more richly colored. Her crown and hindneck were a deeper shade of brown, her rump more rufescent, and the light edgings of her remiges broader and more conspicuous. The dusky streaks on her whitish breast were heavier. I do not know why in this pair the female should have been the more richly attired, but possibly it was a matter of age. Despite his slightly paler plumage, the male possessed the more developed voice, uttering deep, mellow, little whistles and low, confidential trills, whereas the female, as already recorded, was heard to deliver only a sort of weak croak.

During the two mornings when I watched, I saw only the female flycatcher bring material to the nest. As soon as she had completed the outer shell of dry grass blades, slender dry vines, rootlets, and an occasional tendril, she brought scarcely anything except small bits of the fine, dry inflorescences of grasses. These pieces of material were so tenuous that it was difficult to distinguish them in her bill, even through the binoculars. Because her material was so light and delicate, she needed to gather many billfuls to make her nest as thick and soft as is customary with her kind. On the morning of April 26, while she was lining the nest, she brought material as follows:

6:00-7:00 a.m.	21 times
7:00-7:45	18 times
7:45-8:30	did not work
8:30-9:00	13 times
9:00-9:30	19 times

While his mate worked, the male often perched near the nest, and sometimes he even rested for a few moments on its rim, as though to see how the building was coming along. But much of the time he was out of sight among the bushes, whence I occasionally heard his low, full whistles.

This female took about a week to build her nest. Another female required eight or nine days. In their form and mode of attachment by the rim to the arms of a fork, the

nests of *Myiophobus* are like those of no other Central American flycatcher that I know; they resemble nests of the Acadian Flycatcher but are deeper. Their similarity in form to the nests of certain vireos and antbirds is even closer, although they are composed of materials of a different nature. The open nest of the Bran-colored Flycatcher is deeply cupped and well constructed, with substantial walls of dry grass blades, fine herbaceous stems, slender dry vines, rootlets, and an occasional tendril. At times there is more or less green moss in the outer wall, but some Costa Rican nests lack this entirely. The soft lining is usually composed of a considerable thickness of fine, dry branches of inflorescences of grasses such as those of species of *Panicum*. Cobweb is used to bind the nest's



Fig. 54. Nest of the Bran-colored Flycatcher in bushy pasture at Rivas in the valley of El General, June, 1936.

rim to its supports. Often the nest is untidy in appearance because loose ends of stems and grass blades have been allowed to dangle beneath its bottom.

In the Pastaza Valley of Ecuador, I found Bran-colored Flycatchers breeding freely in August, September, and October. On August 14, I discovered, near Puyo at 3000 feet above sea level, a nest with a newly laid egg; four more nests were found in the vicinity between this date and my departure on September 26. On October 25, I watched a pair building in a bushy pasture not far from the Pastaza River, at a point 4200 feet above sea level. The Bran-colored Flycatcher was one of the few birds I found breeding at Puyo in August and September. In site and form these Ecuadorian nests resembled those I had found in Costa Rica; they were neat little cups hung by the rim in horizontal forks of slender twigs or between two diverging petioles, and they were found beside an open space amid a thicket, in a bushy pasture or plantation, or at the edge of the forest.

In height, they ranged from 4 feet 4 inches to about 15 feet above the ground. But while moss was a subordinate constituent in my Costa Rican nests of this species and was quite lacking from some, in this excessively humid region of Ecuador, where most of the trees bore a liberal coating of moss, it was the chief ingredient of the nests. These nests were all externally green, and on the interior they had a brown lining of fibrous materials or very fine pieces of the inflorescences of grasses. The rims were very noticeably incurved, as in the downy nests of many hummingbirds. Nests of the Bran-colored Flycatcher of the nominate race, *M. f. fasciatus* found in Trinidad by Belcher and Smooker (1937:239) had the rim sometimes ornamented with a little green moss; in this respect they resembled the Costa Rican rather than the Ecuadorian nests which I have seen. Although nests were most often placed only 4 or 5 feet above the ground, they were occasionally situated as high as 30 feet.

THE EGGS

An interval of four or five days may elapse between the completion of the nest and the laying of the first egg. In four instances, an interval of two days separated the laying of the first and second eggs. At one nest, however, this interval was only one day, and at another nest it was three days. Thirteen of the fourteen Costa Rican nests contained 2 eggs each; the fourteenth was abandoned before completion. The eggs are dull white or pale buff, with a wreath of reddish brown speckles or blotches around the thick end, and sometimes a few spots of the same color scattered over the remaining surface. The measurements of 12 eggs averaged 17.3 by 13.0 millimeters. Those showing the four extremes measured 19.1 by 13.5 and 16.3 by 11.9 millimeters.

Four nests which I found in eastern Ecuador each contained 2 eggs or nestlings. These eggs agreed closely in coloration with the Costa Rican examples already described, and those of one set measured 16.7 by 13.1 and 15.9 by 12.7 millimeters. In Trinidad, the nominate race lays sets of 2 eggs; the measurements of 8 eggs averaged 17.7 by 13.1 millimeters (Belcher and Smooker, *loc. cit.*).

In 13 nests in the valley of El General, about 3000 feet above sea level, eggs were laid as follows: April, 6; May, 5; June, 2.

INCUBATION

In Costa Rica, I studied two nests during the period of incubation. On May 1, 1936, I devoted six hours to watching from a blind a nest containing two eggs, the second of which had been laid on April 23. I did not succeed in distinguishing the sexes of this pair; but from my failure to observe a single change in the occupancy of the nest, I feel certain that only the female incubated. She was, like so many other very small members of the Tyrannidae, a most restless sitter. In the six hours she took 28 sessions on her eggs. These sessions ranged in length from 3 to 14 minutes and averaged 6.6 minutes. An equal number of recesses varied from 2 to 16 minutes in length and averaged 6.5 minutes. The female kept her eggs covered only 50 per cent of the time. Except in the early morning while the air was cool, I did not once see her sit for as long as ten minutes continuously. While within sight of the blind, she was perfectly silent. I saw the male near the nest only once. At other times he remained beyond my field of vision. However, because the surrounding thicket was so dense, he was not necessarily far away, and it is likely that the female joined him during her many brief recesses from incubation.

On May 20, 1937, I studied the nest in the aguacatillo tree which I had watched earlier while the female built. The male and female of this pair could be distinguished, it will be recalled, by both appearance and voice. On this date, incubation had already been in progress for 15 days. Here, again, only the female covered the eggs. In the first

five hours of the morning she took 25 sessions which ranged in length from less than 1 to 18 minutes and averaged 7.7 minutes. Her 23 recesses lasted from less than 1 to 9 minutes and averaged 4.6 minutes. She spent 62.6 per cent of the time on the eggs, which was a higher constancy than that of the Bran-colored Flycatcher I had watched the preceding year. The per cent of time this female incubated is somewhat better than average for a small flycatcher, yet it is a smaller proportion of time than most birds devote to their eggs. As is often true in small insectivorous birds, her sessions were longer in the early morning, before the sun warmed the air, than later in the day. Following her early-morning absence for breakfast, she took turns on the eggs of 15, 15, and 18 minutes, respectively; then followed 2 periods of 9 minutes, next 2 of 8 minutes, and then 1 of 11 minutes. These sessions, with the intervening short recesses, occupied her until 8 o'clock, after which her periods on the eggs became abruptly shorter. Her last 12 sessions of the morning averaged only 6.5 minutes.

Once the female flycatcher, while incubating, closed her eyes and appeared to sleep for a minute in broad daylight. Sometimes while sitting she regurgitated the seeds of small berries that she had eaten, and once she flew from the nest to carry a seed away. If a tiny insect flew enticingly near, she might dart from her nest to catch it and return at once. Some of her briefer recesses, lasting only a minute or so, were devoted wholly to preening while she rested near the nest.

The male passed much of the morning within a few yards of the nest. He remained near the nest principally in the female's absence. During a good part of the morning the two alternated in their attendance, the female sitting, but the male, when present, merely perching or flitting about close by. Often the female flew from the nest as the male drew near, and at other times he appeared soon after her departure. But he was by no means constant in his guardianship of the nest and sometimes remained out of sight during the female's recesses. Frequently, too, he lingered near the nest while she sat, but he was present more consistently when she was absent. While in the presence of the nest, he passed the time chiefly in flitting among the bushes close at hand, snatching up small insects and often singing; sometimes he rested quietly upon the branch that supported the nest, about two feet distant from it.

The males of some big, powerful species of birds, such as jays and a few of the biggest flycatchers, keep guard over the eggs during the female's absences from incubation, but it is rare to find a bird as small as the Bran-colored Flycatcher standing sentry in this fashion. Yet despite his diminutive size, he valiantly attempted to drive trespassers away. He put to flight a Southern House Wren and a Slaty Castle-builder, both very small birds, yet considerably bigger than himself. As he darted toward the intruders, he spread sideways the brown-tipped feathers of his crown, revealing a conspicuous, pale yellow patch in their midst. The female, too, when in an angry or inquisitive mood, spread her crown feathers in the same fashion, displaying a yellow patch just like that of her mate.

The nest had already become detached from the petiole that supported it on one side, and it remained fastened only to the straight branch at the other side. Hence it tilted strongly toward the unattached side. The female invariably sat facing the supporting branch, that is, facing "up-hill," as birds nearly always do when their nest leans.

The incubation period of the Bran-colored Flycatcher, as determined at three nests, is 17 days. At two of these nests, both eggs hatched on the same day; at the third, only one egg hatched, the other having rolled out when the nest sagged after the petiole which held it up on one side became detached from the twig.

THE NESTLINGS

At the nest in the aguacatillo tree, which has claimed most of our attention, both eggs were pipped on the evening of May 21. When I reached the nest the following dawn, I found that one egg had just hatched, and the empty shell had not yet been removed. The tiny nestling had tightly closed eyes, and bore short, gray down of the usual passerine type. I at once entered the blind, and a minute later the female returned to the nest, appeared to feed the nestling, then brooded. Eight minutes later she flew off as her mate alighted close by. After an absence of four minutes she returned and appeared to feed again, but in the dim light I could not be sure that she actually gave food to the nestling. But at 6:12 a.m. she jumped from the nest, caught an insect that was flying by, and at once returned to deliver it to the nestling. Soon afterward she carried away part of the empty shell. Fifteen minutes later she removed another piece of shell. Between six and seven o'clock the second egg hatched and by the latter hour the nestling was already stretching up its orange-yellow mouth widely agape for food. Throughout the morning, the minute birds were eager for all that was brought to them and never required urging to take their meals, as frequently happens with newly-hatched young of other species. At first the female brooded them after each feeding, but by 8:30 a.m. they required so many of the small insects which formed their fare, that she found it necessary to change her routine and bring food twice between broodings. In the first four hours of the morning, she gave food to the nestlings 28 times.

From the male's close attention to the nest during the course of incubation, I felt sure that he would bring food to the nestlings very soon after they hatched. In this I was mistaken. The male flycatcher continued to be attentive to the nest, but by 10 a.m., more than four hours after the first egg hatched, he had not brought a single morsel to it. I have no doubt that the reason for this neglect was that he had not yet discovered his offspring. Although he flitted all around the nest and many times alighted on his favorite perch only two feet from it, he did not once actually perch upon or immediately beside the nest. I could not convince myself that he really looked into the nest, even from a distance, a single time in the course of the morning. His mate, bearing food in her bill, passed close by him a number of times, but the insects which she brought were small and inconspicuous. He seemed to be a most unobservant bird, and his failure to discover his nestlings with reasonable promptness, coupled with his dull plumage, led me to believe that this was his first nest.

The male flycatcher was still, in his small way, zealous in his defense of the nest. When a yellow-breasted Chestnut-capped Warbler wandered beneath it, he darted angrily at the bigger bird. Overlooking the flycatcher's threat, the warbler sang gaily beneath the nest, while the irate flycatcher trilled but did not repeat his feint of attack. A little later, a male Orange-billed Nightingale-Thrush perched two feet away upon the branch that supported the nest and sang in an undertone. Again the male flycatcher darted toward the intruder, twice as big as himself, and again the trespasser coolly disregarded him. This time, too, the flycatcher did not repeat his threat, but he stood close by, watching the nightingale-thrush, and trilling over and over. While near the nest, I heard him utter his weak little trill only when angry. Whenever I visited his nest, he perched not far off and trilled in the same fashion. But when unperturbed, he sang near the nest with his low, mellow whistles.

Probably because her mate failed to help her feed the nestlings on the morning they hatched, the female flycatcher sat in the nest less than she had while incubating two days earlier. Then, in the first four hours of the morning, she had occupied the nest 60.7 per cent of the time; now she covered the young nestlings only 52.6 per cent of the time. This change was brought about chiefly by the shortening of her periods of sitting from

an average of 8.2 to 6.0 minutes. At the same time, her absences remained substantially the same in length, the averages showing only a scarcely significant increase from 5.3 to 5.4 minutes. Although she now had to find food for the nestlings as well as for herself, she did not remain off the nest for longer periods.

When I resumed my study of this nest at 10:30 on the following morning, the male flycatcher was actively bringing food to the nestlings which were then little more than one day old. Somehow in the preceding 24 hours he had learned of their presence, but to my great regret I was not there at the critical moment. In the next hour he brought food 12 times, whereas the female brought food only 9 times. But the female brooded the nestlings a total of 24 minutes, in periods of from 2 to 5 minutes each, separated by absences that ranged from 1 to 11 minutes. Sometimes when the male brought food while his mate brooded, she took it from him, then rose to pass it to one of the nestlings beneath her. At other times, she darted away as he approached and left him to deliver his offering in person. If the nestlings continued to hold up their open mouths after he had fed them, he sometimes poked his empty bill into their mouths, in a mock sort of feeding.

At another nest, which I watched while it cradled two naked nestlings, both parents also brought food. This male likewise perched upon the rim to pass the items to his mate while she brooded, then she would rise to feed a nestling or, sometimes, swallow the insect herself. In the two hours between 6:26 and 8:26 a.m. these nestlings were fed only 8 times, 5 times by the male and 3 times by the female. Probably later in the day, when the air was warmer and small insects flew in greater numbers, the nestlings were fed more abundantly. This female brooded once for 25 minutes and once for 21 minutes continuously. These were longer periods on the nest than I had recorded while watching two other females incubate. The male protested my intrusion by uttering deliberately a low, serious whistle, instead of trilling like the male of the nest in the aguacatillo tree. Later, however, when the nestlings were feathered, this male also trilled when I visited his nest.

The nestling Bran-colored Flycatchers were nine days old before their feathers began to escape from their horny sheaths. When they were about two weeks old, they were well feathered. At the nest in the aguacatillo tree, the nestlings were brooded by night until they were 14 days old. They remained uncovered in the nest two nights more, departing when they were 16 days of age. At another nest, in which a single nestling was reared, the young bird, taking fright as I approached on my daily visit, flew from the nest when only 15 days old. Visiting a third nest, in which only a single nestling survived, I found the young bird, then 17 days old, perching about a foot from the nest. When I came quite close, it took flight, but weaker on the wing than the other fledgling two days younger than itself, it descended obliquely to the ground, where it attempted to escape by hopping off through the dense vegetation. I caught it and returned it to the nest, but it promptly flew off again in the same manner.

When they leave the nest, the young Bran-colored Flycatchers closely resemble their parents. The two reared in the nest in the aguacatillo tree had brown upper plumage a shade deeper than that of the male, or about as dark as that of the female. After the young flew off into the thicket, I lost track of them and could not follow their subsequent history.

In 1936 I found a nest in which the second egg was laid on June 24. This nest was destroyed before the eggs hatched. Harrower (MS) records a nest from the Canal Zone which contained nestlings on July 18, 1933. These late nests suggest a second brood, but they might, of course, have been only replacements of unsuccessful earlier nests. I have no definite knowledge of a pair that nested again after rearing young.

SUMMARY

Of widespread occurrence in South America, the Bran-colored Flycatcher has been found in Central America only in Panamá and southern Pacific Costa Rica, where it is known only in the Térraba Valley. Here at the northwestern extremity of its extensive range its distribution is peculiarly irregular, for it is abundant in some districts but absent from others, only a few miles away, which offer it the same type of vegetation. It lurks unobtrusively in the low, bushy growth that covers abandoned grain fields and neglected pastures and is difficult to see. In Central America, it ranges from near sea level up to at least 3500 feet, but in eastern Ecuador it breeds up to at least 4200 feet.

Bran-colored Flycatchers take small insects as they fly through low vegetation and vary their diet with berries.

The male utters a low, deep, full whistle and a slight, low, clear trill. The latter is often used to protest an intrusion at the nest. In Ecuador this flycatcher delivered a dawn song consisting of a single note monotonously repeated for many minutes. This dawn song was not heard in Costa Rica, although in other respects the utterances of the two populations of the Bran-colored Flycatcher were closely similar. From a female, which could be distinguished by her plumage, only weak, croaking notes were heard.

In Costa Rica, nest building begins in late March or April. The female alone constructs the open cup which is attached by its rim to the arms of a horizontal fork. The nest may be from 4 to 12 feet above the ground, but usually it is not over 7 feet high. In South America nests are sometimes higher, occasionally up to 30 feet. Cobweb is employed to bind the structure to its supports, and usually some green moss is attached to the outside, far more being used in Ecuadorian than in Costa Rican nests. The construction of the nest takes from 7 to 9 days.

After the nest is finished, 4 or 5 days elapse before the first egg is laid. The second egg usually follows 2 days later, but the interval varies from 1 to 3 days. In Costa Rica, as in widely separated parts of South America, the set regularly consists of 2 eggs.

At one nest the female could be distinguished from her mate by her darker color and weaker, simpler notes. She alone incubated. In five hours her sessions averaged 7.7 minutes, her recesses 4.6 minutes, and she spent 62.6 per cent of the time on her eggs. Another female, watched for six hours, took sessions averaging 6.6 minutes, recesses averaging 6.5 minutes, and sat for 50 per cent of the time. Sessions were longer in the cool early morning than later in the day.

One male often guarded the nest while his mate was absent, but he never incubated.

The incubation period, as determined at 3 nests, is 17 days.

Both parents bring small insects to the nestlings, but only the female broods. The male who could be distinguished from his mate did not bring food during the first four daylight hours after the first nestling hatched, but in the next 24 hours he began to feed the nestlings. His delay in starting to bring food was apparently caused by his failure to notice the nestlings on their first morning.

Newly hatched nestlings bear short gray down and the interior of their mouths is orange-yellow. Their feathers begin to unsheathe when they are about 9 days old, and at the age of 2 weeks they are clothed with plumage which closely resembles that of the adults. They leave the nest when they are from 15 to 17 days of age.

In El General, eggs are sometimes laid in late June, but it is not known whether these are second broods or replacements of earlier, unsuccessful nests.

TROPICAL KINGBIRD¹

Tyrannus melancholicus

The Tropical Kingbird is one of the most widespread and conspicuous of all the passerine birds of continental tropical America. It requires scattered trees and bushes or woodland bordering open spaces, and wherever within its vast range this requirement is met it is likely to be found, whether in regions of high rainfall or in semi-desert. It occurs from sea level up to 5000 feet in Guatemala and to 8000 feet in Costa Rica.

The sexes are alike in plumage, but sometimes the members of a pair can be distinguished by a careful examination of their heads through field glasses. The feathers of the male's crown do not lie quite so smooth and flat as do those of the female's crown. The difference between the sexes is similar to but not so pronounced as that in the Gray-capped Flycatcher.

At both extremes of its breeding range, as in the southern United States and northern Argentina, this kingbird is migratory. At higher altitudes in Guatemala, it forms small flocks in the months of the northern winter. In Costa Rica, however, it remains paired, and in close contact with its breeding territory, throughout the year. Yet even here three individuals sometimes associate closely in January.

The Tropical Kingbird's food consists largely of insects caught on the wing, often at the end of a long, upward dart but sometimes, especially in the evening, on an extended, swallow-like, circling flight, in which a number are captured before the bird returns to a perch. At times the kingbird swoops downward to snatch grasshoppers or other objects from low herbage, or it may alight for a moment on the ground. It often eats berries, and rarely a small frog is taken.

The kingbird's notes are high, shrill twitters and trills such as one would expect to hear from a smaller bird. During about half the year the male sings a dawn song, which he begins as soon as the eastern sky brightens, when scarcely any other bird has broken its nightlong silence. This song is made up of short, clear *pit's* and a series of thin trills which rise in pitch by one or two steps. Generally one or several of the short monosyllables introduce each series of trills. In El General, this twilight song is sometimes heard in late January, but more commonly dawn singing begins in February or March and continues into June, with perhaps sporadic singing at daybreak in July and August. On coming together after a separation, the members of a pair greet each other with high-pitched trills and twitters, at the same time vibrating their partly extended wings. At times they join in this greeting ceremony even when the approaching bird alights on a perch a hundred feet from its partner.

In the Panamá Canal Zone nesting starts in February, but in the valley of El General in Costa Rica, 2000 to 3000 feet above sea level, building has not been observed before mid-March and usually it does not begin until April. The nest is a broad, shallow, bowl-shaped structure composed of lengths of dry vines, small twigs, rootlets, tendrils, weed stems, grasses, and other coarse, dry vegetable materials, with finer materials of the same sort, and sometimes horsehair, in the lining. Often one can glimpse the eggs through the meshes in the bottom of the loose fabric. The nest is placed in a bush or tree standing in a pasture, beside a road, on the gravelly flood plain of a river, or in almost any open space, but scarcely ever in the midst of crowded vegetation. Often the birds choose a very exposed site, as in the top of a small tree with sparse foliage, as though scorning

¹ This life history is a résumé of an account in the Proceedings of the Linnaean Society of New York, 63-65:21-38, 1954, with later observations added.



Fig. 55. Tropical Kingbird.

concealment. Thirty-six nests ranged in height from 6 to 40 feet above the ground, but most of them were at or below 15 feet. In Gatún Lake, Canal Zone, nests were placed among the epiphytes that grew on the trunks of partly submerged trees. Sometimes these were as much as 100 feet from the shore and from 3 to 25 feet above the water.

While seeking a nest site, one member of the pair sits in promising crotches and utters a low, rapid twitter which somewhat resembles the dawn song but is not so loud and high-pitched. This ritual may be repeated day after day in various positions, until at

last the female brings a long piece of dead vine or some similar material to one of the crotches, flying up with much twittering. She alone builds the nest, usually at a very leisurely pace. One female which was building a replacement nest, which in most birds is built more rapidly than the first nest, brought material only 14 times in four hours of the morning. The male may accompany his mate on her excursions to gather material, but more often he rests, preening, near the nest and greets her with a high-pitched trill and fluttering wings as she returns with something in her bill.

In the Canal Zone, a nest with eggs was found on February 24, but in El General the earliest date for eggs is March 22, and only this one set was discovered before April. The eggs are whitish or pale buff, blotched with reddish brown, pale brown and lilac; the markings are most crowded on the thicker end. The measurements of 12 eggs average 24.7 by 18.2 millimeters. Of 25 sets found by the author in Panamá, Costa Rica, and Guatemala, 12 sets contained 2 eggs and 13 consisted of 3 eggs. Sets of 4 have been reported from Guatemala. The size of the kingbird's set increases with distance from the Equator, and beyond the tropics, as in Argentina and the United States, it frequently lays 4 and sometimes 5 eggs. The eggs are deposited rather late in the morning, sometimes around midday. They are laid on either consecutive or alternate days, and both the long and the short interval may be observed in a single set of 3 eggs.

Only the female incubates, as was proved by watching a pair whose members could be distinguished by paint marks, another in which the female's crown was smoother than that of her mate, and a third at which the sexes could be distinguished only by their behavior. In eight hours of observation at a nest in Guatemala, the marked female took 7 completed sessions ranging from 10 to 56 minutes and averaging 32.4 minutes and 8 recesses ranging from 9 to 20 and averaging 12.1 minutes. Thus she sat for 72.8 per cent of the time. In seven hours of watching at a Costa Rican nest, the smooth-crowned female took 5 completed sessions varying from 19 to 92 minutes and averaging 50.8 minutes and 5 recesses ranging from 15 to 47 and averaging 24.6 minutes. Consequently she kept her eggs covered for 67.4 per cent of the observation periods. Her longest session was taken in the middle of the day, when much of the time she was panting in the hot sunshine. Another Costa Rican kingbird, which could not be distinguished by appearance from her mate, was watched for only two hours late in the morning. She sat far less constantly than the others, taking 5 sessions varying from 3 to 30 minutes and averaging 12 minutes and 6 recesses ranging from 5 to 10 and averaging 7.7 minutes. She covered her eggs for 60.9 per cent of the two hours.

Although some males perform sentry duty at the nest while the female is away seeking food, the kingbirds frequently neglect this precaution. Yet from the exposed perches from which they catch insects, they command a wide view of their surroundings and can see a hawk or kite approaching their nest even if they are a good distance from it. Thus the exposed nest is rarely wholly unguarded, at least against aerial predators, which appear to menace it more than flightless ones.

At two nests the incubation period was 15 days and at two other nests it was 16 days.

Newly hatched nestlings have sparse, light gray down which fails to cover their pink skin, and the interior of the mouth is orange. They are fed by both parents but brooded only by the female. At one nest the female brooded her nestlings in the sunny hours of the day until they were at least 10 days old. She was also seen covering them in the early morning when they were 17 days old, although at that time she did not brood them while the sun shone. When the two young birds were 9 days old, they were fed 40 times between 6:25 and 10:25 a.m., 16 times by the male and 24 times by the female. The latter also brooded them for a total of 24 minutes in this period. When they were 17 days old, they were fed 42 times in the corresponding four hours of the morning, at least 19 times by the

male and 20 times by the female, with 3 more feedings by a parent whose sex could not be determined. Thus older nestlings were fed about equally by the parents, at the rate of about 5.2 times per capita per hour. These 17-day-old nestlings were well feathered, preened much, sometimes rested on the rim of the nest, exercised their wings, and uttered high-pitched calls which resembled those of the parents but were weaker.

One nest was built beneath a small colony of Yellow-rumped Caciques on a dead, epiphyte-laden stub rising above the water of a cove of Gatún Lake. The nestlings, after they were covered with feathers, were severely attacked by a swarm of small, biting melipone bees, from which their parents were powerless to protect them. They survived this persecution, however, and lived to leave the nest a few days later. The first nestling left the nest at sunrise; the second left two hours after the first. Both fledglings left quite spontaneously, without parental prompting. As the first fledgling flew over the water, a parent flew just above and apparently in contact with it, forcing it lower. When it came to rest on an exposed bush on the shore, both parents dashed at it and knocked it from its conspicuous perch into the midst of concealing vegetation. A number of birds of other kinds whose nests were in exposed treetops or faced wide expanses devoid of shelter, such as streamside birds, have been seen to follow in similar fashion fledglings that are taking their first flight. The purpose of such "shielding flight" by parent birds is apparently to screen their weakly flying youngsters from aerial attack. This behavior is not restricted to the parents of the fledgling, for other adults of the same species, which happen to be nearby, may likewise follow the fledgling closely. Sometimes birds of a different species accompany the fledgling in much the same way. Thus when the second young kingbird left the nest, three of the caciques hurried after it and forced it down into the water. But they did not harm it, and it easily flapped its way to the neighboring shore.

From one nest, two nestlings departed when they were 19 days old, and from another nest a lone nestling took leave when it was 18 or 19 days of age. The fledglings closely resemble the parent birds in plumage. They are fed by the adults for at least two weeks after they leave the nest.

Evidence for second broods is lacking. The latest nest in El General held well-feathered young on July 24, and one at Zacapa, Guatemala, contained feathered nestlings on August 12; but in Central America one rarely finds an occupied nest after the end of June.

Adult kingbirds have been found roosting in isolated trees standing in a pasture. They rest on slender twigs, sometimes only eight or ten feet above the ground, where they may be wholly exposed on the sides and below but are screened above by the foliage of the tree. The members of a mated pair seem never to sleep in contact with each other, an arrangement which might enable a nocturnal predator to capture both at once, but often they rest only a few feet or yards apart. A few days after they left the nest, two fledglings roosted touching each other on a low, exposed twig such as the adults often choose for sleeping, and one of the parents slumbered about ten inches away from them. This arrangement was discontinued after a few nights.

The aggressiveness of these kingbirds toward harmless birds of other species has been greatly exaggerated. The parent kingbirds often permit such birds to rest and even to nest close to their own nests. Toward hawks, kites, toucans, and other nest robbers they are boldly aggressive, but their dashing attacks do not always save their nests, a large proportion of which are pillaged. Although they buffet a flying toucan, they fear the huge bill of one that is perching; I have seen a Swainson Toucan swallow a nestling while the parents fluttered helplessly around it. The kingbirds' pugnacity toward predators, coupled with their tolerance of harmless small birds, make them a great asset to the feathered community. They impress one as high-strung, nervous birds, intensely alive and alert.

BOAT-BILLED FLYCATCHER¹

Megarynchus pitangua

The Boat-billed Flycatcher is one of the largest and heaviest representatives of its great family. Tolerant of a wide variety of climatic conditions, it ranges from México to northern Argentina, and in Central America it is found from sea level up to 6000 feet or a little more. It appears to withdraw from this upper limit during the wettest and stormiest months of the year. It wanders in pairs or family groups over the roof of the forest and through open country with scattered trees, and it seldom remains long in one spot unless it is nesting.

Its food consists of both insects and small fruits. In the dry season when cicadas are abundant, they form an important part of the bird's diet and are beaten vigorously against a branch before they are swallowed. Insects are snatched more often from leaf and bough, at the end of a rapid dart, than from the air. Berries are often plucked in the same manner.

The common call note of the Boat-billed Flycatcher is a loud, rather high-pitched monosyllable, which is rapidly repeated while the bird perches or flies. It sounds like *choip choip choip choip*. Heard close at hand, this note is slightly raucous, but two or three Boat-bills calling in this manner in distant treetops, their voices softened by distance, are delightfully melodious. While resting, the Boat-bill delivers a long-drawn, whining *churr* that is disagreeable to human ears. Perching high in a tree, the male delivers at daybreak a special song which consists of a loud, clear, ringing *cheer* that is repeated over and over, with from time to time the interjection of a slurred note of very different character that sounds like *bo-oy*. Rarely does the whining *churr* intrude into the song, and the far-carrying, clear notes always predominate. This song is rarely given after sunrise, but it may be heard during the day when the bird is greatly excited, as by a rival. In El General the dawn song is occasionally delivered in January, but the period of sustained singing extends from late February or March to the end of June or even July. Sometimes the female builds her nest in the tree which her mate has chosen for singing, but at other times the singing post and the nest tree are rather widely separated.

In El General, nest building sometimes begins in late February but more often it does not start until March. Usually a tall, isolated tree is chosen for the nest, which is sometimes in a very exposed situation, with scarcely any shade. Dead trees are occasionally selected as the nest site. Twenty-eight nests ranged in height from 20 to about 100 feet above the ground.

The female builds the broad, shallow, cup-like nest without help from the male, who often accompanies her on flights to seek material. When they return, he carries at times a twig or some other bit of vegetation which he fails to add to the nest. The material used by the female is gathered from trees rather than from the ground and consists of coarse twigs, dry vines and at times whole, small, living orchid plants for the foundation and outer layers, whereas for the lining she uses tendrils and the fibrous roots or rhizomes of epiphytic plants. The structure is a broad, relatively shallow, open bowl and contrasts strongly with the domed nest of the Kiskadee, which as a consequence of the close superficial resemblance of the two species has been repeatedly confused with it in published accounts. The female Boat-bill builds slowly, rarely bringing more than 10 billfuls of material to her nest in an hour, although one bird brought 19 billfuls in one hour early

¹ This life history is a résumé of a paper in *The Auk*, 68:30-49, 1951, with later observations added.

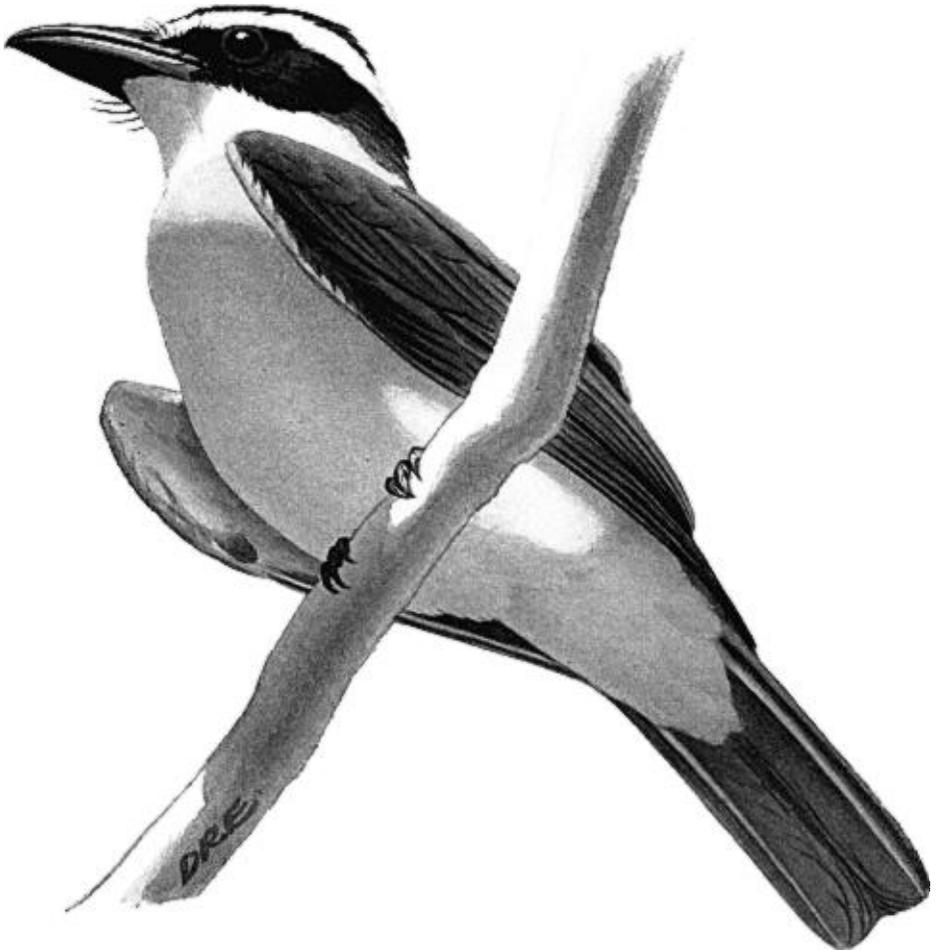


Fig. 56. Boat-billed Flycatcher.

in the morning. The construction of the nest often requires from 10 days to 2 weeks, but a female which had lost an earlier nest worked only 6 or 8 days on the structure she built to replace it.

Five nests contained 2 eggs or nestlings and 5 contained 3 eggs or nestlings. The eggs are whitish, thickly speckled and blotched with brown and pale lilac over the whole surface, although the blotching is most dense on the thick end. Two or sometimes even three days separate the laying of successive eggs. One egg was laid between 10:00 a.m. and noon, another between 11:30 a.m. and 1:15 p.m.

Only the female incubates, taking sessions which often exceed an hour in length and are alternated usually with short recesses. In six hours one female took 5 sessions ranging from 27 to 68 minutes and averaging 44.6 minutes and 6 recesses varying from 5 to 20 minutes and averaging 13.3 minutes; she kept her eggs covered 77.0 per cent of the time. In four and a half hours another female took 3 sessions ranging from 54 to 91 minutes and averaging 69.0 minutes and 4 recesses varying from 7 to 15 minutes and averaging 9.8 minutes; she was in her nest 87.6 per cent of the time. In ten hours a third female

took 16 sessions ranging from 15 to 77 minutes in length and averaging 30.2 minutes; 16 recesses ranged from 2 to 19 minutes and averaged 8.3 minutes; she sat for 78.4 per cent of the observation period. While incubating the female Boat-bill often utters a rapid series of low, soft notes that suggest contentment. During her brief excursions for seeking food her mate often guards the nest, sometimes from a perch close beside it, sometimes while resting in a neighboring tree which affords a good view of the surroundings.

At one nest, where all 3 eggs hatched, the incubation period was 17 days, but at another nest it was at least 18 days.

Both parents feed the nestlings, chiefly with insects. A single feathered nestling was fed 25 times in 5 hours and 40 minutes, or at the rate of 4.4 times per hour. The female alone broods, but while she is away the male watches over the nest, so that, especially while still unfeathered, the nestlings are guarded most of the time. Even well-feathered nestlings almost ready to fly are attended much of the time, the female sometimes brooding, not because this is still necessary, but rather as a variation in her mode of guarding.

The nestlings remain in the nest until they are 24 days old and can fly well.

In El General breeding continues until July, but most late nests appear to belong to birds whose earlier attempts to rear progeny were unsuccessful. Occasionally a pair which has been successful with an earlier brood will nest again, but there is no evidence that these second nestings yield offspring.

Young birds hatched in May or June may continue to accompany their parents until the following February, thus giving rise to flocks of four or five individuals. Pairs which rear no young remain together through the long nonbreeding season. They sometimes roost in a tree in a clearing on perches a few feet apart, where they are canopied above by foliage, but where they are fully exposed from below.

Boat-billed Flycatchers display great antipathy to toucans, which are apparently one of the chief despoilers of their nests. When these huge-billed birds appear in the vicinity, the flycatchers fly a long way to meet and harry them. While attending fledglings, they sometimes fly toward an approaching man and follow him about, scolding and often darting angrily at his head, until he leaves the neighborhood.

A pair of Boat-bills was once watched while they played with a feather, beating it against a branch as though it were an insect, letting it drift earthward, then darting down to catch it and repeat the performance.

TORRENT FLYCATCHER

Serpophaga cinerea

The winsome little Torrent Flycatcher is the tutelary spirit of the wild, rushing mountain streams that plunge loudly down from the highlands of tropical America. These swift rivers are its home, and it rarely ventures far from their boulder-strewn courses. Yet it seems a frail bit of feathered life to dwell always on the brink of foaming surges, which hungrily lap the rocks where it stands, as though to devour it. It wears the colors of the dark rocks and broken water of the mountain torrents which it haunts. Its body plumage is a gray so light that it approaches the whiteness of the foaming water; a blackish hood covers its crown, forehead and cheeks; its wings and tail are of nearly the same color; and there are two faint light bars on the blackish wing-coverts. One of the smallest of the flycatchers, this bird is only about four inches in length. Male and female are alike in plumage.

The Torrent Flycatcher ranges along the backbone of the continent from Costa Rica to Bolivia. In Costa Rica it is found on both sides of the Cordillera from about 800 feet (Carriker, 1910:724) upward to at least 5500 feet above sea level, and in western Panamá it occurs up to 6000 feet (Ridgway, 1907:398). These altitudinal limits appear to be determined by the presence of fairly wide, boulder-strewn streams, full of rapids and broken water. At lower elevations many of the rivers flow smoothly across the coastal plains; above 6000 feet, most of the Costa Rican streams are mere brooks traversing deep and sunless gorges. In the Andes, where the land is much more elevated and large rivers are found at far greater altitudes than in southern Central America, the Torrent Flycatcher is found at higher elevations. In Ecuador, I met the bird along mountain torrents at an altitude of 9000 feet. In this country, it is a familiar figure along the streams pouring down both the eastern and western slopes of the Andes, and it extends downward to at least 2500 feet. In Perú it has been recorded from sea level up to 10,000 feet (Taczanowski, 1884:237).

Both in Costa Rica and in Ecuador, I have nearly always met these flycatchers in pairs, and I have no doubt that they remain mated throughout the year. Each pair claims as its territory a certain length of the stream from which it drives intruders of its own kind.

FOOD

For years I have bathed almost daily in mountain streams where Torrent Flycatchers dwell, but I never tire of watching them catch their food. They forage chiefly from the rocks that rise amid the current or line the shore, and they rarely penetrate the stream-side vegetation. They flit airily from boulder to boulder, now rising above the waterway, where they twist and turn with graceful skill as they catch minute flying insects, now darting softly against the foliage that overhangs the stream and plucking a caterpillar or tiny spider from the leaves, now stooping to pick a morsel from the top of the rock where they stand, now hovering momentarily before the vertical or overhanging face of some taller neighboring rock to seize one of the minute creatures which crawl there. They hop lightly across the flat surfaces of the wider ledges and skim easily over the smoother reaches of the stream, almost touching the water. They cling to the steep, wet sides of rocks overgrown by species of the Podostemonaceae that resemble tiny mosses or small algae, among whose green fronds they find much food. Not infrequently they alight upon a rock surface over which a thin sheet of water is pouring, picking inconspicuous objects



Fig. 57. Torrent Flycatcher.

from its glistening face. Standing with their feet in the water, their breast is wetted by the surge. Now an inviting morsel tempts them to the very brink of the rapids, where their plumage is sprinkled by the spray and they seem in danger of being sucked under by the surge, but they skillfully avoid the lapping waves, flitting away to safety as these reach up toward them. Ever active, light in their movements as downy feathers wafted by the breeze, they forage silently and swiftly, catching chiefly creatures so small that they cannot be detected by the watcher on the shore. At times, however, the Torrent Flycatcher captures a dragonfly half as long as itself and with difficulty gulps down this substantial meal. Small gray moths are often eaten. Rarely wholly quiescent in the daytime, these flycatchers, as they stand on the rocks looking about them for insects, are constantly wagging their short black tails up and down in the manner of so many other fluviatile birds.

VOICE

Often, when after a brief separation the members of a pair come together, they face each other, lift up their heads, and sing in unison a short refrain made up of a sharp *chip*, rapidly repeated. This simple twittering is devoid of all musical quality, but the sharp

notes ring out above the incessant brawling of the stream, which would overpower a more finely modulated song. The character of the Torrent Flycatcher's notes is such that amid the sound of running water they possess an audibility all out of proportion to their volume. Hudson (1920, 1:169-171) describes the somewhat similar duets of the Little Crested Grey Tyrant and the Little River-side Grey Tyrant, two related species inhabiting Argentina.

If the Torrent Flycatchers possess any more musical notes, I have failed to hear them. Yet, like other flycatchers, this species delivers a dawn song, if so slight and monotonous a performance may be dignified with the name of song. At daybreak on a number of mornings in early April, 1948, one of these birds stood on a rock in the channel of the river in front of our house and repeated over and over a single note which, although slight, was sharp enough to be heard above the babble of the current. In character, this note was similar to those which the mated pair pour forth in unison while standing together on a rock, but it was repeated at a slower tempo, often with an interval of ten seconds between successive notes. Sometimes the slow monologue of the dawn song was interrupted by a more spirited duet. The flycatcher did not always perform on the same rock but moved up and down the river over a distance of perhaps a hundred yards. One morning, at the upper end of its beat, this flycatcher had a belligerent encounter with a neighbor upstream. This was marked by the utterance of many slight, sharp notes and much darting back and forth; there was no actual fighting.

NEST BUILDING

In El General, where most of my observations on the Torrent Flycatchers were made, they must on rare occasions prepare their nests about the end of January, for one pair had newly hatched young on February 23.¹ Usually, however, building does not begin until late in March, when the rivers are low after two or three months of greatly reduced rainfall. The compact, open cup is placed along the rivers which the flycatchers frequent, sometimes above the shore but far more often above the water itself, far out from the bank or even above the middle of a wide stream, and at times over rapids. In Costa Rica rushing mountain streams may be bordered by the riverwood or sotocaballo (*Pithecolobium*), a leguminous tree whose massive gnarled trunks lean over the banks and whose far-reaching, epiphyte-burdened limbs overarch the channel. The Torrent Flycatchers often build their nests among the terminal foliage of a slender branch of this tree that droops low above the rushing current. A forked twig with clustering leafage is usually chosen as the nest site, but exceptionally a dead, leafless branchlet is selected.

Many nests are attached to pensile vegetation that dangles above the waterway. Two nests were fastened among the roots of epiphytes hanging beneath boughs which stretched above the river. One nest was supported among slender, pendent, leafy shoots of epiphytes in a similar situation. Another was attached to some slender vines of a *Convolvulus* which draped over the nearly vertical face of a huge rock projecting far out into the channel of a mountain stream. A nest found above the Río Puyo in the eastern foothills of the Ecuadorian Andes was fastened to the end of a long streamer of moss that dangled below a branch leaning over the current. A somewhat similar site was a completely rotten branch that swung beneath the tree from which it had broken and to which it was attached by means of the roots of epiphytes that crept over it. A few ferns and much moss grew on the decayed branch, giving it a green color, and among them the mossy green nest was concealed.

¹ In El General, Torrent Flycatchers at times begin their nests even earlier than this. In 1957, the second half of the year was exceptionally dry. On January 3, 1958, I found a nearly completed nest above the Río Peña Blanca in front of our house. The flycatchers continued to bring material to this structure from time to time until at least February 27. On March 8, I found two eggs in this nest.

A few less usual nest sites may be mentioned. One nest was situated at the base of a tuft of grass that grew from a crevice in an enormous rock standing in the middle of the channel of the Pejivalle River in eastern Costa Rica, where it was completely surrounded by the swift current. In the same region, another nest was placed beneath the slightly inclined face of a great rock rising beside a small river. The surface of this rock was overgrown with a delicate polypody fern with slender creeping stems and small roundish leaves. Some of the rhizomes had torn away from the rock and dangled beneath it. The nest was attached to these loose ferns and hung free, a few inches from the face of the rock and somewhat sheltered by its overhang. Another nest in an unusual position was in contact with the lower side of a thick trunk leaning over a river, tucked in between the bark and the root of an epiphyte that crept over the trunk, and partly screened by the leaves of a small aroid. This nest was close beside a ford where many horsemen and ox-carts crossed the river.

The nests I have found above the channels of rivers ranged from about 2 to 13 feet above the water, the highest being that in the streamer of moss above the Río Puyo in Ecuador. About half of the 21 nests that I have seen in El General were 3 or 4 feet above the water, when the river was not swollen by the heavy afternoon rains which are so frequent in the Torrent Flycatcher's nesting season. One nest, placed above rocks beside a stream rather than over its channel, was only 28 inches up. Some nests, built above the shrunken streams of March or early April, are washed away when the river rises during torrential rains in May. Since these flycatchers have a strong tendency to build in the same spot year after year, sometimes placing their new nest on the remains of the old one from the preceding season, this misfortune may overtake them in two successive years.

I have watched the construction of four nests, at all of which both male and female

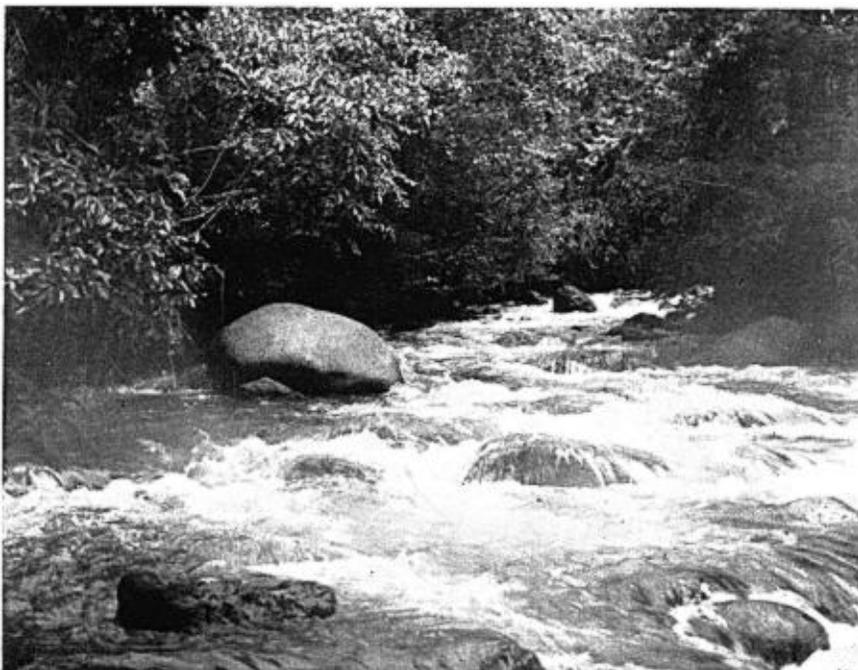


Fig. 58. Río Peña Blanca in the valley of El General, Costa Rica. Torrent Flycatchers forage along the channel and Riverside Wrens hunt through the vegetation on the shore.

shared in the work, but since the two could not be distinguished, it was impossible to decide which took the greater part. Each helped to shape the nest as well as to find and bring materials. At one of these nests, which was attached to a mass of roots of epiphytic plants that dangled above the rocky channel of the Río Pacuar in El General, I watched for two mornings, May 22 and 23, 1940, while the flycatchers were finishing their structure and adding the lining. When one of the pair, arriving with material in its bill, found the other sitting in the cup to give it shape, it was sometimes so eager to place its own contribution that it sat on top of its mate. The flycatcher on the bottom then promptly struggled out and flew away, leaving the latest arrival in full possession.

Although it was late in May, the river was still low, and the lower parts of the rocks rising above the current were covered with the dry pods of two species of the Podostemonaceae. The tiny pods, no larger than the capsules of many mosses, had long ago split into two valves to shed their minute, scarcely visible seeds, but they still stood above the rocks on brown, wiry stalks an inch or two long. The flycatchers plucked these stalks from the rocks, and when they had a billful carried them to their nest, of course with the empty pods still attached. It was not easy for birds so small and weak to tear the stalks from the stone, and they were obliged to relinquish many at which they tugged in vain. Still, these pod-bearing stalks were so numerous that the birds soon found enough that yielded to their efforts. They also gathered moss from the boughs of trees overhanging the river, and sometimes they flew into the thickets along the shore for other material whose character I could not determine.

After building for a while, one of the flycatchers took a bath in the shallow water flowing swiftly over a submerged boulder in the middle of the channel; then it stood on a rock in the sun to preen and dry.

At a later nest, which I watched on April 11, 1949, both members of the pair brought material 25 times in the hour from 7:25 to 8:25 a.m. and 10 times in the following hour. Next morning, in the hour from 7:20 to 8:20, they came with contributions for the nest 18 times. On April 22, 1954, I watched a pair bring materials to their nest 21 times from 7:10 to 8:10 a.m., 22 times from 8:10 to 9:10, and 12 times in the half-hour from 9:10 to 9:40. Ten times in these two and a half hours the second member of the pair came to add something to the nest, or to shape it, before the first, which had also contributed to the structure, flew out of sight. This indicated more than a casual participation in building by both partners. Sometimes, after working at the nest, one of the pair would drop down to a rock in the river bed below it, lift up its head, and pour forth its simple, sharp song.

The completed nest is a deep, thick-walled, substantially built cup. The exterior is usually wholly covered with green moss. The middle layer is of fine rootlets and fibres, and the interior is lined with soft, light-colored fibrous material. In the bottom there is usually an ample inner lining of downy feathers. One nest was lined with blue-gray feathers of the Blue Tanager; another was lined with an unbroken layer of white chicken feathers picked up on the neighboring shore; one had a lining of downy dove's feathers; and one contained a mixture of white and vermilion feathers, the latter from the breast of the White-tailed Trogon. The last nest differed from most of the others in the composition of its walls, which were made largely of dry, brownish materials, such as blades of grass, dry grass inflorescences, strips of plant epidermis, and rootlets. It contained, however, very little green moss and this was mostly concealed among the brown ingredients, so that the aspect of the whole structure was quite distinct from that of the typical nest of the Torrent Flycatcher. Some of the grass blades hung far below the bottom, giving the nest an untidy appearance. Among the materials of the inner part of the wall were many pods of the Podostemonaceae with their wiry brown stalks like moss setae,

and in the bottom were the feathers already mentioned. With its green mossy covering and soft lining of downy feathers, the Torrent Flycatcher's nest is a beautiful structure.

THE EGGS

The earliest nest I have found in El General held newly hatched nestlings on February 23, 1947, which would place the beginning of laying in the first days of February. It is rare, however, to find eggs before April. In Ecuador, on the eastern side of the Andes and between the first and second degrees of southern latitude, I found a nest with eggs near Puyo, at about 3000 feet above sea level, on August 25, 1939, and another newly begun along the Río Pastaza, 4300 feet above sea level, on October 26 of the same year.

Eighteen nests each contained 2 eggs or nestlings, and I have no knowledge of larger sets. In three nests the second egg was laid two days after the first, but in one nest the eggs were laid on consecutive days. The eggs are uniformly pale buff or "old ivory," without any markings. The measurements of 14 eggs average 16.5 by 12.6 millimeters. Those showing the four extremes measured 17.1 by 12.7, 16.7 by 13.5, 15.5 by 12.3, and 16.3 by 11.9 millimeters.

In 20 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: February, 1; March, 1; April, 11; May, 4; June, 3.

INCUBATION

The eggs are incubated by the female alone. As in other small flycatchers that subsist chiefly upon minute insects, she takes very short sessions and seems scarcely to have become comfortably settled in her nest before she darts off to eat again. One female Torrent Flycatcher which I watched for five hours, including both morning and afternoon, at the very end of the incubation period, took 25 sessions which ranged in length from 3 to 13 minutes and averaged 6.7 minutes. Her 23 recesses from the nest varied from 1 to 13 minutes in length and averaged 5.2 minutes. She kept her eggs warm for only 56.3 per cent of the five hours. Another flycatcher which I watched for four and a half hours, divided between the early morning, late morning, and late afternoon, was equally restless. Her 17 sessions ranged from 1 to 14 minutes and averaged 7.2 minutes. Her 14 absences varied from 2 to 17 minutes in length and averaged 9.1 minutes. She devoted only 44.1 per cent of the four and a half hours to warming her eggs.

The first of these flycatchers sat more constantly early in the morning while the air was cool than later in the day. From 5:30 to 8:00 a.m., she took 11 sessions which averaged 8.5 minutes and 12 recesses which averaged 4.8 minutes. Between 8:00 a.m. and 3:00 p.m. (not in one continuous watch), I timed 14 sessions which averaged 5.3 minutes, and 11 recesses which averaged 5.6 minutes. As the day grew warmer, the flycatcher's periods of sitting became shorter and her absences longer. But the second flycatcher took her longest recesses as well as her longest sessions in the early morning and late afternoon. Late in the morning, while the sun shone brightly near the zenith, her periods both on and off the nest were shortest; she came and went every few minutes. Both these females might be lured from the nest by the sight of an insect flying past. Sometimes they would return as soon as they had overtaken the insect in the air, but at other times they would prolong their absence and capture many additional insects. One possible advantage of the enclosed nest built by so many kinds of flycatchers is that the sitting female cannot see the insects that fly close by, or at least she cannot see them on all sides. Hence she is not so frequently tempted to interrupt incubation.

Both the male Torrent Flycatchers were most attentive to their mates; the male of the first nest was especially so. Often while the female incubated, he would perch beside or even upon the rim of the nest to rest or to preen, and at times while standing there he

would bill the feathers of her head or breast in the most affectionate manner. Once he preceded her to the nest and perched on a twig close by it, flagging his tail up and down in characteristic fashion. Then the female came and twittered as she took her place on the eggs. The male then moved along the supporting branch until he reached the nest, where he hopped on the rim and gently pecked his mate's breast. During the female's absences from incubation, the pair foraged together and from time to time sang in unison. They zealously guarded their reach of the river from intrusion by others of their kind.

Torrent Flycatchers sometimes incubate with an amazing disregard of the peril from rushing water. In 1937 I had under observation a nest built far out on a drooping bough of a riverwood tree, only three feet above the current of the Río Buena Vista, a mountain torrent subject to sudden rise from the heavy rains of May. One of these freshets caught the terminal foliage of the supporting branch and pulled it downstream until the nest was scarcely a foot above the rushing water. With the change in the position of the branch, the cup had been turned sideways more than forty-five degrees and the eggs seemed in danger of being shaken out. Yet the flycatcher persisted in warming them, clinging in her precariously tilted nest, which was continuously agitated because the current tugged ceaselessly at the end of the supporting bough. She seemed to disregard the white water of the rapids so close beneath her. Despite her faithfulness, her nest was turned sideways on the following day, and the eggs were spilled into the water.

At one nest the eggs hatched on successive days, the second 17 days after it was laid. At another nest only one of the two eggs hatched, 18 days after the set was complete. The incubation period is accordingly 17 or 18 days. I have few determinations of the lengths of the incubation and nestling periods because the sites of so many of the nests over a rocky river bed made it difficult to follow their history. When I visited another nest on the eighteenth day after completion of the set, I happened to stumble on the irregular, slippery rocks in the river bed over which it was necessary to pass, and as I went down my walking stick struck against the nest and knocked out its contents. One of the eggs fell on a rock exposed above water and broke, revealing that it was addled. The other egg or the nestling that might already have escaped from it fell into the swift current and was whisked away before I saw it.

THE NESTLINGS

The newly hatched Torrent Flycatchers bear a fairly abundant light gray down, but it is not enough to hide their pink skin. They have tightly closed eyes and the interior of their mouths is yellowish orange. They are fed and guarded by both parents, but brooded, as far as I could learn, only by the female. A five-day-old nestling alone in the nest was fed 18 times in two and a half hours, or at the rate of 7.2 times per hour. Two nestlings that were fully feathered and almost ready to depart were fed 110 times in three hours, or at the rate of 18.3 times per nestling per hour. In the hour of most rapid feeding the two together received 42 meals. By the following morning one of these young flycatchers had flown from the nest and was out of sight. The one that remained in the nest received food 33 times in the 80 minutes from 6:40 to 8:00 a.m. Most of the insects brought to these nestlings were small and many of them were moths. But occasionally a parent came with a dragonfly so large that it was carried with an effort. This would be passed to the young bird with the insect's wide-spreading, filmy wings still attached, whereupon it was gulped down with difficulty. Usually a parent fed a single nestling on each visit to the nest, but exceptionally it brought something for both nestlings.

At the age of two weeks the nestlings are well feathered. As the time for their departure approaches, they often stand on the nest's rim, exercise their wings and preen much. One young Torrent Flycatcher that grew up alone in its nest left spontaneously at the

age of seventeen days. The fledglings in juvenal plumage differ most conspicuously from the adults in that the tops of their heads are much lighter, a medium gray instead of dull black. The young birds remain with their parents for five or six weeks after leaving the nest. After that the families separate, and only a single pair patrols each reach of the rushing mountain stream.

The latest Costa Rican brood of which I have a record flew from the nest at the end of July. The parents which reared these fledglings had nested nearby in April and May, but I am not certain whether their first brood was successful.

Although these chubby, whitish birds would be attractive in any setting, their charm is tremendously enhanced by the contrast they form with their background. The antithesis between the Torrent Flycatchers and their wild river home is as great as one can find between any organism and its environment, so that they seem to symbolize the disparity between life and its cosmic setting. The fragile birds are all warmth and animation; the stream is cold and invulnerable. The birds seem ever to tempt the surging waves, yet again and again elude their lapping tongues.

SUMMARY

Torrent Flycatchers dwell along the boulder-strewn courses of swift mountain streams from Costa Rica to Bolivia. In Costa Rica and neighboring parts of Panamá they are found from about 800 to 5500 or 6000 feet above sea level, but in the Andes of Ecuador and Perú they extend upward to 9000 or 10,000 feet. They live throughout the year in pairs, each of which claims as its territory a certain length of the river.

They eat small invertebrates which they snatch from the air above the channel or glean from the surfaces of the rocks, sometimes narrowly escaping the surge as they pluck something from a ledge over which water is shallowly flowing.

Their simple notes are high and weak but sharp enough to sound above the incessant din of a mountain torrent. Male and female join in a duet as they face each other on a boulder rising above the current, and at dawn the male delivers a special "song" consisting of notes of the same character more widely spaced.

In El General, Costa Rica, these flycatchers begin to build in late March, but in exceptional cases they may build as early as the end of January. The nest, a substantial cup usually covered with green moss, is placed in vegetation overhanging the water, from 2 to 13 feet up, but in El General about half the nests are only 3 or 4 feet above the stream. More rarely the nest is situated above the rocky shore rather than the water. Some nests are so low that they are destroyed when the river rises. Both sexes take important shares in building; sometimes both together bring material as often as 25 times in an hour. Most nests are softly lined with downy feathers before the eggs are laid.

The set regularly consists of 2 eggs, of which the second is usually laid 2 days after the first; it is rarely laid on the following day. They are uniformly pale buff, without any markings.

Incubation appears to be performed by the female alone and, especially in sunny weather, she is a most restless sitter. In five hours one female took sessions ranging from 3 to 13 minutes and averaging 6.7 minutes. Her recesses varied from 1 to 13 minutes and averaged 5.2 minutes. She covered her eggs for only 56.3 per cent of the time. Another female was on her eggs for only 44.1 per cent of four and one-half hours. One female persisted in warming her eggs after her nest had been strongly tilted when the supporting bough had been pulled down by high water so that she sat only a foot above the rushing current.

The male often rests on the nest's rim, beside his incubating partner, while he preens himself and from time to time bills her feathers.

In one instance the incubation period was 17 days and in another it was at least 18 days.

The nestlings bear fairly abundant, light gray down. They are fed by both parents but brooded only by the female. They are given small insects, including many moths, and sometimes a dragonfly with wings still attached, so large that they can scarcely gulp it down. A single nestling five days old was fed at the rate of 7.2 times an hour. Two feathered nestlings were fed at the rate of 18.3 times per capita per hour, and a fledgling on the point of departure received 33 meals in 80 minutes. In one instance, the nestling period was 17 days.

The young birds stay with their parents for five or six weeks after leaving the nest. After that the families break up, and a single pair patrols each reach of the mountain stream.

BLACK PHOEBE

Sayornis nigricans

The Black Phoebe is somewhat over six inches in length, with a long and expressively mobile tail. Its plumage is nearly everywhere blackish, but it is darkest on the head. The abdomen and in some races also the under tail-coverts are more or less white, and South American representatives of the species have two narrow white bars on each wing. The eyes are brown, the bill is largely black, and the feet are blackish. The sexes are alike. Since this species is so well known in the southwestern United States and a comprehensive survey of its habits has been given by Bent (1942:154-166), I shall limit the present account to what I have been able to learn about the bird in the tropical portion of its extensive range.

The Black Phoebe is found from northern California and western Texas to northern Argentina. Essentially a bird of mountainous regions, in South America it is confined to the Andean countries and the hilly parts of Venezuela east of the Andes. In Central America, as in South America, it occurs on both sides of the Cordillera. In Guatemala it has been recorded in the Pacific lowlands, and I have met it at points ranging from 1100 feet above sea level along the Río Copom in northern El Quiché, where one was present in mid-winter, to 7000 feet in the neighborhood of Tecpán in the Department of Chimaltenango. In Costa Rica I saw a single individual at about 1200 feet on the Río General in August, but in this region it is rarely encountered below 3000 feet. On the opposite side of the country, it is abundant on the Caribbean slope at an elevation of 2000 feet, whence it extends upward into the intensively cultivated central highlands to possibly 6000 feet above sea level. In Ecuador I met it only on the middle reaches of the Andean streams, up to about 6000 feet. Thus in the intertropical portion of its range the Black Phoebe inhabits chiefly the Tropical and Subtropical altitudinal zones, although in Guatemala it reaches into the lower edge of the Temperate Zone.

The Black Phoebe is rarely found far from water. Like the Torrent Flycatcher and the dippers, it is a familiar figure along the mountain streams of tropical America, where it is often seen standing on a boulder which projects above the rushing water, wagging its long tail up and down in the manner of fluviate birds. Although I have met it far more often than the dippers, it is in my experience neither so tolerant of altitudinal extremes nor so uniformly distributed along mountain streams within its range as the Torrent Flycatcher. At the same time, it is not so narrowly restricted to swiftly flowing water, for it dwells along the shores of lakes and ponds, and it very often establishes itself at the *beneficios* where coffee is processed. Here it is attracted by the open flume of rushing water that is nearly always present for washing the berries, by the insects which collect around the tanks in which the grains are fermented after the mechanical removal of the pulp, and by the wide concrete floors where the beans are finally spread to dry in the sun. I have also found the phoebe around cattle pens where the ground was bare and muddy. Its requirements appear to be open water, absence of dense vegetation, and if possible bare expanses of some sort whence it can pluck at least a portion of its insect food. Although one often meets solitary Black Phoebes, those about San Miguel de Desamparados in the central plateau of Costa Rica were usually in pairs in November, and along the Río Pejivalle and its tributaries on the Caribbean slope of the same country the birds were mated at least as early as January. A phoebe whose territory included a coffee *beneficio* near Cartago, Costa Rica, was alone when I first saw him in August and at this time he repulsed every other phoebe who attempted to share the concrete



Fig. 59. Black Phoebe.

patio with him, but by mid-September he seemed to have accepted a mate. In August in the Guatemalan highlands, I saw several times two phoebes which stayed in the same area and behaved as though they were mated.

FOOD

When they forage from a boulder rising above the current of a river, the phoebes make short darts or long sallies into the air around and above them to snatch up volitant insects, and among others they capture large dragonflies. Sometimes they deftly pick a floating insect from the water's surface without wetting their plumage. Frequently they gather their prey from some solid substratum. The first Black Phoebe that I ever saw, in the neighborhood of Tecpán, Guatemala, was foraging from an expanse of bare ground

beside a stream. It rested on a stranded log or on little hummocks rising above the irregular surface left by the collapse of a portion of the high earthen bank, and from these low vantage points it dropped down again and again to pick small objects from the exposed soil. Later it moved to a neighboring cattle pen, where it perched on the top of a fence post, or more often on the topmost strand of barbed wire. From these points it flew down repeatedly to gather food from the muddy ground churned up by the cattle, after each sally returning to the post or wire. Another phoebe rested on the strands of a fence that ran along the shore of the stream and from time to time dropped down to pluck small creatures from the surrounding herbage. At the coffee *beneficios*, the phoebes perch on fences, overhead electric wires, or the low ridges of concrete which divide the drying floor into compartments, whence they prey not only on flying insects but also on small invertebrates that crawl over the concrete floor. They even enter the porch of a house to gather up moths and other flying things that, attracted to the electric lights during the night, had the misfortune to be caught in the cobwebs and held until morning. In a small town beside a mountain stream, I have seen Black Phoebes perching on the wires above the streets and flying against the walls of the surrounding buildings to capture spiders or insects.

ROOSTING

At "Las Cóncavas," a coffee estate near Cartago, the phoebe that claimed the *beneficio* as his hunting ground roosted at night on an insulated electric wire in a narrow recess between two buildings. There he had a roof to shield him from the cold September rains and walls to protect him from the chilling winds of the highlands. He always slept close against the outer wall of the guest room, where by sticking my head through the window I could see him above me almost every night before I retired. On another coffee plantation in the same country, the overseer pointed out to me the spot where a phoebe passed its nights, on an electric wire a few inches below the ceiling of the front porch and just in front of the door. Whenever the man's numerous nephews and nieces came to visit his two children, the house was so noisy in the evenings that the phoebe was constrained to seek a quieter lodging at a distance, but after the departure of the guests it returned to its preferred roost. Although I happened to visit this plantation at one of the festive periods when the phoebe was absent from the porch, the overseer pointed out his feathered lodger on the front lawn, so that I had no doubt as to its identity. This house was rather distant from the nearest stream. Alfaro (1927:371) found evidence in the form of droppings that Black Phoebes roosted in the recess among the riverside rocks where they nested.

VOICE

The common call of the Black Phoebe is a simple *chip*, which is sometimes uttered sharply and briskly and at other times weakly. Its song consists of the monotonous reiteration of a disyllabic phrase which resembles that of the Eastern Phoebe and is responsible for its name. This plaintive chant is most often heard at dawn, at which time it is continued for many minutes. A Black Phoebe that lived about the thermal baths and the hotel at Baños on the eastern slope of the Ecuadorian Andes sang his weak, melancholy dawn song in August and September, but in October he fell silent. In Guatemala, a phoebe sang at daybreak on November mornings on the high ridge of a coffee planter's big house that faced an artificial lake. In Costa Rica, early one morning in September, I watched a phoebe circling slowly in the air high above the coffee patio where he caught insects. The bird was holding the axis of its body almost upright and was calling *fe-be*, *fe-be* over and over. Similar singing on the wing has been recorded for this species in the United States (Bent, 1942:155). On several occasions I heard this bird sing later

in the day, and once in the evening, while perching rather than in the air. Apparently this singing in full daylight was caused by the intrusion of rival birds upon his domain. Once while I examined a nest, the male phoebe stood on a rock in midstream and sang *fe-bé*, *fé-be*, *fe-bé*, *fé-be*, with the stress alternately on the first and the second syllables. While uttering these notes, he slowly raised his half-spread wings to a position above his back and let them fall to his sides again, continuing these movements as long as he sang.

NEST BUILDING

There are surprisingly few records of the nesting of this widespread bird in Central America. Alfaro (1927) found a phoebe building in Costa Rica on May 1, attaching its nest to a rock at a point a meter and a half above the water of a stream. On the Hacienda Chilata in El Salvador, Dickey and van Rossem (1938:349) found one breeding pair of phoebes for about every mile of the course of a small stream that flowed down a steep-walled ravine. The nests were placed in niches among the great rocks overhanging deep pools or waterfalls. They were built of mud pellets and lined with fine grass stems. Apparently, favorite sites had been used for nests year after year; for near every occupied nest were several old ones, usually completely overgrown with bright green moss, although they preserved their usual outlines. On April 28 these nests contained eggs and young in all stages of development, and there were also full-grown fledglings along this stream. Along the Pejivalle River in Costa Rica, I found well-grown fledglings as early as April 10, but some phoebes were then just beginning to build.

The only nest of the Black Phoebe that I have seen was found beside this same river on April 15, 1941. I should never have noticed it had I not chanced to see the phoebe with straws in its bill. This was in an area of great, irregular, moss-covered rocks beside the broad, turbulent stream, beneath the deep shade of the massive sotacaballo trees whose sturdy boughs were laden with a profusion of varied epiphytes. When I sat on a rock to see where the bird, which I assumed was the female, would take her burden, she hesitated, standing on a boulder that projected above the water and jerking her tail nervously up and down. Thence she flew up to cling at various points to the sides of the higher rocks along the shore, only to drop down to the low platform still holding the straws. Apparently she was trying to mislead me as to the nest's location. But I continued to sit quietly and to watch, until at last she flew up beneath the projecting portion of a huge, moss-covered boulder that stood at the brink of the stream. I could not see the bird beneath the great rock, but when she flew out her bill was empty and I felt sure that the nest was there. I then waded out and stooping beneath the rock found the structure that I sought. The underside of the rock presented a nearly flat expanse of several square yards, about four feet above the shallow water at the river's edge. From this ceiling of stone, well back from its edge, a cushion-like ridge projected downward. To the nearly vertical side of this ridge of rock the mud-walled nest was attached, 46 inches above the water at its present low level. Here the nest was completely sheltered from wind and rain, screened from the eyes of animals that prowled along the shore and of predatory birds which flew above the river, and beyond the reach of most creatures which crawl and creep. Except for the peril from a sudden rise of the river, a safer place for a nest could scarcely be found.

I watched the nest briefly on the following morning, and from 6:23 to 8:53 a.m. on April 17. Unfortunately, the stone on which I sat above the river did not afford a view of the nest itself, but I could watch the low rock projecting above the water on which the phoebe often rested on her way to the nest or just after she had added something to the structure. In the two and a half hours of my vigil on April 17, I saw material taken to the nest 49 times. Sometimes the bird darted up beneath the rock from the farther

side, where I could not see her well, so that I probably failed to count a few of her visits to the nest. I could not distinguish the sexes, but I saw nothing to suggest that the male ever helped with the building.

The female phoebe alternately brought mud and fine grasses or similar material. The vertical face of the rock above the nest was covered with moss in which many tufts of fine grass were rooted. These were now dry and brown and supplied the bird with much of the material she needed for lining the nest. Usually the phoebe flew up from the top of the lower rock, which was her favorite resting place, tore away a billful of fine grass while hovering on the wing in front of the vertical face, then without alighting dropped down to the lower rock for a short rest before she flew up to the nest with the material. Rarely the bird clung to the mossy side of the rock while it tore away the dry grass. This grass, and a certain amount of similar material which was collected farther away, was used for the lining. This was applied first at the rim and in the course of the morning was gradually extended down toward the bottom of the cup.

The mud was gathered on the shores of the river and brought in small billfuls. As I learned by examining the nest later in the morning, it was placed on the outside just below the rim. Here the soft, freshly laid clay contrasted with the hard, dry mud nearer the bottom. Thus the bird continued to build up the masonry of the outer wall at the same time that she lined the interior of the nest with straw.

The male sometimes followed his mate when she brought material to the nest and rested briefly on the rock below it, her own favorite resting place. But most of the time he remained at a greater distance, either on the wide expanse of exposed, water-rounded rocks a hundred feet or more upstream, or more rarely on the rocks near the shore opposite the nest. The female nearly always travelled back and forth without an escort.

By April 19, four days after I found it, this nest appeared to be completed. In form it closely resembled the nest which the Eastern Phoebe plasters on a vertical wall beneath a bridge, but it lacked the green moss which the northern bird so often uses. Forming a sort of bracket on the smooth, perpendicular face of the rock, the nest was flat on the side in contact with the stone and convex on the outside and bottom, while on top was a deep, rounded concavity. The thick walls were composed of pellets of gray mud strengthened by bits of dead vegetation, in the manner that men use chopped straw for binding the clay in constructions of adobe and *bahareque*. The interior of the hollow was lined with fine grasses and a few downy feathers. The external dimensions of the nest were 4 inches in height by $4\frac{1}{2}$ inches from side to side, and its internal diameter at the top was $2\frac{1}{2}$ inches. The space between the outer part of the nest's rim and the ceiling of rock above it, through which the bird entered and left, was only 2 inches high.

THE EGGS

The first egg was found in this nest on April 24, nine days after I discovered it at an advanced stage of construction. The second egg was laid on April 26, and with it the set was completed. These eggs were strongly ovate in shape and immaculate white in color. Alfaro (1927) describes another set of 2 eggs from Costa Rica as being white with reddish dots and blotches scattered over the whole surface. They measured 20 by 16 millimeters. Four nests found in El Salvador on April 28 by Dickey and van Rossem (1938: 349) contained, respectively, 2 eggs, 3 newly hatched young, 3 half-grown young, and a single nestling nearly ready to fly. The 2 eggs were white, each with about a dozen minute brown spots, and they measured 19.1 by 14.9 and 19.1 by 14.5 millimeters. In the southwestern United States the Black Phoebe lays far larger sets, consisting of 4, 5, or even 6 eggs. Even in the same set, some of the eggs may be immaculate and others spotted with red (Bent, 1942:158).

INCUBATION

On May 2 and 3, I devoted nearly 12 hours to watching the course of incubation at the nest beside the Río Pejivalle and found no evidence that the male took a share in warming the eggs. The huge rocks scattered irregularly along the shore left no place for setting up my blind, and I perforce watched from exposed positions on top of ledges and boulders, beneath the shade of the spreading sotacaballo trees. Since the phoebe was somewhat mistrustful of me, I did not succeed in making as complete a record of the rhythm of incubation as I wished to obtain; but in compensation I was able to study certain other rarely seen aspects of the birds' behavior. My first observation post was a rock about 35 feet from the nest, with nothing to screen me from the view of the phoebe while she sat on her eggs. She had flown off as I went to take up this position at 5:45 a.m. on May 2, and when she returned and saw me watching her, she was uncertain whether she could safely cover her eggs. In this undecided state of mind, she stood on some low rocks which rose above the rushing current below her nest; and after a while she flew up as though to enter it, but at the last moment lost courage and dropped down to the low rocks again. Several times she started toward the nest only to veer aside before she reached it. While she delayed in this vacillating state, her mate arrived and hovered in front of the nest, beneath the huge overhanging rock. His presence gave her confidence, and without further loss of time she darted up and settled on the nest before him. Then he dropped down to stand quietly for ten minutes on the rock below the nest while she incubated above him. After he went away, she continued to sit on the eggs three minutes longer, then she flew off to catch insects.

When she returned after a recess of six minutes, she still lacked courage to enter the nest in my presence, despite the fact that she had already sat for thirteen minutes while I watched from exactly the same position. As last time, she flew up very close to the nest, only to drop back to the low rocks. Again and again she repeated this performance, sometimes actually touching the nest's rim, but always in the end she returned to the low rocks. She flew across the river, then in a few moments came back and continued to make starts toward the nest without reaching it. But she could not quite overcome her reluctance to enter while I watched, and finally she flew upstream to seek her mate. Soon she was back again with the male, who went unhesitatingly to the nest and stood on its rim, facing inward. Now at last the female went to the nest without further vacillation and settled on the eggs at his feet. He remained standing beside her for a minute, then dropped down to rest on the rocks below for a minute or two longer before he flew away.

Through the remainder of my five-hour watch, the female phoebe would never enter her nest unless her mate was close by. Sometimes he would accompany her as she returned from her outing, and then she would promptly settle down to warm her eggs. At other times she would come alone and stand on the rocks below the nest, calling *chip* until he arrived to see her safely on it. Once, while he perched on the rocks on the opposite side of the river, catching insects above the water, she waited ten whole minutes for his arrival, meanwhile catching insects herself from the low rocks beneath the nest. At other times, becoming impatient, she would go off in search of her mate and finally bring him back with her. The male phoebe would sometimes stand on the nest's rim, and then the female would go promptly to sit in it. When this occurred, I often heard a low, sweet trilling that sounded above the roar of the current as the female settled on her eggs in front of her mate. I could not tell, however, whether these notes were uttered by one member of the pair or by both of them. At other times, the male would hover momentarily in front of the nest, and this had the same effect of bringing the timid female promptly back to her eggs. On still other occasions he did not go to the nest but merely stood on a rock below it, and then the female would usually make a few false starts toward it before

she settled down to incubate. Her mate would always linger a while on the rock below her, from less than a minute to as much as ten minutes.

This behavior, unique in my experience with birds, raised an important question. Was I witnessing the normal, unconstrained behavior of this pair, such as they would have followed if they could not have seen me, or was it that the female phoebe would not enter her nest in the absence of her mate because she was mistrustful of me and needed him to bolster her courage? To gather further evidence on this point, I returned in the afternoon and seated myself on a more distant rock, about 50 feet from the nest, although here also there was nothing to screen me from the view of the phoebe as she incubated. Soon she arrived alone and stood on one of the rocks below the nest. But she would not enter and after a minute or two flew up the river, apparently in search of her mate, for she went toward the neighboring pasture where he was often to be found. Presently she returned without him and alighted as before on the rocks below the nest, whence she flew up as though to enter it but did not complete the movement. After a few minutes she went upstream again, doubtless still searching for her partner. But for the third time she was obliged to come alone to the nest, and now she settled in it without much delay. After incubating for 19 minutes and taking a recess of 4 minutes, she returned alone and, after procrastinating for about 3 minutes, entered the nest in her mate's absence. A session of 18 minutes, a recess of 10, and again she returned alone to her eggs. With my continued presence and greater distance, she was losing her distrust of me and no longer needed her partner to encourage her.

When she completed her session and flew upstream, I advanced to the rock on which I had sat during the morning, only 35 feet from the nest. When she returned she was accompanied by the male for the first time in nearly two hours. He went to stand on a low rock across the river while she alighted on a stone below the nest. Soon she flew up and clung to it for a few seconds, but instead of entering she dropped down again to the rock, calling. Whereupon her mate flew across the channel to join her, alighted on the rock, then stood on the nest's rim while she settled down on the eggs in front of him.

On her next return to the nest, the female came alone and without hesitation entered it, although I was still watching from the nearer rock. The afternoon had become darkly overcast; the river was becoming turbid and rising rapidly from rains in the higher mountains whence it flowed. Already it was pouring over the low rock on which the phoebe was accustomed to stand before she proceeded to her nest. Apparently she felt more urgently the need to cover her eggs, and at the same time she was losing her distrust of me.

The following morning I watched for four hours from the more distant rock, 50 feet from the nest. Of the 12 returns to her eggs which I witnessed, on nine the female came alone. Sometimes she flew up from the distance directly into the nest, without first alighting on the rocks below it. Only three times, or on one quarter of her returns, was her mate present. Once he stood on the rock below and twice he rested on the nest's rim while the female entered it. This may be about the normal rate of the occurrence of this custom. On the preceding day, the male was present at every return because his mate, in her mistrust of me, would not enter the nest in his absence but always waited for his arrival before she resumed incubation. As a further test of this conclusion, after witnessing 12 returns from the rock 50 feet away I again advanced to the rock five yards nearer the nest. On her next return, the female alighted on a stone below the nest, called over and over, flew once up toward the nest without entering it, and procrastinated until at length her partner, who had been resting on the opposite shore, came to stand beneath the nest, when she promptly settled on her eggs. She sat for 25 minutes—one of the longest sessions that I timed—and when she left I moved forward about seven feet, to the near-

est point from which I ever attempted to watch her. On her return from a six-minute outing she behaved as last time, making incompleting flights toward the nest and calling for her mate, who was on the opposite side of the river. But when he refused to come to her, she soon settled on the eggs in his absence.

The behavior of this female phoebe, which in the presence of an animal she mistrusted would not go on her nest unless her mate was close to her, opens fascinating glimpses into the mind of a bird. These glimpses unhappily suggest more than they prove. It is for this reason that I have dwelt on her behavior at such length. I doubt that her conduct, in refusing to enter her nest in the face of supposed danger unless her mate was with her, was instinctive in the sense that it followed an hereditary pattern. Only the study of several nests could settle this point, and no more nests have been available to me. But certainly the behavior of this pair was not strictly utilitarian; it had no "survival value." When an enemy too large or too powerful to be driven off approaches their nest, birds do well to steal away in silence, not to call their mates, because the presence of two birds attracts more attention than one alone would do. But certainly the conduct of this female phoebe was very human-like; for men frequently display greater courage in the presence of a companion whom they love or trust than they do alone. And toward the end it was easy to believe that the female was taking advantage of the situation to win additional attention from her mate by feigning mistrust of me. But however we interpret the behavior of this pair of birds, it shows once more how inadequate our too mechanistic theories of animal conduct become when we confront them with the complex situations and delicately shaded motives that we actually observe in nature.

Considering only the record which I made from 3:13 to 4:18 p.m. on May 2 and from 5:51 to 10:01 a.m. on May 3, when I sat 50 feet from the nest and when the phoebe seemed perfectly at ease in my presence, I timed 14 sessions which ranged from 8 to 23 minutes and averaged 15.9 minutes and 13 recesses which ranged from 3 to 10 and averaged 5.8 minutes. She spent 73.2 per cent of the five hours and fifteen minutes on the nest, which is rather high constancy for a flycatcher. While I sat closer to her, she twice continued on the nest for 25 minutes, but this seemed to be because her preceding recess had been unusually prolonged, or her last session abnormally short. On leaving her nest, the female usually went to join her mate, most often upstream, where he spent much of his time in the neighborhood of a water-driven sawmill and a cattle shed, or on a wide expanse of exposed boulders.

Before the eggs hatched this nest fell from the rock, either having been washed away by the high water from the heavy rains which fell in early May, or else as a result of becoming saturated with the rain water that seeped down the lower face of the rock by way of the moss that covered it. The incubation period of the Black Phoebe in the United States was 18 days in one instance and 16 days in another, and the nestling period varies from 15 to about 21 days (Bent, 1942:158).

SUMMARY

In the mountainous regions of Central and South America, the Black Phoebe is found beside streams, flumes, ponds and lakes, chiefly in the Tropical and Subtropical zones between 1000 and 6000 feet above sea level. At times it descends to near sea level and in Guatemala it occurs in the Temperate Zone at 7000 feet. It often establishes itself at the *beneficios* where, with the use of much water and wide concrete floors for drying, coffee berries are processed for the market. These birds are found in pairs through much if not all the year.

Black Phoebes subsist on insects, including dragonflies, which they catch by darting out from the boulder where they rest above the current of a mountain stream. They also

pluck many small invertebrates from bare ground or the concrete floors used for drying coffee, or even from the walls of buildings in towns. They enter porches to gather moths which have become entangled in the cobwebs on and around electric light fixtures.

They roost on insulated wires beneath eaves or porches and at times also in recesses among streamside rocks.

Their call is a simple *chip* and their song consists of the monotonous reiteration of the phrase *fe-be*, which is uttered with the accent alternately on the first and last syllables. It is often continued for many minutes at dawn, and sometimes it is delivered while the bird circles high in the air, holding itself almost upright.

The few available records indicate that in Central America nesting occurs chiefly in March, April and May. The nest is a sturdy cup of dried mud or clay strengthened by the inclusion of bits of vegetation and lined with fine grass and a few feathers. It is placed among rocks along streams and is sometimes attached to a vertical surface. At one nest the building was done by the female, which brought about 50 billfuls of material in two and a half hours.

In Central America the set consists of 2 or 3 eggs, which are white and either immaculate or more or less spotted with reddish brown.

Only the female incubates. One female would not return to her eggs while the observer sat unconcealed about 35 feet away unless her mate stood below the nest, hovered beside it, or perched on its rim. But when the observer moved to a more distant point, she usually resumed incubation in the absence of the male, although occasionally he escorted her to the nest. As she settled on the eggs while he stood on the rim facing her, a low, sweet trill was heard above the roaring of the river. In five hours and fifteen minutes one female took sessions averaging 15.9 minutes and recesses averaging 5.8 minutes, spending 73.2 per cent of the time on her eggs.

STREAKED FLYCATCHER

Myiodynastes maculatus

The big, boldly-marked, sweetly-singing Streaked Flycatcher is in many ways a bird of distinction. One of the larger members of its family, it is about the size of a starling, eight inches in length. Its pale grayish brown upper plumage is thickly streaked with dusky. The upper tail-coverts and the tail are reddish cinnamon with dusky markings. The feathers of the wings are dusky, margined with cinnamon and pale buff. A rather broad stripe of yellowish white arches from the base of the bill above each eye; there is a dark streak through the eye, and below this another broad whitish streak. The under plumage, dull white with a tinge of yellow, is conspicuously streaked with dusky. The heavy bill is blackish; the eyes and feet are dark; and there is a concealed crown patch of yellow. In the Central American portion of its range, this conspicuously streaked flycatcher can hardly be confused with any other except the related Sulphur-bellied Flycatcher. The latter, however, has a more definitely sulphur-yellow breast and a whiter, more prominent stripe above the eye. After one has become familiar with the voices of these birds, they can be more readily distinguished by sound than by sight, for the common call note of the Sulphur-bellied Flycatcher is far sharper, more insistent, than that of its relative. Many ornithologists, recalling the difficulty of making identifications in the flycatcher family, will consider the ease of recognizing this bird a sufficient claim to distinction.

The species is unevenly distributed over an extensive area stretching from southern México to northern Argentina and Chile. In Central America there is a curious hiatus in its range, for it appears to be absent from El Salvador, Nicaragua, Honduras, and most of Guatemala. It reappears in northern Guatemala and southeastern México. My own acquaintance with the Streaked Flycatcher is limited to Panamá, where it occurs on both sides of the Isthmus, and Costa Rica. In the latter country it seems at present to be confined to the Pacific side, although there are old records from Turrialba and Cervantes on the Caribbean slope (Ridgway, 1907:661). I once saw a Streaked Flycatcher in the central plaza of San José, at 3800 feet above sea level; Cherrie (1892:251) recorded it as a rare resident in the vicinity of that city. It is far more abundant at lower altitudes. In the valley of El General the Streaked Flycatcher seems not to nest above 2400 feet; but at slightly higher altitudes I have met it as a rare straggler in the spring and fall, when it appears to be on migration. Yet in western Panamá it ranges upward to 4800 feet (Ridgway, *loc. cit.*), and, in the Santa Marta region of Colombia, Todd and Carriker (1922:345) found it from sea level up to 4500 feet and noticed no variation in its abundance between these limits.

Like its relative, the far-wandering Sulphur-bellied Flycatcher, this bird appears to be migratory, at least in the Costa Rican portion of its range, although the extent of its semiannual journeys is unknown. In November and December, 1937, I looked in vain for Streaked Flycatchers both in Guanacaste, in the northwestern section of the country, and in the neighborhood of Buenos Aires de Osa in the south. There are numerous collectors' records for both regions, and, since this flycatcher is not easily overlooked, I think it a fair conclusion that it occurs in these portions of the Pacific *tierra caliente* only at other seasons.

My experience with the Streaked Flycatcher in the basin of El General supports this



Fig. 60. Streaked Flycatcher.

conclusion. In 1939, when I resided during the first half of the year near San Isidro, at an altitude of about 2000 feet, I did not meet the species until March 1, when I saw two birds together. Later I found three nests in the immediate vicinity. In other years, when I lived at altitudes slightly above the breeding range of the Streaked Flycatcher, I first saw it on March 4, 1936; March 3, 1942; March 13, 1943; February 26, 1944; February

17, 1945; February 25, 1946; and February 9, 1953 (the earliest record). My latest fall record is of a bird that lingered near my residence at Quizarrá (2500 feet) from September 10 to 21, 1943. Thus the Streaked Flycatcher appears to arrive in El General toward the end of February or early in March and to remain until late September. During its period of migration, it is likely to be seen as a rare and usually solitary straggler at points a few hundred feet higher than its nearest nesting area. These birds probably "winter" farther south, but the locality is unknown. Paynter (1955:191) states that the Mexican race, *insolens*, winters in South America.

On the Isthmus of Panamá the Streaked Flycatcher seems to be resident throughout the year. I have found it on Barro Colorado Island in December and January, and it nests until August in the same locality. In Venezuela, *Myiodynastes maculatus maculatus* is resident throughout the year (Friedmann and Smith, 1955:521), whereas the race *solitarius* is a migrant from the south (Phelps and Phelps, 1950:152), as likewise it is in Surinam (Haverschmidt, 1955a:107).

This large, conspicuous flycatcher is found in pastures and other clearings with scattered trees and at the forest's edge, but it is not found in the midst of closed woodland. A typical flycatcher in its mode of foraging, it usually darts out for insects from perches well above the ground, and it almost always selects a lofty perch for singing. Although its diet consists largely of insects, Gross (1950:192) reports that it eats small lizards, up to three inches in length.

VOICE

The three Central American species of *Myiodynastes* all make very free use of their voices. The common callnote of the Streaked Flycatcher is a wiry, nasal *tsu-ká, tsu-ká*. It is an indescribable note, at once whimsical and agreeably confidential. This is probably the utterance written as *witchy, witchy* by Gross (*op. cit.*) and as *chupeé* or *chupeét* by Eisenmann (1952:40). While engaged with their nest, the pair converse together in a varied language of twitters, churrs, clucks, and near-trills. But the most notable utterance is the twilight song, which apparently is the prerogative of the male bird alone. While a considerable number of flycatchers sing distinctive songs at dawn, only a few, including the Streaked Flycatcher and the Wood Pewee, repeat their chant as daylight fades. I first heard the delightful twilight song of the Streaked Flycatcher on Barro Colorado Island on January 5, 1931. After the sun had fallen behind the wall of forest that surrounds the narrow clearing where the buildings stand, a Streaked Flycatcher perched on the topmost twig of a tall tree at the edge of the open area to sing his evening song. The melody was a pleasant, simple refrain, repeated over and over in a voice clearer and softer than most flycatchers can command. The bird seemed to me to sing *right-here-to-me, right-here-to-me*; but Dr. Frank M. Chapman, in whose company I enjoyed this rare treat, detected a fifth syllable and paraphrased the verse as *kawé-teedly-wink*. The first syllable, *ka*, does not carry well and frequently is not heard; *wé-teedly-wink* is often a more accurate rendition. The following evening the flycatcher again sang at the forest's edge. But in 1934, when I was resident on Barro Colorado from early February to June 1, I did not hear the Streaked Flycatcher sing until March 14. Again this first music of the year was an evening song, delivered from the edge of the woods beside the banana plantation. On March 17, I heard the bird sing at dawn for the first time. In late April and May, the height of the nesting season, the twilight song was delivered at great length at the break of almost every day. One dawn a Streaked Flycatcher at the forest's edge performed with scarcely a pause for 26 minutes. These Streaked Flycatchers on Barro Colorado continue their singing at least until the end of July, for Gross heard it while he studied a late nesting in this month. He paraphrased the song as *cheer-o-wee-wee, cheer-o-wee-wee, cheer-o-wee-wee* and states that he heard it at various times of day.

In the valley of El General in Costa Rica, where the Streaked Flycatcher does not arrive until late February or March, my earliest record of the song is March 7, 1951, when I heard it under peculiar circumstances. In the afternoon, as I sat in the shade of an orange tree absorbed in a book, the light suddenly grew dim, although I could see the sun shining on the forest across the valley. A Streaked Flycatcher, a lone bird which for a week or more had lingered about our house without a mate, began to sing his twilight song, which for several years I had not heard. When I looked at my watch it indicated only 4:15, but I thought that it must be slow. Then my wife called my attention to the sun, which was being eclipsed by the moon. A week later this Streaked Flycatcher sang again, this time at sunset, but he did not stay to nest with us.

In 1939, I first heard the twilight song on April 5. As the day waned I was sitting on the porch of a farmhouse by the Río Pacuar, talking to the farmer and his family, when a Streaked Flycatcher began his vesper song, somewhere off in the treetops. Although the people with whom I talked were not ordinarily attentive to the voices of birds, this was such a sweet-toned, calmly beautiful song, sounding after other bird notes were hushed, that it drew the notice and the commendation of everyone present. The lilting notes were continued without interruption for many minutes, dying away at length as I walked off through the dusk.

Although as a rule reserved for the twilight, this song may under stress of great excitement, as in courtship or in disputes with rival birds, be delivered in broad daylight, but then it is given usually in a lower voice, and more briefly than in the crepuscular hours to which it is particularly dedicated. The Sulphur-bellied Flycatcher and the Golden-bellied Flycatcher of the Costa Rican highlands both deliver beautiful dawn songs, but in the evening twilight I have heard them seldom or not at all.

NEST BUILDING

Although Chapman (1929:59), Eisenmann, and Gross give records of nesting on Barro Colorado Island extending from late December into August, when the last young left the nest, in this locality most of the breeding activity appears to take place between March and June. In El General one bird began to build as early as March 13, but April and May are here the principal months for nesting. In Trinidad, according to Belcher and Smooker (1937:232), the nesting season falls in the months of May, June, and July.

The usual nest site of the Streaked Flycatcher is a cavity in a tree, frequently the abandoned hole of one of the larger woodpeckers, situated in a clearing or at the forest's edge. The lowest nest cavity of which I have a record was 18 feet up in a stub at the edge of a Costa Rican pasture; the highest, about 75 feet above the ground, was in the trunk of a tall living tree in another pasture in the same locality. This lofty natural cavity had two openings, through the larger of which the building female entered, whereas she emerged through the smaller one. In 1935, I found two nests in cavities in decaying trunks (remnants of the forest that was inundated when Gatún Dam was closed) rising above the waters of Gatún Lake near the shore of Barro Colorado Island. One was about 30 feet above the water and 300 feet from the land; the second was 20 feet above the water and only a few yards from the shore. When nesting in a woodpeckers' hole, the Streaked Flycatcher, like her relative the Sulphur-bellied Flycatcher, fills the cavity up to the entrance with coarse material, then she builds the nest at the top where she can look out through the doorway as she sits on the eggs, and where, unless the site is very lofty, at least her head can be seen by an observer on the ground. One of the birds that nested in Gatún Lake had actually filled the hole to above the lower edge of the opening, so that from a cayuco I could see much of her body as she brooded her nestlings.

A somewhat different nest site was a crevice among the stumps of fallen fronds in

the lower part of the crown of a tall palm (*Attalea*) which stood in a clearing beside the Río Pacuar in southern Costa Rica. This nest was also high, about 70 feet above the ground. I watched the female carry material into the cranny amidst the mass of loose, tangled fibers which filled the spaces between the decaying bases of the massive petioles, about which draped the hanging spathes and heavy clusters of ripening fruit. A pair of Blue Tanagers and a pair of Masked Tityras were nesting in similar niches in the



Fig. 61. A tall silk-cotton tree (*Bombacopsis Fendleri*) at the edge of the clearing on Barro Colorado Island, Canal Zone, Panamá. This narrow clearing was inhabited by Streaked Flycatchers, Vermilion-crowned Flycatchers, Tropical Kingbirds, and Southern House Wrens. Within the forest lived Southern Bent-bills, Olivaceous Flat-bills, and Song Wrens.

same crown. In Trinidad, Belcher and Smooker (1937:232) found nests built in large bromeliads attached to the trunks of trees, as well as in shallow hollows in trees, from 20 to 40 feet up. If no more adequate site is available, the Streaked Flycatcher may even build its nest on gently sloping plates of corrugated metal roofing, where the nest is somewhat protected by the eaves of a higher roof but exposed to much full sunshine (Gross, 1950).

The pair of Streaked Flycatchers to which I devoted the most attention lived in the laboratory clearing on Barro Colorado, where I first heard the vesper song. About the middle of March, 1935, the male flycatcher, which occupied the upper part of the clearing and was possibly the same that I had heard sing four years earlier, began his courtship. He sometimes sang a version of his twilight song even while the sun was high, but the song was softer and continued for brief periods, while the syllables were not so clearly

enunciated as at dawn and after sunset. More frequently he delivered a sort of song which was something between a churr and a trill, scarcely musical but pleasant to hear. For a while, three Streaked Flycatchers flew about the clearing and there was great confusion. By the end of March, the male which retained possession of the area appeared to have definitely won a mate, and the pair set about to look for a nest site. The several buildings in the clearing looked promising to them, and they alighted together on the roofs and window sills, searching for a suitable cranny. While engaged in this quest, they frequently conferred together, uttering a queer churr. I placed a nest box for them on the side of the tool house, but for a long while they appeared not to notice it.

Through most of April the pair of flycatchers continued their fruitless search for a nest site among the buildings at the upper end of the clearing. On April 19, I found the female carrying material into the rain gutter under the eaves of the main building. Fortunately, she did not wait for a rain before deciding that this was not a desirable location. On April 24, she was carrying up material to the broad sill of the little window in the gable of the Chapman house. But like most window sills, this did not have a rim to hold the incipient nest in place, and as she pushed the material around in her effort to give shape to the intended nest, she threw most of it over the edge of the sill. I found a great deal of this wasted material on the ground below the window. It consisted almost wholly of the dried petioles or rachises of compound leaves, from which the leaflets had fallen, and dry flower stalks that had lost their flowers. The male flycatcher, as far as I saw, did not help with the work, but he often perched on the window sill beside his mate as she tried industriously but foolishly to fashion a nest.

By noon of April 24, the flycatchers seemed to have concluded that after all the window sill would not serve, for they had resumed their endless, fruitless search under the eaves, in the rain gutters, and in the blank windows in the gables of the big house. The male and female always conducted these investigations together, to the accompaniment of much low conversation. They continued to ignore the nest box which I had made for them at the beginning of the month, until I decided to move it from the side of the tool house, where it was not at all conspicuous, to the mango tree in the middle of the clearing behind the big house.

This nest box was of a type that I have frequently found acceptable to Southern House Wrens. It had a wide, low entrance across the entire front, which made it easy for the building birds to carry in stiff pieces of material held athwart the bill. At either side of the front was nailed a slender twig to serve as a perch. Unfortunately I have not preserved the dimensions of the box, but it was roomy. It did not take the Streaked Flycatchers long to discover and take possession of this box in its new position in the midst of the dark, dense foliage of the mango tree. On April 25, the day after I had placed it there, I was away in the forest in the morning, but in the afternoon I found the pair proclaiming their ownership with much low twittering and many nasal calls. They either perched opposite each other on the two twigs at the front corners of the box, or else one remained in front while the other sat inside. On opening the box in the evening, I found that in the course of the day the female had carried in a large number of petioles or rachises and flower stalks. In a later year in the same locality, Gross watched a female gathering such material high up in a tree while her mate perched at the very top.

Two days after the flycatchers took possession of the box, I stuck a little paintbrush in the doorway, in such a fashion that any bird passing through would be likely to rub against it and stain its plumage. Soon one of the pair had acquired a large vermilion spot on its abdomen, so that at last I could distinguish the two. Later, by watching her lay an egg, I proved beyond all doubt that the marked bird was the female. After she had been marked, I continued to watch from 7:45 to 10:15 a.m., in which period she took material

into the box 28 times, or at the rate of about one visit every five minutes. Often she carried several petioles or flower stalks in her bill at once. Inside, she often pushed the materials around so vigorously that she shook the box. The male did not once enter while I watched, but several times he came to the doorway and looked in, as though to see how the work was progressing. He spent much time on one of the perches at the side of the entrance, while his mate went in and out, and he frequently accompanied her on her trips to fetch material, although he never brought any himself. The two talked much together in their indescribable, droll language. They were not at all afraid of humans and would go about their work while I watched in plain sight from the porch of the little library building. Even the presence of a second observer, and low conversation between us, seemed not to bother them.

In the following days the female flycatcher worked with a will, carrying into the box a great mass of dry petioles and flower stalks, covering the entire floor with them and heaping them up to a considerable height in the right rear corner. Here, as early as April 29, the fifth day of building, she began to form a hollow to contain the eggs. By the following day she had a neat, round, deep depression, which she proceeded to line with a few fine, dry rachises of some small, acacia-like, compound leaves, from which the leaflets had fallen. On May 2, the female was still taking material into the box, but by evening of the eighth day the nest appeared to be completed. The female watched by Gross in 1949 likewise built her nest in about eight days.

At three Costa Rican nests of the Streaked Flycatcher to which I gave more or less attention during the period of construction, I likewise saw only the female bring material. In the pair studied by Gross on Barro Colorado Island the female also did all the actual building, although the male sometimes carried fibrous material. Female Sulphur-bellied Flycatchers and Golden-bellied Flycatchers also build without the male's assistance. But in all three of these species of *Myiodynastes*, the male is most attentive to his mate while she labors, taking great interest in the progress of her work. Often he accompanies her on journeys to find material, perches close beside the nest cavity while she is arranging the stuff within, or goes to the doorway to see how the nest is advancing. One male Streaked Flycatcher, whose mate was building in the crown of a tall palm tree, rested close beside her while she worked and occasionally sang a phrase of his twilight song, although the sun was nearing the zenith. Males of both the Sulphur-bellied and the Streaked flycatchers may pick up nest material and carry it about, finally dropping it without taking it into the cavity. One evening while the female Streaked Flycatcher was building in the nest box in the mango tree, the male arrived with some long fibers dangling from his bill, at the same time calling loudly for his mate, which just then was out of sight. After a while he let the fibers fall across the branch where he perched. Later, I again saw him with the same or similar fibers in his bill. He took them into the mango tree and perched near the nest box, where he called loudly and churred in his peculiar fashion. The female was still absent, and after a short while he flew off with the fibers still in his bill. Since no fibrous material was ever incorporated into this nest, but only petioles, rachises, and flower stalks of varying degrees of fineness, it is probable that even if the female flycatcher had been at hand, she would not have used what her mate seemed so eager to give her.

Before I moved the box to the mango tree, while the female was still fruitlessly carrying material into the rain gutter, I saw one of the pair tugging at some long, thread-like pistillate inflorescences of *Myriocarpa yzabalensis* (a small tree of the nettle family) hanging loosely below a Bananaquit's newly finished nest in a nearby guava tree. This tugging finally upset and wrecked the honeycreeper's little closed nest. The female used no material of this nature in her nest, and probably she would not have wasted her time

gathering it. The female studied on Barro Colorado by Gross, however, lined her nest with long, thin plant fibers, rather than with rachises as in the case of my female in the box.

THE EGGS

The nest in the mango tree was, as we have seen, completed or nearly so by May 2. The first egg was laid on May 5. The second egg was laid by the marked female between 9:50 and 10:08 a.m. on May 7. On May 8 I was absent from the island. The third and last egg was found at 9:30 a.m. on May 9. Apparently the eggs were deposited at intervals of about 48 hours. These eggs shared with those of the Sulphur-bellied Flycatcher, which they much resembled, the distinction of being the most beautiful flycatchers' eggs I have ever seen. They were whitish, heavily marked with irregular spots of cherry red and pale lilac. The markings of both colors were fairly close together over the entire surface, and those of cherry red were especially heavy in a wreath about the thicker end. These eggs measured 28.2 by 19.1, 27.8 by 18.3, and 27.0 by 18.3 millimeters. A very late set measured in the same locality by Gross in July, 1949, consisted of three eggs that were much shorter but somewhat broader than the foregoing, their average measurements being 23.3 by 19.2 millimeters and their average weight 4.65 grams. Five eggs measured by Belcher and Smooker in Trinidad showed the extremes of 25.3 by 20 and 22.8 by 18 millimeters.

A Costa Rican nest of the Streaked Flycatcher contained on May 12 three eggs which I could see with a mirror in their hole in a decaying trunk. In a very high Costa Rican nest, where incubation was in progress from about April 25 to May 12, three nestlings were reared.

INCUBATION

At 12:30 p.m. on May 13, the fifth or sixth day of incubation, I began to watch the nest in the mango tree, continuing my vigil without interruption until nightfall, then resuming it at the following daybreak and carrying on until noon. Thus, assuming that the birds passed a quiet and uneventful night, I obtained a complete record of activities at the nest over a period of nearly 24 hours. While watching the nest box I sat in front of the library building without any concealment, much of the time in low conversation with a fellow watcher, for while incubating, these flycatchers were as indifferent to humans as they had been while they built. The female of the pair still bore on her abdomen the vermilion mark which I had put there while she was building the nest; but it was becoming faint, and I managed to add a little more pigment to her plumage by the same method.

As at a nest of the Sulphur-bellied Flycatcher which I had studied in Guatemala some years earlier, the female alone incubated. Her sessions on the eggs ranged from 15 to 72 minutes in no regular sequence, for the long period of 72 minutes, which was taken during a morning shower, came between two short ones of 26 and 16 minutes, respectively. The average of 13 sessions on the nest was 30.3 minutes. An equal number of recesses ranged from 8 to 18 minutes and averaged 12.6 minutes. Thus the female spent 70.6 per cent of the period of diurnal activity on the eggs.

Although the male did not incubate, he was most attentive to his mate. He had the chivalrous custom of escorting her into the mango tree as she returned to her eggs at the end of a recess. Frequently, before flying away, he would go to one of the perches at the front of the box, from which he could peer inside and see that all was well. Less often he stood in the doorway with his head inside, and rarely he hopped right into the box to remain for a few moments with his mate, with whom he talked in low, contented notes that I could describe only as twitters, although they were not exactly that. These visits

to the perches in front of the box, the door sill, and the interior were almost always made by the male immediately after his mate had returned to her eggs; but once, in her absence, I saw him enter the box and linger for several seconds, "twittering" in a manner that suggested that he might be trying to call her back to her duty. Unlike many male birds that I have watched, this Streaked Flycatcher was equally attentive throughout the day.

The female Streaked Flycatcher studied by Gross in the same locality in July, 1949, showed a very different pattern of incubation. In the course of a single day toward the end of the incubation period, her sessions varied from 2 minutes to 3 hours and 26 minutes and her recesses from 5 minutes to 3 hours and 10 minutes. Between 6:00 a.m. and 6:45 p.m., when she returned to the nest for the night, she was on her eggs a total of only 5 hours and 43 minutes and off for 7 hours and 2 minutes. This peculiar and irregular incubation was caused by the site of the nest, which was at times exposed to full sunshine and even when in the shade of the eaves was in clear weather heated by the intense insolation of the metal roofing beneath and close above it. It is remarkable that the flycatcher compensated for her unusually long absences by unusually long periods of continuous sitting, and that two of her three eggs were much of the time kept sufficiently warm by the sunshine beating on the roof to survive this treatment and hatch after 15, or possibly more, days of incubation.

Two of the eggs in the nest box in the mango tree hatched on May 24, the third on May 25. Because of the uncertainty as to whether the last egg of the set was laid on May 8 or 9, there is a corresponding uncertainty in the length of the incubation period, which must be stated as 16 or 17 days. At one nest of the Sulphur-bellied Flycatcher, the incubation period was 16 days.

THE NESTLINGS

Because of my departure from Barro Colorado Island a few days after the eggs hatched in the mango tree, I was unable to study the development and care of these nestlings. But at two high, inaccessible nests, one in the Canal Zone and the other in Costa Rica, I saw that the male took an important share in feeding the nestlings, although only the female, as far as could be determined, brooded them. The first of these nests was situated in an old, decaying trunk standing above the waters of Gatún Lake, about a hundred yards from the shore of Barro Colorado Island. The parents caught along the shore many of the insects for the nestlings, frequently flying back and forth over the water. Passing each other above the lake, they would exchange greetings in queer, soft notes. Each delivered directly to the nestlings the food it had brought, and if the female happened to be brooding when the male arrived with a meal, instead of taking it from him she flew from the nest to allow him to feed the nestlings. After feeding, the parents often remained for a few minutes in the doorway, looking attentively at their little ones. On the day after these observations were made, I watched the nest as night fell. Returning from the shore in the twilight, the female flycatcher tried to cover her nestlings, but they were now so big that she could not make herself comfortable on the nest. She flew out and came to rest on the top of a neighboring slender stub, where she seemed to settle down for the night. After many minutes of immobility, she was still resting in this exposed position when I paddled away through the dusk.

The Costa Rican nest was situated about 75 feet above the ground in a towering ojoche tree in front of the cabin I occupied in 1940, in the valley of the Río Pacuar in El General. While attending the nestlings the parents were always very noisy, frequently voicing their half-harsh, half-liquid notes. In hunting food, they often watched from a low perch in the pasture, and when they spied a grasshopper, they darted down to catch it, beating it against a branch before carrying it up to the nest. As they grew older, the

young flycatchers became as noisy as their parents, calling much and loudly from their high nest. On June 3, three well-feathered nestlings, rather closely resembling their elders except for their stubby tails, flew from this lofty nest in the ojoche tree. Since I had seen the parents take food into the nest as early as May 13, these young birds were evidently no less than 21 days old at the time of their departure. For two days they perched close together in a small tree near the cabin, where the parents brought them food. On the third morning they were led farther away. They now followed their parents rather widely, to the trees that fringed the river, to those that stood scattered on the ridge behind the house, and to the edge of the forest to the east. But after each change of position they would perch quietly and usually close together in a tree, where the parents fed them. As late as their eighth day in the open, when they were almost a month old, I did not see them attempt to find food for themselves. After this, they wandered beyond my ken.

At Gross's nest the male began to bring food on the morning the first egg hatched. These nestlings left their exposed nest on the roof when only 18 days old. It is to be expected that young birds will quit an exposed nest resting on an extensive, nearly flat surface sooner than they will venture forth from a high, well-enclosed nest. None of the Streaked Flycatchers studied by me was conspicuously demonstrative when I examined their nest, whether directly, as in the case of that in the bird box, or with a mirror raised on a pole, as at the lowest of my Costa Rican nests. But when Gross visited his exposed nest on the roof, even before the eggs hatched, the flycatchers attacked him with spirit, swooping down and striking his head with their wings. While he was measuring the eggs on the roof, they attacked more fiercely than usual. One of them dashed at his hand and struck the metal calipers so hard that it knocked out a bunch of feathers; but the bird suffered no serious injury and continued the onslaughts.

SUMMARY

The Streaked Flycatcher inhabits the forests' edges and pastures, plantations, or other clearings with scattered trees, but it avoids the interior of closed woodland. In the valley of El General and other parts of the Pacific side of Costa Rica, it appears to be migratory, arriving in El General in late February or March, remaining to breed, and leaving about September. Where these birds spend the rest of the year is unknown. In the Canal Zone the species is present from at least December to August.

The species subsists on insects caught on the wing and varies its diet with small lizards.

It is a voluble bird with a great variety of notes, including twitters and near-trills. In the morning twilight, and again in the evening, the male delivers from some high perch a beautiful, soft, sustained song, consisting of a phrase of four or five notes tirelessly repeated, sometimes for nearly half an hour. While the sun is above the horizon, this song is rarely heard except when the flycatcher is greatly excited.

In the Canal Zone the breeding season extends from late December to mid-August, but it is at its height from March to June. In El General, Costa Rica, building may begin in mid-March but nesting takes place chiefly in April and May. In Trinidad the species breeds in May, June, and July.

The nest is usually built in a cavity, such as an old woodpecker's hole or one resulting from decay, preferably high up in a tree trunk. Crevices among the bases of the fronds of tall palm trees are also chosen, and in Trinidad the species is reported to place its nests on bromeliads growing on trees. Bird boxes are accepted where available, and in lieu of a better-enclosed nook the bird may build in an exposed corner of a roof. Dead trees standing in lakes, well out from shore, are sometimes chosen as nest sites.

Only the female builds. The male at times carries materials, sometimes of inappro-

priate sorts, which he may bring to the entrance of the nest cavity but fails to take inside. If the cavity is deep, the female first fills the bottom with coarse materials almost to the level of the entrance, so that she may look through the doorway while sitting on the completed nest. The nest is a shallow, saucer-shaped structure, composed largely of the coarse, dry petioles and rachises of compound leaves from which the leaflets have fallen and of dry flower stalks. It is lined with finer rachises or sometimes with fibrous materials. In two instances, nest construction took about eight days.

Two or three days after the nest is finished the first egg is laid, and others follow at intervals of one or two days. One egg was laid about 10 a.m. The set consists of 3 or sometimes only 2 eggs.

Only the female incubates, as was proved by day-long observation of a pair of which the female was marked with paint. Her 13 sessions ranged from 15 to 72 minutes and averaged 30.3 minutes. An equal number of recesses varied from 8 to 18 minutes and averaged 12.6 minutes. She spent 70.6 per cent of the day on the eggs.

The male often accompanied his incubating mate on her returns to the nest box. After she entered, he sometimes stuck his head into the box and less often he went completely inside. More rarely he entered the box in his mate's absence, but he stayed for less than a minute.

At one nest the incubation period was 16 or 17 days.

Both parents feed the young, but apparently only the female broods them. As they grow older the nestlings become very noisy. From a very high nest three young left 21 days after the parents were first seen to take in food.

SULPHUR-BELLIED FLYCATCHER

Myiodynastes luteiventris

The Sulphur-bellied Flycatcher is one of the larger members of its family, about eight inches in length, and its plumage is nearly everywhere conspicuously streaked. Its crown is brownish gray or olive with blackish streaks. The forehead and superciliary zone are grayish white, with fewer and narrower streaks, especially on the latter, which contrasts with the dusky band that passes from the base of the bill to behind the eye. Below this dark stripe the cheeks are whitish or faintly tinged with yellow. The back and upper rump are light olive with a buffy tinge and broadly streaked with dusky. The lower rump and upper tail-coverts are cinnamon-rufous with narrow, dark streaks. The tail feathers are likewise cinnamon-rufous with a dark stripe along the center of each. The wing feathers are dusky with yellow, buff, or grayish margins. The chin and sides of the throat are grayish with broad, dusky streaks, whereas the center of the throat is white with less prominent streaks. The remaining under plumage is sulphur yellow, with broad, dark streaks on the chest and fainter ones on the sides and flanks. There is a concealed patch of yellow in the center of the crown. The eyes are brown, the bill and legs are dark. The sexes are alike in plumage. This big, prominently streaked flycatcher can hardly be confused with any other Central American bird except the Streaked Flycatcher, and at the beginning of the account of that species the reader will find suggestions for distinguishing these two related flycatchers in the field.

The Sulphur-bellied Flycatcher breeds from southern Arizona to Costa Rica and winters in South America, according to Zimmer (1937) chiefly in Bolivia and Perú. It arrives in Central America from its winter home considerably later than the Piratic Flycatcher and the Yellow-green Vireo, and I have no record of its presence earlier than March 7, 1938, when it appeared at Vara Blanca, Costa Rica. Dickey and van Rossem (1938:354) met it in El Salvador on March 12. Peters (1929:448) first saw it at Lance-tilla on the northern coast of Honduras on March 28. In 1932 I did not encounter it in the Motagua Valley of Guatemala until March 28, more than a month after I began field work there. Griscom (1932:250) stated that it was not known to occur in Guatemala before March 31. In México it has been recorded in the Yucatán Peninsula on April 5 (Paynter, 1955:191) and farther north, in southwestern Tamaulipas, on April 4 (Sutton and Pettingill, 1942:21). In Arizona it appears to arrive much later, May 17 being the earliest date given by Bent (1942:106).

In Central America the Sulphur-bellied Flycatcher breeds from the lowlands of both coasts up to at least 5600 feet in Costa Rica but apparently it does not range so high in Guatemala. It seems never to establish itself as high in Central America as in Arizona, where it nests from 5000 to 7500 feet above sea level. Although this flycatcher breeds freely in more northerly parts of the Pacific slope of Central America, it seems not to nest in El General, where I have met it only rarely as a transient in late March and April. In Costa Rica it is most abundant on the Caribbean slope from about 2000 to 5000 feet above sea level. Throughout Central America it dwells in clearings with scattered trees, in shady coffee plantations, and at the edges of woodland, but it avoids the interior of heavy forest. It usually remains well up in the trees, where it would be difficult to find were it not so active and noisy. Its food includes insects, which it catches on spectacular darts into the air, and a variety of berries and other small fruits.

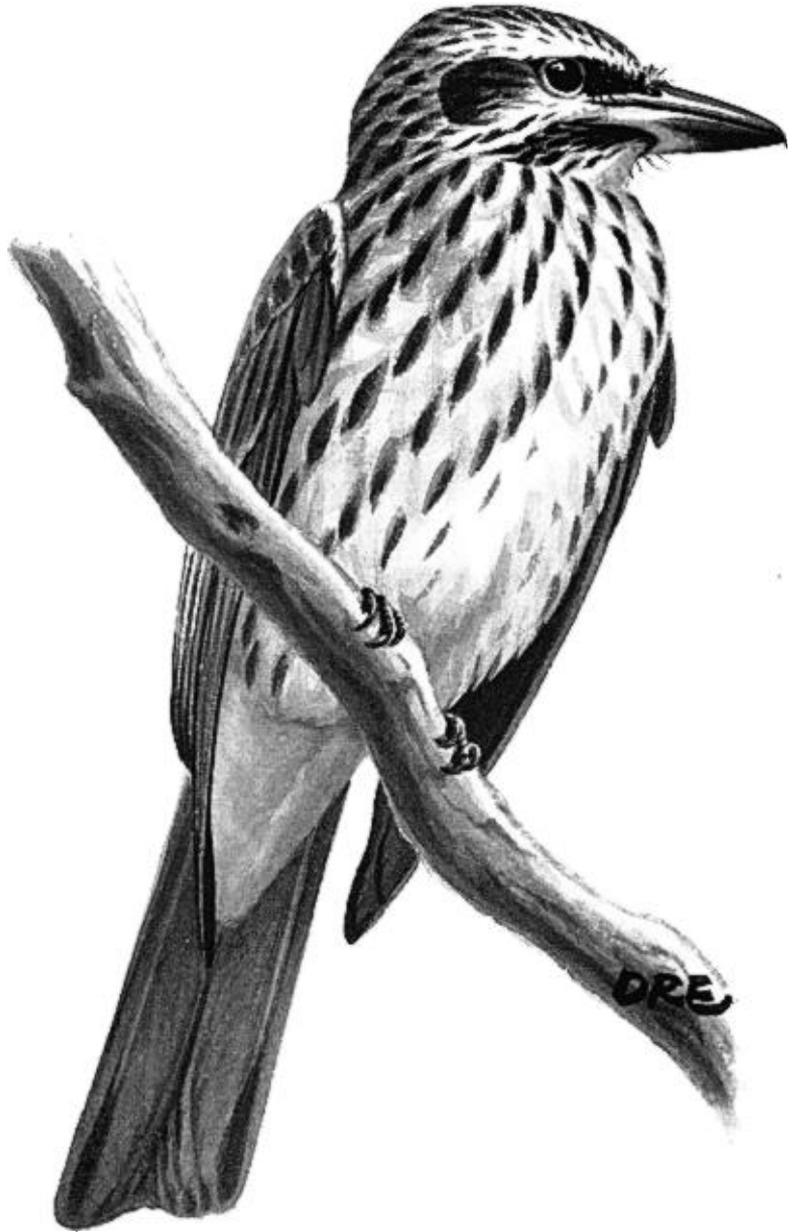


Fig. 62. Sulphur-bellied Flycatcher.

VOICE

As soon as it arrives from the south, the Sulphur-bellied Flycatcher makes its presence known by its shrill cries and quarrelsome habits. It is at this season one of the noisiest and most aggressive of the flycatchers. By March most of the permanently resident members of the family have long been mated and settled on their territories, hence they

have little cause to dispute with their neighbors. Arriving when the breeding season is about to begin, the Sulphur-bellied Flycatchers must hurriedly find territories and form pairs, and the difficulty they experience in establishing themselves is increased by the circumstance that the cavities which they need for their nests, and which they cannot make for themselves, are not always available in sufficient numbers. They now pursue each other through the open groves and clearings with scattered trees crying *p' p' p' pe-ya*, *p' p' p' pe-ya* in shrill, petulant voices. They continue to use these sharp calls even after they are happily settled and attending their nests. Another common utterance suggests a withered old dame screaming for her grandson in a cracked, irritated voice, *weel-yum*, *weel-yum*. With these same notes they scold a man who approaches their nest, and sometimes they dart spiritedly at the intruder's head.

One would hardly expect that a bird with such a thin and petulant voice could really sing, but in the dawn, during the breeding season in April and May, the male mounts to some lofty perch and delivers a song of appealing beauty. Frequently he chooses as his singing perch the topmost dead twig of a tall tree standing either in a clearing or at its edge; and here, his dark form silhouetted against the brightening sky, a hundred feet above the dew-laden earth, he pours forth his dawn song for many minutes together. *Tre-le-re-re*, *tre-le-re-re* he repeats tirelessly over and over, in a soft, liquid, almost warbling voice. One morning I timed a bird which sang for 17 minutes without a pause. In the hours of full daylight, this charming song is rarely heard, except when the flycatcher is excited by a rival of his own kind, or it may be heard in brief snatches, at the beginning of the nesting time, as though the bird were practicing. What a contrast between this soft, cool, pellucid dawn song and the high-pitched, strained, excited notes which the same bird utters at other hours of the day!

The foregoing description of the Sulphur-bellied Flycatcher's dawn song was written in the Cordillera Central of Costa Rica. Far away to the north, near Colomba on the Pacific slope of Guatemala, I heard an individual which sang a somewhat different song. Resting in the top of a very tall tree in a coffee plantation at dawn, he seemed to be demanding *traiga agua*, *traiga agua*. His voice was not as full and strong as that of the Costa Rican birds; but possibly this was because the time was late July, when the breeding season was coming to an end. The habit of singing a special song at dawn is well developed in the genus *Myiodynastes*, and the three species with which I am familiar perform delightfully at daybreak. The song of the Golden-bellied Flycatcher is very similar to that of the Sulphur-bellied Flycatcher.

While the female fills the nest cavity with material, her mate sometimes rests in front of the doorway and delivers a low, hurried, slightly harsh, twittering song.

NEST BUILDING

My earliest date for the beginning of nesting in Central America is April 15, 1941. At that time I found a Sulphur-bellied Flycatcher building by the Río Pejivalle, at an altitude of about 2000 feet. On April 25, 1951, I discovered one of these flycatchers building near Cartago, at an altitude of 4500 feet, and on April 28, 1938, a female was choosing a nest site near Vara Blanca at 5600 feet. All these localities are on the Caribbean slope of Costa Rica. The single nest which I found in Guatemala was at a low altitude in the Motagua Valley and was about finished when I first saw it on June 3, 1932.

The nest is usually placed in a dead or dying tree standing in a clearing or open grove. Often an old hole of a woodpecker or, in the Costa Rican highlands, of the Quetzal is claimed by the flycatchers, but sometimes they choose a cavity resulting from decay or a woodpecker's excavation so altered by decay that it is no longer recognizable as the work of that bird. The seven nests of which I have records ranged in height from about 11 to 90 feet above the ground.

The nest is built by the female without help from her mate. If she has chosen a deep cavity, she faces an arduous task, for she fills it almost to the top, so that she can look through her doorway upon the surrounding world while she incubates her eggs and broods her young. At Vara Blanca late in April, 1938, I devoted considerable attention to a pair of Sulphur-bellied Flycatchers which were establishing their nest in a pasture studded with living trees and many dead, decaying trunks riddled with cavities of various sizes. The female was having difficulty in deciding which of two tempting sites to use, and while she hesitated to make her choice, she carried twiglets alternately into both. One nest site was apparently an old nest of the Quetzal, about 15 feet above the ground in a low, decaying stub. The other was an irregular cavity at least three times as high, in a tall, branchless, charred, dead trunk, about 25 yards distant from the first. A pair of Hairy Woodpeckers were feeding nestlings on the opposite side of the same tall trunk, a little above the cavity which interested the flycatcher.

The female alone carried material. When she flew toward one or the other of the holes which she was filling, her mate often hurried ahead of her and came to rest on the sill of the doorway; or he clung to some convenient projection close beside it, where he sang a low, hurried, twittery, somewhat harsh-voiced song, while his partner arranged the material within. When she took twigs to the Quetzal's hole, he often got in her way by clinging in the doorway before she could enter. Fortunately, the width of the aperture allowed her to slip past him.

By May 5, the female flycatcher had definitely decided in favor of the higher cavity near the woodpecker's nest and appeared to be completing her own nest there, for she had already filled up the hollow almost to its rim. Doubtless she would have finished her building sooner, but for the unfavorable weather during the preceding week. The cavity she selected was rather open above and would not afford her complete protection from the rain. In this respect, the lower Quetzal's hole seemed preferable.

The female flycatcher worked principally between eight and ten o'clock in the morning, and I interrupted my observations on the Quetzals, which were feeding nestlings nearby, to watch her. She broke fine twiglets, and possibly also at times bladeless petioles, from the crowns of the neighboring trees, and she called *weel-yum, weel-yum* in her high, shrill voice as she flew toward her nest with them. Sometimes her mate, on hearing her approach, would fly along with her and come to rest on a little ledge just below the cavity, where he would at times sing his low, hurried twitter while she arranged the new material in the nest. He sang in this fashion less often than he had a week before, when building the nest was a newer and more exciting occupation.

I saw nothing to indicate that the male helped to build the nest. Frequently he followed his mate on her journeys to gather material, but on these occasions he never brought anything himself. More often he delayed in the top of a small dead tree in front of the nest and caught insects while the female worked. On three occasions I saw him pick up a fine twig which his mate had dropped and which had lodged on the little shelf below the nest. But instead of taking this fallen material where it would be of use, he toyed with it, tossing it about in his bill, or knocked it against the branch on which he perched, as though it were a newly caught insect, and then let it drop to the ground. A few days later I watched the male of a different pair behave in just the same way.

The Sulphur-bellied Flycatchers, especially the male, harried other birds in the vicinity of their nest. They frequently pursued the Quetzals which were feeding nestlings nearby, worrying them a good deal but doing them no harm. One morning the male flycatcher attacked a Ruddy Pigeon, which was innocently eating berries in the top of a tall tree some distance from the nest, and drove it from its meal. When a pair of Spangle-cheeked Tanagers alighted in the dead tree just in front of the nest, the flycatcher darted

upon one of them. But the smaller bird held its ground, screaming shrilly, while the assailant hovered menacingly above it. When it found that the tanager could not be bullied into retreating, the flycatcher took no further heed of it, and for some minutes the pair of tanagers and the pair of flycatchers rested peaceably close together in front of the latter's nest.

The only low, unoccupied nest available to me for detailed examination was that in the Motagua Valley. After the departure of the nestlings, I removed the contents of the deep hole and learned that the flycatcher had filled the greater part of it with a loose mass of sticks about ten inches deep. At the top of this pile, at the back of the cavity and only two inches below the lower edge of the opening, she had arranged petioles and thin sticks to form a cup-shaped nest. The materials composing the nest were more carefully tucked in and more closely packed together than the loose mass on which they rested. There was no soft lining. The entrance to this cavity was wide and of irregular shape, measuring $3\frac{1}{2}$ inches in height by 5 inches from side to side.

At the northern extremity of its range in the Huachuca Mountains of Arizona, where the Sulphur-bellied Flycatcher usually nests in a knothole enlarged by decay, it likewise fills up the cavity with various coarse materials to within an inch or two of the opening. Here the bird uses for the nest proper chiefly petioles and rachises of the dry leaves of walnut trees, with sometimes an admixture of pine needles or fine, stiff weed stems. As in my Guatemalan nest, there is no soft lining, but the finer petioles are smoothly adjusted to the contour of the depression which holds the eggs. The same cavity seems to be used for nesting year after year (Bent, 1942:100).

THE EGGS

In two of the inaccessible nests which I found at Vara Blanca, incubation was in progress by May 20. My Guatemalan nest held 3 eggs, which were laid on consecutive days from June 5 to 7, and a nest near Cartago sheltered 2 feathered nestlings on July 1. In Arizona this species lays sets of 3 or 4 eggs. Here nesting begins very late in the season, and the earliest date for eggs given by Bent (1942: 106) is June 20. The eggs in the Guatemalan nest were, with the possible exception of those of the Streaked Flycatcher, the most handsome flycatcher's eggs I have ever seen, and indeed few birds of any kind have more beautiful eggs. Their glossy white shells were heavily mottled all over with cherry red, and among these blotches of deep, rich color were scattered fainter and relatively inconspicuous marks of pale lilac. These eggs measured 26.2 by 19.1, 25.4 by 19.1, and 25.0 by 19.1 millimeters.

INCUBATION

A week after my Guatemalan Sulphur-bellied Flycatcher completed her set, I stuck into the entrance of the nest a small twig which bore on its end cotton soaked in vermilion paint. After persistent efforts the birds succeeded in removing it, but not before both had acquired marks on their pale yellow under plumage. Those on the bird which subsequent watching showed to be the female were far more conspicuous, yet the fact that her mate had also rubbed against the improvised paintbrush led me to suspect that, unlike other male flycatchers, he, too, took a share in incubation. But in this I was mistaken. The stain on his breast was circumstantial evidence that he helped to remove the paint-soaked cotton from the nest, and twice during my subsequent watches I saw him rest for a few moments in the doorway while his mate was taking a recess, but he did not sit on the eggs. The more heavily marked individual alone incubated. In nearly seven hours of watching in the afternoon of June 14 and the following morning, she took 15 completed sessions which ranged from 5 to 32 minutes and averaged 17 minutes and 15 recesses which varied from 1 to 21 and averaged 8.5 minutes. She covered her eggs 66.7

per cent of the seven hours. Her longest session was taken during a heavy afternoon shower, but in clear weather she once sat for 29 minutes and twice for 26 minutes without interruption. She left her eggs three times to chase away the Golden-fronted Woodpeckers which were feeding nestlings in another hole in the same low stub, and these sallies with subsequent prompt returns were responsible for her shortest session and absence. While she sat at ease, her head was about level with the lower edge of the wide doorway, and when at times she raised it, I could see her from the ground at a point a short distance in front of the nest. Unlike most birds which breed in cavities in trees, while incubating she surveyed her surroundings, was easily alarmed, and flew out whenever she saw me approach.

At this nest, where the third egg was laid on June 7, two had hatched and one was pipped on June 22. This egg probably hatched on the following day, but I could not visit the nest because of my departure from the plantation where these observations were made. Thus the incubation period was approximately 16 days.

THE YOUNG

The nestlings bore rather copious, long, dusky down. Their bills and the interior of their mouths were yellow. The parents remained out of sight while I examined the young. At a nest near Cartago, Costa Rica, which contained two feathered nestlings on July 1, both parents brought food. On leaving the nest, the young rather closely resemble their parents but the yellow of their ventral plumage is paler.

DEPARTURE FROM CENTRAL AMERICA

At Vara Blanca, where in the nesting season these flycatchers were so common and conspicuous, they all vanished during a severe storm of wind and rain which lasted from July 14 to 23, 1937. Thereafter I saw none until the following March 7, after which they soon became abundant. In 1938, when July was less stormy, some remained until August 9, but after mid-July I saw few of them. In Guatemala I met a single individual at Zacapa on August 15, 1935. Griscom (1932:250) states that the species is not known to occur in Guatemala later than August. In Arizona it is rarely encountered after August 24, although there is one record of its presence on the abnormally late date of September 20. Since here it may have newly hatched nestlings as late as August 28, it must depart for the south as soon as the young birds are strong enough to undertake the journey (Bent, 1942:100, 105, 106).

SUMMARY

In Central America and farther north, the Sulphur-bellied Flycatcher is known only as a summer resident, arriving from its winter home in South America some time in March. It breeds in the lowlands of both coasts and upward to at least 5600 feet in the highlands, but it seems to occur in the valley of El General only as a transient. It settles in clearings with scattered trees, in shady coffee plantations, and at the edges of woodland but avoids the interior of heavy forest. It catches insects on spectacular darts into the air and varies its diet with small fruits.

On their arrival from the south, these flycatchers are very noisy and quarrelsome while engaged in forming pairs and finding suitable nesting areas. Their calls are loud, shrill and insistent. But at dawn in April and May, the male mounts to the top of a tall tree and sings a beautiful dawn song, the sweet, cool notes of which contrast greatly with the shrill cries uttered later in the day.

Nest building begins in Costa Rica about the middle of April. The nest is placed in a cavity in a tree, such as the old hole of a woodpecker or a Quetzal or one resulting from

decay, at heights varying from about 11 to 90 feet. If the cavity is deep, it is filled with twigs and other coarse materials to within an inch or two of the doorway. Here is fashioned the nest proper, a shallow cup composed of petioles, rachises and fine twigs neatly interlaced, and with no finer lining. Only the female builds, collecting slender twigs and petioles by breaking them from the crowns of trees. One female had difficulty in choosing between two attractive cavities and for a while carried material alternately into both of them. The male often follows his building partner, stands in the doorway to sing a low, hurried twitter, and sometimes picks up twiglets only to play with them and drop them again.

One Central American set consisted of 3 eggs laid on consecutive days and another nest contained 2 nestlings. The glossy eggs, heavily marked with cherry red, are of exceptional beauty.

At a nest where the parents were marked, only the female incubated. In seven hours her 15 sessions averaged 17 minutes, her 15 recesses $8\frac{1}{2}$ minutes, and she sat for 66.7 per cent of the time. The male sometimes stood in the doorway but he did not cover the eggs.

At one nest the incubation period was about 16 days.

Newly hatched nestlings bear rather long, dusky down and the interior of the mouth is yellow. They are fed by both parents.

These flycatchers disappear from Central America in August.

GOLDEN-BELLIED FLYCATCHER

Myiodynastes hemichrysus

While two of the Central American species of *Myiodynastes* are confusingly similar in appearance, the third is distinct and bears a closer resemblance to certain flycatchers of other genera than to its own near relatives. The Golden-bellied Flycatcher measures about eight inches in length and is one of the larger members of its family. Its forehead, crown, and hindneck are dusky and the rest of the upper plumage, including the lesser wing-coverts, is plain olive-green. The tail feathers are dark grayish brown bordered with pale brown or cinnamon. The wings are grayish brown, with the inner secondaries broadly margined with dull white, the outer secondaries and inner primaries narrowly edged with cinnamon. The dusky crown has a concealed patch of bright yellow, and it is bordered by broad white superciliary stripes which converge but do not meet at the back of the head. Below each of these a wide blackish band covers the lores, auricular region, and much of the cheeks. A prominent grayish olive malar stripe extends from the base of the bill to the dusky of the hindneck and is separated from the black of the cheeks by a narrow white band on their lower parts. The chin is white and the rest of the under plumage is bright yellow, with broad but faint streaks of olive on the sides of the breast instead of the prominent ventral streaking of related species. The bill is largely black and the eyes and legs are dark. The sexes are alike in appearance.

The Golden-bellied Flycatcher is confined to the highlands of Costa Rica and western Panamá, and in the former country it is rare. I have met it only on the northern slopes of the Cordillera Central below Vara Blanca, from about 3500 to 5600 feet above sea level. At the time of my long sojourn in this region in 1937 and 1938, these excessively rainy mountains were still largely covered with forest composed of tall, crowded trees whose massive trunks and boughs were heavily burdened with an extraordinary profusion of epiphytes of the most varied kinds. In the stormy months of the northern winter, when many of the common, wide-ranging flycatchers which nested on these wet heights seemed to withdraw to lower and milder regions, this was the large flycatcher which I most often saw in the vicinity. The Golden-bellied Flycatchers usually remained high up in the tree tops, in the forest and at edges of clearings. They were active, restless, and noisy and were usually in pairs even in October, November, and December.

In coloration the Golden-bellied Flycatcher closely resembles several other flycatchers of different genera, including the smaller Vermilion-crowned Flycatcher and the larger Boat-billed Flycatcher and Kiskadee. To add to the likelihood of confusion, one of its calls is similar to the plaintive *pee-ah* so frequently uttered by the Vermilion-crown, which nests in clearings in the forests where the Golden-bellied Flycatcher resides. Since it was difficult to obtain a good view of this active bird of the treetops, I at first mistook it for a form of the widespread Vermilion-crown, although certain of its notes were very different from any that I had ever heard from the latter in other regions. When finally I was permitted a good view through my field glasses, the heavy dark malar stripes, together with the larger size and more slender form of the Golden-bellied Flycatcher, at once drew attention to its distinctness. These streaks on the sides of the throat also serve to distinguish it from the Boat-billed Flycatcher and the Kiskadee, which likewise mingle with it in forest clearings. But the voice of the Golden-bellied Flycatcher, once it has become familiar, suffices to reveal the identity of the species even when it is too far off for the details of its coloration to be clearly seen.



Fig. 63. Golden-bellied Flycatcher.

VOICE

More characteristic of the Golden-bellied Flycatcher than the plaintive note already mentioned is a high, sharp, loud call, which in tone resembles a common note of the related Sulphur-bellied Flycatcher. Like its more widely distributed relative, the Golden-bellied Flycatcher also has a very different utterance, a clear, melodious phrase of three liquid syllables, which sounds to me like *tree-le-loo*, and which is usually repeated over and over to form a flowing song. In October, when I first became aware of this attractive

song, I heard it in the morning after sunrise and again in the middle of the afternoon. Probably it was delivered at this season and at these hours by a male seeking a mate, for this utterance appears to be the counterpart of the equally melodious dawn songs of the Streaked Flycatcher and the Sulphur-bellied Flycatcher. I did not again hear the *tree-le-loo* song until the following May and June, when it was delivered at dawn by a bird which perched down in the gorge of the Río Sarapiquí where I could not come close to him.

NESTING

While the noisy Sulphur-bellied Flycatchers, which were abundant in the clearings at Vara Blanca, built their nests in holes in trunks, as they do in less humid parts of their varied range, their relatives the Golden-bellied Flycatchers, confined to the epiphyte-burdened mountain forests, nested in sites more in keeping with their special environment. Instead of choosing cavities in wood, they selected nooks and pockets in the masses of moss and roots of epiphytes which on these rainy heights thickly en-



Fig. 64. Heavy forest in the Costa Rican mountains at 5500 feet, near Vara Blanca; Cerro Congo in the distance. Golden-bellied Flycatchers and Tufted Flycatchers frequented the treetops, while Highland Wood Wrens, Ochraceous Wrens, and Russet Nightingale-Thrushes lived at lower levels.

veloped the trunks and major branches of the larger living trees. The first nest of this flycatcher which I found was about a hundred feet up, in a niche among the matted roots of air plants which grew on a branch at the top of a stately yos tree (*Sapium* sp.). This tree was standing in a pasture near the forest's edge. Had I not seen the flycatcher dart into this recess with a twig in her bill, one afternoon in early May, I should never have suspected the presence of the nest. Since she stayed within the mass of plants for a good while, she was probably already incubating.

On the morning of May 11, a pair of Golden-bellied Flycatchers flew about among the tall trees which stood in a narrow, forest-rimmed pasture where I was studying the nesting of Quetzals, Allied Woodhewers, Hairy Woodpeckers, and other birds. The fly-

catchers were investigating the many nooks and recesses that were to be found among the abundant roots of the epiphytes. At times one of the pair, whose sex I could not distinguish, pushed into a cranny and delivered a rapid, low twitter such as birds of this genus and of *Myiozetetes* utter while they choose their nest site and sometimes while they build. From among the potential nest sites which they examined they selected a nook among the roots of the epiphytes covering the upright trunk of a tall tree, just below a big tank bromeliad, at a height of about 75 feet. Here building was in progress by the following afternoon.

The female Golden-bellied Flycatcher built without help from her mate. Instead of the twigs and petioles which Sulphur-bellied and Streaked Flycatchers gather for their nest's foundation, she chose green moss plucked from the trees. Sometimes she brought her material from the forest to the east of the clearing and sometimes from that to the west. Her mate rested much of the time on a lofty branch near the nest, whence he darted out from time to time to snap up flying insects or chase intruding birds, while she went back and forth alone. But at times he accompanied her on her journeys to find moss; or if she went alone and delayed too long in the woodland, he called and then flew off to seek her. If the female arrived in the tree with material in her bill and found him absent, she uttered a high, sharp call. Sometimes when she returned to the nest tree with moss and met him there, they greeted each other with notes of the same character. One morning after sunrise I found the male singing *tree-le-loo* near the nest, but the only dawn singing which I heard came from far down in the neighboring gorge, where possibly this male roosted.

Because of the inaccessibility of this nest, I made no attempt to follow its subsequent history. As far as I know, the eggs of this attractive bird have never been seen by an ornithologist.

SUMMARY

In Costa Rica the Golden-bellied Flycatcher inhabits wet, epiphyte-laden mountain forests between 3000 and 6000 feet above sea level. It may venture forth from the woodland into adjoining clearings with scattered trees, but it usually stays high up in the treetops. It lives in pairs at all seasons.

Its calls are mostly loud and sharp, but it has also a melodious, liquid song which is delivered chiefly at daybreak.

Two nests were placed in crannies among the roots of the epiphytes which heavily burdened great trees standing in recently made clearings in the forest. The nests were at heights of about 75 and 100 feet. At one nest where the building was done by the female alone a great deal of green moss was carried into the niche. Her mate remained close by and sometimes accompanied her when she flew off for more moss, but he was not seen to carry nest material.

DUSKY-CAPPED FLYCATCHER

Myiarchus tuberculifer

The Dusky-capped or Olivaceous Flycatcher is one of the smaller and more easily recognized of the many confusingly similar species of *Myiarchus* which inhabit tropical America, where in many lowland areas two or more kinds occur together. The Central American forms of this widely distributed and variable species range from five and three-quarters to about seven inches in length. The top of the head varies from brownish olive or sooty brown to black and is usually much darker than the olive or greenish olive back and rump. The tail is grayish brown and its feathers have cinnamon-rufous or at least paler outer edges. The wings are dark grayish brown, with lighter, often cinnamon-rufous, margins on the ends of the middle and greater coverts and edgings of the same color on some or most of the remiges. The auricular region is sooty brown. The cheeks, chin, throat, and upper breast are very pale gray, which merges into light yellow on the more posterior under plumage. The eyes are brown, and the bill and legs are dark.

The species, as it is classified at present, extends from southern Arizona to Bolivia and Argentina and appears to be migratory at the extreme northern limit of its range, in the United States. In Central America it is one of the most widely distributed of all the smaller birds, for it is found in some of the wettest districts as well as in some of the driest, and from sea level far up into the mountains. In Panamá, Costa Rica, and Guatemala, as in South America, it ranges generally up to about 6000 feet, and, in the western highlands of Guatemala, I occasionally met it at 7800 feet above sea level, but it was rare at this altitude. In the plantations and scrubby growth around Lake Atitlán in Guatemala, at an altitude of 5000 feet, I found it the most abundant of the flycatchers.

The Dusky-capped Flycatcher inhabits clearings with scattered trees, open groves, shady plantations, second-growth woods, and even fairly tall forests, but it is found only at the edges of the heaviest woodland. It catches most of its insect prey by darting out from some exposed perch, but I have seen it alight on fallen brush in a pasture and drop to the ground to pick up grasshoppers, spiders or other small creatures. It never flocks, and in the central plateau of Costa Rica, where it is easier to observe than in regions with lusher vegetation, I found these flycatchers living singly rather than in pairs in October and November. Yet in the valley of El General many are mated by early January if not before.

Once while I sat in a blind in the forest on Barro Colorado Island, watching a nest of the Black-throated Trogon, a Dusky-capped Flycatcher sunned itself in a patch of sunshine that fell on a prostrate tree close beside me. Lying flat on the trunk, it spread its wings and fluffed out its body feathers to let the sun's rays penetrate deeply into them. A short while before, a Blue-crowned Wood Nymph Hummingbird had sunned herself in the same spot and in much the same attitude.

VOICE

The usual call of the Dusky-capped Flycatcher is a long-drawn, mournful whistle or whine. At daybreak in the breeding season, and at times also in the evening twilight or late on cloudy afternoons, it delivers a long-continued song with a character all its own. I have heard this dawn song in the Motagua Valley in Guatemala, in the valley of El General in Costa Rica, and in the Panamá Canal Zone. In all these widely separated



Fig. 65. Dusky-capped Flycatcher.

regions the song was much the same, although the Dusky-capped Flycatchers inhabiting these regions belonged to different races. The slight variations in my rendering of the birds' notes may be due to actual differences in song or to my own diverse responses to it in different years. In Guatemala the flycatcher's dawn song consisted of a short, sharp, whistled *whit*, a long-drawn, plaintive, whistled *wheeu*, and a whistle cut off short, *whe-du*. These notes were not always delivered in the same sequence; but compounded in various orders, they were poured forth with scarcely a break for many minutes in a weak, querulous voice. On Barro Colorado Island the birds sang *wheel wheédu*, *wheer wheédu* over and over, in serious, deliberate tones without much melody. Occasionally they varied the performance by introducing a harsh trill.

At the height of the breeding season this song is begun as soon as the sky begins to

brighten and before most birds have broken their nocturnal silence, and it is continued with scarcely a pause until daylight has penetrated to the depth of the woodland. One Dusky-capped Flycatcher which I timed in Guatemala sang continuously for at least 20 minutes. He did not always maintain the same perch but flitted from branch to branch of a low tree in a hedgerow. On other mornings he sang from perches not over ten feet up in a small tree in a brushy pasture. But in the woodland the flycatchers perform well up in the treetops. In El General I have heard this dawn song from some time in February (my earliest date is February 8, 1937) until about the end of June.

I have only a single record of this species singing in the evening twilight. On April 28, 1932, a flycatcher in a hillside pasture above the Motagua Valley sang for many minutes after sunset, but not so continuously as at daybreak, for he often interrupted his monologue to pursue insects. In various parts of the Dusky-capped Flycatcher's far-flung range I have often heard it deliver the twilight song late in cloudy afternoons, before the hour of sunset. A long, harsh trill usually figures prominently in these afternoon performances.

NESTING

In the Caribbean lowlands of Honduras and Guatemala I discovered three nests in 1930 and 1932, but in many subsequent seasons in various parts of the bird's range I have, inexplicably, failed to notice a single additional nest. Like other species of *Myiarchus*, the Dusky-capped Flycatcher breeds in cavities in trees. Two of those which I found were in fence posts where the hollows had been formed by decay, whereas the third was in a small, leaning tree on a steep, scrubby hillside. This last nest was in a deep cavity in a strongly inclined trunk whose top had split off, and the eggs rested seven inches below the opening, in a space so narrow that only by dint of much squeezing could I reach them with my finger tips. The nest was so well concealed that I certainly should not have found it had not the parents complained so persistently while I sat on the leaning trunk watching a pair of Black-chinned or Rufous-tailed Jacamars attend their nestlings in a neighboring tunnel in the steep slope. In height these three flycatcher nests ranged from $3\frac{1}{2}$ to $5\frac{1}{2}$ feet above the ground. In each case the cavity was stuffed and lined with cotton or other softly fibrous materials, hair, feathers, and the like. In one nest a fragment of snake skin had been added to this accumulation, but it had fallen apart into its component scutes. The presence of snake skin in the nest is widespread in the genus *Myiarchus*, as it is in the hole-nesting wrens of the genus *Troglodytes*, and although some have seen a special significance in this material, I believe that it is gathered because it is soft and pliable, like tissue paper and cellophane, which are also frequently used by nesting birds.

The first nest, situated in the Lancetilla Valley in Honduras, held three nestlings when I first saw it on May 19, and the young took wing a week later. The second nest was in the hills beside the Motagua Valley near Los Amates and contained four eggs which were on the point of hatching when I discovered them on April 26. The third nest, in the same locality, had four eggs, almost ready to hatch, on June 3. The eggs were dull white, heavily blotched and speckled with chocolate, especially in a wreath around the thick end. On the rest of the surface, the markings tended to take the form of irregular longitudinal streaks, but on one egg dots rather than streaks were present here. The measurements of these 8 eggs average 20.0 by 15.0 millimeters. Those showing the four extremes measured 20.6 by 15.5 and 19.1 by 14.3 millimeters.

I have seen no published records of Central American nests of the Dusky-capped Flycatcher. In Trinidad, Belcher and Smooker (1937:236) found eggs in two successive years in the same hole in a dead stump near a forestry plantation, about fifteen feet

above the ground. The nest was made of dried weed stems and moss and was lined with black, horsehair-like fibers strongly woven together. These materials were quite different from those which composed my Guatemalan nests. The eggs, in each case three in number, were also more heavily marked, for the buffy ground color was "almost obliterated with blotches, longitudinal streaks, and tangled lines of dark purplish-brown, paler brown, and lavender-grey, most pronounced at the larger end." These two sets were found on June 15, 1932, and April 17, 1933. At the northern extremity of its range in Arizona, this species lays in June; sets are of four or five eggs placed in natural cavities or abandoned woodpecker holes, from 4 to 50 feet above the ground (Bent, 1942:138).

I found the Guatemalan Dusky-capped Flycatchers almost fearless of me when I examined their nests. One parent rested, panting in the intense afternoon heat, on a leafless twig and scrutinized me intently with bright brown eyes while I measured her eggs and recorded the figures in my notebook. A sudden movement which I made sent her away, but in a minute she returned to resume her inspection of her visitor from the same perch, which was well within my reach. In the nest on the scrubby hillside the four eggs had hatched by April 27, the day after I found them. By May 10 the three remaining nestlings were well feathered in the pattern of their parents. When I lifted them laboriously from their snug cranny for a closer examination, they snapped their broad, flat bills, making a loud, clacking sound, and struggled to free themselves. Two managed to slip through my fingers, and although only 13 days old they flew so well that I could not recover them. Alighting in the thicket, they called with long-drawn, plaintive whistles, miniatures of the adults' call, and these calls soon drew both parents. When they heard the third of their youngsters crying in my hand as it struggled to escape, the parents darted at my head with such swiftness and vigor, and with such a loud clacking of their bills that, although I had resolved not to move because I wanted to see how close they would come to me, at each rapid onslaught I involuntarily ducked at the crucial moment in order to save my eyes. After several of these threatening darts they drew off a space and uttered long-drawn whistles, which in the circumstances sounded more than ordinarily forlorn. I returned the third fledgling to its nest, feeling certain that it would not stay much longer. Probably if undisturbed these Dusky-capped Flycatchers would have remained in the nest at least 14 days. In my other Guatemalan nest, the chicks were killed by fire ants the day after they hatched.

SUMMARY

The Dusky-capped Flycatcher inhabits the lighter woodlands, shady plantations, and pastures in both humid and arid country from sea level quite generally up to 6000 feet and occasionally as high as 7800 feet. The species was found living singly in October and November but in pairs in early January.

Its call is a long-drawn, weak, querulous whistle. At daybreak it continues for many minutes a distinctive twilight song, which is often heard late on cloudy afternoons and more rarely after sunset.

In the Caribbean lowlands of Honduras and Guatemala, it breeds in April, May and June. The nest is built of various soft materials in a cavity in a tree or post, and sometimes it contains a fragment of snake skin. Three nests ranged in height from 3½ to 5½ feet above the ground. Each of two nests contained four eggs, which were whitish heavily marked with chocolate. The third nest held three nestlings.

Both parents guard the nest, darting very close to a human visitor and snapping their bills in a threatening manner.

The nestlings fly well when 13 days old.

LONG-TAILED FLYCATCHER

Colonia colonus

This easily recognized flycatcher is found through the more humid lowlands of tropical America from the Segovia River in northeastern Honduras to southern Brazil and Paraguay, but it is far less uniformly distributed than many other far-ranging species. In Central America north of Panamá, it is confined to lower elevations on the Caribbean side, up to possibly 2500 feet above sea level. It frequents the borders of the forest along waterways and about the edges of plantations and other clearings, where it perches, usually well above the ground, on dead trees or the exposed ends of leafless branches, whence it makes spectacular sallies into the air to snatch up flying insects. It is generally seen in pairs or family groups. Although a number of writers have recorded that it nests in old woodpecker holes or other cavities in dead trees at or near the forest's edge, these nests have always been high, and apparently no one has ever examined their contents or observed the behavior of the breeding birds. I have never found a nest of this bird in Central America, where it breeds as late as July and August (Arbib and Loetscher, 1935), but in Ecuador in 1939 I had an opportunity to watch a breeding pair of this species. In view of the paucity of information on this attractive bird, it seems permissible to pass beyond the geographical limits of this work and record here what I was able to learn about it.

In the neighborhood of Puyo, at an altitude of about 3000 feet in the eastern approaches to the Andes, the Long-tailed Flycatcher was not abundant, and in two months I saw only a single family, which lived in a hillside pasture at the edge of the forest that occupied most of this hilly region. The male of this pair was nine or ten inches long, but well over half of this length was accounted for by his tail. Thus in body length he was the size of one of the smaller flycatchers. His hindhead and crown were hoary gray with darker spots, and there was a white border on the forehead and above the eyes. The sides of his head, shoulders, back, wings and tail were black, but the rump and an indistinct streak along the middle of the back were whitish. All of his under plumage was blackish. The two slender central feathers of his tail greatly exceeded all the others in length. His bill, eyes, and legs were black or at least very dark. His mate was similar in plumage, but her very narrow central tail feathers were far shorter than his, although still much longer than her own lateral rectrices. A young bird which accompanied them was wholly blackish in plumage except that the top of its head was somewhat lighter and its lores were white. Its central tail feathers scarcely projected beyond the lateral ones.

When I first met this family on August 17, the three flycatchers, parents and young, perched on the ends of slender dead trunks standing in the clearing, or else on dead branches at the woodland's edge, and from these lookouts they made long, graceful sallies to snatch insects from the air, returning usually to the same perch. Sometimes, as the male darted swiftly upward, his tail whistled loudly in its passage through the air. From time to time one of the flycatchers uttered a soft *weet*, the only note I ever heard from them. The single youngster seemed to be wholly self-supporting, for it caught many insects for itself and did not plead for food. Once I saw the female enter a cavity in the side of a tall dead trunk of a palm, but she promptly came out.

Wishing to learn whether the Long-tailed Flycatcher has a special dawn song, like so many other members of the family, I went one morning before daybreak to the clearing where they were nearly always to be found. To my disappointment, I failed to hear the male sing in the dim light.



Fig. 66. Long-tailed Flycatcher.

NESTING

In the evening of August 30, I again visited these flycatchers in the spot where I first encountered them. The female seemed to be incubating in the cavity in the palm trunk which I had seen her enter momentarily a fortnight earlier. This hole was about forty feet above the ground and had a wide oval entrance, the long axis being vertical. Possibly the cavity was the work of woodpeckers, with the entrance enlarged by decay. The female retired into it for the night, while the male disappeared as darkness fell. I did not see the young flycatcher.

The almost incessant rain and mist of this period interfered with my plan to make an extended study of this nest. But I watched from 10:00 to 11:30 on the morning of September 1, when incubation was in progress. During this time the female alone covered the eggs and was a most impatient sitter, at least in the spells of fair weather which favored insect catching. Her 9 completed sessions ranged from 3 to 7 minutes and averaged 5.1 minutes, while the 8 recesses that separated these sessions varied from 2 to 5 minutes and averaged 4.3 minutes. She was in the nest a total of 46 minutes and outside a total of 34 minutes. When she left the nest, she would sometimes fly directly through the doorway and catch an insect in the air before she sought a perch.

Her mate remained constantly in the vicinity of the nest. Much of the time he rested a short distance below the doorway, on a slender projecting branch of a dead vine which embraced the slender palm trunk. Sometimes, while his partner was incubating, he perched on the sill of the doorway and bent his head inward. Low, soft notes then issued from the nest, but I could not tell whether they were uttered by the male or his mate, or by both together. Again I failed to see the young bird.

On September 8, when the eggs had hatched, I devoted an hour to watching the nest. From 8:43 to 9:43 a.m., the male went to the nest 15 times and either entered or, more often, stuck his head inside while he rested in the doorway. I could see only rarely that he had food in his bill when he flew to the nest. In all probability, however, he took something to the nestlings on each visit, and the smallness of the insects made it difficult to distinguish them in his bill. He went to the hole both in the absence of the female and while she was within brooding the nestlings. Her periods of brooding, like her sessions during incubation, were short and usually lasted about 4 minutes, although they ranged from 1 to 6 minutes, while her absences varied from 3 to 7 minutes. In the hour, she devoted a total of 25 minutes to warming her nestlings and was outside a total of 35 minutes. I could not make certain that she brought food to the nest when she returned from a sortie. Perhaps the male kept the nestlings amply supplied with food.

SUMMARY

Over much of the humid lowlands of tropical America, the Long-tailed Flycatcher frequents the forest's edge, especially along waterways and about the margins of clearings. It perches conspicuously on dead trees or leafless boughs and makes long sallies to catch flying insects.

Its call is a soft *weet*, and the species appears to have a very limited vocabulary.

This flycatcher breeds in holes well up in dead trees and apparently its nest and eggs have never been described. In eastern Ecuador a female began in August to incubate the eggs of her second (or later) brood. In rainless weather her sessions and recesses lasted only a few minutes, so that she was constantly entering and leaving the nest. Her mate sometimes went to the doorway but he did not incubate. Later he took a large share in feeding the nestlings, which the female alone brooded.

GRAY-CAPPED FLYCATCHER

Myiozetetes granadensis

Noisy and active, preferring the open spaces to the forests or the thickets, the Gray-capped Flycatcher is a bird with a strong personality. Over a wide territory stretching from Nicaragua to Bolivia and Brazil, it is one of the first birds to force itself upon the attention of the bird watcher. Its loud, unmelodious notes can hardly be confused with those of any other bird with which it dwells. A flycatcher somewhat above the medium size, about six and a quarter inches in length, its appearance is in keeping with its whole character, neither brilliant nor dull, neither beautiful nor dingy, bordering perhaps on the commonplace, yet with pronounced individual features. The olive-green upper plumage, white chin and throat, bright canary-yellow breast and belly are common enough among the larger flycatchers, but the head markings are distinctive. The gray of its crown shades off to white on the forehead, and the sides of the head are dusky. In the center of the crown, especially on the male, is a patch of flame-colored feathers which are revealed only on rare occasions. Otherwise male and female are almost identical in plumage, yet it is usually possible to distinguish the male of a mated pair by the loose, slightly raised feathers of his crown. Even in repose the male has a somewhat tousled head, whereas his mate wears her crown feathers sleek and flat, as though carefully combed back from the forehead. The eyes of both sexes are dull yellow; the bill, legs and feet are black.

Some writers have called the Gray-capped Flycatcher quieter and more retiring than the related Chipsacheery or Vermilion-crowned Flycatcher, and this is doubtless true in certain regions where both occur together, as on the Caribbean side of Costa Rica and Panamá. But in the valley of El General, on the Pacific side of Costa Rica, it is no less abundant about human habitations, and no less noisy, than its more widely distributed congener. Although the Gray-cap is perhaps neither more loquacious nor more aggressive than the Chipsacheery, its notes are so much louder, harsher, and more forceful than the latter's usually soft and somewhat plaintive utterances, that it gives the impression of being the bolder and more forward bird. Both species inhabit agricultural country, where they are found in shady pastures, hedgerows, orchards, and almost everywhere that scattered trees surrounded by open spaces provide the ideal conditions for flycatching. In forested terrain, they are confined to the shores of rivers and lagoons. They sometimes forage among the treetops and open spaces of the forest; but they are never found more than a short flight within its edge, and they are never seen in the dark undergrowth.

In Costa Rica, the Gray-cap ranges from sea level on both coasts upward to at least 5500 feet in the mountains. At the highest elevations where they breed, they appear to be present merely as summer residents. In the clearings amid the forest at Vara Blanca, an extremely wet region on the exposed northern slope of the Cordillera Central, I found Gray-caps only from late February to August, and in May I discovered one of their nests at 5400 feet. After the close of the breeding season they apparently dropped down toward the lowlands. At an altitude of 3000 feet in the Térraba Valley, they nest in great numbers and are resident throughout the year. After the separation of the young of the latest brood from their parents, in October or November at latest, Gray-caps are usually met in pairs.

FOOD

Much of the food of the Gray-capped Flycatcher consists of winged insects which are snatched from the air, often by means of a long, spectacular dart which takes the bird



Fig. 67. Gray-capped Flycatcher.

well above the treetops. Early morning and late afternoon are the periods of the day when the Gray-cap is most active in flycatching. This species also consumes a variety of small fruits, and I have seen it devour the blackish berries of *Miconia*, the little lead-colored fruits of the aguacatillo (*Persea Skutchii*), and the seeds of a species of *Xanthoxylum*, each enclosed in a thin black aril that provides a small amount of nourishment. The red arils enclosing the seeds of *Alchornea latifolia* are also eaten. When softer fruits are scarce, these flycatchers will even eat the green fruiting spikes of the cecropia tree, darting up to the dangling inflorescence to tear away a billful of the tissue, then alighting on some convenient perch to swallow it.

Probably because they are so rich in digestible oil, the hard green fruits of the acuituno (*Simaruba glauca*), which resemble miniature olives, are eagerly sought by birds so diverse as Chestnut-winged Chachalacas, Blue-crowned Motmots, and Gray's Thrushes. One morning I watched a Gray-capped Flycatcher who aspired to join the

feast of its larger neighbors in the aceituno tree in front of our house, but the bird found the green drupes too big for it to swallow. After each trial and failure to force one of them down, the flycatcher knocked it against its perch, as though it were an insect; but it was too hard to be softened in this manner. Several times the pressure of the bird's mandibles caused the slippery fruit to shoot forward from its bill, as one can project a bean by pressing it between a thumb and finger. Each time the flycatcher darted forward and caught it before it had gone the bird's own length—an amazingly prompt reaction. But at last the refractory morsel fell to the ground.

It has been said (Lack, 1944) that when two congeneric species occur together, they must have somewhat different food requirements, or the one that happened to be stronger, or better adapted to its environment, would eventually supplant its weaker relative. Everywhere that I have met the Gray-capped Flycatcher I have also found the Vermilion-crowned Flycatcher, and always they live on intimate and friendly terms, flycatching from the same trees, eating berries in the same bushes, and building their nests only a few feet apart. In general, the food of these two closely related species is much the same, although a quantitative analysis might reveal important differences in the species of insects or fruits most commonly taken by them. So far as I have been able to learn, however, without studying the contents of stomachs, the chief difference in the mode of foraging of these two species is that the Vermilion-crown very often picks up things from the ground, as on a lawn, close-cropped pasture or bare shore, either darting down from a rock or other low perch or else actually hopping over the ground; whereas I have not seen the Gray-cap hop over the ground, and it darts down to the ground from a rock or other low perch far more rarely than the Vermilion-crown. But if the Vermilion-crown often hunts nearer the ground than the Gray-cap, it also joins the latter in snatching insects from high in the air. Thus who shall say whether the slightly greater adaptability in foraging of *Myiozetetes similis* accounts for its far wider geographic range?

ROOSTING

In the evening, Gray-capped Flycatchers, often in company with Vermilion-crowns, continue to pursue flying insects in the failing light after most other birds have gone to rest. They are very noisy at this time, giving loud, harsh cries. Finally, when it is growing dark, they retire to their roosts. Often they sleep amid the dense foliage of an orange tree. In March, 1944, two Gray-caps, evidently a pair, roosted in the compact crown of a sour orange tree in my dooryard. Two others, which I believe were another pair, passed the night in separate but closely neighboring mandarin trees growing near the sour orange.

In February, 1943, many Gray-caps roosted in a small, recently planted patch of sugar cane in which the canes were still low and crowded. At the close of the day, they would gather in the surrounding trees, constantly repeating their dry notes, and darting forth to catch flying insects. After sunset they gradually dropped down into the cane leaves. Here they were mostly invisible to me as I stood on a slight elevation beside the field; but their voices issued from the depths of the bright green foliage, and now and again one of the yellow-breasted birds shot up to snatch an insect from the air above the crests of the canes, then fell back into concealment. They continued this until the light grew dim. The few birds that I was able to glimpse among the canes roosted on the flat surfaces of the broad, arching leafblades, at the top of the arch where their course was horizontal. It was hardly possible to make an accurate count of the Gray-caps that passed the night in this little canefield, but there were at least ten or twelve. With them slept a few Vermilion-crowns and many Rough-winged Swallows.

For several weeks in February, 1953, a pair of Gray-caps roosted nightly in some small trees on the hillside behind our house. Here it was far easier to pick them out with

a flashlight than when they slept in the dense foliage of an orange tree or in a canefield. The members of the slumbering pair were never in contact but always occupied separate slender perches, a yard or more apart. Once they roosted in different trees, about twenty yards from each other. They slept with their heads tucked back into their feathers and were not disturbed by the light.



Fig. 68. A shady pasture near Almirante in western Panamá. The scattered trees provided lookouts and nest sites for Gray-capped Flycatchers, Vermilion-crowned Flycatchers, Tropical Kingbirds, and Kiskadees.

VOICE

Gray-capped Flycatchers have a large and varied vocabulary. They seem to possess a distinct utterance for every important occasion in their lives. Probably this is true of many or even of most birds, but while some species express different meanings by slight variations in the tempo or inflection of their notes, difficult for the human ear to detect and for human memory to retain, the Gray-cap's utterances are so diverse that they are readily noticed and remembered. Few of the notes, however, can be termed melodious.

Perhaps the most frequently used of the Gray-cap's notes is a loud, sharp, harsh, staccato monosyllable which at various times I have written *whip*, *whit*, *wic*, *bic* or *bip*. Often joined with this is another loud note, which sounds like *burr*. These syllables are uttered in the most varied combinations, as *bip bip bip*, or *bic bic bic burr*, or *bip bip bip burr burr burr*—the variants are innumerable. Mated individuals are constantly calling back and forth with these notes from neighboring trees. The female of one pair would call *wic wic burr burr burr*, the last two syllables emphasized with a peculiar intonation. Her mate would answer *wic wic wic wic*. These differences seemed to be constant for this pair, but I am not sure whether they are general for the species.

When alarmed by the swift passage of a hawk across the sky, the Gray-cap gives a very rapid sequence of sharp notes, almost a rattle. This is the alarm cry, and it sends all small birds scurrying into shelter and causes a hush to fall over the countryside until the bird of prey is gone. This sharp rattle is apparently the specific warning for a flying hawk; when its nest seems to be endangered by a man or a toucan, or while worrying a hawk at rest, the Gray-cap gives voice to notes more closely resembling its ordinary calls.

As the season for building the nest approaches, the Gray-caps fly about the clearings and investigate potential nest sites. When one of them finds a forked branch that looks promising, it sits there and utters a low, long-continued *churr* or rattle. While one member of the pair, most often the female, hums the nest song, the other perches on the end of a twig close by and shouts *bic* and *burr*. Later, after the nest has been completed and the eggs laid, the female while incubating often sings a more elaborate nest song. This song is neither liquid nor melodious but is a sort of cackling chant, a song in a talking voice. Most female Gray-caps find difficulty in remaining silent for many minutes while sitting in their covered nests, and when not singing they utter their usual harsh *bip* and *burr* from time to time. Later, after the eggs hatch and the female begins to bring food to the nestlings, she voices the "feeding-song." This somewhat resembles the male's dawn song, next to be described, but it is far lower in tone. It is used by the parent chiefly when younger nestlings are slow in swallowing the food that is offered to them; it seems to be an eager, hurried, slightly vexed expostulation to the sluggish nestlings. Although one may question the propriety of calling these utterances "songs," our language contains no simple term more appropriate to describe them. To designate them as "calls" fails to suggest their length and continuity.

Like so many other flycatchers, the Gray-cap has a dawn song, which is reserved for the morning twilight in the breeding season and is seldom heard at other times of the year or the day. When other birds raise their sweet and liquid voices to greet the returning light, the Gray-cap awakes, utters a number of his ordinary calls, then shouts out in his hoarse voice, over and over, *hic, bit of a cold; hic, bit of a cold*. At least, this is what the first Gray-cap that I heard perform at dawn seemed to be crying. Other individuals that I have listened to have used slightly different phrases, but all have apparently been equally afflicted with catarrh. And the Gray-caps do not perform at dawn as long and uninterruptedly as some of the other flycatchers, such as the soft-voiced Vermilion-crown. Thus, one morning at the end of March, three Vermilion-crowns within hearing of our house continued their dawn songs for from twenty minutes to half an hour, but the two Gray-caps closest at hand performed for only eight or ten minutes.

In 1944, and again the following year, two pairs of Gray-capped Flycatchers, as has already been mentioned, roosted in neighboring citrus trees in our dooryard. In March and April, two males sang their dawn songs from two guava trees growing so close together that their boughs interlocked. These trees were only a few yards away from the trees where they slept. Usually the birds would merely perch in the low treetops and try to out-shout each other, but at times one would give spirited chase to his rival. One evening, too, as it was growing dark, they had a quarrel and drove each other back and forth among the trees, at the same time shouting snatches of their harsh dawn song. It is only under stress of excitement such as this that the song is heard during the hours of full daylight and in the evening twilight, and then usually it is delivered very briefly. The Gray-cap does not ordinarily chant again at the day's end, like the Wood Pewee and the Streaked Flycatcher. Indeed, when greatly excited, the Gray-cap may utter a few phrases of his dawn song in any month of the year and any hour of the day.

While the two male Gray-caps proclaimed themselves loudly in the guava trees at dawn, the mate of one, still in a neighboring mandarin tree where she slept, would from time to time call out responsively *he ha ha* in a loud, sharp tone, even harsher than that in which the male sang. Likewise in the evening, as the two rival males, after having chased each other, settled down to rest and shouted back and forth at each other through the dusk, the mate of one often added her voice to theirs. The male seemed to yell *quick, little girl*, and his mate in the other mandarin tree close by called back harshly *he ha ha*. This response was repeated several times, answering as many vociferations of the male.

But the other female, in the dense umbrage of the sour orange tree with her mate, was demurely silent.

In the valley of El General, at an altitude of about 2500 feet, the Gray-capped Flycatcher's dawn singing continues from late February or, more usually, middle or late March until early or mid-June, so that it is practically coextensive with the season of nesting. Although in northern birds the male often begins to sing weeks or even months before the female starts to build, the same is by no means true of those many tropical birds whose singing is distinctly seasonal. The Gray-cap's dawn song is heard little if any before the earliest nests are started, and in some pairs the female begins to build before the male sings. Thus, in 1944, the female of one of the two pairs whose crepuscular discord we have just considered laid the foundation of her nest on March 12, but the males did not begin to sing until March 15 and 18, respectively. Another female, at a slightly greater distance from the house, started her nest even earlier, on March 10, but if her mate sang at dawn before March 15, I failed to hear him. In 1945, I found a nest already well started on March 24, but I heard no dawn singing until March 28. In 1946, I first heard the Gray-caps sing a few notes of the dawn song on February 21, and on this date I found a nearly finished nest high up in a tree beside the river in front of our house. As I stood before the house three days later, I heard four Gray-caps singing profusely, and on this same day I discovered that a female was already lining her nest in the top of an orange tree in the garden. The following year, 1947, a female started a nest in this orange tree about March 10, but I heard no dawn song until March 14, when two birds performed briefly near the house. In 1948 when, because of the severity of the dry season, nesting began late, a Gray-cap by the house sang a little at dawn on March 24, but I heard no more dawn singing until April 5, when two males performed in the garden. My first nest was not found until April 25, when it was newly begun. Thus in this late year, unlike most others, singing appeared to precede building by several weeks. But in 1949, the first song was heard on March 17 and the first nest which I discovered was started only a week later, on March 24. Needless to say, one is far more likely to overlook the earliest nests than to fail to hear the first songs.

In three years, 1945, 1948, and 1951, I noticed a renewal of dawn singing in mid- or late August, after about two months of silence. In each year I heard only a single individual perform at this late date, and he continued singing only from five to ten days. In each of these years I found evidence of late nesting at the time of the male's renewal of dawn singing. In August, 1945, an old nest, from which the nestlings had flown about three months earlier, was repaired and contained two fresh eggs, which the female was incubating. It is significant that I discovered late nesting only in the years when I heard contemporaneous singing and that I heard song in August only in the years when there was evidence of nesting. This late breeding is discussed in more detail later. My purpose in mentioning it here is to show how closely dawn singing is associated with nesting in this species.

We have touched only upon some of the highlights in the language of this amazingly vocal flycatcher. When treating of the nestlings, we shall have occasion to refer to yet other sounds and combinations of sounds. A complete analysis of the Gray-capped Flycatcher's utterances would reveal convincingly the wealth of vocal expression which wild birds command.

NEST BUILDING

In the valley of El General, the foundations of the earliest nests are laid in favorable years at the beginning of March, or very rarely even in February. Usually, however, it is the second half of March or even early April before nest building becomes general. The bulky roofed nest is placed in a tree or shrub growing in a pasture, dooryard, or

plantation, or very often it is situated in a tree or bush growing along the shore of a river or lagoon. Sometimes the nest is built on a bough projecting far out above the water. The nests that I have seen above dry land ranged in height from 3 to 60 feet, but those higher than 20 or 25 feet or those as low as three feet are exceptional. Many of the nests built in bushy pastures or thorny orange trees are only 5 to 10 feet above ground. One female built a nest at a height of about 60 feet on a thick bough of a tree standing in a pasture, and when some mishap befell this first structure, she made a second nest only 8 feet up in a clump of small palms close by. Apparently the attraction of the first site was the proximity of a wasps' nest, of the second, the thorniness of the palms. Height in itself appeared to be a minor consideration with her. One nest that I found above a rushing mountain stream was only 30 inches above the water, and many in similar situations were no more than 5 or 6 feet up. Occasionally, however, streamside nests may be placed at a good height. Where available, a thorny orange or lemon tree is a preferred nest site, and most of the nests about our house have been in these trees.

Frequently the Gray-cap builds close beside a wasps' nest, apparently depending on these stinging insects to drive away larger animals. But most Central American wasps have tempers far less fiery than northern hornets, and if the observer is not too brusque in his movements, he may examine a bird's nest situated within a foot or so of a hive of wasps without getting stung. At times, in lieu of a wasps' nest, the Gray-cap will build her nest beside one of the silken structures that small black ants (*Camponotus senex*) weave amid the foliage. These irregular, gray, ants' nests have somewhat the appearance of a wasps' nest. The ants, however, do not sting, but only bite feebly with their jaws, and they can give but slight protection to the birds. At times the ants appear to trouble the birds by crawling too freely over their nest. One female Gray-cap, while brooding newly hatched nestlings, spent much time plucking these ants from the doorway of her nest. I could not ascertain whether she ate them or merely threw them aside.

Like the Vermilion-crown, the Gray-capped Flycatcher at times uses the recently abandoned nest of another bird as a foundation for her own. One female took possession of an empty, cup-shaped nest of a Blue Tanager and, adding a roof, converted it into an oven-shaped structure of the usual form. Another Gray-cap found a broad, shallow nest built by a Tropical Kingbird and transformed it into the more commodious roofed edifice of her own kind. In a later year a Gray-cap converted the more spacious open nest of a big Boat-billed Flycatcher in the same manner. But at times a Gray-cap, when ready to build, will fail to take advantage of an empty and abandoned open nest which is still in good repair, seems to offer an adequate foundation, and is close beside the crotch where she proceeds to construct her own nest.

It is not unusual to find occupied nests of both the Gray-capped and the Vermilion-crowned flycatchers in the same small tree. Sometimes the nests are only a yard or two apart, but these two related species live in perfect amity. However, I have never seen two nests of the Gray-cap in the same tree, or even in closely neighboring trees, and I have very rarely found two nests of the Vermilion-crown close together.

As they choose the site of the nest, the pair of Gray-caps seem to confer together. Probably the female actually makes the choice, but her mate attends her closely, taking great interest in all she does. Sitting in the prospective nest site, the Gray-cap utters a long-drawn, soft rattle or twittering *churr*. The search for a location may begin several weeks before a start is made at building, and by no means is every forked branch where the female sits and sings eventually used as the site of a nest.

I have watched for longer or shorter periods at least ten Gray-capped Flycatchers as they built, without ever seeing a male enter into the work. Usually while the female labors he rests on the end of a bough close by the growing structure and greets her with

a *bip*, a *beh* or a *burr* each time she flies past him on her way to deposit a billful of material in the nest. Sometimes he quivers his wings at the same time that he utters the dry, sharp salutation. More rarely he follows on her excursions to collect material. Some female Gray-caps work hard at gathering the constituents of their nest. One that I watched tore long fibers from a length of disintegrating woody vine that had been tied up beside a cabin as a clothesline. Another, building above a stream, struggled valiantly to pull rootlets from an undercut bank. The earliest nests of the year are built in a most dilatory fashion, so that the watcher grows tired of waiting for the bird to resume her work. While constructing later nests, the Gray-cap works more steadily, often continuing through much of the day. At times she may bring 24 billfuls of material to her nest in an hour.

While building, Gray-capped Flycatchers are often a sore trial to their bird neighbors. Their bulky nest requires a great amount of material, and rather than gather it toilsomely from primary sources, the Gray-caps often take what they can from conveniently situated nests of other birds, especially from unfinished or abandoned structures. A Gray-cap which in May, 1943, built in the top of a cashew tree close beside our house found many quarries for material among the neighboring trees and rarely needed to fly far afield to gather fresh straws or rootlets. Within ten yards of her newly laid foundation were empty nests of the Blue Tanager and the Boat-billed Flycatcher, recently abandoned and in good condition, which she might, like others of her kind, have roofed over to hold her own eggs. But she preferred to start afresh, and instead of taking advantage of one of these cup-shaped nests in its entirety, she used both nests piecemeal. She tore material alternately from these empty nests, and from a recently abandoned structure which I believe had been built by the same female earlier. The latter nest was in an orange tree in a corner of the garden.

In another direction, a Vermilion-crown was at the same time building in a lemon tree. The loose ingredients of this unfinished nest were easier to detach than those of completed structures. Thus when the Vermilion-crown rested from her morning's labors, the Gray-cap made visit after visit to the unguarded nest, each time bearing off in unchallenged triumph a great billful of material exactly suited to her own edifice, since it came from one of similar design. There was poetic justice in the robbery of this Vermilion-crown, for she herself had pilfered her material from the tiny nest which a Blue Honeycreeper was building in a neighboring calabash tree. Later the honeycreeper's little cup vanished completely, doubtless carried away by her larger, inconsiderate neighbor. To complete the tale of the thievery of building materials which had been rife in our garden, I must record that this same Gray-capped Flycatcher tore a big hole in the bottom of a nest which a Yellow-green Vireo was trying to finish in a neighboring guava tree. But the vireos, when present, easily put to flight the Gray-cap which was twice their own size. Fortunately for the smaller birds, the Gray-capped Flycatchers are easily driven off when engaged in pilfering. They themselves are by no means immune from this sort of annoyance by neighbors of various kinds, but I believe that they steal far more than is stolen from them.

It is difficult to determine just how long the Gray-capped Flycatcher takes to finish her nest, for often a number of days elapse between the virtual completion of the structure and the laying of the first egg, and in this interval she may continue to add slowly to the lining. The period devoted to nest building varies from one to two weeks; the birds when constructing the earliest nests sometimes take nearly twice as long as with those begun later in the season.

The completed structure is roughly globular in shape, with a domed roof usually thick enough to shed the rain, and a round entrance in the side facing out from the tree.

A typical nest had the following overall dimensions: height, 7 inches; diameter, from side to side, 6 inches, and from front to back also 6 inches. The doorway was 3 inches wide by $2\frac{1}{2}$ inches high. The nest was composed chiefly of dry grasses, an admixture of herbaceous stems of other kinds, rootlets, strips of fibrous bark, and much down from a neighboring balsa tree. The latter was used especially in the foundation, outer walls, and roof. The bottom was lined with fine, light-colored vegetable fibers. There was a little green moss below the entrance and in the roof. Another nest, built near a stand of giant cane (*Gynerium sagittatum*), was constructed almost wholly of feathery branches of the dry inflorescences of the cane. A nest built close to a maize granary contained much dry, brown corn "silk."

In the top of an orange tree, I found a nest with an opening that faced straight upward instead of sideward. It resembled the cup-shaped nest of a thrush or a tanager, but it was far less tidy than most open nests, with many straws sticking up around the rim. Probably the Gray-cap had begun to build a covered nest of the usual type, but it had fallen backward and she had not for that reason abandoned it. She started to incubate in this nest without a roof, but her eggs vanished before they hatched.

THE EGGS

The first egg is laid from two to nine days after the virtual completion of the nest, the interval being longer in the earlier nests than in later ones. The whole interval between the start of building and the deposition of the first egg may be as much as three weeks for first nests begun in March and as little as nine days for replacement nests built in May. Because the very earliest activity in building often fails to lead to a completed nest, while other nests begun early proceed very slowly, a considerable period elapses between the onset of the nesting operations and the laying of the first egg. My earliest records of freshly laid eggs are March 23, 1944, and March 27, 1947, but in El General eggs before the second week of April are by no means common. In the Caribbean lowlands of Costa Rica the Gray-cap breeds earlier. Carriker (1910:714) records a set of three eggs found along the Río Sixaola as early as March 8.

The hour of the morning when the Gray-cap's eggs are laid is quite variable. Eggs are never laid very early in the day, as is the rule in many species of finches and tanagers, and they may be laid well past the middle of the morning or even around noon. I have information on the approximate time of laying of 20 eggs in 13 nests. Only two of these eggs were definitely laid before 7:40 a.m. Six of the eggs were laid between 7:30 and 10:00. Twelve other eggs were laid after 9:00. Of these, one was laid between 10:00 a.m. and 12:30 p.m., one between 10:55 a.m. and 12:10 p.m., and one between 11:15 a.m. and 12:10 p.m. The interval separating the laying of successive eggs in the same set is usually 2 days, but it may be either 1 or, more rarely, 3 days. Of 31 known intervals, 26 were 2 days, 4 were 1 day, and 1 was 3 days. In eight nests, the same interval of 2 days separated the laying of the first and second eggs and the second and third. In three nests, the second egg was laid 2 days after the first, but the third egg only 1 day after the second. In one nest, the interval between the first and second eggs was 3 days, but that between the second and third only 2 days.

The full set usually consists of 3 eggs, sometimes only 2, very rarely 4. Of 40 nests examined in El General, 25 contained 3 eggs or nestlings, 14 contained 2 eggs or nestlings, and there was 1 set of 4 eggs. Huber (1932:232) found a set of 4 eggs at Eden, Nicaragua. The eggs of the Gray-capped Flycatcher are dull white, speckled and coarsely blotched with pale lilac and shades of brown, chocolate and burnt umber. These markings are usually aggregated into a heavy wreath about the thick end of the egg and scattered sparingly over the remaining surface. The measurements of 53 eggs average 23.3

by 17.0 millimeters. Those showing the four extremes measured 25.0 by 17.1, 24.2 by 17.5, 20.6 by 16.7, and 23.8 by 15.9 millimeters.

In 50 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: March, 4; April, 24; May, 19; June, 2; August, 1.

INCUBATION

Incubation is carried on by the female alone. Two females began to sleep in their nests on the night before the set of three eggs was completed, but another did not pass the night in her nest until after she had laid the third egg. In nocturnal visits to nests, I have nearly always found the female Gray-cap sleeping with her head exposed, in the manner of doves, rather than turned back and buried in her plumage in the usual manner of passerine birds.

At nest 21, situated in an orange tree in front of my house, I devoted six hours to watching the female incubate on the morning of May 19, 1943, a week after the last of her three eggs was laid, and an additional six hours were divided between the morning and late afternoon of May 27, when the eggs were pipped and on the point of hatching. By the latter date the female had acquired vermilion marks by rubbing against a little wad of paint-soaked cotton that I stuck in the doorway of her nest. But even without the stain, with continued watching I found it easy to distinguish the members of this pair. The feathers of the male's crown were looser, more upstanding than those of the female; the gray of his head encroached farther upon the white of his throat, but was interrupted by hair-fine, white malar stripes, which the female lacked. In fact, his whole facial expression was different from that of his mate.

In 12 hours of watching at this nest, I timed 22 sessions on the eggs, all by the female, and ranging in length from 7 to 42 minutes, with an average of 20 minutes. Her 21 recesses varied from 7 to 20 minutes and averaged 11.8 minutes. Half of her sessions were between 15 and 30 minutes, half of her recesses between 10 and 15 minutes. She spent 62.9 per cent of the time on her eggs. It is of interest to make a further analysis of the records, comparing that of the seventh day after the set of eggs was complete with that of the fifteenth day, the last before her eggs hatched. Contrary to what we might expect, the female Gray-capped Flycatcher sat more steadily on the seventh than on the fifteenth day. On both mornings I timed the 10 sessions following the bird's first departure from the nest. On the seventh day of incubation, these 10 sessions totalled 241 minutes, which gives an average of 24.1 minutes, while 10 recesses added up to 108 minutes, giving an average of 10.8 minutes. But on the last morning of incubation her first 10 sessions made a total of only 160 minutes or an average of 16 minutes, and an equal number of recesses totalled 120 minutes, giving an average of 12 minutes. On the seventh morning, her sessions ranged from 9 to 42 minutes; on the last morning, from 7 to 33 minutes. On the seventh morning, her recesses varied from 7 to 16 minutes; on the last morning, from 9 to 20 minutes. Thus comparison of the data for the two mornings, however made, shows that the female Gray-cap sat more constantly on her eggs at mid-period of incubation than at the end of incubation.

The female Gray-capped Flycatcher sat sideways in the covered nest, her right side toward the doorway, her tail held upright against the wall. Far from incubating in silence, she was perhaps the noisiest bird that I have ever watched as she warmed her eggs. She seemed not to be afraid of revealing her nest's position by the constant use of her voice. She sang the quaint, cackling nest song throughout the day, but she sang it most frequently in the early morning and late afternoon. This appeared to be an expression of the contentment she found in sitting quietly on her three speckled eggs. But how shall we qualify those loud, sharp shouts which from time to time issued from the nest, in answer to the equally loud calls of her mate which perched nearby? The bird seemed to be throw-

ing prudence to the winds, but then Gray-caps are at all times so vociferous that it would perhaps be too much to expect them to remain silent even while devoting themselves to parental obligations. While sitting, the female from time to time regurgitated the seeds of small fruits that she had eaten. Some of these fell through the doorway to the ground, others lodged temporarily in the straws below the entrance.

While incubating, Gray-capped Flycatchers are, despite their seemingly rash vociferations, as a rule so wary that it is all but impossible to steal a glimpse of them as they sit in their nests. The Vermilion-crown, whose nest and eggs cannot with certainty be distinguished from those of the Gray-cap, is almost equally shy. Thus when a pair of each species have nests close together in the same tree, as frequently happens, it is by no means easy to learn which nest belongs to the Gray-cap and which to the Vermilion-crown, unless one watches from a blind or other adequate concealment. But although so distrustful in the presence of a man, the Gray-cap in the orange tree would return to her low nest while a horse grazed below it.

Her mate perched much of the time on a high branch of a guava tree at no great distance from the nest tree. Here he preened, darted out upon flying insects, and shouted to his heart's content. From his favorite lookout, he could probably see something of the nest through gaps in the foliage of an intervening bough of the orange tree. Although he kept in close vocal contact with the female, he did not often approach her nest. Once, indeed, he flew up to it with her as she returned to her eggs, but he shot rapidly past it and could hardly have seen the interior. Later he hovered momentarily in front of the doorway as the female was preparing to enter. This was on the seventh day of incubation. In six hours on the last day of incubation, he did not go near the nest but merely called to his sitting partner from a distance. Doubtless, like most of his kind and sex, he had been very attentive to the nest while his mate was engaged in building, but he gradually lost interest as she sat in it day after day and nothing happened. Thus both male and female of this pair were more attentive to the nest after one week of incubation than after two weeks. All this, of course, changed when the eggs hatched.

The following year, 1944, a Gray-capped Flycatcher built a nest (number 28) in a lemon tree only a few yards from the orange tree which had held nest 21. Probably both of these nests belonged to the same pair, but since the birds were not marked I could not be certain of this. On May 25, when the three eggs were pipped, I devoted six hours of the morning to watching this nest, timing 15 sessions, which ranged from 6 to 50 minutes and averaged $15\frac{1}{2}$ minutes, and 16 recesses, which varied from 4 to 14 minutes and averaged 8 minutes. The unusually long session of 50 minutes was taken while a dense mist hung over the valley; the female's next longest session on the eggs lasted only 29 minutes. Although the female came and went more frequently than in the preceding year, her recesses were adjusted to her sessions in such a manner that she covered her eggs a slightly greater proportion of the time, 66.0 per cent as opposed to 62.9 per cent in 1943. Again she often sang the nest song and called loudly from the nest. Once, while she sat, a female Salvin Manakin flew into the lemon tree from the neighboring forest, hopped all around the nest, and finally pulled a bit of material from it. The flycatcher came out to drive the far smaller thief away, then returned at once to her eggs and sang the nest song.

The male Gray-cap was still easily distinguished from the female by his tousled head, which contrasted with her neat, smooth coiffure. Now his favorite perch was in the orange tree where last year's nest had been. Here he had the crown of the lemon tree between himself and the present nest, so that he could not see it. But he maintained constant vocal communication with his incubating partner. When a Swainson Toucan approached, he sounded the alarm, and the female promptly left the nest.

The escape from the shell is for the Gray-capped Flycatcher a more protracted proc-

ess than it is for small oscine birds that I have studied. Often the first minute fracture of the shell, effected by the bill of the chick within, may be detected as a slight roughness of the surface on the second day preceding the hatching of the egg, not on the preceding day as in many small songbirds. In one instance, an interval of at least 41 hours elapsed between the first pipping of the shell and the hatching of the nestling; in another, the interval was at least 39 hours; in yet others, at least 36 and 35 hours. In numerous cases, the chick required more than 24 hours to break its way out of the shell. Probably the actual period was a good deal longer than this, but it was not more accurately determined because of the spacing of my visits to the nest.

At ten nests, when the eggs were about to hatch, I made visits at nightfall, dawn, the middle of the morning and noon, in order to learn when the nestlings emerged from the shells. Of 20 eggs, seven hatched between nightfall and daybreak, nine between daybreak and the middle of the morning, three between about 9:00 a.m. and noon, but only one in the afternoon. Apparently the chick hammers most vigorously at the shell which imprisons it during the latter part of the night or in the early morning. If it does not succeed in escaping by midday, it usually takes a rest until the approach of the following morning. This is at present only a theory which must be supported by more observations, but it seems to explain the observed distribution of the hours of hatching and why some Gray-capped Flycatchers require such a long time to effect their escape from the shell (see Skutch, 1952a).

In 1944, the eggs in several nests were numbered as they were laid. In three of these nests, the eggs successfully hatched, and they all hatched in the same order as they were laid. But in 1945, one set of three eggs and another of two eggs hatched in inverse order, egg III before II, and II before I. The nesting season of 1945, when the dry season was severe and prolonged, seemed in many respects to be abnormal. As a rule, all the eggs in a nest hatch during a single night and the following morning, so that all the nestlings of the brood are first seen between dawn and noon of the same day. But at one of the nests in which the eggs hatched in inverse order, eggs III and II hatched in the forenoon on May 1 and egg I during the following night.

The incubation period was determined at 18 nests. At 12 nests it was approximately 16 days, at five nests it was 17 days, and at one nest it was 18 days. A more precise determination of the incubation period showed that at one nest it was between 15 days and 18 hours and 16 days, while at two other nests it was between 15 days and 22 hours and 16 days and 3 hours.

THE NESTLINGS

First day.—Two eggs in nest 21 in the orange tree hatched during the night of May 27-28, the third before 7:40 the following morning. Long before sunrise, the female Gray-cap began to feed the nestlings. At first she brought very minute insects, held within her bill where I could not see them, so that it was difficult to be sure exactly when the nestlings received their first meal, but I believe that it was in the dim light at 5:19 a.m. Soon she was bringing food at short intervals and brooding for brief periods (less than 1 to 16 minutes), so that her flights to and from the nest were much more frequent than on the mornings before the eggs hatched. Her pleasant nest song, so often repeated in the early hours of the days when she incubated, was now silenced. I did not hear it until 8:29 a.m., when she had been feeding the nestlings more than three hours, and I rarely heard it thereafter. As on other mornings, she called loudly and sharply to her mate both while sitting in the nest and after leaving it. I do not believe that these calls were intended to acquaint him with recent events there. To my ear, they sounded exactly like her outcries of previous mornings, and the male did not alter his behavior on hearing them, nor make any move to indicate that he had been informed of the hatching of his offspring.

At 7:52 a.m., the female Gray-cap first brought an insect so large that I could detect a portion of it projecting from her bill. Soon after this, I heard a new utterance from her. While standing in the doorway with her back toward me, apparently coaxing a nestling to take food, she delivered what sounded to my ear like a low-voiced version of the male's dawn song. It seemed an eager, hurried remonstrance to the nestlings which were sluggish in taking their meal. It is significant that it was first voiced after she had begun to bring larger items, which the tiny nestlings might find difficulty in swallowing. I repeatedly heard this feeding song through the remainder of the nestlings' first morning. It may be compared to the low, melodious murmurings that other birds use for coaxing newly hatched nestlings to take food. This song was one of the things that led the male Gray-cap to the discovery of the nestlings. That it was not primarily intended for this purpose is, I believe, obvious from the fact that the song was first uttered at least three hours after the eggs hatched, and that it continued to be repeated, at mealtime, long after the male Gray-cap himself began to bring food to the nestlings. I heard it as late as the sixth day after the young had hatched.

In the first three hours of the morning, as during six hours on the preceding day, the male did not come within two or three yards of the nest. His re-awakening of interest in the nest began when I first noticed somewhat larger insects in the female's bill and first heard the feeding song. From his perch above the road, he could see his mate as she rested on a bough of a lower guava tree reaching out toward the nest, and doubtless his keen eyes could discern the insect projecting from her bill, as mine could do with the aid of the field glasses. He could also hear the feeding song. Which of his senses, sight or hearing, played the larger part in leading him to awareness of the nestlings, I am unable to tell.

In any event, his first display of interest in the nest, on the morning the nestlings hatched, was at 8:04, one minute after I first heard the feeding song, and 12 minutes after I first detected food in the female's bill. All that he did on this occasion was to fly past the doorway of the nest so rapidly that he could hardly have seen what was within. His next manifestation of interest came at 8:16 a.m., when his mate, arriving with a fairly big insect that I could plainly see with my unaided eyes, perched in the guava tree in front of the nest where he could see her, and doubtless also what she held, from his lookout above the road. He flew down to hover above her while she fed the nestlings, but the closed nest hardly permitted him to distinguish what was happening within it. Then, after she had flown off, he hovered twice beside the nest and once above it, but he did not alight directly in front of the nest, where alone he might have seen the nestlings. This was his greatest display of interest in the nest that I had witnessed in 15 hours of watching.

During the next hour, the male Gray-cap remained much of the time on a perch directly in front of the nest, where formerly he had never lingered, instead of on his erstwhile preferred bough above the roadway. He was clearly much interested in what was happening at the nest, but his efforts to solve the mystery did not reveal much intelligence. Again and again, while his mate was in the act of delivering food, or immediately after she had fed the nestlings, he hovered in front of the nest, or above it, then returned to his perch a few yards in front. Plainly, he had lost his former habit of going directly to the doorway to look in; at first, he even seemed somewhat doubtful as to its exact location. But at last, at 9:26 a.m., after hovering before the doorway he alighted upon the doorsill. Clinging there, back outward, he delayed long enough for a close examination of the little ones within. His response to the sight of them was immediate and unhesitating. He knew precisely what to do, and he did it in the most approved fashion. Going to a nearby tree, he darted out to seize the first suitable small insect that flew by, mashed

it in his bill as is proper for newly hatched nestlings, and within two minutes returned to feed one of them, singing a snatch of the nest song in a low voice as he did so.

So much detail on the male Gray-cap's slow discovery of his offspring has been given because his behavior contrasts so sharply with that of nearly all the other male birds which I have watched on the day when their eggs hatched. Nearly all have, whether early or late, become aware of their nestlings at a single stroke. The Gray-cap, more than any other bird that I have watched at this critical period, seemed to be laboriously striving to solve a mystery. The habits the male had formed in the period of incubation helped to lead him to the discovery of the nestlings, but he did not discover the young promptly. He was plainly led to awareness of the nestlings by his interest in the strange new things his mate began to do and say after the eggs had hatched. There is no evidence that the female tried to acquaint her mate with the fact that the eggs had hatched by means of a vocal communication. Also it is questionable whether the feeding song, now first heard, was more important than the food visible in her bill, or the postures she assumed while clinging in the doorway to deliver food, in leading her mate to the momentous discovery.

The following year, nest 28 was built in a lemon tree a few yards distant from the orange tree that held the foregoing nest, and it probably belonged to the same pair of flycatchers. The female Gray-cap was just as noisy as she had been a year earlier, singing and shouting in her nest through much of the day. The male's favorite perch was now the orange tree where last year's nest had been. There he had the entire crown of the lemon tree between himself and the present nest, so that the nest was hidden from him. Probably this circumstance accounts for the different course of events on the morning the eggs hatched.

In six hours on the final day of incubation, when the eggs were already pipped, the male did not once come close to the nest, although he called to his mate and was answered by her. The first egg to be laid was infertile and failed to hatch. The second hatched in the night of May 25-26. I first saw the nestling when the female flew from the nest at 5:18 the following morning. She possibly fed the nestling at 5:44, and certainly at 5:48. I first heard the feeding song, delivered in a very low voice, at 5:59, which was an earlier time than it had been heard at the preceding nest. I do not know exactly when the third egg hatched, but the down of the nestling that emerged from it was already becoming fluffy when, at 8:31 a.m., I left the blind to look into the nest.

In neither of the two years was the female flycatcher seen to eat or intentionally remove any part of a shell. Some of the pieces became entangled in her plumage and were inadvertently carried out as she flew from the nest; one worked up under a wing while she brooded, annoyed her, and was thrown through the doorway by a flick of her wing. Yet the shells of both eggs had disappeared from the nest by noon of the day after they hatched, and since only the parts of a single shell were found on the grass below the nest, those of the other shell may have been carried away later. Other Gray-caps have been fairly prompt in removing the empty shells.

As I had been led to expect by his aloofness from the nest this year, the male Gray-capped Flycatcher was slow in beginning to feed his offspring. At 8:49, the female brought a morsel bigger than any that I had previously seen and gave the feeding song somewhat loudly. The male heard this at his usual perch in the orange tree and flew at once to the lemon tree, where I had seldom seen him. But he did not look into the nest, soon went off, and subsequent repetitions of the feeding song, even when he was within hearing, did not stir his interest afresh. Six hours after the female flew from the nest at dawn, revealing that an egg had hatched, the male Gray-cap had not fed or even seen the nestlings. Since it appeared unlikely that I should be able to maintain an uninter-

rupted vigil until he first brought food, I now suspended observations, to resume them soon after noon on the following day. At 1:30 p.m. on the day after the nestlings hatched the male was first seen to bring a billful of insects to them. Still, he was feeding very slowly, coming with only two meals in as many hours, while the female fed the nestlings seven times in this period. I am not sure what called his attention to the nestlings, but since the feeding song seemed most to arouse his interest, probably it was that.

The hatching of her eggs causes a profound change in the rhythm of brooding of the female Gray-capped Flycatcher. Both her sessions and recesses become abruptly shorter, she comes and goes far more frequently. A Gray-cap with dependent young is indeed a busy bird, and she cannot afford to delay long in one spot! The difference in the character of the movements of the incubating and the brooding female is analyzed in table 7, where comparison is made of the female's periods on and off nest 21 on the seventh day of incubation, the last day of incubation, and the day on which the nestlings hatched. Similar information is given for nest 28 (which it is believed was built by the same individual the following year) on the last day of incubation and the day on which the eggs hatched. The records actually made at nest 21 on May 19 and May 28 covered in each instance six hours, but for the sake of a more direct comparison with the shorter record made on May 27, only the first four and one-half hours covered by these records was employed in drawing up the table. There are no essential differences between this and the six-hour records.

Table 7

Rhythm of Brooding by Two Female Gray-capped Flycatchers Before and Immediately After Their Eggs Hatched

Date Hour, a.m. Stage	Nest 21, 1943			Nest 28, 1944	
	May 19 5:11-9:41 Seventh day of incubation	May 27 5:01-9:41 Eggs pipped	May 28 4:55-9:34 3 newly-hatched nestlings	May 25 5:23-11:26 Eggs pipped	May 26 5:18-11:18 2 newly-hatched nestlings
Sessions					
Number	8	10	28	15	37
Shortest (minutes)	9	7	1	6	1
Longest (minutes)	42	33	16	50	20
Average (minutes)	22.0	16.0	4.8	15.5	5.2
Recesses					
Number	9	10	29	16	37
Shortest (minutes)	7	9	1	4	1
Longest (minutes)	16	20	13	14	19
Average (minutes)	10.4	12.0	5.0	8.0	4.5
Per cent of time spent in the nest					
	67.9	57.1	49.0	66.0	53.6

The rate of feeding the nestlings is from the first rapid. At nest 21, on the morning the nestlings hatched, the female appeared to give them food on nearly all of her numerous returns to the nest. She rarely brought an item without remaining to brood. But because of the difficulty of detecting the first minute insects in the flycatcher's bill, and of seeing exactly what she did as she stood in the doorway with her back toward me, it was not possible to keep an accurate count of the number of meals delivered to the nestlings. Nest 28 was somewhat more favorably situated for observation, yet even there it was not always possible to be certain whether the nestlings were given food. In the first 6 hours of the morning when the eggs hatched in this nest, the female fed the nestlings approximately 32 times. At the beginning of the morning there was only one nestling, but by 8:30 a.m. there were two. As at the other nest, the female sometimes fed the newly hatched nestlings twice in a single interval between broodings. The nestlings usu-

ally swallowed their first meals without much parental coaxing, but at times a bigger item was presented to them for a minute or so before it went down.

The male, when he begins to bring food, usually delivers it directly to the nestlings rather than to the female. At nest 21 he once passed an insect to the brooding female. At nest 28, I saw the male arrive with small insects in his bill while his mate covered the nestlings. He approached the nest hesitantly and by an indirect course. When he reached the doorway, the female opened her mouth to take the food from him, but he would not yield it to her and retired a short distance from the nest. After a minute he returned to the doorway and again the female rose with open bill to accept the insects from him, but the nestlings stretched up their gaping mouths in front of her and received their meal directly from the male.

Older nestlings.—Newly hatched nestlings bear a sparse, light gray down which fails by a great deal to cover their pink skin. Their eyes are tightly closed and the interior of the mouth is bright orange-yellow. Their development is slow, and at the age of 11 days they are still rather naked, for their contour feathers are then just beginning to escape from the tips of their short sheaths. They are now able to open their eyes, but they keep them closed much of the time and appear to sleep.

When the three nestlings in nest 21 had reached this stage of development, I again watched their nest in the orange tree from a blind. The 11-day-old Gray-caps were fed with surprising frequency. Between 6:40 and 7:40 on the morning of June 8 their parents brought food 43 times. In the next hour they brought food 65 times. They often came and went so rapidly that I was unable to distinguish male from female by their slight differences in appearance. It was easy to see that both were working hard to supply the nestlings' nourishment, although it was impossible to determine which parent brought the most food. The food delivered to the nestlings consisted almost wholly of small, winged insects, and often a number was brought at one time. Twice the young birds were given fruits from a neighboring aguacatillo tree. Twice, when the nestlings were slow in accepting their food, I heard the feeding song. One of these occasions was when an aguacatillo fruit was offered to them.

The female brooded, or at least started to brood, six times in the two hours. Once she brooded for six minutes continuously, twice for a minute or less, and three times she had hardly settled on the nest when her mate arrived with food and she flew out so that he might feed them. Twice the male passed food to her as she brooded. On one of these occasions, she rose up to put it in the mouth of one of the nestlings beneath her, but on the other occasion she carried the food from the nest, then returned at once to deliver it while clinging in the doorway, as though she had brought it from a distance. During her six-minute spell of brooding she sat very restlessly, constantly rising up to look down at her 11-day-old nestlings. Doubtless her restlessness was caused by their squirming around beneath her.

The nestlings were already loquacious like their elders. Much of the time they repeated weak, squeaky imitations of the parents' calls, keeping up a constant chatter in the nest. Each time one received food the clamor was intensified in volume, and since they were fed so often, they were crying out most of the time. During a brief lull in food-bringing they became quieter. They were also silent while being brooded and until the first feeding after the female's departure. Although still sparsely feathered, they made their first infantile attempts to preen.

I had hoped to continue my study of this nest in the orange tree, but unfortunately the nestlings began to disappear, one after another, until all had vanished. The following year those in nest 28 in the neighboring lemon tree fared better. At the age of two weeks these two nestlings were well feathered and already resembled their parents. Whenever

I looked in at them, they would cease their endless chatter and crouch down in the nest, bringing their conspicuous white foreheads below the lower edge of the doorway, where they were somewhat screened from outer view, and exposing their neutrally colored backs to the eyes of the intruder. This also is a habit of nestling Vermilion-crowned Flycatchers.

When these two nestlings were 17 days old and almost ready to leave the nest, I devoted an entire morning to watching them from a blind. They were no longer brooded by day in fair weather. As at the earlier nest, both parents brought food, often coming together, but their movements were so rapid that I found it impossible to distinguish them on every visit and to determine how many times each fed the nestlings. The two together delivered food as follows:

Time in a.m.	Times food was brought
5:20 to 6:20	28
6:20 to 7:20	10
7:20 to 8:20	19
8:20 to 9:20	51
9:20 to 10:20	32
10:20 to 11:20	18

Total 158

There was great variation in the rate food was brought from hour to hour. The maximum activity occurred between 8:20 and 9:20 a.m., when the nestlings were fed 51 times. This was less for the nest as a whole than the maximum I had recorded the preceding year at the nest with three 11-day-old occupants, but more per nestling, 25.5 times per capita per hour as opposed to 21.7 times per capita per hour at the earlier nest. Considering the whole six-hour period, the average rate of feeding was 13.2 times per nestling per hour. The parents frequently fed the nestlings 3 times within one minute and once they fed them 4 times. The latter apparently involved two feedings by each parent. From 8:21 to 8:41 the nestlings were fed 22 times in 20 minutes; from 8:52 to 9:12, 20 times in 20 minutes; and from 9:23 to 9:43, 17 times in 20 minutes. The longest interval between feedings in the whole six hours was 17 minutes, from 7:23 to 7:40 a.m. There was one interval of 14 minutes, one of 12 minutes, and two of 11 minutes.

But despite these great variations in the activity of the parents, on careful analysis of the record I find it difficult to recognize regularly alternating periods of "attention" and "inattention." As in other species in which I have attempted to apply this concept to the behavior of the parents in attending their nestlings, it can be used only if we assign a purely arbitrary limit to the interval between feedings allowable within a period of "attention." If we say, for example, that when a parent remains away from the nest for more than six minutes it has been "inattentive," we may indeed recognize periods of "inattention"; but what then shall we do with all of the five-minute intervals between feedings? At nests of other species where the parents can be distinguished with ease, one finds the same irregularity in the lengths of the intervals between feedings by each of them. The only portion of the nesting cycle in which clear-cut, rhythmically alternating periods of attention and inattention can be distinguished is the period of incubation, but to describe the bird's behavior at this time the terms "session" and "recess" or "absence" recommend themselves because of their greater brevity.

The food of these nestling Gray-caps, like the food of the younger ones in the earlier nest, consisted largely of small, winged insects. The parents often came to the nest with bills overflowing with insects, and I wondered how they managed to hold those first captured while they snatched additional victims from the air. They also fed the nestlings

many small berries of contrasting colors. The nestling on the right side of the doorway, being slightly nearer the approaching parent, usually received the food the parent brought, but since the restless young birds shifted about a good deal, their income of nourishment was probably equalized in the long run. Later in the morning, there appeared to be a change in the kinds of insects the nestlings received, doubtless due to the fact that different species were active at different hours. Unfortunately, I was unable to identify these several kinds of insect food. I heard the female sing the feeding song very briefly only once or twice.

The nestlings always rested in the nest facing outward, but to deliver their droppings to their parents for removal, after being fed, they turned around 180 degrees. Most of the droppings were carried away in the parents' bills, but at times they were swallowed. Once a parent carelessly permitted a newly delivered dropping to slip from its bill and it then dived down in pursuit of it through the thorny branches of the lemon tree, almost to the ground.

As to the nestlings themselves, they were alternately noisily active and drowsily silent. These fluctuations in their activity corresponded roughly with the greater or less diligence of the parents in bringing them food; but sometimes a morsel was offered to them when they were drowsy. In their active moods, the youngsters preened much, stretched wings and legs, and even found space in their high-vaulted chamber to exercise their wings by flapping them. They called often and loudly, voicing the usual unmelodious notes of their elders, both of one and two syllables, but in tones not yet mature. A few days later I heard them, or one of them, imitating the dawn song of the male Gray-cap. Such precocious utterance of the adults' notes by unfledged youngsters is common in the Tyrannidae as in non-passerine families, but it scarcely ever occurs in the families of true songbirds. The latter as a rule do not attempt the more complex songs of the adults until some weeks after they have left the nest.

Departure from the nest.—Although at one nest I found the female brooding by night when her three nestlings were 16 and 17 days old, the Gray-cap in the lemon tree ceased nocturnal brooding a day or two earlier. On the morning of June 15, I witnessed from a blind the departure from the nest of the two young birds, now 20 days old and completely feathered. Long before sunrise the young birds began to call and to preen. Two boys approached the nest from in front, and the nestlings crouched down while they were still 50 feet distant. I was not sure whether this was in response to the parents' calls of alarm or a direct result of seeing the boys, but I suspect that it was the latter. The young birds were fed a number of times by both parents. At 6:26 a.m. one of the young birds, in response to an inner impulse and quite without urging by the parents, pushed through the doorway and rested on a branch in front, where it received another meal. Then it flitted to a twig a few inches higher, calling loudly all the while. Here it received food again, and a minute later the nestling still in the nest was also fed. The latter was now most restless, and both young birds preened vigorously. The one in the open soon flitted a foot farther away from the nest, then it embarked on a longer flight which took it around the crown of the lemon tree to the neighboring orange tree. It covered about 20 feet on a rising course, apparently with plenty of power to spare. The parents promptly joined it in the orange tree, where I could not see them. But I heard the nest song, which had been forgotten during the busy activities of the past few days, repeated over and over, and I also heard the feeding song. These subdued "songs" appeared to express the parents' elation in having their fledglings with them on the wing. They reminded me that a year earlier I had heard a Vermilion-crowned Flycatcher sing the nest song on finding that her fledgling had just flown from the nest. Both of these yellow-breasted flycatchers begin and end their nesting with the same song.

Half an hour after the departure of the first fledgling, the second young Gray-cap spontaneously hopped out of its nest in the lemon tree and promptly flitted out of sight in the foliage. I am not sure whether these two fledglings left the nest in the order of hatching. Even allowing for this uncertainty, it is possible to give the age of one of these two young birds within a few hours. The one that hatched last departed the nest at the age of 20 days \pm 2 hours. Other nestlings, when undisturbed, have left the nest at ages varying from 19 to 22 days. Taking all my records together, and assuming that all the nestlings left in the order of their age, 9 departed from 4 nests when 19 days old; 13 left 9 nests when 20 days old; 11 left 7 nests when 21 days old; and 2 left 1 nest when 22 days old. If the assumption that the young always left the nest in the order of their age is contrary to fact, the range of the nestling periods may be greater than that given, but the average age of departure would remain the same.

After leaving the nest, the young Gray-caps continue for a number of weeks to fly around through the trees with their parents. Old and young together form an exceedingly noisy family party. Before they have been many days out of the nest, the youngsters develop a form of calling such as I have heard from no other bird except the related Vermilion-crown. They utter sharp notes like those of the adults, harsh *bic*'s and *burr*'s, and at the same time they give weak juvenal *cheep*'s. These two widely different utterances are intermingled in a rapid, almost uninterrupted flow. Indeed, they seem to be voiced simultaneously. The combination is exceedingly bizarre and so unexpected that it required repeated observations to convince me that both the sharp *wic*'s and the soft *cheep*'s issued from the same throats. The young Gray-caps continue to beg and to receive food from indulgent parents even after they have long been full grown and have become expert at catching insects on the wing. They begin to molt their remiges while still attended by their parents.

THE SECOND BROOD

The pair of Gray-capped Flycatchers that in 1944 reared two fledglings in a sour orange tree close beside our house behaved most oddly. During the morning following the departure of the young, I happened to be in a blind watching a Vermilion-crown's nest in the same tree. One of the parent Gray-caps went repeatedly to their empty nest and gave the feeding song. Later one went to the nest and delivered the nest song, and at other times they perched close beside it and uttered loud and varied calls. They repeatedly brought food to the empty nest only to carry it away again, for their fledglings were elsewhere. Early in the afternoon of the following day, the male Gray-cap flew again and again to the sour orange tree and perched close beside the nest while he sang a spirited, bizarre "song"—if this word may be rightly applied to a rapid flow of sharp, hard notes, now high, now low, and quite devoid of melody. Twice while he was declaiming in this way the female arrived and sang the nest song. She voiced this song either while perching close beside the nest or actually within it; I could not see her because of the foliage. This behavior was frequent during the week following the departure of the nestlings, and a full month after the young had left the nest I watched both parents "sing" loudly in the nest tree. Meanwhile, at least one of the young birds remained in the vicinity and was dutifully attended by the adults. I thought that this sustained interest in nest and nest tree betokened a second brood, but in this I was mistaken.

In the valley of El General, most pairs of Gray-capped Flycatchers have young on the wing by May or June and do not attempt to produce a second brood. I have only four records of eggs laid after the first of June. Three of these sets were in nests built in successive years in the same small orange tree in front of our house and presumably they belonged to the same pair of Gray-caps. In 1943, a new nest in this tree contained a set of two eggs which were laid about June 12 and which disappeared before they hatched.

There had been no earlier nest in this tree that year, but possibly the pair had raised a first brood in a neighboring tree. The following year a nest was built in the same orange tree in early March; two young were reared here and took wing on May 4. On June 1, I again found an egg in this nest and another was laid the following day, but they vanished two days later. In late March of 1945, a nest was built in almost the exact site of the nest of the previous year, and in it three young were successfully reared, departing on May 20 and 21. On August 23, I was amazed to find the female Gray-cap incubating two freshly laid eggs in the old, weathered nest. She continued to incubate during the next two weeks, and I was eager to learn whether these exceptionally late eggs would prove fertile. Before they could hatch, however, some nest robber ate them. In not one of the three late nests in this orange tree did the eggs hatch. I have no knowledge of a successful second brood of the Gray-capped Flycatcher in El General, but possibly in lower and drier regions, where the rains of May and June are not so hard and cold, the rearing of two broods in a season is more frequently and more successfully undertaken.

From about August 18 to 23, 1945, while the female Gray-cap was preparing for the late brood in the orange tree, a male in the vicinity sang at great length at dawn. This occurred after an interval of about two months in which no dawn song was heard from this species. From about August 11 to 21, 1948, a Gray-cap by the house sang each morning, and at the beginning of this period he performed as long, as loudly, and as harshly as in April and May. At about the same time I discovered a new nest, inaccessible in the top of an orange tree. I could not ascertain whether eggs were laid in it, but no brood was reared there. Again on August 9, 1951, I found a female Gray-cap finishing a nest in a riverwood tree growing beside the river in front of the house, in a site about ten feet above the water and well out from the shore, so that it was inaccessible to me. I could not tell whether eggs were laid in that nest, but if so they apparently were not incubated. From August 19 to 23 of the same year a Gray-cap sang each morning at day-break near our house; on some mornings he continued singing for many minutes. Thus the only years in which I have heard sustained dawn singing after June were years in which I also found evidence of nearby nesting at about the same time. It appeared most likely that the single singing male in the area was the mate of the single female which was found nesting out of the usual season.

This out-of-season nesting with contemporaneous singing raises an interesting question. How does it happen that the male and female engage in unseasonable activities at the same time? If this occurred among birds which mate anew for each nesting, we might explain it by selective mating: the male or female who felt the urge to reproduce might attract a partner of the opposite sex which happened to be in the corresponding physiological state. But in birds which remain constantly paired, like so many tropical species, this seems unlikely. It is equally improbable, in view of the rarity of reproductive activity at this period in the local population of the species, that the mated male and female should come independently into the breeding state. It is far more likely that one of them, as a result of some genetic or physiological idiosyncrasy, should engage in nest building, song, or some other activity associated with reproduction, at a time when scarcely any neighboring individuals of the species do so, and that this activity should stimulate the mate to engage in the corresponding activity. Thus, in the present case, unseasonable nest building by the female might incite her mate to sing at a period when he would otherwise be songless. If this be true, the singing would seem to be due primarily to psychic stimulation rather than to physiological changes such as the re-activation of the gonads. It is questionable whether the changes in the male would go far enough to make him able to fertilize his mate's eggs. Unfortunately, in my only accessible August nest of the Gray-capped Flycatcher a predator took the eggs before they had time to hatch, so that I was unable to determine this point.

A number of observations on this and other species of tropical birds lend support to the view that building by the female incites her mate to sing. As mentioned earlier, I have in some years found female Gray-capped Flycatchers building before the males in the immediate vicinity began to sing. The same is sometimes true of the Scarlet-rumped Black Tanager (Skutch, 1954a: 131), in which I have also noticed that in localities where the females have ceased to nest the males sing scarcely at all. In neighboring areas, however, where there are belated nests they may be singing freely. I have also observed the simultaneous beginning of building by the female and singing by the male in species like the Oleaginous Pipromorpha, which do not form pairs; in this instance the view that the activity of one sex incites the corresponding activity of the other sex is more difficult to maintain.

Family groups of Gray-caps, consisting of parents with their young of the year, seem to hold together at least loosely until September or October. In these months the flycatchers are very noisy, shouting back and forth to each other from the very tops of tall trees that are often a hundred feet apart. After a while one loses its temper and dashes at another, a general melee ensues, but there is no real fighting. All this excitement is probably associated with the formation of pairs by the young, still unmated birds. But because of the difficulty of distinguishing individuals, ages and sexes, it is scarcely possible to follow the course of these activities, or even to be sure what they signify. At any rate, after October most of the Gray-caps seem to be in pairs. One such pair usually slept in the wet November nights in the sour orange tree in our garden, where in April and May there is often a nest.

ENEMIES

One of the principal enemies of the Gray-capped Flycatcher is the Piratic Flycatcher. This relatively small species is an anomaly in a family of birds which exhibits marvelous diversity and skill in the construction of nests; it has wholly lost the art of building and lays in a variety of covered or enclosed nests which it wrests from birds so diverse as trogons, oropéndolas, becards, and flycatchers of several genera. But the Piratic Flycatcher seems to prefer the commodious domed structures built by the species of *Myiozetetes* to any other type of nest. I have often found Piratic Flycatchers breeding in nests which might have been built by either the Gray-capped or the Vermilion-crowned flycatchers, and I have several times actually witnessed the capture of a nest from the Gray-caps by a pair of Piratic Flycatchers, as told in detail in the account of the latter species.

The Gray-capped Flycatchers do not tamely relinquish their nests to the pirates with striped breasts; on the contrary, they offer spirited resistance, which results in a prolonged but bloodless conflict that often draws as interested spectators a number of birds of other kinds. But the Piratic Flycatchers are most pertinacious, and the defenders display more zeal than good strategy. The result is that the assailants are usually able to slip in and throw the eggs from the coveted nest, after which the owners cease to defend it. The loss of nest and eggs, however, does not discourage the Gray-caps. Before the noise of battle has died away, while the exultant whistles of the victorious Piratic Flycatchers still ring in their ears, the Gray-caps go off to a neighboring tree and sing the long-drawn, rattling nest song, proof that they are already prospecting for a site for a new nest. In a day or two the new structure is begun, usually not far from the one they have lost, and it is more rapidly completed than the first nest which was started earlier in the season.

One nest taken by Piratic Flycatchers from a pair of Gray-caps collapsed a few days later, its roof beaten down by a heavy rain. Then the pirates watched their victims convert a recently abandoned open nest of the Blue Tanager in a neighboring tree. As soon as the remodelling was completed, they obtained possession of this structure through the same tactics and successfully reared a family in it. In another instance, the Piratic Fly-

catchers after evicting the Gray-caps lost interest in their conquest within a few days. Then the female Gray-cap tore apart her old nest and used its materials in the construction of a new one.

Persecution by the Piratic Flycatcher delays the breeding of the Gray-capped Flycatchers, causing them to bring forth their brood at a later, wetter and apparently less favorable period of the year. If more than one nest is wrested from the same pair of Gray-caps, they may be unable to reproduce their kind that year. In any event, Gray-capped Flycatchers, like all birds and especially those that breed in the tropics, must contend with many other enemies, and at best their reproductive success is not high. Even if the Piratic Flycatchers do no more than retard the date at which the Gray-caps hatch their eggs, and so diminish the number of renestings that might be attempted if the first brood is destroyed, they must very seriously diminish the breeding success of the Gray-caps. When a pair of Gray-capped Flycatchers is exploited by a pair of Piratic Flycatchers, their chances of losing their nest are doubled; for if any mishap befalls the parasites' nest, they will probably steal another from their helots. I have no evidence that Piratic Flycatchers take nests from these or other birds while they contain nestlings.

Unfeathered nestlings of both the Gray-cap and the Vermilion-crown are often heavily parasitized by *tórsalos*, the larvae of a dipterous fly. These fat, white, long-necked grubs, covered with recurved black spines in serried ranks which make their extraction a matter of much difficulty, develop in the skin of their hosts, causing great swellings, often as big as a pea, on the head, back and wings. Sometimes there are six or eight of these larvae on one victim. In some instances the young flycatchers outgrow their parasites and live to fly from the nest. I kept watch over one nestling Vermilion-crown that supported 11 *tórsalos* and appeared none the worse for the experience. But at one nest with three Gray-cap nestlings which were heavily infested with these larvae, the feathering of the young birds proceeded with abnormal slowness. These nestlings vanished one by one, but I am not sure whether they succumbed to their parasites and were removed by the parents, or whether they fell victims to some predator. The contour feathers of the last survivor developed so slowly that when I last saw it, on its sixteenth day, it was still nearly naked, although normal nestlings are fully feathered at the age of 14 days. A kind-hearted girl once told me that with tweezers she had extracted eight *tórsalos* from a *pecho amarillo*, which may have been either the Gray-cap or the Vermilion-crown, and that the nestling survived the cure, which I suspect was considerably more dangerous to it than the disease.

The Piratic Flycatcher and the flesh larvae are the only enemies of the Gray-capped Flycatcher that I have actually seen at work. Undoubtedly toucans, snakes, marsupials, and other small mammals destroy many nests of this species as well as those of the other birds with which it associates. In El General, hawks are not as serious a menace.

SUMMARY

Gray-capped Flycatchers inhabit open country with scattered trees and are abundant in districts devoted to agriculture and grazing; they avoid the sunless interior of woodland. In Costa Rica they breed from sea level up to about 5500 feet, but at the highest altitudes at which they nest they appear to be summer residents. They are found in pairs or family groups at all seasons. The male is readily distinguished from the female by the looser plumage of his crown.

These flycatchers take a variety of insects on the wing, often making spectacular sallies. They also eat many fruits and arillate seeds. They do not forage on the ground as much as the related Vermilion-crowned Flycatcher.

Gray-capped Flycatchers sometimes roost socially in fields of sugar cane, but more

often they sleep on the branches of trees. Male and female of a mated pair then roost a few yards apart rather than in contact with each other.

The species has an impressively varied language and is exceedingly noisy. Notable among the utterances are the male's dawn song, a harsh and tuneless performance rarely heard except at daybreak in the breeding season; the peculiar rattling or churring "song" which they deliver while trying out nest sites; the somewhat more elaborate cackling chant which the female often utters while sitting on her eggs; and the peculiar series of notes which is voiced when young nestlings are being coaxed to accept food. In El General, the dawn song is given from late February, or more usually from middle or late March, until early or mid-June; but in three years a single bird sang for a few mornings in mid-August, when a female was engaged in building an unseasonable nest nearby.

The nest is a bulky, domed structure of straws and weed stems with a wide doorway in the side. It is placed from 3 to 60 feet above the ground, but most often it is found between 5 and 25 feet up. Thorny trees, especially citrus, are preferred for the nest, and often it is situated close beside a wasps' nest. Many nests are placed over streams, sometimes as low as 30 inches above the water, although other streamside nests are high. Only the female builds, and early in the season she may take two weeks to complete her structure. She often pilfers material from unguarded nests of other birds. Sometimes she chooses an abandoned, cup-shaped nest of another species and roofs it over for her own use. Often she nests in the same small tree with the congeneric Vermilion-crowned Flycatcher.

The first egg is laid from two to nine days after the virtual completion of the nest. The set consists usually of three eggs, often of two eggs, and very rarely of four eggs in Central America. The eggs are laid at almost any time of the forenoon but rarely before 8:00 a.m. Two days generally separate the laying of successive eggs, but the interval is sometimes one day and exceptionally is three days.

Only the female incubates, and she is very noisy while she sits in the nest, calling out loudly and often singing the peculiar nest song. In twelve hours one female took sessions which ranged from 7 to 42 minutes and averaged 20 minutes, while her recesses varied from 7 to 20 minutes and averaged 11.8 minutes. She spent 62.9 per cent of the time on her eggs. In another year a female with pipped eggs covered them for 66.0 per cent of six hours. At the first nest both male and female became somewhat less attentive as incubation advanced.

The interval between the first fracture of the egg shell made by the young chick and its final emergence may exceed 40 hours and is often more than 24 hours. Hatching occurs most frequently early in the forenoon, less often in the night, and rarely in the afternoon. This suggests a diurnal rhythm in those movements of the chick which lead to its escape from the shell. The incubation period is usually 16 days, but it is sometimes prolonged to 17 and very rarely to 18 days.

At one nest the male's interest was gradually aroused by the novel activities and utterances of his mate after her eggs hatched. His mounting curiosity led to his inspecting the interior of the nest about $4\frac{1}{2}$ hours after his earliest opportunity to view the nestlings, and a minute or two after he first saw them he fed them. The following year, when the male's favorite perch was not in sight of the nest, he first fed the nestlings between 6 and 32 hours after they hatched.

The female alone broods the nestlings, continuing to cover them even on clear days until they are about 12 days old and by night until they are 15 to 17 days of age. Both parents rapidly bring insects to the young, as well as a few small fruits. In 6 hours, two nestlings 17 days old were fed 158 times, or 13.2 times per capita per hour. Three nestlings 11 days old were fed 65 times in an hour.

Even before they are feathered the nestlings are very noisy, like their parents. When two weeks old they are clothed with plumage and closely resemble the adults. They leave the nest, spontaneously and without parental urging, when from 19 to 22 days of age, but most often they leave the nest when they are 20 days old. As they follow their parents through the trees, they constantly utter a bizarre combination of harsh adult notes and weak juvenal *cheep's*. They receive food from their parents even after they are expert at catching insects on the wing.

In El General, second broods are rarely attempted and none of those observed was successful. In three years, nesting in August was associated with contemporaneous dawn singing by a single male after two months of silence. It seems likely that building by the female stimulates her mate to sing at a season when he would not otherwise do so.

Family groups consisting of parents and the young of the year appear to hold together at least loosely until September or October. At this season Gray-caps are unusually quarrelsome and even noisier than at other times. Apparently the young birds pair in these months.

Gray-capped Flycatchers suffer much from persecution by the Piratic Flycatcher, which captures their nests for its own use. Nestlings are at times heavily infested with larvae of a dipterous fly, which form great swellings beneath their skin. Usually they survive this infestation.

VERMILION-CROWNED FLYCATCHER

Myiozetetes similis

Over much of the immense territory stretching from México to northern Argentina, the Vermilion-crowned or Chipsacheery Flycatcher is one of the most familiar birds of clearings and open country at lower altitudes. In Central America it ranges upward to about 6000 feet in both Guatemala and Costa Rica. Almost any kind of unforested terrain forms an acceptable home for this adaptable bird, provided there are at least scattered trees and that water is not far away. The tree-shaded courses of rivers flowing through cultivated districts are attractive to it, and shady pastures are a favorite resort. But so strict is the Chipsacheery's avoidance of heavy forest that a report that this species had been found nesting in Greenland or Australia would surprise me no more than the discovery of its nest in the midst of unbroken rain forest, a few hundred yards from the clearings where it is so abundant.

This middle-sized flycatcher, about six and one-quarter inches in length, is brighter in plumage than most members of its family. The species would be easy to identify in the field were it not for the fact that it shares its rather bold color pattern with a number of other species of flycatchers, some of them belonging to other genera. The top of the Vermilion-crown's head is dark gray, with a crown patch of bright orange-red that is spread and displayed only on rare occasions when the bird is angry or excited. A fairly broad white stripe begins at the base of the bill and arches above each eye, extending to the hindneck, where those of the two sides of the head converge but fail to meet. The cheeks and ear-coverts are dusky. The back, rump, and lesser wing-coverts are olive-green. The remainder of the wings is grayish brown with pale olive edgings, which form two indistinct light bars on the wing-coverts, and the tail is likewise grayish brown. The chin and throat are white but the rest of the under plumage is bright canary-yellow. The eyes are brown; the short, narrow bill and the feet are black. The sexes cannot be distinguished in life by any method I know except by their behavior at the nest. The best method of distinguishing the Vermilion-crown from the other flycatchers of similar color pattern is by voice; the notes of this species are much softer than those of the Kiskadee and the Boat-billed Flycatcher, but they are stronger than the shrinking tones of the Cayenne Flycatcher. Although much smaller than the Kiskadee and the Boat-bill, the Chipsacheery is about the same size as the Cayenne Flycatcher and the two are confusingly alike in appearance.

In Central America the Vermilion-crown appears to be a permanent resident wherever it nests, except possibly at the highest altitudes. At Vara Blanca, on the stormy seaward slope of the Cordillera Central of Costa Rica, these birds were absent from the neighborhood of my dwelling, 5500 feet above sea level, during the months of the northern autumn and winter, but they returned, probably from lower on the mountain side, toward the end of February, as the nesting season approached. The species remains in pairs throughout the year. My studies have been made chiefly with the race *Myiozetetes similis columbianus* in the Térraba Valley of Costa Rica, the Almirante Bay region of western Panamá, and the Canal Zone. In addition I have also learned something of the nesting habits of *M. similis texensis* in the Caribbean region of Guatemala, Honduras and Costa Rica. I discovered no noteworthy differences in the habits of these two races except in the phrasing of the dawn song.

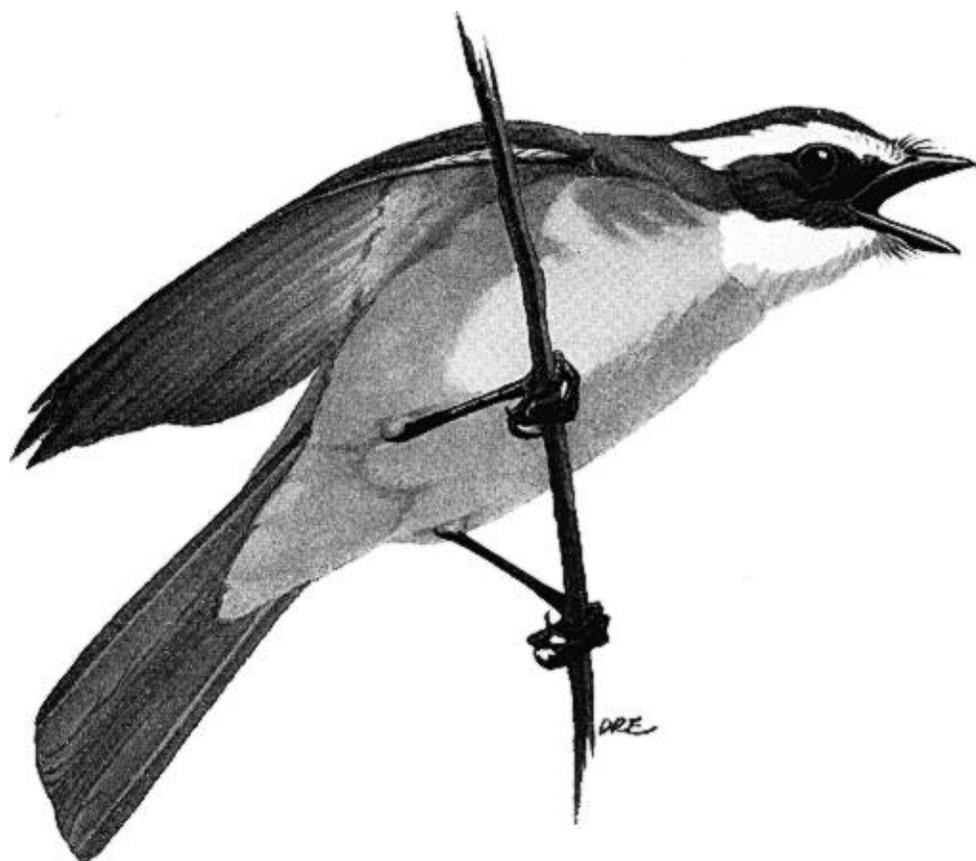


Fig. 69. Vermilion-crowned Flycatcher.

FOOD

Vermilion-crowned Flycatchers subsist on a varied diet consisting of both insects and fruits and display great versatility in procuring their food. Like other large flycatchers, they catch many insects in the air, often making long sallies and returning to the same tree from which they started. But they also take many small invertebrates from the ground. They like to rest on a rock, fence wire or low branch in a pasture and drop down to the ground to seize some insect or spider they spy crawling there. Sometimes they hop over the short-cropped grass gathering up their small prey. Those individuals which dwell near rivers or ponds hunt over the moist, bare ground at the water's edge or upon flat ledges of rock. Sometimes they venture into shallow pools up to their thighs to catch small tadpoles that rest in the quiet water, or they may perch above deeper water and fly down to pick some floating edible object deftly from the surface, without submerging themselves.

They are fond of berries and often gather in numbers in a tree laden with small fruits attractive to them. They eat many of the little lead-colored drupes of the aguacatillo (*Persea Skutchii*) and are fond of the black arils which enclose the hard little seeds of species of *Xanthoxylum*. They gather with flycatchers of other species to feast on the small red fruits of the royal palm (*Roystonea regia*), which they snatch from the heavy cluster while hovering on wing beside it. The mucilaginous berries of the parasitic mistle-

toes (Loranthaceae) are also eagerly sought by them, and fruits of the vine *Cissus sicyoides* are often eaten.

ROOSTING

Close beside a house which was on a great coffee estate on the Pacific slope of Guatemala was a dense clump of tall timber bamboo in which many birds roosted in January of 1935. Conspicuous among these roosting birds were three Chipsacheeries, which each evening perched in full view on the ends of slender outjutting twigs and repeated their plaintive notes over and over before they retired into the midst of the sheltering foliage. The other birds which slept here, including resident Gray's Thrushes and Abbot Tanagers, and many wintering Rose-breasted Grosbeaks, Baltimore Orioles, Orchard Orioles, and Tennessee Warblers, were more careful not to reveal where they roosted. Unlike the Vermilion-crowns, they flew up from a distance and darted into the midst of the clump so swiftly that I caught only fleeting glimpses of them.

In El General I found adult Vermilion-crowns roosting in a field of sugar cane in company with more numerous Gray-capped Flycatchers and Rough-winged Swallows (see p. 405). Also, three young Vermilion-crowns slept in a compact row on an exposed twig of a guava tree (see p. 443). Van Tyne (1950:9) discovered two of these flycatchers roosting beside their half-finished nest, which was placed in a bush on the edge of a little floating island moored to two tree stumps in Gatún Lake in the Canal Zone. These birds slept in plain sight on the outer portion of a slender, leafy twig of the bush which was about three feet above the water.

VOICE

The Vermilion-crowned Flycatcher utters a great variety of calls, all in soft, high-pitched, usually plaintive tones. Characteristic call notes sound like *cheee* and *pee-ah* and are delivered in a thin, high voice; the trisyllable *tapéah* appears to be a variant of the latter. These short calls are often heard from a bird which has become separated from its mate or seems to be distressed or unhappy over something, as when the nest appears to be in danger. When alarmed over the safety of its nest, this flycatcher also utters a querulous *chee chee cheep*. As the members of a pair come closer to each other after a wider separation, or at intervals while they perch quietly not far apart in the same tree, the two deliver simultaneously a short, high-pitched, somewhat trilled call, at the same time fluttering their wings. This soft, chiming utterance thus serves both as a greeting and an assurance that each is within hearing of its mate and all is well with them. When they are together, or not far apart, one sometimes gives voice to a rapid, high-pitched *che che che che che che che*. At times the last note of the series may be prolonged to a *cheep*. These various calls are delivered with many modifications and diverse intonations, so that the bird seems capable of expressing a wide range of emotions and calling attention to many diverse situations.

The dawn song of the Chipsacheery Flycatcher of the race *columbianus* is characterized by the reiteration of the phrase of four syllables which suggested the name I have given to the bird. In the gray early light, the flycatcher, without much doubt the male, "tunes up" by uttering over and over his plaintive call notes. Soon he voices the longer phrase and the song is well begun. One Chipsacheery that I heard in Panamá sang *pee-ah chip chup chips-a-cheéry*, repeating this again and again, with minor variations, in a pleasing voice which was not musical yet was far from harsh. Whichever of his more common call notes the bird may introduce into his song, the incessantly repeated *chipsa-cheery* is its distinguishing feature. This latter phrase should be pronounced just as the common English words "chips" and "cheery" are written, and with a short *a* between them. At the height of the breeding season, the flycatcher sings with scarcely an inter-

mission for as long as 25 or 30 minutes. He begins his song in the dim light of dawn and ends it before sunrise. On Barro Colorado Island in 1935, I first heard the dawn song on March 15. In the valley of El General in Costa Rica, between 2000 and 3000 feet above sea level, singing begins between March 13 and 30, or in a very dry year on April 5, and continues until early or middle June.

The dawn song of the Vermilion-crowned Flycatcher of the northern race *texensis*, as I have heard it at Pejivalle on the Caribbean slope of Costa Rica and in the Motagua Valley of Guatemala, differs from that of the Colombian race in the absence of the clearly enunciated *chipsacheery*. It consists of a common call note repeated a variable number of times and followed by a garbled polysyllable that I cannot paraphrase, but which seems to be a faltering attempt to pronounce the *chipsacheery* so clearly enunciated by the more southerly race. The call note used by the flycatcher at Pejivalle was a clear monosyllable, *cheee*, but the individual that I heard singing at dawn in Guatemala used the disyllable *pee-ah*. In addition both birds uttered from time to time the garbled, somewhat trilled polysyllable which bears a faint resemblance to the word *chipsacheery*. Chipsacheery Flycatchers of both races begin to sing later in the morning than other members of the family in the same neighborhood, including the Yellow-bellied Elaenia, Tropical Kingbird, Sulphur-bellied Flycatcher, and Gray-capped Flycatcher, but they usually continue singing longer than these, ceasing only when the light has grown strong.

The phrase *chipsacheery* is seldom voiced by the flycatchers except when they sing before sunrise. Only under stress of great excitement is it delivered later in the day. On October 20, 1936, the pair which lived near my cabin, and appeared to claim the surrounding area as their exclusive territory, suffered an invasion by another pair of their kind. Then I heard the *chipsacheery* repeated many times over, at a time of the day and the year when it was almost never uttered. The four flycatchers also called *chee chee chee* in tones high and seemingly distressed, as they pursued each other back and forth among the scattered trees. Later in the afternoon, while rain fell, one of them came alone to the lemon tree in front of my window and called plaintively many times for its mate. Soon afterward I saw the two re-united. It appears from this and similar observations that the mated Vermilion-crowned Flycatchers maintain a territory throughout the year.

A very distinct utterance of the Vermilion-crown is the nest song, a long, rapid series of low, soft notes given while the pair are seeking a nest site, by the female while she incubates, and by the male when he comes from time to time to look in at the eggs. The feeding song resembles the nest song in form but is softer and often shorter; it is used chiefly to arouse nestlings which are slow in responding when food is offered to them.

NEST BUILDING

On Barro Colorado Island I found a Vermilion-crown beginning a nest on February 24, 1935, but this structure was never finished. Van Tyne (1950:9), however, found completed nests on the island in February. In El General a bird was carrying straws on March 10, 1944, and another individual carried nesting material on March 12 of the same year. The female Vermilion-crown, like the female Gray-capped Flycatcher, starts to build at about the same date that the male begins to sing his dawn song; she may even start building somewhat before such singing is heard. In 1944, for example, the earliest dawn song was noticed on March 17. Usually it is late March or early April before building becomes widespread in El General. In Central America as a whole the height of the breeding season for both races is in April and May, and the latest broods leave the nest in June or exceptionally in July. At Satipo, 2300 feet above sea level in the eastern foothills of the Peruvian Andes at 11° S latitude, I found a Chipsacheery building on September 4, 1940, as the southern spring began.

The nest site appears to be selected by both sexes together; at least the male, whether or not his preference carries much weight, is an interested spectator while his partner chooses the site. While hunting for a suitable position for the nest, the birds sit in promising crotches and sing the nest song, a long-continued, rapid sequence of low, soft, twittering notes. I have heard this pleasing utterance after the termination of the breeding season in July; I have also heard it in November, but it is infrequent at this season in El General. In February and March, as the date for building approaches and the Chipsacheeries are actively searching for adequate sites, the nest song is delivered often.

The sites of the Vermilion-crowns' roofed nests are most varied. The most usual site is in a bush or tree standing in a pasture, dooryard, plantation, or other situation where the taller plants are scattered rather than crowded into a closed stand. Where available, a thorny, densely leafy orange or lemon tree is preferred. These birds, however, are not always careful to find concealment and may build in the open crotch of a cecropia tree where no foliage screens their bulky structure. Three nests were found in spiny Pejilaye palms, one in a spathe, one among the bases of the plume-like fronds, and the third on the broad surface of a frond. Forty nests built in trees or bushes above dry land ranged from 5½ to about 50 feet in height, but the majority were less than 25 feet up. In El General, the Chipsacheery tends to build higher than its close neighbor, the Gray-capped Flycatcher, so that, although the two species are about equally abundant, I have had fewer nests of the former that were well situated for study. The Chipsacheery's nest is very often placed on a bough overhanging the shore of a stream or lake, and in such a situation it is usually low, sometimes no more than two feet above the water, although exceptionally it is high. One nest, built among the dead branches of a tree which had fallen into the Tela River in Honduras, was only two feet above the water of the middle of the channel and well screened by a vine of *Cissus*, which had grown out from the neighboring shore and covered over the leafless boughs. In Gatún Lake, a nest was found on a stump well out from the shore, where it was supported among some aroids only two feet above the water.

A curious situation for a Vermilion-crown's nest was a trestle which carried a light tramline over a small creek in the Lancetilla Valley of Honduras. The bird's structure fitted neatly into the space between the heavy horizontal beam and the steel rail. Twice I found this nest, which evidently had been removed by inquisitive passers-by, lying on the bank of the stream, and twice I replaced it before the flycatcher started to lay. But despite this interference she deposited four eggs and began to incubate, flying out from the nest whenever one of the light tramcars rumbled over the bridge. It was doubtful whether she could have reared a family here, because the cars sometimes passed by night and if she had left the nest then the eggs or nestlings might have chilled before she returned in the morning light; but she was not even permitted to try, for the nest was once more torn from its niche and the eggs destroyed. Another odd site for a nest was on top of the signal post that rose above the roof of Tucurrique station on the Northern Railroad of Costa Rica. Situated between the two moving signal arms and facing the tracks, it sheltered three well-feathered nestlings on June 27, 1941. Both of these nests along railroads belonged to Vermilion-crowns of the northern race, *texensis*. I have not found a nest of the Colombian race built on human constructions, possibly because I have studied birds of this race chiefly in the more remote regions into which railroads have not penetrated.

The Vermilion-crown often places its nest close beside an occupied wasps' nest, or sometimes near an arboreal ants' nest, such as the silken structure built by *Camponotus senex*, which somewhat resembles a wasps' nest. In drier regions, it often builds in the cornezuelo or bull's-horn acacia, the paired, hollow thorns of which resemble the stout

horns of an ox and are inhabited by fiercely stinging ants which go in and out through a little perforation which they make just below the tip of one of the horns of the pair. In all these situations, the bird's insect associates may give it more or less protection from animals that might otherwise destroy its eggs or young. Occasionally, however, the close proximity of these insects may prove disastrous. Although he failed to mention the species, the "yellow and brown flycatcher" of which Belt (1888:291) tells a tragic tale was probably a Vermilion-crown. On the savannas of Nicaragua, this bird had built its nest in a shrub with sharp, curved prickles and had placed it alongside the nest of a banded wasp, so that with the thorns and the wasps it was well guarded. Darting hurriedly out of its domed nest as the naturalist and his party were passing, the yellow-breasted bird "was caught just under its bill by one of the curved hook-like thorns, and in trying to

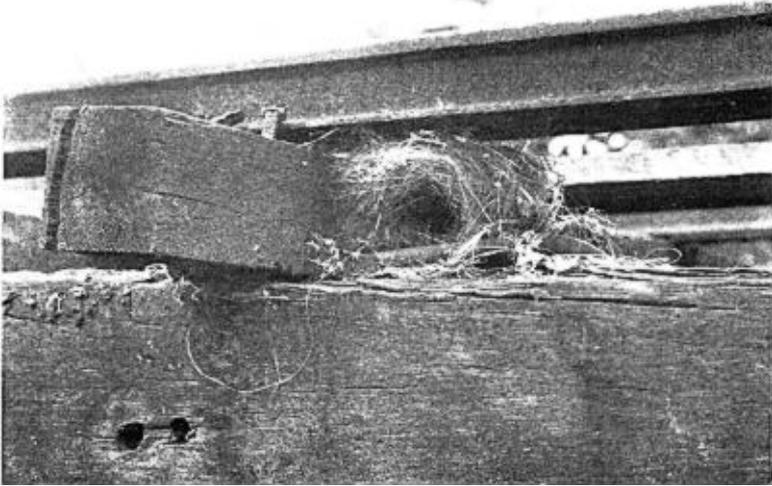


Fig. 70. Nest of Vermilion-crowned Flycatcher beneath rail on a rail trestle above a small stream in the Caribbean lowlands of Honduras; near Tela, May 15, 1930.

extricate itself got further entangled. Its fluttering disturbed the wasps, who flew down upon it, and in less than a minute stung it to death. We tried in vain to rescue it, for the wasps attacked us also, and one of our party was severely stung by them. We had to leave it hanging up dead in front of its nest, while its mate flew round and round screaming out its terror and distress." An occurrence such as this is apparently very rare, and no similar instance has come to my attention either through personal observation or reading.

Sometimes the Vermilion-crown uses the nest of another bird as a foundation for its own. Near Almirante, in 1929, one took possession of the recently abandoned, cup-shaped nest of a Scarlet-rumped Black Tanager. This Chipsacheery had just begun her nest in another part of the same lime tree, but after the nestling tanagers had been killed by ants, she began carrying her straws and weed stems to the empty nest and soon roofed it over, converting the open structure into a domed one with the entrance in the side. I have on several occasions known the related Gray-capped Flycatcher to effect a similar conversion. One Chipsacheery founded her nest upon the bulky structure of a Gray-cap, of which the doorway had collapsed, rendering it untenable.

As far as I have been able to learn by watching the construction of a number of nests

of both races, the building is done by a single member of the pair, and although the sex of the builder was not revealed by its appearance, I have little doubt that the laboring bird was in each instance the female. While she flies back and forth bringing material, her mate rests much of the time on some exposed perch near the nest, and whenever she passes him with laden bill, he greets her with a flutter of wings and soft, high-pitched, chiming notes, almost or quite a trill. Sometimes he repeats this greeting as she leaves the nest after arranging her material, and when her bill is empty, she may return his salutation in the same manner. I have watched building Vermilion-crowns in the Canal Zone, in El General, and on the Caribbean slope of Costa Rica, and each of the males en-



Fig. 71. Nest of Vermilion-crowned Flycatcher made by roofing over an abandoned nest of the Scarlet-rumped Black Tanager; near Almirante, western Panamá, April 12, 1929.

couraged his toiling partner with the same soft notes and partly spread, fluttering wings. In El General, a Vermilion-crown and a Gray-cap were at the same time building nests only ten feet apart in a small tree leaning over a meandering stream. The male Vermilion-crown often greeted the female Gray-cap when she flew past him, exactly as he saluted his own mate.

On Barro Colorado Island, a Vermilion-crown made her nest in an orange tree close beside the main building. In the top of the same small tree a Tropical Kingbird had a newly completed nest. The male kingbird would rest near this nest and dart at the Chip-sacheery when she approached her own half-finished structure with material, causing her to turn tail and flee without any resistance, although occasionally one of the smaller flycatchers would display its vermilion crown-patch in anger. Sometimes the Vermilion-

crown would dodge past the aggressive one and carry her load into the nest, where she was not molested. For all his bluster, the kingbird was not violent and never harmed the nest or its builder. While this Chipsacheery built, the trade wind of the dry season blew strongly across the lake and sometimes detached a loose seed-plume or some other light material from the outside of her nest. When the flycatcher caught sight of her laboriously gathered materials sailing away on the breeze, she darted in pursuit of them, seized them in her bill, and returned them to the nest. Once she left the nest with a seed-plume sticking to her tail and flew into a neighboring tree without seeming to notice what she carried with her. Here the wind blew it loose; she saw it at once, caught it in the air as though it were an insect, and took it back into the nest. The male also retrieved some of this wind-blown material, snatching it from the air and returning it to the nest, but he was careless and sometimes let the piece drop to the ground after catching it. When, after a period of absence, this pair of Chipsacheeries came back to their nest, male and female would in turn go to the doorway and utter the long, low, complex twitter which I have called the nest song. Then the male would settle down to rest on his perch close by, while his mate flew off to bring material to her growing structure. At a later nest I also saw the male take a scrap of material to the roof and drop it there, but he made as little effort to attach it properly as the male Chipsacheery on Barro Colorado.

The Vermilion-crown's nest may be completed in from six to ten days. One building female brought 19 billfuls of material to her nest in an hour. When finished, the nest is a bulky, roughly globular, roofed structure with a wide round doorway in the side facing outward from the supporting tree or bush. This entrance is usually well protected by the forward projection of the roof. The nest is composed of straws, weed stems, dry vines and the like, and it sometimes contains much down from the balsa tree or from the seed pods of bromeliads, or cotton when it is available. The outer wall infrequently contains a little green moss. The lining in the bottom is of fine grasses or fibers but not of soft down; the latter if used at all is placed in the outer walls. Sometimes pieces of the coarse materials that form the foundation hang down untidily a foot or two below the bottom. At times this foundation material is brought in such quantity that it forms a platform on which the oven-shaped structure rests. A typical nest measured $6\frac{1}{2}$ inches in height, not counting the dangling ends of the weed stalks which formed the foundation. The outside diameter from front to back was 6 inches and from side to side $5\frac{1}{2}$ inches. The doorway was $2\frac{1}{2}$ inches high by 3 inches wide.

Sutton and Pettingill (1942:21-22) found a number of nests of this species in southwestern Tamaulipas, México, the earliest of which was under construction on April 4. They noticed the propensity of the Vermilion-crown to place its nest near that of some other bird, such as that of the Rose-throated Becard, Boat-billed Flycatcher, Kiskadee, or Black-throated Oriole, and for this reason they called it the "Social Flycatcher." Cherrie (1916:235) found an occupied Vermilion-crown's nest in the same tree with nests of *Legatus*, *Pitangus*, and *Icterus*. A large proportion of the Chipsacheeries' nests that I have found have also been close to nests of other species, but this may have been merely because the kinds of trees chosen by them, especially orange and other fruit trees in clearings, are usually popular with a variety of nesting birds. Often the Vermilion-crown's nest is placed within a few yards of a nest of a Gray-cap or a Cayenne Flycatcher. The nests of these three species are indistinguishable in appearance, and the birds themselves are very similar. In fact the Vermilion-crown and the Cayenne Flycatcher are bewilderingly alike. Yet these three flycatchers seem never to display enmity when nesting so close together. Vermilion-crowns build far closer to nests of these congeneric species than to nests belonging to other pairs of their own species, and they are not social in the manner of many icterids, weaver birds, and other colonial species.

THE EGGS

The interval between the virtual completion of the Vermilion-crown's nest and the deposition of the first egg is quite variable; it may be only two or three days or as much as two weeks. The whole interval between the beginning of construction and the laying of the first egg may be as much as 24 days for early nests or as little as 8 or 10 days for late ones. In a nest which I found on Barro Colorado Island on April 7, the four eggs were already hatching, whence I computed that laying had begun about March 15; but Van Tyne (1950:10) found well-incubated eggs here as early as March 7. At other points where I have studied this species it has started to lay considerably later: April 10, 1929, at Almirante, western Panamá; April 13, 1944, in El General, Costa Rica; April 15, 1930, near Tela in northern Honduras; April 18, 1932, in the Motagua Valley of Guatemala. Some females appear not to lay before May. The long interval between the inception of building and the beginning of laying is accounted for by the slowness of the construction of the earliest nests, the frequency with which they are abandoned before completion, and the at times considerable interval between finishing the nest and laying the first egg.

The eggs are laid in the forenoon, at variable hours but apparently as a rule after sunrise. Two were laid before 8:00 a.m., another between 8:25 and 9:50. The interval between the deposition of successive eggs may be one, two or, rarely, three days. It is not constant even for the same set, for at some nests the interval between the laying of the first and second egg is one day, whereas that between the second and third is two days. Again, the interval between the first and second egg is two days and that between the second and third is one day; or the same interval of two days separates the laying of the first and second egg and the second and third egg.

The number of eggs in a set varies from 2 to 4. For Central America as a whole, I have original records of four nests with 2 eggs, 15 nests with 3 eggs, and 13 nests with 4 eggs. For the race *Myiozetetes similis texensis* my records are five nests with 3 eggs and three nests with 4 eggs. For *M. similis columbianus* there are four nests with 2 eggs, 10 nests with 3 eggs, and 10 nests with 4 eggs.

The eggs of the Chipsacheery are white or creamy white, sometimes with a pinkish tinge, speckled and blotched with shades of brown, chocolate and pale lilac. These markings are often heaviest and most concentrated in a cap or wreath on the thick end, whereas over the remaining surface of the egg they are more thinly scattered. The measurements of 11 eggs of *M. similis texensis* average 23.5 by 16.7 millimeters. Those showing the four extremes measured 24.2 by 16.7, 23.8 by 17.1, and 23.0 by 15.9 millimeters. The measurements of 22 eggs of the smaller race *M. similis columbianus* average 22.3 by 16.5 millimeters. Those showing the four extremes measured 23.0 by 16.7, 22.6 by 17.5, and 20.6 by 15.5 millimeters.

In 27 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: April, 14; May, 13.

INCUBATION

The eggs are incubated by the female only. She usually begins to sleep in the nest before her set is complete, while it still contains only one or two of the three or four eggs that it will eventually contain. Often, stealing up to the nest in the night and throwing in the beam of a flashlight, I have found the bird sleeping with her head exposed; more rarely it has been turned back and hidden among the feathers of her shoulders.

In May, 1932, I found a Vermilion-crown's nest with four eggs. The nest was situated in a bull's-horn acacia tree which was growing on the flood plain of the Río Morjá in Guatemala. With painted cotton placed in the doorway of the nest I marked one of the

pair of flycatchers, whose subsequent behavior indicated that it was the female. Concealed in a little green booth that I had made of the leaves of giant cane and banana plants on the stony flood plain, I passed nine hours watching this nest and saw only the paint-marked bird enter it. Her 11 sessions on the eggs varied from 1 to 49 minutes in length, her 11 absences from 1 to 31 minutes. Probably because her nest had been disturbed when I put the "paintbrush" in it, her behavior did not appear to be quite normal, and for this reason I did not compute her total time on the eggs. Once the unmarked male went to peer through the doorway, but otherwise he remained at a greater distance from the nest.

On May 9 and 10, 1944, I devoted ten hours to watching a nest (no. 43), with four eggs near the point of hatching, situated in a calabash tree in front of our house in El General. I did not attempt to place marks upon the birds at this nest, but after I watched it for a while I learned that I could distinguish the female from the male by her darker cheeks. This dark-cheeked individual alone incubated. The 12 sessions which I timed ranged from 9 to 72 minutes and averaged 30.4 minutes. Twelve recesses ranged from 11 to 31 minutes and averaged 18.5 minutes. The female Chipsacheery spent 62.2 per cent of the 10 hours on her eggs. She took her first recess late in the morning, not leaving her eggs until 6:18, more than an hour after daybreak. Then, after an absence of 26 minutes, she sat for 72 minutes continuously. This session, in the cool, misty early morning, was by far the longest of all that I timed. Her subsequent morning sessions were all less than half as long. Her afternoon sessions were irregular in length, and her recesses showed no definite tendency to change in length through the day.

The female Chipsacheery always sat in her domed nest facing outward, her tail held erect against the rear wall. The high arched ceiling left ample clear space above her. Compared with her noisy neighbor, the Gray-capped Flycatcher which was just beginning to incubate in the nearby lemon tree, this Vermilion-crown was a silent bird. Several times she gave a low version of the nest song as she passed through the doorway on her return to the eggs, but while actually incubating she rarely uttered a note. While sitting she regurgitated a constant succession of small, light-colored seeds, those of the green mistletoe berries plucked from the parasites that infested the neighboring lemon tree. Some of these she swallowed again without dropping them from her mouth; others she picked up again from the sill of the doorway in front of her; but she allowed a number of them to drop to the ground.

Her mate spent much of the day in the vicinity of the nest, often resting in the nest tree itself. He showed a tendency to guard the nest during the female's absences, but he was not consistent in the performance of this office. Twice, after his mate flew from the nest, he went to the doorway and, resting there with his head inside, delivered the nest song which consisted of a rapid sequence of low, soft notes. As the female passed him on her way to and from her eggs, he sometimes greeted her with a soft trill and vibrating wings.

Both members of this pair foraged much in the open pasture about the nest, resting on rocks or even small loose stones, from which they darted up into the air to capture flying insects, or else jumped down to the close-cropped sward to catch small creatures moving there. At times they hopped over the ground, but they never walked. They did not protest when one of the Chipsacheeries which had a nest in the orange tree at the other side of the pasture alighted on a big rock less than 50 feet in front of their own nest, where they themselves often rested. They made scarcely any effort to defend their territory.

At the end of the same month of May, I studied the mode of incubation at a neighboring nest (no. 44) of the Vermilion-crowned Flycatcher. This nest was situated in a

sour orange tree beside our house and contained two eggs nearly ready to hatch. The female at this nest was easily recognized by the pronounced and permanent curvature which her tail feathers had acquired while she sat in the confined space of the roofed nest; the male's tail was straight. The female alone incubated, and in more than nine hours of watching, her mate did not once visit the nest nor even come to the nest tree. He perched in more distant trees from which he frequently replied to her calls.

Compared with the silent Chipsacheery which I had watched on May 9 and 10, this female was a very voluble bird. On nearly every return to her nest at the end of a recess, she sang a longer or shorter version of the nest song as she passed through the doorway and snuggled down on her eggs. Sometimes, too, she repeated the nest song in the midst of a session on the eggs, and while incubating she not infrequently called out more loudly in varied tones and was at times answered by her distant mate. While calling in the nest, she often caused her concealed crown-patch to expand like a brilliant scarlet flower, lighting up the whole interior of the nest chamber. I never saw her neighbor do this.

While incubating, this female Vermilion-crown also regurgitated many seeds of mistletoe fruits and other berries, especially in the afternoon. Sometimes, during the warmest hours of the afternoon, she made the appearance of one of these regurgitated seeds an excuse for terminating her brief session on the eggs, so that she might carry it away. But she promptly swallowed other seeds, while she permitted still others to drop from her doorway, or to remain among the straws below the entrance where they lodged and where many of them were already germinating. A branch of a small jacaranda tree near the nest, where the female Chipsacheery spent much time during her absences from her eggs, was studded with dozens of regurgitated mistletoe seeds, many of which had already germinated and were displaying their twin green cotyledons.

This female Chipsacheery was in every respect less patient at incubation than her more silent neighbor which I had watched earlier. In nearly 10 hours of observation, I timed 25 sessions, which ranged from 4 to 32 minutes and averaged 12.8 minutes. Her 23 recesses varied from 4 to 27 minutes and averaged 10.2 minutes. She spent only 55.7 per cent of the time in the nest. Her whole rhythm of coming and going was far more rapid than that of the other Chipsacheery. The difference between the two individuals was most pronounced in the afternoon, when the bird in the sour orange tree was exceedingly restless.

It is of interest to compare the behavior of this Chipsacheery in the morning and in the afternoon during dry weather:

	Morning	Afternoon
Hours of observation	6	3.5
Sessions		
Number	13	12
Longest, in minutes	25	32
Shortest	5	4
Average	14.1	11.5
Recesses		
Number	13	10
Longest, in minutes	27	11
Shortest	6	4
Average	13.1	6.5
Per cent of time on eggs	51.8	63.9

The first minute fracture which indicates that the chick has started to break its way out of the shell may be detected, as a slight roughness of the surface, from 24 to 36 hours before the egg hatches. Of 7 eggs of which I know the time of hatching, 4 hatched in

the night and 3 between dawn and the middle of the morning, but none in the second half of the morning or the afternoon. The incubation period was 15 days at two nests and 16 days at two other nests. At a nest where an effort was made to determine the period in hours, the second egg hatched between 15 days 22 hours and 45 minutes and 16 days and 35 minutes after it was laid, which is almost exactly the same as the incubation period of the Gray-capped Flycatcher. Van Tyne (1950:10) found the incubation period for the Chipsacheery to be 15 days at two nests on Barro Colorado Island.

THE NESTLINGS

First day.—Early in the morning of May 12, three of the eggs were pipped in nest 43, where earlier I had studied the mode of incubation. On May 13, I entered the blind near this nest at 5:10 a.m., while the light was still dim. For the next two hours the female Vermilion-crown sat almost motionless, while her impatient mate called with growing urgency from neighboring trees. At 7:00 she at last flew out for a belated breakfast. Going to the nest, I found that the first egg had hatched, but the chick was still partly within the divided shell. At 7:20 the female returned, stood in the doorway looking down at the nestling, and lowered her head two or three times as though feeding, although I could detect nothing in her bill. Then she settled down to brood, but she constantly rose up and snuggled down again, in strong contrast to her earlier motionless sitting. At 7:29 she again rose up, picked part of the empty shell from beneath her and flew out with it. Her mate was at the moment close by, but he seemed not to notice this. At 7:32 she returned, bringing a minute insect in the tip of her bill. The nestling did not swallow the morsel, so she resumed brooding, still holding the food. From time to time she rose up to offer it again to the little one, and finally at 7:45 it vanished—the first indubitable meal. At 8:02 she fed again and removed the other part of the empty shell. At 8:14 she carried out another piece of shell, thereby telling me that another egg had hatched.

The male Chipsacheery, although he passed most of his time in the small nest tree and often rested very close to the nest, was unaccountably slow in discovering what had happened in it. At 8:24, while the female was in the act of feeding a nestling, the male, perhaps because he saw her standing in the doorway, tail outward, in an attitude she did not often maintain while she incubated, became interested and alighted on the twig closest in front of the doorway, where he sang the nest song. This perch, although only about six inches from the nest, was unfortunately somewhat below it. Had it been a little higher, I might have a different course of events to report. On this occasion the nestling again failed to swallow the proffered morsel, which was rather too big for it. After the female had settled down to brood, still holding the insect conspicuously in her bill, the male hovered for a moment in front of her. He could not see the nestlings, for she was covering them, and either he failed to notice the insect she held or the sight of it did not convey any meaning to him. He retired to a slightly more distant perch and resumed his endless preening.

Throughout the morning, preening, scratching, and stretching his wings were the chief occupations of the male Vermilion-crown. Apparently he was annoyed by vermin, as I have never seen a bird preen more assiduously, nor scratch himself more vigorously. Often through the morning he was preening within a few feet of the nest while his mate fed the nestlings. His perch was usually behind or to one side of the nest, where he could hardly see what she was doing, for the roofed edifice was on an outer branch, its doorway facing out from the tree. But again at 11:03 he came to rest on the twig close in front of and below the doorway, while his mate delivered food; and again he appeared to take an interest in what she did. Still, his lower position made it impossible for him to see the

nestlings, and once more he failed to grasp the significance of the female's attitude while she gave them food. When I left the blind at 11:40, more than four hours after the female had taken the first food to the nestlings, the male had yet brought nothing, and to all appearances he did not know that they had hatched. Yet throughout this period he was in constant vocal communication with his mate.

Returning to the blind at 1:05 p.m., I waited nearly half an hour without seeing the male Chipsacheery bring food to the nest. Then, at 1:29, he followed his mate as she returned with food, and he alighted on the perch that was nearest the doorway, singing the nest song, while she fed the nestlings. When she had finished feeding them and settled down to brood, facing outward as always, he rose to hover in front of her. All this was a repetition of his behavior at 8:24, five hours earlier. But now the female did something I had not previously seen: she opened her mouth as though begging for food, at the same time rising slightly. This last visit to the nest caused an abrupt change in the male's behavior. Going first to a neighboring bough, he darted out and caught a very small insect. Holding this in his bill, he uttered low, soft notes that followed each other with increasing rapidity and led up to the nest song. Then he went to the nest and passed the morsel through the doorway to his brooding mate, and she rose up and placed it in the mouth of one of the nestlings beneath her. This was at 1:34 p.m., six hours after the female first brought food to the nest, about six and a half hours after the first egg hatched. As though to make up for lost time, he brought six more meals in the next half hour.

When the male Vermilion-crown went to look into the nest at 1:29 p.m., his mate not only opened her mouth to show that she was hungry but also rose slightly. It is possible that he caught a glimpse of the nestlings beneath her. It is also possible that he heard the slight, rapid peeping they already uttered. But since we have already seen that he was an unobservant bird, I think it likely that the most obvious sign is what caught his attention, and that he brought food because his mate had shown him by "begging" that she was hungry. If this be true, he might not have seen the chicks until his second subsequent visit to the nest, when the female was absent and he fed them himself.

The history of this pair shows us that the female bird can be in the closest association with her mate, constantly exchanging calls with him, yet fail for several hours to convey to him the information that her eggs have hatched. The female's act in opening her mouth, while her mate looked in the doorway at 1:29 p.m., was the more noteworthy because, in years of association with this and other species of *Myiozetetes*, I have never seen a male feed his mate; and I have never seen this or any other female behave in just this fashion on any other occasion. This gesture so expressive of hunger certainly seemed to be decisive in starting the male to bring food to the nest. But it would be wrong to attach too much weight to it, because it is not impossible that the male saw or heard the nestlings at the same time. Probably a combination of factors finally incited the male Chipsacheery to bring food to the nest.

At the neighboring nest (no. 44), the embryo in the egg that was laid first developed in an inverted position, its head in the sharp rather than the blunt end. Apparently it was not able to rotate freely within the egg, and instead of cracking the shell over a considerable part of the circumference in the usual manner, it pierced the shell prematurely by continuing to hammer too long at one spot. Its bill caught in the perforation, so that it was even less free to move about and tap upon other parts of the shell. While the chick was thus held prisoner, small black ants entered the hole in the shell and bit away its nostrils, soon killing it. I removed the egg with the dead chick in it, then continued to watch the parent bird while she sat on her second egg, which was already pipped.

When I resumed my watch of this nest at 8:35 on May 31, the surviving egg was well pipped but still unhatched. A few minutes later the female returned with a billful of small insects. For about a minute she stood in the doorway, as though offering them to a nestling, then she settled down to brood, still holding the insects. Again and again she rose up to look beneath her. After sitting for eight minutes, she flew from the nest to catch another insect in the air and add it to the store in her bill, which bristled with projecting legs and gauzy wings. Then she went back to the nest, stood a few minutes in the doorway as though delivering food, but finally resumed brooding with her mouth full. While sitting she swallowed the contents of her bill. After four minutes she darted out again, caught another insect, and again went through the motions of feeding while she stood in the doorway. This time the insect vanished. After delivering the insect the bird flew away. Going to the nest, I found the nestling lying between the pieces of the severed shell, from which apparently it had now, at 8:59, just escaped, to find its first meal already awaiting the first opening of its mouth. Although I had on a number of occasions seen male birds of several kinds offer food to eggs, with the single exception of a Tropical Pewee, this was the first time I witnessed a female bringing food to the nest before her nestlings had actually hatched. Possibly the circumstance that the chick in the first egg had pierced its shell nearly two days earlier, only to die before it could emerge, had something to do with this exceptional conduct.

The female Chipsacheery gave the newly hatched nestling its second meal a quarter of an hour after the first. She removed half of the empty shell at 9:45, the other part at 10:19. She came often with food in the course of the morning, and when the nestling was slow in taking what she offered, she coaxed it with the feeding song, a rapid sequence of low notes bearing some resemblance to the nest song but softer in tone. I had not heard this utterance before the egg hatched, and the nest song that was formerly so often repeated was now rarely given. This change in the character of the notes issuing from the nest might have told the male that something of interest had happened there. However, he never came nearer than a neighboring guava tree, whence he frequently answered the calls of his mate, who busily attended the nestling.

As late as the morning of June 6, six days after the nestling hatched, the male had not begun to feed it. But by the morning of June 10 he was bringing food regularly, as a male Chipsacheery should. Of all the birds that I have studied in this connection, this male flycatcher was slowest in finding his nestling. My surmise is that he was finally made aware of its existence by its increasingly loud calls. It is significant that of the two male Vermilion-crowns, the one which had made occasional visits to the nest while it contained eggs began to feed the nestlings about six and a half hours after the first hatched whereas the other, which was never seen near the nest toward the end of the incubation period, had not started to bring food on the morning of the sixth day after the nestling hatched.

On the morning when their first eggs hatched, the manner of brooding of the females at nests 43 and 44 was strikingly different. With an egg hatching beneath her, the female did not leave nest 43 for her first recess of the morning until 7:00, two hours after her mate had begun to sing his dawn song. While incubating four days earlier, she had taken her first recess at 6:18 a.m. She sat during the early morning of hatching almost immobile, not rising up to look beneath herself, as many birds do while their eggs are hatching. But after the first nestling had emerged from the shell, she came and went much more frequently than had been her custom while she incubated. In the next four hours and forty minutes, her 18 periods of brooding ranged from 1 to 20 minutes and averaged 5.6 minutes. Her 18 absences from the nest ranged from 3 to 24 minutes and averaged 9.9 minutes. But the absence of 24 minutes, and another which lasted 20 min-

utes, were those during which I left the blind to look into the nest and they apparently were lengthened by this disturbance. Her next longest absence that morning was of 18 minutes' duration. She brooded the nestlings only 36.1 per cent of the time. She fed them 25 times. The male, it will be recalled, did not bring food until the afternoon.

At nest 44, during the first three hours after the nestling hatched, the female brooded it for 9 periods ranging from 3 to 32 minutes and averaging 12.6 minutes. She was absent for 7 periods lasting from 4 to 13 minutes and averaging 7.3 minutes. Hence she kept the chick covered for 63.2 per cent of the time, whereas in the corresponding three hours of the next-to-last day of incubation she had sat only 53.9 per cent of the time. Thus she markedly increased her time in the nest after the egg hatched, behavior just the reverse of that of her neighbor at nest 43. Possibly the circumstance that she had only one nestling, whereas the other Chipsacheery hatched two in the course of the morning, had something to do with this difference in the amount of brooding. But the female at nest 44, although she had been inconstant at incubation, continued to give much time to brooding. On the morning when her nestling was three days old, she covered it for 65.2 per cent of the two hours during which I watched her.

This nestling was fed about 9 times in the first three hours of its life outside the shell. Its mother was first seen to remove a dropping $1\frac{1}{2}$ hours after she had first fed it, which indicates that the young flycatcher's digestion was rapid.

Older nestlings.—When newly hatched, the Vermilion-crown bears sparse, light gray down quite inadequate to cover its pink skin. This is at first plastered in curly strands against the skin and requires from four to six hours to dry and spread out in soft, light filaments. The eyes are tightly closed and the inside of the mouth is yellow. When the nestling is six days old, the sheaths of its remiges begin to push out through the skin on the posterior margin of its stubby wings. When the young are from 11 to 15 days old, they become fairly well clothed with feathers in the colors of the adults, but they are still far from ready to leave their nest. If the nest is approached at this time, the young crouch down, stooping forward and laying their heads against the bottom. In this way the conspicuous white superciliary stripes are screened by the door sill and are less likely to attract attention. Or if the young happen to be facing inward, they press against the rear wall of the chamber. Within a few hours of hatching, the chicks utter a slight, rapid peeping. When they are ten days old, their weak, plaintive *cheep* or *pee-ah*, which resemble the calls of the adults, are audible at some distance from the nest. When hungry, as they seem to be most of the time, the nestlings voice these calls constantly.

In three hours on the morning of its tenth day, one nestling was brooded for 4 short periods of 7, 12, 13 and 5 minutes, respectively, a total of 37 minutes. Nocturnal brooding continues still longer, until the young birds are from 12 to 15 days of age, depending on the nest. The female continues to cover her family by night until the growing nestlings occupy so much of the available space that she sits far forward in what appears to be a most uncomfortable position and leaves her head exposed in the doorway instead of turning it back and burying it in her feathers.

The lone ten-day-old nestling mentioned in the preceding paragraph received in the course of 3 hours in the early morning a total of 39 meals, 17 from the male and 22 from the female. It was fed at the rate of 13 times per hour. In June, 1943, I devoted a number of hours, on four successive mornings, to watching another nest containing a single nestling, the departure of which I was eager to witness, and which lingered in the nest longer than I had expected. In a total of 8 hours, all before the middle of the morning, the young Vermilion-crown, which was 19 days old on the first day included in this record and 21 days old on the last, received food from both parents a total of 104 times. The number of feedings in a single hour varied from 8 to 17, and the hour in which the

nestling received the fewest meals fell between two periods in which it had received the greatest number. The average rate of feeding was 13 times per hour, the same rate as that at the nest with the ten-day-old nestling.

At the nest with the older nestling, I could not distinguish the parents, but they came together often enough to indicate that both took an active share in feeding. They brought chiefly small, winged insects, usually a number in the bill at one time. Often, arriving at the nest tree with a full bill, they would shoot out and catch yet another flying creature to add to their store, without dropping any that they already held. This was a feat at which I never ceased to marvel. They also brought a few small fruits, chiefly the little lead-colored berries of the aguacatillo and the red arillate seeds of *Clusia*. The food was delivered while the parent clung in a fairly upright position to the doorway of the

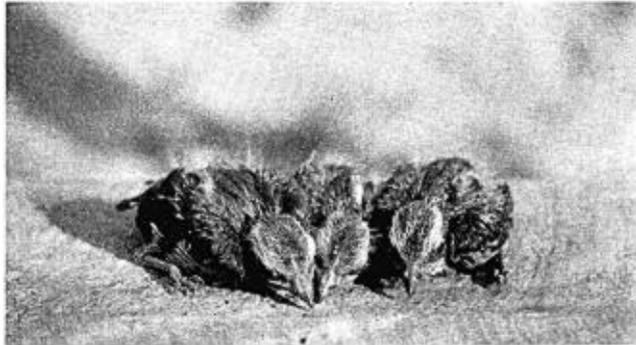


Fig. 72. Nestling Vermilion-crowned Flycatchers, 12 days old, in the crouching posture they assume when alarmed; near Tela, Honduras, May 15, 1930.

nest, its tail bent forward and touching the side below the sill. When one of the parents, resting near the nest, was passed by the other on its way to feed the nestling, or as it flew away, it greeted its mate by uttering a rapid sequence of low notes, almost a trill, and vibrating its lifted wings. Often, after taking food, the nestling turned completely around to deliver a dropping to its parent. More rarely, in the absence of the parents, it would deposit the sac on the sloping side of the nest just outside the sill. When the parents returned, one of them would remove it. The parents either swallowed the fecal sacs or carried them away in their bills, and they kept the nest irreproachably clean. The young bird often regurgitated seeds, usually leaning forward so that they would fall beyond the sill of the doorway. In that way they might either be caught up among the straws or roll to the ground.

Departure from the nest.—During the four mornings on which I watched the older nestling, its activity and interest in the world beyond the narrow confines of the nest gradually increased. It was rather noisy, incessantly voicing a weak, plaintive *pee-ah*, a juvenal version of a common call of the adults. It preened much and often stretched its wings, or it flapped them vigorously. When it flapped its wings it did so either while within the nest or standing sideways so that one of them projected through the doorway. On June 16, when 19 days old, it did not once perch in the doorway during my three-hour vigil. The following morning it repeatedly looked out with its head in the doorway. On June 18 the 21-day-old nestling often looked through the doorway, stretching its head far out, and three times in three hours it stood on the doorsill, the last time delaying there for 25 minutes. The approach of a diminutive Bananaquit, which tried to pull straws

from the outside of the nest, caused the youngster to return inside and crouch down in the habitual manner of nestling Chipsacheeries when alarmed. On this morning the young bird was very restless and noisy.

At 6:15 a.m. on June 19, the 22-day-old Chipsacheery hopped up to stand upon its doorsill. When, at 6:22, a parent came to offer a billful of insects, it was already so stuffed from earlier feedings that it disdained them. They dropped from the parent's bill to the sloping front of the nest, but the adult gathered them up and presented them once more to the young bird which swallowed at least some of them. A minute after the parent's departure, the young bird suddenly flew from the nest. It left without any preliminary wing flapping or stretching through the doorway; a moment before its take-off, it appeared to be far less on the point of leaving than it had been several times on past mornings. It flew a slightly descending course to the crown of a small madre de cacao tree down the slope, a distance of about 25 feet. Its departure was wholly spontaneous and made at a time when its parents were out of sight.

The young Vermilion-crown had been resting for a minute or two in the dew-laden foliage where it first alighted when one of the parents—the female, I believe—returned to the nest tree with a billful of food. She rested there briefly, without much doubt seeing her fledgling in its exposed position in the neighboring tree. She went neither to the empty nest nor to the fledgling, but flew with her load of insects to the crown of a guava tree at the foot of the steep slope. Then she came promptly back to the nest tree, whence she flew to the crown of another guava tree close beside the first. Here she voiced a long-continued, rapid sequence of low, soft notes, very like the nest song. It was, in fact, the same utterance the female Chipsacheery uses as she selects her nest site and begins to fashion her nest. The fledgling now flew from the madre de cacao tree down to the guava tree where its parent sang with food in her bill. Here it at once vanished from my view in the dense foliage at the top of the rounded crown. Thus the parent had succeeded in leading the fledgling from an exposed position to one well screened on all sides, and also doubtless the young bird had received its first meal in the open.

For many minutes the parent Chipsacheery continued to pour forth her low, sweet notes amid the sun-drenched foliage of the guava tree, with her fledgling beside her. I had not heard this song during the first three mornings on which I watched the nestling; but on the fourth morning one of the parents, arriving with the next to the last meal that the young flycatcher received in the nest, delayed on a neighboring bough and sang briefly in this fashion before proceeding to deliver the food. Can it be that the parent was aware that the departure of the nestling was imminent? The parent did nothing that I could interpret as an effort to bring about the departure of the young bird, and to my more obtuse faculties it was by no means obvious that the young one was about to leave. It seemed to me also that parent Southern House Wrens, Montezuma Oropendolas, and Black-crowned Tityras were unusually excited just before their fledglings left the nest.

If frightened, nestling Chipsacheeries burst out of the nest when they are only 16 or 17 days of age and can fly for short distances. In one nest a single nestling lingered undisturbed until 20 days old, and in another the lone young bird stayed until it was 22 days old. After leaving the nest the young remain with their parents for as long as three or four months. While they still receive food from the adults they call incessantly with a startling combination of notes. These sounds consist of a rapidly repeated high-pitched monosyllable which is punctuated at short intervals with the *pee-ah* call of the adults.

In mid-June, 1953, I found three young Chipsacheeries roosting, pressed close together in a row, on an exposed twig of a guava tree in the pasture behind our house. With their fresh new plumage, blackish faces set off by whitish superciliary bands, and bright

yellow breasts all turned the same way, they made a delightful picture. In the morning a parent, which had slept at a distance, fed one of them on the roost before they flew away.

THE SECOND BROOD

From a nest in northern Honduras, three 16-day-old nestlings departed prematurely on May 19 and 20 and on May 29 the first egg of a new set was laid in the same structure. This is my only evidence for a second brood, and I am not sure that the young of the first brood survived. In El General, the fledglings of the Chipsacheery leave their nest in late May or June, after which I have seen no further reproductive activity by this species. It will be recalled that in early June the Chipsacheery ceases to sing at dawn. Harrower (MS) found a nest with two feathered young at Gatún in the Canal Zone on July 25. This is the latest date for an occupied nest in Central America that has come to my attention.

ENEMIES

Like its cousin, the Gray-capped Flycatcher, the Vermilion-crown often has its newly completed nest wrested from it by the Piratic Flycatcher. Before they are feathered, the nestlings are sometimes heavily infested with screw-worms or *tórsalos*; but I have known one to survive eleven of these dipterous larvae, three of which were in the head, where they caused relatively huge swellings beneath the skin. One day I surprised a Swainson Toucan in the act of gulping down a well-feathered, two-week-old nestling Vermilion-crown. The huge-billed bird had torn off the entire roof of the nest in order to reach its prey.

The first nest of the Vermilion-crown that I studied was that at Almirante which had been built using a nest of the Scarlet-rumped Black Tanager as a foundation (p. 432). All went well with this pair of flycatchers until two of their nestlings were well feathered. The seventeenth day of their brief lives was dark and rainy. As I approached the nest tree at noon, I heard a great commotion among the birds, in which the Vermilion-crowns, their neighbors the Gray-capped Flycatchers, and several Gray's Thrushes participated. A large hawk, barred with black and white, rose from the nest tree as I came in view, only to settle in another tree a few paces off. As it rested there the air above it was filled with Vermilion-crowns calling in querulous tones, Gray-caps voicing their anger with a staccato *wic wic wic*, and thrushes uttering melancholy cries, so different from their lilting song. In its yellow talons the hawk held the two young flycatchers, crushed together with the straw which roofed over their nest. The top had been torn from the structure in the lime tree and it was in ruins. As I came nearer, the bird of prey flew off to a low bough of a fig tree on the edge of a steep bank. The flycatchers and thrushes pursued it, making darts which often came so close to its head that it ducked. For a long while it sat very still in the rain, occasionally looking around at the small birds which threatened it, sometimes erecting the white-tipped black feathers of its crown, but making no move either to fly away or to devour its victims. After a while all the hawk's assailants withdrew except the thrushes, three or four of which continued a spirited offensive, darting time and again at its head and sometimes appearing to graze it, while at intervals they raised their piercing, melancholy cries of alarm.

For more than an hour the hawk neither moved nor fed, and gradually carrion-eating insects gathered, buzzing around the corpses in its talons. There is no telling how long the bird of prey might have persisted in this unaccountable behavior; but presently the gardener came with his shotgun and killed it, because it was a menace to the domestic chickens and the many small birds then nesting in the shrubbery around the house. From the photograph which I took of the dead bird, it was later identified as an immature Black Hawk-Eagle, a species whose melodious calls are often heard in Central America as it soars high up in the blue sky during the dry season.

SUMMARY

The Vermilion-crowned or Chipsacheery Flycatcher inhabits open country with scattered trees and the wooded margins of streams and lakes, from sea level up to about 6000 feet in Central America. At the highest altitudes where it nests, it appears to withdraw to lower and warmer regions after the close of the breeding season. It remains mated throughout the year.

The species exhibits great versatility in the quest of food. Many insects are caught on long, spectacular darts into the air; but it also drops to the ground from low perches and even hops over close-cropped grass and bare shores in search of small invertebrates. It wades into shallow pools for tadpoles and deftly plucks floating objects from the surface of deeper bodies of water. Its diet includes a variety of small fruits.

Its calls or songs are most varied. Notable among its utterances are the long-continued dawn song, heard chiefly at daybreak in the breeding season, and characterized by the repetition of the phrase which suggested the bird's common name; the greeting notes uttered by the members of a pair as they come together after a separation; the long, rapid sequence of soft notes voiced as it tries out a nest site or as the female incubates; and the somewhat similar feeding song, used to arouse sluggish nestlings. The races *Myiozetetes similis columbianus* and *M. s. texensis* have rather different dawn songs, but otherwise their notes and habits are similar as far as they were observed.

Nest building begins in February in the Canal Zone and in March in the valley of El General. The bulky, roofed nest, with a doorway in the side, is placed in a wide variety of sites. Those over land are situated from 6 to 50 feet up, by preference in a thorny tree or bush, and often close beside a nest of stinging wasps. Occasionally the bird builds on railway trestles, in the space beneath a rail, and on signal towers. Many nests are placed over water, sometimes only 2 feet above the surface. At times an abandoned open nest of a tanager or other bird is converted into a typical Chipsacheery's nest by adding a roof. Only the female builds, while her mate rests close by the nest and greets her with soft notes and fluttering wings as she passes him. The construction of the nest requires about 6 to 10 days.

In Central America, sets of 3 and 4 white eggs, spotted and blotched with shades of brown and pale lilac, are about equally frequent; sets of 2 eggs are far less common. Laying begins from 2 to 14 days after the virtual completion of the nest. The eggs are deposited at various hours of the forenoon. The interval between the laying of successive eggs may be 1, 2, or rarely, 3 days. In the valley of El General, laying has been observed only in April and May, but at lower elevations the nesting season begins somewhat earlier and continues longer.

Only the female incubates, as was proved by prolonged observation at a number of nests where the sexes could be distinguished by slight natural differences in appearance or by paint marks. In ten hours, one female took sessions ranging from 9 to 72 and averaging 30.4 minutes, while her recesses varied from 11 to 31 and averaged 18.5 minutes. She covered her eggs for 62.2 per cent of the time. Another female incubated for 55.7 per cent of 9.5 hours.

The first minute fracture of the shell can be detected from 24 to 36 or more hours before the chick emerges from the egg. Hatching occurs in the night or early forenoon but was not observed later in the day. The incubation period is 15 or 16 days. Empty shells are carried away by the female.

Although only the female broods the nestlings, both parents feed them. One male first brought food about 6½ hours after his earliest opportunity to do so, but another male began to feed the nestlings when they were between 6 and 10 days old. Yet he was in constant vocal communication with his mate.

The nestlings are brooded by day until at least 10 days old and by night until 12 to

15 days of age. A solitary 10-day-old nestling was fed at the rate of 13 times per hour, and another solitary nestling was fed at the same rate during eight hours when it was 19 to 21 days of age.

Newly hatched nestlings have pink skin with sparse gray down and the interior of the mouth is yellow. When 11 to 15 days of age, they become fairly well clothed in plumage which resembles that of the adults. If frightened they burst from the nest when they are only 16 or 17 days of age and can fly for short distances, but if undisturbed they remain in the nest until 20 to 22 days old. One nestling, watched from concealment, flew from the nest early in the morning, spontaneously, in the absence of its parents. When the female discovered the young bird in the open, she sang the nest song for many minutes.

Three fledglings, still attended by their parents, roosted in a compact row on an exposed twig of a guava tree.

In El General second broods are unknown; but in a nest in the Caribbean lowlands of Honduras the first egg of a new set was laid in a nest from which the young had flown, somewhat prematurely, nine days earlier.

Vermilion-crowned Flycatchers are frequently deprived of their nests by Piratic Flycatchers, while Swainson Toucans and Black Hawk-Eagles were seen in the act of carrying off nestlings.

CAYENNE FLYCATCHER

Myiozetetes cayanensis

In size and coloration, the Cayenne Flycatcher very closely resembles the Vermilion-crowned Flycatcher. The chief differences are the cinnamon-rufous or rusty-brown margins of the larger wing feathers of the former, and the deeper, more blackish, tone of the crown and cheeks. But these distinctive features can be detected in the field only by observation in very favorable conditions, and the two species can be separated far more readily by voice than by appearance. Although many of the utterances of the Vermilion-crown are high pitched and weak, giving one the impression that he is listening to a sad, faint-hearted bird, the notes of the Cayenne Flycatcher possess this melancholy quality in an even higher degree. Its most frequent call is a high, thin, somewhat squeaky, long-drawn *see-ee* or *seecu*, which seems the expression of a bird deficient in courage and energy.

The Cayenne Flycatcher is found over much of tropical South America from Amazonian Brazil and Bolivia to Colombia and the Guianas, but in Central America it extends no farther northward than central Panamá. It inhabits all sorts of open country that is not severely arid if there are scattered trees present for its flycatching and nesting, and it is often seen in swampy areas and along the shores of rivers, lagoons, and lakes. A lowland species, it does not extend as high as the adaptable Vermilion-crown, but at Balzapamba on the Pacific slope of the Andes in Ecuador I found it the more abundant species between 2500 and 3000 feet above sea level. It was also common in the somewhat arid upper Cauca Valley in the vicinity of Cali, Colombia, at about 3500 feet. It has also been recorded at this altitude on Mount Roraima in the interior of British Guiana (Ridgway, 1907:446).

NESTING

Haverschmidt (1955a:107) states on the authority of the Penards that in Surinam (Dutch Guiana) this flycatcher may nest in all months of the year, but that it breeds chiefly from January to July. In the drier regions of eastern and central Venezuela it appears to breed only in April, May, June and July (Cherrie, 1916:234; Friedmann and Smith, 1955:521). In the Panamá Canal Zone it starts to nest far earlier than its close associate the Vermilion-crown. I found it building about the shores of Barro Colorado Island at the beginning of January; yet it continues to nest about as late as the related species, and Eisenmann (1952:40) found it incubating at Panamá City in early July.

Along the shores of forested Barro Colorado Island, I discovered two nests in January, 1931, and four more nests from February to May, 1935. In size, shape, and the materials of which they were composed, these oven-shaped nests could hardly be distinguished from those of the Vermilion-crowned and the Gray-capped flycatchers. In location, too, they could be matched by nests of these species. Three of these nests of the Cayenne Flycatcher were in small trees growing in the narrow, grassy clearings about the buildings and along the shore of the lake; one of these, in an orange tree, was eight feet above the ground. Another nest was among the aerial roots that thickly covered a decaying trunk that rose above the water of a cove. This was the same stub that previously had supported a colony of Yellow-rumped Caciques (Skutch, 1954a:307, fig. 50). Still another nest was in coarse grass growing in the shallow water of another cove. Both these nests were only two feet above the water, but a structure built atop a bare and

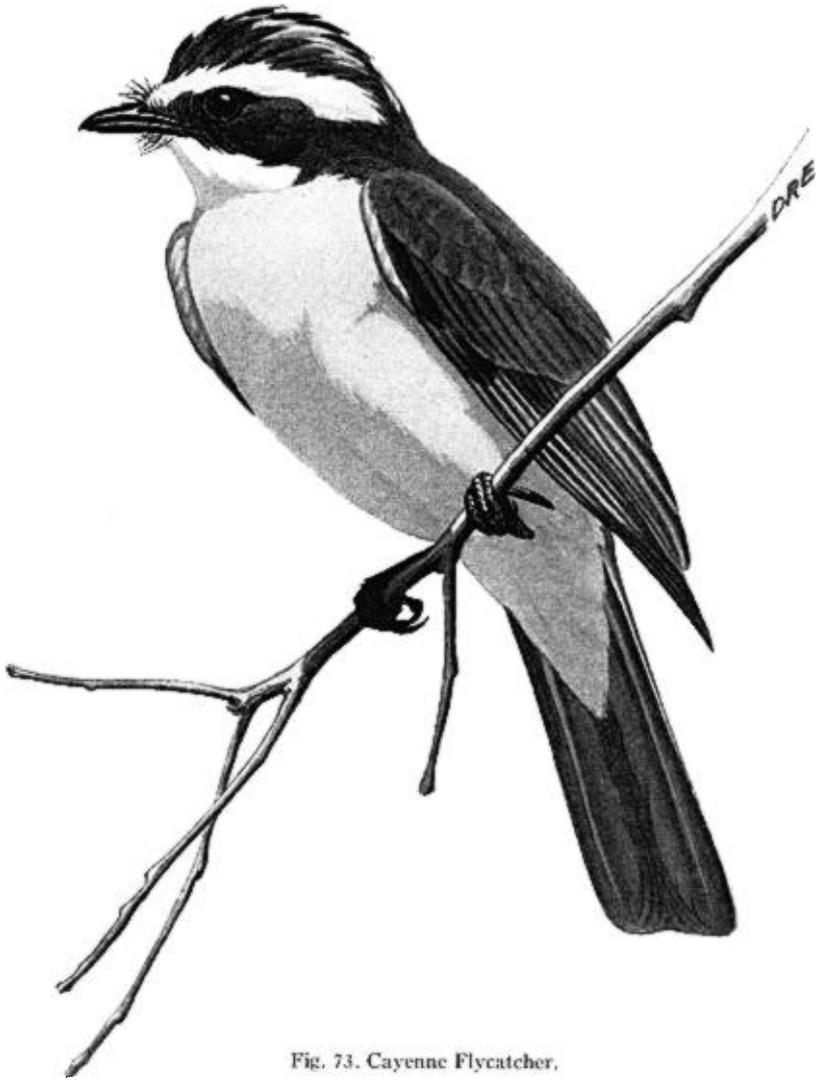


Fig. 73. Cayenne Flycatcher.

decaying slender stub in still another inlet in the shoreline of the island was 12 feet above the water level.

The last mentioned of these nests was begun as early as January 5, and when next examined on January 19 it held a single fresh egg. The nest eight feet up in the orange tree was practically completed when found on February 7, and three eggs were laid in it on February 14, 16, and 18. The second of these eggs was deposited between 7:30 and 10:15 a.m. The Cayenne Flycatcher is like the Vermilion-crowned and the Gray-capped flycatcher in having an interval of two days between laying of successive eggs and in the late hour of laying. Although I had hoped to learn more about this conveniently situated nest, the eggs had vanished by March 5. Two eggs of a new set were found in this structure on March 24, but two days later it was again empty, having been pillaged the second time by an unknown predator. The nest in the coarse grass growing in the water con-

tained three eggs on March 20, and the one in the caciques' tree held an undetermined number of nestlings on May 19.

According to Cherrie (1916:234) the Cayenne Flycatcher lays two, three, or rarely four eggs in the Orinoco region. The eggs of the nest in the orange tree were white, with a heavy wreath of reddish brown spots about the thick end and a scattering of the same over the remaining surface. Cherrie states that the ground color varies from delicate white to a faint pinkish buff, that occasionally the reddish brown speckles are quite evenly distributed over the entire surface, and that some eggs bear a few underlying pale purplish gray patches. Six eggs in two sets measured by me in Panamá averaged 22.1 by 16.1 millimeters. Those showing the four extremes measured 23.8 by 15.9 and 19.8 by 16.3 millimeters.

Like other species of *Myiozetetes*, the Cayenne Flycatcher is a victim of the Piratic Flycatcher. Chapman (1929:119-121) tells how a pair of these thieves took one nest of the Cayenne Flycatcher, abandoned it, then assailed the owners of a second nest of the same kind.

ROOSTING

In the latter part of December, 1931, three Cayenne Flycatchers went to roost every evening at about sunset on a slender twig of a small shrub that grew in the water in the marshy mouth of a small stream near the laboratory clearing on Barro Colorado. The three flycatchers sat as close together as possible, about four feet above the water and in plain view of the boat house, for their position was surprisingly exposed. Their yellow breasts were all turned the same way. While daylight faded, they repeated their thin, plaintive calls over and over. Although these birds did not appear to be juveniles, what I have since learned about the roosting habits of the Vermilion-crowned Flycatcher (see p. 429) and other flycatchers leads me to believe that these were young, still unmated individuals. In other species, as far as I have been able to discover, adults even when mated do not roost in contact with each other, as young birds often do.



Fig. 74. Drowned forest and floating vegetation, consisting largely of grasses and the fern *Nephrodium aureum*, in the backwaters of Gatún Lake, on the southern side of Barro Colorado Island, in 1931. The emergent stubs and aquatic vegetation furnished nest sites for Cayenne Flycatchers, Vermilion-crowned Flycatchers, Tropical Kingbirds, and Streaked Flycatchers.

SUMMARY

The Cayenne Flycatcher closely resembles the Vermilion-crowned Flycatcher in appearance but it is readily distinguished by its higher, more plaintive notes. It inhabits open country with scattered trees and is often found along the wooded shores of rivers and lakes. Its vertical range extends from sea level up to at least 3500 feet.

In the Canal Zone this South American species breeds from early January into July. The nest, a bulky roofed structure with a wide doorway in the side, is placed in a tree in a clearing, or sometimes in coarse grass growing in shallow water, or even on a dead, leafless stub rising above deeper water.

The set consists of 2, 3 and, in South America, rarely 4 eggs, which are white or whitish with a heavy wreath of reddish brown spots about the larger end and a scattering of the same over the remaining surface. In one nest the eggs were laid on alternate days, and one of these eggs was deposited rather late in the morning.

In December three of these birds roosted pressed close together on an exposed, slender twig of a bush at the mouth of a brook. Although apparently adult, they were probably still unmated.

PIRATIC FLYCATCHER

Legatus leucophaeus

The Tyrannidae and the Icteridae are both large and exceedingly varied families of birds which are confined to the Western Hemisphere. Both show an immense variability in the construction of nests, which range from the most elaborate structures made by any bird to some of the simplest receptacles for eggs. And each of these families, strangely enough, has one or more species which build no nest of any kind, but place their eggs in structures made by other birds. In their degree of parasitism, the several species of cowbirds go farther than any flycatcher of which we have knowledge; for the former leave their eggs to be incubated and their offspring to be nurtured by the maker of the invaded nest, whereas all the flycatchers for which we have observations hatch out their own eggs and attend their own young. To the novice in ornithology, the Icteridae or American orioles and their allies, with many brilliantly colored and highly musical species, is sure to be an interesting and stimulating family; on the contrary, the American flycatchers, with a host of small, obscurely colored species difficult to recognize, will be looked upon as a monotonous, unexciting group, tedious to study. But to one who has devoted years to discovering the hidden ways of these birds that often but by no means invariably are dull colored, the Tyrannidae seems no less interesting than many another family renowned for brighter plumage.

So far as I know, the only one of the more than three hundred species of American flycatchers which departs from normal nest-building instincts is the Piratic Flycatcher. It is also one of the very few species of passerine birds breeding in Central America which may be classed as a "summer resident," because it migrates, apparently to the south, after the close of the breeding season. In the valley of El General, where I have learned most of what I know about the habits of this aberrant flycatcher, it returns toward the end of January or early in February. My extreme dates of first arrivals in 17 of the years between 1936 and 1956 are January 20, 1944, and February 8, 1945. Farther north, the Piratic Flycatcher seems to arrive later, for Wetmore (1943:286) recorded the first appearance of this species in southern Veracruz, México, on April 11, 1939, and April 8, 1940.

Small and dull of plumage, the Piratic Flycatchers make their arrival known to the ear rather than to the eye, so that each year I have heard them before I have seen them. No sooner do the males reach their breeding ground than they perch on high, exposed twigs in isolated trees standing by the roadside, in pastures or in plantations, and proclaim their presence with loud, breezy notes. Within a week or ten days after the appearance of the first individual, the Piratic Flycatchers have become numerous in El General; and their confident whistles are heard in all situations where trees stand singly above cultivated fields, pastures, or low thickets. Many frequent the fringe of trees along the rivers which traverse the agricultural districts and make their voices heard above the roaring of the current tumbling down its rocky bed. However, they are rare or absent in the heavy forest. For the next six or seven months, their notes will be constantly heard through the greater part of each day; for *Legatus* is one of the noisiest of the flycatchers.

This flycatcher which makes such a stir in the avian world is slightly under six inches in length. Its plumage is not only dull, like many members of its family, but it is also dingy in appearance, which most flycatchers are not. Its head is sooty brown, with a band of dull white beginning on the forehead, arching above each dark brown eye, and extend-



Fig. 75. Piratic Flycatcher.

ing to the hindhead to meet that from the opposite side. The rest of the upper plumage is deep grayish brown. There are inconspicuous whitish wing bars and light margins on the remiges. The lower cheeks, chin, and throat are white. The breast and belly are pale sulphur yellow, more or less heavily marked with dusky streaks. Its short, broad bill is black and its legs are dark gray. In the center of the crown there is a patch of light yellow which is revealed chiefly in moments of excitement. Male and female are alike in appearance.

The Piratic Flycatcher is found from southern México to northern Argentina. In parts of Panamá and Costa Rica it is abundant as a breeding bird, particularly in the Térraba Valley in the southern part of the latter country. To the northward of Costa Rica this flycatcher is rare and I have not myself seen it. It appears not to have been recorded in El Salvador or Honduras; but if, as seems to be true, the Mexican population is migra-

tory, it probably passes through Honduras on migration. In Costa Rica it ranges from both coasts upward to 5500 feet, occasionally.

The food of the Piratic Flycatcher consists of berries, the green fruiting spikes of cecropia, and insects caught on the wing, among which dragonflies are prominent.

VOICE

The characteristic call of the male Piratic Flycatcher is a clear, high-pitched, long-drawn, not unmusical *pee-e-e-e*. The bird repeats this whistle over and over as he perches in the treetops, and at intervals he varies his utterance with a softer, half-trilled *pee-dee-dee-dee*, which does not carry so far as the longer note. This is the phrase written as *tiddle-dee-dee* by Chapman (1929:43) and as *pirirree* by Eisenmann (1952:40). The whistles of the female are similar to those of the male but, at least in certain pairs, they are somewhat weaker and lower in pitch. While sitting in the nest, the female may be heard to voice a low, melodious, rhythmic murmur, at times almost a soft warble, which is pleasant to hear. When their stolen nest is threatened by danger, the Piratic Flycatchers utter a short, melodious whistle deeper than their usual notes, repeating it rapidly over and over with frog-like regularity: *dee dee dee dee dee dee*.

KINDS OF NESTS USED

Soon after their arrival in El General in the dry and sunny month of February, the Piratic Flycatchers form pairs. But instead of proceeding in due course to building the nest, which most birds appear to find a happy occupation, they continue to perch indolently in the treetops, whistling all day long as though they had not a care in the world. Without doubt, however, they keep diligent watch over the prospective victims whose nests they will pirate, and from time to time they even worry the usually larger bird victims by way of asserting their mastery. Before proceeding to consider the strategy by which *Legatus* captures the coveted nest, let us list his victims. The structures in which this flycatcher has been found nesting, by myself or by others, are of surprisingly varied types and are as follows:

Vermilion-crowned Flycatcher (*Myiozetetes similis*) and Gray-capped Flycatcher (*Myiozetetes granadensis*).—In southern Costa Rica these two fairly big, yellow-breasted flycatchers, common in the clearings and along the shores of streams and lagoons, appear to be the chief providers of nests for *Legatus*. Both build bulky, roofed nests with a wide opening in the more exposed side. These nests are constructed of straws, weed stems and other dry herbaceous vegetation, and they are placed conspicuously in trees standing in pastures or dooryards, or on boughs overhanging water. It is impossible to distinguish the nests of these two species when the builders are not present. Accordingly, when one finds a Piratic Flycatcher already in possession of one of these roofed structures, it is no longer possible to determine by which of these two yellow-breasted flycatchers it was made. I have records of eight nests of *Myiozetetes* occupied by *Legatus*. Three of these had definitely been built by the Gray-capped Flycatcher, three by the Vermilion-crown, but the other two were found too late to determine the species of the builder.

Cayenne Flycatcher (*Myiozetetes cayanensis*).—The nest of this yellow-breasted flycatcher closely resembles that of the two foregoing species. Chapman (1929:119-120) tells how a pair of *Legatus* in the Canal Zone stole a newly completed nest of this species, attacking the builders and driving them away. The same orange tree held also a second nest apparently built by the Cayenne Flycatchers; but although the Piratic Flycatchers examined both structures, they used neither.

Sulphury Flat-bill (*Tolmomyias sulphurescens*).—The nest of this small, dull-colored flycatcher is quite different in form from that built by species of *Myiozetetes*.

The pensile structure, composed of thickly-matted black or blackish fibrous materials, is shaped like a chemist's retort. The roughly globular chamber where the eggs repose is entered through the end of a narrow, spout-like tube that points almost straight downward. These curious nests are attached by their upper extremity to a slender twig or free-swinging vine; they are placed at heights of usually 10 to 20 feet above the ground, in shady pastures, above roadways or waterways, or in open spaces in second-growth woodland. In the three successive years of 1944, 1945, and 1946, and again in 1955, the Piratic Flycatcher nested in structures made by the Sulphury Flat-bill in the pasture in front of my house in El General. I had actually watched the flat-bills build two of these nests. The sites of the first three were within a distance of about 100 feet, and doubtless the same pair of Piratic Flycatchers used them all, for it appears exceptional for *Legatus* to occupy nests of the flat-bill.

Eye-ringed Flat-bill (*Rhynchocyclus brevirostris*).—The pensile nest of this flycatcher is similar to that of the Sulphury Flat-bill in form, but it is bulkier and made of coarser material. Since it is usually placed in woods too dense for the Piratic Flycatchers, it is not often molested by them. But I once found a Piratic Flycatcher incubating in an Eye-ringed Flat-bill's nest that hung in the sunlight at the forest's edge, beside a clearing which had been made only two months earlier.

White-winged Becard (*Pachyramphus polychopterus*).—The nest of this small co-tinga is a very bulky, globular structure, from six to eight inches or even more in diameter, and it is entered through a small round doorway in the side. It is usually placed in a tree standing isolated in a clearing, at heights of from 14 to 60 feet above the ground. I have twice found the Piratic Flycatcher breeding in nests of the White-winged Becard. In one of these structures the interlopers were feeding nestlings.

Chestnut-headed or Wagler Oropendola (*Zarhynchus wagleri*).—Chapman (1929: 111-121) tells how by persistent persecution Piratic Flycatchers caused female oropendolas to relinquish their skillfully woven pensile pouches which hung in populous colonies from the outer twigs of a tall, isolated tree. He watched a flycatcher carry material into one of these stolen nests, and later he found evidence that the female was incubating in the inaccessible structure. A colony of Chestnut-headed Oropendolas situated at an altitude of about 5400 feet in the Costa Rican mountains had its attendant pair of noisy Piratic Flycatchers, but I did not find the latter actually breeding there. When I studied the Montezuma Oropendola in northern Central America, where the Piratic Flycatcher is rare, I found none of these intruders in the colonies of the oropendolas. However, in more southerly regions, where *Legatus* is more abundant, the Montezuma Oropendolas are probably no more immune to its attacks than is their relative the Chestnut-headed Oropendola. A small colony of Yellow-rumped Caciques, nesting in a dead tree standing above the water of a cove in the shoreline of Barro Colorado Island in Gatún Lake, had attracted a Piratic Flycatcher, which made itself objectionably conspicuous in the vicinity. It seemed to have singled out one of the caciques' nests for capture and began to persecute the larger birds in the neighborhood of this nest; but at this point a snake cleaned out practically all of the nests in the colony and put an end to my observations. The nests of the two oropendolas and the cacique differ chiefly in size; all are long, woven pouches entered at the top, and all would seem to be equally acceptable to the Piratic Flycatcher.

Yellow Oriole (*Icterus nigrogularis*).—In the middle Orinoco region, Cherrie (1916: 232) found the Piratic Flycatcher breeding in what he took to be year-old, abandoned nests of this species. More probably they were nests of recent construction, captured by the flycatcher soon after completion. Cherrie describes these nests as "typical oriole nests, bag-shaped, about 30 cm. long and 10 cm. in diameter at the bottom, slightly con-

stricted at the top." He took eggs of the flycatcher from two structures of this type. Some six or eight nests of this flycatcher came under his observation, and in each instance they were in trees where other species of birds were nesting. One nest claimed by *Legatus*, apparently made by the oriole and still without eggs, hung within a few feet of another nest of the Yellow Oriole containing eggs of the builder. In the same tree were nests with eggs of the Kiskadee and the Vermilion-crowned Flycatcher. In Trinidad, Belcher and Smoother (1937:231, 529) found that the Yellow Oriole was frequently robbed of its nests by the Piratic Flycatcher.

Violaceous or Gartered Trogon (*Trogon violaceus*).—These glittering green, yellow-bellied trogons lay their eggs in a chamber which they carve into the heart of a wasps' nest, usually choosing a large, turbinate, silvery-gray structure, attached near the end of a branch far up in a tree. The trogons attack nests occupied by thriving colonies of wasps, catching and killing many of the insects before they begin to dig into the nest. At the beginning of March, 1936, I watched a pair of Violaceous Trogons prepare a nesting chamber in a wasps' nest, situated about a hundred feet above the ground in a huge tree at the edge of the forest in southern Costa Rica. A pair of Piratic Flycatchers perched in the tree while the trogons worked, but the flycatchers only rarely molested them. When the excavation appeared to be finished, the flycatchers became more actively aggressive toward the larger birds, darting at them repeatedly whenever they approached the wasps' nest. Most of the time the trogons ignored these feints of attack, hardly taking the trouble to duck their heads as the smaller birds shot over them. Now and again they lost patience and drove at their tormentors in a spirited manner, causing their immediate and hurried retreat. But the pestiferous little flycatchers soon returned and continued to annoy the trogons, acting as though the wasps' nest were theirs, and from time to time they entered the wide opening that the trogons had made in the side. I do not know whether the female trogon laid eggs in this nest. But soon the pair of them lost interest in it, while the female flycatcher spent so much time within that I felt sure she was incubating. By the end of April, the flycatchers appeared to be feeding nestlings in this lofty wasps' nest. The Violaceous Trogon is the only non-passerine bird whose nest I have known to be occupied by the Piratic Flycatcher. My records contain two instances of this.

In the morning of April 19, 1946, a pair of Piratic Flycatchers took great interest in an abandoned nest of *guitarrón* wasps (*Synoecca* sp.) in our coffee plantation. This structure, built of strongly corrugated gray papery material, extended for about six feet along the trunk of an *Inga* tree, high above the ground, and it had many holes in its walls. The flycatchers called incessantly while perching on neighboring twigs, often fluttered beside the wasps' nest, and at times clung to one of the gaps in its corrugated envelope. They continued this for about an hour, but they did not finally occupy the nest, so far as I could tell. I have never known the nest of this wasp, which is slow to anger but greatly feared by men for its sting, to be occupied by the Violaceous Trogon.

METHOD OF CAPTURING NESTS

The Piratic Flycatchers appear to select their prospective victims soon after the latter begin to build. While the builders are at work, the intruders rest conspicuously on neighboring perches, constantly repeating their whistles, and without much doubt watching with keen eyes the progress of their future nest. As long as the other birds are actively building, the Piratic Flycatchers only rarely manifest belligerent intentions, probably realizing, instinctively if not explicitly, that the less they interfere, the sooner their nest will be ready for them. But after the completion of the structure, the pirates become more actively aggressive, darting waspishly at the rightful owner or owners, continuing to

harass them for long periods, going now and again to the nest's entrance and causing the builders to fly up and drive them off, and in general making themselves unbearably offensive. Chapman has described this sort of behavior on the part of Piratic Flycatchers which captured nests of the Wagler Oropendola and the Cayenne Flycatcher. Whether such persecution would in itself cause the nearly always bigger and more powerful nest builders to abandon their work, I am not sure. I doubt whether it would result in the desertion of nests in which incubation had begun, for within the covered structure the sitting bird could easily defend itself. Sometimes, indeed, it has appeared to me that the owners deserted their handiwork merely as a result of merciless persecution continued by the Piratic Flycatchers for an hour or more, but since these nests were above my reach, I could not be certain that *Legatus* had not had recourse to its definitive strategy, namely, throwing out the eggs.

On April 27, 1937, I had the unparalleled good fortune to witness, in front of the thatched cabin which I then occupied in the valley of El General, the actual eviction of a pair of Gray-capped Flycatchers from a nest in which the female had been incubating for about a week. A day or two earlier a pair of Piratic Flycatchers, nesting in a structure built by either Gray-capped or Vermilion-crowned flycatchers, had lost their stolen edifice, which was pulled to pieces by, I believe, Swainson Toucans. Now the bereaved flycatchers crossed the road and in their usual vociferous fashion made their presence known in the vicinity of my cabin. Next day the piratic pair fell upon their new victims.

Early in the morning I was attracted by intense excitement about the Gray-caps' nest in my front yard. The Piratic Flycatchers, not slow in getting down to business, had already begun their siege of the nest. The owners put up a spirited defense. At times the Gray-caps darted at the intruders and caused them to flee, but the latter only circled around and a moment later dashed upon the defenders, which in turn were forced to make a quick change of position. The Gray-caps called incessantly *bip* and *bur*, while the Piratic Flycatchers did not cease to utter their high-pitched, penetrating *pee-e-e-e*, or at times a lower, fuller, oft-repeated whistle—the alarm call. A number of birds of other kinds, including Gray's Thrushes, Song Tanagers, Blue Tanagers, Golden-masked Tanagers, and even a tiny Paltry Tyranniscus, were drawn by the excitement and became interested onlookers. Despite all the dashing back and forth by the contestants, I saw only one actual clash, when a Gray-cap momentarily came to grips with a Piratic Flycatcher in the air. Very few feathers were shed in the entire conflict.

Whenever a Piratic Flycatcher attempted to enter the coveted nest, a Gray-cap dashed furiously toward it and made it flee. But before the battle had lasted long, one of the invaders found an opportunity to steal into the nest while the attention of both the defenders was drawn by its mate. In a moment it came out again, carrying in its bill a white egg, which it dropped when a few yards from the nest. After this, the skirmishing proceeded as before, with little loss of blood or feathers on either side. Within the next half-hour, a Piratic Flycatcher was able to slip into the nest twice more and remove the two remaining eggs. While one of the piratic pair was within making ready to carry off an egg, its mate came to the doorway and conspicuously displayed its usually concealed yellow crown-patch.

In order to see what would happen, after the Piratic Flycatchers had removed the Gray-caps' three eggs, I placed in the nest an addled egg of the Song Tanager. At their earliest opportunity, the Piratic Flycatchers carried out this pale blue egg in the same manner as they had the Gray-caps' white eggs. I believe that they must carry the eggs by transfixing the shell with their closed bills, for their mouths appear to be too small to grasp the whole egg. Since the ejected eggs broke on striking the ground, I could not settle this point.

In this conflict the Piratic Flycatchers did not demonstrate themselves to be better fighters than the far bigger Gray-capped Flycatchers, but they were clearly better strategists. Rarely indeed will a bird use a second time a nest from which its eggs have been taken; and as soon as they discovered that their eggs were gone, the Gray-caps lost heart in their cause and their defense began to weaken. By the middle of the morning the freebooters were undisputed masters of the nest, the Gray-caps having ceased to defend it. Through much of the remainder of the day, the male Piratic Flycatcher perched in a low tree in front of the captured nest and proclaimed victory with his untiring crescendo whistle.

As when schoolboys read the *Iliad* their sympathies are usually with the beleaguered Trojans, so while I watched this conflict my sympathy was all on the side of the Gray-caps. But there was no way of helping them without destroying the assailants, and even if I had wished to take so drastic a course, I possessed no weapon that would serve to accomplish my purpose.

Eight years later, in the yard of another residence in El General, I witnessed another conflict between Gray-capped and Piratic flycatchers for the possession of a nest which the former had just completed. This nest was beyond my reach in a guava tree, and I could not determine whether an egg had been laid in it. When my attention was first drawn to the disturbance in the guava tree, one of the Piratic Flycatchers was perching there with a small, dry leaf in its bill. The invaders persisted in approaching the nest and the owners tried to drive them away. There was much chasing back and forth, sometimes a momentary clash in the air, but never any real fighting. The birds never clutched and fell to the ground, and few if any feathers were lost. Sometimes a Gray-cap would chase a Piratic Flycatcher and sometimes the reverse. There was more noise than battle, the Gray-caps calling loudly *wic wic* and *beh burr burr*, the Piratic Flycatchers whistling with what to me was exasperating levity. One of the latter persisted in resting on a twig a few inches from the nest and often going to look in through the doorway, to the great annoyance of the builders. These at first drove angrily at the intruder and chased it away; but as the minutes passed they attacked less regularly, and the Piratic Flycatcher was permitted to spend more time on the perch near the nest and at the doorway.

After nearly an hour of this, the Gray-caps seemed to give up their nest as lost, without, so far as I saw, the ejection of an egg. This long-continued dispute drew numerous birds of other kinds as spectators, but after a while they lost interest in the controversy and went off to attend to their own affairs. Victory in this instance appeared to have been won by the superior persistence of the Piratic Flycatchers, their capacity to continue a quarrel longer than their opponents and so to wear out their patience even if they inflicted no physical injury. They waged a "war of nerves." Finally, the Gray-caps retired to the neighboring sour orange tree, where they sang their rattling nest song, as though they already contemplated building a new structure there. Meanwhile the Piratic Flycatchers remained in the guava tree, one resting close beside the Gray-caps' nest, the other at the top of the tree, repeating its *pee-e-e* and *pee-de-de-de-de* in a manner which made it difficult to resist the conclusion that it insolently gloated over the discomfiture of the Gray-caps.

With victims other than the Gray-capped Flycatcher, I have not witnessed the decisive encounter whereby the coveted nest was definitely won by the Piratic Flycatchers. In the case of Violaceous Trogons and Yellow-rumped Caciques, however, I have seen something of the persistent badgering to which the victims are mercilessly subjected prior to, we may presume, the final conflict, and Chapman has described similar behavior by Piratic Flycatchers which finally gained possession of nests of Wagler Oropendolas. The trogons, caciques, and oropendolas are all many times bigger than their tormentors.

The loss of one nest by Gray-capped Flycatchers or other victims of *Legatus* is no guarantee that subsequent structures built by the unfortunate birds will be immune from the attacks of the same pair of thieves. For if the Piratic Flycatcher loses its nest, it will claim another from its helots. Thus the hazards of reproduction of the latter are now about doubled, since their ultimate success may depend upon the fate of their tormentors' nest as well as on that of their own. Among tropical birds nest losses are nearly always high. This close linkage between the success of a persecuted race and that of persecutors provides matter for moral reflections (see Skutch, 1944).

In May, 1936, a pair of Piratic Flycatchers dispossessed a pair of Gray-caps of a nest in the top of a small tree beside my cabin. That same morning the evicted pair passed to the orange tree on the other side of the cabin and sang the low, long-drawn twittering *churr* which announces the selection of a nest site. In this instance they chose the open, cup-shaped nest from which fledgling Blue Tanagers had flown only two days earlier. The female Gray-cap promptly began to roof over this open structure, converting it into a domed nest such as Gray-caps invariably use. Before she had completed the alteration, the nest which she had surrendered to the Piratic Flycatchers was damaged and became unserviceable, its roof having collapsed, apparently, under a beating rainstorm. The pirates lost no time in moving over to the orange tree, watched the Gray-cap complete the conversion of the Blue Tanager's nest, then promptly captured it. The nest which birds of two species took a share in building finally became the shelter of a successful brood of the third species. In 1945, I again saw a pair of Gray-capped Flycatchers lose two successive nests to a pair of Piratic Flycatchers. I have on several occasions known the Piratic Flycatchers to abandon nests they had captured, even when the structures appeared quite sound and serviceable and as far as known had not been molested by predators. Chapman remarks upon the same wasteful habits of *Legatus*. What it easily acquires it lightly abandons.

Even when comfortably installed in their stolen nest, the Piratic Flycatchers sometimes, from mere force of bad habit, inflict injury on their peaceful neighbors. On April 24, 1936, I found a Piratic Flycatcher incubating in a domed nest built by *Myiozetetes* in a small, vine-draped tree growing in a canebrake. On the opposite side of the same tree, and somewhat higher, a pair of Vermilion-crowned Flycatchers had a nest containing fresh eggs. Possibly the female Vermilion-crown had earlier built the neighboring nest now occupied by *Legatus*, possibly also this nest was the work of a Gray-cap, for these two related species often build close together. In any event, while the female Piratic Flycatcher incubated and the female Vermilion-crown was absent with her mate, the male Piratic Flycatcher went to the doorway of the unguarded nest and pulled out an egg, which he dropped at once—an act of pure wantonness.

Yet it is apparently only from covered nests, of kinds they sometimes use, that Piratic Flycatchers remove eggs. In early June, 1956, a pair of these flycatchers nested in a domed structure, built by a Gray-capped Flycatcher or a Vermilion-crown, in the top of a small orange tree behind our house. A foot away was a nest of a Song Tanager, open above as is always true of this species and containing two bright blue eggs; about a yard lower was the much smaller open nest of a Variable Seedeater, containing two nestlings a few days old. Whenever the female Song Tanager returned to her nest while the female Piratic Flycatcher was incubating, the shaking of the branches caused her to fly out of her covered structure. Then she and her mate became greatly excited, calling much, hovering close to the tanager's nest, and showing their yellow crown-patches. But I did not see them offer violence to the Song Tanager's nest, and she mostly ignored these smaller neighbors. After a few days I noticed that the flycatchers' nest was abandoned. I then opened the two eggs which remained in it and found that they contained half-

formed embryos, already dead. No cause for desertion was apparent save the disturbing presence of the innocuous Song Tanager, who continued to attend her two eggs. Likewise the nestling Variable Seedeaters a little lower in the orange tree continued to thrive. By throwing out the tanager's eggs the flycatchers might have relieved themselves of a neighbor whose close proximity troubled them, yet they never took this decisive step.

NEST BUILDING

Although the Piratic Flycatcher appears incapable of constructing a nest in its entirety, the bird's instinct to build has not been wholly lost. For this flycatcher, the act of building has been reduced to carrying into the stolen nest a loose litter of dead leaves, chiefly whole small leaflets from compound leaves. The amount of this material collected by the Piratic Flycatcher varies greatly from nest to nest. One nest built by *Myiozetetes* contained about sixty dry dead leaflets of the sotacaballo trees (*Pithecolobium*) which shaded the mountain torrent beside which the nest was situated. The nest made by the Blue Tanager and roofed over by the Gray-capped Flycatcher was, after capture by the Piratic Flycatcher, furnished with 29 dead leaves, chiefly the whole leaflets of some tree with compound leaves. Species of *Myiozetetes* never take such litter into their neatly lined nests. One nest of the Sulphury Flat-bill in use by the Piratic Flycatcher contained a few small dry leaflets in the bottom, but another, in which incubation was in progress, contained no leaflets. The flat-bill does not place such material in its nest. Cherrie (1916: 233) found a few small dead leaves of the salada tree in nests built by the Yellow Oriole and occupied by the Piratic Flycatcher, but he was not certain whether they had been taken there by the latter bird or had fallen in from above. Belcher and Smooker (1937: 231) also noticed that in Trinidad nests of this oriole, occupied by the Piratic Flycatcher, were covered on the bottom with a bed of loose bits of leaf.

When taking possession of a completed oropendola's nest, the Piratic Flycatcher would find a similar, although coarser, litter already present, gathered by the original builder. Likewise nests of the White-winged Becard contain loose leaves placed in the bottom by the builder. It is difficult to understand why the Piratic Flycatcher should require for her eggs more of a lining than that which *Myiozetetes* and *Tolmomyias* had already provided for their elaborate nests. But we have seen that sometimes the Piratic Flycatcher occupies trogons' nests, which are normally unpadded, and possibly it also captures the unlined cavities of other non-passerine species about which we have no information. In such circumstances, the litter of leaves which the flycatcher introduces may be of some use. It has been suggested that the loose leaves in the bottom of the long swinging pouches of certain oropendolas tend to keep the eggs from knocking together and breaking when the pouches sway in a strong breeze. If the Piratic Flycatcher were to capture such a nest before the builder had carried in enough leaves, its own effort in this direction might be of use; but if the builder had already completed its nest, such leaf bringing would seem superfluous.

Although I have sometimes seen Piratic Flycatchers, both male and female, with leaflets or similar material in their bills, I have not had the good fortune to watch sustained nest building by this species. One female took a fragment of dead leaf into a nest where apparently she had already begun incubation. Her mate held in his bill the valve of a flat seedpod of an acacia-like tree, but he finally dropped it without taking it into the nest. Chapman watched a female Piratic Flycatcher carry material into a captured nest of a Wagler Oropendola. In the course of 20 minutes in the early afternoon, the bird brought material 10 times.

THE EGGS

In the valley of El General, the Piratic Flycatcher begins to lay toward the end of March. It is significant that both of my earliest records of nesting are of pairs of Piratic Flycatchers which occupied holes dug into wasps' nests by Violaceous Trogons. The latter breed somewhat earlier than the passerine birds which this flycatcher chooses as victims. In one of these inaccessible wasps' nests, incubation appeared to be in progress on April 3, 1936, and in the other the parents were feeding nestlings on April 14, 1948. The eggs from which these young hatched could have been laid no later than the last week of March. But my earliest dates for eggs actually seen, in this region, are April 19, 1943, when the first egg was laid in a nest built by the Gray-capped Flycatcher, and April 18, 1955, when the first egg was laid in a nest made by the Vermilion-crowned Flycatcher. In the first of these nests, 3 eggs were laid at intervals of two days, on April 19, 21 and 23. In the second nest 2 eggs were laid with an interval of two days, on April 18 and 20.

Most of the nests of the Piratic Flycatcher that I have discovered were out of reach. I have records from Costa Rica of two sets consisting of 3 eggs and four sets of 2 eggs. The eggs are of a peculiar aspect and suggest that the affinities of this aberrant bird may be with the cotingas rather than with the American flycatchers. The ground color I have described for various sets as *café-au-lait*, unsaturated brown, or smoky brownish gray with a suffusion of darker brown over most of the surface. About the thick end there is a wreath of deeper, dirty brown in confluent blotches. Three of the sets bore over the remaining surface irregular, crooked, brown striations, like crease-marks in a thin membrane, or veinings and marblings of the same color. On the eggs of the fourth set the markings of the latter type were obsolescent. The measurements of 12 eggs average 21.7 by 16.3 millimeters. Those showing the four extremes measured 23.8 by 16.7, 22.2 by 17.5, and 20.6 by 15.5 millimeters. In the Orinoco region Cherrie found sets of 2 and 3 eggs, and in Trinidad Belcher and Smooker found a set of 2 on April 21.

In 15 nests in the valley of El General, eggs were laid as follows: March, 2; April, 7; May, 4; June, 2.

INCUBATION

Once in secure possession of their ill-gotten nest, the Piratic Flycatchers guard it as zealously and attend with as much care and devotion the eggs and young it shelters as though they had built it by their own industry. When a man or other animal which they regard as dangerous comes near, they protest with a low, full note rapidly repeated—an utterance that conveys an impression of seriousness and sincerity quite lacking in the flippant *pee-e-e-e*, *pee-de-de-de-de* of ordinary occasions. And the female, while sitting on her eggs, at times gives voice to low, musical notes which suggest that she carries on contentedly the monotonous task of incubation.

As in other flycatchers, the female keeps the eggs warm without help from the male. In 1936, I devoted ten hours to watching incubation in the Blue Tanagers' nest in the orange tree to which the Gray-capped Flycatcher had added a roof, and I did not once see the male Piratic Flycatcher come to replace his mate on the eggs. In the morning, the female's 8 sessions in the nest ranged from 20 to 49 minutes and averaged 34 minutes. Her 8 recesses varied in length from 5 to 18 minutes and averaged 12.9 minutes. She kept her eggs covered for 72.5 per cent of the 6 hours and 15 minutes.

In the afternoon, this female's behavior was strikingly different. When I began to watch at 2:35 p.m. on June 3, she was in the nest and she stayed continuously until nightfall, without ever going off to catch a bite of supper. Such a long session by day was unparalleled in my experience with flycatchers; it is altogether unusual to find a

bird, which in the forenoon takes frequent recesses, sit uninterruptedly through most of the afternoon. Yet the weather on this particular afternoon was rather better than usual at this season. The sky was overcast and a slow rain fell much of the time. However, there were long rainless intervals in which the flycatcher might have come out of her nest to forage, since in any case her eggs were protected by a good roof. She sat in the covered structure always facing outward through the round doorway, as the Gray-cap from which she stole it might have done. When at intervals she bent down her head to adjust the eggs beneath her, she sometimes revealed the yellow feathers in the center of her crown. The latter were usually covered over and concealed by the sooty brown feathers on either side.

Nineteen years later, I again made a study of the mode of incubation of the Piratic Flycatcher, choosing this time one which was nesting in a domed structure which a Vermilion-crowned Flycatcher had built in an orange tree behind our house. From a blind, I watched this nest from 12:10 p.m. until dusk at 6:10 on April 28, eight days after the set of eggs was complete, and from daybreak at 5:20 next morning until 11:09 a.m. At this nest, too, there was an abrupt contrast between the rhythm of incubation through the early and middle hours of the day and in the late afternoon. The turning point may be considered to have come at 3:17 p.m., when the flycatcher began a session nearly three times as long as any that she had taken earlier in the day. In the forenoon and first half of the afternoon I timed 13 sessions ranging from 13 to 40 minutes and averaging 26.0 minutes and 13 recesses ranging from 6 to 22 minutes and averaging 11.3 minutes. The bird sat for 69.7 per cent of the 8 hours covered by this part of the record.

After entering the nest at 3:17, the flycatcher sat continuously until 5:10, or for 113 minutes. At the end of this long session she left the nest for only 3 minutes, then at 5:13 returned, to remain within until nightfall. Thus she practically ended her day's activity at 3:17. Although the late afternoon was cloudy, with drizzles and a few short showers, there were long rainless intervals when she might have left her nest without a drenching. Indeed, she was out under the hardest shower of the afternoon, which fell around 2:30. Hence it is not likely that rain was responsible for her long period in the nest. The weather greatly resembled that on the afternoon nearly 19 years earlier when I had watched the first Piratic Flycatcher incubate. The similarity in the behavior of these two birds, observed at such a long interval of time, shows forcefully how conservative the species is in its rhythm of incubation, which is determined primarily by innate factors, although of course greatly influenced by environmental conditions, especially if these depart strongly from normal. Although it is in my experience unusual for a bird which most of the day takes short sessions on its eggs to end her normal diurnal activity so long before nightfall, such behavior is not without precedent in the annals of ornithology. Armstrong (1955:183) gives a record of a Winter Wren which settled on her eggs for the night at 5:42 p.m. when sunset occurred at 8:17. He mentions similar early retirement by the Irish Dipper, Hawfinch, and Great Tit, the last of which sometimes began the long night session two or three hours before sunset. I once watched a Blue-black Grosbeak which sat continuously from noon to nightfall, but even in the forenoon this bird had been taking sessions of unusual length for her kind (Skutch, 1954a:57).

This second Piratic Flycatcher was very noisy while sitting on her eggs, repeating innumerable times, both morning and afternoon, the soft, rhythmic twitter or murmur already mentioned. When her mate, resting in neighboring trees, uttered his breezy whistles, she answered with a high, sharp note which was followed immediately by the soft twitter, and this was often continued for considerable periods. I could not distinguish the sexes by their appearance, but I saw no change-overs on the eggs such as might have occurred if both members of the pair had taken turns warming them.

The male Piratic Flycatcher of the first pair spent his leisure resting on high, exposed perches in the trees that commanded a view of the nest that the Blue Tanagers had begun. Here he repeated interminably his loud, far-carrying *pee-e-e-e*. The female in the nest would often respond with the low, melodious, rhythmic murmur that suggested well-being and contentment. While taking an outing from the nest, she might answer with a whistle somewhat lower and weaker than the male's. Now that they were occupied in quiet domestic tasks and their piratical tendencies were not immediately evident, the voices of these flycatchers sounded more agreeable than during the preceding days of lawless strife and persecution of their neighbors. Yet even now their bellicose nature was not wholly dormant. The male was a zealous guardian of the nest and its surroundings, and he tried to drive away every other bird that came near. He even chased away a little Golden-masked Tanager which rested in the orange tree and certainly would have done no harm to the eggs. He frequently drove viciously at the Southern House Wrens which were carrying more material into the already stuffed gourd that I had placed for them in the lower part of the same tree. The male wren, because he made himself conspicuous by singing, was especially singled out for the flycatcher's persecution. Although such big flycatchers as the kingbirds (*Tyrannus*) have a reputation, largely undeserved, for quarrelsomeness, they do not as a rule molest in this fashion the small and harmless birds which come near their nests. While the female Piratic Flycatcher took her recesses, her mate sometimes rested on the end of an exposed twig of the orange tree, guarding the nest from close at hand.

At one nest the 3 eggs were laid on April 19, 21, and 23. The first hatched on May 8 and the other 2 before 9:15 a.m. on May 9, giving an incubation period of 16 days. At another nest the eggs were laid on April 18 and 20. The first hatched on May 5 and the second the following day, likewise giving an incubation period of 16 days.

THE NESTLINGS

The newly hatched Piratic Flycatcher is dark-skinned and blind, with short, rather dense, tawny down on head, shoulders, wings, back, rump, flanks, thighs, and legs. The interior of the mouth is bright yellow. These nestlings are fed by both parents, but they are brooded only by the female. In 1936, I watched the nest in the orange tree during the first two hours of June 11, when the two nestlings were, respectively, three and two days old. In this period the male brought food to them 12 times, the female brought food 8 or possibly 9 times. They gave the nestlings both insects and small red berries. The male was especially fond of bringing the latter. When he came with food and found his mate covering the nestlings, he did not pass it to her but waited, perching in front of the nest, until she flew out and made way for him. Usually she left promptly when she saw that he had arrived to feed the nestlings, but sometimes she kept him waiting for several minutes. Then he would show impatience by hovering momentarily before the doorway, repeating this at brief intervals, each time returning to his perch if the female continued to occupy the nest, until finally she darted forth and left the young exposed. Then he would deliver his billful to them and usually fly off at once. On one occasion, however, he lingered in the nest for about a minute, shielding if not brooding the nestlings. After his departure the female might return promptly to continue to warm the chicks if she had not been brooding long when her mate's arrival caused her to fly forth.

At a high and inaccessible nest I saw the parents carry in three dragonflies and some berries, all in ten minutes.

By their tenth day the nestlings in the orange tree had become very noisy, calling for food in weak, inarticulate voices and from time to time uttering a low and seemingly tearful imitation of the male's whistled *pee-e-e-e*. When 12 days old they were fairly

well clothed with feathers. Thenceforth with increasing age they rested more silently in the nest. They left on June 28, when 19 and 20 days of age, respectively. They now resembled their parents in plumage, the chief differences being the absence of streaks from the sulphur-yellow breast and belly, the buffy tinge on the broad superciliary lines, and the deeper buff of the light edgings of the wing feathers. On the day of leaving the nest they flew with ease. One was closely escorted by a parent, as it flew farther away from the nest, in the way I have seen parent birds of many kinds follow their newly emerged young in shielding flight. Already the fledglings just out of the nest uttered at short intervals a loud *pee-e-e-e*, much in the tone of the adults.

From a second nest, in which three young were reared, the fledglings departed when two were 18 and one was 19 days old. The lone survivor in a third nest left at the age of 18 or 19 days. The nestling period, then, varies from 18 to 20 days.

AFTER THE BREEDING SEASON

Although I have found young in the nest in mid-July, I am not sure that the Piratic Flycatcher rears more than one brood in a season. Even after the close of the breeding season, the adults continue to be noisy, incessantly whistling in the treetops as they have been doing since their arrival five or six months earlier. They also take considerable interest in the closed nests of other birds, even at so late a date that it is certain they will not use them in the present year. On August 1, I watched a Piratic Flycatcher, which had been calling loudly, enter an old, half-overturned, domed nest, of either the Gray-capped Flycatcher or the Vermilion-crowned Flycatcher, which hung 75 feet above the ground in contact with a large and populous wasps' nest. The flycatcher went in and out rapidly half a dozen times, then flew off to some trees beside the river. The nest was almost certainly empty.

In September the Piratic Flycatchers disappear from El General. My latest record of their presence here is October 4, 1936. Doubtless they withdraw to the south, but just how far the local birds go is unknown.

SUMMARY

The Piratic Flycatcher avoids heavy forest and inhabits areas with scattered tall trees, in which it usually forages and perches well above the ground. In Costa Rica it ranges from sea level up to about 5500 feet but it is rare at the higher altitudes. In southern Costa Rica, and probably throughout the more northerly portions of its great range, it is migratory. In El General, Costa Rica, it arrives between January 20 and February 8, breeds, and withdraws in September. The latest record of its presence is October 4.

The species is extremely noisy, from its first arrival calling incessantly from the treetops with a high-pitched, long-drawn whistle which it varies with a softer, somewhat trilled note. While sitting in the nest the female often utters a melodious rhythmic murmur.

The Piratic Flycatcher does not build a nest but uses a variety of closed structures wrested from other birds. These include cavities dug into wasps' nests by the Violaceous Trogon, the domed nests of flycatchers of the genus *Myiozetetes*, the pensile retort-shaped nests of *Tolmomyias*, the bulky globular nests of White-winged Becards, and the long swinging pouches of a number of oropendolas and American orioles.

While the chosen victim builds its nest, the pair of Piratic Flycatchers perch conspicuously and noisily nearby, watching the progress of the structure but only rarely actively molesting the builder. After the nest has been completed, and possibly after the eggs of the builder have been laid in it, the thieves become more actively aggressive. In one instance, in which the victims were a pair of Gray-capped Flycatchers, the Piratic

Flycatchers harassed them until they angrily chased their annoyers, who then took advantage of intervals when the nest was unguarded to slip in and throw out the Gray-caps' eggs. This caused the Gray-caps to abandon their nest and start another. Perhaps in other cases the Piratic Flycatchers win the nest merely by the persistent harrying of the builders, which might not yet have laid eggs. If some mishap befalls the stolen nest or its contents, the pirates may wrest another from the same victims. The Piratic Flycatchers threw out a foreign egg placed in their newly acquired nest. While his mate incubated, one male wantonly removed an egg from a neighboring nest of the Vermilion-crowned Flycatcher.

Usually the Piratic Flycatchers carry into their stolen nest a loose litter of dead leaves, chiefly whole small leaflets of compound leaves. One nest contained 60 such leaflets, but another had none. This loose lining may be useful in the unlined chambers of trogons, but it seems superfluous when the nest of some other flycatcher is occupied.

In El General, laying begins toward the end of March; and the earliest eggs of the Piratic Flycatcher are laid in wasps' nests taken from Violaceous Trogons. April is the chief month for laying, but late sets are deposited in June. The set consists of 2 or less often 3 eggs of a type found more frequently in the Cotingidae than in the Tyrannidae.

Incubation is carried on by the female alone. At two nests the morning and early afternoon were taken up by a number of short sessions and recesses, but both females ended their active day long before nightfall. One was in the nest continuously from 2:35 p.m. until darkness fell, whereas after 3:17 the other left only once for three minutes. During the active part of the day the sessions of the first averaged 34 minutes, her recesses 12.9 minutes, and she sat for 72.5 per cent of six hours. The second female's sessions averaged 26 minutes, her recesses 11.3 minutes, and she was in the nest for 69.7 per cent of eight hours.

At two nests the incubation period was 16 days.

The nestlings are brooded by the female and are fed by both parents. The young are nourished with berries and insects, including many dragonflies. At hatching they bear a short, rather dense, tawny down on much of their dorsal and ventral surfaces. They are sightless and the interior of the mouth is bright yellow. As they grow older the nestlings become noisy like their parents and often call in the nest. At the age of 12 days they are fairly well feathered. The nestling period, as determined at three nests, varies from 18 to 20 days. The young fly well as soon as they leave the nest.

Apparently a single brood is raised in El General. After the close of the breeding season the Piratic Flycatchers continue to take an interest in the deserted, closed nests of other birds, although they will not use them. In September, or at latest early October, they leave the region, but where they go is unknown.

PALTRY TYRANNISCUS

Tyranniscus vilissimus

Of minute size and exceedingly plain coloration, this flycatcher appeared so insignificant to the two English ornithologists who first described it that they disdainfully named it *vilissimus* which means paltry—an adjective that fails to convey the full weight of the contempt implied by the Latin superlative. Possibly the stuffed dry skin is a thing to be viewed with disdain, but the living bird has so much personality, is so distinct in its notes, mannerisms, and mode of constructing its nest, that those who know it intimately are not likely to view it scornfully, nor to confuse it with other tiny flycatchers whose plumage is also drab.

Well under four inches in length, the Paltry Tyranniscus or Tyrannulet is clad wholly in shades of olive and gray, with modest trimmings of pale yellow. The top of its head is grayish. The hindneck, back, rump and lesser wing-coverts are greenish olive. The tail is grayish brown, its feathers margined on the outer side with greenish olive. The dusky greater coverts, remiges and bend of the wing are prominently edged with yellow, but there are no conspicuous wing-bars. A not very pronounced whitish line begins at the base of the bill and arches over each eye. The chest and breast are pale gray with indistinct darker streaks on the former, while the belly is faintly yellowish. The short, straight, narrow, black bill is not at all typical of the flycatcher family but somewhat resembles that of the chickadees. Likewise the black legs, rather long and prominently displayed as the tiny bird perches, or seems rather to stand, on a twig, are not in the least characteristic of its family. These, coupled with the fairly long, narrow tail, which is often held tilted upward, give the bird an aspect quite distinct from that of nearly all other flycatchers and help greatly in distinguishing it from the other small, grayish or olive members of the huge family.

The species ranges from the extreme south of México to northern Venezuela. In Central America it is at home on both coasts, but it is most abundant in the more humid regions, as the Caribbean slope and the Pacific side of southern Costa Rica. It extends far upward into the highlands. In Costa Rica I found it abundant and breeding on the very wet northern slopes of the Cordillera Central at 5500 feet, and in Guatemala Salvin (1888:33) recorded it as high as 7000 feet. It frequents the edges and more open parts of the rain forests, second-growth woodlands, the shade trees of coffee plantations, orchards, and scattered trees in pastures and about houses. In short, it is very adaptable both as to climate and habitat. It is solitary and usually forages well above the ground.

FOOD

The favorite foods of this tyranniscus are the berries of mistletoes, of which many species parasitize the trees of tropical America. Neglected fruit trees, especially the avocado and the lemon, are often heavily infested with mistletoes, which attract the little flycatcher to the vicinity of houses. The tyranniscus devours the small green mistletoe berries in great numbers, often plucking them while poising on wing after a short dart up to the cluster. When it regurgitates the indigestible seeds, it is often obliged to free itself of them by wiping its bill against a twig, for they adhere too stubbornly to drop. Mistletoe berries appear also to form the principal food of the nestlings. Occasionally small berries of other kinds are eaten. These flycatchers do not dart conspicuously into the air to capture their insect prey but gather it while flitting amid the foliage.

VOICE

The most common call of the tyranniscus is a low, full, plaintive whistle, repeated over and over. A somewhat similar whistle is more rapidly reiterated, forming a soft, tremulous, sweetly appealing utterance. The dawn song, probably delivered only by the male, is the most shrinking, melancholy bird song I have ever heard. *Yer-de-dee, yer-de-dee* the tyranniscus whispers, over and over, then adds a faint, quavering *pe-pe-pe*. In the morning twilight, this refrain is continued for many minutes, impressing the imaginative human hearer as an unbroken flow of sadness. It is a true dawn song, but it is a most faint-hearted greeting to the newborn day. For several years a tyranniscus that lived in my dooryard delivered a very different sort of utterance, which I have not heard elsewhere. It was a little rattle or trill, sometimes wooden and sometimes metallic in tone, and it suggested a diminutive antbird, or a woodpecker no bigger than a piculet. This weak trill was often incorporated into the dawn song, which then consisted of three distinct phrases: the *yer-de-dee*, sad, low whistles several times repeated, then the little trill.



Fig. 76. Paltry Tyranniscus.

The tyranniscus has an extended nesting season, and in the valley of El General it delivers its dawn song over a longer period than any other flycatcher. Although in 1949 I first heard it on January 29, dawn singing usually begins in February and in some years I have not recorded it until early March. From that time on it continues with fair regularity until late July. It is not infrequently heard through August and September, and I have records of it in October and even late November. In the damp, chill dawn following a rainy night at the height of the wet season in September or October, the weak shrinking notes and sad quavering trills seem to emanate from a bird which is thoroughly melancholy and downcast. The very fact that he sings, however, proves that he has not been depressed by the steady rain; for, as Plato said, no bird sings when it is dejected.

NEST BUILDING

In 1949, when I heard the exceptionally early dawn song, I found a Paltry Tyranniscus beginning a nest in the same locality on January 21, and I have several other records of building at the end of this month. But more commonly the nest is started in February in El General, and the height of the breeding season is reached in March, before most flycatchers have begun to build.



Fig. 77. Nest of Paltry Tyranniscus in a dangling orchid plant in the valley of El General, June, 1937.

The nests of the tyranniscus vary greatly in situation, for the female displays much ingenuity in finding a place to attach her cozy little ovoid structure which has a doorway in the side. Most often she fastens it among the tufts of green moss which drape below a more or less horizontal limb of a moss-laden tree. At times lichens may also be used for attachment. Twenty-two nests, well over half of all that I have seen, have been fastened to mosses or lichens in this fashion. Many of these nests were in calabash trees (*Crescentia cujete*), which nearly always are heavily laden with mosses and larger epiphytes, such as ferns, orchids, and bromeliads. A less frequent site is in the midst of a curled dead leaf, especially the ample, palmate leaf of the cecropia, which often rolls up into an irregular ball as it dries. Such leaves are sometimes caught up in a tangle of vines instead of falling to the ground, and here the tyranniscus may find them and hide her

nest in their dark brown folds. Or a number of smaller dead leaves which drape beneath the blighted twig of a tree may be chosen for the nest's attachment. I have records of seven nests placed in or among curled dead leaves, mostly those of the cecropia.

Two nests were fastened to the roots or stems of orchid plants that grew on slender branches. One of these supporting orchids had nearly torn away from the tree and dangled precariously below it, suspended by a few of its many roots. In two successive years a tyranniscus built in an annatto bush (*Bixa orellana*) growing beside my house, each time placing her nest in the midst of a cluster of the brown, dry, spiny capsules

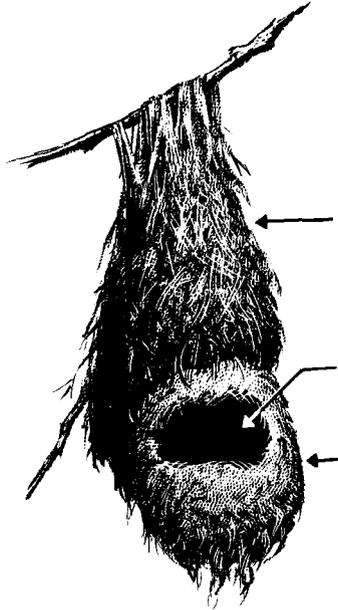


Fig. 78. Nest of Paltry Tyranniscus attached to bottom of nest of a Sulphury Flat-bill. Upper arrow marks flat-bill's nest. Lower arrows mark doorway and mossy side of the tyranniscus nest.

that had persisted on the bush from the preceding year, and whose long, soft, close-set bristles made attachment easy and provided good concealment. In two later years a tyranniscus fastened her nest to a dangling cable composed of the cord-like rhizomes of a polypody fern which hung for a distance of two yards below a branch of an epiphyte-laden tree in our garden and swung in every breeze. Another tyranniscus built in the top of a fallen dead tree at the edge of a ravine, placing her nest among close-set twigs partly covered with lichens and tufted here and there with moss. However situated, these nests are so inconspicuous that they are rarely found except by watching the movements of their builder.

Twice I have known a tyranniscus to make use of the hanging, retort-shaped nest, composed of blackish fibers, of the Sulphury Flat-bill. In the first instance, the mossy globe of the tyranniscus was attached to the rounded bottom of the flat-bill's chamber, where the spout-like entrance tube of the supporting nest projected downward on one side of the newer structure. The green color of the latter contrasted sharply with the black nest to which it clung (fig. 78). So far as I could learn, the tyranniscus never laid

in this nest, for it soon became partly detached. Haverschmidt (1954) described and figured a closed nest of the small flycatcher *Camptostoma obsoletum* similarly attached to the bottom of a nest of a flat-bill.

Years later, a tyranniscus occupied the inside of a flat-bill's nest. This structure, which hung at the end of a drooping bough of a guava tree in the pasture in front of our house, had been used by the flat-bill for raising a brood which had emerged in early June. Thereafter the female flat-bill continued to sleep in her nest until at least the end of July. On August 17, I found a single egg in this well-enclosed chamber, and two days later there were two eggs. Since the eggs were discovered by feeling with a finger rather than by sight, I at first naturally assumed that the flat-bill had laid again, although I had no other record of a second brood by this species. But as I approached several mornings later, a tyranniscus rather than a flat-bill seemed to fly out of this nest, and this led to further investigation. The bottom and lower parts of the sides of the rounded chamber had been lined with fine, light-colored plant down, such as the tyranniscus uses in its own nest but which the flat-bill never employs. The orifice at the bottom of the entrance spout was becoming closed as a result of the softening and collapse of the fibers of which it was made, after many months of almost daily wetting. There was a round hole in the front of the entrance tube, at the level of the chamber and well above the normal opening at the end of the tube. Although at first the tyranniscus entered through the bottom of the tube in the manner of the nest's builder, with the passage of time she made increasing use of the higher aperture, which was slowly enlarged, while the original opening became occluded. This new mode of going in and out was more like that which the tyranniscus follows at nests it has made itself. In this borrowed nest two young were successfully reared and left on September 24. This is the latest brood of which I have a record.

One nest of the tyranniscus was built well within the forest and another in an open part of the forest near its edge. The others were in pastures, plantations, dooryards, or clearings in the forest, but all were in regions where much woodland remained. In height these nests ranged from $6\frac{1}{2}$ to about 50 feet above the ground. Twenty-eight of the 37 nests of which I have recorded the height were between $6\frac{1}{2}$ and 15 feet up. Both of the nests in the forest were high, 40 and 50 feet, respectively, above the ground. The tyranniscus may build in either dead or living trees. One of the nests was found at Vara Blanca, Costa Rica, at an altitude of 5500 feet above sea level, the others in El General, between 2000 and 3000 feet.

I have watched with some care the construction of a number of nests and believe that they are built by the female alone. The sexes cannot be distinguished by appearance or call notes. However, I have never seen both birds working together, and the male when present perches nearby and watches rather than taking an active part in the task. At 2:30 on the afternoon of May 27, 1945, I had the good fortune to discover a tyranniscus just beginning a nest in an annatto tree beside my house, where I could watch from an open window without disturbing her. In about ten minutes she plucked nearly 14 tufts of moss from the boughs of neighboring trees and in as many journeys brought them to her chosen site in the midst of a cluster of dry fruits from the preceding year. Each tuft of moss was carefully pushed in among the soft bristles, which were between a quarter and a half inch in length and closely set over the surface of the capsules. Then over a period of about half an hour the little flycatcher brought billful after billful of cobweb and painstakingly attached it to the bristles surrounding the space where the nest would be. Then she brought four more billfuls of moss. At 4:20 p.m. she stopped for the day. The following morning she resumed building, bringing more moss, cobweb, and an occasional fiber or stiff, wiry rootlet. From 6:35 to 7:35 a.m. she brought material 11 times; in the following hour, 44 times. Two days later the nest was damaged,

probably by some other bird gathering material for its nest, and after that it was abandoned unfinished.

While the female tyranniscus built, her mate rested on a neighboring branch, or sometimes followed on her trips to gather material. From time to time he voiced his sad little whistle. Whenever I approached the nest, one or the other of the pair uttered a most mournful note of complaint.

Between 7:00 and 9:00 in the morning, another tyranniscus brought to her nest 51 billfuls of material, including tufts of moss, wefts of spiders' silk, short stiff brown fibers, and bits of dry flower stalks. She was careful and painstaking in arranging her materials, deliberately tucking or pulling them into the desired position. Her mate appeared from time to time in the vicinity of the nest, but I saw nothing to suggest that he helped with the building.

A third tyranniscus, building in a high, dangling orchid plant within the edge of the forest, pulled many tufts of green moss from trunks and branches which were well above the ground. Later, when her nest neared completion, she plucked the fine rootlets from epiphytic plants; these also grew well above the ground. Some of the strands of cobweb which she gathered were very long and floated out far beyond her as she held them in her bill. After she entered the nest they streamed beneath it and slowly shortened as she hauled them into the cavity. The male remained close by while she worked, sometimes following when she went off for more material; at other times he waited near the nest for her return. At intervals, while the female was busy inside, he fluttered momentarily before the doorway to look in at her, but as far as I could tell he never entered. When a Golden-masked Tanager happened to alight near the nest, the male tyranniscus valiantly strove to drive away the larger intruder. Also when an Olivaceous Woodhewer, creeping along the supporting branch, approached the nest, he likewise hurried it on its way. From time to time these flycatchers uttered their low, sad whistle, and occasionally their longer, quavering call was heard.

In the course of half an hour, another tyranniscus brought 25 billfuls of material to a nest which she was building in a curled cecropia leaf.

The nest of this species is a small, ovoid structure higher than wide, with a narrow, round, sideward-facing doorway on one side, usually near the top. In a typical structure the outer covering is of green moss, bound together by cobweb. Within this is a layer composed of the slender, dry rachises of a small, acacia-like leaf. Then follows a layer of fine, dark, fibrous materials, principally threadlike rootlets. Within this again, in the bottom, is a layer of fine, light-colored bast fibers, many small pieces of foliaceous lichen, and a few black fungal filaments. Finally, there is a thick, soft lining composed exclusively of the long, silky, tawny hairs of some plumose seed. Two nests which I analyzed showed only minor differences in composition; one lacked the rachises and had only four distinct structural layers, whereas the other had five. The nests vary from $3\frac{1}{2}$ to $4\frac{1}{2}$ inches in height by $2\frac{1}{4}$ to $2\frac{3}{4}$ inches in transverse diameter. The doorway is from $1\frac{1}{8}$ to $1\frac{3}{4}$ inches in diameter. For coziness and elaborate construction, this nest has few equals even in the flycatcher family, which excels all others in the Western Hemisphere in the variety and beauty of its nests.

Beebe, Hartley, and Howes (1917:221 and fig. 66) described and figured a nest of *Tyranniscus acer* found in the top of a mango tree in British Guiana. In form this nest resembled that of the Paltry Tyranniscus. Like the latter, it was covered with living green moss, within which were five consecutive layers of lining material. "The outer layer was of coarse fiber, the second of animal hair, the third of wild cotton, the fourth of animal hair, and the fifth, the inner, of wild cotton."

THE EGGS

My earliest date for laying in El General is February 7, 1947, but this is exceptionally early. Most of the nests of the tyranniscus are difficult to reach and ascertain their contents; but I have records of 13 which contained 2 eggs or nestlings, and I have never found more than this. In three instances, two days elapsed between the laying of the first and second eggs of a set, and in two instances the interval was three days. The female may or may not sleep in her nest at night between the laying of the first and second eggs. Three eggs, in each case the second in its set, were laid between 7:00 and 9:15 a.m.; one of these was laid between 8:05 and 8:55 a.m. Thus the eggs are deposited well after sunrise rather than about sunrise as in many birds.

The eggs are dull white, speckled or blotched with shades of cinnamon ranging from pale to rufous-cinnamon. On some eggs the markings are scattered rather uniformly over the whole surface, while on others they are concentrated in a wreath about the thicker end. Such variation is sometimes seen in a single set. The measurements of 7 eggs average 17.5 by 13.2 millimeters. Those showing the four extremes measured 18.7 by 13.1, 17.5 by 13.5, and 16.7 by 12.7 millimeters.

In 23 nests in the valley of El General, 2000 to 2500 feet above sea level, eggs were laid as follows: February, 3; March, 5; April, 4; May, 4; June, 3; July, 3; August, 1.

INCUBATION

The female tyranniscus incubates without help from the male. She sits in her snug nest facing outward, her head framed in the round or oval doorway. From time to time she regurgitates a mistletoe seed, letting it fall through the doorway to the ground. I watched one nest with eggs for five hours of the morning. The female's sessions in the nest, which were long in the early morning, became very much shorter as the sunny day grew warmer. Her three turns at incubation before 9:00 a.m. lasted 30 (incomplete), 75, and 46 minutes; the next four sessions were 31, 13, 8, and 22 minutes. Her recesses varied in length far less than her sessions, being 18, 14, 10, 13, 10, and 10 minutes. She was in the nest 72.2 per cent of the five hours. She sat far more constantly than most small flycatchers, apparently because the mistletoe berries she so freely ate were more quickly gathered and sustained her longer than the minute insects which form the mainstay of the diet of many other species.

Another tyranniscus, which I watched from 5:40 to 10:59 a.m. and from 12:59 to 2:10 p.m. in early June of 1948, sat somewhat less constantly. Her eight sessions ranged from 22 to 35 minutes and averaged 27.4 minutes. Her 9 recesses ranged from 10 to 24 minutes and averaged 13.3 minutes. She was in the nest for 67.3 per cent of the approximately six hours covered by my record. This tyranniscus showed no progressive shortening of her sessions as the sun rose higher. Her longest absence, lasting 24 minutes, was taken between 1:40 and 2:04 p.m. while a light shower fell. After her return to the nest, the rain became much harder and I went to shelter. As we grew more familiar with each other, this tyranniscus became almost fearless of me. On the day her eggs hatched she remained sitting while I climbed up the ladder and touched her bill. At neither nest did the male appear while I made the records just given, but on some of my briefer visits I found him close by.

At two nests the incubation period was 16 days, but at the unusually late nesting in the Sulphury Flat-bill's nest it was at least 17 days.

THE NESTLINGS

The newly hatched tyranniscus bears on its crown, back, and sides long gray down which is rather dense for a passerine bird but not enough to cover its pink skin. Its eyes

are tightly closed. Its bill, the interior of its mouth, its legs, and its toes are intensely yellow. These nestlings are fed by both parents but brooded only by the female. On May 19, 1940, I watched for two hours a nest containing two nestlings, one five and the other six days old. The female, whom I recognized by her brooding, brought food 8 times, the male 5 times; twice food was brought by a parent whose sex I could not determine, making 15 feedings for the two nestlings in two hours. The female brooded, for periods of 12, 12, 13, 11, and 6 minutes. When the male came with food and found her in the nest, he would cling before the doorway and pass the food to her; at other times she would fly out as he arrived, and he would cling at the entrance to feed the nestlings directly. But he did not stay to brood, which I took to be strong evidence that it was not his custom to do so. The only food that I could recognize in the bills of the parents as they approached the nest was mistletoe berries. They would come with a whole row of these lined up in their short, black bills. This seemed a hard, dry diet for nestlings so young.

Once, when the male tyranniscus arrived in the nest tree with food in his bill, he found a Bananaquit investigating a nest site there. The little honeycreeper sat in the center of a cluster of close-set, mossy branchlets and moved its head about, pulling at them with its bill here and there, seeming to test whether they were at the proper distance and of sufficient strength for the attachment of a nest. When the still smaller flycatcher found the intruder there, he promptly attacked, and the female tyranniscus, which had been quietly brooding, flew from the nest to help her mate. The Bananaquit, surprised by the sudden onslaught, quite by chance took its stand on top of the flycatchers' covered nest. This, of course, served only to increase their excitement. But here, in the midst of the twigs and the roots of the orchid plant that supported the nest, the honeycreeper was in a well-fortified position, and it valiantly defended itself with its sharp bill while both flycatchers attacked with spirit, uttering slight, mournful notes. Soon the Bananaquit found it prudent to retreat, and everything became quiet again at the nest.

In 1948, I gave considerable attention to a low nest hidden in a curled cecropia leaf caught up in a vine. This was the nest where the female permitted me to touch her bill. My first extended watch, after the two nestlings hatched on June 13, was on June 21, when they were 8 days old. From 7:00 to 9:00 a.m. they were fed 30 times, and I could not convince myself that more than one parent was attending them. Twice while one parent was clinging at the doorway to deliver food the other dropped down from the trees and clung momentarily to its back, then flew away without having given anything to the nestlings. On another occasion the second parent hovered in front of the nest just after the first had fed, but it did not bring anything. This bird seemed to be the male trying to learn what the nest contained. Three times the attendant swallowed droppings and once it carried one away in its bill. The young were not brooded in this period.

On June 24, the two nestlings, now 11 days old, were fed 21 times between 6:00 and 7:00 a.m. and again 21 times between 9:05 and 10:05 a.m. Both parents were now bringing food, but it was not possible to determine their respective shares. Again the nestlings were not brooded.

On June 27, from 10:00 to 11:00 a.m., the nestlings were fed 26 times by both parents. The food consisted of small insects, mistletoe berries, and at times a larger berry of another sort. The parents continued to deliver food, clinging woodpeckerlike in front of the doorway, even while I stood almost beneath the low nest. The nestlings, now two weeks old and well feathered, rested with their heads at the back or side of the chamber rather than in the doorway in the manner of the female while she incubated and brooded. They were active, preened much, and uttered low whistles as well as a faint version of

the dying trill, *yer-de-dee*, of the male's dawn song, repeating this over and over while they waited for food. They constantly regurgitated the sticky seeds of mistletoe, some of which they promptly swallowed again, although most adhered to their lower mandible or chin and sometimes two or three hung there together until a parent removed them after delivering food. The parents ate these seeds. Sometimes the parents swallowed the droppings and sometimes they carried them off in their bills. That same afternoon, between 2:00 and 3:00, the nestlings were drowsy, slept much with their heads at the back or side of the nest, and were fed only 11 times in the hour. The following night the 14-day-old youngsters were not brooded. I last watched them on June 29, when from 8:50 to 9:50 a.m. both parents together fed them 26 times. One nestling flapped its wings so vigorously at the front of the nest that it almost fell out. Although mostly silent, at times they voiced low whistles and very rarely the *yer-de-dee* of the dawn song. Both left the nest in the forenoon of July 1, after 18 days in the nest.

In July, 1938, I watched the care of an older nestling. This was in a nest attached between strands of moss which draped down on the sides of a slender, drooping bough of a tall tree standing in a clearing in the dripping rain forest near Vara Blanca, at an altitude of about 5500 feet above sea level. The nest was 50 feet above the ground and inaccessible to me, but with binoculars I could see a single feathered nestling through the doorway. The young bird repeated incessantly the low, soft, tremulous, sweetly appealing polysyllabic call of the parents, or at times it uttered low, deep whistles much resembling the call of the Dark Pewee which lived in the clearing. As it grew older it delivered the monosyllabic whistle far more frequently and the tremulous call less often. Both parents brought food at a rapid rate and clung sideways to the doorway, or even hovered on beating wings before it, while they passed the morsels to the nestling. As the young bird became stronger, it stretched far out through the doorway to take its meals from the parents, which now almost invariably poised on wing before the nest while they delivered the food. The nestling was constantly regurgitating viscid seeds, doubtless of mistletoes. Some of these fell from its mouth directly to the ground, but others lodged on the edge of the nest, or were wiped off there when they stuck pertinaciously to the young bird's bill. The parents carefully removed these adherent seeds from the nest while hovering in front of it. This nestling departed on July 22.

In all, four nestlings left when 18 days old, two when 19 days old, and one when 20 days old. The nestling that stayed in the nest for 20 days and one of those that remained for 19 days formed the very late brood reared in the Sulphury Flat-bill's nest, where the incubation period was also longer than usual. These youngsters took wing in the forenoon of September 24, 1954. So far as I can learn, neither the fledglings nor the female parent return to sleep in the covered nest, as the female flat-bill does. But once a female which had lost her eggs roosted in the empty nest for three nights, after which she abandoned it; this reveals a slight tendency to use the cozy nest as a dormitory. The great length of the breeding season, which in El General begins in late January and may extend well into September, would allow time for rearing several broods, but it is not known how many broods a single pair produces in a season. Many nests are prematurely lost, and some pairs must try again and again to raise a single brood.

SUMMARY

The Paltry Tyranniscus is a very small, solitary, arboreal bird which frequents the edge of the forest, open woodland, and scattered trees in humid regions, from sea level up to at least 5500 feet in Costa Rica.

It subsists largely on fruits of the Loranthaceae but eats other small berries and insects which it gleans from foliage.

Its notes are varied but mostly low. It has a slight, weak dawn song, sounding most plaintive to the human ear, which is delivered persistently in the morning twilight. In El General this is heard from February or March, or sometimes even late January, until late July, and occasionally into November.

In El General nest building sometimes begins in January but more often in February. The nest, a cozy ovoid chamber with a round doorway in the side, is most often placed amid tufts of moss hanging below a branch of a tree. The next most frequent site is in the midst of a curled dead leaf, especially of the cecropia tree, caught up on branches or vines. Other nests are attached to the roots, rhizomes or branches of hanging epiphytic plants, such as orchids and ferns. One nest was fastened to the rounded bottom of a pensile nest of the Sulphury Flat-bill. Another tyranniscus used the inside of such a nest, dispossessing the flat-bill which, after rearing her brood, was using it as a dormitory. She lined the chamber of the borrowed nest with soft materials before laying her eggs. Only the female builds, sometimes bringing material at the rate of about 50 times an hour.

Laying continues from February to July or, exceptionally, August, with its peak from March to May. The set regularly consists of 2 eggs, laid with an interval of two or three days.

The female alone incubates, sitting with her head in the doorway. She sits with a constancy unusual in so small a flycatcher. One female took sessions that ranged from 8 to 75 minutes and averaged 32.5 minutes. Her recesses varied from 10 to 18 minutes, with an average of 12.5 minutes, and she sat for 72.2 per cent of five hours. Another tyranniscus, somewhat less assiduous, was in her nest for 67.3 per cent of six hours.

At two nests the incubation period was 16 days but at an unusually late nest it was at least 17 days.

On hatching the nestlings bear fairly abundant gray down. They are brooded by the female and fed by both parents, at rates up to 13 times per hour per nestling. Their food consists of small insects and berries, particularly those of mistletoes (Loranthaceae). The seeds of these are regurgitated by the nestlings, sometimes only to be swallowed again. The young have difficulty in getting rid of these adhesive seeds, which the parents carefully remove from the nest or from the nestlings' bills and chins.

The nestling period was most often 18 days, sometimes 19, and in one instance 20 days. After the departure of the young, neither they nor the parents returned to sleep in the nest.

BLACK-FRONTED TODY-FLYCATCHER

Todirostrum cinereum

Scarcely any other of the scores of extremely small flycatchers which inhabit tropical America is so easy to recognize, and to know intimately, as the Black-fronted Tody-Flycatcher. And its acquaintance is well worth cultivating, for it has more character than most small birds, and indeed than many large ones. Its length is slightly over three and a half inches, more than half of which is taken up by its long, straight, flat bill and its narrow, strongly graduated, uptilted tail. Its boldly marked head seems far too big for so diminutive a body. A black area covers the forehead, more or less of the crown, the lores and sides of the head to just below the eyes. On the posterior part of the crown and behind the eyes, the black becomes paler, merging into slate-color on the nape, sides of the neck and more or less of the back. The rump, upper tail-coverts and lesser wing-coverts are olive-green. The longer wing feathers are largely black with conspicuous yellow or yellowish edgings and two pale yellow bars on the coverts of each wing. The black tail feathers are tipped with white, which is most prominent on the shorter outermost rectrices. The lower cheeks and all the under plumage are clear sulphur yellow. The iris is pale yellow except just above the pupil, where it is suffused with deep red in curious fashion. The bill is largely black and the legs are blackish. The sexes are alike in appearance.

In my first paper on this species (1930), I used Ridgway's name "Northern Tody-Flycatcher," but this is applicable only to the race *Todirostrum cinereum finitimum*, not to the species as a whole. In more recent papers I have referred incidentally to this bird as the "Black-crowned Tody-Flycatcher." But the name "Black-fronted Tody-Flycatcher" seems far more appropriate. The pale yellow eyes stand out prominently from this jet black frontal area and give the flycatcher its characteristic expression.

The species ranges from southern México to Perú, Brazil, and the Guianas. In Central America it is found over the lowlands of both coasts and upward in both Costa Rica and Guatemala to about 4500 feet above sea level, at which altitude I once found a nest in the central plateau of Costa Rica. An inhabitant of open country, it is present in shady plantations, parks and gardens, roadside trees, pastures with scattered trees and bushes, and wherever shrubs and trees stand in open spaces. It also forages along the margins of woodland and tree-bordered waterways. It strictly avoids the interior of all kinds of closed woodland, both primary and secondary, as likewise the low, dense thickets which are the home of the Slate-headed Tody-Flycatcher. It lives in pairs at all seasons.

Like so many of the smaller members of their family, the Black-fronted Tody-Flycatchers hunt in foliage and do not make long aerial sallies in pursuit of insects. Much of their small prey is captured as they make short darts from branch to branch of some sheltering tree or bush, sometimes near the ground but often in the tops of trees of medium size. Sometimes they fly against a leaf to pluck off an insect, and often they climb among the boughs, gathering small creatures from foliage and bark more in the manner of a warbler or vireo than of a flycatcher. They have a curious habit of hopping sideward along slender branches, wagging their narrow tail rapidly from side to side as they go. This lateral tail-wagging is very characteristic of them, and it is a mannerism which they share with no other flycatcher that I know; for others with mobile tails wave them up and down. Unlike the elanias, pipromorphas and many other members of the family, the tody-flycatchers seem not to vary their insect diet with berries.



Fig. 79. Black-fronted Tody-Flycatcher.

VOICE

Perhaps the most frequent utterance of the tody-flycatcher is a clear, resonant, little trill. As they forage within hearing of each other, the mated male and female keep in touch with this pleasant call. Usually they utter this call simultaneously, but sometimes it is given in sequence. This responsive calling is not neglected while the female incubates her eggs or broods her nestlings, and often from her swinging nest she trills in answer to her mate. Since these flycatchers remain in pairs throughout the year, they trill to each other at all seasons. Another common note is a low *chip* or *tick*, which unlike the somewhat similar calls of wood warblers is usually repeated in measured time: *tick tick tick tick tick*. As they pursue a rival or an enemy, they make a sharp, clicking sound by rapidly opening and closing their broad bills.

I had known the tody-flycatcher for many years before I became aware of its dawn song. Although the dawn songs of some of the larger flycatchers command attention by their loudness or their beauty, whereas those of a few of the smaller species are unforgettably quaint, that of the tody-flycatcher is so extremely simple that one may question whether it deserves this classification. But since this particular mode of vocal expression is rarely used except before sunrise and it is then, especially in the breeding season, continued for many minutes together, I believe that we must concede that it is a true dawn

song, comparable to the more elaborate twilight performances of the Tufted Flycatcher or the Streaked Flycatcher. The song consists merely of a slight, sharp *tic* repeated rapidly innumerable times, sometimes at the rate of 110 notes per minute. However, such rapid singing is rarely long continued. After a few minutes, the flycatcher seems to tire and delivers his notes in shorter sequences with longer pauses between them. As the light grows brighter, the performance becomes increasingly intermittent. Sometimes it is varied with an occasional clear trill, but on other mornings one hears only endless *tic*'s until the flycatcher finishes his recital and begins to search for food. I have heard this auroral singing only around my house in El General, where the tody-flycatchers perform in the tops of the shade trees in which they roost. Dawn singing begins in the last week of January or in some years not until late in February, and it may continue until the end of September. The performances are much longer at the height of the breeding season in April and May than they are earlier or later in the year. When singing most persistently, the flycatcher may continue for about a quarter of an hour, but the *tic*'s come less frequently toward the end of such a prolonged recital. Of the local flycatchers, only the Paltry Tyranniscus, which has a much longer breeding season, has a comparably long song period.

NEST BUILDING

In the Almirante Bay region of western Panamá I found a recently begun nest on February 25, 1929, and in the valley of El General, at about 2800 feet above sea level, I discovered a structure nearing completion on March 21, 1937, and another almost finished on March 28 of the same year. The tody-flycatcher's pensile nest is usually attached to a slender dead twig or to a living one with sparse foliage, where it hangs free of surrounding vegetation. It may be in dooryard shrubbery, a plantation or pasture, or a hedgerow. A slender, drooping vine projecting from the forest's edge is sometimes chosen for the nest's attachment. Many nests are built above watercourses or over the shores of wider bodies of water, and others are placed above paths or roadways. The nests are nearly always exposed and easy to detect. In the banana-growing districts of the lowlands I sometimes found the tody-flycatchers' nests attached to telephone wires beside railroads, where the birds must frequently have been disturbed by the thunderous passage of the long banana trains. The nests which I have seen ranged in height from 3 to 60 feet above the ground or water, but most nests were at intermediate heights. Although even in a single locality the tody-flycatchers choose a wide variety of situations for their nests, in different regions they show a preference for different sites. Those tody-flycatchers which nested on the grounds of the old research station on Farm 6 near Almirante often hung their nests in shrubbery or shade trees where they could be reached with or even without a ladder, and I found a number of nests situated very favorably for observation. In El General the birds more often select high sites, or if the nest is low it usually dangles above a stream or a steep bank. Thus few nests in this area have been accessible for examination of their contents.

Male and female cooperate closely in building the nest. I have observed building by many pairs in various parts of Central America and also that of one pair near San Ramón Chanchamayo in the eastern foothills of the Peruvian Andes. The latter pair were finishing their structure on October 22, 1940. The first step in construction consists in covering the point chosen for the nest's attachment with fine vegetable fibers, cobweb, and other strands. When wrapping fibers around the slender supporting twig, the agile little birds pivot their bodies completely around the twig. Soon they bring a variety of light and fluffy materials, such as the pappi of composites and other kinds of down, shreds of vegetable epidermis and papery bark, fine grass blades and perhaps also small withered flowers, forming a loose mass which grows downward like an icicle. Then, coming with a

new contribution, they alight on the twig at the top of the elongate, tapering tuft and creep head downward over its surface, often at the same time circling it, thus tracing a descending spiral as they attach what they have brought. They make no attempt to weave their fibers into the fabric in the manner of oropendolas and orioles but merely tangle them together until they have formed an irregular dangling mass considerably larger than themselves. Then, one at a time, they cling to the side of this continuous fluff of material and try to push into its midst. At first they succeed in forming only a slight depression in the side of the tuft, but little by little the cavity is expanded until it occupies the central part of the nest. New materials are then taken into the growing hollow and some are attached to the top and sides of the structure as well. When this central cavity, the future nest chamber, is first formed, the walls are thin, and they must be adequately lined with fibers and miscellaneous materials—a time-consuming process. Finally an inner lining of small feathers is applied to the top, sides and bottom of the chamber, until it is tapestried all around with feather-down.

These nests, especially those begun early in the year, are built with extreme slowness. The first tody-flycatcher's nest that I ever saw was found in a *Codiaeum* bush on the lawn of the research house at Almirante on February 25, 1929, when it was already well begun. Two days later the builders started to make the depression in the side of their growing

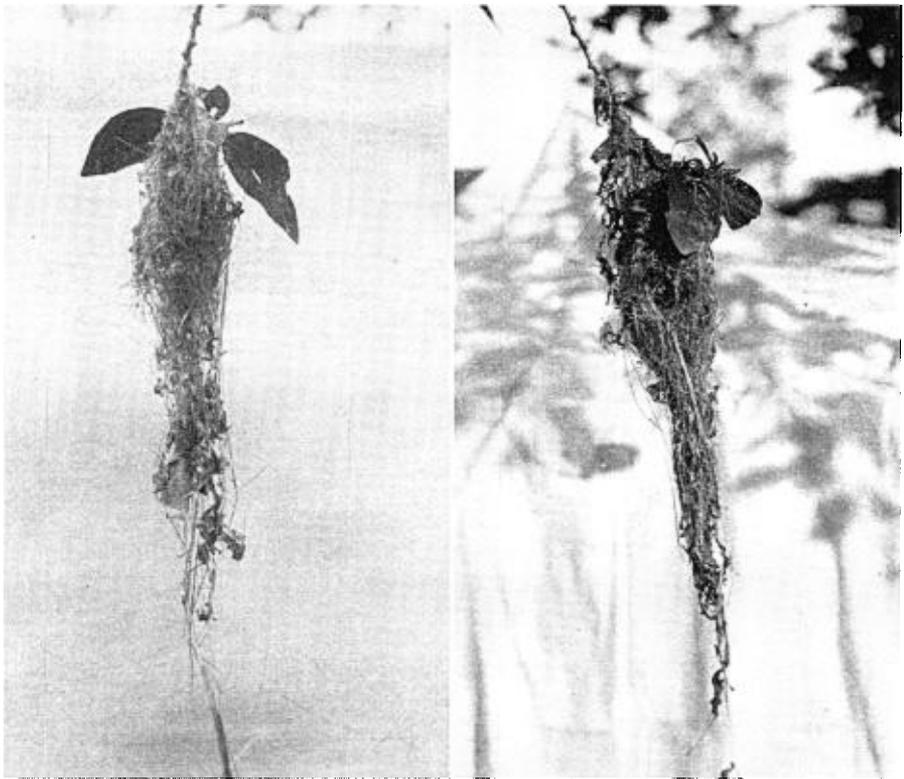


Fig. 80. Left. Nest of Black-fronted Tody-Flycatcher in an early stage of construction, still without a trace of the chamber which will be formed by spreading apart the materials of the hanging mass; near Almirante, Panamá, April 27, 1929.

Right. Same nest two days later, showing the depression in the side which will become the nest chamber.

accumulation. By March 26 they had lined their chamber with downy chicken feathers. I had never before seen a bird's nest such as this, and as I followed the almost imperceptible progress of the pair, eager to learn what would result from these protracted preparations, I at this point impatiently wrote in my record that their structure "was practically completed two or three weeks ago. It is now more than a month since these birds began to build, and if they ever intend to lay they are very slow about it." Two days later an egg did at last appear in the feather-lined chamber. A neighboring nest, begun about March 7, was still receiving additional material on April 10 and did not contain an egg until April 17. Near Tela, Honduras, a nest begun about April 24 showed scarcely any progress until May 7, and the central hollow did not begin to take shape until May 25. The builders then accelerated their pace and their work seemed to be finished by June 3. The first egg was laid three days later.

Although some pairs take five weeks or more to build their nest, others work much more rapidly. A nest begun in El General about April 19 seemed to be finished by May 4. Replacement nests are built even more quickly. If a nest is despoiled of its contents, or somehow injured before completion, the flycatchers usually make a new one close by, using the old structure as a source of materials. My first nest, which had taken at least a month to build, was pillaged on April 22, when the nestlings were five days old. By April 25 the parents had started a new nest in a hibiscus bush in a corner of the lawn, four and a half feet above the ground and 50 feet from the first. The flycatchers drew freely upon their earlier structure for materials, tearing at it until the remains fell to the ground, after which they appeared to neglect the additional stuff it might have supplied to them. By May 2, before it was finished, this second nest was somehow damaged. By May 7 these flycatchers had started a third nest, seven feet up on a slender dead twig of a cashew tree close beside the hibiscus bush. A week later they were lining this latest structure with fine fibers torn from the outermost decaying sheaths of banana trunks. By May 17 this third nest was lined with downy feathers and seemed to be finished. This nest was completed in only ten days instead of the month which was devoted to building the first nest in this series. The first egg was laid here on May 23. In my first ornithological paper (1930), I gave more details of the history of this pair of tody-flycatchers.

These flycatchers not only tear apart their own ill-fated nests to acquire materials for a later construction, they also help themselves to suitable ingredients in the unguarded nests of birds of other kinds. When building their first nest in the *Codiaeum* bush, the pair just mentioned found an unfinished nest of a Rieffer Hummingbird in the cashew tree where later they built their third structure. One morning I watched them make four devastating visits to the hummingbird's downy nest, each time tearing away billfuls to carry back to their own structure. They were most extravagant with the hummingbird's materials. With some of the down from this nest already in their bills, they would tear more and more from it, until they held an overflowing mouthful. Then they would shake their heads until most of their plunder fell away and fly back to their nest with the remnant. Once, when one of the flycatchers held a loose fluff of down, it wiped it against a branch until the projecting portion was detached, then the bird returned to its nest with only a small particle in its bill. The flycatchers seemed to prefer the hummingbird's soft fibers to the looser down and cobwebs which this half-finished nest contained. Among other materials which were transferred to the flycatchers' pensile nest was a puff of white down which this hummingbird had pilfered from another of her own kind, so that it was twice-stolen goods. More details of these strange transactions are to be found in my account of the Rieffer Hummingbird (1931).

The completed nest of the Black-fronted Tody-Flycatcher is an elongate, pensile structure attached at the upper end to a slender twig or similar support. Somewhere in

its length there is an enlargement which contains the rounded nest chamber. This is often at or somewhat above the middle of the nest's length. In many nests there is a long, tapering "tail" below it, representing the unexcavated portion of the originally continuous mass of entangled materials. In other nests the chamber is at the bottom, which is then rounded, and there is little or no tail hanging beneath it. Whether or not the nest is equipped with a tail appears to depend upon the length and strength of the fibers available to the building flycatchers; if the strands are longer than necessary, the excess por-



Fig. 81. A completed nest of the Black-fronted Tody-Flycatcher in a *Codiaeum* bush in a garden near Almirante, Panamá, March 14, 1929.

tion hangs below the chamber in the form of a useless appendage. A tailless nest is roughly pyriform, while one with a generous tail tends to be fusiform. The narrow round doorway in the chamber's side is often shielded by a visor-like projection from its upper edge. This appears to result from the flycatchers' habit of always alighting below the aperture and moving upward, when they enter with lining for the cavity, rather than placing it there by a special operation. A nest with a long tail may be a foot or even more in length, without including the nethermost slender, trailing filaments, whereas a pyriform, tailless structure may be only half as long. The chamber itself occupies only about a third of the length of the longer structures.

The materials of which this nest is composed are most varied and their nature depends largely upon what the immediate vicinity affords. Where available, the strong, flexible fibers from the disintegrating outermost sheaths of the false stems of bananas or related plants form the mainstay of the structure. Fibrous stuff of some sort is essential to the construction of the nest. In this is entangled a great variety of dry vegetable materials which give the walls bulk and a firm consistency. These include scraps of papery

bark, seed down of various sorts, fine grass blades, fragments of weeds, and small withered flowers. There is usually a liberal quantity of cobweb to bind these heterogeneous ingredients together. In the choice of the materials for lining the chamber the flycatchers reveal a similar latitude of taste. A nest built in a raintree (*Pithecolobium saman*) was lined with a great number of small withered flowers of this leguminous tree, horse hairs, fine vegetable fibers, bits of grass, a few feathers and miscellaneous odds and ends. When available, downy feathers may be used to cover the whole inner surface. Carriker (1910: 733) found nests in the Caribbean lowlands of Costa Rica "made almost entirely of green moss with some weed-fiber intermixed . . . the whole interior lined with fine weed-fibers and a few hairs." I have never seen nests of the tody-flycatcher in which moss was a conspicuous ingredient. These green nests were usually placed among vines hanging beside a large tree left in a pasture or on the edge of a banana plantation, and each resembled a bunch of moss hanging from a twig. In construction and site, to judge from the description, these green nests were rather similar to those of the Oleaginous Pipromorpha; and one might suspect some error in their identification, were not the eggs much smaller than those of the pipromorpha.

Although it has been justly remarked (see Richmond, 1893) that the tody-flycatcher's nest has an untidy, ragged appearance and often resembles a bunch of driftweed caught on a twig overhanging a stream, we should go far astray if we judged its comfort and utility by its external aspect alone. The nest of the tody-flycatcher is a cozy, well-made structure, with substantial walls capable of shedding a long, hard rain and of protecting the eggs and nestlings for the many days required for their development. Usually the nest hangs from a slender support which would seem to make it inaccessible to all but winged predators. The long, loose appendage which dangles uselessly below the bottom of the chamber of many of these nests reveals the indirect manner of their construction and serves at once to distinguish them from the somewhat similar but usually larger pensile pouches of orioles and oropendolas. These sharp-billed birds, like other weavers, work downward from the top, forming a hollow sleeve at whose lower edge fresh fibers are woven in, until finally the bottom is closed off in similar fashion. In them there is never a loose, irregular mass of entangled materials which must be spread apart to form the nest chamber, hence there is no unused remainder to hang below the finished structure. With a flat and relatively short bill which seems a poor instrument for weaving, the tody-flycatcher must resort to an indirect method of constructing a pensile nest. Yet as a safe receptacle for eggs and young, its finished product is scarcely inferior to that of the skillful weavers.

THE EGGS

My first nest at Almirante contained one egg on March 28 and two on March 30, 1929. Richmond (1893) also found eggs in late March in eastern Nicaragua. In the valley of El General, at an altitude of 2900 feet, I discovered a set of two eggs on April 6, 1937, and this is my earliest record for the region. From Panamá, Costa Rica, Honduras, and Guatemala I have records of nine nests with 3 eggs or nestlings and four nests with 2 eggs. Of these four sets of 2, two were the earliest of the season. One was laid to replace a brood which had been destroyed and one was laid by a pair which had already successfully reared a brood. Three, then, appears to be the usual number of eggs in a set for first layings, especially at the height of the breeding season. In addition to my own records, Carriker (1910) states that the eggs are usually 3 in number in Costa Rica, Richmond (1893) found sets of 2 and 3 in Nicaragua, and Jewel (Stone, 1918) discovered three sets of 2 eggs in the Canal Zone. An interval of 2 days seems always to separate the laying of successive eggs. At least, I have found this to be so in eight instances. In two nests with 3 eggs, the second was deposited 2 days after the first and the third 2 days after the sec-

ond. In two nests with 2 eggs, the second was laid 2 days after the first. In one nest with 3 eggs the second was laid 2 days after the first, and in another the third was laid 2 days after the second. The other intervals for these last two nests are unknown.

The eggs are usually immaculate white, but Cherrie (1916:221) found in the Orinoco region eggs (of *T. cinereum cinereum*) with a few tiny brownish spots on the larger end. One of these eggs was in a set of 3, of which 2 were unmarked; but in another set all 3 of the eggs were lightly marked. The dimensions of 3 eggs which I measured were 15.5 by 11.1, 16.3 by 11.5, and 16.3 by 11.9 millimeters. Carriker gives the measurements of Costa Rican eggs as 15 to 15.5 by 10.5 to 11.5 millimeters. All the foregoing dimensions refer to the Central American race, *T. cinereum finitimum*. The eggs of *T. c. cinereum* measured by Cherrie were slightly longer, the extremes being 17.25 by 11 and 15.75 by 11.5 millimeters.

In the valley of El General I made records of 23 nests, but since the majority of these hung out of reach, I do not know the months in which eggs were laid in them. Building, as we have seen, begins in this region early in March, for on March 21 I found a nest nearing completion. My latest record for building is June 8, 1937, when I found a recently begun nest. I do not know whether the latter nest was completed. At another late nest the parents were feeding nestlings on June 9, 1956, and I also found fledglings being fed by their parents on June 29, 1943. The height of the breeding season in El General is April and May, and I have no knowledge of occupied nests after mid-June. But in other parts of Central America breeding continues longer. At an altitude of 4500 feet near Cartago, Costa Rica, a pair was building on June 20, 1937, but I do not know whether they finished and laid in this nest. In the Caribbean lowlands of Honduras a pair began to lay for a second brood on June 12, 1930, and another pair was building on June 27, but its nest was somehow destroyed a few days later. A nestling left another nest on July 16. In the Caribbean lowlands of Guatemala, one female began to lay on June 8, 1932. In the Caribbean lowlands of Costa Rica, Carriker found eggs from April 11 to July 17. In the Canal Zone, Jewel (Stone, 1918) found a set of eggs on June 23 and Eisenmann (1952) watched a nest in which the eggs hatched on July 10. I have no knowledge of occupied nests anywhere in Central America later than July, although if the latest of the nests just referred to were successful, the young did not leave them until August.

INCUBATION

In four instances, the female began to sleep in her nest in the evening of the day on which she laid her first egg. Two of these females laid sets of three, and two laid sets of two eggs. By night as by day, the tody-flycatchers rest in their snug chambers with their heads at the doorway.

On the morning of July 21, 1932, I stuck a small improvised paintbrush in the entrance of a nest hanging in a pasture in the Motagua Valley of Guatemala. In passing through the doorway one member of the pair stained itself with vermilion paint, more heavily than I desired. I then removed the brush and set up my blind to watch, and 15 minutes later the marked individual returned to the eggs. Continued observation convinced me that this was the female. Her mate had the custom of flying beside or a little behind her whenever he happened to be near as she went back to her eggs. Male euphonias and chlorophonias frequently accompany their mates to their covered nests in the same spectacular fashion. After he had escorted his partner to her doorway, the male tody-flycatcher turned aside and went to the nearest convenient perch, where he uttered a low, rattling trill, such as I had not heard before. The female, which meanwhile had entered and turned around to bring her head to the opening, replied with a similar trill. Sometimes, too, when the female seemed to delay overlong in the open, the male flew

toward the doorway, as though about to enter himself, but he veered aside just in time to avoid striking the hanging nest. It appeared that he was trying to suggest to his mate that she had been absent long enough and should now return to her duty.

At the end of a session the female sometimes rested on a little bush directly in front of my blind to preen and stretch her wings. Then she flew farther off, while the male usually remained close to the nest, contenting himself with such provender as he could snatch up in its immediate vicinity. Once, when a female Black Variable Seedeater tried to pull some material from the nest to use in the construction of her own, the pair of flycatchers darted at her before she could accomplish her purpose. After they had driven away the diminutive finch, they celebrated their little victory with a paean of trills.

When I returned to continue my watch in the afternoon, I found that a slender, thorny twig of the *Buettneria aculeata* which supported the nest, blown by the wind, had stuck to the structure's side, with a leaf squarely blocking the doorway. I removed the obstruction before taking my place in the blind. I waited two hours for the female to return to her eggs, but in vain. Several times, indeed, she clung before the entrance with her head inside and remained in this position for a minute or two, but she would not go in. Toward the end of my watch in the morning she had done this with increasing frequency. I could not, of course, see what was happening inside the nest where her head was, but I surmised that she was troubled by some spots of vermilion paint which had rubbed from her feathers onto the white shells of her eggs. As a rule I tried to clean any eggs which had accidentally become stained in the course of marking one of the parents for identification, but I deemed it more prudent not to attempt to remove these delicate eggs from their well-enclosed chamber. Much of the time the male flycatcher lingered near the nest, calling to his mate with his measured *tick tick tick*, but she refused to obey his summons to return to her task of incubation.

Next morning I watched for another hour, hoping that incubation would be resumed. As on the preceding afternoon, the male remained close to the nest much of the time, calling incessantly. Sometimes the female trilled in reply from the distance, yet she would not return. I have rarely known a male bird of any kind to show such obvious concern over his mate's neglect of her eggs. But despite all his solicitude for the continuance of incubation, he did not once cover the eggs himself. One could hardly have desired a more convincing proof that it was not his custom to sit in the nest.

Seven years later, on May 12, 1939, I again attempted to study in detail the tody-flycatcher's mode of incubation. I had ceased to mark flycatchers with paint, for this seemed to increase the probability that their nesting would be a failure. I had long since convinced myself that in this family males do not normally incubate, and I now depended upon observing a change-over on the eggs to reveal any departure from the rule. Hence it did not matter that this nest hung beyond my reach above a meandering stream in El General. Twice in the course of an hour I saw the male follow his mate closely as she flew to her doorway at the end of a recess, much as the male had done at the earlier nest in Guatemala, but this Costa Rican tody-flycatcher flew behind rather than beside his partner. While sitting on her eggs the female often uttered a low, throaty trill or rattling sound which suggested contentment. Sometimes, too, while in the nest she called back and forth with her mate, both using the usual clear trill. She took one session of 9 minutes and one of 25 minutes, separated by a recess of 16 minutes. The first session was interrupted when a Yellow-green Vireo foraged closer to her nest than she approved and she sallied forth to drive the larger bird away with loud clacking of her bill. Then she trilled to her mate and was answered in the same fashion. At the end of the hour I was interrupted by an unexpected visitor and was unable to resume this study.

At two nests in Panamá the incubation period was 18 days and at one nest it was 17

days. Haverschmidt (1955*b*:329) found the incubation period of the Spotted Tody-Flycatcher to be 17 days at two nests.

THE YOUNG

In early May, 1929, I spent much time watching a nest in an avocado tree which held three recently hatched nestlings. The female brooded them through much of the day, while her mate hopped and flitted through the boughs of the tree, searching for insects. Frequently he called with his clear trill and she replied with a similar trill from within the nest. Whenever he captured an insect, he approached the nest by flitting from limb to limb in his usual unhurried manner, often stopping to wipe the object in his bill against the bark, perhaps in an attempt to break off the wings. Meanwhile his partner would stretch her head forward through the doorway and look around expectantly, as though impatient of his delay. Finally he would fly up and, clinging beneath the aperture as a woodpecker to the bark of a tree, pass his billful to his brooding mate. After his departure, peering through my fieldglasses into the dimly lighted interior of the nest, I could barely see her bend down her head and place the insect into the mouth of one of the nestlings which she covered. At intervals she left the nest for short periods to seek food for herself, and on returning she brought a moth or some other insect, which she passed to a nestling while she clung in front of the doorway, before she entered to resume brooding. Before the nestlings were a week old they began to disappear from their hanging nest, but the last survivor was still brooded much on the sixth or seventh day of its short life, when its pinfeathers were growing long. Then it, too, shared the mysterious fate of its nest mates.

At Almirante I found four accessible nests close to the house before eggs were laid in them, and I tried to determine the length of the incubation and nestling periods in these nests. They contained in all 11 eggs, of which all hatched except one set of 3 eggs, which disappeared after about two weeks of incubation. But not one of the eight nestlings in the other three nests survived until it was feathered. In later years in other localities, I made three or four additional attempts to learn the nestling period, but these, also, were unsuccessful. The low, accessible nests of the Black-fronted Tody-Flycatcher, unlike those of the Slate-headed Tody-Flycatcher hanging in an open space amid dense thickets, seem rarely to escape predation before the young can fly. But at Almirante I discovered a somewhat higher nest which, although close to my residence, escaped my notice until the young were well feathered. The female brooded them through the fifth night before they left, but not on their last four nights in the nest. When they flew forth on May 30 they resembled their parents in plumage, except for the shortness of their tails; but their eyes were brown instead of yellow and red. While still in the nest they uttered a trill much like that of their parents, although it was weaker and less melodious, and they did this even at night when I looked at them with a flashlight, after the female had ceased to brood. The parents were zealous in defending the young birds, driving away a pair of Palm Tanagers and some Scarlet-rumped Black Tanagers with a loud clacking of their bills when these much larger but harmless birds flew into the tree where the newly emerged fledgling tody-flycatchers rested.

I have only once known the tody-flycatcher to attempt a second brood. In a nest near Tela, Honduras, from which three young flew on May 10, I found the first egg of a new set on June 12, and next day the second egg was present. Inexplicably, these two eggs were deserted a few days later. If some mishap befalls the eggs or nestlings, the parents never seem to lay again in the despoiled nest, even if it is uninjured. Usually, unless the season is far advanced, they begin within a few days to build another nest. Often the new nest is only a short distance from the old one, and they often tear materials from the old nest and use them for their new structure. A female which lost five-day-old nestlings slept

a single night in her despoiled nest, then she abandoned it. Three days after that, I noticed that she and her mate had started a new nest 50 feet from the first. Another pair, which lost week-old nestlings, had a new nest well begun, in another part of the same tree, only five days later. As already stated, these replacement nests are built much more rapidly than first nests.

ROOSTING

In the evening of June 12, 1945, as I walked through the shady pasture in front of our house on my return from a visit to a nest of the Slate-headed Tody-Flycatcher, I heard the serious little trills of the Black-fronted Tody-Flycatcher floating down from the trees above me. Peering upward, I saw three of these flycatchers perching in a row on a slender, horizontal twig at the top of a guava tree, about 20 feet above the ground. They were pressed closely together and all faced the same way. One flew off, but the other two remained motionless in the treetop. I sat on a big rock in the pasture to watch them. After about five minutes the third bird returned, seemed to feed one of the others, then resumed its former position beside them. Their breasts, forming a continuous expanse of yellow, were turned toward me, and a gap in the foliage of the tree left the sky as the background against which I viewed their diminutive bodies. The light was now growing dim, and as the twilight deepened one by one they turned back their heads and buried them in the plumage of their shoulders, leaving only their narrow tails to break the roundness of their forms. They had chosen a very exposed situation for their roost.

At the end of the night, I found these three birds sleeping in the same position where I had left them in the evening. They continued to slumber with their heads concealed while many neighboring birds became active and sang. At last the one on the left of the row awoke and raised its head, then the one on the right did the same. But the flycatcher in the center continued to sleep until one of its neighbors stretched out its wings and, doubtless inadvertently, nudged it. Then all three flew off among the guava trees and began to trill.

Two evenings later the three flycatchers went to roost on the same twig, but this time two faced in one direction while one was turned in the opposite direction. As on the earlier occasion, one of the end birds went to rest considerably later than the other two. A fourth tody-flycatcher likewise continued to flit about in the vicinity after the first two had settled down on their roost, then it went to rest in some spot where I could not find it. This appeared to be a family consisting of parents and their full-grown young. If I was correct in supposing that one of the three which slept in the row had fed another on the evening when I first found them, then one of the parents, doubtless the female, roosted in contact with her two fledglings. But I may have been in error, as I did not actually see food pass from bill to bill. Sometimes also a young bird, accustomed to being fed, expects food from one of its contemporaries which flies up to join it, and it makes a movement to receive a morsel. In this case all three of the birds in the row may have been young, and this would agree with my observations on some of the larger flycatchers, including the Tropical Kingbird and the Vermilion-crown, fledglings of which sleep pressed together in a row while their parents roost apart from them. But since I failed to detect more than four individuals in this family, I believe it more probable that the tody-flycatcher departs from the custom of the bigger flycatchers and that the female parent roosted close beside her offspring, while the male parent slept alone in the vicinity. Later observations showed me that the members of a pair of tody-flycatchers often if not always roost on separate perches, in the manner of adults of other species of flycatchers.

For at least a month after I first found them, or until July 13, the three tody-flycatchers continued to roost on most nights in the same guava tree. Occasionally I failed to find them there, although I heard them nearby; one evening only two went to rest on the

usual perch. A few evenings later, however, I found that the third member of the trio had rejoined the other two.

After July 13 I have no further record of these birds until September 15. In the evening of this date a clicking of bills drew my attention to some tody-flycatchers in a burio tree (*Heliocarpus*) close to the house, beneath which I was passing. Two or three individuals were chasing each other through the branches, clacking their bills angrily, while another rested on a slender, nearly leafless twig about 20 feet above the ground. Presently one of the birds that had been engaged in the quarrel alighted on the twig where the lone individual rested. The latter then sidled along the branch and snuggled up close to the newcomer. But when a third bird tried to join the other two, one of these left its perch to renew the chase. Soon two birds were resting side by side once more. When the third again attempted to keep them company, the flycatcher that became middle bird flew out and then the two end ones pecked mildly at each other. Presently two were again perching affectionately side by side, and when the third joined them the one on the other side simply took leave. This happened several times.

It was obvious that the third flycatcher was considered to be one too many, but it was difficult to decide whether this superfluous individual was always the same. One individual remained more constantly on the perch, as though waiting for another to join it, but I am not sure that this bird was quite steadfast in its affections. Once when another bird flew up, it sidled toward that bird, but the third bird arrived a moment later and the central figure at once began to move the other way and snuggled beside the latest comer. It was all very confusing to watch because I could recognize neither individuals nor sexes; yet it was quite clear that all three did not dwell in perfect amity. But as it grew dark the trio gathered once more on the same slender twig, where, pressed closely side by side, they all fell asleep. It is probable that these were the same three flycatchers which from June 12 to July 13 had roosted in the guava tree less than 100 yards away.

The following evening, September 16, a single flycatcher arrived in the burio tree at about half-past five. It trilled loudly, then went to the twig where the trio had roosted, but as its companions did not promptly arrive, it flitted away again. Soon three more tody-flycatchers flew into the tree, and there was chasing and snapping of bills as on the preceding evening. On two occasions, three of them settled in a compact row on the roosting twig, but each time one or two promptly left. Finally two of the flycatchers disappeared in the foliage, leaving two to roost together on the same twig where they had slept on the preceding night. As these birds came into contact on their perch, they uttered very low trills that spoke of contentment. They pressed together as closely as they could, and while there still remained enough light to see them clearly, they turned back their heads and went to sleep. The twig on which they rested had lost the few leaves that it held twenty-four hours earlier and was now quite bare. The slumbering flycatchers were plainly visible from the ground and exposed on the sides, but they were canopied above by the crown of the burio tree.

The next evening, September 17, the flycatchers had difficulty in deciding where to roost, but after trying various positions in the burio tree they finally settled on the naked twig where they had slept on the preceding nights. Once the third flycatcher came and alighted close beside the other two, but in a moment it spontaneously flew away, with the result that this evening there was scarcely any chasing and snapping of bills. But at one time even the two that seemed friendly had a disagreement, pecking at each other while perching side by side, then immediately separating. Yet in less than a minute they forgot their quarrel and settled down on another twig to sleep touching each other.

In the evening of September 24 the third flycatcher, after trying a number of perches and finding none to satisfy it, joined the other two, which were already roosting in contact

with each other, and was received without protest. This was the last time that I found all three sleeping in a cluster. On subsequent evenings the third bird sometimes alighted beside the other two only to go off again at once, quite spontaneously, as far as I could see. Hence there was now far less chasing than when the trio first began to break up. In the evening of September 30 the third flycatcher, after being driven off from the other two, attempted to join the fourth, which rested solitarily high in the crown of a neighboring burío tree. But it was rebuffed with clacking bill, and finally it settled down alone, about a yard from the other. On this night all four of the tody-flycatchers roosted on petioles of the broad leaves of the burío; two birds sat side by side on a petiole of one tree and the other two roosted a few feet apart on petioles of a closely adjoining tree. At the time, rain was falling steadily. It seemed that one of the original trio was willing to sleep with either of the other two, but these two were antagonistic to each other. Thus in the evening of October 4, after two individuals had settled on different petioles, the third arrived and joined one of them, and I heard the low, contented trill as they came together. But soon the latest arrival left this companion and went directly to the other bird, beside which it snuggled for the night. The flycatcher which roosted singly often took longer to settle down than those that slept together, and it continued to try various perches after the others had composed themselves for the night.

As early as September 28, two of the flycatchers, after the voluntary withdrawal of the third, snapped their bills at each other, then perched side by side on a petiole, but they at once separated and rested on neighboring petioles, where they fell asleep a few inches apart. On October 8, 10, and 11, I found only one bird in the burío tree. In the evening of October 12 two again went to rest side by side on a petiole, facing in opposite directions, while the other two apparently roosted in other parts of the tree, as I saw them disappear into the leafage above me. After this, the rain which fell almost every afternoon and evening interfered with observations, and I did not again in that year see two tody-flycatchers roost in contact with each other. But on a few evenings in November and December I watched a lone bird go silently to rest in the burío trees about the house.

On October 22 of the following year, 1946, I again found two tody-flycatchers roosting side by side in the burío tree by the house. These might have been a mated pair but more probably were two young birds hatched earlier that same year, or a young one and the female parent. For some weeks they continued to sleep in the same manner, but on December 6 I found them roosting an inch or two apart rather than in contact, and on December 9 only one was present. In the evening of December 11 the second arrived and alighted close beside the first, but then one flew away and left the other alone for the night. On the fifteenth, while a slow rain fell, one came early to its usual roost on a slender twig and presently the second flew up beside it. But they pointed their bills at each other and appeared not to be friendly. They moved around each other, then one by one they flew away. After a few minutes they returned, perched close together and displayed mild antagonism as before. Suddenly one again flew away, leaving the other to pass the night alone. But on December 21 and 22 the two once more went to rest side by side on their usual twig. Their disagreement, whatever its cause, seemed to have been amicably composed.

This was the last time that I found two or more tody-flycatchers sleeping in contact. Not long ago I tried to follow a family of young birds to their roosting place, but they vanished in the crown of a burío tree that stood on a precipice which made them difficult to observe. I have repeatedly found grown individuals sleeping singly. On April 17, 1947, I watched a pair go to roost in the guava tree behind our house in which they were building a nest. After sunset one of them settled down on a rather exposed twig in

the crown of the tree and its mate twice darted at it, causing it to move. It seemed that the mate considered this situation too exposed and dangerous and took this means of forcing its partner to choose a more sheltered perch, or perhaps it had other motives which I could not fathom. After some moving around, the two settled for the night on opposite sides of the spreading crown of the guava tree, where they were sheltered above by clustering foliage but were wholly exposed below. On the following night they again roosted on opposite sides of the tree, but they did not sleep on the same perches as on the first night.

For about three months, from April 17, 1956, to at least July 7, a lone tody-flycatcher roosted in the top of a guava tree close beside our house. I believe that this was the male of the pair that nested in this interval in a neighboring tree. It is significant that he seemed to be always alone. During part of this period his mate slept with her eggs and nestlings, although the inaccessibility of the nest made it difficult to learn just when she was incubating the eggs and brooding the young. She probably did not sleep in the nest throughout these three months, but certainly she did not roost in contact with her mate.

To summarize these and other observations on roosting which need not be reported in detail: The Black-fronted Tody-Flycatchers roost on a slender twig or the petiole of a large leaf, in the crown of a small or medium-sized tree growing in a clearing, commonly from about 20 to 40 feet above the ground. Usually the birds are well screened by a canopy of foliage above them but often they are readily visible from below. Sometimes they select a perch which is rather exposed to the sky as well as to the ground. The situations which they choose for roosting suggest that they are in no danger of attack from below but must be screened from enemies that fly above the treetops, such as owls; although even from these there seems to be no great danger, or they would sleep more consistently beneath a protecting canopy. The members of a mated pair often and probably always roost separately, and they have been seen to do this even while working together at the construction of their nest. Juvenal birds sleep pressed close together in a row on a perch of the usual type, and apparently the female parent is one of the group. However, these clusters of sleeping birds were found only after the young were so well grown that they could no longer be distinguished from their parents in the twilight. Young that were probably hatched in April or May roosted in contact until the following September. Toward the end of this month they began to display antagonism as they settled down to rest in the evening. However, two individuals were repeatedly found sleeping in contact in October, and occasionally in November and December, after which, until next year's broods were fledged, tody-flycatchers were always found roosting singly, although frequently two individuals were not far apart.

SUMMARY

The Black-fronted Tody-Flycatcher inhabits clearings with scattered trees and bushes, the edges of woodland and the tree-lined shores of streams. In Central America it breeds from the lowlands of both coasts up to about 4500 feet above sea level. It lives in pairs throughout the year.

It subsists upon insects which it catches as it hops and flits through the boughs of trees and bushes, and many are plucked directly from foliage and bark. It has a curious habit of sliding sideward along slender branches, and frequently it wags its slender, up-tilted tail rapidly from side to side—a mannerism rare among flycatchers.

Its most characteristic note is a clear, resonant trill, which both members of a mated pair use frequently at all seasons to keep in contact with each other. It also utters a measured *tick tick tick tick*. Enemies are chased with a loud clacking of the broad bill.

At dawn the tody-flycatcher delivers a sort of song which consists of a slight, sharp *tic* repeated over and over at varying rates, sometimes as often as 110 times per minute, and for many minutes together. This monotonous ticking may or may not be interspersed with trills. In El General the dawn song is heard from late January until the end of September, but it is delivered at greatest length in April and May.

Building began in late February in the Caribbean lowlands of Panamá and in early March in the valley of El General, 2000 to 3000 feet above sea level. The nest is a pensile structure attached at its upper extremity to some slender twig or projecting vine, at heights varying from about 3 to 60 feet above the ground or the surface of a stream. Usually it swings free in a clear space, sometimes above a roadway or watercourse. It varies from about seven inches to more than a foot in length, and it contains a rounded chamber which is entered through a small circular aperture in the side. It is built by both sexes, not by weaving but by felting fibers and other materials together and then opening in the midst of the mass a cavity which is lined with vegetable fibers, bits of grass, small withered flowers, and finally downy feathers. The construction of nests begun early in the season may require as long as five or six weeks, but replacement nests are sometimes built in about ten days.

The set consists of 3 or less often 2 eggs which are white and usually immaculate, although exceptionally they are lightly marked with fine brownish spots. In sets of 2 or 3, an interval of two days separates the laying of successive eggs.

Only the female incubates, and usually she begins to sleep in the nest in the evening of the day on which she lays her first egg. As she flies up to her doorway on her return from a recess, her mate escorts her by flying close beside or behind her, then veering aside just in time to avoid striking the nest. When a marked female deserted her eggs, her mate lingered near the nest and often flew toward the doorway as though to suggest that she enter, but he did not himself cover the eggs.

At two nests the incubation period was 18 days and at one nest it was 17 days.

The nestlings are fed by both parents but are brooded only by the female. Because of the heavy predation on nestlings in accessible nests, the nestling period was not determined. Fledglings resemble their parents in plumage but have brown rather than yellow and red eyes. Even before they leave the nest they trill much as their parents do.

Tody-flycatchers roost on slender twigs or long petioles in the crowns of small or middle-sized trees standing in clearings, usually from 20 to 40 feet above the ground. Often they are wholly exposed to view from below but usually they are screened by the canopy of foliage above them, although sometimes even this is scanty or lacking. The members of a mated pair as a rule roost separately although often they are not far apart, and a male and female, engaged in building, roosted on opposite sides of the nest tree. In June three fully grown flycatchers which slept in a compact row on a roost of the usual sort were apparently two fledglings with the female parent. The male parent slept in a neighboring tree. This trio continued to roost in contact with each other until late September, when antagonism grew between some of them and one slept apart from the other two. Two individuals slept side by side into October. From January until the young are on the wing in June, tody-flycatchers were always found roosting singly.

SLATE-HEADED TODY-FLYCATCHER

Todirostrum sylvia

It requires much patience to become familiar with a bird so small and retiring as the Slate-headed Tody-Flycatcher; yet once the bird watcher comes to know it well, he finds that, like most members of the flycatcher family, it has distinct individuality. In length this bird measures only about three and a half inches from the tip of its broad, flat, relatively long, black bill to the end of its short, narrow, blackish tail. In both sexes the top of the head is a blackish slate-color and the hindneck is slate-gray; there is a whitish line that begins at the base of the bill and arches, becoming narrower, above each eye. The back and rump are bright olive-green. The black wing-coverts display two conspicuous yellowish bars, and the dusky remiges have yellowish margins. The under plumage is pale gray, becoming whitish on the throat and very pale yellow on the sides, abdomen, and under tail-coverts.

The species ranges from southern México to northern Brazil. In Central America it is found in the less arid parts of both coasts, but the paucity of records from many regions within its range suggests that it is neither abundant nor uniformly distributed. It is fairly common on the Pacific side of Costa Rica, especially around the Gulf of Nicoya and thence southward; in the cultivated portions of the Térraba Valley it is abundant. There it is found upward to about 3000 feet above sea level. It is an inhabitant of the dense thickets which after two or three years cover over resting grain fields or uncleaned pastures. In these places the diminutive bird dwells in a tangle of bushes, creepers and young trees so close-set that a man can scarcely move without cutting his way with a machete. When the trees grow high, forming a closed canopy that excludes most of the direct sunlight from the lower vegetation, which then becomes more open, the Slate-headed Tody-Flycatcher goes in search of newer thickets. In the Orinoco region, Cherrie (1916:221) found this species in the undergrowth of heavy forest, a habitat where I have never met it in Central America.

The Slate-headed Tody-Flycatcher subsists on small insects which it captures while hopping and flitting from twig to twig in the dense thickets. It rarely covers more than a few feet between perches and never darts conspicuously high into the open air, like so many of the flycatchers. A bird so small and modestly attired, inhabiting vegetation so difficult for a man to penetrate, is heard more readily than seen. Fortunately, the notes of this flycatcher are as distinctive as they are quaint. As it moves restlessly through the densest portions of its sheltering thickets, it constantly repeats low, somnolent, confidential notes: a little, throaty *tic* or *tuc* or *too*, a longer *tuc-too*, or a slightly trilled *tu-u-u*. The skin of the small bird's light throat throbs outward as it utters its brief *tuc*. These notes are likely to be noticed only by one with ears well attuned to the voices of birds; yet they are a characteristic sound of the second-growth thickets where the Slate-headed Tody-Flycatcher dwells. By paying attention to the answering calls of male and female, I have become convinced that the pairs remain mated throughout the year—a fact which it would be most difficult to prove by visual evidence alone.

NEST BUILDING

In the upper Térraba Valley, between 2000 and 3000 feet above sea level, the Slate-headed Tody-Flycatchers begin their nests early in April. The pensile structure is attached to the end of a slender dangling vine or to a thin, drooping leafy branchlet, so that

the nest swings free in a little clear space in the thicket. Usually there is a heavy canopy of foliage over it. Nine nests that I found were suspended from 6 to 10 feet above the ground. Cherrie found a nest hanging only 30 inches above the ground amid dense undergrowth in a belt of heavy timber along the bank of the Orinoco River near Caicara; in the same locality he saw another nest swinging only a yard above a pool surrounded by bushes, in the midst of thick forest.

I have watched the construction of two nests, both of which were built by male and



Fig. 82. Slate-headed Tody-Flycatcher.

female together. The first was found when barely started, on April 6, 1937. It was attached to the end of a long, slender branch, drooping into a clear space beneath a tall, dense thicket, in the same spot where I had discovered a nest of this flycatcher the preceding year. On this date there was merely a thin, pensile tuft of light-colored fibrous material, with no cavity in its midst to indicate the position of the future nest chamber. For several days the tuft increased scarcely at all in size, and I began to fear that the work had been abandoned. But by the afternoon of April 12 it had grown greatly, and the fibers had been spread apart to form the chamber in the center of the mass. I then set up my blind, and the following morning watched the birds at work. Although male and female were quite alike in appearance, I was sure that both built, because four times, in the course of two and one-half hours, they came together with material in their bills. Each placed in the nest what it had brought. They brought fine fibers or papery bits of vegetable tissue, evidently from decaying leaves or stems, and took them into the cham-

ber to line the walls. Several times, too, one of them brought a longer and heavier fiber, alighted upon the attenuated upper end of the nest and took a turn or two around the supporting twig, thereby wrapping the new strand around the older ones and attaching the whole mass more firmly to its anchorage.

These flycatchers did not work very energetically. After adding a few billfuls of material to their nest, they would wander off through the thicket together, uttering their low *tuc*'s and *too*'s, until their voices were extinguished by the distance. Then, after an interval, the same notes would become audible again, grow louder, and soon the pair would appear together to advance their work a trifle further. This nest appeared to be finished by April 17, 11 days after I found it in the earliest stages of construction, but the first egg was not laid in it until April 26.

Eight years later, I watched another pair of Slate-headed Tody-Flycatchers build their nest. When found, the pensile mass of fibrous material had nearly reached its final size and had been spread apart to leave a hollow in its center for the future nest chamber. But the walls surrounding this were still thin, and the birds' efforts were directed chiefly toward making them thicker by lining the interior. From the blind I watched for two and one-half hours, during which male and female together brought material 104 times. Although each went its own way independently of its mate, flying up to the nest as soon as it found a suitable contribution without waiting for the other, on 21 occasions both members of the pair brought material at the same time, leaving no doubt that both took substantial parts in the work. Their material consisted of plant fibers in pieces ranging from short shreds to long strands of decaying bast fibers twice the birds' own length, slender strips from monocotyledonous leaves, and small fragments of grass inflorescence. A few of the longer strands of material were attached at the top of the nest, where they were given one, two, or even three turns around the supporting twiglet, the bird pivoting around it with the whole body as it placed them. But the great bulk of the material, including pieces far longer than the flycatchers, was taken into the chamber. Almost always, each builder took in and arranged its own contribution, not entering until after its partner had emerged. Sometimes while one was within, the other would fly to the doorway and deliver what it had brought.

When a Slaty Castle-builder passed beneath the nest, one of the flycatchers darted at it, uttering slight angry notes, and readily drove it off. But when a tiny male Olivaceous Piculet came by, pausing here and there to peck at slender dead twigs near the ground, the flycatchers had to deal with a more refractory trespasser. Again and again they darted at the diminutive woodpecker, uttering angry sounds. The piculet, however, merely clung upright to an erect twig and glared defiantly up at the flycatchers, then continued to examine the dead wood at his leisure, and moved off at his own good time. This nest appeared to be finished by May 16, but the first egg was not laid until six days later.

The completed nest closely resembles that of the Black-fronted Tody-Flycatcher. It is a roughly pyriform structure with a little round entrance in the side, protected by a visor-like projection of the wall above it. The rounded chamber to which this doorway gives access is very thickly lined. The structure is composed of fibrous materials, bits of the blades and flower-stalks of grasses, plant epidermis, and the like. The color of the nest is brown. One nest measured 11 inches in length (not including the grass blades that hung loosely below the bottom), by $3\frac{1}{2}$ inches in thickness at its widest part. Nests from the Orinoco region described by Cherrie (1916:222) were apparently essentially similar in form, but they were far more bulky because of the broad grass blades which loosely covered them over and hung far below the bottom. He describes these nests as looking "exactly like a handful of broad-leaved drift grasses suspended from the tip of a slender drooping twig." One measured 18 inches in length by $4\frac{3}{4}$ inches in greatest diameter.

THE EGGS

In the basin of El General the earliest egg of which I have a record was laid on April 26, but May appears to be the principal month for laying. Seven nests in this region each contained 2 eggs or nestlings. In two of these nests, an interval of two days separated the laying of the first and second eggs. These eggs are white, with a wreath of chocolate spots and a sprinkling of the same over the remainder of the surface. The measurements of 8 eggs laid in Costa Rica average 17.7 by 13.0 millimeters. Those showing the four extremes measured 19.1 by 13.1, 17.1 by 13.5, and 17.1 by 12.7 millimeters. Cherrie records two nests with 2 eggs and one with a single egg. These were found near Caicara on the Orinoco between June 15 and 29.

In 9 nests in the valley of El General, 2500 to 3000 feet above sea level, eggs were laid as follows: April, 1; May, 7; June, 1 (probably laid at the very beginning of the month).

INCUBATION

The female alone keeps the eggs warm. She sits in her pensile nest facing outward, like the Black-fronted Tody-Flycatcher. With her head framed in the round doorway, the narrow white lines arching from her lores to above her eyes make her appear to be wearing white-rimmed spectacles. On May 18, 1936, I watched from 5:58 to 11:00 a.m. and from 1:00 to 2:00 p.m. a nest in which incubation had been in progress for at least 10 days. In the six hours the female took 11 sessions varying from 14 to 33 minutes in length and averaging 21 minutes. Her 10 recesses ranged from 9 to 16 minutes and averaged 12.7 minutes. She covered her eggs for 62.3 per cent of the time.

On June 9, 1945, from 5:50 to 11:14 a.m. and from 2:55 to 5:00 p.m., I watched another Slate-headed Tody-Flycatcher which had laid her second egg 16 days earlier. In the seven and one-half hours, this female took 11 sessions in the nest, from 13 to 38 minutes in length, averaging 20.0 minutes. Her 10 recesses ranged from 11 to 29 minutes and averaged 20.3 minutes. Because her absences were so long, she covered her eggs only 49.6 per cent of the time—far less than the first flycatcher, although the sessions of the two were of about the same duration.

Nine more years elapsed before I again studied a nest of the Slate-headed Tody-Flycatcher where incubation was in progress. On May 22, 1954, I watched from 5:35 to 11:20 a.m. a nest in which the second egg had been laid 15 days earlier. In the nearly six hours that I spent in the blind the flycatcher took 10 completed sessions ranging from 10 to 22 minutes and averaging 17.2 minutes. Her 9 recesses ranged from 13 to 25 minutes and averaged 17.9 minutes. She was in her nest for only 49.0 per cent of the six hours.

At the first nest, the male often came with his mate as she returned to her eggs after an absence. From time to time he clung in front of the doorway to look in, either before or after the female had entered. During much of the morning I heard his slight, odd notes issuing from the surrounding thicket, even when I could not see him. Once he flew at a Slaty Castle-builder that had wandered near his nest, making a clacking noise with his bill as he darted toward the intruder. At the second nest, also, the male flycatcher was most attentive to his mate, frequently escorting her as she returned from a recess, lingering much in the vicinity while she sat, or else returning to call her out after she had incubated for a while. But although he often came within two or three feet of the nest, he did not once, in the more than seven hours that I watched, go quite up to it, nor cling to the doorway to look in, as the male at the earlier nest had done.

At the third nest, the male sometimes hovered before the doorway, or clung in front of it, both while his mate was within warming the eggs and in her absence. While she was away, he would sometimes remain close by the nest, as though to protect it, although he was far from consistent in the performance of this duty. While guarding he would as a

rule stay within a yard of the nest, either resting on a slender twig or flitting about to capture minute insects, some of which he appeared to pluck from the nest's surface. At times he would cling to the twiglet which supported the nest. When a Rieffer Hummingbird hovered close in front of the hanging structure, he chased it away, making a grating noise as he flew at the trespasser. He was not given the opportunity to display his zeal as a guardian in the face of any larger bird.

At two nests, both eggs hatched 19 days after the second was laid, while at another nest the incubation period was 18 or 19 days.

THE NESTLINGS

In the nest which I had watched on June 9, 1945, I found both eggs pipped in the evening of June 11. At daybreak the next morning I resumed my watch at this nest. When the female flew out at 5:56 a.m., I left my blind to look into the nest chamber and found that one of the eggs had hatched. The female appeared to give the nestling its first meal at 6:41, but it was difficult to detect the minute insects in her bill. I continued my watch until noon, when the second egg was still unhatched, and the empty shell of the first had not yet been removed. In the course of the morning the female flycatcher brooded the nestlings for 13 periods, ranging from 8 to 24 minutes in length and averaging 16 minutes. Her 13 absences varied from 4 to 20 minutes and averaged 12.2 minutes. She was in the nest 56.7 per cent of the time—considerably more than while she incubated three days earlier. Although I could not always see the tiny insects that she brought, I believe that she fed the nestling between 12 and 14 times in the course of its first morning.

The male Slate-headed Tody-Flycatcher failed to see or to feed the nestling during the first six hours of daylight activity following its hatching. This was to be expected from his failure to visit and look into the nest on the morning of June 9. On the few occasions when the parent that fed the nestling did not stay to brood, I could not be certain of its sex, but without much doubt it was the female. If the male had been bringing food, it is most likely that he would have arrived occasionally during the long periods that his mate spent in the nest. While brooding, the female repeatedly uttered low notes that I had not heard while she incubated three days earlier. Whether these calls were intended to draw her mate's attention to the nestling I cannot tell, but if so they were quite without effect. Although the male flycatcher failed to attend the nestling, he often escorted the female to near the nest and spent much time in its vicinity, as he had while incubation was in progress. He drove away a trespassing Sulphur-rumped Myiobius and a Chestnut-capped Warbler.

The second egg hatched during the afternoon of June 12. Two days later, I devoted three hours of the morning to watching the nest. The male was now taking his full share in feeding the nestlings, having begun between 6 and 49 hours after his earliest opportunity to do so. I do not know what led him to discover his offspring.

Between 7:15 and 10:16 a.m. the two nestlings in this nest were fed 15 times, at least 7 times by the male and 6 times by the female. The latter brooded 7 times, for periods ranging from 10 to 18 minutes and averaging 13 minutes. Her 6 absences varied from 8 to 22 minutes in length, with an average of 14.3 minutes. She spent 47.6 per cent of the three hours in the nest, almost as much as while she incubated on June 9.

In feeding the nestlings, both parents clung upright in front of the doorway, with tail propped against the side of the nest, and passed the food through the aperture. After delivering the food, the female would often enter to brood the nestlings. The male would sometimes pass food through the doorway to his brooding mate, but in her absence he delivered it directly to the nestlings. So far as I could see, the food consisted wholly of minute insects, brought in the tips of the birds' long, flat bills.

The newly-hatched nestlings are minute, sightless, pink-skinned creatures which bear little tufts of gray down on the crown, occiput, shoulders and the middle of the back. At the age of a week they are in pinfeathers. As in other flycatchers reared in a pensile nest, they delay long in its comparative safety. At one nest, two nestlings, already hatched when I found them, left 19 days later. From another nest the two nestlings left when 21 days old; at a third nest the nestling period was 18 or 19 days.

My latest nest, built to replace another which had been abandoned in late May, sheltered a nestling that was beginning to become feathered on July 8, 1936. The paucity of occupied nests after June in El General suggests that in this region a single brood is raised each year.

SUMMARY

The Slate-headed Tody-Flycatcher lives in low, densely tangled thickets such as, in the humid tropical lowlands, cover fields and pastures which have not been cultivated or cleaned for several years. If these areas remain undisturbed by man until the trees grow higher and the undergrowth becomes more open, the flycatchers move to younger thickets. The birds are difficult to see, but their answering voices reveal that they remain in pairs throughout the year.

Their food appears to consist wholly of small insects and spiders, caught as they flit through dense thickets.

Among their calls are monosyllables, a bisyllabic utterance, and a slight trill. All of the calls are low and weak.

In the valley of El General nest building begins in early April. The nest, a pensile structure containing a small chamber entered through a round aperture in the side, is attached to a slender twig or dangling vine. As a rule it hangs in a little clear space beneath a heavy canopy of foliage, from 6 to 10 feet above the ground. Both sexes take important shares in its construction. In one instance building required about 11 days.

The set regularly consists of 2 eggs, laid with an interval of 2 days, usually in May in El General. They are white, with chocolate spots in a wreath about the thick end and a few scattered elsewhere on the surface.

Incubation is carried on by the female alone. In nearly 20 hours of watching at three nests, sessions ranging from 10 to 38 minutes were recorded, while the recesses varied from 9 to 29 minutes. The first female, whose sessions and recesses averaged 21.0 and 12.7 minutes, respectively, sat for 62.3 per cent of six hours. The second female, whose averages were 20.0 and 20.3 minutes, incubated for 49.6 per cent of seven and a half hours; the third female, whose averages were 17.2 and 17.9 minutes, was on her eggs for 49.0 per cent of six hours.

The male sometimes escorts the female on her return to her nest. From time to time he may go to look into the chamber, either while the female is present or in her absence, and he may guard the nest during her recesses from incubation, although he does not do so consistently. He succeeds in driving away very small trespassers such as humming-birds and castle-builders.

The incubation period, as determined at three nests, is 18 or 19 days, more often the latter.

Both sexes feed the nestlings, but only the female broods them. At one nest, where the male was not seen to inspect the interior while it contained eggs, he failed to bring food in the first six daylight hours after hatching, but two days later he was taking his full share in feeding.

At hatching, the pink-skinned nestlings bear little tufts of gray down on head and back. They develop slowly and leave the nest when from 19 to 21 days old.

Apparently only a single brood is reared yearly, at an altitude of 2500 feet in southern Costa Rica.

SULPHURY FLAT-BILL

Tolmomyias sulphurescens

The Sulphury Flat-bill is one of those small, unobtrusive flycatchers of whose existence I first became aware through the discovery of its remarkable nest. The bird is about five inches in length. The top of its head and hindneck are slate-gray. The rest of its upper plumage is bright yellowish olive-green. The tail feathers are deep grayish brown with olive-green margins on the outer webs. The dusky feathers of the wings have conspicuous yellowish margins. The eyes are surrounded by a whitish ring which in front is interrupted by a dusky spot, over which arches a narrow grayish white line that extends from the base of the bill to above the eye. The cheeks are gray, the throat paler gray, the breast gray faintly tinged with yellow, and the remaining under plumage sulphur yellow clouded with olive on the sides. The short, straight, flat bill is blackish. The eyes are pale yellow. The legs and feet are dark gray. The sexes are alike in appearance.

Sulphury Flat-bills range across tropical America from southern México to southern Brazil, Paraguay, and northern Argentina; the Sulphury Flat-bills of the race *Tolmomyias sulphurescens cinereiceps* were long considered a distinct species and occupy the portion of the species' range from western Panamá northward. From Costa Rica to México these flycatchers are at home in the lowlands of both coasts. Carriker (1910:725) states that in Costa Rica they extend "up to at least 3000 feet on the eastern slope and 2000 feet on the western side"; but in the Térraba Valley, in the Pacific drainage, I have found them as high as 2900 feet, although they are not as abundant there as a few hundred feet lower. Unlike many other birds of the Tropical Zone, the species extends about as high in Guatemala as in Costa Rica.

Wherever I have met it, in Guatemala, Honduras and Costa Rica, the Sulphury Flat-bill has been an inhabitant of the lighter woodland and the forest edges rather than of the interior of heavy rain forest. Groves of tall second-growth, coffee plantations with well-spaced shade trees, shady pastures and dooryards, tree-lined waterways flowing through agricultural lands, and wider roadways cut through the forest are its habitat, at least in the more humid portions of its range. Usually solitary except in the nesting season, this flat-bill hunts insects unobtrusively in the foliage of the crowns of the lower trees. Often it flies against a leaf to pluck off an insect or larva crawling there, and it does not often dart up into the open air. It varies its diet with a few small berries. It is so quiet and inconspicuous that the bird watcher does not begin to become well acquainted with it until he has found its nest. Its call, too, is so slight and weak that it does not often attract attention. The usual note is a thin, somewhat hissing whistle, which bears some resemblance to the call of the Cedar Waxwing. Sometimes this is repeated several times in rapid sequence, and with each repetition the call becomes sharper and more insistent, until it differs strongly from the waxwing's softer call.

NEST BUILDING

The prevailing black, pensile, retort-shaped nests of the Sulphury Flat-bill are so unusual in appearance and hang in positions so conspicuous, that they often take the eye of the observant traveller, be he ornithologist or not. Far more has been written about these nests than about their modest builders. Not long ago, while visiting an entomologist at a northern university, I was shown one of these curious nests which he had collected years before in Colombia. He did not know the name of the bird which built it,

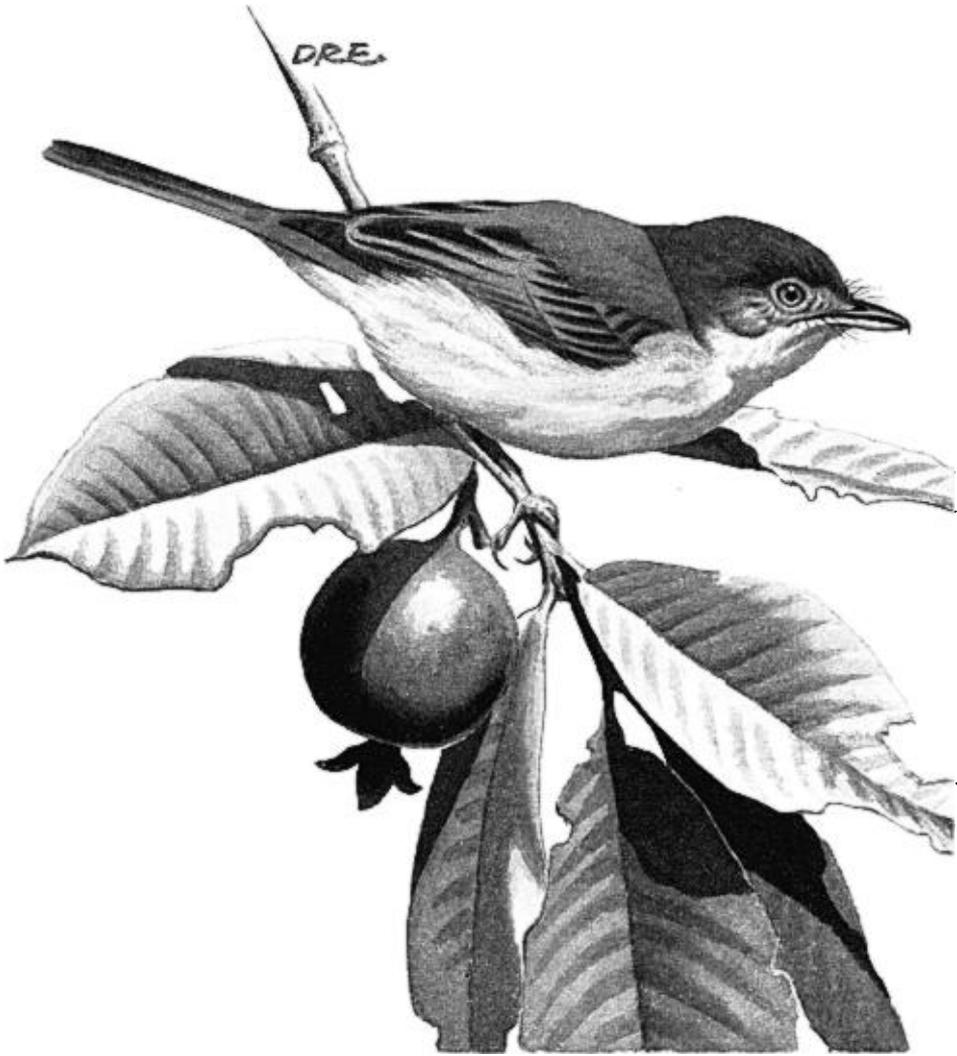


Fig. 83. Sulphury Flat-bill.

but I recognized it at once as the work of the Sulphury Flat-bill or some closely related species.

I have a record of a nest which was begun in the valley of El General on March 7, 1943, and of another on March 17, 1940. Neither of these very early nests was completed. Nest building apparently does not begin in earnest until toward the end of March; I have records of structures which when found on March 23 and 30 appeared to be newly begun and were later completed and contained eggs. April is the month of greatest activity in building by this species throughout Central America, and for the northern parts I have no knowledge of nests begun earlier than this month.

The site chosen for the attachment of the nest is almost invariably a slender, drooping, usually leafy twig of tree or creeper, so situated that the structure when completed

will swing free of surrounding vegetation. The nests are often hung above the middle of a narrow stream or the shore of a wider one, but in my experience they are more frequently placed above dry land. The edge of the forest, of second-growth woodland, or of a taller thicket are favorite situations. While travelling along forest trails beside which trees have been cut to let in the sunshine and dry out the mud, I have frequently noticed the flat-bills' nests attached to vines and branches by the trailside. A shade tree in a pasture, dooryard or coffee plantation may be selected to support the nest, or perhaps a tree or vine in a hedgerow. At times the structure is merely hung above or beside a small open space in a grove or light woodland. Aloofness from surrounding branches and foliage is the essential consideration in choosing the nest site. In height I have found these nests from $5\frac{1}{2}$ to about 20 feet up, the range of elevations being about the same whether the structure is hung above land or water. Sometimes the nest is built close beside one of wasps or of ants, but more often there is no colony of biting or stinging insects close by. Once I saw a nest of the flat-bill attached to a telephone wire beside a railroad passing through a second-growth thicket in the lowlands of Honduras.

The nest is built by the female alone; at least, so I conclude from having watched for longer or shorter periods the construction of a number of nests. In the course of these watches I have never seen two individuals actually engaged in building at the same time. Sometimes, when both members of the pair are present, the amorous attentions of the idle one make it clear that it is the female which works; but more often she labors in lonesome silence. Like the pensile nests of other species of flycatchers, that of the Sulphury Flat-bill is made by a process of felting rather than weaving. The female begins the nest by entangling thin fibers around the slender twig which is to support it. As additional strands are worked into the mass, it becomes a loose, unsubstantial weft which soon grows to the size of a man's fist. Arriving with fibers in her bill, the bird alights on the supporting twig at the top of the mass, or flutters head downward over its surface, and tucks in the new material with a deft, almost instantaneous movement of her bill. There is none of the careful, deliberate weaving which one witnesses at the nests of oropendolas and orioles.

When the fluff of material has grown sufficiently, sometimes only three or four days after the nest was begun, the flat-bill clings to its side and forces apart the fibers at the same time that she adds new ones, thereby forming a pocket or depression. This is the future nest chamber. As it expands in response to continual pushing from within, the nest becomes a hollow, ovoid structure with a large round opening in the side. By a process difficult to follow in detail, but apparently consisting merely of pushing the fibers surrounding the orifice outward and downward with bill and feet, a spoutlike entrance tube grows out from the side of the nest. While shaping the chamber, the flat-bill alternately attaches material to the outside and takes it into the hollow. When she does the latter, the thin fabric that surrounds her bulges and trembles as with vigorous movements of feet and wings she shapes the chamber and expands it to the proper size. Sometimes with empty bill she enters again and again, clings upright in the cavity for a few seconds and continues the work of giving it shape and felting together the fibrous strands.

After the downward-pointing spout has been formed, the flycatcher exhibits the greatest skill in flying into it even with a burden in her bill. Approaching with a long strand, she first alights on a twig near the nest to look about her; then, convinced that she can safely enter, she drops below her perch and describes a graceful curve which bends sharply upward to the orifice at the lower end of the spout, into which she shoots with great exactitude and a rapid uniform movement, never appearing to experience the least difficulty in entering the narrow opening. Her work inside done, she darts out head first and flies away for more fibers.

The nest is made almost wholly of a class of materials which has been aptly called "vegetable horsehair." It consists in part of fine fibrous rootlets, in part of the lustrous blackish fungal hyphae which in humid tropical regions creep over branches and stems in the undergrowth of the woods, and perhaps of similar fibers of different origin. There is an admixture of cobweb. I have seen building flat-bills tug strenuously to tear the fine rootlets of epiphytic plants from the trunks and branches of trees. As a rule the flat-bills



Fig. 84. Nest of Sulphury Flat-bill near Tela, Honduras, June 2, 1930. The opening is at the end of the tube-like projection on the left side of the bottom.

are not shy at their usually inaccessible nests, and I have watched them build while seated a few yards away with no attempt to conceal myself. Considering the difficulties they must experience in finding and pulling free the fine, tough materials which they use, the flat-bills come frequently to their nests when working actively. One bird brought material 19 times in an hour. Another came 14 times in 40 minutes on one day and 25 times in 90 minutes on another. A third, working at a more leisurely rate, made only 21 visits to the nest in 140 minutes. A fourth flat-bill, which I watched on several mornings, brought material 51 times in 3½ hours. In the hour of greatest activity, she came 17 times. From one to two weeks is the period required to give the structure its final size

and shape, but the walls are then still very thin and the bird devotes several days more to bringing additional fibers of the same character for lining the interior. Two to three weeks appears to be the total time used for building the nest.

When hung too near the ground, the strange nests of the Sulphury Flat-bill attract the attention of curious people and meet an untimely end. The first nest of which I watched the construction was situated beside a mule pen on a Guatemalan plantation. Returning to visit it one day, I found that the vine to which it was attached had been cut off. That afternoon the overseer's cook gave me the nest, distorted out of shape. Her brother had found it and thought that it would interest me! On a Costa Rican farm a flat-bill made her headquarters in a row of orange trees growing in a pasture on the back of a ridge near the edge of woodland. Her first nest was begun in mid-April, and for some unknown reason it was abandoned unfinished. By May 10 she was completing a second nest 100 feet from the first. This nest was cut down with a knife before the bird began to incubate. Then she built a third structure about 25 feet from the site of the first, and she was incubating two eggs in it when in the second week of June this nest was also wantonly cut down. Building birds of other species covet the fine fibers of the flat-bill's nest for the lining of their own nests, and if the owner is not present to defend it, they may pull at them until the swinging structure falls to the ground. Many newly begun nests disappear after a few days.

The completed nest of the Sulphury Flat-bill resembles a chemist's retort hung so that the tubular neck is vertical or nearly so and its opening points to the ground. The roughly globular or pyriform body of the retort contains the chamber which holds the eggs and nestlings, and above this there is a tapering portion by which it is attached to the supporting twig. A typical nest measured $3\frac{1}{2}$ inches in greatest transverse diameter by $8\frac{1}{2}$ inches in total length. Of this the portion which contained the chamber accounted for $5\frac{1}{2}$ inches, while the tubular entrance projected 3 inches below the rounded bottom. The nests are as a rule constructed largely of black or blackish horsehair-like material, with more or less cobweb to bind it together. The firm consistency of the fabric is attained principally through the careful intertangling of all the constituent fibers by a process of matting or felting. One nest that was attached to a leguminous scrambler with twice-compound leaves had a few of the fine, curved secondary rachises of these leaves incorporated in the outer wall, and another structure contained many of these rachises. Some nests contain a small proportion of light-colored fibers. As described and figured by Haverschmidt (1950), the nest of the Yellow-vented Flat-bill of northeastern South America is quite similar to that of the Sulphury Flat-bill.

THE EGGS

Since most nests of the flat-bill hang beyond reach and since it is impossible to see their contents by raising a mirror above them, it is difficult to learn when the eggs are laid. However, I have no evidence, either direct or indirect, of the presence of eggs before the second week of April in Central America. My earliest date for an egg actually seen is April 12, 1956, when laying began in a low, accessible nest in El General. The interval between the laying of successive eggs is usually two days but at times apparently only one day. One egg, the first of a set, was deposited between 6:50 and 8:20 a.m. Carriker (1910:725) states that "two eggs are invariably laid," but I have records of four sets of 2 and four sets of 3 eggs. In Trinidad and Tobago, Sulphury Flat-bills of the race *T. s. exortivus* lay 2 or 3 eggs in a set (Belcher and Smooker, 1937:240), while farther north, in Chiapas, those of the Central American race lay 3 or 4 (Alvarez del Toro, 1952:16). Eggs from Central America are whitish, or according to Carriker, creamy white with a slight rufous tinge. They are speckled, usually rather sparingly and chiefly on the thick

end, with shades of brown, cinnamon-rufous or pale cinnamon. Belcher and Smooker distinguished three widely differing types of coloration on the eggs of this species in Trinidad. Carriker gives the measurements of Costa Rican eggs as 21 by 14 and 20.5 by 14 millimeters; in Chiapas eggs of the same race are, according to Alvarez del Toro, 21 by 15 millimeters in size.

The removal of the eggs from the nest of the Sulphury Flat-bill is difficult and can hardly be accomplished without inverting the structure, then righting it slowly in such a fashion that they roll down the entrance tube into one's hand. Since such treatment jeopardizes the nest, I have rarely followed it but contented myself with examining the contents by inserting a very small mirror attached to the end of a wire, at the same time illuminating the interior by means of a small electric bulb.

In 11 nests in the valley of El General, 2000 to 2500 feet above sea level, eggs were laid as follows: April, 8; May, 2; June, 1.

INCUBATION

Incubation is performed by the female alone. Long before she lays her first egg, and even before the nest is quite finished, she sleeps in it. In five instances, the female had slept in her nest from seven to ten nights before she began to lay. Thus the first egg receives a certain amount of heat from her body for usually two nights before the second is deposited; and if the set consists of 3 eggs, the first receives correspondingly more heat. The flat-bill sits in her well-enclosed chamber with her head above the entrance tube. One can see her by standing directly below the nest and looking upward, and in at least the higher nests she often sits steadily, returning her visitor's gaze.

The study of the flat-bill's rhythm of incubation is not easy. Except when directly below, the watcher cannot see whether or not the female is on the nest, and undeviating attention must be given to avoid missing her swift dart out and her almost equally rapid return. On April 29, 1940, I devoted two hours to watching an inaccessible nest in which, apparently, incubation had begun only a few days earlier. Between 8:29 and 10:36 a.m. the flat-bill took 4 sessions of respectively 25, 10, 26 and 21 minutes, separated by recesses of 13, 16 and 16 minutes. By May 12 the eggs in this nest had apparently not yet hatched, for I could detect no food in the female's bill as she returned to it. Between 6:45 and 10:00 a.m. on this date she took 5 sessions of 36+, 11, 10, 26 and 12 minutes' duration, and an equal number of recesses which lasted 14, 13, 52, 13 and 8 minutes. Her absence of 52 minutes was inexplicably long. Taking the two mornings together, in 5 hours and 22 minutes I timed 9 sessions averaging 19.7 minutes and 8 recesses which averaged 18.1 minutes. The bird was in her nest 52.1 per cent of the observation periods. To leave her nest, the flat-bill dived downward through the entrance tube headfirst then looped up to some convenient perch. To return, she shot vertically upward into the mouth of the downward pointing tube and vanished in the act. The male remained much of the time in the vicinity of the nest, sounding frequently his thin, high, sibilant notes, which could be approximately imitated by whistling through the teeth.

On May 12 and 14, 1953, my wife and I spent more than seven hours watching a nest in which the eggs were within a few days of hatching. The flat-bill took 14 completed sessions ranging from 10 to 28 minutes and averaging 17.4 minutes. Her 14 recesses ranged from 7 to 28 minutes and averaged 13.5 minutes. She was in the nest only 56.4 per cent of the time, which is a constancy only slightly greater than that of the first flat-bill. Her mate came now and then to perch for a short while near the nest, but he never entered it while we watched.

At a nest in which the third egg was laid on April 27, the first nestling hatched at about 1:00 p.m. on May 12 and the third had hatched by noon on May 14, giving an

incubation period of 17 days. At another nest, in which only 2 of the 3 eggs hatched, the incubation period was at least 17 days; and at a nest in which 1 of 2 eggs hatched, it was no less than 18 days. Because the female sleeps in her nest during the period of laying, the earlier eggs have already been incubated somewhat before the last is laid. Hence the eggs usually hatch on successive days, doubtless in the order of laying.

THE NESTLINGS

At hatching the flat-bills have dark skin which is quite devoid of down, and the interior of their mouths is yellow. They never acquire any nestling down, but soon their pinfeathers begin to sprout, and when about 12 days old they are fairly well covered by their expanding plumage. At a low nest I observed repeatedly that the nestlings rested with their heads at the back of the chamber and their tails toward the entrance tube, which is just the opposite of the way the female sits. In most flycatchers with covered or pensile nests, in which the female incubates or broods with a definite orientation, the young at an early age assume this same orientation, resting with their heads outward if the female sits that way, with their heads at the rear of the nest if the female incubates in this position. Such orientation has been observed in the Royal Flycatcher and in the Sulphur-rumped Myiobius.

The female alone broods the nestlings, but both parents join in bringing them small insects and an occasional berry. I was interested in the behavior of the male at the inaccessible nest that I had studied during the period of incubation in 1940. By May 17 the female was taking tiny insects to nestlings which might already have been a few days old, and she brooded them for intervals of ten minutes or less. Once, while she was absent, the male came with a small insect and perched near the nest. He held the insect for about five minutes, as though awaiting the female's return. At last he grew tired and carried the food away. When he came again with an insect, more than hour later, the female was within the nest, brooding. He rested for a few minutes near the nest with the food in his bill, then again carried it away.

In an hour's watching on May 19, I still failed to see the male flat-bill take food into the nest. But on May 21 I waited only five minutes before he came with a small insect while the female brooded. She flew from the nest as he alighted upon the yielding branch that supported it and caused it to swing. Then he took the food into the nest and promptly departed. Three minutes later he again brought food and took it into the nest. Later he came with a small insect, perched near the nest, then carried it away again, as I had seen him do four days earlier. How had he learned that the nestlings had hatched? Since he had apparently not been in the habit of entering the closed nest, it is not probable that he learned by seeing them. Possibly he heard the cries of the nestlings and responded to them, but until May 21 these cries were too weak to reach me where I sat six or seven yards away. I think it likely that he brought food because he had seen his mate do so. At first he did not know what to do with the insects he brought, but after a few days he learned, again, I believe, by watching the female. His instinct to feed the nestlings was at first too weak or too imperfect to fulfill its end; apparently he had to learn the duty of a parent by watching the actions of his mate.

In 1953, I again tried to learn how soon the male flat-bill would bring food. At this time I was watching an accessible nest which held a single nestling that had hatched on May 17. In observation periods of an hour or more in the mornings of May 18, 19, 21, and 22, I found no evidence that the male was attending the nestling. On these days the nestling was brooded about half the time and fed about twice in an hour. The male followed his mate to the nest once on May 19 and twice on May 22 but brought nothing in his bill and did not enter; on the other days I did not even see him. But in an hour's

watch on May 24 he came with food while his mate was brooding. Twice he hovered below the opening of the entrance tube, but he did not enter until the female left. Thus he apparently began to attend the nestling between five and seven days after it hatched. Since, so far as I could tell, he never made a visit of inspection to the nest, it seems evident that in this instance, too, he was stimulated to bring food either by seeing his mate do so or by hearing the nestling's voice. There is, of course, the possibility that the female directed his attention to his parental obligations by means of some special signal, vocal or otherwise; but my studies of the beginning of feeding by the males of a number of species make this appear unlikely (Skutch, 1953*a*).

I made further observations on this nest after the single nestling was well feathered and no longer brooded. In a total of four and one-half hours of watching in the mornings of June 5 to 9, inclusive, when it was from 19 to 23 days old, it received food from both parents 65 times, or at an average rate of 14.4 times per hour. The maximum rate was 25 times in an hour and the minimum 6 times. At 8:10 a.m. on June 5 I found the nestling calling with a short, harsh whistle, lower and harsher than the note of the adults. For the next 10 minutes it repeated this call over and over at intervals of a few seconds, but it received no food. At 8:20 a parent came and began to feed very rapidly, taking food into the nest 11 times in the next 7 minutes. Many of these morsels were tiny insects caught amid the foliage of the guava tree that supported the nest. After this the meals were spaced more widely, but food had been brought 25 times by 9:20.

As the nestling grew older it called frequently and shook its swinging nest much and vigorously. On June 9, when it was 23 days old, I found it with its head and breast over the entrance tube and now for the first time I could see it by looking up from below without climbing a ladder and using a mirror and electric light. Now the parents coming with food fluttered repeatedly below the entrance, only to return to a perch without going in to deliver what they had brought. Some observers would interpret this as an effort to lure the young bird into the open by withholding nourishment, but it appeared to me that with the entrance tube blocked by the nestling they could not readily pass the food to it. Despite these delays, they fed it 8 times in half an hour.

On the following morning, June 10, the nest was shaking violently when I came within sight of it at seven o'clock. In a minute or two it became still again and I walked to my usual observation post at the top of the neighboring river bank. While my back was turned the young flat-bill must have flown out, for when I again faced the nest it was empty. A parent came to the nest with an insect and went in and out five times, still bearing its mouthful of food. A little searching disclosed the fledgling resting in a dense tangle of vines at the edge of the neighboring woodland, and here a parent fed it.

This lone nestling did not fly until 24 days old. Two nestlings left another nest when 21 or 22 days old. At a nest which contained two or three nestlings they departed when from 21 to 23 days old. At a fourth nest the nestling period was at least 20 days. Thus the nestling period is normally about 22 days and exceptionally as long as 24 days.

THE NEST AS A DORMITORY

In El General, a single brood appears to be reared. I have only one record of eggs in June, and these were laid by a flat-bill that had lost or abandoned two earlier nests. Instead of using her well-enclosed, durable nest for a second brood, the female flat-bill employs it as a dormitory. As was noted earlier, she begins to roost in the nest even before its completion, at least seven to ten days before she lays her first egg. She continues to pass her nights there throughout the period of laying and incubation, and two individuals that were carefully watched slept with their young until they flew from the nest. In another instance the female parent was with her nestlings on the third

night before their departure, but rain prevented observations on the last two nights they were in the nest. The fledglings do not return to pass the night in the nest but roost in the open beneath the rains that are so frequent at the season when they venture forth into the world. The female, however, continues to lodge in her comfortable nest, which shelters her from drenching showers.

One female began to lodge in her nest on April 19, before it was finished, and she laid her first egg there on April 27. She brought forth her single young on June 10 and continued to sleep in her nest until at least October 1. By the middle of this month the entrance tube was becoming flattened and closed as a result of innumerable soakings, and I no longer found the bird present at night. A neighboring flat-bill began lodging in her unfinished nest on April 15, laid her first egg on April 24, and brought forth two or three young on June 4. She continued to pass the nights in her low nest until at least the end of July. When I again investigated this nest in the middle of August, it was occupied by a Paltry Tyranniscus which had lined the bottom of the chamber with downy material and laid an egg.

Usually it is possible to see whether the flat-bill is sleeping in her nest by going out in the night and throwing a flashlight beam up into the entrance tube. If the female is present, her pale yellow breast is visible at its upper end. She continues to slumber soundly until one turns out the light and steals away. Sometimes, however, the chamber is somewhat deeper than usual, or she sinks down lower, so that no part of her is visible through the entrance tube. Then one must watch in the evening or morning to see whether she comes or goes.

Although female flat-bills take advantage of their comfortable nests for sleeping, they apparently never build such structures as lodgings alone. In the shady pasture in front of our house, where these observations on roosting were made, I found nests under construction only in the breeding season from March until May. No new nest has ever in so far as known been built in other months. Although the nest of the flat-bills is a remarkably durable structure, it gradually deteriorates as a result of almost daily wettings for months together. If the entrance tube does not wear away by much passing in and out, it may collapse through the softening of the fibers which compose it. Sometimes wasps or birds of other species may take possession of the nest which, after the young have flown, remains unguarded all through the day. Although the nest may hang conspicuously from its slender twig from one breeding season to the next, I have not known it to be used as a dormitory after October. Hence, as far as I can learn, the female flat-bill, although capable of constructing such a safe and comfortable lodging, sleeps in the open through the wettest and the coldest months of the year, and the male does so at all seasons.

Thus the Sulphury Flat-bill represents the earliest stage in the use of dormitories. The first step in the evolution of this custom appears to be the construction, or at least the occupation, of a covered nest for breeding; for with the exception of rails and other marsh birds which build open platforms where they rest above the water or sodden ground, and Bendire Thrashers which find an open nest useful when roosting in spiny cacti, birds scarcely ever lodge in a nest which lacks a roof. The next step is the occupation of the breeding nest by night when it contains neither eggs to be incubated nor nestlings to be brooded, and this is the stage exemplified by the Sulphury Flat-bill. A more advanced stage in the evolution of the dormitory is represented by flat-bills of the genus *Rhynchocyclus* (formerly *Craspedoprion*), which build nests somewhat similar in form to that of the Sulphury Flat-bill, not only to hold their eggs, but outside the breeding season as special dormitories not employed for reproduction. It is not known whether in this genus of flycatchers the dormitory nests are built by both sexes or by the female

only, but in the Bananaquit males no less than females build dormitories in which they sleep singly at all seasons (Skutch, 1954*a*). A still further advance in the dormitory habit is exhibited by those birds which lead their fledged young to share the shelter of a nest with them, as is true of some of the wrens treated in this volume. Finally, the dormitory becomes the family dwelling, occupied by the two parents with their self-supporting young through much or all of the year, as in certain other wrens and several kinds of woodpeckers. But I know no flycatcher that has advanced so far in the use of lodgings (see Skutch, 1956).

ENEMIES AND SECONDARY TENANTS OF NESTS

I have twice known unfledged nestlings to disappear from nests which were neither torn nor forced out of shape, and I believe that nothing but a slender snake could have entered to take them. The flat-bill is sometimes robbed of its nest by the Piratic Flycatcher. In three successive years a Sulphury Flat-bill built her nest in the same part of the shady pasture in front of our house, and each year the Piratic Flycatchers took possession of it for their own eggs. Doubtless the thieves employed the same tactics that I have seen them use in gaining control of the nest of the Gray-capped Flycatcher (see pp. 456-457). One year the Piratic Flycatchers placed a few small, dry leaves in the bottom of their stolen nest, but the following year they were content to use it as they found it. The entrance tube was considerably enlarged by the passage of the bigger birds.

Although the Paltry Tyranniscus usually constructs its own closed nest, it sometimes makes use of a flat-bill's nest. In 1940, I found the cozy globe of the smaller flycatcher attached to the bottom of a newly made but still unoccupied nest of the flat-bill. In 1954, a tyranniscus took possession of a flat-bill's nest in which the builder had been lodging for some months. Doubtless the change in ownership was effected without fighting, because the flat-bill was absent in the daytime when the tyranniscus carried in downy materials to line the chamber more softly. In this borrowed structure the tyranniscus reared an exceptionally late brood of two (p. 469).

The following year this same flat-bill, as I suppose, built a nest in a neighboring orange tree and laid her first egg on the exceptionally early date of April 17. The second egg was laid on April 19, but the following day the nest was empty. A Piratic Flycatcher, which complained loudly when I looked in, had probably thrown out the eggs as the first step in gaining possession of the nest. But the flat-bill slept in her nest at least one more night after this. For a night or two the nest remained empty; then I found an adult Bananaquit ensconced within it for the night. It slept there at least four nights, then an immature Bananaquit took up lodgings in it. But the latter bird did not enjoy a long tenancy, for the nest was soon torn apart as a source of fibers by other building birds. Finally, to complete the list of secondary avian tenants, in El Salvador the Banded Wren may breed in old nests of the Sulphury Flat-bill (Dickey and van Rossem, 1938).

Wasps sometimes build their nests in the retort-shaped structures of the flat-bill, doubtless waiting until the birds have abandoned them. Hanging close together from the vines which draped over a small tree beside a river in the Caribbean lowlands of Honduras were two nests of the flat-bill. Investigation of the lower structure brought out a swarm of small yellow wasps, which fortunately did not sting. The only way we could reach the higher nest, which appeared to be unoccupied, was by cutting down the supporting tree. This was effected without inciting the attacks of the mild-tempered wasps. When we could examine this second structure, we found within it only a broken egg shell. My companion decided that he would keep the oddly-shaped nest as a specimen, and in order not to burden himself unnecessarily on the outward journey, he hung it in a bush about two hundred feet upstream from its original site, intending to pick it up as we

returned. But we came home by a different route. When, three days later, my friend went to retrieve his specimen, he found the nest occupied by a colony of wasps, apparently the same that had been driven from the other nest when we cut down the supporting tree and it fell into the river. Passing this way a month later, I found the nest still hanging where we had placed it, but it was now abandoned by the wasps. I carried it away as a memento. Nests of the flat-bill are remarkably enduring, and in the humid lowlands are among the few birds' nests which come through the long rainy season in a recognizable condition.

SUMMARY

The Sulphury Flat-bill inhabits light woodland, the edge of heavy forest, orchards, shady lawns and pastures, from sea level up to about 3000 feet in Costa Rica. Except when nesting, it is a most unobtrusive bird, easily overlooked. It appears to be solitary in the nonbreeding season.

The species subsists on small insects and larvae caught by short flights in the foliage rather than conspicuous darts into the air. Occasionally it eats berries.

The call is a thin, sibilant whistle.

In southern Costa Rica nest building begins in March and becomes general by April. The pensile nest, a remarkable retort-shaped structure entered through a downward-facing tube, is far more conspicuous than the bird itself. It hangs from a slender, drooping twig or vine at a height of from $5\frac{1}{2}$ to about 20 feet above the ground. It is always built in the midst of a clear space, often above a watercourse or roadway, or beneath a spreading tree. The female alone builds the nest, using blackish fibers, which are not woven together but matted or felted. After forming a continuous loose weft of fibers she clings to the side and spreads them apart to form the chamber, around the orifice of which the spout is gradually extended downward. Building usually requires from two to three weeks. The builder begins to sleep in her nest before its completion.

In El General laying begins in mid-April. In Central America sets of 2 and 3 eggs are about equally abundant, and farther north sets of 4 have been reported. The eggs are usually laid with an interval of two days.

Only the female incubates, sitting rather inconstantly. In 5 hours and 22 minutes one flat-bill took sessions ranging from 10 to 36+ minutes and averaging 19.7. Her recesses varied from 8 to 52 minutes and averaged 18.1 minutes and she was in the nest 52.1 per cent of the time. Another flat-bill incubated for 56.4 per cent of 7 hours. The flat-bill enters her nest with a skillful upward dart and on leaving she shoots downward headfirst.

The incubation period is 17 or 18 days. The eggs tend to hatch on successive days.

The newly hatched nestlings are dark skinned and entirely devoid of down; the interior of the mouth is yellow. They are fed by both parents but are brooded by the female alone. Compared with other flycatchers, the male is tardy in beginning to attend the nestlings, and at one nest he apparently did not bring food until the chick was from five to seven days old. Since he was never seen to make a visit of inspection to the nest, he was apparently stimulated to feed the nestling by hearing its cries or by seeing his mate take in food. In the first days after hatching a single nestling was fed about twice an hour by its mother. When almost ready to leave, it was fed at an average rate of 14.4 times an hour by both parents, with a maximum of 25 feedings in a single hour. During its first few days it was brooded about half the time.

The nestling period is usually about 22 days, but in one case it was 24 days.

In El General, a single brood is normally reared.

The female begins to sleep in her nest before she finishes it and by the time she lays the first egg she has already passed seven to ten nights in it. She continues to sleep there

throughout the period of laying, incubation, and rearing the nestlings. After the young take wing they do not return to lodge in the nest, but the female continues to do so. A female whose nestling left on June 10 continued to use the nest as a dormitory until at least the following October 1, after which the entrance tube flattened and closed as a result of decay. Another female whose young departed on June 4 continued to sleep in her nest until at least the end of July, after which it was occupied for breeding by a Paltry Tyranniscus. But there is no evidence that the female flat-bill builds a nest outside the breeding season especially for sleeping, or that the male does so at any season. In the wettest and coldest parts of the year even females appear to roost in the open. Thus the Sulphury Flat-bill exhibits the first step in the evolution of the custom of using the nest as a dormitory.

The closed nests of the flat-bill are used by various birds and also by wasps. The Piratic Flycatcher sometimes dispossesses the builder and uses the nest for rearing its own brood. The Paltry Tyranniscus may attach its nest to the bottom of the flat-bill's nest or even occupy the chamber, to which it adds a softer lining. The Banded Wren has also been reported to breed in the flat-bill's nest. Bananaquits sometimes roost in abandoned nests, and wasps may establish their colonies in them.

EYE-RINGED FLAT-BILL

Rhynchocyclus brevirostris

The Eye-ringed Flat-bill is a very plainly attired flycatcher of medium size, about six inches in length. Its upper plumage is plain olive-green, with margins of the same color on its dusky wing and tail feathers. There is a conspicuous whitish ring around each large, dark eye. The throat and chest are likewise olive-green, and the more posterior under parts are pale yellow. The eyes are dark. The upper mandible of the short, heavy bill is black and the lower mandible is horn-colored. The legs and toes are plumbeous. The distinctive features of this unobtrusive, olive-clad bird are its large head with a prominent eye-ring and its broad, heavy bill with the contrasting colors of its upper and lower mandibles.

The Eye-ringed Flat-bill occurs from southern México to Brazil. Wagner (1953) met it in México only from April to July and believes it to be migratory there, but Paynter (1955:201) found it in the Yucatán Peninsula in December and February, and in southern Central America it is present at all seasons. Here it is found on both coasts and far up into the mountains. In Costa Rica I saw it occasionally on the northern slope of the Cordillera Central around 5500 feet above sea level, and on Volcán Chiriquí in western Panamá it has been recorded from 4000 to 7500 feet (Ridgway, 1907:389). It inhabits not only the heavy forest but also the taller second-growth woods, and in El General it frequents the shady riverside groves, even where these are separated by considerable stretches of fields or pastures from extensive tracts of forest. It is a solitary bird, rarely seen with another of its own kind, but it sometimes associates with the mixed flocks of small birds of other species. Although it stays beneath the shade of the tall forest trees, it at the same time remains well above the ground, so that it is perhaps most often seen from 20 to 50 feet up. In such places it perches quietly for considerable periods, looking from side to side with large prominently rimmed eyes set in a big head, and from time to time it darts suddenly to snatch some creeping creature from leaf or stem. The only note that I have heard from it is a weak, harsh, often spluttering, whistle.

NEST BUILDING

Perhaps the point of greatest interest about this phlegmatic flycatcher is its nest, which in form resembles that of the Sulphury Flat-bill but is much bulkier, not only because it must accomodate a larger bird but also because of the coarser materials which compose it. Unlike the Sulphury Flat-bill, the Eye-ringed Flat-bill builds nests especially for sleeping; but first we shall consider those used for reproduction, which on the whole are more carefully constructed and have longer entrance tubes. These retort-shaped structures are attached near the extremity of a slender, leafy branch, or less often of a dangling vine, and hang in a clear space in the woodland or in a shady riverside grove. The six nests of which I made records ranged from 8 to about 35 feet above the ground. In El General the earliest breeding nests seem to be begun in February, for I once found one with an egg well advanced in incubation on March 20.

The first nest of which I watched the construction was discovered near San Isidro del General on April 10, 1939. It was then a loose tuft of dry materials, largely coarse fibers with some half-decayed leaves entangled in them, and it swung free at the end of a thin leafy twig, about fifteen feet above the bed of a dry watercourse a short distance within the forest. To see the builder at work on this structure required much watching,



Fig. 85. Eye-ringed Flat-bill.

largely unrewarded. I sat in my blind from 7:00 to 8:00 a.m. on April 12 without seeing her at all. In the next half hour she brought only one billful of material. From 8:30 to 9:00 I was absent, but from 9:00 to 9:30 I again watched fruitlessly. But in the next hour, 9:30 to 10:30, ten contributions were brought to the nest. Some of the fibers were twisted once around the supporting twig at the top of the nest, while others were carried in to strengthen the walls of the cavity which the flat-bill had been forming by spreading apart the materials of the originally continuous mass.

With so few visits to the nest, it was difficult to decide how many individuals were building it. But I saw definitely that two birds were interested in it and that the approach

of one was vigorously opposed by the other. Without much doubt it was the female that resented the presence of the male. Early in the morning a flat-bill, without material in its bill, alighted on top of the nest and delayed there a few minutes, until another came bringing fibers and drove it away. Later, while the supposed female was working more actively, she arrived with a large weft of bast fibers and as usual perched near the nest to look around before flying up to it. While surveying the surroundings, she spied the other flat-bill, which was approaching with a small scrap of material. She dropped her fibers and drove at the other, uttering a low, angry, spluttering whistle. Several times she flew threateningly toward the second flycatcher which each time retreated to another perch. In the intervals between her dashes at the intruder she perched, angrily twitching her wings and tail. Two Oleaginous Pipromorphas that happened to be passing by just then were interested spectators of the altercation, twitching their wings in their habitual nervous fashion, just as the flat-bill, a more stolid bird, did in anger. Finally both of the flat-bills vanished into the undergrowth of the forest, and I waited in vain for the resumption of work on the nest.

On the next morning, which was overcast and sultry, I watched this nest from 7:00 to 7:40 and again from 9:20 to 10:00, hours at which most birds work actively at their nests, without once seeing the builder. Disappointed with the morning's results, I resolved to resume my vigil at one o'clock in the afternoon, precisely because I deemed it improbable to find her working actively in the hottest part of the day. After I had waited about a half hour without seeing the flat-bill, a mixed flock of small birds approached through the woodland. Among them were a pair of Red Ant Tanagers, a pair of Slaty Antwrens, a pair of Chestnut-tailed Automoluses, and a few others. With them came the flat-bill, which proceeded to build, and in the next 55 minutes, while the motley party remained within sight or hearing, she brought 20 billfuls of material to her swinging structure. Often she came with large skeins of long, coarse fibers, which trailed far behind her as she flew through the underwood. As on the preceding day, the material was either placed atop the nest, looped once around the supporting twig, or else carried inside. A large leaf skeleton was at first taken to the top of the nest, but when the bird found it difficult to attach there, she wisely carried it inside. At 2:30 p.m., while the flycatcher was resting on her usual lookout perch with a strand of fibers in her bill, preparatory to taking it into the nest, a stray ox approached noisily through the bushes and ended this rewarding session by chasing her away. I drove off the intruder but waited in vain for the bird's return. The second flat-bill did not appear in this period of concentrated building. This nest seemed to be finished by April 29, 19 days after I found it at an early stage. Three days later it was lying on the ground, empty.

I next watched building on May 19, 1956, when I found a flat-bill at work on a structure which hung, 30 or 40 feet up, from a vine that swung free over a clear space in a fringe of second-growth woods beside a roadway. In three-quarters of an hour the flat-bill brought 20 contributions of material, and as far as the surrounding foliage permitted me to see, it was always alone.

A typical nest had roughly the shape of a chemist's retort, with a rounded chamber entered through a downwardly-directed tubular spout. From the upper extremity, where it was attached, to the opening at the bottom of the spout, the structure measured 14 inches in length. At the level of the chamber, where it was thickest, it measured 6 inches from front to back and 5 inches from side to side. The spout or tubular entranceway projected $2\frac{1}{2}$ inches below the rounded bottom of the chamber. This bulky structure was composed of a great mass of vegetable fibers of various kinds, some black, others brown, still others very light in color. These were matted and entangled (not woven) into a compact fabric, the general tone of which was blackish. Fragments of dead leaves

and a few tufts of green moss were mixed with them. On the outside of the nest, toward the top, were attached some large pieces of papery, partly decayed leaves and a whole, small, living orchid plant. Some dry, shrivelled petioles were fastened to the sides. Some flat-bills extend their structure upward by covering over the supporting twig with fibers, dry leaves and the like to a distance of six inches or more above the nest proper. Thereby they increase the bulk and prominence of an already conspicuous structure.

EGGS AND YOUNG

The nest just described in detail contained a single egg, near the point of hatching, on March 20. Another nest in El General held two eggs on May 28 and a third had two eggs on June 16. It is scarcely possible to remove these eggs without destroying or at least seriously injuring the nest, and they can be seen only by inserting a small mirror pivoted on the end of a wire, while the interior is illuminated by an electric bulb. Hence I have no measurements of them. Part of the shell of an egg, which apparently the flat-bill herself had rolled out of her nest when leaving, was pale reddish brown, mottled with a darker shade of reddish brown in a wreath around the thick end. At one nest the period of incubation was at least 16 days and probably several days more.

The newly hatched nestlings have pink skin which bears sparse but rather long, gray down. In April, 1937, I spent seven morning hours watching my first nest, which then contained a single nestling, possibly a week old. It was still naked except for its scattered tufts of natal down. From 6:10 to 10:10 on April 3 it received food only four times, and from 6:00 to 9:00 on the following day it was fed six times. As far as I could tell, it was given only insect food, which often was carried inside the parent's broad bill. The latter remained open only a trifle to reveal that there was something in it. At other times long legs or antennae, or the wings of a moth, projecting well beyond the sides of the bill, revealed more clearly the nature of its contents. Returning with something for the nestling, the flat-bill usually flew several times back and forth across the clear space in which the nest hung, as though to survey the vicinity and make certain that no enemy was in sight. Then the bird flew beneath the nest, turned sharply upward, and darted neatly into the spout, without clinging for support until it was well inside. Sometimes it approached the nest as though it were about to enter but veered off before touching it and returned to a convenient perch. Possibly the flycatcher had miscalculated the angle of approach. It delivered the food to the nestling while clinging upright in the tubular entrance spout with only the tip of the tail showing at its lower end.

After feeding, the flat-bill usually climbed into the chamber to brood the nestling. The bird, which was presumed to be the female, sat with her head toward the front; for once, when I stealthily crept beneath the nest and threw the beam of an electric torch up the tube, I saw her light-colored lower mandible projecting over the sill of the chamber into the spout. To leave, she darted down the tube head foremost, and on gaining the open inclined her course upward into the branches of the trees. In the seven hours she brooded the nestling 6 times, but only 5 of these sessions were spontaneously terminated. These 5 sessions ranged from 13 to 40 minutes in length and averaged 25.4 minutes. For one of the smaller flycatchers these are rather long periods of brooding, in keeping with the sluggish temperament of this flat-bill. At no time did I see a second parent near this nest.

This nestling left on April 21, 19 days after I first saw it, at which time it was already several days old. I estimated its period in the nest as not less than 23 days. In 1949, I had an accessible nest nearer my residence and made a more accurate determination of the nestling period. The single remaining egg (the other had fallen from the nest) hatched on June 13. By June 29 the nestling was in pinfeathers. Soon after noon on July 9, I,

for the first time, found the youngster with its head in the entrance tube, where I could see it from the ground. Thereafter I refrained from climbing up to the nest in order to avoid causing a premature departure. The nestling was in the same position at noon on the following day, but by 12:30 p.m. on July 11 it had gone, after 28 days in the nest. This is the longest nestling period I have ever determined for a flycatcher. Whenever I visited this nest the parent remained well up in the trees, often out of sight, repeating its harsh whistle. I never saw or heard a second parent.

On May 6, 1959, I spent most of the morning watching a low nest containing two well-feathered nestlings. In the five hours from 6:00 to 11:00 a.m., they were fed 30 times, or 3 times per hour for each nestling. The most rapid feeding was from 8:00 to 9:00, when 10 meals were brought; the least rapid feeding was in the following hour, from 9:00 to 10:00, when only 2 meals were brought. As far as I could see, only insects were given to the nestlings. All except a few small moths were of unrecognized kinds. At no time was a second parent in sight. When I visited this nest six days later, both nestlings darted out and flew beyond sight in the underwood, although it seems unlikely that they could ever before have spread and flapped their wings.

SLEEPING

Since I discovered that the Sulphury Flat-bill uses its breeding nest as a dormitory after the departure of her fledglings, I have not had an accessible breeding nest of the Eye-ringed Flat-bill to ascertain whether it employs the nest in the same manner.¹ But I have long known that the Eye-ringed Flat-bill, like its congener the Olivaceous Flat-bill, roosts singly in a nest, and at times it builds for this purpose one which is never used for breeding. These dormitory nests resemble the breeding nests and are placed in similar situations, but often they are of flimsier construction, with shorter spouts or none at all. The length of the spout depends in part on the period the nest has been occupied, for with the bird's repeated passage in and out the tube tends to wear away. At the beginning of February in 1944, I found a nest, hanging only seven feet up from the lowest branch of a tree in second-growth woods, which already appeared old and weathered, although it still had a prominent entrance spout. Until the following March 16, a single flat-bill slept in this nest. Revisiting it on March 21, I found that the dead supporting twig had broken off and the nest had fallen to the ground. As far as I know, it never contained an egg.

The foregoing is an instance of a nest occupied as a dormitory before the breeding season. I have also found flat-bills sleeping in nests after the nesting season has apparently ended. In early August, 1944, I discovered a nest, with scarcely any entrance spout, attached to mistletoe growing on a tree on the shore of the river below our house. For the remainder of the month a lone bird slept in it, and on repeated visits I failed to find an egg in it. Indeed, the bottom of the chamber was so shallow that if an egg had been laid there, it would probably have rolled out. An even later dormitory nest was occupied by a single flat-bill in late September and early October, 1945. However, it was 20 feet up at the end of a long, slender, drooping twig, and I could not examine its interior for the presence of eggs. But it was not attended by day; and it was most unlikely that the flat-bill was breeding at this season, when none of the local flycatchers, with the possible exception of the Yellow Flycatcher, does so.

These flat-bills were all very shy in approaching their nests in the evening, and they would scarcely ever enter in the presence of an unconcealed observer. Hence I studied

¹ Since this was written, I have found a parent sleeping in a nest from which young had just departed. Probably because the shy flycatcher was disturbed by my watches in the evening to see whether she would lead her fledglings back to sleep in the nest, she abandoned it after a few nights.

their sleeping habits chiefly by watching them emerge at dawn. I cannot tell whether both sexes or only one sex occupy these dormitories. If only one, it is doubtless the female, as seems to be true of the Sulphury Flat-bill.

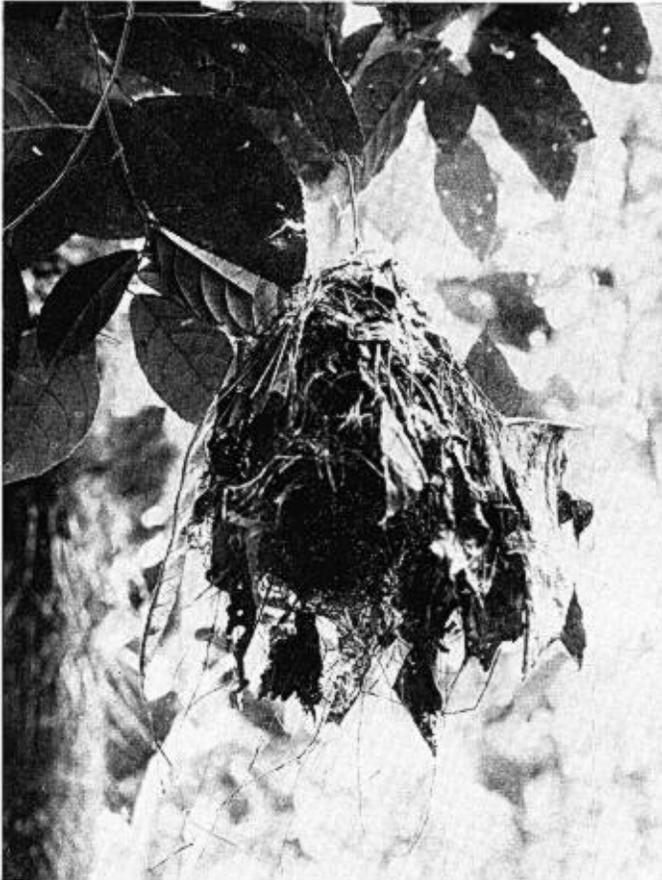


Fig. 86. Sleeping nest of the Olivaceous Flat-bill in the forest on Barro Colorado Island, Canal Zone, March, 1935. This short nest lacks the entrance tube which is prominent on breeding nests in this genus.

SUPPLEMENTARY OBSERVATIONS ON THE OLIVACEOUS FLAT-BILL

In the Canal Zone, eastern Panamá, and much of tropical South America there occurs a second form of flat-bill of the genus *Rhynchocyclus*, which differs from the one we have just considered chiefly in its paler, grayish olive rather than olive-green chest and the more yellowish margins of its wing-coverts. These two forms are so similar that some systematists have united them in the same species, but as Griscom (1932:271) states, they occur together in eastern Panamá, a fact which is incompatible with the view that they are conspecific. My journals of two decades ago refer to the notes of the Olivaceous Flat-bill (*R. olivaceus*) as "harsh monosyllables" and "simple, unmelodious squeaks,"

which are terms that might equally well apply to the calls of the Eye-ringed Flat-bill (*R. brevirostris*). Thus, given the close similarity in appearance of these two birds, one wonders what prevents their interbreeding if they do actually come in contact.

In the early months of 1935, I found the Olivaceous Flat-bill fairly common in the forest on Barro Colorado Island in the Canal Zone, but aside from their mode of sleeping, I learned little about these solitary and mostly silent birds. I do retain a vivid memory of watching one of these thick-billed flycatchers perch well above me in the underwood of the forest and calmly swallow a scorpion of medium size.

As I roamed through the forest on Barro Colorado in the dry month of February, I found a number of nests of various forms, and in good condition as though recently made, which I revisited day after day without finding an egg. Finally it occurred to me that these nests might be used as dormitories, and I undertook to investigate this supposition. The network of clean trails covering the island made nocturnal visits to these nests easy and favored my investigation. When I threw a beam of light into the entranceway of certain retort-shaped nests I had discovered, the rays revealed a pale yellow, downy breast framed in the round aperture. But I could not by this method see enough of the nest's occupant to recognize its kind, and the bird was invariably so shy that only by watching from a blind as it approached in the evening could I obtain an adequate view of it.

By March 18, I had found four occupied sleeping nests of the Olivaceous Flat-bill. All were attached to the ends of slender, drooping, leafy twigs and swung free in clear spaces beneath the trees at heights of 6, 10, 18, and 20 feet. In form they resembled those of the Eye-ringed Flat-bill which I later found and described (p. 512). They showed the same variations, some having a prominent entrance spout, up to three inches in length, while others were devoid of such an appendage and had an opening flush with the walls. One of the latter type had so little concavity in the bottom of the chamber that an egg laid in it would almost certainly have rolled out. I surmised that the more elaborate nests belonged to females and the simpler, spoutless ones to males; but the similarity of the sexes made it impossible to prove this in the continued absence of eggs. These nests were composed of black fibrous roots, fine brown fibers from leaves or stems, and light partially decayed sticks; and on the outside, especially toward the top, a number of fairly large dead leaves were loosely attached to them. Although these nests, like those of the Eye-ringed Flat-bill, had an untidy appearance, the thick, matted walls, with their additional thatch of leaves, seemed adequate to shed the hardest rain and keep the interior snug and dry. One of the better-made nests, with a prominent spout, was 11 inches in length and 5 inches in diameter.

The first of these nests, a short one devoid of a spout, was found on February 9, and when investigated after nightfall on February 19 it contained a sleeper, which continued to lodge in it until at least March 8. By March 12 it was abandoned. The second nest, which had a fine spout, had an occupant from at least February 21 to March 27. The third and fourth, which hung out of reach, sheltered sleepers during the night of March 11-12; the second also was occupied six nights later. The high nests were unattended by day, indicating that they did not contain eggs or young. The interiors of the low ones were examined from time to time throughout the period of these observations, but no eggs were found in them. In late February and March these flat-bills entered their dormitories between 6:00 and 6:12 in the evening and flew out between 6:19 and 6:30 the next morning.

I did not find a breeding nest of the Olivaceous Flat-bill, but Eisenmann (1952:43) records one, found by E. Thomas Gilliard on Barro Colorado on April 13, 1937, that contained young a few days old.

RELATIONSHIP OF RHYNCHOCYCLUS AND TOLMOMYIAS

The genera *Rhynchocyclus* and *Tolmomyias* construct nests of the same form, yet one which, as far as I know, is not duplicated in any other genus of flycatchers. Both use these peculiar nests as dormitories; yet I am familiar with no other member of the flycatcher family which takes advantage of its nest for lodging, even when it makes a covered structure. *Rhynchocyclus* appears to build nests especially for use as dormitories; whereas *Tolmomyias*, as far as I have learned, merely sleeps in its old breeding nests until they collapse or fall. Hence it is tempting to conclude that these two genera are closely related, and that the situation with regard to sleeping found in *Rhynchocyclus* is a further development of that exhibited by *Tolmomyias*. One who first knew as *Rhynchocyclus* the genus we now call *Tolmomyias*, when the present *Tolmomyias* was designated *Craspedoprion*, is especially likely to assume that they are closely related. But certain features in the life histories of the two groups weigh against this assumption. *Tolmomyias* forms pairs and *Rhynchocyclus* does not (as to the mated state of *T. flaviventris*, see Haverschmidt, 1950). The eggs of *Tolmomyias* are white and speckled, whereas those of *Rhynchocyclus* have a reddish brown shell. The young of *Tolmomyias* are hatched without down, whereas those of *Rhynchocyclus* bear natal down. Although these two genera seem to be nearer to each other than to the remaining members of the Tyrannidae, their relationship is certainly not close.

SUMMARY

The Eye-ringed Flat-bill inhabits primary forest and taller second-growth woodlands, where it remains above the shrubs but below the crowns of the great trees. It is a solitary bird and appears not to form pairs even in the nesting season, but it may follow mixed flocks of the small birds of the woodland. It subsists on insects. Its call is a weak, harsh, often spluttering, whistle.

Nests are used not only for breeding, but they are also used for sleeping outside the season of reproduction. The two sorts of nests are similar, but those in which eggs are laid are larger and more carefully constructed than some of the dormitory nests. The breeding nest is a retort-shaped structure, with a downward-pointing entrance tube leading into a well-enclosed chamber. The usually dark walls are of matted fibers, with large dead leaves and other material attached loosely to the exterior. These nests are attached to slender, drooping twigs or more rarely vines, where they hang in a clear space in the woodland, from eight to 35 feet above the ground. At two of these nests, a single bird built. One of these builders drove away a second flat-bill that approached bearing a scrap of material. The construction of one nest required about three weeks.

The set consists of 2 eggs, which are pale reddish brown mottled with darker reddish brown, especially in a wreath about the thick end. Incubation lasts more than 16 days.

Newly hatched nestlings bear sparse gray down on their pink skin. A single parent feeds and broods the young. One nestling stayed in the nest until 28 days of age.

Nests are used for roosting through most if not all of the year. Some of these dormitories lack an entrance spout, so that their doorway is a simple opening in the wall, and the concavity at the bottom of the chamber is so shallow that an egg would probably roll out. The flat-bills sleep singly in these nests.

In the Panamá Canal Zone, four occupied dormitories of the Olivaceous Flat-bill were found in February and March. Each had a single occupant of undetermined sex. Careful watching failed to reveal that an egg was laid in any of them.

Despite the similarity in shape of their peculiar nests and the fact that in both genera they are used as dormitories, the genera *Rhynchocyclus* and *Tolmomyias* appear not to be closely related.

ROYAL FLYCATCHER

Onychorhynchus mexicanus

The Royal Flycatcher nearly always travels with his regal diadem concealed beneath a drab and undistinguished headgear. Seen thus in the deep shade of the forest, this flycatcher of dull plumage and medium size, about six and a half inches in length, has few features to attract the eye, save possibly the tawny-orange of its tail and a peculiar knot of feathers at the back of its head. Its upper plumage is olive-brown, becoming yellowish buff on the lower rump and upper tail-coverts. Its throat is pale yellowish buff, merging into tawny-yellow on the rest of the under parts. There are faint, dark transverse bars on the breast, especially at its sides. The tawny-orange of the greater portion of the tail shades to brown at the tip, and there are spots of buff on the wing-coverts. The eyes are dark. The black bill is long, broad and straight, with a little hook at the tip. The inside of the mouth is bright yellow, as are the legs and toes.

At times one may glimpse a trace of scarlet in the center of the bird's crown, but it is not often that one has the good fortune to see the splendid diadem raised and fully expanded. When this occurs, the modestly attired flycatcher is converted, momentarily at least, into the most resplendent being in all the huge family Tyrannidae. To behold the Royal Flycatcher with expanded crest is an unforgettable experience; for it is only in pictures painted by artists who never saw the living bird that the diadem remains for any considerable period in this position. It is now many years since I first saw a Royal Flycatcher display its headgear, but the memory remains as fresh as though it happened yesterday. I had been sitting on a log stranded upon rocks beside a mountain torrent in the forested foothills of northern Honduras, watching a Royal Flycatcher's nest, when a shower began to fall and soon increased to a heavy downpour. I took shelter by crouching beneath a neighboring ledge of rock, overgrown with moss and ferns. My retreat proved dry for only a short while; for as the water accumulated above, it formed little rivulets, which trickled down the slanting lower side of the ledge until they met some sharp projection, from which they precipitated themselves in jets to the ground. I was having difficulty in adjusting myself between the external deluge and the numerous streams descending from my roof and becoming uncomfortably wet in the cold rain when I noticed that the Royal Flycatchers had returned and were thoroughly enjoying the shower, flitting from twig to twig above the river, spreading wings and tail to the raindrops, and preening their plumage with evident satisfaction.

In this general rearrangement of feathers, the birds did not neglect their dull olive crests, which lay very flat and projected at the back of the crown in a little tuft of feathers, giving the flycatchers an odd, hammer-headed aspect. For a moment the crest of the male was raised and spread fanwise to its fullest extent, encircling his head with a halo of glory, a scarlet aureole bordered with spots of bluish violet and velvety black, beside which the flame-colored crests of kingbirds and other big flycatchers pale to insignificance. Little had I suspected what splendor the Royal Flycatcher kept concealed beneath those dull feathers that covered his folded crest! Then the female opened out her queenly headgear, as widely spreading as her mate's and only slightly paler in color. The display lasted less than a minute; the gorgeous diadems were folded away, and the birds were transformed once more into plainly attired hammerheads.

These brilliant crests are the regal splendors of the Royal Flycatchers, their title to a place among the nobility of birds. But I still know all too little about their significance in the lives of the birds, except that they are displayed far too seldom to satisfy the bird



Fig. 87. Royal Flycatcher.

watcher. Once again along this same mountain stream I saw a Royal Flycatcher spread its crest, also while the bird was preening its plumage in a shower. Despite many casual encounters with these flycatchers, I did not again witness the expansion of the diadem until nine years later, this time by a male whose mate was building a nest above a Costa Rican stream. After another 16 years, I saw a male display to his mate which was already attending eggs (see under Incubation). Collectors affirm that the crest is displayed

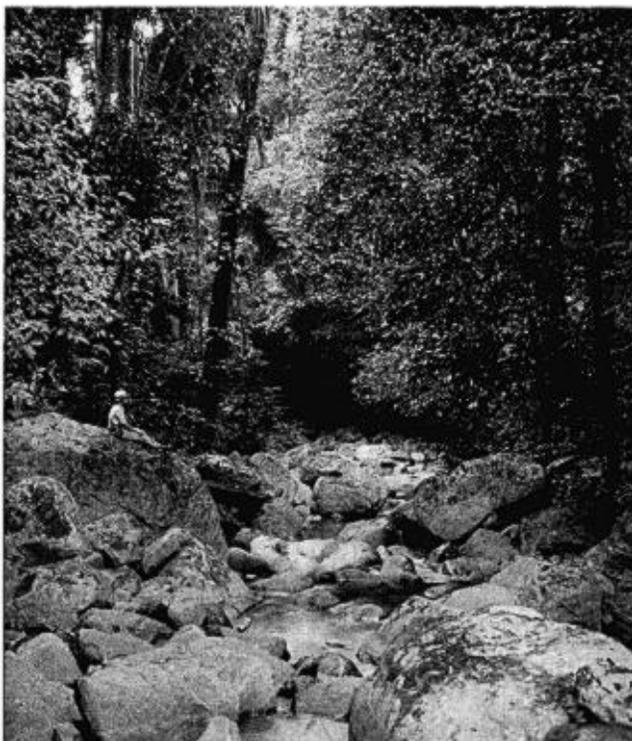


Fig. 88. Forest stream in the Caribbean foothills of Honduras. Above or beside this watercourse were found nests of the Royal Flycatcher, *Oleaginous Pipromorpha*, Gray's Thrush, and Massena Trogon.

while the birds fight, which I have never seen them do, and that when wounded and taken in hand, the flycatcher unfolds its crest and turns its head slowly from side to side. Doubtless the principal use of the diadem is in courtship, but I have never had the good fortune to witness the prenuptial activities of the Royal Flycatcher.

Royal Flycatchers of the genus *Onychorhynchus* are found in the forested parts of continental America from southern México to southeastern Brazil and western Ecuador. Four species, some of which possibly do not deserve this rank, are recognized. Of these, the subject of our present study is the northernmost species and ranges from southern México to Colombia and northwestern Venezuela. In both Guatemala and Panamá it occurs in the lowlands of both coasts, but in Costa Rica, oddly enough, it is known only on the Pacific side. A heat-loving bird, it does not extend as far above sea level as many another lowland species. In southern Costa Rica I have found it nesting up to an altitude of 2500 feet, and it is an occasional straggler about 1000 feet higher. It is at home in the

heavy rain forest, where it hunts at no great height above the ground, and usually in the neighborhood of streams. But it is by no means absent from areas of second-growth woodland and thickets even at a distance from the primary forest; I never have found the species more abundant than in the light, tangled second growth along the Río Copón in the northern part of the Guatemalan Department of El Quiché, at an altitude of 1100 feet. It appears to venture into the bushy lands more often after than during the breeding season, yet it may nest along streams flowing between open fields and pastures if they are well shaded by a fringe of tall trees and the forest is not far distant. Except when they are nesting, I have seen Royal Flycatchers alone more often than in pairs, and they never flock.

FOOD

Royal Flycatchers subsist upon insects which they catch in their broad, flat bills as they dart swiftly from branch to branch in the underwood, or above the channels of forest streams. At times they capture prey as large and swift as dragonflies, and big butterflies are included in their diet. From these the wings are removed by vigorous beating against the perch before the body is swallowed. The Royal Flycatchers do not, as has been quaintly suggested, spread their crests while hunting, so that insects may mistake them for nodding scarlet blossoms and, coming to claim the nectar that the supposed flowers should contain, fall the readier prey to the flycatcher!

VOICE

The Royal Flycatcher's most common note is a loud, mellow, hollow-sounding whistle, not unlike that of the Crested Flycatcher, but it is fuller and clearer and possessed of a weird, melancholy quality as one hears it emanating from the bird unseen amid the dim foliage of the forest depths, or rising above the loud murmur of a mountain stream. It has a quality in keeping with the wildness of the setting, which is in turn enhanced by it. In at least some pairs, the voice of the male is deeper and fuller than that of the female, but while engaged in the duties of the nest, she calls more often than he. The male at times utters a call consisting of a single kind of note of most peculiar character, higher in pitch and slightly sharper than the usual single whistle, and repeated deliberately many times over.

NEST BUILDING

The pensile nest of the Royal Flycatcher, a yard or two in length, is one of the most amazing structures made by any of the numerous species of a family of birds which in variety of architecture is second to none. In Guatemala, Honduras, Costa Rica, and Panamá I have found nine of these nests, and all were attached to the ends of slender drooping branchlets, or to thin vines, hanging above rivulets or wider streams flowing through the forest or between well-shaded banks amid neighboring clearings. In height these nests ranged from about 8 to 20 feet above the water. Lawrence (1862:329) and Nutting (1882:396) also state that the nest is always suspended from a branch above a stream.

Nest building may begin in mid-February in the Canal Zone, in early February in the upper Térraba Valley of Costa Rica, but apparently not before April in northern Central America. In 1939, I watched the construction of two nests in the Térraba Valley. The first was discovered on April 4, when recently begun. It was attached to a long, slender branch of a scrambling shrub which reached far out above the channel of a sluggish, meandering stream flowing through second-growth woodland. Here it swung free

about ten feet above the water. The flycatcher had fastened material to this bough in two places: to the end of the main branch, and to a point near the end of a short lateral twig, about two feet distant from the first. By the morning of April 8, when I began to watch, the mass of material suspended from the end of the main branch was considerably greater than that attached to the lateral. The long, thread-like pistillate inflorescences of *Myriocarpa*, a shrub or small tree belonging to the nettle family and frequent along the water-courses of the Central American lowlands, were the foundation material of both incipient nests. They had already ripened their myriad minute achenes and were dry and brown. Among these were entangled shorter fibers, pieces of dead leaves, cobweb, and bits of other material. About 30 feet downstream hung the remains of an old Royal Flycatcher's nest, possibly the last year's nest of the bird now building.

Seated on the sloping bank of the stream seven or eight yards from the nest, with nothing to conceal me, I watched the flycatcher at work. Not only was she indifferent to my presence as long as I did not stand upright, but in approaching her nest she often flew close above me, once almost brushing my hat as she passed. After adding her billful to the structure, she sometimes rested above the bank of the stream close in front of me, far nearer to me than I was to her nest.

At first I could distinguish the sexes of this pair only by the more yellowish shade of the female's crest, when this was from time to time revealed by a slight separation of the olive feathers that covered it. Later I noticed that the folded crest of the male projected slightly farther at the back of the head than that of the female. In six hours of attentive watching divided between three mornings, I saw no indication that the male took a share in nest building, although he was often in the vicinity.

On April 8 the female was adding material to both of her incipient nests, although she chiefly devoted her energies to increasing the mass of material at the end of the terminal branch. This was still a loose weft of tangled strands which revealed no trace of a cavity for the accommodation of the eggs. Arriving nearly always from downstream with material in her bill, the female flycatcher usually alighted upon the supporting twig at the point where the nest was fastened. Then she had two quite distinct modes of procedure. She might attach her material at the point where she rested, simply bending down to push her billful into the mass below her or wrapping longer strands about the supporting branch by pivoting around it once or even twice with her entire body. Or she might drop down below her perch, at the same time turning to face the nest, and with her bill thrust the new material into the side of the mass while she hung on fluttering wings beside it—an almost instantaneous act. She appeared unable to hover for even as long as two or three seconds, and if her first forward thrust did not transfer all the material from her bill to the nest, she found it necessary to return to her perch, rest a brief while, then repeat the same procedure. Sometimes upon arriving with material she alighted upon the lateral branch but discovered her error in time to flit across to the main branch before depositing her billful. But at other times she affixed the stuff at the wrong place and allowed it to remain there.

Between 7:15 and 9:15 a.m. the female flycatcher brought material 32 times for both masses. At 9:30 it occurred to me to keep the record for the two sites separately. During the next hour she brought 16 billfuls to the terminal mass and seven billfuls to the lateral. She was working more actively now than earlier in the morning. In the course of this hour a gust of wind entangled the branch that supported the nests with a neighboring slender branch. While the two boughs were crossed, the bird brought material four times, and each time attached it to the lateral mass, which was farthest from the interfering foliage of the other branch. After another gust of wind had separated the two boughs, the bird resumed work on the terminal nest. Probably the entanglement of the

terminal nest with the neighboring bough was originally the cause of the flycatcher's starting the second nest.

In the next two days the bird concentrated her efforts on the terminal nest, which advanced considerably, while the lateral accumulation of material scarcely increased. She now spread apart the fibers of the former at a point just below the foliage at the tip of the supporting bough, thus forming the shallow, sideward-facing niche which was destined to hold the eggs. While I watched on the morning of April 11, she alternately took material into this niche and attached it to the top of the nest and to the supporting twig. Conspicuous among the materials fastened to the upper extremity of the nest were more brown inflorescences of *Myriocarpa*, pieces of dead leaf, and skeins of cobweb. Some of these materials were carefully wrapped around the branch with a complete turn or a turn and a half; others were negligently attached with only a half-turn around the support, or else still more slightly stuck into the top of the nest with a single rapid and seemingly heedless movement of the bill. Yet most of them stayed where they were put, although one bit of dead leaf fluttered down to the water as soon as the bird left it on the nest. She was attaching material higher and higher up the supporting branch, so that her structure, or at least superstructure, grew slowly upward. I saw her add nothing to the outside of her nest, except at the top.

The material taken into the niche to line it consisted chiefly of dry inflorescences of *Myriocarpa*. Arriving with something for the lining, the flycatcher would alight upon the supporting bough at the top of the nest, and after a moment's rest she would drop down to the chamber. But the sudden removal of her weight from the branch would cause it to swing, and this movement would confuse the bird when she tried to enter the niche. Often she found it necessary to rest on a neighboring bough and try again to fly into the niche after the movement of the nest had stopped. Finally she learned to approach the niche from some point beside the nest rather than from the supporting bough. In the two hours between 7:05 and 9:05 on April 11, the female flycatcher brought 63 billfuls of material to the nest.

Four days later, on April 15, the Royal Flycatcher was still alternately taking material into the niche and attaching things loosely to the top of the column that had been climbing up the supporting branch. During 40 minutes she brought material 17 times. Thirteen of these billfuls consisted of fine brown fibers which she took into the niche as lining; four billfuls were material that she fastened at the top of the nest. The bird had by this time loosely covered over the supporting bough, with brown fibrous material and pieces of dead leaf, for a distance of at least a yard above the original point of attachment of the hanging portion of the structure. This upward extension had carried the nest begun on the terminal twig to a point well above the lateral twig to which the bird had also attached material, as though beginning a second nest. Her work on the latter was not wasted, for it now blended with the general mass of loose material above the nest proper. The function of this seemed to be to divert attention from the actual position of the protectively colored eggs and young in their shallow niche. The entire structure was now about six feet long; the hanging portion was far shorter than the elongate mass of loose material wrapped about the twig above it. The niche was therefore well below the middle of the whole nest. After about 12 days of building the structure appeared to be completed; although ten more days elapsed before the first egg was laid, the nest was not perceptibly changed in the interval.

While building, the female Royal Flycatcher was fairly noisy, often sounding her loud, mellow whistles as she perched near her nest. The male was more silent. Although he spent much time in the vicinity of the nest, especially in the early morning, he took no share in building and never actually visited it. Once he chased another Royal Flycatcher away from the vicinity of the nest.

About the same time, I watched a second Royal Flycatcher build a nest above a narrow rivulet that flowed through a grove of guava trees. When found, the chamber had already been formed but its walls were still very thin. This bird was far more timid than her neighbor and would not go ahead with her work unless I concealed myself in a blind. She also built without help from her mate, and like the other bird lined the niche at the same time that she covered over the supporting twig at the top of the structure, depositing her material, according to its nature, now within, now atop the nest. In two hours,



Fig. 89. Nest of Royal Flycatcher from the Caribbean foothills of Honduras, June 27, 1930. The boy's finger indicates the niche where the eggs were laid.

she attached material to the twig 39 times and took fibers inside for the lining 23 times—a total of 62 visits to the nest between 6:35 and 8:35 a.m. With this Royal Flycatcher, as with the first, the deposition of a new piece of material was an almost instantaneous act, a mere push of the bill; she gave almost no attention to its careful arrangement, in the way that most birds do. Yet practically all of the material she stuck so loosely to the supporting twig stayed where she put it; she had the knack of doing her work deftly with a minimum of effort. Among the things used to extend the nest upward and cover over the supporting branchlet were small dry grass plants, dry leaves, and rootlets picked from the ground beneath the guava trees.

The male of this pair, too, although he did not work, lingered much of the time in

the vicinity of the nest, and once drove away an intruder of his own kind. He, also, was far more silent than the female, rarely uttering a sound; whereas in approaching or leaving her nest the female constantly repeated her whistle, in a voice slightly higher than his. Once I saw the male spread his wide, flaming crest—a memorable event! This nest was torn apart, probably by a toucan, before completion.

Although not the most beautiful nor the most commodious, the nest of the Royal Flycatcher is the most unexpected example of bird architecture that I have ever found, and it has caused more speculation on its origin and significance than any other nest. My first Royal Flycatcher's nest, discovered soon after I began the study of tropical birds, was so utterly different from any bird's nest that I had ever seen in northern lands, that I sat a long time in sight of it without suspecting its nature. Until the continued interest of the flycatcher in the elongate mass of brown vegetable material led me to investigate, I took it to be a mass of dead vegetation fallen from the epiphyte-burdened trees above and caught up on the branch of a shrub, or perhaps deposited there by a rise in the current of the mountain stream above which it hung. My first examination of the curious structure failed to disclose the two protectively colored eggs that it already contained. This nest, which because it was my first received the most careful scrutiny and was most minutely described, may well serve as our "type specimen." Others which I found later differed from it only in minor details.

The nest hung in the deep shade of heavy forest above a mountain torrent in northern Honduras, where by standing on a ledge of rock I could barely manage to reach and examine it. From the top to the dangling end of the longest pendent fiber it measured 5 feet. About half the length of the irregular, tangled mass had been built around the pen-sile vine that supported it; the remainder hung free below the end of the vine. In the unattached lower portion of the mass, somewhat below its middle, the fibers had been spread apart to form a shallow niche in which the eggs reposed. This open chamber measured $4\frac{1}{2}$ inches in height by $2\frac{1}{2}$ in diameter. The doorway or opening in the side was $3\frac{1}{4}$ inches high by $1\frac{1}{2}$ inches wide; its lower edge was barely $\frac{1}{2}$ inch above the bottom of the chamber. The eggs were accordingly in a depression so shallow that it would not have required much shaking of the nest to roll them out; fortunately, in this narrow valley deep in the forest, it was never agitated by strong breezes. The materials of the nest were long, dry inflorescences of *Myriocarpa*, coarse roots of epiphytic orchids and even the entire basal portion of smaller species with roots attached, slender rhizomes of epiphytic ferns, fibers apparently from the leaf bases of palms, a few dead leaves, and a few bits of green moss. The irregular mass of tangled material was thickest above the niche, where it formed a large swelling, and the predominant color was brown. In some nests the superstructure or portion above the niche that holds the eggs is formed by covering over with material several neighboring twigs and is quite wide and spreading. The niche is regularly in the unattached portion below this upper mass, and below the niche there is always a long, slender "tail." Nests vary greatly in total length, from slightly more than two to nearly six feet. Two or three weeks, and at times over a month may be devoted to the construction of these elaborate nests.

THE EGGS

On Barro Colorado Island, Canal Zone, I found a Royal Flycatcher incubating in an inaccessible nest on March 18, 1935, but in the upper Térraba Valley of Costa Rica I have seen no eggs before March 23. In two nests in northern Honduras, the eggs, as calculated from the date of hatching, were laid in mid-May. At the nest watched most closely, at least a week elapsed between the completion of the structure and the laying of the first egg. The second egg was deposited two days after the first. At a nest in El

General which was recently begun when found on the surprisingly early date of February 7 and which seemed to be finished on March 10, the first egg was laid on March 23 and the second egg was deposited after 7:00 a.m. but before noon on March 25. Six nests whose contents I was able to examine contained two eggs or nestlings each. Lawrence (1862) states that the number of eggs in a Royal Flycatcher's nest is "invariably two."

The eggs have a most peculiar aspect, quite different from that of any other flycatcher's eggs that I know, and of all the flycatchers' eggs that I have seen, they are the darkest. Eggs found in northern Honduras and Guatemala were deep reddish brown on the thicker end, paling to dull buff on the sharp end, appearing as though the entire surface had originally been of the latter color and the reddish brown pigment had been poured upon the thick end and allowed to run down over the sides of the egg. Eggs from Panamá are described by Lawrence: "the ground color is of a dull pale reddish white, marked for half the length with dull reddish brown lighter at the end, which gives the appearance of a confused broad belt just back of the largest diameter; the smaller end is irregularly spotted and streaked with the same dark color." The measurements of four eggs that I found in northern Central America averaged 19.7 by 14.8 millimeters. Those showing the four extremes were 20.6 by 15.5 and 18.7 by 14.3 millimeters. Lawrence gives the measurements of eggs from Panamá as 20.6 by 15.9 millimeters ($1\frac{3}{16}$ by $1\frac{1}{16}$ inch).

INCUBATION

The eggs are incubated by the female only. I have always seen her sitting in the shallow niche with practically the whole length of her tawny-orange tail projecting horizontally through the doorway into the outer air. Indeed, were she to sit in the reverse position, there would hardly be room for it in the nest. The tail, despite its fairly bright color, is far less conspicuous than one might suppose. As she sits in the shaded interior of the open niche, her head turned sideways beside the rear wall, the olive-brown bird is too dull a figure to attract attention. Her tail, especially when illuminated by a patch of sun filtering through the foliage above, is so much brighter than the modestly attired bird herself that it seems a thing apart from her—a freshly fallen leaf of lighter hue that has been caught up among others in the tangled mass of vegetable fibers that constitute the nest.

In 1939, I spent a total of six hours, four in the morning and two in the afternoon, watching the Royal Flycatcher incubate in the nest that I had seen her build above the sluggish, meandering stream. In this period I timed 10 sessions which ranged from 9 to 32 minutes in length and averaged 17.9 minutes, and 10 recesses which varied from 4 to 18 minutes and averaged 12 minutes. The bird spent only 59.9 per cent of the six hours on her eggs. Once she darted out of her niche to snatch up a moth that passed temptingly close in front of it; then she returned to her eggs two minutes later. However, I did not count this brief intermission as a recess. In the morning the male often appeared and lingered near the nest, but I could detect no relationship between his visits and the movements of his mate. He never actually went to the nest. In the late afternoon I did not see him.

In 1955, I at last discovered a nest of the Royal Flycatcher on our farm in El General. This appears to be at the upper edge of this bird's breeding range in this part of Costa Rica. The unusually short nest dangled nine feet above the surface of a still pool in a narrow, rocky channel that ran parallel to a small stream and carried a current only in rainier periods, especially when the swollen stream overflowed into it. The sequestered pool lay in the midst of tall second-growth woods between our house and the Peña Blanca River. When found on April 22, the nest already contained two eggs, whose dark coloration made them difficult to distinguish in the mirror which I used to inspect the nest chamber.

From a blind set at the edge of the rocky channel, I watched this nest all of the morning of April 26 and all of the following afternoon, a total of slightly more than 12 hours. The incubating female began her first recess of the day at 6:06 a.m. on April 26 and entered the nest for the night at 5:50 p.m. on April 27. During her active period I timed 19 sessions ranging from 4 to 52 minutes and averaging 22.4 minutes and an equal number of recesses which varied from 3 to 33 minutes and averaged 13.6 minutes. Thus she kept her eggs covered for 62.3 per cent of the day. She sat slightly more constantly in the forenoon than in the afternoon, and her longest session, 52 minutes, ended just before midday. Her comings and goings were erratic; long sessions alternated with very short ones, and long recesses with short recesses, in a most capricious fashion. Much of the time while sitting she kept her crest slightly spread, and the intensely yellow feathers gleamed brightly in the shadow at the back of the open niche; for like others of her kind, she incubated with her head inward and her long orange-tawny tail projecting outward through the doorway. Since her mate's crest was brilliant scarlet, this often-glimpsed yellow of her crown served to distinguish her and to convince me that she alone sat in the nest.

Five of this flycatcher's morning sessions were terminated by some slight disturbance: when a squirrel passed near the nest; when a White-fronted Dove flew close by it; when a Gray-necked Wood Rail jumped with spread wings into the still pool beneath it; when a bough crashed down in the distance; and when a horse neighed out of sight in the pasture beyond the creek. Three of these interrupted sessions happened to be just 31 minutes in length, hence well above the average; the other two lasted 10 and 14 minutes.

On leaving her eggs, the female flycatcher usually flew to a low, sparsely branched bush just in front of the nest. Here she spent much time preening and scratching. All her movements, especially those of her bill in preening, were very rapid, so that, in contrast to the leisurely preening of some birds, she seemed to perform this office in a great hurry. Sometimes while engaged in this endless occupation she spread her yellow crest. At times, in the midst of her preening, she would twitch both wings simultaneously, at the same time slightly spreading her tail. These movements are more pronounced in the male's display. From time to time the female darted rapidly from one branch to another of the bush in which she rested, tracing an erratic course and weaving her way through the twigs with marvellous skill. If these darts were for the purpose of catching flying insects, the victims were too small to be seen from where I sat; the bird seemed to make these flights as an exercise or a game. In longer sallies, more obviously for the purpose of catching insects, she displayed the same skill in weaving a course through tangled vegetation near the ground. All her movements were quick and graceful, as befitted a bird so splendidly adorned.

Although after 1:15 in the afternoon the male was not once seen near the nest, in the morning he was conspicuous in its vicinity; yet he did not once go to look into it. As was true of the female, this male revealed his crest more often than the Royal Flycatchers I had earlier studied. Sometimes the crest was spread widely while he preened. In the middle of the morning he came with his mate when she returned from an excursion for finding food. Alighting on a vine near the nest, he spread his scarlet diadem to the full and turned his head from side to side so rapidly that the feathers quivered. At the same time, he shook his half-opened wings, fanned out his yellowish tail, and uttered a rapid series of peculiar notes, somewhat like the usual piping call but sharper. This superb display, the only one I have ever seen in many hours of watching Royal Flycatchers, lasted only a few seconds. At its conclusion, the female, which gave no overt response to it, entered her nest. An hour later, when a Buff-throated Saltator

perched below the nest, the male flycatcher darted at it with his flaming crest spread widely. Although the trespasser refused to retreat, he did not press his attack. The rarity of the full display of the Royal Flycatcher's diadem adds to its marvellous effectiveness.

At one nest the second egg was laid on April 27 and both hatched on May 19, giving an incubation period of 22 days. At another nest the first egg was laid on March 23 and the second on March 25; one egg hatched on April 16 and the other on April 17, after an incubation period of 23 days.

THE NESTLINGS

Despite the long period of incubation, the Royal Flycatchers are at hatching no further developed than other members of the family. They are blind and utterly naked, without the sparse natal down usually found on flycatchers. They are fed and brooded by the female alone. The male, so far as I could learn by careful observation of three nests in the Terraba Valley, did no more than to guard the young. The nest at which I watched the process of building and incubation also received the greatest share of my attention while it contained nestlings. Observations on brooding and feeding are summarized in table 8, where I also give for comparison that part of the record for incubation corresponding to the hours of the day during which I watched the care of the nestlings.

Table 8

Care of Two Nestling Royal Flycatchers

Date 1939	Hour a.m.	Age of nestlings	Minutes of incubating or brooding by female	Times female fed nestlings
May 6	6:53-8:53	Eggs	19, 32, 22=73	0
20	6:45-8:45	1 day	20, 4, 5, 3, 7, 42=81	5
22	6:51-8:51	3 days	3+, 2, 14, 9, 10, 15=53	5
25	6:57-8:57	6	13, 10, 2, 9=34	7
31	6:55-8:55	12	0	15
June 7	6:10-7:40	19	0	18

It is of interest that the female Royal Flycatcher sat longer in the nest on the day after the nestlings hatched than during the corresponding period on the ninth day of incubation, and that her longest session which I recorded after the nestlings hatched, 42 minutes, was 10 minutes longer than the longest session that I timed while she incubated.

Compared with many other flycatchers, young Royal Flycatchers are at all ages fed rather seldom. So far as I could see, their food consisted entirely of insects, mostly too small to be distinguished as to kind. Once, after the nestlings were feathered, they were served a slender demoiselle fly. While delivering food, the female flycatcher stood upright in the entrance in a woodpecker-like attitude, her tail pressed against the side of the nest below the sill. Then, while the nestlings were younger, she would usually settle down to brood them, and her tail would become horizontal. She always brooded with her tail outward, the same position as she had used while incubating.

The male Royal Flycatcher continued to spend considerable time in the vicinity of the nest and to drive away intruders of his own species, but I never saw him actually go to look into the nest. When I stood on the nearest point of the shore and viewed the nestlings by holding a mirror above them, he added his voice to the complaints of the female; but he called far less than she and remained at a greater distance. At a nest

that I studied the following year, also in the Terraba Valley, the conduct of the male was much the same; he often came near the nest and sometimes lingered for considerable periods, but never, so far as I saw, took any interest in the nestlings. At this nest the female had a yellowish crest, far paler than the scarlet diadem of her mate. After delivering food, she would rest upon a branchlet near the nest and spread her crest more or less widely but never completely, usually delaying here a good while before she flew down the river to catch more insects. Thus I could nearly always determine beyond doubt the sex of the parent that fed the nestlings.

The parts taken by the parents at the nest in front of our house in 1955 were much the same as at the two earlier nests. On the morning when the two nestlings were five days old I watched from 7:10 to 11:10 a.m. In the four hours the young were fed only eight times, or at the rate of once per nestling per hour. Six of these times I positively identified the female as the food bringer by her yellow crown feathers which were partly exposed. In the four hours she brooded only six times, for 16, 8, 6, 3, 5 and 4 minutes, a total of 42 minutes or only 17.5 per cent of the period. This seemed like insufficient time for naked nestlings, yet it was probably long enough, for the morning was mild. Her absences were at times surprisingly long; one lasted 42 and another 76 minutes. Probably she stayed away so long because she foraged at a good distance from the nest, in the primary forest, to reach which she flew swiftly across a shady pasture which separated it from the second-growth woodland where she nested. On her return she nearly always bore food which seemed to consist of insects, apparently at times of butterflies, which were difficult to recognize because the wings had already been removed.

While brooding in her usual position, with tail outward and head turned sideways at the rear of the chamber, she usually expanded her crest more or less widely, sometimes to about half its full spread. From my post in the blind, the bright yellow was conspicuous in the dark niche, and it seemed to diminish the value of the otherwise so admirable concealing coloration of the sitting bird. But a leaf projecting over the opening screened this gay display from above.

I watched this nest again from 9:00 to 11:00 on the morning of May 28, when the two nestlings were 19 days old. They were fed five times in the first hour and nine times in the second hour. Ten of these 14 feedings were certainly brought by the female, which I recognized by her crest. She no longer brooded. I did not once definitely identify the male as the food bringer; even when I could not see the concealed crown feathers of the nestlings' attendant, its mannerisms were those of the female rather than of the male. As on the earlier morning, the male was often in the vicinity of the nest, where he spent most of his time preening, revealing more or less of his scarlet crest, which once he spread fully. At no time did I see him go to look at his nestlings.

The Royal Flycatcher, in which the male guards but does not feed the nestlings, occupies a position intermediate between the many species of flycatchers in which the male takes his full share in feeding and those few in which the male apparently takes no interest at all in the nest, including species of *Myiobius*, *Oncostoma*, *Terenotriccus*, *Pipromorpha* and *Rhynchocyclus* (= *Craspedoprion*).

The nestling Royal Flycatchers develop slowly. Wholly naked at hatching, at the age of one week their eyes are still closed and their feathers ensheathed. When they are ten days old their eyes are partly open and their feathers begin to escape the sheaths. At the age of 12 days they are fairly well clothed with plumage. Although in all other species of Tyrannidae that I have studied the juvenal plumage is essentially similar to the adult plumage, in the Royal Flycatcher the feathered nestling in its barred attire

is strikingly different from its parents, whose plumage is only obscurely barred. Narrow, alternating bars of yellowish buff and dusky cover all the upper parts including head, hindneck, back, rump, wing-coverts and tail-coverts, and extend to the foreneck and chest. The belly, sides and flanks are sulphur yellow. The remiges are dusky, the inner primaries and secondaries margined on the inner vane and tipped with yellowish buff. The greater coverts are dusky, and all except the outermost are tipped with yellowish buff. The tail feathers are buffy orange at the end, and they are more dusky, but



Fig. 90. Nestling Royal Flycatcher, 20 days old, in its usual orientation in the nest. Near Tela, Honduras, June 30, 1930.

still tinged with orange, toward the base. The crest of barred feathers is already prominent when erected. The feet are yellow, the irides are dark brown, the upper mandible is black, and the lower mandible is orange.

From an early age the nestlings rest in their shallow niche with their heads at the rear and their sprouting tails in the doorway. This is exactly the same orientation as the female assumes while incubating and brooding. Their food is passed to them over their backs. As they grow older, they become very crowded in their narrow swinging cradle, which is barely wide enough to hold one with comfort. During the last of their three weeks in the nest one nestling usually rests upon the other. Now they spend much time preening their barred plumage and when engaged in this activity sometimes spread their small orange crests, just as their parents do while preening. At times they utter, in a voice slightly weaker than the female's, a note much resembling her me!low whistle.

From the nest studied most carefully in 1939, both young departed at the age of 21 days. From another Costa Rican nest that I watched the following year, two nestlings flew away when they were 21 or 22 days old. In Honduras, a nestling reared alone quit the nest when it was 21 days old, and another lone nestling left a neighboring nest when it was 21 or 22 days old. In the nest which I studied in 1955, one of the two nestlings remained for the exceptionally long period of 24 days. On the following day it lay dead in the niche and wasps were eating it. I could not make certain that the other nestling left in good health, but apparently it did. I surmised that the retarded development and death of one nestling may have been caused by some factor associated with altitude above sea level, since this was the highest nest of the Royal Flycatcher that I had seen. But four years later two nestlings were successfully reared in almost the same spot, and they left on May 9, when they were 22 and 23 days of age. I looked for a second brood in this exceptionally early nest or in a neighboring structure, but I found none.

After leaving their nest, the young birds with stubby tails are led off through the forest, and one sometimes finds them high up on the ridges, at a good distance from the waterways above which they are hatched.

INTERPRETATION OF THE NEST

One may well question why a bird inhabiting a tropical region, which so teems with predators that hardly one nest in six escapes premature destruction, should make its nest so much larger than necessary and place it conspicuously in the open, above a forest stream. Remembering my own first encounter with a Royal Flycatcher's nest, and the testimony of others who saw it for the first time, I once supposed that its failure to suggest a bird's nest of the more usual type saved it from the visits of hostile creatures. The whole structure greatly resembles a hank of disintegrating fibrous leaves or a bundle of driftweed, and the nest proper occupies so small and inconspicuous a part of the entire irregular mass that it is likely to be overlooked in a cursory examination. The very dark color of the eggs, unusual in the flycatcher family, and the barred plumage of the nestlings, also exceptional in the family and serving to render them less prominent by breaking their outline, strengthen the view that both eggs and young escape detection by being inconspicuous parts of a conspicuous whole. It is as difficult for the human eye to pick out eggs or young of the Royal Flycatcher, in the midst of the great mass of nest material, as to detect the protectively colored eggs or downy nestlings of a Whip-poor-will or other goatsucker on a patch of leaf-strewn ground. The barred plumage of the nestling Royal Flycatchers seems to blend into the pattern of light and shade formed by the meshwork of the thin walls of the niche where they rest and through which light passes.

Against the view put forward in the preceding paragraph, it may be urged that in the course of many generations the chief nest-robbing animals of the regions where Royal Flycatchers are abundant would come to associate this elongated mass of dead vegetation with the presence of food and the conspicuousness of the nest itself would counterbalance the protective coloration of eggs and nestlings. I have watched toucans (*Ramphastos sulfuratus* and *R. swainsonii*) examine and pull at empty nests as though searching for food. It is also hard to believe that the many snakes that lurk along the banks of forest streams would fail to follow the parent bird as she comes and goes from the nest during its long period of occupancy. Hence I incline increasingly toward the belief that the contents of these nests owe their safety to their inaccessibility more than to their invisibility. The nest is as a rule too high for a small mammal to reach by jumping, and it is attached to a shoot or vine too slender to be climbed. The mass of fibrous and leafy material which loosely envelopes the supporting branch, for the

distance of a yard or more above the niche that contains the eggs, would seem to make it more difficult for either a mammal or a snake to creep along this branch. It would seem also to discourage clumsy, nest-robbing toucans from attempting to cling to a support already too weak to sustain their heavy bodies. A Swallow-tailed Kite would find no difficulty in extracting the edible contents from such a nest while hovering beside it on beating wings, but these insatiable nest robbers ply their trade among the tree-tops and in the clearings rather than in the lower stories of the forest where the Royal Flycatchers' nests hang.



Fig. 91. Nestling Royal Flycatcher, 15 days old, showing the broad, flat bill and barred dorsal plumage. Near Tela, Honduras, June 20, 1930.

Still, the unusual coloration of the eggs and nestlings of the Royal Flycatcher are indubitable facts which we would find it hard to explain on evolutionary principles except by admitting that they have been of value in saving the progeny from destruction. Flycatchers whose pensile nests are so well closed at the top and sides that it is difficult to see their contents lay eggs which are nearly or wholly white, and their young present no peculiarities of coloration. Doubtless it is the combination of invisibility and inaccessibility which preserves the Royal Flycatcher's eggs and nestlings from destruction. And so effective is this combination that the Royal Flycatcher can afford to take longer to hatch its eggs and rear its young than almost any other member of the Tyrannidae. Both incubation and nestling periods are unusually long even for a family which is notoriously slow in these matters. It is one of the marvels of tropical nature that the nest, hanging so conspicuously in a forest teeming with predatory birds, mammals and

reptiles, can escape destruction during the long period of about 45 days which elapses between the laying of the first egg and the departure of the young.

In addition, Royal Flycatchers appear to enjoy a higher degree of reproductive success than most other birds of the lowland forests of Central America. Of six Royal Flycatchers' nests with eggs or nestlings that I attempted to follow through, four or possibly five were successful, while the sixth was lost through an ill-considered experiment of my own. The number is perhaps not great enough to be statistically significant; yet I made a much greater number of attempts to follow the complete history of the

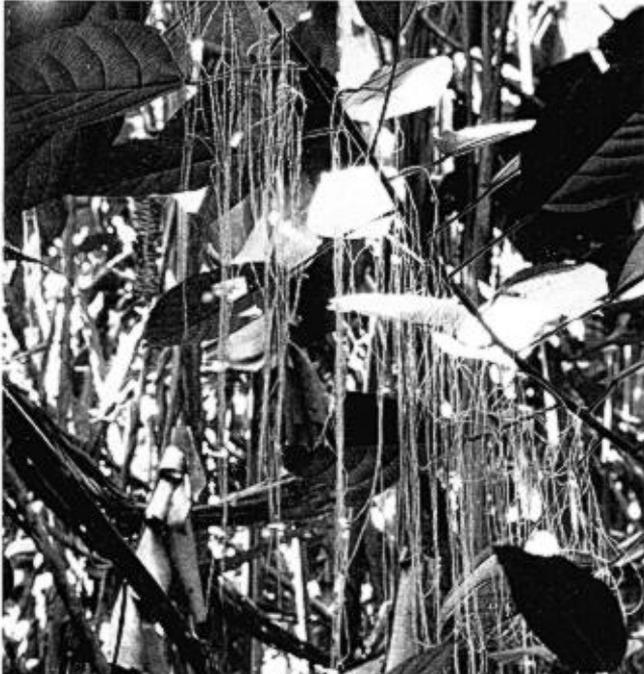


Fig. 92. Pistillate inflorescences of *Myriocarpa yzabalensis*, a small tree of the nettle family. These slender strands are sought by many building birds, including the Royal Flycatcher, Sulphur-rumped Myiobius, and Oleaginous Pipromorpha. Near Almirante, Panamá, February 10, 1929.

exceedingly slight and inconspicuous nests of the manakins which dwell in these same forests before I found one that was successful.

Of course, sometimes the confident flycatcher miscalculates the position of her nest and hangs it where one of her enemies can reach it. In this event, it is doubtful whether she could rear a brood before she received an unfriendly visit, even if her eggs hatched and nestlings developed as swiftly as those of some ground-nesting finch. But if she places her nest with good judgment, she may go about the business of reproduction as deliberately as she will. Dr. Stresemann pointed out (*in litt.*) there is a tendency for the incubation and nestling periods of birds to be long, unless they are kept short by natural selection.

SUMMARY

In Central America, the Royal Flycatcher inhabits heavy lowland rain forest as well as the higher second growth. It is found in the lower levels of the woodland rather than in the treetops, and it prefers the vicinity of streams, above which its nests appear always to be hung. In Costa Rica it breeds up to about 2500 feet above sea level but it may wander to points about 1000 feet higher. It never flocks but appears to lead a solitary life when not nesting.

The widely spreading, fan-like, scarlet to yellowish crest, which is the most distinctive feature of the bird, is rarely displayed, so that it does not ordinarily serve for field identification. From time to time it is expanded while the flycatcher preens its plumage, especially in the rain. In courtship display, which was witnessed only once in a pair that already had eggs, the male spreads his crest widely, turns his head rapidly from side to side to make the scarlet feathers vibrate, quivers his half-open wings, and fans out his tail, at the same time rapidly repeating a peculiar note.

The Royal Flycatchers' food consists largely of insects caught on swift darts through the underwood or above the channels of forest streams. Large dragonflies and butterflies are often captured.

Both sexes utter a loud, mellow whistle, but that of the male is often fuller and deeper. He also has an utterance consisting of a note which is higher and sharper than the ordinary whistle and is repeated deliberately many times.

Nest building may begin in February in the Canal Zone, in early March in southern Costa Rica, and in April in northern Central America. All the nests that were seen hung above shady waterways, either in the woodland or between neighboring clearings. Their height varied from about 8 to 20 feet above the water.

The remarkable nest is an elongated structure, composed largely of fibrous materials, and it varies in length from about 2 to 6 feet. It consists of an upper portion formed by wrapping much material around the supporting twig or vine and a lower part that hangs free below the support. Near the top of the latter the bird makes a shallow chamber by spreading apart the materials of the nest and lining the resulting niche. The work of lining proceeds simultaneously with the upward extension of the superstructure by wrapping more fibers around the support. Only the female builds, and when working hardest she may bring contributions at the rate of once every two minutes. A nest found when recently begun was finished about twelve days later, but others are built far more slowly.

A week or more may elapse between the apparent completion of the nest and the deposition of the first of the two eggs which form the normal set. In two instances the second egg was laid two days after the first. The dark reddish brown color of these eggs is unusual in the flycatcher family.

Only the female incubates, sitting with her head at the back of the niche and her tail projecting through the doorway. In twelve hours one female took 19 sessions ranging from 4 to 52 minutes and averaging 22.4 minutes and an equal number of recesses which varied from 3 to 33 minutes and averaged 13.6 minutes. In six hours a second female took 10 sessions ranging from 9 to 32 minutes and averaging 17.9 minutes and 10 recesses which fluctuated from 4 to 18 minutes and averaged 12 minutes. The first female incubated for 62.3 per cent of the day and the second for 59.9 per cent of the six hours.

At one nest the incubation period was 22 days and at another it was 23 days.

The nestlings are fed and brooded only by the female. Diurnal brooding continues until they are about a week old. The female covers the nestlings with her head inward

and tail outward, sitting just as she did while incubating. The young are nourished with insects whose wings are generally knocked off at a distance from the nest, so that they are difficult to recognize. The male guards the nest but has never been seen to inspect its contents.

When newly hatched, the nestlings are sightless and wholly devoid of natal down. From an early age they rest in the niche with heads inward, with the same orientation that the female assumes while she incubates and broods. To feed them, the female clings upright, woodpecker-fashion, at the doorway and passes the food over their backs. Soon the young are so crowded in their narrow niche that they rest one above the other.

The nestlings develop slowly, but at the age of 12 days they are fairly well covered with feathers. In striking contrast to other American flycatchers, whose first plumage as a rule closely resembles that of their parents, the nestling Royal Flycatchers don a conspicuously barred plumage which differs greatly from the obscurely barred plumage of the adults. At five nests the nestling period varied from 21 to 23 days; but a nestling remained within another nest for 24 days and then died there.

The long nest, hanging in an open space above a waterway, is a conspicuous structure, and its safety during some 45 days of occupancy, from the laying of the first egg to the departure of the young, appears to depend primarily on its inaccessibility to predators. But the coloration of eggs and young, so unusual in the flycatcher family, is difficult to account for except on the assumption that they are thereby made less conspicuous in a chamber which occupies only a small part of the total bulk of the nest. It appears to be the combination of the inaccessibility of a conspicuous nest with the concealing coloration of its essential contents which gives the Royal Flycatcher an unusual degree of nesting success.

RUDDY-TAILED FLYCATCHER

Terenotriccus erythrurus

The Ruddy-tailed Flycatcher is one of a host of very small species of the Tyrannidae that inhabit tropical America. Measuring only slightly more than three and a half inches in length, it is one of the most diminutive of all, but because of the prevailing bright ochraceous color of its plumage it is more easily recognized than many of the smaller flycatchers (see frontispiece). The top of its head, hindneck, and back are grayish olive. Its rump and under plumage, including the under wing-coverts, are buffy-ochraceous, which is duller on the throat. The outer surface of the closed wings is ochraceous, whereas the upper tail coverts and tail are bright cinnamon-rufous or tawny-ochraceous. Its short, broad bill is blackish. The sexes are alike in appearance.

The species ranges through the rain forests from eastern Guatemala to Bolivia, Amazonia, and the Guianas. In Central America it occurs throughout the Caribbean lowlands as far north as the Motagua Valley, but on the Pacific side it is found only from the Gulf of Nicoya southward. In Costa Rica it extends upward to about 2500 feet above sea level on the Pacific slope and, according to Carriker (1910:706), to about 3000 feet on the Caribbean slope. It dwells both in the lower levels of the heavy forest and amid the older and taller second-growth woodland and it is almost invariably solitary.

While perching, this diminutive bird often twitches its wings rapidly upward above its back. It does not twitch them alternately like the pipromorpha but moves both wings together and far more rapidly. On the flycatcher's brief flights from twig to twig these short wings are vibrated so rapidly that they produce a whirring sound somewhat like the wings of manakins. The movements of the Ruddy-tailed Flycatcher are sudden and brisk. It subsists largely on small insects which it captures on its short darts from twig to twig in the lower levels of the woodland. From time to time it utters a low, weak whistle consisting of two notes with a slight interval between them. At daybreak on an April morning, I heard a Ruddy-tailed Flycatcher repeat this disyllabic phrase over and over, making a sort of dawn song of it.

NEST BUILDING

I have seen five nests of the Ruddy-tailed Flycatcher, only three of which were completed and used. The three nests with eggs or young were all under observation on Barro Colorado Island in the Panamá Canal Zone between March and May of 1935. Two nests were found in early stages of construction and were apparently never occupied; the first of these was discovered near Los Amates in the Motagua Valley of Guatemala on April 16, 1932, and the other was found on my farm in El General on February 28, 1943, when it was newly begun.

The pensile nest is attached to the end of a slender, drooping twig, to a thin dangling vine, or beneath a palm frond. One nest was fastened to the end of a slender vine that hung from near the tip of a low palm frond, but another was affixed directly to the rachis of the frond. In height these nests varied from 5 to 15 feet above the ground. One hung above a nearly dry stream bed in light second-growth woodland; the others were in primary or secondary forest, at a distance from streams.

At both the Guatemalan and the Costa Rican nests, which I found when recently begun, the female worked in complete solitude and was not even attended by a mate. Her

first step in constructing the nest is to attach fibrous material in a loose weft about the end of the supporting twig or vine. Bits of brown dead leaves are entangled in the fibers. When this mass has attained sufficient size and hangs down about six inches below the point of attachment, the builder clings to its side and pushes her body into the midst of the weft, gradually forcing the fibers apart and forming a rounded chamber. Now many additional fibers are taken into the expanding cavity to line its floor and walls. While arranging these strands, the bird sits in the chamber with her rufous tail projecting outward through the opening in the side. This is also the position that she will assume while



Fig. 93. Nest of Ruddy-tailed Flycatcher in undergrowth of forest on Barro Colorado Island, May, 1935.

incubating and brooding. At the same time that she lines the chamber, the flycatcher also attaches additional material, chiefly bits of dry leaves, to the outside of the mass. Flying up with a fragment of leaf in her minute bill, she hovers or rather glides head downward with vibrating tawny wings over the surface of the pensile nest, pausing scarcely an instant to thrust in the new material with a deft movement of her head. When working actively, one female brought 12 contributions to her nest in 40 minutes. One Ruddy-tailed Flycatcher was still engaged in lining her nest 20 days after I found her beginning it.

A completed nest, found on Barro Colorado Island on March 21, 1935, was a pyriform structure, tapering upward and measuring 9 inches in length from its rounded bottom to the pointed apex by which it was attached. Its greatest transverse diameter, just above the bottom, was 3 inches. A roughly spherical chamber occupied the lower third of the structure. This was entered through a round doorway in the side, above

which was a visorlike projection from the upper wall. The latter kept out the rain and shielded the interior from the prying eyes of nest robbers. The general color of the nest was blackish. It was made of black fibrous roots, fine brown fibers, fragments of dead leaves, bits of decaying sticks, small pieces of bark and other fragments of vegetable debris. The lining was composed of fine, light-colored fibers.

A nest discovered a week later in the same locality was of the same form, but it was smaller and less carefully made. In length it measured only 7 inches, not including some loose material that dangled below the rounded bottom; but the diameter was the same, namely 3 inches. The walls were frailer than those of the first nest and the visorlike projection above the doorway was rather skimpy, but the entrance was well shielded by a living leaf of the supporting twig.

THE EGGS

The nest which I discovered on Barro Colorado Island on March 21 contained its full complement of two eggs by March 25. The nest that I found on March 29 already held two eggs and no more were laid. The eggs in both sets were white with chocolate blotches of irregular shape forming a heavy wreath about the larger end, and a few of the same blotches were scattered elsewhere over the surface. The measurements of the 4 eggs averaged 15.8 by 11.6 millimeters. Those showing the four extremes measured 15.9 by 11.9, 15.5 by 11.9, and 15.9 by 11.1 millimeters.

INCUBATION

I did not find time to watch continuously a nest where incubation was in progress, but it seems likely that the female incubates without the assistance of a male, since he does not help in building the nest or in feeding the nestlings. Indeed, even at nests of species of flycatchers of which the male is most attentive to the female, I have never known him to take a turn on the eggs.

In my first nest on Barro Colorado Island the eggs were laid in the interval between March 21 and March 25, and they both hatched on April 16. Thus the incubation period was at least 22 days, and possibly a day or two more than this. Twenty-two days is the incubation period of the Royal Flycatcher and the Sulphur-rumped Myiobius, which like the Ruddy-tailed Flycatcher build pensile nests in the woodland.

THE NESTLINGS

The newly hatched Ruddy-tailed Flycatchers are minute creatures with pink skin quite devoid of down and with tightly closed eyes. When the nestlings in my first nest on Barro Colorado were three days old and still blind and naked, I devoted four hours to watching their nest from concealment. In this period no male appeared, and the female attended her nestlings alone. Returning with an insect held in her abbreviated bill, she would come to rest on the petiole of the dead palm frond, beneath the tip of which her nest swung at the end of a dangling vine. Here she delayed for a minute or two, turning her head from side to side for a careful survey of her surroundings. Then she always about-faced to continue her scrutiny from a different point of view. When satisfied that all was safe in the neighborhood, she darted beneath the palm frond and looped upward to rise beneath the visor that shielded her doorway. The swift vibration of her short wings produced a sharp whirring sound. She clung upright before the entrance, her orange-tawny tail propped woodpecker-fashion against the side of the nest, while she placed the food in the mouths of her nestlings, which I could not see within the chamber. After delivering the meal she usually climbed inside to warm them. She invariably sat with her head at the back of the nest and her tail projecting through the doorway. This

is the position in which the Royal Flycatcher and the Sulphur-rumped Myiobius always sit whether they cover eggs or nestlings. In the four hours she brooded for 6 periods ranging in length from 1 to 46 minutes and totalling 106 minutes. She fed the two nestlings 10 times.

When I returned to this nest a few days later, I was dismayed to find it empty. The second Barro Colorado nest was more fortunate. Only one of the eggs hatched, on April 10. After the nestling grew older, it always rested with its head at the back of the chamber, which was the orientation that the female always assumed. This nestling was two weeks old before its feathers began to burst from their long, horny sheaths. When I looked into the nest, it made its feathers stand on end and bristled all over like a sea urchin. Visiting the young flycatcher on April 29, when it was 19 days old, I found it well feathered, closely resembling the adults in coloration. While I was at the nest the female came and flitted among the bushes close at hand, voicing at intervals a short, weak whistle. When I tilted the nest for a better view of the young bird, it suddenly darted out and flew very well, but it remained only a few feet above the ground and landed on the bank of a shallow gully. The female hurried to join her fledgling on its first flight, and for the last few feet of its way she flew almost in contact with it.

The young Ruddy-tailed Flycatcher might have delayed in its nest a few days more if I had not disturbed it. I thought it would be safer if it passed at least one more night in its swinging cradle, but it flew too well to be caught and eventually took refuge in some tangled vegetation where I could hardly follow. The female flitted about near it, uttering her weak whistles, which at times the young bird answered with a similar but shorter whistle. The female frequently threw up both of her wings together, opening and closing them in the twinkling of an eye. No mate appeared to help her take care of the fledgling. When a male bird takes any interest in the nest, he is usually present during the excitement attending the departure of the young, especially if they seem to be in peril. His failure to appear now strengthened the conclusion drawn from earlier observations that the Ruddy-tailed Flycatcher does not form pairs and the female receives no aid in attending the nest. This is true also in *Pipromorpha*, *Myiobius* and *Oncostoma*.

SUMMARY

The Ruddy-tailed Flycatcher dwells in the lower levels of heavy rain forest and in older second-growth woodland. In Costa Rica it ranges from the lowlands up to about 2500 feet above sea level on the Pacific slope and to 3000 feet on the Caribbean slope. It is nearly always solitary and does not appear to form pairs.

It subsists largely on small insects caught on short flights from twig to twig.

Its call is a low, weak whistle consisting of two slightly separated notes. In flight its short wings produce a whirring sound. While at rest it often flips up its wings simultaneously, in an almost instantaneous movement.

Three occupied nests were found on Barro Colorado Island, Panamá Canal Zone, from March to May; newly begun nests were found in El General, Costa Rica, on February 28 and in the Motagua Valley of Guatemala on April 16. The nest is suspended from a slender drooping twig or thin dangling vine, or sometimes beneath a palm frond, at heights, in five instances, ranging from 5 to 15 feet above the ground. The elongate, pensile structure, made largely of dark-colored fibers and fragments of dead leaves, is roughly pyriform in shape and it contains a rounded chamber entered through a circular opening in the side. This doorway is often protected by a visorlike projection from the wall of the nest. It is made by a process of felting rather than by weaving. While building, the solitary female is not attended by a mate. One bird was still lining her nest 20 days after it was begun.

Two sets each consisted of 2 eggs. The eggs were white, marked with irregular chocolate blotches, forming a heavy wreath on the large end, with a few scattered elsewhere over the surface.

The female sits with her head inward and her reddish tail projecting through the doorway. At one nest the incubation period was at least 22 days.

Newly hatched nestlings have pink skin, wholly devoid of down, and tightly closed eyes. They are nourished with small insects brought by the female. As they grow older they rest with their heads at the back of the chamber, in the orientation taken by the female while incubating and brooding. One nestling flew from the nest when 19 days old, but it might have remained somewhat longer if it had not been disturbed. In its first plumage, the nestling resembled the adults.

SULPHUR-RUMPED MYIOBIUS

Myiobius sulphureipygius

In the depths of the tropical forest where brilliant color is not abundant, the Sulphur-rumped Myiobius flits restlessly, exposing its bright rump patch. This flycatcher (see frontispiece) is a little less than five inches long. Its primrose-yellow rump contrasts sharply with its greenish olive back and head and with its dusky wings and blackish tail. Its under plumage is largely canary yellow, with the chest and sides suffused with a warm shade of cinnamon or tawny-brown. It bears a concealed patch of yellow on its crown. Its dark eyes are large for so small a bird. There are conspicuous stiff bristles at the base of its short bill. The upper mandible may be flesh-color heavily clouded with black or almost wholly black, whereas the lower mandible is blackish at the tip. The legs and toes are also blackish. Male and female are too closely similar in appearance to be distinguished with certainty in the forest.

As though conscious of the possession of a badge of distinction which few other members of its family possess, the myiobius takes special care to display its yellow patch. It has the habit, almost unique among the flycatchers, of hopping and flitting about with its tail spread fanwise and its wings slightly lowered. In this fashion the yellow dorsal area is completely revealed. While resting on a perch, the flycatcher often flits out both wings together, as though to balance itself. Its custom of moving through the trees with spread tail and drooping wings reminds one of a similar habit of the redstarts among the wood warblers, especially the Slate-throated Redstart and the American Redstart. This flycatcher is as active and restless as any warbler, seldom delaying long on one perch, turning and twisting in most intricate fashion as it pursues insects on the wing and captures them with a loud snap of its broad bill. Unlike many other flycatchers, it seems not to vary its diet with berries or other fruit.

The Sulphur-rumped Myiobius is most at home in the undergrowth and lower levels of the primary forest, but it sometimes enters neighboring areas of tall second-growth woods and it may even wander along shady waterways that flow through the clearings, in regions where much forest remains. These flycatchers never form pairs but are at all seasons intolerant of the presence of another of their own kind. Yet a single myiobius often attaches itself to a mixed company of antbirds, tanagers, woodhewers, manakins, and other small birds that roam through the forest in search of food. I have sometimes found a myiobius in the motley feathered crowd that gathers around a horde of army ants to prey on the fugitives. Resting on low perches above the swarming ants, it now and again darts briskly out to snatch up some small flying insect set in motion by them.

The Sulphur-rumped Myiobius ranges through the lowland rain forests from southern México to western Ecuador. In northern Central America it is found only on the Caribbean drainage and even there it is by no means abundant. But from southeastern Nicaragua into Panamá, this is one of the common birds of the forests of the Caribbean lowlands. In Costa Rica the species crosses to the Pacific side of the continent and is numerous in the Térraba Valley. I have studied it chiefly in the latter place. On both the Caribbean and Pacific slopes of Costa Rica it ranges upward to 3000 feet, or a little more, above sea level.

VOICE

The usual note of the Sulphur-rumped Myiobius is a low, sharp *psit*, *fit*, or *pit*. In many years of familiarity with this flycatcher, I have on only two occasions knowingly

heard any other utterance from it. On a warm, sultry afternoon in early March, a myiobius flew into a small riverwood tree growing in the stream in which I was bathing. Spreading the feathers of its crown to reveal the bright yellow patch that is usually hidden, it rapidly uttered a refrain consisting of about five high, sharp notes followed without a pause by about the same number of warbled notes. The performance was musical enough to be called a song. A few minutes later the refrain was repeated, but now the bird was out of sight.

More than two years passed before I again heard from this species any utterance more elaborate than the sharp *psit*. On a morning at the end of April, a myiobius perched in the undergrowth of tall second-growth woods and sang *cheu cheu cheu cheu* in a pleasant voice. These notes seemed to be the same as those which formed the second part of the song that I earlier heard. Probably both of these songs were given by males, since in many hours watching at nests I have never heard anything similar from a female.

NEST BUILDING

In the valley of El General, the Sulphur-rumped Myiobius may begin to build as early as the last week of January. I have two records of nests started about this time, both of which were about 3000 feet above sea level. By March finished nests containing eggs are abundant. Thus these birds begin their nesting operations at the height of the dry season which is a much earlier time than most of the other flycatchers of the region begin nesting. They continue breeding, however, into April and even May, when rain is of almost daily occurrence.

The elaborate pensile nest is attached to the tip of a slender drooping branch of a tree, or to the free end of a dangling vine or to a spray of scrambling bamboo. The supporting shoot may be either leafy or naked. The nests often hang above a watercourse that traverses the woodland. Carriker (1910:708) states that in the Santa Clara Valley of Costa Rica, in late April or early May, "a nest could always be found by following a little brook through the forest for a short distance." The same is true in El General which is on the opposite side of the country. But the nests of the myiobius are by no means invariably placed above water; they may be found above forest pathways, or indeed above any small opening amid the undergrowth which allows them to swing free, out of contact with the surrounding vegetation. I have even found nests above the edge of a pasture, beside second-growth woodland. The important point is that they hang in an open space where climbing and creeping predators cannot reach them save by way of the supporting twig or vine, whose slenderness is an obstacle to most of them. I have seen nests ranging in height from 6 to 35 feet above the ground or above the water of a small stream. Often the nests are so low that they can be brought within a man's reach and examined by pulling down the yielding support with a hooked stick. When released they spring up to their original position, none the worse for this treatment. Sometimes, as nesting proceeds, the nests sink down until they are only four or five feet above the ground; this is especially likely to occur to the low nests in wet weather.

I have devoted more or less attention to the construction of a number of nests and invariably found the builder, undoubtedly the female, quite solitary. Only once did I see a second myiobius approach an unfinished nest, and on this occasion both visitor and builder promptly vanished into the forest, as though the former had not been welcome. Early in 1937, I followed in detail the successive stages in the construction of a nest. Others which I studied later passed through the same phases of growth.

When discovered on January 25, 1937, the nest to whose construction we shall pay particular attention consisted of merely a small, irregular tuft of fibrous materials attached to the attenuate end of a slender, hanging, leafless twig of a small tree, at a

height of 12 feet above the ground, in a narrow opening amid the forest undergrowth (fig. 94, *a*). On the morning of January 27, I watched the solitary bird at work on her recently begun structure, which in the past two days had changed little in appearance. She built actively through much of the forenoon, but she was particularly busy between eight and nine o'clock. Arriving with a thin, inconspicuous fiber in her bill, she alighted

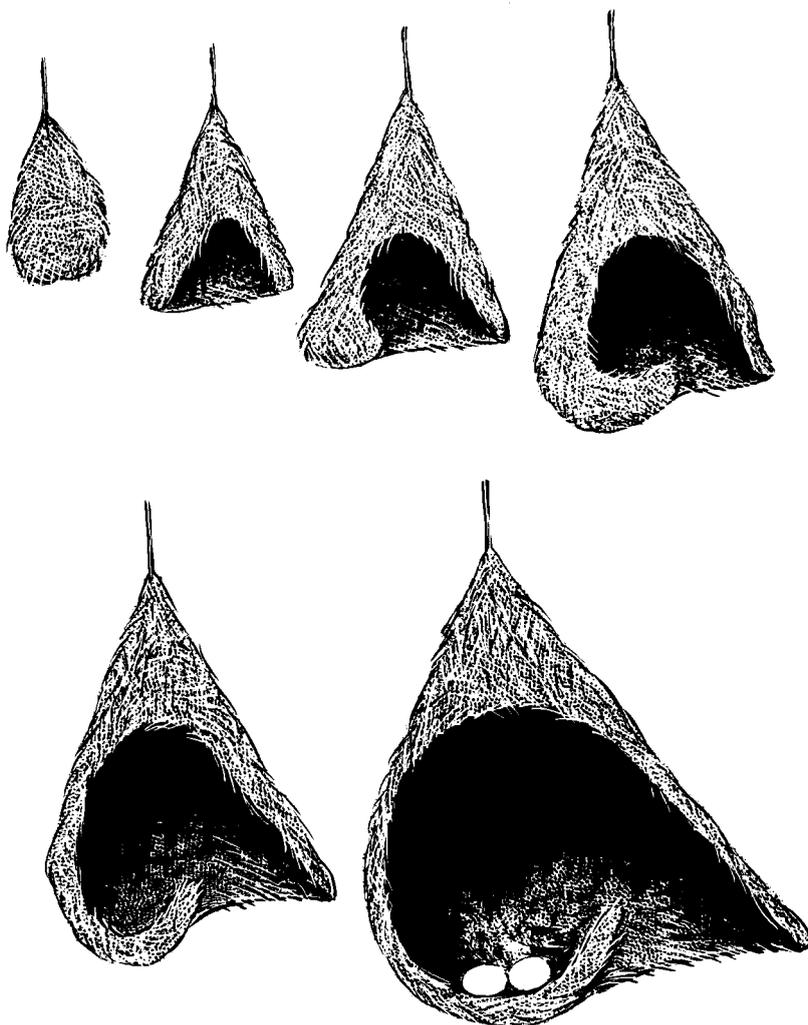


Fig. 94. Sections of nest of Sulphur-rumped Myiobius showing construction. Upper four in order left to right show successive stages, *a*, *b*, *c*, *d*. Lower two show near final form and the completed structure with eggs.

sometimes on the supporting twig, just above the tuft of material, but more commonly she alighted on the bunch of fibers itself. Then, with her whole body, she made a quick revolution around the tuft and at once flew off again. Sometimes she made only half a turn, sometimes a revolution and a half; but usually she took about one complete turn around the supporting twig. Invariably she ended her maneuver with body inverted, head downward. Sometimes she paused at the end to push the fiber into the mass with

her bill, but usually she contented herself with the turn about the support which served to wind the latest fiber around the tuft. She then darted off an instant after she had alighted upon the growing mass. Indeed, the whole operation of adding a new fiber was so rapidly performed that it was difficult for my eyes to follow exactly what the myiobius did. At the moment of alighting on the nest she usually uttered a low, sharp *pit*, and she almost always repeated this note as she sped away again.

The loose mass of material which was to form the nest of the myiobius grew slowly but steadily. By February 4 the lone builder had begun to push apart the matted fibers, working upward from the bottom, and giving the mass roughly the form of a bell or hollow cone, but with a thicker wall on one side of the central hollow than on the other (fig. 94, *b*). On the morning of February 7, when the nest was still in this stage but somewhat larger, I watched the flycatcher at work. Arriving with fibrous material in her bill, she first rested on a perch several yards from the nest. After a few seconds, she flew to the dangling nest, hovered below it an instant, then rose upward into the cavity in the bottom of the cone. Sometimes a moment sufficed to attach what she had brought and she dropped out in the twinkling of an eye; sometimes she clung for several seconds to the inner wall, back downward, while she fastened the fibers more carefully and, to judge by the shaking of the nest, worked to give it form. She always clung to the side where the wall was thickest and apparently always added the new material to this side, with the result that this part of the structure grew in bulk, while the opposite wall of the hollow cone remained thin. It already seemed probable that the thick side would contain the nest chamber, of which there was still no indication, while the thin side would serve as the apron that shields the doorway.

Flying upward into the hollow of the nest was evidently a difficult feat which taxed the builder's skill. Many times she hovered beneath the opening with material in her bill, only to return to her perch and rest briefly before making a fresh attempt. Practically all the new material now went inside the cone; only once in the early half of the morning of February 7 did I see the bird add something to the exterior, as she had formerly done. On the following morning, however, she attached a number of fibers to the top of the structure. Now she fastened her material more securely than at first, taking two or even three turns with it around the supporting twig instead of the single revolution which had formerly satisfied her. When she noticed a loosely-attached fiber dangling from the mass, she plucked it off while hovering on wing beside the nest, then either took it inside or attached it to the top.

The greater part of the new material, however, was still taken inside the nest. By February 8, the myiobius had begun to hollow out the nest chamber in the thickest part of the wall surrounding the central cavity (fig. 94, *c*). The future chamber was represented merely by a slight depression on the inner side of the mass of material. The flycatcher still clung back downward while attaching new material on the inside of the cone, usually continuing in this posture for two or three seconds, sometimes for only a moment, and exceptionally as long as five or six seconds, vigorously shaking the walls while she arranged the fibers and shaped the fabric. This effort seemed to tire her quickly, for when she dropped out of the bottom of the nest, she at times fluttered down to rest a short while on the leafy twigs below instead of flying at once to her customary perch. There, four or five yards from the nest, she would delay between her excursions to gather material, preening her plumage, or making short aerial sallies to snatch up small insects which flew temptingly near. She would also alight there on her return with laden bill for a brief breathing spell before taking her fibers into the nest.

By February 12, the cavity which the flycatcher was forming in the thickest part of the wall was deep enough to have a definite bottom or floor (fig. 94). Most of the new

material brought for the nest was attached while the builder clung in the same relative position as formerly, hence it was added to the inner wall of the growing nest chamber. While fastening new material to the interior of the chamber, the myiobius still clung with her tail nearly vertical. To shape the nest she now sat in it with her tail horizontal and shook the wall with her vigorous movements. After she could work in a less strained position, her periods devoted to arranging the fibers and shaping the structure became considerably longer. From time to time she would twist a strand around the supporting twig at the top of the nest, giving it two or three turns.



Fig. 95. Nest of Sulphur-rumped Myiobius on Barro Colorado Island, Canal Zone, May, 1935.

By February 15, three weeks after I had found it as a small, featureless tuft of material, the nest had assumed its final form (fig. 94, lower). Probably a certain amount of work remained to be done in lining the interior, but because I was busy with other birds, I neglected to watch it. Revisiting the nest on March 2, I found that it had fallen or, more probably, been torn from its support. Beneath the point where it had hung I picked up a broken egg, of which the incubation could scarcely have begun. The construction of the elaborate nest of the myiobius appears always to be a time-consuming process. On two other occasions I have known this flycatcher to devote 19 or 20 days to building, but this was probably not the whole period required for finishing the nest.

A typical nest of the Sulphur-rumped Myiobius, which I had watched the bird build on Barro Colorado Island in March, 1935, was a pyriform structure when completed, tapering from the rounded bottom to the pointed apex, where it was attached to the thin supporting twig. In length it measured 9 inches, not including loose fibers protruding from both ends, and it was $3\frac{1}{2}$ inches in transverse diameter at the widest part, near the bottom. The lower half was occupied by a rounded chamber, entered through a circular opening in its side. This entrance was shielded and concealed in front and on both sides by an apronlike projection, continuous with the outer walls. Thus the doorway of the chamber opened on a sheltered space which could be entered only from below. It was an antechamber which represented the original hollow formed by the builder in the bottom of her growing mass of entangled fibers. The nest was constructed of a variety of fibrous materials which formed an open meshwork on the sides, and like all others of this species that I have seen, it was brownish in color. The bottom of the chamber was thickly lined with fine, light-colored fibers. Sometimes fibers and other materials are wrapped about the supporting twiglet or vine above the actual top of the nest, and in one instance this apparently superfluous superstructure was extended upward for about 15 inches.

The pensile nest of *Myiobius* is of the same general type as those built by *Oncostoma*, *Todirostrum*, *Terenotriccus*, *Pipromorpha*, *Tolmomyias*, and *Rhynchocyclus*. The nests of these genera of American flycatchers differ widely in the materials of which they are constructed and in the thickness of their walls, but considering form alone, the chief difference between them lies in the degree of protection provided for the doorway. In this respect the nest of *Myiobius*, with its antechamber open only on the underside, occupies a position intermediate between those of *Todirostrum*, *Oncostoma*, *Pipromorpha*, and *Terenotriccus*, whose doorway is unprotected or shielded only by a simple, visorlike projection from above, and the nests of *Tolmomyias* and *Rhynchocyclus*, which are entered through a long, downwardly pointing spout that extends well below the bottom of the nest chamber. Whereas the pouch-like nests of members of the family of American orioles (Icteridae) are given their definitive form as the builder gradually extends her woven fabric, the pensile nests of the American flycatchers are matted rather than woven. All, so far as I have seen, are gradually pushed into shape by a process fundamentally similar to that described for *Myiobius*.

THE EGGS

The earliest egg of which I have a record was found in El General on March 2, beneath the site of a recently finished but prematurely destroyed nest. Laying continues until the end of April or early May. The full set consists typically of 2 eggs: I have records of seven sets of 2 eggs, and Carriker (1910:708) states that this is "invariably" the number. At one nest an interval of two days or more separated the laying of the first and second eggs. In three of my sets the eggs were white or grayish white, finely speckled all over with chocolate, the markings heaviest in a wreath around the middle or the larger end. In the fourth set the chocolate markings were in the form of irregular flecks and scratches covering the whole surface in a most curious pattern. The measurements of 8 eggs average 18.3 by 13.0 millimeters. Those showing the four extremes measured 19.1 by 12.7, 17.5 by 13.5, and 18.7 by 12.3 millimeters.

In 8 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: March, 5; April, 2; May, 1.

INCUBATION

One female slept in her nest at least four nights before she laid her first egg, and this egg was covered for two nights before the second egg was laid. This observation reveals

that the myiobius has a tendency to use the breeding nest as a dormitory, as the Sulphury Flat-bill does. Unfortunately, this nest was despoiled by a predator, and another nest suitably situated for a fuller investigation of this question has not recently been available.

In 1956, I studied a low nest which hung above a narrow, nearly dry watercourse in tall second-growth woods; the eggs were within a few days of hatching. On April 12, I watched from noon until 3:45 p.m., when a hard shower drove me to shelter. The following day my vigil extended from daybreak at 5:25 a.m. until noon; on April 14 I watched from 3:41 until the light grew dim at 6:05 p.m., to include the part of the afternoon when rain interrupted my observations on April 12. Thus the record I made covered the whole day. The myiobius began her active day by leaving her nest at 5:29 on April 13 and she ended it when she entered at 4:58 on April 14, more than an hour before darkness fell. Within these limits I timed 22 sessions which ranged from 7 to 33 minutes in length and averaged 14.1 minutes. Her 23 recesses varied from 8 to 28 and averaged 15.6 minutes. Thus she was in the nest only 47.5 per cent of the time. Her longest session, lasting 33 minutes, was taken from 3:58 to 4:31 p.m. and preceded her final outing of the day. Her next longest session, 22 minutes, was taken from 6:37 to 6:59 a.m. Her shortest sessions, a series of 4 ranging from 7 to 9 minutes, came in the early afternoon. Although in the forenoon the myiobius was in her nest slightly more than she was absent, in the afternoon she was away far more than she was present, until she settled down for the night at about five o'clock, while the sun still shone upon the treetops high above her.

On returning from an excursion, the myiobius alighted on a slender, horizontal twig a few yards in front of the low nest and on a level with it. From this she made a number of swift sallies to snatch additional insects from the air or from the surrounding foliage. After each such excursion she returned more or less directly to the same perch. Finally, her hunger satisfied, she darted forward and into her nest. On reaching her doorway she clung momentarily in an upright position before it, her tail pressed against the rounded side of the nest below her. Then, as she settled into her incubating posture, her tail rose until it became nearly horizontal, as I could see through the meshes of the apron that covered over the doorway. She always sat with her head inward and her tail projecting into this antechamber formed by the apron, which concealed her yellow rump. Without this screening visor, her yellow rump would have been conspicuous from above. Sometimes as she entered her nest she voiced a sharp *pit*. To leave her nest she reversed the movements she made on entering it, first rising into a nearly upright position at the doorway and then darting away.

A number of times I saw a second myiobius fly through the woods near the nest, and a few times this or another individual followed the incubating bird as she returned to her favorite perch in front of the nest. But the stranger never showed any interest in the nest itself.

At two nests the incubation period was 22 days. The known incubation periods of flycatchers which build pensile nests are all surprisingly long.

THE NESTLINGS

The newly hatched myiobius is blind, dark-skinned, and quite devoid of down. The interior of its mouth is yellow. I have watched four nests containing young without ever seeing more than one parent in attendance on them. One of these nests was attached to a slender vine dangling below a far-reaching bough of a sotacaballo tree growing on the forested shore of the broad Río Pacuar. It swung free and out of my reach about ten feet above the smooth surface of a deep, darkly-shaded, fish-haunted reach of the river. Seated on the shore, beneath the cool shade of the sotacaballo trees, I watched

this nest for two hours on a beautiful, sunny morning at the end of April, 1940. Although I rested unconcealed only a few yards from the nest, the parent myiobius did not appear to be uneasy in my presence.

The food she brought to the nestlings consisted chiefly of small, winged insects, some of them moths, others with lacy wings. On arriving from the forest with food in her bill, the flycatcher would flit back and forth a few times between the boughs on either side of the nest; then, diving downward and uttering a single sharp monosyllable, she would describe a narrow curve in the air and bend her course abruptly upward, to shoot deftly into the downwardly opening antechamber of the nest. Here she would cling upright, her tail bent inward against the bottom of the nest chamber, while she passed the food to the nestlings within. Then, if she intended to brood, she would enter the chamber, voicing one or two of her sharp notes—*fit, fit*—as she snuggled down upon the nestlings. Otherwise she would drop out of the antechamber tail first and fly away. On leaving the nest after a period of brooding, she would dart out suddenly head foremost and swing upward into the foliage. All her movements were sudden and brisk. The nestling(s), of unknown number and age, were fed 17 times between 7:00 and 9:00 a.m. They were brooded 6 times, from 6 to 8 minutes at a sitting, making a total of 39 minutes.

On the morning of April 24, 1956, I devoted the four hours from 7:00 to 11:00 to watching the low nest where I had earlier studied the rhythm of incubation. The two nestlings, respectively 6 and 7 days old, were still naked and their eyes were closed when I examined them. The morning was cloudy, with a slow rain falling from about 10:00 to 10:40. In the first hour the nestlings were fed 10 times, in the second hour 14 times, in the third hour 19 times, and in the fourth hour 11 times, making 54 feedings for the two young in four hours. They were brooded for 7 periods ranging from 5 to 9 minutes and totalling 46 minutes. The longest period of brooding was in the rain. Although once a second myiobius flew rapidly by the nest, it took no interest in it.

After these two nestlings were feathered and no longer required brooding, I watched them for single hours on two mornings. In the first of these hours they were fed 34 times and in the second 32 times. Again I saw nothing to suggest that more than one parent attended them. They appeared to receive only insect food. Once the parent came with a fairly large butterfly that had glints of blue on its wings. The nestlings had difficulty in swallowing this insect that was so big in relation to themselves, and the female took it to the nest six times before it vanished. She did not try to knock off the wings to make it easier to gulp down, as many other birds would have done. Sometimes, coming with food, she hovered for a moment beneath the nest and then returned to her usual perch. Apparently she did this because the young birds, which were restless, were in a position that made it difficult for her to cling in her customary place while she fed them.

The nestlings of the Sulphur-rumped Myiobius develop slowly. Their naked skin, already rather dusky at birth, continues to darken until it is nearly black, at least on the dorsal surface. They are six or seven days old before the feather rudiments begin to push out from the bare skin. Those of the remiges are the first to appear, as projections along the posterior edges of the stubby wings. A day later the pinfeathers begin to sprout along the middle of the back. Even before the feather sheaths break, it is evident from their light color that the rump will be bright yellow, as in the adults. The young are about two weeks old before their feathers begin to shed the horny cases and expand; but a few days later, when they are 16 or 17 days of age, they are finally clothed with plumage. From an early age they rest with their heads at the back of the nest and their tails toward the doorway, which is the orientation the female always takes while incubating and brooding. In this position they are able to void their droppings over the

opening so that they fall to the ground without soiling the nest; the parent does not remove the droppings of older nestlings after she feeds them.

Although I have seen many nests of the myiobius, few have been both accessible and successful. From the first of these low, successful nests, the two well-feathered young flew out when I peeped in at them in the afternoon of the twenty-first day after they hatched. Doubtless but for my visit they would have stayed safely in their swinging nursery until the following morning. Thus I have recorded their nestling period as 22 days. At the nest which I studied in 1956, the young hatched on April 17 and 18. When I visited this nest at 7:55 a.m. on May 11, I found that one fledgling had left since the preceding noon, and the other now flew forth at my approach. These young were in the nest respectively 23 and 24 days. On first taking wing, the young myiobius can fly too well to be caught by a man. It utters the same sharp monosyllable, *pit*, as its parents. In its bright new plumage, it closely resembles the adults except that the color of the underparts, especially the tawny of the chest, is paler.

In El General, a single brood seems to be reared each year, and one seldom finds occupied nests later than early June. The production of this brood requires a long period. From the laying of the first egg to the departure of the young, about 47 days elapse. This is a long while for such tempting food as eggs and nestlings to lie in a conspicuous nest that hangs in full view of the many reptilian and mammalian predators of the tropical lowlands. In some of the districts where I studied the myiobius, snakes were exceedingly abundant, and I surprised them attacking the eggs or young of a number of birds of other kinds, whose nests were far smaller and more carefully concealed. It is only by being inaccessible to the more common predators that the swinging structure of the myiobius can escape their devastating visits. If unwisely placed and within their reach, the nest is soon emptied by them, as I have seen several times. If their nests were as accessible as they are conspicuous, I doubt if even the shortest of incubation and nestling periods would permit these flycatchers to rear enough offspring to avoid extinction. But if the supporting vine is sufficiently long and slender and if the nest hangs far enough from all surrounding objects, it can flout the wingless nest robbers indefinitely. Hence there is little ecological pressure to shorten the periods of incubation and helpless infancy. But if the nesting, which generally begins in dry weather, continues well into the wet season, the constant soaking of the nest and the supporting vegetation may cause it to sink down under the increased weight or even to fall, with disastrous consequences to the brood.

THE BLACK-BREADED MYIOBIUS

On May 26, 1942, I discovered in the forest on my farm in El General a nest which hung 12 feet above the ground. It was attached to a slender, drooping twig of a small tree. This nest resembled that of the Sulphur-rumped Myiobius, and the nestlings it contained, of undetermined number, were attended by a parent which also resembled a Sulphur-rumped Myiobius, with one important difference. The plumage of this myiobius was strongly marked with blackish in a broad band that crossed the central underparts but was slightly interrupted in the middle. I surmised that this bird was an aberrant individual of *Myiobius sulphureipygius*.

I have no record or recollection of having seen another myiobius of this description for the next 14 years. But in May, 1956, I discovered one of these dark-breasted birds building a nest at the edge of the woodland beside the pasture, close by our house. Attached to a long, slender strand of the scrambling, bamboo-like *Lasiacis*, the nest hung about six feet above the ground and was the most conveniently situated for study of all the nests of *Myiobius* that I have found. In the course of this study I enjoyed excellent opportunities to examine this bird at the closest range of my eight-power

binoculars. Her upper plumage closely resembled that of a normal Sulphur-rumped Myiobius. Her chin and throat were pale yellowish gray, and posterior to this, on the chest, was a prominent crescentic patch of orange-tawny, of the same shade as the chest of normal individuals. But this band of rich color was far narrower than on a typical Sulphur-rumped Myiobius, and at its posterior margin it abutted abruptly on a very broad zone of dull black or deep slate-color, marked by many fine, longitudinal, whitish streaks, that covered the breast, sides and upper abdomen. The lower abdomen, under tail-coverts, flanks, and under wing coverts were pale yellow, as in a normal Sulphur-rumped Myiobius. The tawny feathers of the chest stood out beyond the dark feathers posterior to them, seeming to be fuller and thicker. The plumage of the dark ventral band appeared, by contrast to these tawny feathers, to be worn or possibly matted down by wetting; yet in the approximately two months that I had this bird under observation, I detected no change in it. In the colors of her eyes, bill, legs and toes, as in her voice, mannerisms and in the form of the nest she built, this peculiar bird closely resembled the numerous Sulphur-rumped Myiobiuses of the neighborhood.

It seemed to me that a comparison of all the stages in the life history of this puzzling bird with those of a normal Sulphur-rumped Myiobius would help to throw light on her relationship to them. I was particularly interested to learn whether the young would resemble their mother or be like an ordinary juvenal Sulphur-rumped Myiobius. After her nest was finished toward the middle of May, the black-breasted myiobius slept in it at least one night before she laid her first egg, which was deposited before 7:10 a.m. on May 15. The second egg was laid between 7:00 and 9:00 a.m. on May 17. These eggs were light grayish pink, very heavily mottled with rufous-brown, which on the thicker end covered well over half the surface. Here it was present in large, irregular areas of varying intensity of color. On the pointed end of the eggs the brownish pigment occurred chiefly in irregular streaks and flecks. Both of these eggs measured 17.9 by 13.5 millimeters. Hence in size they fell within the range of eggs of typical *Myiobius sulphureipygius*, but they were more deeply and richly colored. They were also rather different in appearance from the eggs of the Black-tailed Myiobius, to be described later. It is also noteworthy that these eggs were laid later than any set of the normal Sulphur-rumped Myiobius that appears in my records. Although my first black-breasted myiobius, which was feeding nestlings on May 26, had nested somewhat earlier, it was still rather late for a myiobius in this locality.

I passed the morning of May 23 watching the black-breasted myiobius incubate. The early morning was dull and cloudy. At about nine o'clock the sun began to break through the thinning clouds, and during the rest of the forenoon there were gleams of watery sunshine. In six hours of watching I timed 7 sessions ranging from 15 to 30 minutes and averaging 23.1 minutes. The same number of recesses ranged from 14 to 47 minutes and averaged 24.6 minutes. The myiobius was in the nest only 48.5 per cent of the morning which was about the same constancy as was displayed by the normal Sulphur-rumped Myiobius that I had watched in the preceding month. In the early morning her sessions were longer than her recesses, but after 8:30 the reverse was true. She sat in the nest with her tail outward, like other myiobiuses. On leaving her eggs she would fly to a favorite perch in a bush at the edge of the woods, from which she caught insects for a while before going deeper into the woodland. After a period in which she remained out of sight, she would return to the edge of the woods opposite her nest and continue to catch insects. Sometimes from her favorite perch she would dart out almost to her nest, only to turn abruptly in the air and return to her bush, apparently with a tiny insect in her bill. These last-minute snacks greatly prolonged her absences from her eggs and were largely responsible for the great length of her last recess of the morning, which was

extended to 47 minutes. She was silent except for a sharp *pit* or two which she uttered as she returned to her nest, just as the Sulphur-rumped Myiobius does. I did not see another myiobius, of either the black or normal kind, in the course of my vigil.

The first egg hatched between 5:00 p.m. on June 7 and 7:35 a.m. on June 8, the second between 7:35 and 9:00 on June 8. Thus the incubation period was almost exactly 22 days, with a margin of uncertainty of two hours in either direction. The sightless nestlings had darkish pink skin devoid of down, much as in typical Sulphur-rumped Myiobiuses. At an early age they oriented themselves with their heads at the back of the chamber, a position which they thereafter retained rather constantly as long as they remained in the nest. Their skin soon grew even darker, and when they were ten days old their feather rudiments were prominent.

The afternoon rains had now become long and hard, and with continued soaking the mass of projecting vegetation beneath which the nest hung sank down until its bottom was only about four feet above the grass at the pasture's edge. On June 21 the afternoon deluge was particularly prolonged and copious, and when I went out to visit the myiobius's nest in the dark before going to bed, I found it lying on the ground, the strand of bamboo which supported it having broken. The soaked nestlings were still alive, although one was moribund, so I took them into the house and covered them with soft cotton for the night. At dawn I tied up the fallen structure as nearly as possible in its original position and placed the surviving nestling in it. The female was close by in the neighboring thicket when I did this, and as soon as I went off I saw her hover twice in what appeared to be the very point in space where her nest had hung before it fell. Neglecting the plain evidence of her eyes, which certainly took in the nest now hanging a few inches farther to the south, she was orienting herself by memory, as I have seen other birds do in corresponding circumstances. But soon she awoke to her mistake, fed the nestling or at least tried to do so, then settled in the nest to give it a much needed warming. Later in the day it appeared to be none the worse for its fall and drenching.

The female continued to brood her nestling by night long after it was well feathered. On my visits by flashlight I always found her sleeping with her black tail projecting outward from the nest chamber into the antechamber, where it was clearly visible from below, just as she incubated or brooded by day. The young bird slept alone in the nest for only two nights, the last two nights of June, and it left before 7:15 on July 1, when it was 23 days old. I found it in the neighboring thicket, attended by the female parent, and enjoyed a good view of it in the bright morning sunshine. The examination I then made through fieldglasses merely confirmed what I had already seen when I last held it in my hands a few days earlier, that it closely resembled a typical Sulphur-rumped Myiobius of the same age. Its chest was ochraceous or tawny, but of a hue much paler and more buffy than on the adults, and it quite lacked the black ventral area of its mother. But when the pale tawny and yellow feathers of the nestling's breast were parted, they disclosed some dark gray feathers of more tardy development, which when the young bird was 18 days old were just escaping their sheaths. Much shorter than the brighter feathers that grew farther toward the sides, they were completely concealed by them. But these central dark feathers provided at least a foundation for the plumage exhibited by the black-breasted female. When the other nestling died, at the age of about 14 days, its plumage was beginning to expand and it closely resembled the surviving nest mate. It was already possible to see that the feathers toward the center of its breast would be much darker, at least at their tips, than those which bordered them laterally. I have not since I had this nest of the black-breasted myiobius been able to examine nestlings of a normally colored female to learn whether they bear concealed dark feathers at the center of the breast.

The black-breasted myiobius did not return to sleep in her nest after the departure of her fledgling, in the manner of the Sulphury Flat-bills which nested in the neighboring trees. Neither did the young bird take advantage of this shelter, but it evidently spent the wet nights amid the foliage. At no time did I see a second myiobius, of either the normal or the black-breasted variety, show an interest in the nest or its attendant.

My tentative conclusion is that the black-breasted myiobius is a mutant or color phase of the Sulphur-rumped Myiobius, and one which is rare in this region. I doubt that it can be a hybrid between the Sulphur-rumped Myiobius and the Black-tailed Myiobius, for the latter is far from abundant in the valley of El General and I have never seen it in the district where I found the black-breasted myiobius. Moreover, the Black-tailed Myiobius does not have a black or even a very dark breast. But in view of the uncertainty as to the taxonomic status of this form, I have kept my observations on it entirely separate from those on the normal Sulphur-rumped Myiobius.

SUMMARY

The Sulphur-rumped Myiobius inhabits lowland rain forests and taller second-growth woodland from southern México to Ecuador. In Costa Rica its altitudinal range is from sea level up to about 3000 feet on both the Caribbean and Pacific slopes. Although it may attach itself to mixed flocks of other small birds, it is always solitary as to its own kind. As it flits restlessly through the lower levels of the woodland, snapping up small insects, it frequently lowers its wings and fans out its tail, making its bright yellow rump even more conspicuous than it ordinarily is.

The usual note of this myiobius is a low, sharp *psit* or *pit*; very rarely it delivers a simple song.

In the valley of El General, building may begin toward the end of January. The elaborate pensile nest is attached to the end of a slender hanging vine or a drooping twig of a tree, at heights varying from about 6 to 35 feet above the ground. The female builds without even being attended by a mate, and she may require three weeks or more to complete her task. As she works, her originally continuous tuft of fibrous material is hollowed out from below to take the form of a bell or hollow cone, whose wall is thickest on one side. Most of the subsequent contributions are attached to this thick side. By spreading apart the fibers of this thickened part, the builder forms a chamber which opens into the covered space beneath the bell.

In El General, 2000 to 3000 feet above sea level, March is the principal month for laying. The set regularly consists of 2 white eggs, speckled with chocolate.

Only the female incubates, sitting with her tail projecting through the doorway, but her bright rump is screened from above by the apron which covers the front of the nest. In 12 hours of watching one female took 22 sessions ranging from 7 to 33 minutes and averaging 14.1 minutes, and 23 recesses ranging from 8 to 28 and averaging 15.6 minutes. She was in the nest only 47.5 per cent of her period of diurnal activity. At two nests the incubation period was 22 days.

Newly hatched nestlings have dark skin which soon becomes blacker. They are devoid of down. Their eyes are tightly closed and the interior of their mouth is yellow. They early orient themselves with their heads at the back of the chamber and their tails at the doorway, just as the female sits. Their development is slow and they are not covered with plumage until 16 or 17 days old. They are brooded and fed by the female alone. At one nest two young 6 and 7 days old were fed 54 times in 4 hours. Two feathered young were fed 34 times in an hour. Their food appears to consist wholly of insects. The parent does not remove the droppings of older nestlings; these are voided through the doorway so that they fall to the ground.

The young remain in the nest from 22 to 24 days and on leaving fly well. They resemble their parents in coloration but the under plumage, especially the ochraceous-brown on the chest, is paler.

The conspicuous nest contains eggs or young for about 47 days, and its safety through this long period depends on its inaccessibility to wingless predators. The sinking down of the nest when its weight is increased by frequent soaking in rainy periods constitutes a grave hazard.

A single brood appears to be reared each year.

In El General, two nesting females resembled normal individuals of the Sulphur-rumped Myiobius except that their ventral surface was crossed by a broad belt of dull black or deep slate-color, finely streaked with white. Careful study of one of their nests showed that the black-breasted form agrees closely with the normal form in its life history. The nests were typical of the Sulphur-rumped Myiobius but the eggs differed in coloration. The incubation period was 22 days and the nestling period was 23 days. The female alone attended the nest and no second myiobius took an interest in it. The development of the young was normal for the Sulphur-rumped Myiobius; and when feathered the nestling resembled a typical Sulphur-rumped Myiobius of the same age in plumage, lacking the black ventral area of the female. The black-breasted myiobius appears to be a mutant or color phase of *Myiobius sulphureipygius* rather than a distinct species or a hybrid.

BLACK-TAILED MYIOBIUS

Myiobius atricaudus

The Black-tailed Myiobius rather closely resembles the Sulphur-rumped Myiobius in size and coloration, its most conspicuous difference being the buffy-olive rather than the bright ochraceous-brown color of the breast and sides. Widely distributed in South America, in Central America it occurs only in Panamá and Costa Rica, and in the latter country it is found only on the Pacific side from the Gulf of Nicoya southward; even there it is uncommon. In the valley of El General, where the Sulphur-rumped Myiobius is so abundant, the Black-tailed Myiobius is rare, and I have seen it only along the Río Buena Vista in the neighborhood of Rivas. In this area it appeared to be confined to the riverside thickets and low second growth, whereas the Sulphur-rumped Myiobius was numerous in the heavy forest, even high up on the ridges. Thus my experience with this species is just the opposite of that of Carriker (1910:709) who states that the Black-tailed Myiobius occurs high on the crests of the ridges, far from water.

The single nest of the Black-tailed Myiobius which I found was discovered on April 1, 1936, in a tall and densely tangled thicket near the Río Buena Vista, at a point about 2900 feet above sea level. The nest was newly begun, a small web of material that hung ten feet above the ground at the end of a slender, dangling vine. By April 13 it was finished or nearly so, and it so closely resembled nests of the Sulphur-rumped Myiobius that a separate description appears unnecessary. It was, indeed, somewhat longer and less regular in form than typical nests of the Sulphur-rumped Myiobius, and there was a constriction in its middle; but this appeared to result from an accident of construction rather than to be a distinctive feature of the Black-tailed Myiobius's architecture.

Between April 16 and 20 two eggs were laid. I can best describe them as of a dull peach color. One bore an ill-defined wreath of a slightly darker shade of the same color; the other lacked this wreath but had a diffuse brownish area on one side. These eggs measured 17.5 by 13.1 and 17.1 by 13.1 millimeters. In coloration, although not in size, they were easily distinguishable from eggs of the Sulphur-rumped Myiobius. They were somewhat closer in appearance to the eggs of the black-breasted myiobius. One of these eggs vanished in the course of incubation. The other was not pipped by the afternoon of May 11 but it had hatched by May 13, after at least 22 days of incubation plus possibly a day or two more. By the date when the egg hatched, the nest, which at this season was much of the time heavy with the water it absorbed from the almost daily showers, had sunk to less than half of its original height of ten feet.

The newly hatched nestling had blackish skin devoid of down. The inside of its mouth was yellow. When six or seven days old it still showed no trace of down or feathers, although it had doubled or tripled its size and its eyes were beginning to open. Unlike most Sulphur-rumped Myiobiuses that I have watched, the female parent was very shy, so that it required a stealthy approach to glimpse her sitting in her nest, and after flying out of sight she never returned to protest while I examined her offspring. Accordingly, to study her behavior, I was obliged to hide myself in a blind. This procedure was rarely necessary in the case of the Sulphur-rumped Myiobius.

I watched from 6:10 to 9:16 on the morning of May 19, when the air beneath the thicket was cool and damp and all the vegetation dripped unpleasantly with water from the heavy rain of the preceding afternoon. The naked nestling required much warming,



Fig. 96. Black-tailed Myiobius.

and the female brooded it for 15 periods ranging from 2 to 10 minutes in length. Her 14 absences varied from 3 to 11 minutes. Counting from her first return after I entered the blind, she was in the nest a total of 87 minutes and her total time away was exactly the same. Like the Sulphur-rumped Myiobius, she always sat facing inward, with her broad black tail projecting through the doorway but shielded above by the apron which covered the antechamber.

In three hours the single nestling was fed 21 times. To deliver food, the myiobius clung in front of the doorway with her body nearly upright and her tail pressed against the bottom of the nest. If the nestling did not promptly accept her offering, she dropped out of the antechamber and flew to a convenient perch in front of the nest, where she

rested for a few seconds. Then she went again to the doorway, to offer the morsel in the same manner as before. Once, when she had brought a small moth, which still was large for so tiny a nestling, she went eight separate times to the nest before it vanished. After feeding the nestling, she either climbed inside to brood it, taking her position in the nest without turning around, or else she dropped out and continued to forage.

When flitting through the bushes and tangled vines, the female myiobius often spread her broad black tail and let her black wings droop down, very much in the fashion of a Slate-throated Redstart. When she preened she fluffed out the sulphur-yellow feathers of her rump, making them very conspicuous. She was at all times completely silent.

Twice, while I watched, a second Black-tailed Myiobius came within sight of the blind. The first time it flitted close beside the nest, tail fanned out and wings relaxed, yet gave no indication of having noticed it. On its second appearance, it approached close to the female, which was perching close in front of the nest, and made advances to her. This bird may have been the mate of the female but I saw no indication that he helped to take care of the nestling.

By May 22, when it was nine or ten days old, the nestling's pinfeathers were beginning to sprout. Six days later I found it lying dead in its nest, apparently having succumbed to the cold dampness of this relatively high altitude.

SUMMARY

At the northern limit of its range on the Pacific side of Costa Rica, the Black-tailed Myiobius is rare in regions where the Sulphur-rumped Myiobius is abundant. It was found chiefly in riverside thickets and low second growth.

A nest was found in El General at 2900 feet above sea level. Attached to a dangling vine, it hung ten feet above the ground in a riverside thicket and closely resembled the nest of the Sulphur-rumped Myiobius in construction.

Two eggs, of a dull peach color, were laid in mid-April and hatched after 22 or 23 days of incubation.

The newly hatched nestling had blackish skin devoid of down. It was brooded and nourished by the female alone, which fed it 21 times in three hours when it was six or seven days old. Once she went eight separate times to the nest to deliver a moth which was too large for the nestling to swallow easily. She was completely silent while attending the nest. The nestling died prematurely, apparently as a result of heavy rainfall.

A second Black-tailed Myiobius sometimes passed by the nest but paid no attention to it and did not appear to be mated to the female.

NORTHERN BENT-BILL

Oncostoma cinereigulare

The Northern Bent-bill is a very small, plainly attired flycatcher, less than four inches in length. The top of its head is dull slate-gray, more or less tinged with olive. The back, rump and upper tail-coverts are light olive-green, and the dusky tail feathers have olive-green margins. The wings are dusky, with conspicuous olive-green edgings on both coverts and remiges but there are no prominent wing bars. The sides of the head are gray; the throat and chest are pale gray with darker streaks, whereas the more posterior underparts are sulphur yellow, with an olive tinge on the sides and flanks. The eyes are pale yellow, the bill is black on the upper mandible and lighter on the lower, and the legs are yellowish. Although the plumage of this diminutive flycatcher is undistinguished, its short, strongly downcurved, dark bill is unlike that of any other genus in its huge family.

The species extends from southern México to western Panamá and through most of its range is found on both coasts. Griscom (1932:272) regards it as being more abundant on the Pacific side than on the Caribbean side in Central America. A lowland species, it extends upward to about 2500 feet in El General, and I have no knowledge of its occurrence higher than this. It is at home in the taller and denser second-growth woodlands and thickets as well as in the primary forest, usually at no great distance from its edge. Unless accompanied by dependent young, it is always solitary. It spends most of its time among the bushes and herbs near the ground. Its food consists largely if not wholly of insects and spiders, which it usually plucks from the under surface of leaves. It seems to me that its strongly downcurved bill, so rare among flycatchers, is well adapted to this mode of insect catching. As the bird darts obliquely upward to the underside of a horizontal leaf along which its prey is crawling, the upper surface of the terminal portion of its bill is more or less parallel to the lower surface of the leaf. Hence the upper mandible may slide between the insect or caterpillar and the leaf and render capture easier and more certain than would be true if the bill were straight.

VOICE AND COURTSHIP

The female bent-bill is in my experience as silent as she is solitary. The male, which seems to form no lasting attachment, is a loquacious bird in his own small way. His voice proclaims his presence in one restricted part of the woodland, day after day, year after year. There is a corner of the primary forest on my farm which is bordered on the east and south by fields where rice and maize are occasionally planted but which most of the time lie fallow until they are covered with tall, woody second growth. Here at the forest's edge, beneath the shade of an enormous fig tree supported on great flying-buttress roots, a bent-bill, or a succession of them, has been present in most if not all of the last ten years. The bird is frequently heard but seldom seen, for he is a very small figure to pick out among the heliconias and other great-leaved herbs and shrubs which flourish at the forest's margin. As he makes his way slowly along the edge of the woodland, he constantly repeats notes which I can best describe as little growls and croaks. One utterance, perhaps the most frequent, is a long-drawn, dry and throaty churred note, an unmelodious *gr-r-r-r-r* with a very queer intonation, such as in a man or a dog would indicate anger or ill-temper. Other calls are shorter and more like whistles; but all that I have heard incline toward harshness, and most are loud for so diminutive a bird. April, May and June are the months when I chiefly hear the bent-bill in this spot.

His presence year after year in the same restricted area is the more significant, because bent-bills are far from numerous in this district. Although I have never witnessed courtship behavior, it seems likely that this flycatcher establishes a headquarters and draws the opposite sex to him by tirelessly repeated noises, in the manner of manakins and many other birds.



Fig. 97. Northern Bent-bill.

NESTING

On April 5, 1939, Efraim Flores found for me in the forest near San Isidro del General a recently begun bent-bill's nest. It consisted of a mass of fine, soft, light-colored fibers hanging below the rachis of a large, pinnately compound leaf of a sprout from a cut-off sapling. It was attached just behind the terminal leaflet, only 16 inches above the ground, near the base of the massive trunk of a tall tree, in a spot where it was well screened by the foliage of the undergrowth. Mixed with the fibers which were the principal component of the fluffy mass were many tufts of green moss, some wefts of the silken egg cases of spiders, and a few seed plumes. When I first saw it in the evening of April 5, the builder had just begun to push into the center of the loose, globular mass of fibers, separating them to hollow out a chamber in their midst.

From a blind which I promptly set in view of this nest, I began to watch it at the following dawn. But it was 6:30 before the builder appeared and flew rapidly into the half-finished structure. She came rather infrequently and by 9:00 had made only 23 visits to it. Usually she bore long strands of light-colored fibers which trailed conspicuously behind her as she flew briskly through the undergrowth. With her burden in her

bill she came to rest either on or within a few inches of the ground; obstructing foliage prevented my seeing this clearly. Then, after a brief pause, she flew sharply upward into the nest. Inside, she worked vigorously to tuck the new material into the fabric, making the loose walls bend and shake with her movements. At times her short bill pushed through to the outside, showing that she carefully tucked the new strands in among the old, but she did not actually weave in the manner of oropendolas and other orioles. Sometimes she brought material twice or three times in quick succession, but most of her visits to the nest were widely spaced. She labored in perfect silence, and I did not hear a single note from her while I had her in view.

At times I heard, off in the woodland, the peculiar growling notes of a male bent-bill, and once I saw him in a vine tangle not far behind me. But he never accompanied the builder on her visits to the nest, and he never came near the nest itself. There seemed to be so little understanding between the two bent-bills that I greatly doubted that they were a mated pair.

This nest appeared to be finished by April 13; but although I made periodic visits of inspection, I never found an egg in it. I have not seen the eggs of the Northern Bent-bill, which according to Alvarez del Toro (1952:15) are white and are laid in sets of two. However, a year later I discovered, by the Río Pacuar near the head of the valley of El General, another nest which already held young. This was attached to the tip of a slender branch among open, bushy growth just within the forest's edge, and it was partly screened by the terminal foliage of the supporting twig. The bottom of the pensile, roughly ovoid structure was only 18 inches above the ground. It was composed almost wholly of bast fibers of a very pale color, but it had a thin, incomplete covering of green moss on the top and sides. On one side was a narrow, round entrance, which was shielded by a visorlike projection from the wall and gave access to a snug, rounded chamber. The nest measured $4\frac{1}{2}$ inches in height by $2\frac{3}{4}$ inches in diameter. When found on April 10, 1940, it held two nestlings already in pinfeathers.

On April 12, I watched this nest from my blind from 6:30 to 10:30 a.m., and in these four hours the two nestlings were fed 43 times, all, as far as I could tell, by a single parent. I did not once see two bent-bills in the vicinity. As a rule, with birds which bring food as frequently as flycatchers, one does not have to watch for many minutes to learn how many parents are attending the nestlings, for if two are feeding them their visits will before long coincide. Still, in order to make quite sure that only a single parent was nourishing the nestlings, I decided to try to mark her, and to this end I placed, that same afternoon, a tuft of cotton soaked in red dye in front of the doorway. On arriving to feed the nestlings, the parent paid little attention to this bright object, but brushed against it as she passed through the entrance, thereby staining her right wing. This mark was fairly conspicuous when the wing feathers were somewhat spread, but unfortunately it was difficult to distinguish when they were closed. From 3:50 to 5:00 that same afternoon the nestlings were fed 13 times, and at least 10 of these times I identified the red-winged bird as the food bringer. Next morning, from 6:45 to 9:45, they were fed 31 times. On 21 of these visits I could distinguish the mark on the parent's wing. This left open the possibility that the second parent was also bringing food. But my failure always to discern the not very conspicuous mark was in my judgment outweighed by the fact that not once in over eight hours were two bent-bills in sight of the nest, despite the fairly rapid rate of feeding. My experience at the nest at which I had watched building the preceding year, as with a nest of the Southern Bent-bill, strengthened my belief that only one parent was in attendance. I decided that in the bent-bills, as in *Pipromorpha*, *Myiobius* and a few other genera of flycatchers, the male takes no interest in the eggs and young.

The female bent-bill had ceased to brood by day. She always fed the nestlings while clinging upright before the doorway, her tail braced against the side of the nest below it. Their food consisted of a variety of adult insects, which I could not distinguish as to kind, and numerous caterpillars. From the conspicuousness of legs rather than of wings on the insects in the parent's bill, I inferred that they were chiefly plucked from the foliage rather than caught in the air. Once, however, she brought a small butterfly. She was perfectly silent while I watched her.

By April 17, before they were well feathered, these nestlings had vanished. Whatever had taken them seemed to be responsible for the small, round hole in the wall of the nest above the doorway, an opening such as I have occasionally found in despoiled closed nests of various kinds of forest-dwelling flycatchers and wrens, although I have not learned what makes it. It is strange that the Northern Bent-bills' nests should be placed so near the ground, within easy reach of snakes and small mammals. The pensile nests of most species of flycatchers hang well above the ground, on a very slender support and in a space clear of vegetation, where they are beyond the reach of the majority of wingless predators. Their success appears to depend on their inaccessibility. But the two bent-bills' nests I have seen were neither inaccessible nor inconspicuous, for their light color, imperfectly concealed by tufts of green moss, did not blend well with the prevailing colors of the lowest stratum of the forest vegetation.

SUPPLEMENTARY OBSERVATIONS ON THE SOUTHERN BENT-BILL

In Panamá, from the Canal Zone eastward, and in northern Colombia there occurs a second kind of bent-bill (*Oncostoma olivaceum*). This bird is considered by some ornithologists to be conspecific with the form we have just treated, although Griscom (1932:272) adduces good reasons for regarding the two as specifically distinct: there are no intermediates, and the ranges of the two forms are separated by most of the Panamanian province of Chiriquí and the whole of Veraguas. The Southern Bent-bill differs from the Northern chiefly in its light olive-yellow rather than light gray throat and chest and its olive-green rather than slate-gray pileum. On Barro Colorado Island I found this flycatcher in heavy forest, but others have met it in light woodland and even second-growth woods and thickets. In the Santa Marta region of Colombia, Todd and Carriker (1922:384) record its presence "among the shade-trees of the cacao-plantations and in open situations along the little streams, seldom in the forest itself."

On Barro Colorado Island I did not find a male calling in the same area day after day, as in the case of the Northern Bent-bill in El General. But once when I inspected a nest of the Yellow-thighed Manakin the protests of the female attracted, among other diminutive birds, a Southern Bent-bill, which alighted a few feet from me and uttered a peculiar, harsh, growling note. The bird stretched and bent forward its neck as it scolded. This grating note seemed to irritate the female manakin, for she darted at her unappreciated sympathizer and put it to flight.

Toward the end of April I found a nest new to me. It hung, 14 feet above the ground, from a slender, leafy branch of a small tree which stood by a narrow watercourse, in the midst of the forest on Barro Colorado. The neat, pyriform structure, attached to the twig by its slender upper extremity, was $5\frac{1}{2}$ inches in length by 3 inches in greatest diameter. In the side facing the interior of the tree's open crown was a narrow, round aperture giving access to the central chamber. The nest was constructed almost wholly of very light-colored, soft fibers from some disintegrating herbaceous vine, several nearly entire lengths of which hung below the rounded bottom and destroyed its symmetry. The floor of the chamber was lined with the soft, buff-colored down from some kind of seed.

Although apparently completed, this attractive nest was without eggs when I found it, and despite repeated visits I did not at this stage see a bird which appeared to be its owner. Finally, on April 30, an egg was present, and two days later another was laid. These eggs were white, with a wreath of small blotches and fine scrawls of pale brown around the thick end and a few such marks scattered elsewhere over the surface. They measured 15.9 by 12.7 and 15.9 by 12.3 millimeters.



Fig. 98. Nest of the Southern Bent-bill in the forest on Barro Colorado Island, Canal Zone, May, 1935.

Even after the female began to incubate, it was not easy to identify her. She stuck very closely in the nest, where I could see little of her except her head and that imperfectly. It required much shaking of the supporting tree to make her come forth; but when finally I persuaded her to leave, she shot through the foliage so quickly that I hardly saw her. Finally I hid myself in a blind and had a good view of her as she carefully surveyed her surroundings from a nearby perch before she flitted to the narrow doorway and then climbed inside the nest. She sat quietly for 72 minutes, from 8:46 to 9:58 a.m. After this long session she took a long recess, lasting 40 minutes. I did not continue my watch because the site of this nest made prolonged observation difficult.

A few days later I found a small circular hole in the nest's rear wall. It was about the size of the doorway and neatly rounded, as though by the sharp teeth of a mouse. But whatever made the perforation failed to take the eggs or to harm the flycatcher,

which continued for a while to sit in her nest with two entrances. One day she sat staunchly while I climbed a ladder, with much inevitable shaking of the supporting tree and rustling of the foliage through which I pushed, until my head was level with the nest and I looked in at her from a distance of a few inches. She was sitting with her head toward the doorway and her tail held nearly erect against the rear wall, just as Gray-capped Flycatchers and Kiskadees sit in their larger nests. After returning my gaze with her pale yellow eyes for a few moments, she turned around and slipped out through the hole which had been made in the rear of her chamber. On another occasion she was absent when I climbed up to examine her nest. When she returned and found me, she hovered all around me at a short distance, and her wingbeats were rapid and whirring like those of a manakin. Presently she alighted on a twig directly in front of me and for several seconds we stared at each other at close range. After her departure, I reached forward and without changing my position touched the spot where she had rested. Despite her attachment to her nest, it was abandoned a few days after it had been mutilated. On all my visits, I never saw a second bent-bill in the vicinity, which suggests that the nesting Southern Bent-bill receives as little help and encouragement from a mate as the Northern Bent-bill.

The only other nest of the Southern Bent-bill of which I have knowledge was found by Harrower (1936) near Gatún, Canal Zone, on August 7, 1933. The flask-shaped structure hung from slender twigs about three feet above the ground in dense, scrubby second growth, at the edge of a clearer space which permitted much light to reach it. It contained a single egg when found, and two eggs were present when it was next visited on August 15.

SUMMARY

The Northern Bent-bill occurs on both sides of southern México and Central America and from sea level up to about 2500 feet in Costa Rica. It inhabits the taller and denser second-growth woodland as well as primary forest, where it is usually found near the edge. A solitary bird, it spends most of its time in the undergrowth near the ground, where it catches insects among the foliage, often darting up to pluck them from the lower sides of leaves. The strongly decurved bill may be an adaptation for this method of foraging.

Although the female is a silent bird, the male utters a variety of queer, harsh notes, including miniature growls and croaks and short whistles. The male is to be found day after day and year after year in the same small area, repeating his odd sounds, which apparently serve to apprise the females of his presence. Thus he seems to maintain a courtship station in the manner of manakins and hummingbirds. He takes no interest in the nest.

Two nests found in April in the valley of El General were respectively 16 and 18 inches above the ground. They were in bushy growth in primary forest but near its edge. Suspended by the apex from a leaf or twig, they were roughly ovoid structures composed chiefly of light-colored bast fibers, with tufts of green moss on the outside. The cozy chamber was entered through a narrow, round aperture in the side. At one of these nests the female built alone.

The eggs of this species are unknown. The second nest contained two nestlings in pinfeathers, which were attended by a single parent. They were fed 87 times in 8.2 hours, chiefly with small insects. These nestlings vanished prematurely.

A nest of the Southern Bent-bill on Barro Colorado Island resembled those of the Northern Bent-bill but was much higher, 14 feet up in the forest. It contained two eggs which were abandoned after some animal made a round hole in the back of the chamber. Only a single adult was seen in the vicinity of this nest.

OLEAGINOUS PIPROMORPHA

Pipromorpha oleaginea

Some birds are so distinct in color or form that it is scarcely possible to confuse them with any other species. Who having seen the Quetzal, the Scissor-tailed Flycatcher or the Three-wattled Bellbird could possibly mistake them for anything else? On the other hand, there are many other species so commonplace in appearance that we cannot with confidence identify them from written descriptions or even from colored pictures, and in spite of repeated encounters with them we are not quite sure that we are dealing with the same bird. In this class are many of the small flycatchers which abound in both the tropical and temperate regions of the Western Hemisphere. But many of these small, dull-colored birds, with no outstanding physical character by which one can lay hold of them, possess peculiarities of habit which are no less distinctive than the long train of the glittering Quetzal. These habits are specific and serve for the identification of the bird no less surely than the bright contrasting colors or peculiar form of bill or feet of other species. However, these habits are not so easy to grasp; as a rule we cannot distinguish them through our powerful binoculars nor examine them in the specimen we may have shot. Through most of the year they may be latent in the bird, to be manifested at the appropriate season. We become familiar with them only through long-continued, painstaking study in the field. But as the science of ornithology reaches its majority, and our books which treat of the birds of tropical countries become something more than dreary necrologies, we shall depend increasingly on the habits and mannerisms of birds for their identification, with the result that we shall recognize them with far more certainty than we at present do by superficial characters alone. For the voice of a bird, its mode of flight and the form of its nest, are characters as integral and durable as any of those currently employed in the classification of species and genera.

The Oleaginous Pipromorpha is an outstanding example of the class of birds to which I refer. In appearance it is one of the least prepossessing of feathered creatures, yet it has habits so remarkable that it deserves to be as widely known as the bower-birds, the bellbirds, or the cock-of-the-rock. It is a slender, long-tailed, greenish olive bird, five inches or less in length. The sides of its head, chin, and throat are more grayish. The Central American forms of the species lack prominent wing-bars and conspicuous light margins of the wing and tail feathers. Of the bird's physical characters, perhaps the peculiar shade of ochraceous-yellow on its lower breast and abdomen, much the color of tarnished brass, serves best to identify it among the host of small, olive-clad flycatchers and other birds of tropical America. Its predominantly black bill is fairly long and slender and bears a small hook at its tip; it is hardly a typical flycatcher's bill. The eyes and legs are also dark. The mouths of many adult males have yellow corners; this is a persistent juvenal character which the adult females lack. The pipromorpha also possesses a mannerism which helps greatly in the identification of the living bird; it is continually twitching its wings up above its back, first one and then the other, folding each down at once. One can rarely watch a pipromorpha for half a minute without seeing it do this a number of times. The small, mute bird seems to be trying to send a message by semaphore, using the two-flag system! This persistent nervous trait adds to the impression of restlessness which the shy, active flycatcher creates. I do not know how widespread this habit of wing-lifting may be in the species; but it is deep-rooted in the pipromorphas of the Pacific slope of Central America from Guatemala to southern Costa Rica, and in those of western Ecuador.

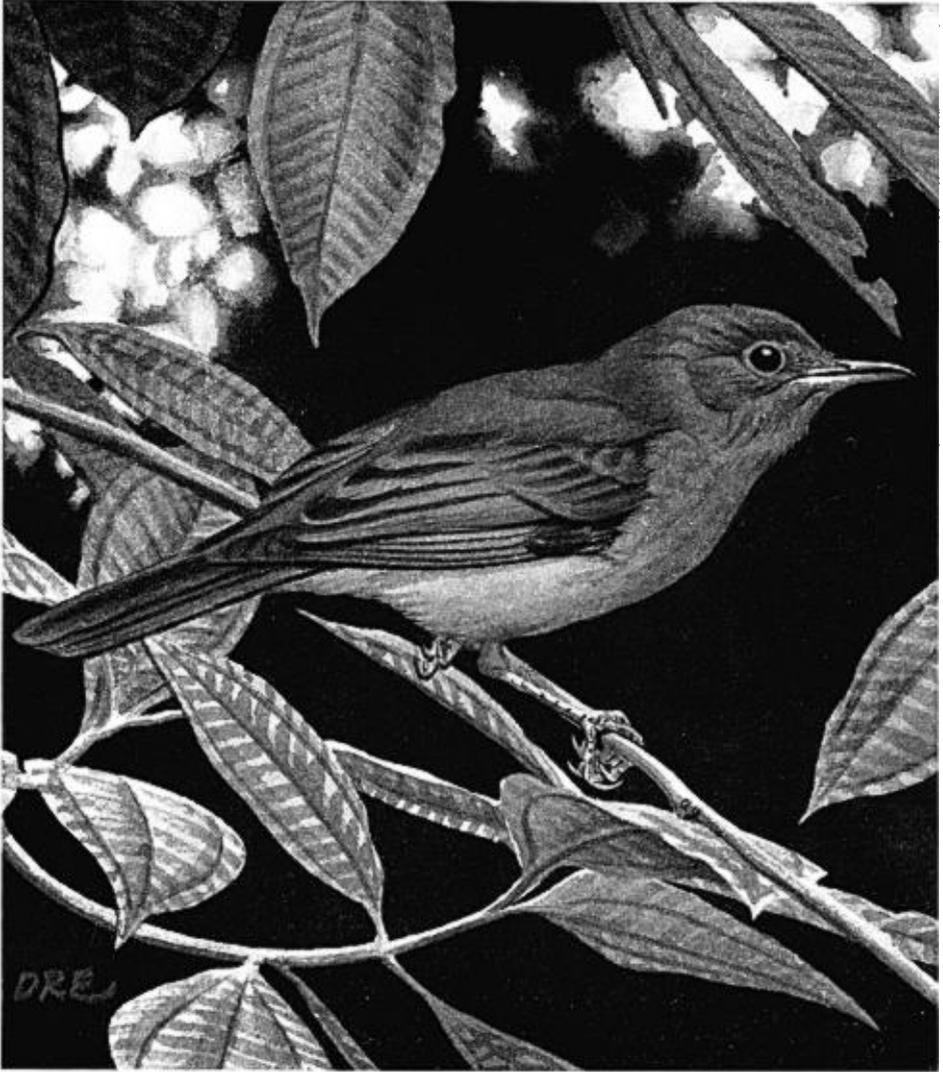


Fig. 99. Oleaginous Pipomorpha.

This inconspicuous flycatcher is found from southern México to Perú and Brazil. It is one of the most solitary of birds, never flocking nor even associating in pairs. At best a lone individual may attach itself to one of the mixed flocks of small birds that roam through the underwood of the lowland forest, but its association with such flocks is of the loosest sort. Although most at home in the forest, it often comes to forage in neighboring clearings with scattered trees, sometimes venturing several hundred yards beyond the confines of the heavy woodland, and it may hang its nest along tree-shaded water-courses even where these are bordered by cultivated fields. On the Pacific slope of Guatemala, I found pipomorphas abundant among the coffee bushes planted under the shade of the original forest. In both this republic and Costa Rica the species ranges

from the lowlands well up into the foothills, to about 4000 feet above sea level or possibly even higher.

FOOD

The pipromorpha subsists on small insects which it snatches from the foliage while flitting restlessly from twig to twig. Sometimes it plucks insects and spiders from fallen branches near the ground. I have never seen it make spectacular sallies into the air to catch flying insects, in the manner of so many other flycatchers. It is fond of small fruits, particularly of the berries of various species of mistletoe (*Loranthaceae*). The mistletoes which often heavily infest orange, lemon and other fruit trees seem to be the attraction which frequently lures the pipromorpha from the depths of the forest into the neighboring clearings. These parasitic shrubs generally grow on the more exposed branches of the host tree. The flycatcher alights on the parasite, picks off a berry or two, then darts back into the sheltering foliage of the fruit tree, often with the last berry still held in its bill, to be swallowed later. It also eats the little, shiny, black seeds of species of *Xanthoxylum*, apparently for the sake of the thin aril that encloses the bony seedcoat. In the dry season it joins a large variety of other birds in the trees of *Alchornea latifolia* in the clearings, to devour quantities of the bright red arillate seeds. When the pungent, lemon-scented red fruits of the shrubby *Siparuna* split irregularly to display minute, pointed, gray seeds, each with a bright red aril at one end, the pipromorpha includes them in its diet.

ANTING

Once I watched a pipromorpha engage in that peculiar and little-understood occupation called anting. A lone male flew into a small tree growing on the bank of the stream in front of our house. He plucked a small, dark object from the foliage and, holding it in the tip of his bill, placed it beneath his wing, probably rubbing it along the inner surface of his remiges. As he did this his wing was slightly opened and his tail bent forward beneath his perch. The object in his bill disappeared after he removed his head from beneath his wing, but he found another small, dark body and treated it in the same fashion. I could not actually distinguish what the bird held in his bill, but after he flew off I examined the tree and found it to contain a small silken ants' nest, the occupants of which were crawling over the boughs and the foliage. Without much doubt it was these ants which the pipromorpha rubbed beneath his wing, as birds of numerous other kinds have been seen to do.

COURTSHIP

The pipromorpha is a bird that can be either very silent or loquacious. Females seem at all times to be perfectly silent, and so are males through a large part of the year. But during the long breeding season, the males take up stations in the underwood of the forest and call as tirelessly as only pipromorphas and hummingbirds can. Unlike the majority of flycatchers, this species does not form pairs; but the males advertise their presence at definite localities which they frequent for months together, while the females build their nests and rear their young with no help from them. Thus the relation between the sexes resembles that found in manakins, numerous cotingas, and hummingbirds.

At the height of the dry season in early March, the male pipromorphas select in the underwood of the high forests of El General the stations where they will be found almost constantly for the next six or seven months, or well into September. Within a week or so after they sound their first tentative notes, each is singing freely in his chosen location. This is not a sharply delimited area on the ground, like the "court" of the Salvin Manakin, nor one particular branch, like the display perch of the Yellow-thighed Manakin, but rather it is a restricted area from 30 to about 100 feet in diameter. Within this

limited territory, the pipromorpha flits restlessly from perch to perch, singing first from one, then from another, until he has made the rounds of his domain. Some males remain low, between 5 and 15 feet above the ground; others stay somewhat higher, between 20 and 40 feet, rarely ascending to 50 feet. But always they are found well down in the shade of the forest, far below its lofty canopy. Perhaps most often they perform from 10 to 30 feet above the ground.

While he perches on a slender, bare, horizontal branch of a sapling or small tree, the pipromorpha sings tirelessly. His voice is weak and unmelodious, his refrain simple and tuneless; but because of the character and import of his utterance it must be classified as song. It bears a general resemblance to the songs which many species of hummingbirds deliver in their singing assemblies, although the pipromorpha's voice is not as sharp as that of many hummingbirds. He begins by uttering low, weak notes, widely spaced and repeated a variable number of times, then he changes to a slightly fuller note which he delivers more rapidly, in measured time. As nearly as I can represent it in written syllables, the pipromorpha's song runs this way: *Whip wit whip wit wit chip chip chip chip chip chip chip*. Of the widely spaced notes, the bird may deliver from 4 to 10, and rarely as many as 14; these are followed by from 2 to 12 of the more animated *chip*'s. This simple refrain is repeated tirelessly through the day, and day after day, week after week, month after month, through about half the year. Flycatchers which are monogamous and form pairs often have a dawn song which they repeat continuously for many minutes before sunrise, but no other species that I know sings so persistently through the entire day.

As he sings, the male pipromorpha keeps the feathers of his crown slightly raised, forming a low crest, which the female lacks. In addition he lifts his wings momentarily above his back, one at a time and usually alternately, just as the silent females do. Doubtless this gesture helps to draw the attention of the females to the males' small and obscurely colored bodies, which when motionless are hard to detect in the dim light of the forest undergrowth. The Brown Flycatcher has rather similar methods of courtship, and he also frequently flicks up his wings, a habit which is shared by the female of the species, as I have seen in the forest on Barro Colorado Island. In this connection, it may be mentioned that in manakins of several species, the females perform some of the antics used by the males in courtship display. Rarely delaying long on one perch, the male pipromorpha flits from bough to bough as he sings, and as he moves about he plucks small insects from the foliage, scarcely interrupting his monologue to eat.

The male pipromorphas perform in the same stations year after year. Often several are found in the same part of the forest, so spaced that the weak notes of one may be plainly if faintly heard at the center of his neighbor's territory. As in other birds, the selection of territories by the pipromorphas is not effected without a certain amount of rivalry between neighboring males, although this appears to be of a very mild character.

On March 11, 1944, a few notes of the song led me to the discovery of two of the small greenish birds, in the same part of the forest where birds had performed in the two preceding years. By the time I came in sight of them they were silent but obviously excited; for they twitched up their wings even more frequently than is usual and flitted nervously from twig to twig. This went on for some minutes, when suddenly one darted at the other and pursued him through the undergrowth. Presently they reappeared and flitted about each other, twitching their wings as before, until it all ended in another pursuit. As the birds chased each other they uttered low, angry notes that reminded me somewhat of the calls of the Gray-capped Flycatcher, but these were of course much weaker, as befitted the smaller size of the pipromorpha. Between the pursuits, which

were widely spaced in time and not violent, the birds snatched inconspicuous insects from the foliage and preened. Each was silent except while pursuing his rival, and they did not repeat their "singing" notes after I came in view of them. After perhaps half an hour, two more pipromorphas appeared on the scene, and then in a general chase all flitted away through the underwood and did not return. As well as I could see, the latest arrivals also had yellow corners to their mouths and hence were males like the first.

In spite of a good deal of watching, I have never been so fortunate as to witness the behavior of the male pipromorpha in the presence of the female for whom he so tirelessly calls. The darkness of the woods, the density of the vegetation, the smallness and dull coloration of the birds, and above all, their failure to remain in one spot make observations of this sort most difficult.

Although most of the pipromorphas perform in the primary forest, a few take up their stations beneath the older second growth. This tendency appears to be increasing as the original forests of El General shrink before the inroads of agriculture.

THE NEST

At about the same time that the males start to sing, which is early in March in the valley of El General, the females begin to fashion those wonderful nests which are the pipromorpha's chief claim to distinction. The pyriform structure of green moss is always attached to some slender, swinging support, such as a dangling vine, a thin, drooping branchlet, or the long, cord-like aerial root of an epiphytic growth. Sometimes the structure is attached to two or three roots that hang down close together, but as a rule only one is used. Most nests are placed along forest streams, but many are built along rivers that flow through clearings if there is a fringe of spreading, umbrageous, epiphyte-laden trees along their banks and the forest is not far off. More rarely the nest is in the woodland at a distance from running water. At times the structure swings free in a clear space in the forest or above a waterway, but often it hangs close beside if not actually in contact with some solid support such as a massive trunk in the forest, a verdant cliff beside a mountain torrent, a low earthen bank, or even a huge, verdure-crowned boulder in the middle of a forest stream. It is rarely attached at any great height, and 12 feet above the ground is the greatest elevation that I have recorded. Many nests are only 4 or 5 feet up, and some that hang beside the banks of small streams are so low that the longest dangling fibers of which they are made touch the mud at the water's edge.

The nests of the Oleaginous Pipromorpha hang above the beds of forest streams over much of tropical America, at lower altitudes. In Trinidad, Belcher and Smooker (1937:247) found that it was "exceptional to walk along any hill-forest stream in the breeding season, February to May, for more than a couple of hundred yards without coming upon a nest." They discovered nests also in the undercut sides of quarries and dangling beneath heavy fallen logs.

With the possible exception of the ovenbirds (Furnariidae), no family of birds of the Western Hemisphere builds nests so varied in form as those of the flycatchers. Among the many beautiful, ingenious and elaborate structures made by members of this gifted family, the nest of the plainly clad pipromorpha is the loveliest, the most commodious, the most enchantingly unexpected of all. It is a roughly pear-shaped structure measuring 12 to 14 inches in length by about $3\frac{1}{2}$ in diameter at its thickest part. A round entrance in the side, about $1\frac{1}{2}$ inches in diameter and shielded above by a visor-like projection of the wall, gives access to a softly padded, roughly ellipsoidal chamber about 4 inches high by $2\frac{1}{2}$ inches in diameter in the heart of the pendent nest. The foundation material of the nest is almost always the thread-like pistillate inflorescences of

species of *Myriocarpa*, small trees of the nettle family not uncommon along the lowland streams of Central America. These pendent fruiting strands are often three or four feet in length and they bear myriads of minute achenes. The tree flowers early in the year, and the long, flexible inflorescences are usually brown and dry when gathered by the female pipromorpha for building. She twists them around the dangling root or vine where she will attach her nest, until she has a long, loose mass in which she can entangle the materials of other kinds which she now proceeds to bring.

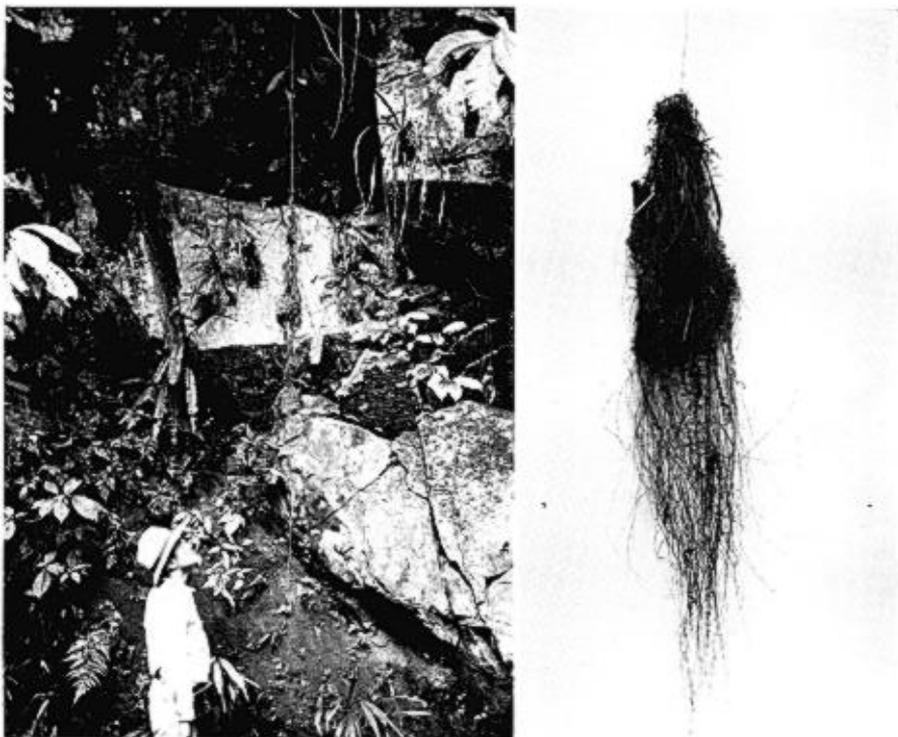


Fig. 100. Nests of Oleaginous Pipromorpha in Caribbean foothills of Honduras, near Tela.

Left, nest attached to a cord-like aerial root hanging beside a cliff above a forest stream, June 6, 1930.

Right, a nest of July, 1930.

The outer covering of the nest is nearly always of bright green living mosses and hepatics, but one exceptional nest built in dry weather was brown, possibly because the builder could not find enough green moss. The middle layer of the walls consists of bits of leaf skeletons, thin fibrous rootlets, and other fine fibers. The soft, thick inner lining is composed of delicate, light-colored bast fibers or similar materials. In the forests on the foothills of northern Honduras, the pipromorphas lined their nests with fibrous strands from the center of decaying trunks of the stately manaca palm so abundant there. The triple wall of mossy covering, fibrous middle layer and soft lining is about half an inch in thickness. The "neck" of the pear-shaped nest is solid and composed largely of moss. Below the rounded bottom of the chamber the long, thread-like, brown inflorescences of the *Myriocarpa* hang loosely, sometimes to the length of three feet. The whole structure,

if these free ends of the foundation material are included in the measurement, may be about four feet long.

The pipromorpha's nest is as comfortable as it is beautiful, and it is almost as secure as it is comfortable. In the well-padded central chamber, eggs and nestlings are sheltered from rain and are well insulated from the hot sunbeams that often cause acute discomfort to nestlings. When it swings free from a slender, dangling support, the nest is beyond the reach of most predatory mammals and reptiles, although it may be robbed by toucans. When it hangs above a forest stream beside a dripping cliff all verdant with ferns, aroids, orchids and mosses, the green structure is by no means easy for inexperienced eyes to detect.

In the Honduran foothills, years ago, a pipromorpha fastened her nest to the roots of an aroid that grew on top of a huge boulder standing in the middle of a mountain torrent. The supporting roots hung down over the edge of the great rock, the sides of which were covered with green moss. In working my way up or down the streambed to visit other nests that I had found, I was obliged to pass along a narrow ledge of rock that skirted the rapids beside the boulder. I passed within a foot of this nest perhaps a dozen times before I finally noticed it, although it was concealed only by its green coloration.

It was above this same mountain stream that I discovered my first nests of the pipromorpha. The very first that I ever saw was attached to the twig of a small shrub that grew in a cleft in a vertical, rocky cliff and bent over a pool of dark water at the margin of the swiftly flowing stream. With a hooked stick I could draw the nest down far enough to see the three eggs that it contained. At the first movement of the nest, a small, dark-colored bird darted out, and flying close along the rocky wall, made its way into the forest above. No other bird whose nest I have found proved quite so difficult to identify. At first it delayed in the nest until I could almost touch it; then it darted forth and never paused until it was out of sight in the surrounding forest, having given me only the most fleeting glimpse of itself. It sat so closely that I believe I might have caught it by advancing stealthily and clapping a hand over the doorway, but I desisted from doing so because of the probability that such a procedure would cause it to desert the nest. Later, when as a result of my repeated visits it became more wary and shot out and away at the sound of my approach, I began to regret that I had not captured it in this manner, for efforts to obtain an adequate view of it by other means had failed.

After the nestlings hatched I spent many hours, at all times of the day, sitting quietly on a rock in or beside the stream, sometimes close to the nest, sometimes a good distance away, hoping to see a parent enter with food; but as long as I was in the slightest degree visible, no parent ever appeared. I erected a blind close to the nest, and hidden within I waited in vain for two hours for a parent to come to it. Later it did feed the nestlings in front of my blind, but it came and went so quickly that I saw it most imperfectly. Similar attempts to obtain a satisfactory view of the owners of other nests of the same kind were equally futile. Then, with a butterfly net, I tried to catch these birds while they sat in the mossy structures; but all had become more wary as a result of my frequent visits. The birds were invariably perfectly silent.

But at last my efforts were rewarded. One day one of these greenish birds, that had barely escaped my butterfly net, instead of at once darting off into the forest beyond my sight, alighted in some low bushes overhanging the stream where it flitted nervously from twig to twig and even paused to preen its feathers in full view. I was able to study all the details of its obscure plumage through my binoculars—an examination which left little doubt, after I had thumbed through my reference books, that the uncooperative little bird was a pipromorpha.

On Barro Colorado Island in the Canal Zone, the pipromorphas were just as difficult to see in the vicinity of their nests. So, too, they must be in Trinidad and Tobago, for Belcher and Smooker (1937:247) wrote of this species and the related *Mionectes*: "All one sees of the bird when a nest is found is a tiny patch of olive darting away. One may wait hours in this part of the world for a bird to return to its eggs." It was so difficult for them to obtain an adequate view of the owners of these mossy nests that often they could not decide which belonged to the pipromorpha and which to *Mionectes olivaceus*, which builds a similar structure. But in the valley of El General, I found individual pipromorphas that were more cooperative with the birdwatcher. When she began to incubate, one female would at my approach fly as rapidly out of sight as her Honduran sisters of earlier years. But as her eggs approached the point of hatching, she became bolder and would sit in the nest, facing outward, until I was only a few feet in front of her. Then she would flit to a neighboring bush and watch me feel inside the nest, while she briskly flipped up her wings in the usual manner. Other pipromorphas in this region remained as close while I examined their eggs or nestlings.

This nest is of course built by the female alone. One female that I watched brought material 30 times in the 75 minutes from 7:00 to 8:15 a.m., after which she stayed out of sight until 9:00. She attached longer fibers by giving them a turn around the dangling root to which her nest was fastened. Another female took 6 contributions to her nest in 10 minutes, but then I waited 40 minutes more without seeing her again. The bulky nest may be completed in two weeks or slightly less.

THE EGGS

The earliest egg that I have seen was laid in El General on March 6, 1958. Another early set was completed on March 22, 1937. Each of 15 nests contained 3 eggs, and six nests held 2 eggs or nestlings. Three eggs also appear to constitute the usual set in Trinidad and Tobago (Belcher and Smooker, 1937:248). At one nest an interval of two days separated the laying of the first and second eggs, as likewise that of the second and third. At another nest the third egg was laid two days after the second. The eggs are pure white, unspotted. The measurements of 10 eggs average 20.2 by 14.5 millimeters. Those showing the four extremes measured 20.6 by 15.1 and 19.8 by 14.3 millimeters.

In 14 nests in the valley of El General, 2000 to 3000 feet above sea level, eggs were laid as follows: March, 4; April, 7; May, 2; June, 2; July, 1.

In the foothills of northern Honduras, near Tela on the Caribbean coast, I found three occupied nests in early June, 1930; but by July 8 the numerous nests which I discovered by working along the rocky watercourses were all deserted.

INCUBATION

Because for years I have not had a nest satisfactorily situated for watching from a blind, I have made no study of the rhythm of incubation of the pipromorpha. The female sits facing her doorway, not with her tail outward like the Royal Flycatcher, the Sulphur-rumped Myiobius, and a number of other small flycatchers that build pensile nests. At four nests the incubation period was, respectively, 19, 20, 21, and 21 days. At one of these nests the eggs were laid on April 13, 15, and 17, and they hatched on May 6, 7, and 8. Incubation evidently began before the second egg was laid.

THE NESTLINGS

The newly hatched nestlings have pink skin with a sparse but fairly long, gray natal down, and their eyes are tightly closed. When the female comes to feed them there is

nothing visible in her bill. After a survey of the surroundings from some perch near the nest, she flies up and clings upright in front of the entrance, with her head within and her tail pressed against the mossy side. Delivering food to younger nestlings is a lengthy process and the parent may cling with her head in the doorway for well over a minute. What she does in this position it is impossible to see, but apparently she feeds her nestlings by regurgitation. After feeding, she may fly swiftly away, or she may climb into the nest, turn around, and settle down to brood them. On leaving the nest after a period of brooding, she shoots outward and downward, headfirst, and glides swiftly away. A female with three nestlings between 4 and 5 days old fed them only 6 times in the three hours from 6:00 to 9:00 a.m. She brooded them 4 times, for periods of 18, 13, 9 and 10 minutes.

Another pipromorpha, whose three nestlings appeared to be about five days old, fed them only 7 times in the four hours between 6:25 and 10:25 a.m. on May 19, 1957. Each time that she came with food, she clung with her head inside the doorway, apparently regurgitating, for an interval which ranged from about one and a half to three minutes. Once, at the end of a feeding which lasted for two minutes, I noticed in her bill a red object, apparently a berry or an arillate seed, which she promptly swallowed, but otherwise I saw nothing of the food that she brought. Although the morning was cloudily and cool, the nearly naked nestlings were not brooded for a single minute; yet they were warm to the touch at the end of my vigil.

Ten days later, when these three nestlings were nearly feathered, I again watched their nest for four hours, from 6:45 to 10:45 a.m. on May 29. The rate of feeding had hardly increased, for the nestlings were fed only 8 times, as opposed to 7 on the earlier date. The food was now somewhat more rapidly delivered, and at each visit the parent remained with her head in the nest from 75 seconds to two minutes. The more violent movements of her body now more definitely suggested that she was regurgitating. After delivering food, the female took the nestlings' droppings, sometimes swallowing them and sometimes carrying them off in her bill. On both mornings, both she and the young birds were perfectly silent. There was never more than one parent in sight of my blind.

At the age of 16 days the nestlings are well clothed with feathers and closely resemble the adults. Although the mature female is silent, some young birds cry much in the nest. They are sometimes attacked by the larvae of flesh flies, which live beneath the skin and cause great swellings. When 16 days old the young pipromorphas can fly a few yards, but they remain in the nest until they are at least 18 or 19 days of age, when they have acquired considerable skill in flight.

By early July most of the female pipromorphas have finished nesting. I discovered one bird building in early July, but on later visits I failed to find an egg in this nest. On August 7, 1945, a particularly late nest with two eggs in it was discovered beside the Río Volcán, at about 1500 feet above sea level in the Terraba Valley. The males continue to sing more or less until about mid-September, but in the second half of this month they rapidly become silent.

SUMMARY

The Oleaginous Pipromorpha lives chiefly in the lower levels of the heavier lowland forests, but it often enters neighboring clearings for food. Nests are often built along shady watercourses at a distance from the woodland. In Central America the species ranges upward to about 4000 feet above sea level. Its persistent habit of flipping up its wings, one at a time, helps in the recognition of this plainly colored bird. It does not form pairs and is always solitary, although several males may sing within hearing of each other.

This pipromorpha subsists on small invertebrates, which it plucks from foliage or twigs at the end of a short dart, and on a variety of small fruits and arillate seeds. It is especially fond of mistletoe berries.

One individual was seen to engage in "anting," in a tree rather than on the ground.

The pipromorphas are very silent birds, with the exception of males in the breeding season. In the forests of El General, each male settles down in March in the small area where he will proclaim his presence for the next six months. He does not sing from one particular perch but moves restlessly from twig to twig in his chosen area. Usually he performs between 10 and 30 feet above the ground, although he may choose a perch as low as 5 feet or rarely one as high as 50 feet. His song consists of about three different notes, all weak and unmelodious, variously combined to form a fairly long verse devoid of musical quality. While singing he flips up his wings one at a time and usually alternately, and this serves to make his small, dull figure more conspicuous. Often several males perform within hearing of each other, each in his chosen territory. At the beginning of the season, before they are well settled in their territories, the males chase each other, but no fighting was observed. Apparently the function of these vocal performances is to attract the females to the courtship area, but it is very difficult to learn just what happens when a female arrives. In September the males become silent.

In El General, Costa Rica, nest building begins in early March, before the return of the rains. The nest is a beautiful pyriform structure, with a small round doorway in the side that gives access to a softly padded chamber. The nest is nearly always covered everywhere with green moss, although rarely a brown nest is found. It is attached to a slender, swinging support, such as a drooping branchlet, a dangling vine, or very frequently to the cord-like aerial root of an epiphyte. Although sometimes it swings free in a clear space in a forest or above a watercourse, it often hangs close beside or even in contact with a massive trunk, a cliff covered with green vegetation, or even the low bank of a stream. In height these structures range from about 2 to 12 feet above the ground or water. They are built by the female alone. About two weeks is required to complete a nest.

The set consists of 2 or more often 3 pure white eggs, laid at an interval of two days.

The female incubates, sitting with her head rather than her tail in the doorway. Usually it is extremely difficult to obtain a good view of a female at her nest. At four nests the incubation period varied from 19 to 21 days.

The newly hatched nestlings have pink skin which bears sparse gray down. The female brings food in her mouth or throat rather than held visibly in her bill. At the age of 16 days the young are feathered and can fly a few yards, but if undisturbed they remain in the nest until they are at least 18 or 19 days old, when they fly fairly well. They then resemble their parents in plumage. Although belated nests have eggs in August, most of the females appear to finish nesting in July.

GENERAL SUMMARY OF INFORMATION ON THE TYRANNIDAE

The American or Tyrant Flycatchers form a vast and heterogeneous family of exceedingly small to middle-sized passeriform birds. With about 365 species (Mayr, 1946:66), this is one of the largest of all families of birds and the biggest family confined to the Americas. The generally used designation "Tyrant Flycatcher" has little to recommend it beyond the fact that it contains a literal translation of the Latin name. The great majority of the members of this family are among the mildest and least offensive of birds; and the kingbirds of the genus *Tyrannus* themselves, although admirably bold in the defense of their nests from large and dangerous predators, are not habitually domineering over smaller neighbors; they are tyrant-chasers rather than tyrants, as Benjamin Franklin long ago recognized when he proposed that the Eastern Kingbird rather than the Bald Eagle be chosen as the symbol of the newly created North American republic. Of the many species of American Flycatchers which I have studied intimately, the Kiskadee is the only one to which I am inclined to apply the epithet "tyrant."

In coloration the flycatchers are preponderantly dull; shades of olive, gray and brown predominate in their plumage. The frequent lack of distinctive color patterns, coupled with the equally frequent absence of well-marked structural characters separating allied species and even genera, makes the classification of the group exceedingly perplexing to the systematist, as Ridgway (1907:337) was careful to point out. But the earnest field naturalist, who pays attention to voice, mannerisms and nidification, does not find it as difficult to recognize the living birds as might be supposed from an examination of a large collection of museum specimens or the written descriptions in taxonomic works. Nevertheless the attachment of the proper names to the several species in the field may be a puzzling matter, for field characters are too often ignored in taxonomic works and at best are not easily conveyed through written descriptions.

Only exceptionally are flycatchers brightly colored, the brilliant Vermilion Flycatcher being an outstanding example of this. A few species of *Fluvicola*, *Muscivora*, and others are clad in a striking livery, with contrasting areas of pure white and black. Sometimes the plumage is almost wholly black, as in the Black Phoebe and species of *Lichenops* and *Knipolegus*. Delicate and exquisite shades of pink and buffy-orange are found in the plumage of the Scissor-tailed Flycatcher and in species of the South American genus *Myiotheretes*, whereas rich hues of chestnut, cinnamon and russet occur in the attire of numerous tropical American representatives of the family. Bold streaking characterizes the big flycatchers of the genus *Myiodynastes*. Bright yellow ventral plumage is widespread in the family. Concealed patches of scarlet, vermilion, yellow, or white are found on the crowns of numerous species, large and small, including many which are otherwise very plainly attired. The crown feathers are spread and displayed only when the bird is angry or otherwise excited. The development of the crest reaches its climax in the splendid Royal Flycatcher, and the naturalist who has seen this retiring bird of forest waterways spread fanwise its brilliant scarlet or yellow tiara, ornamented with spots of violet and black, is indeed fortunate. Greatly elongated tail feathers are found in *Muscivora*, *Colonia*, and a few other South American genera. Thus, although in general it may be said that the flycatchers are monotonous in plumage, many of the species are most beautifully or curiously attired. Nearly always the sexes of flycatchers are alike in plumage, but in the colorful Vermilion Flycatcher and in a few other species the female differs markedly from the male. In the family as a whole, seasonal changes in coloration are slight or absent.

The great majority of the flycatchers dwell in the tropics and are resident where they

breed. Although most abundant in species and individuals in the warm lowlands, many have adapted themselves to the rigorous climate of the high mountains and the páramos. Many of the tropical flycatchers remain mated throughout the year. A number of species migrate to high latitudes both north and south to build their nests; they then return to warmer regions before frost and snow make insects too difficult to find. A few flycatchers that breed in the tropics are known to perform longer or shorter migrations; among these are species of *Legatus* and *Myiodynastes*.

The food of the flycatchers is made up largely of insects, whose capture is facilitated by usually broad, flat bills, provided at the rictus with stiff bristles that apparently help to deflect the victims into the bird's open mouth. Many kinds of flycatchers rest on an exposed perch and look sharply about them until they spy some flying insect, dart out to seize it with an expressive *clack* of the mandibles, and return to their perch, against which they may beat the prey before gulping it down. The long aerial sallies of some of the bigger flycatchers are most spectacular, but usually the birds make a single capture on each dart and only occasionally do they remain in the air and circle around to overtake a number of insects without alighting, in the manner of the swallows. I have sometimes seen the Tropical Kingbird hawking insects swallow-wise for short periods. Many flycatchers do not shoot out into the open spaces, but catch their prey as they make usually short, inconspicuous darts from bough to bough, or else they pluck it from the bark or foliage where it rests. This is the common method of hunting among the smaller species, especially those which dwell in woodland and thickets, and even big Boat-billed Flycatchers capture resting insects in preference to those that fly. Many flycatchers stand on a low perch and scan the ground or short herbage beneath them, drop down to seize an inviting morsel, then return to their lookout. "Ground-gazers" was the name applied by Hudson (1920, vol. 1:139) to flycatchers that forage in this manner, which in Central America is a practice followed to a certain extent by the Vermilion-crowned Flycatcher and the Black Phoebe and by wintering Yellow-bellied Flycatchers.

Some members of the family that live on the open plains of South America have long legs and run rapidly over the ground to capture their prey (Hudson, 1920). Others, like the Torrent Flycatcher, rest on the boulders that rise above the broken water of mountain streams, darting into the air to seize gnats and braving the surge to pluck small creatures from rocks covered by a thin sheet of flowing water. In addition to insects, the Kiskadee devours a variety of small vertebrates, including lizards, tadpoles and minnows, for which it plunges into shallow water, and nestlings of other birds. Berries and other fruits enter largely into the diet of many if not most flycatchers. *Tyranniscus* is especially fond of the fruits of mistletoes.

The voices of the flycatchers are not as well developed as in songbirds, a result of the simpler construction of their syrinx. Their call notes, whether harsh or mellow, strident or shrinking, are so varied that the species I know can all be readily recognized by the ear alone. Such sustained singing as they do is usually confined to the twilight hours. A large number of species perform in the morning twilight, but only a few, such as the Wood Pewee and the Streaked Flycatcher, sing again at nightfall. The dawn song consists usually of a simple phrase, which is repeated interminably with little variation for many minutes together. It nearly always ends before sunrise. Flycatchers' dawn songs are of such diverse types that by themselves they form a whole branch of bird music; some are loud and harsh, others low and shrinking, some inexpressibly quaint, and a few are pure and beautiful in tone. Among these last, the crepuscular songs of species of *Myiodynastes* are outstanding. While the sun is above the horizon, these special songs are rarely uttered except under the stress of great excitement, as when two

pairs quarrel over territory. Many flycatchers have nest songs, usually low, confidential utterances which they voice as they choose the nest site or incubate their eggs.

Flight songs appear not to be common in the family but have been observed by Hudson (1920, vol. 1:192) in the Fork-tailed Flycatcher and the Vermilion Flycatcher (*op. cit.*:183), by Fitch (1950:163) in the Scissor-tailed Flycatcher, by MacQueen (1950:202) and others in the Least Flycatcher, by de Kiriline (1951:154) in the Eastern Phoebe, and by me in the Vermilion Flycatcher, Black Phoebe, and Bellicose Elaenia. The Fork-tailed Flycatcher performs "just before the sun sets," when it rises high into the air, then precipitates itself downward with the greatest violence, uttering a succession of sharp, grinding notes. The Bellicose Elaenia mounts upward in similar fashion to sing in the evening twilight, but it rarely sings in flight at any other time.

The courtship habits of a few species are peculiar. Although monogamy prevails in the family, in a few genera the birds appear never to mate and the males have not been seen to take any interest in nest, eggs or young; among these are *Pipromorpha*, *Myiobius*, *Terenotriccus*, *Oncostoma* and *Rhynchocyclus*. At the beginning of the breeding season, the male pipromorphas choose stations in the undergrowth of the forest, generally where several are within hearing of each other. Then for many months each one is to be found daily in the same small area, where he tirelessly repeats a simple and tuneless "song" and flips up his wings, one at a time, in characteristic fashion. Comparable "singing assemblies" have not been found for the other genera mentioned; but *Myiobius* flits through the forest with drooped wings, spread tail, and conspicuously exposed yellow rump; and *Oncostoma* lurks in the dark undergrowth, voicing ever and again a slight, growling note. From the account given by Hudson (1920, vol. 1:157-161) of the habits of the Silverbill, I suspect that this flycatcher fails to pair and that its courtship habits resemble those of *Pipromorpha*, the manakins, and the hummingbirds.

Nuptial feeding is rare in the family, but it has been witnessed in the Vermilion Flycatcher (Lack, 1940:176), Crested Flycatcher (Gillespie, 1924), Wood Pewee (Bent, 1942:269), Eastern Phoebe (de Kiriline, 1951:152), Tropical Pewee, and exceptionally in the Least Flycatcher (de Kiriline, 1948:152; MacQueen, 1950:199). In the last four species the male fed the female while she incubated. In the Tropical Pewee the female also brought food and offered it to the eggs, suggesting that both parents were anticipating nestlings.

Polygamy seems not to have been observed in those flycatchers which form lasting associations between the sexes.

The nest is more varied in form in the Tyrannidae than in any other family of birds represented in the Americas, with the possible exception of the Furnariidae. Usually it is an open structure, saucer- or cup-shaped. It may be loosely constructed of coarse materials, as in the Tropical Kingbird, or compactly made of fine, soft stuffs, as in the diminutive Golden-crowned Spadebill, whose neat little chalice might be mistaken for the work of a hummingbird. Some of the smaller nests may be attached by the rim, vireo-fashion, as in the case of the Bran-colored Flycatcher and the Acadian Flycatcher; or they may be saddled over a thick branch, like some nests of the Wood Pewee and the Yellow-bellied Elaenia. Nests of the two last-mentioned species are prettily encrusted on the outside with lichens; whereas those of the Torrent Flycatcher, placed on boughs overhanging rushing streams, are thickly covered with green moss. Very different from these are the bulky, roofed structures of *Myiozetetes* and *Pitangus*. These have a wide round doorway in the side and are built of straws and weed stems. Somewhat resembling these last, and transitional between them and the true pensile nests, are the much smaller oval structures made by *Tyranniscus*. They are supported among moss that drapes beneath boughs in humid regions, in dangling epiphytic orchid plants and a variety of

kindred sites, and each contains a cozy rounded chamber entered through a circular aperture in the side.

The pensile nests of flycatchers form a long and imposing array, showing a wide variety of shapes, materials, sizes and colors. Those of the tody-flycatchers of the genus *Todirostrum* are elongate structures attached at the top and made of many kinds of dry vegetable materials, giving them a generally brown color. The snug central chamber is entered through a round doorway in the side that is usually protected by a visorlike extension from the wall. In the swinging nests of *Myiobius* the chamber has a wider aperture but the visor has become an apron which covers it completely, so that the bird must enter the antechamber so formed by flying vertically upward. The elongate, pear-shaped nests built by *Pipromorpha* are often attached to a single, slender, dangling root of an epiphyte and are exquisite constructions covered with bright green moss and softly lined with fine fibers. The nest of the Sulphury Flat-bill is built almost wholly of black or blackish fibrous roots, fungal hyphae, and the like; it has the shape of a retort and the well-enclosed chamber must be entered through the spout-like tube that extends below its bottom, opening downward. Similar in form, the more bulky nest of the Eye-ringed Flat-bill is composed of dead leaves and sticks in addition to fibrous materials. But perhaps the most remarkable of all the pensile nests are those hung above shady waterways by the Royal Flycatcher. These long, slender, brown structures may be as much as five feet in total length, which includes the long fibers that dangle loosely at the bottom. Somewhere about the middle of the tangled mass of material a shallow open niche provides precarious accommodation for the two reddish brown eggs.

Unlike the swinging pouches of the Icteridae, the hanging structures of the flycatchers are not woven but are made by entangling or felting a loose mass of material, which is then forced apart to leave a cavity in its center. As this hollow is gradually expanded by pressure from within, additional material is worked into the wall from the interior or placed loosely at the top.

The nests of some of the phoebes of the genus *Sayornis* are composed of a plaster made of mud mixed with vegetable materials and are fastened to the vertical faces of cliffs or boulders, to the piers beneath bridges, the walls of buildings, or to surfaces in various other sheltered positions. The relatively shallow depression in the top of the bulky structure is lined with soft materials and opens upward. A number of flycatchers build their nests in old woodpecker holes and other cavities in trees, in crannies in buildings, or in bird boxes where available; among these are species of *Myiarchus*, *Myiodynastes*, *Colonia*, and *Machetornis*. Although few members of the family nest on the ground, the Yellow-bellied Flycatcher builds at ground level, often in peat moss, and the Strange-tailed Tyrant at times places its nest on the ground (Hudson, 1920, vol. 1:153).

Exceptional in this family of versatile nest builders is the Piratic Flycatcher, which seems unable to construct its own nest but wrests closed structures from birds of a number of other species, including several members of the Tyrannidae and Icteridae and even at times trogons. It throws out the eggs of the birds which built these nests, then takes in a number of small dry leaves to form a loose litter.

The nest is built by the female alone in most flycatchers that have been studied, but in a few species the male regularly takes a larger or smaller share in the work. This is true of the Kiskadee, Black-fronted Tody-Flycatcher, Slate-headed Tody-Flycatcher, Yellow-bellied Elaenia, and Torrent Flycatcher. It is not unusual for two or three weeks or even more to be devoted to the construction of the more elaborate nests, especially those begun early in the season.

The eggs of flycatchers appear usually to be laid in the morning, but the hour is quite variable even in a single species. They are rarely laid before sunrise, as in many

tanagers and finches, and sometimes they are deposited near noon. Many are laid about the middle of the forenoon. The eggs of flycatchers are white, pale gray, buff, or cream-color, sometimes immaculate, but in the majority of species more or less heavily spotted and flecked with rufous, brown, chocolate or pale lilac. The eggs of *Myiodynastes* and *Tyrannus* are exceedingly beautiful; their glossy white or cream-colored shells are heavily marked with rich shades of reddish brown and lavender. The eggs of the Piratic Flycatcher have an exceptionally dark ground color, best described as smoky brownish gray. Darkest of all the flycatchers' eggs that I have seen are those of the Royal Flycatcher, which on the thicker end are almost solidly deep reddish brown. This color pales to dull buff on the sharper end.

The set normally consists of 2 eggs in a number of tropical species, including the Yellow-bellied Elaenia, Bellicose Elaenia, Royal Flycatcher, Bran-colored Flycatcher, Torrent Flycatcher, and Sulphur-rumped Myiobius. Other tropical species lay 3 or rarely 4 eggs in a set. Flycatchers which breed at higher latitudes, both north and south, lay from 2 to 6 eggs, the most common number probably being 4 in a set.

Incubation is performed by the female alone in about 27 species of 22 genera in which I have given careful attention to this point. The male of a number of North American species is said by various authors to participate in incubation, but the most careful studies indicate the contrary. Because of the similarity of the sexes in almost all species of flycatchers, only by painstaking observations can we hope to settle this question. Some of the small flycatchers which subsist on flying insects incubate most inconstantly; their sessions on the eggs averaging only from 5 to 15 minutes, with recesses of almost equal or even greater length. Most of the other species which have been studied, including some of the largest, took sessions whose average length was between 15 and 30 minutes. The Boat-billed Flycatcher incubates with far greater constancy, often sitting for an hour at a stretch; it rarely incubates for less than half an hour. The percentage of time spent on the eggs by day ranged from less than 50 per cent for some individuals of the Torrent Flycatcher, Slate-headed Tody-Flycatcher, and Sulphur-rumped Myiobius to more than 70 per cent for the Piratic Flycatcher, Black Phoebe, Paltry Tyranniscus and Boat-billed Flycatcher. The female of the last-mentioned species sometimes covers her eggs for 80 per cent or more of the day.

The incubation period varies greatly from genus to genus. For a number of North American species it is given as 12 to 16 days (Bent, 1942; Kendeigh, 1952). For the Least Flycatcher it is 15 days according to de Kiriline (1948:152) and 15 or 16 according to MacQueen (1950:198). For the Eastern Phoebe it is approximately 16 days according to various authors and my own observations. For 20 Central American species the periods ranged from 14 to 23 days and were longest in those species which build pensile nests, although some of them are small birds. The long period of incubation in the hanging nests is probably to be explained by the fact that when well placed they are inaccessible to wingless predators and in consequence the rapid development of embryos and nestlings is not so urgent as in nests within easy reach of snakes and small mammals.

The nestlings are hatched blind and helpless. Usually they bear sparse or sometimes moderately dense natal down, but they are wholly naked in species of *Onychorhynchus*, *Myiobius*, *Terenotriccus*, *Tolmomyias* and *Platyrinchus*. The interior of the mouth is yellow or orange-yellow in all species for which information is available. The nestlings are brooded by the female alone, but normally they are fed by both parents in those species which are regularly mated. An exception is the Royal Flycatcher, in which the male does not bring food to the nest although he is present and guards it. Thus this genus is in this respect transitional between the more typical flycatchers and those rela-

tively few genera, including *Pipromorpha*, *Myiobius*, *Terenotriccus*, *Oncostoma* and *Rhynchocyclus*, in which the male seems to take no interest at all in the nest. Except in *Pipromorpha*, the nestlings' food is carried in the bill or mouth rather than regurgitated, and when it consists of small flying insects, it is brought with great frequency. The maximum rate observed was at a nest of the Gray-capped Flycatcher, where three 11-day-old nestlings were fed by both parents together 65 times in an hour.

Injury-simulation has been recorded for the Gray Flycatcher by Russell and Woodbury (1941), but distraction displays are extremely rare in the family. Although I have devoted more time to the study of the flycatchers than to any other family of birds, I have only once seen a somewhat convincing display. This was given by a Bellicose Elaenia which fluttered slowly along a few inches above the ground as she left her egg on my approach. Even in this species this was an exceptional occurrence. As a rule, the bolder flycatchers—which include some of the smallest—dart at the intruder's head, uttering angry notes and loudly snapping their broad bills, but only rarely striking the object of their anger. The more timid ones perch at a distance and utter complaining sounds when their nests are disturbed, or else they completely vanish. The parent Boat-billed Flycatchers guard their nestlings much of the time even after they are feathered.

The nestling period varies from about 14 to 28 days. The longest period was recorded for a single nestling of the Eye-ringed Flat-bill, and the next longest, 24 days, for the Boat-billed Flycatcher, the Sulphury Flat-bill, and the Sulphur-rumped Myiobius. Size for size, those nestlings reared in pensile structures, in which the eggs take longest to hatch, remain longest in the nest. If undisturbed, young flycatchers usually delay in the nest for some days after they are fully feathered and can fly well.

Helpers at the nest are practically unknown, but one Eastern Phoebe fed nestling Tree Swallows (Deck, 1945).

In most flycatchers, of which the sexes are alike in plumage, the young on quitting the nest bear a fairly close resemblance to their parents. Indeed, their fresh new plumage may be even brighter than the worn and faded feathers of the adults. But the fledgling Royal Flycatcher, in its strongly barred attire, has an aspect very distinct from that of its parents. In the Fork-tailed and Scissor-tailed flycatchers, too, the juveniles are clad in a plumage easily distinguished from that of the adults. In the Vermilion Flycatcher, exceptional in the family because of the pronounced sexual difference in plumage, the young birds in their scaled and spotted attire do not closely resemble either parent, although they are more like the female than the male. When the young birds differ from the parents, they appear to change into a plumage essentially adult, although perhaps not of the fullest brilliance, before the first breeding season following that in which they hatched.

Roosting amid vegetation is the general custom among the flycatchers. In a number of species which remain constantly mated, including the Boat-billed Flycatcher, Tropical Kingbird, Gray-capped Flycatcher, and Yellow-bellied Elaenia, the male and female have been found sleeping a few feet or yards apart but not in contact with each other. Young flycatchers, however, may sleep perching close together in a row, as has been seen in the Vermilion-crowned Flycatcher and the Black-fronted Tody-Flycatcher, and apparently also in the Cayenne Flycatcher. The more gregarious species, as the Fork-tailed Flycatcher, Scissor-tailed Flycatcher, and the Eastern Kingbird while on migration, may gather in crowded roosts, often in the dense foliage of an orange tree or in tall, dense grass; but most flycatchers sleep singly or in smaller groups. The Black Phoebe sometimes finds a perch beneath the eaves of a house. The female Sulphury Flat-bill begins to sleep in her pensile, retort-shaped nest as it nears completion, and she may do so for a week or ten days before she lays her first egg. After her single brood is fledged,

she alone returns to sleep in the nest, and she may continue to lodge in it until it falls or collapses several months later. Thereafter she apparently roosts in the open, for she seems not to build a special dormitory nest. The male of this species appears never to lodge in a nest. The flat-bills of the genus *Rhynchocyclus*, however, construct nests especially for sleeping, and some of these dormitories have a chamber too shallow to hold eggs. Unlike the Sulphury Flat-bill, *Rhynchocyclus* lodges in a hanging nest at all seasons; but it is not known whether both sexes do this or only one. This genus, accordingly, represents the highest development of the dormitory habit at present known in the family.

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