LIFE HISTORY OF THE GROOVE-BILLED ANI

BY ALEXANDER F. SKUTCH

This paper is a report on observations made on the Groove-billed Ani *(Crotophaga sulcirostris)* in Central America over many years, but chiefly from 1930 to 1940, when I lived in regions where these birds are more abundant than about my present abode in the Valley of El General in Costa Rica. In subsequent years a little additional information was gathered. The species has a wide range from the lower Rio Grande Valley in Texas through Middle America and much of northern South America. Since, as far as I know, no one has ever published a comprehensive study of this common and most interesting bird and available accounts of its breeding habits are only compilations from scattered sources, it will perhaps be of value to students of bird behavior to have all of my observations in a single paper.

Characteristics and Daily Life

Appearance.—Although the anis have much to recommend them to the attention of the naturalist, it is not by their beauty that they attract him. With the exception of the vultures, they are the least comely birds that I know. Yet they are not absolutely ugly, for being birds, they wear feathers and, as Grey of Fallodon once wrote about another not very comely bird, having feathers they cannot avoid a certain degree of beauty. The anis are lean and lank and loosely put together, and their long tails, which are almost invariably frayed and worn, seem so inadequately attached to their bodies that they are in danger of being brushed off as the birds push through the tall grasses and weeds where they forage. In facial expression they are especially unfortunate. The Groove-billed Ani's black bill is narrow and very high, with the upper mandible strongly arched and furrowed lengthwise by parallel curved ridges and channels. Its black face is largely bare of feathers and prominent lashes shade its dark, beady eyes. Its plumage is everywhere black, but the feathers on its neck present a scaled appearance, while greenish and purplish glints play over its body and wings in the sunshine and redeem the black monotony of the bird.

Voice.—In voice the anis are hardly more pleasing than in appearance. Members of the cuckoo family, they are not songbirds and they lack even the stirring calls of some of their relatives. The call-note of the Groove-billed Ani is well paraphrased by one of the common names given to it in Guatemala, *Pijúy* (pronounced *pe-húy*) or *Pichuy*. This disyllable is uttered as the anis perch or fly, usually

thrice together in a soft, high-pitched voice, neither unpleasant nor particularly delightful, and it is usually preceded by a few preliminary throaty clucks which one can hear only when close to the bird, thus: *tuc tuc tuc pihuy pihuy pihuy.* A Costa Rican name for the ani, *Tijo tijo (téeho téeho)* represents another attempt to reproduce its peculiar call in human language. These notes are certainly more attractive than the high-pitched whine of the Smooth-billed Ani *(C. ani)* of the West Indies and South America. Where the ranges of these two black birds overlap, as in western Ecuador, Colombia, Venezuela and Panamá, they can be distinguished by their voices more readily than by their appearance.

Other utterances which I have heard from the Groove-billed Ani include a full, long-continued, mournful call, soft but deep, an expression of anxiety or distress, which one individual delivered while I examined its nest and another after it had been repeatedly repulsed by some Smooth-billed Anis which it tried to join; a harsh, rasping *grrr* voiced as the birds attack intruders at their nests; and a cackling sound which parents used when trying to coax a fallen nestling to return to its nest.

Sociability.—But if the anis lack beautiful plumage and a melodious voice, they have been amply compensated in other ways. They have been endowed by nature with an extraordinarily affectionate disposition, a degree of adaptability which enables them to thrive in a far greater range of environments than most other birds, and nesting habits which make them, in the eyes of the bird-watcher, second in interest to none. Few birds crave the company of their kind more constantly than the anis. I have never seen them engage in a quarrel or fight. When one is separated from its flock it calls and calls until it finds its companions. Even in hot weather, when there is no need to huddle together for warmth, two, three, or more perch side by side as closely as they can press. If one of the inside birds of such a group flies off, the others at once close the gap until they touch each other again. While one stretches up its neck its neighbor carefully bills and nibbles at the feathers, possibly searching for insect pests; and when the first has finished its kind office to the second, the latter reciprocates the favor.

When not nesting, the anis associate in small parties which usually include from ten to twenty individuals. These travel over their home range in a leisurely manner, foraging as they go, or pausing to rest on low perches singly or in little groups. They do not, as some birds, form a close flock which moves as a unit and seems to be motivated by a single will, but they straggle along singly or a few together, often

strung over a distance of a few hundred feet, and keep in contact by their voices. Sometimes one ani starts off on an expedition only to find that its companions do not care to follow, in which case, after calling to them in vain, it turns again in the direction of the main party.

Flight.—The anis' mode of flight is as characteristic as any other of their peculiar habits. A long journey, say anything much in excess of a hundred yards, is seldom made by a continuous flight, but the bird advances with frequent pauses in conveniently situated trees and bushes. As it alights on one of the lower branches, the momentum of its long tail carries it forward above the bird's head with a jerk. Recovering its balance, the ani delays here for some moments, looking around with caution and calling in a high-pitched voice. Then, satisfied that the path ahead is clear, with a *tuc tuc tuc pihuy pihuy pihuy,* it launches itself upon the next stage of its journey. A few rapid beats of its short wings serve to impart the requisite momentum; then it sets them for a long glide, by which it may cover a surprisingly long distance, on a slightly descending course, without further muscular exertion. If its ultimate destination is a certain branch in a tree or bush, it will often arrest its flight on another limb considerably lower. Then, by a few queer, rapid, sideways hops along the bough and some bounds or, better, bounces from limb to limb, it gains the desired position, where, most likely, it spreads its wings to the morning sunshine.

Sun-bathing.—In the cold, wet weather of the rainy season, the anis are a picture of misery as they huddle together on a perch, their heads drawn in among their damp, bedraggled feathers. Although they dislike wetness, they must often seek their food amid water-laden grass and foliage. Then to dry themselves they perch atop a fence post, a stake or a bare limb and patiently hold their wings spread to the rays of the sun, looking very much (if they will forgive the comparison) like miniature vultures. This habit of resting in the sunlight with outstretched wings seems best developed in birds with black or blackish plumage. In Central America the species I have most often seen sunning their wings in this manner are the Turkey Vulture *(Cathartes aura),* the Black Vulture *(Coragyps atratus),* the Anhinga *(Anhinga anhinga)* and the anis. Because not only in plumage but also in this mannerism the ani resembles a vulture, in Costa Rica it is sometimes called *zopilotillo,* the diminutive of *zopilote* (vulture).

Habitat.—The variety of habitats acceptable to the anis is great and their chief restriction seems to be that they do not tolerate the forest. Birds of open country, they seem nearly indifferent to its type. In

the cultivated parts of the humid coastal regions of Central America they are one of the most conspicuous species, although certainly not more numerous than the tiny seedeaters *(Sporophila spp.),* which are legion but much less noticeable because of their smallness. Their favorite habitats are bushy pastures, orchards, light open woods, lawns with shrubbery, and the cleared areas about the huts of squatters. Marshland is almost as acceptable to them as a well-drained hillside; and I found them numerous in such extensive stands of sawgrass as that surrounding the Toloa Lagoon in Honduras, although it is probable that in these areas they do not venture far from some outstanding hummock or ridge which supports a few low trees or bushes in which they can roost and nest. In the semi-desert regions of the interior, where their associates of the coastal lands, if present at all, are as a rule rare and confined to moist thickets along the rivers, the anis are abundant, living among thorny cacti and acacias as successfully as amid the rankest vegetation of the districts watered by twelve feet of rainfall in the year. In altitude they range upward to about 5000 feet above sea level in Guatemala and 7500 feet in Costa Rica, but they are not nearly so abundant in the highlands as in the lowlands.

Food and foraging.—The food of the anis consists largely of insects, which they obtain both from the ground and amid the foliage of bushes, and to a much smaller extent of berries and other fruits. They vary their diet with an occasional small lizard. Often they hunt grasshoppers and other creatures amid long grass or tall weeds, where they are completely hidden from view except when from time to time they leap a foot or so above the herbage to snatch up an insect which has tried to escape by flight. Whether they run or hop in such dense vegetation it is scarcely possible to learn, but when they forage over bare ground or the short grass of a lawn one can see that they progress by both running and hopping, as best suits the occasion. Sometimes they course swiftly after an insect and finally overtake it by a bound into the air. But their favorite method of foraging is beside a grazing cow, horse or mule. Several together remain close to the head of the quadruped, moving along by awkward hops as it moves and barely keeping out of the way of its jaws and forefeet, ever alert to seize the insects stirred up from the grass by the passage of the herbivore. Rand (1953) presented numerical data to show that the anis catch more insects per minute when foraging with cattle than when hunting alone, and that the quadrupeds are especially helpful to them in the dry season when insects are relatively scarce.

It is frequently stated in books, and affirmed by residents of the

countries where the anis live, that they alight upon cattle and pluck ticks and other vermin from their skin—whence the name *garrapatero* (tick-eater) given to them in parts of Central America. While this is doubtless true to a limited degree in certain parts of the anis' range, I have watched them in the neighborhood of cattle from Panamá to Guatemala and only with extreme rarity have I seen one alight on a cow. Since the ani associates so much with cattle without alighting upon them, and the Giant Cowbird *(Psomocolax oryzivorus),* another black bird of approximately the same size, does frequently perch on them and relieve them of parasites, it seems likely that the ani may often receive credit for the good offices of the cowbird, especially since the latter is shyer and less known. I have occasionally questioned a man who informed me that the ani plucks ticks from grazing animals, only to find that he was unaware of the existence of the Giant Cowbird. At a slight distance such an unobservant person might easily suppose that the birds upon the animal's back were the same as those of the same color about its feet; and since his nearer approach would leave only the latter, the illusion would probably persist. Rand (1953) failed to see anis perch on cattle in El Salvador, and only once did he see one of these birds pluck a tick from a cow.

Frequently I have come upon a group of anis, sometimes a dozen or more, clustered together in the same spot on the ground or low among bushes, calling excitedly and jumping about in a lively, apparently aimless fashion, as though they had lost their wits. Such animated assemblies generally indicate that they have discovered a battalion of army ants and have flocked to the feast. It is difficult to see just what they do, for often the vegetation is dense, and if one approaches too close they melt away. The anis are canny birds, more or less indifferent to the presence of a man as long as he does not too obviously pay attention to them, but shy and restless whenever they discover that they are being watched. Yet I have little doubt that on these occasions they seek not the ants but the cockroaches, spiders and other small creatures driven from their hiding places in the ground litter by the myrmecine horde. If they preyed upon the ants themselves, so much excitement and apparently aimless jumping around would be inexplicable, for in this case they could stand beside a moving column and pick up multitudes of them without much exertion. The mixed parties of antbirds, Gray-headed Tanagers *(Eucometis penicillata)* and other birds which accompany the army ants in the lowland forests behave in much the same manner, and in their case it is relatively easy to see that they prey not on the ants but on the unfortunate creatures driven from concealment by them. In Vene-

zuela, Beebe (1910) found Smooth-billed Anis following army ants in the same fashion. Thus the adaptable anis avail themselves of creatures as diverse as oxen and ants as hunting dogs to drive up their small prey.

The anis forage among bushes, vine tangles and low trees as well as on the ground. It is amusing to watch them as they jump from branch to branch with a clumsiness of appearance which conceals their real agility. Going either up or down, they progress by a series of short hops from twig to twig and pluck off the invertebrates they discover among the leaves. If an insect attempts to escape by flight, they may dart into the air and snatch it up on the wing. When the first showers that usher in the wet season send the winged brood of the termites forth from their nests in countless multitudes, one may watch the anis everywhere foraging like flycatchers, making ungraceful darts, not exceeding a few feet, from low twigs and fences; but the insects are then so numerous that the birds can catch many without quitting their perches.

Roosting.—Thus, in an unhurried manner, the flock of anis visit each day their favorite hunting grounds, the pasture where they forage at the heads of the cattle, the dooryard where they seek insects amid the shrubbery, more rarely a bush or vine which supplies ripe berries. In the warmest hours of the afternoon they rest in a compact group in the shade. Toward evening they forage more actively again, and before sunset they gather for the night in their roosting tree, by preference an orange tree whose dense, dark green foliage and branches armed with formidable thorns provide both concealment and protection, or a thick clump of spiny bamboos, or these failing, a tangle of vines at the edge of a thicket.

General Observations on Nesting

Breeding season.—Throughout Central America the anis nest late, beginning after the majority of their neighbors of other families have reared one or even two broods. This is because they wait until the dry season has come to an end and returning rains have caused the herbaceous vegetation to grow more lushly, thereby increasing the abundance of grasshoppers and other insects which live in it, and on which the anis depend largely for food. In waiting for the rains to refresh the vegetation before they begin to breed, the Groove-billed Anis resemble the Smooth-billed Anis, which, as Davis (1940) demonstrated, nest sooner in years when the dry season ends early than when it is prolonged. In Central America egg-laying usually begins in June.

The earliest occupied nest of the Groove-billed Ani which has come to my attention in Central America is one which I found on April 26, 1942, on our farm in the valley of El General, Costa Rica, at an altitude of about 2400 feet above sea level. On this date the nest already contained four eggs, which disappeared a few days later. The following year, 1943, a pair of anis began on April 4 to build in an orange tree close by our house, but they left the vicinity before completing their nest. In both 1942 and 1943 much rain fell in March and by April the herbage was already lush. Anis are, inexplicably, by no means so abundant in the valley of El General as in many other agricultural districts of Central America at the same altitude, and they have not again, to my knowledge, attempted to nest on this farm. I have no other records of breeding in El General.

In the Pejivalle Valley on the opposite or Caribbean side of Costa Rica, at an altitude of about 2200 feet, I found on May 31, 1941, a completed nest in which the first egg was laid a day or two later. Bent (1940: 27) quotes from G. K. Cherrie an account of some anis which began to build on May 20 in Costa Rica, probably in the central plateau. But in other parts of Central America, including the humid Caribbean lowlands, one rarely finds evidence of breeding before June. On my first visit to Central America, I spent six months near Almirante in western Panamá and was extremely eager to find nests of the Groove-billed Anis, which were abundant in the vicinity, but I saw none until June 6, the day of my departure, when I was shown a completed nest, still without eggs. The following year, near Tela on the rainy northern coast of Honduras, I found a pair of anis beginning to build on June 4, six weeks after my arrival, and I saw my first nest with eggs on June 23. In 1932, near Los Amates in the humid lower Motagua Valley of Guatemala, I first discovered anis building on June 9, nearly four months after my arrival in this region. On June 26 anis were seen constructing a nest at El Rancho, higher in the same valley, where the rainfall is much less; and on June 29 building was in progress at Cobán, in Alta Verapaz.

In both the humid and arid parts of Central America, July and August are the months when occupied nests are most abundant. At least two broods are reared, and breeding continues into September. My latest nests include: one near Colomba, on the Pacific slope of Guatemala at about 3000 feet, with eggs on September 30, 1934; two at Zacapa in the arid part of the Motagua Valley of Guatemala with eggs on August 13 and 15, respectively, in 1935; and two near Cartago, at 4500 feet in the highlands of Costa Rica, with fresh eggs on August 26 and September 8, respectively, in 1938.

The nest.—The Groove-billed Ani builds by preference in a tree or bush with dense foliage standing in an open space, or at least near the edge of a grass-covered area where it can forage. Its favorite nest site is an orange tree with crowded thorny branches and profuse foliage, or some other kind of *Citrus.* Approximately half of the 29 nests of which I have records were in trees of the orange, lemon, or other varieties of citrus fruits. Thorny plants of other kinds are frequently chosen: one nest was in a dense clump of low, spiny palms,

another in a compact, thorny *Randia;* while in arid regions an organ cactus or an opuntia bristling with needle-like spines is often chosen to support the nest. Where a well-armed, compact tree or shrub is not available, the anis often build in a dense tangle of vines which have overgrown a tree standing in the open or near the edge of a thicket. One nest, in the most impenetrable second-growth, was about 25 feet from the margin of a neighboring grassy plantation and 13 feet above the ground. Sometimes the nest is placed in a clump of bamboo. One pair of anis took possession of the ample, cup-shaped nest which a Boat-tailed Grackle *(Cassidix mexicanus)* had abandoned and refurbished it by adding a few sticks to the rim and lining the bottom with fresh green leaves; but such appropriation of nests of other species is unusual in my experience. In height the nests which I have seen ranged from 4 to 25 feet above the ground, but two-thirds of them were from 5 to 10 feet up. Miller (1932) found a nest only two feet up in El Salvador. As a rule, anis' nests are well concealed by foliage and not easy to find.

The nest is a bulky, usually shallow, bowl-shaped structure, open above. It is constructed of coarse materials, including woody twigs, lengths of dead herbaceous vines, weed stalks, tufts of grass which often have the roots attached to them, strips of palm leaf, rather coarse roots, and the like. The constituents of different nests vary considerably according to what the locality affords. The lining always consists of small leaves, which are placed there while fresh and green and never removed after they wither. The first of these leaves are brought at an early stage of construction and others are added daily until the eggs hatch, so that finally there is a thick layer of dead and dying leaves in the bottom of the nest. It is difficult to give the overall dimensions of such a structure, for one does not know how far along the projecting ends of the constituent twigs, some of which are nearly a yard in length, he should measure. Often the body of the nest is about a foot in diameter. The internal diameter of 6 nests varied from 4¼ by 4½ to 6 by 6½ inches, while in depth these nests ranged from 2¼ to 4¼ inches. The widest nest was also the deepest, but the narrowest was of about average depth, 2¾ inches. Nests more than 3 inches deep are exceptional.

Unfortunately, the unusually ample nest was despoiled before I could learn how many pairs were using it, and I do not know whether if undisturbed it would have provided space for an exceptionally large number of eggs and young. My records are inadequate to show whether structures built and occupied by several pairs are consistently more capacious than those which belong to a single pair.

The nest is built by both sexes of all the co-operating pairs, with

the male usually bringing material which his mate arranges while she sits in the structure, although this division of labor is by no means rigidly adhered to and the female also brings twigs and leaves. Details of nest construction are given in the following sections of this paper.

The time taken to build a nest is most variable. A single pair, whose second-brood nest was despoiled after only two eggs had been laid in it, had three days later a new nest in which the female now began to lay. This latest nest was built on the remains of an earlier structure which this same pair began but failed to finish; however, little of their former work remained when they returned to this site, and practically all the building was done in three days. On the other hand, three or more pairs of anis which started a joint nest in Guatemala about June 9, 1932, were still bringing leaves to it, and had not yet laid, on July 11. Not only do the anis continue to bring green leaves to their nest after incubation has started, at times they even build up the walls with sticks and similar materials.

The eggs.—Whereas tanagers, finches and wood warblers usually lay early in the morning, and many thrushes and flycatchers lay at various hours of the forenoon, anis commonly deposit their eggs around or soon after midday, as I have seen in both the Groove-billed and the Smooth-billed Ani. In the latter species, Davis (1940) also found that eggs are as a rule laid in the early afternoon, although they may be deposited at any time from before 7:00 a. m. to after 5:30 p. m. The interval separating the laying of successive eggs of the Groove-billed Ani is variable, and may range from two to three days even in the same set. Details are given below in the history of the solitary pair.

It is difficult to learn with accuracy the number of eggs laid in an anis' nest. More often than with any other bird that I know, one finds eggs lying on the ground beneath the nest, either whole or broken, and these must be added to those still within the nest to give the full number that were laid. One can never be sure that he has recovered all the eggs that somehow fell from the nest in the course of laying. I do not know just how these eggs get removed from the nest, for I have never been present when this happened. Most anis' nests are so well built that even if a dozen eggs were laid in them they would not roll out of themselves. Possibly the birds carelessly knock them out, but it is also possible that this is done by some predator that is attracted by the appearance of the eggs but after sampling one finds them unpalatable.

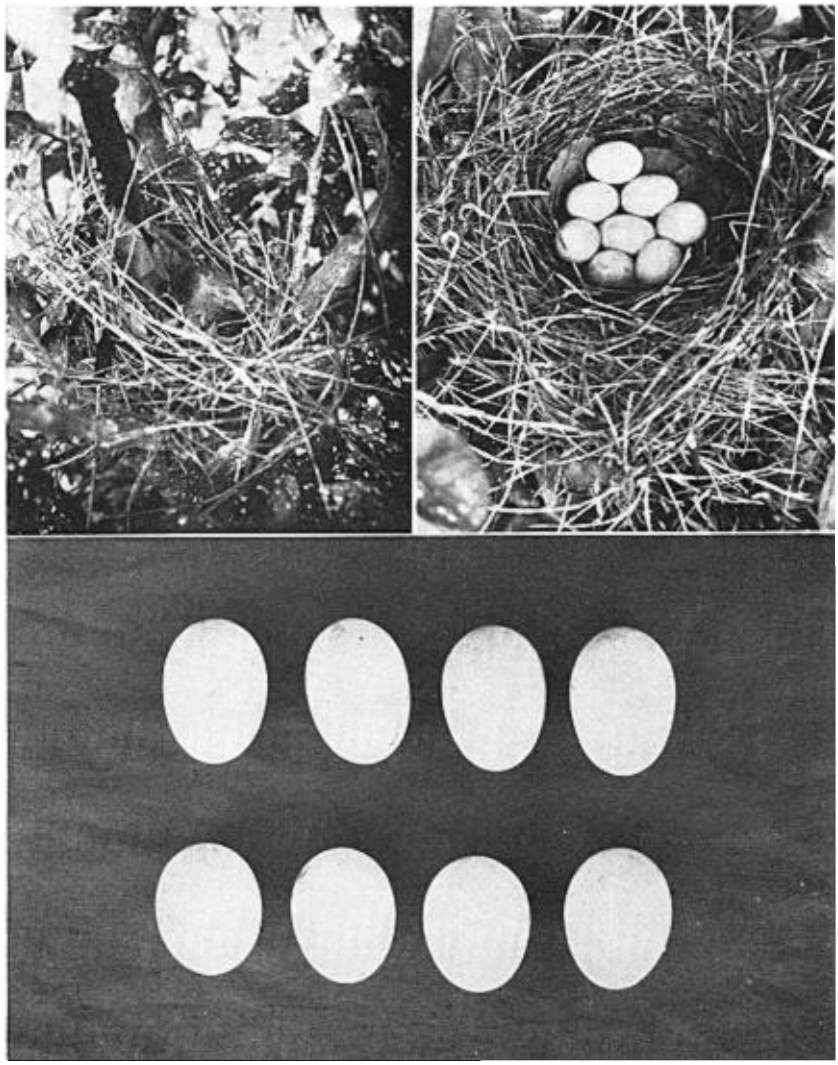
The number of eggs in apparently completed sets that I have seen has ranged from 3 to 12, but one set of 15 was reported to me by a reliable observer. I have found in print no mention of a larger set.

Thus the Groove-billed Ani does not produce such big nestfuls as the Smooth-billed Ani, in which several females may lay as many as 29 eggs in a nest (Davis, 1940). Nests of the Groove-billed Anis attended by a single pair contained from 3 to 5 eggs, but usually a single female produces a set of 4. In one instance a nest with 8 eggs was attended by 4 adults, and another set of 8 eggs was cared for by at least 3 anis. In all, I have watched (rather than merely found) 5 nests in which 2 pairs took an interest; but in the other 3 nests laying had not been finished, or some of the eggs or nestlings had apparently been lost. I once watched at least 6 anis, or 3 pairs, building the same nest, and that which contained 12 eggs seemed to be the property of 3 pairs. The apparently complete sets which appear in my original records were of the following composition (including in 2 instances an egg found beneath the nest): 1 set of 3; 7 sets of 4; 1 set of 5; 3 sets of 8; 1 set of 11; 1 set of 12; 1 set of 15. According to Davis, the female Smooth-billed Ani in Cuba lays between 4 to 7 eggs, and this agrees with my more limited experience with this species in Panamá.

The eggs of the Groove-billed Ani are bluntly ovate in shape. When newly laid they are uniformly covered with a chalky white deposit, which is readily scratched off with a fingernail and in the nest is removed by the birds' bills or toenails, or by rubbing against projecting sticks. The removal of this superficial deposit reveals the blue or blue-green color of the underlying shell, which is equally evident on the inner surface. Not only is the chalky outer layer readily scratched away, it is easily stained by the dying or dead leaves on which the eggs rest, so that by the combined action of scratching and staining the shells soon lose their original whiteness and are far less conspicuous on their bed of green leaves. One can estimate how long they have been in the nest by the degree of their discoloration. The measurements of 56 eggs which I temporarily removed from the nest average 32.1 by 24.2 millimeters. Those showing the 4 extremes measured *35.7* by 25.0, 31.8 by *25.4*, and *28.6* by *22.2* millimeters.

Egg dates.—In 19 nests in the Caribbean lowlands of northern Central America (Tela and lower Ulua Valley in Honduras, Motagua Valley from Los Amates to El Rancho in Guatemala) eggs were laid as follows: late June, 3; July, 11; August, 4; early September, 1.

Details of building, incubation, hatching, care and development of the young, etc., are given in the two following sections and summarized at the end of this paper.



(Above, left) Male Groove-billed Ani, "Whiteface," incubating eggs. Near Tela, Honduras, July 5, 1930. *(Above, right)* Nest of Groove-billed Ani containing eight eggs, apparently laid by two females. Ulua Valley, Honduras, August 5, 1930. *(Below)* Eggs of Groove-billed Ani from a single nest, showing their great variation in size and shape. Those in the upper row were apparently laid by one female and those in the lower row by another. Ulua Valley, Honduras, August 5, 1930. (Photos. by A. F. Skutch.)

HISTORY OF A SOLITARY PAIR

The First Brood

The nest and eggs.—Although several pairs of Groove-billed Anis often lay in the same nest, I hold it fortunate that the first nesting I watched was of a single pair, for thus I was able to discover certain essential points which it is not so easy to learn in the more complex associations of several pairs breeding together. On June 21, 1930, a student at the Lancetilla Experiment Station in Honduras found this nest while spraying a small orange tree, amid whose dense foliage it was well concealed, at a height of seven feet above the ground. When he showed it to me two days later there were two eggs, which had not been present when he first saw the nest. These rested on the bed of fresh green leaves which lined the shallow, rather bulky cup of coarse sticks. I pulled out one of the longest and found it to be 34 inches in length. Although I often saw an ani on the two eggs by day, they were still left uncovered at night. On June 27, four days after the second egg was present, the third and last egg was laid. Even after the set was complete, these erratic birds left the eggs uncovered during the night. Perhaps they awaited a fourth egg, since that is the usual number, but if so they waited in vain. By day they incubated and brought fresh green leaves to the nest. Finally, in the evening of June 29, the third after the last egg had been laid, a bird remained on the nest.

Marking the birds.—The male and female were so similar in appearance and voice that in order to learn their respective parts in incubation I found it desirable to place a distinguishing mark on one of them. By setting into the hollow of the nest a brush soaked with white paint, I was able to mark one member of the pair on its head. I named this bird "Whiteface" and its mate, by way of contrast, "Blackface." Whiteface always sat on the nest at night. Subsequent observation in connection with egg laying established that Whiteface was the male (see p. 299 *infra;* Plate 11, *Above, left*).

Incubation.—These two anis were paragons of conjugal affection. It was pleasant to see, on the morning when I first set up my blind before their nest, how the one who had been frightened from the eggs by my operations flew straight to its mate, who was perched on an exposed branch drying its wings. The two sat as close together as they could press and each billed the other's plumage. They showed their attachment in a dozen little ways. They were constantly calling to each other, even as they entered and left the nest; and sometimes one while sitting answered the call of its mate in the distance. Both

took turns on the nest, but they were at first most impatient sitters, constantly replacing each other. In seven hours of watching during the first six days after the completion of the set, 30 minutes was the longest session that I witnessed. Sometimes one of them sat for only a minute or so before the other flew up to relieve it; and sometimes at the call of its mate the sitting bird would leave the nest unattended to go and perch or feed with its partner. Often they flew up together to the nest, which had been left unguarded for from a few minutes to nearly half an hour while they enjoyed each other's company. One took its place on the eggs while the other, after lingering a moment beside it, went off again. From 7:10 to 10:32 a. m. on July 2, Whiteface incubated for 4 periods ranging from 2 to 19 and totalling 50 minutes, Blackface for 5 periods ranging from less than 1 to 22 minutes and totalling 69 minutes, while the eggs were left alone for 7 periods ranging from 2 to 27 and totalling 83 minutes.

Many times every day, when they came to take their turns at warming the eggs, they brought to their nest fresh leaves which they plucked from a neighboring tree or bush. They tucked these beneath the eggs, and since they never took the trouble to remove the old ones as they withered, by the time the eggs hatched there was a thick layer of dead leaves on the inside of the cup. Usually each bird itself placed the leaf it brought, but sometimes it gave it to the sitting mate, who arranged it in the nest. The eggs were never covered by the leaves but always lay above them. Even when a parent went off spontaneously and left the nest unattended, it made no attempt to conceal or protect the eggs beneath the leaves. From time to time the anis also brought sticks and straws, and while incubating they sometimes arranged the materials of the nest.

As the days slipped by, Whiteface and Blackface shared the common experience of newly-mated couples and became less eager for each other's company. The one who was free stayed at a greater distance from the nest, and they called back and forth less frequently. At first each were rarely out of the other's sight; before their eggs hatched they had settled down into a humdrum routine. While at the beginning of incubation they sat on the eggs for from one to 30 minutes at a time by day and often left them uncovered, by the last two days of incubation their sessions had lengthened greatly and were now seldom less than half an hour. As soon as one partner saw that the other had left the eggs, it went at once to cover them, often plucking a green leaf on the way. In over 5 hours of watching on July 9 and 10, Whiteface took 3 sessions lasting 51, 26 and 53 minutes and totalling 130 minutes, Blackface took 4 sessions lasting 30, 46, 36 and 59 minutes

and totalling 171 minutes, and the nest was unattended for only 2 periods, each of about a minute's duration. Like the Lesser or Rufous-rumped Ground-Cuckoo *(Morococcyx erythropygius),* the anis continued to bring an occasional stick to their nest to the end of incubation.

A chick's emergence from the shell.—One of the three eggs vanished soon after it was laid. Fourteen days after the deposition of the last egg, I held one of them in my hand while the chick worked its way out. When I first took it up there was a gap in the thicker end which extended about a third of the way around the circumference. The little bird's short, thick bill was in this gap, and so pressed out of position that the lower mandible extended beyond the upper one—a temporary condition. At intervals the struggling prisoner drew its bill farther into the egg, then suddenly pushed it outward, bringing the keeled upper edge, armed with a rather insignificant egg-tooth, against the edge of the shell at one end of the hole, and breaking off a small fragment on the outward thrust. In its squirmings the chick, propelling itself I know not how, rotated imperceptibly slowly in the shell, in such a way that its head, turned under one wing, moved backward and the upper edge of the bill was constantly brought to bear against a fresh portion of the shell, which was chipped off at the next outward thrust. Occasionally the struggling birdling emitted a weak cry. Thus bit by bit the ragged-margined aperture was lengthened until it extended about two-thirds of the way around the circumference of the egg, when the struggles of the bird succeeded in cracking the remainder, and the large end of the shell fell off as a cap. Then the naked creature wormed its way out into my palm, where it lay exhausted by its sustained effort.

The nestlings and their departure.—The two nestlings were blind, black-skinned and without any trace of feathers. In this respect they differed from the Yellow-billed and Black-billed Cuckoos *(Coccyzus americanus* and *C. erythropthalmus)* of North America, which at birth bear a rudimentary down in the form of long, stiff bristles. The parents at once began to show more solicitude for the nestlings than they had ever done for their eggs, and both together flew very close to me, calling *pihuy pihuy.*

At first the nestlings were brooded almost continuously. Usually each parent remained covering them until the other arrived with food, when it left to make way for its mate, who stood on the rim of the nest to place an insect in the widely opened mouth of a youngster. Then, often after delaying several minutes on the rim, it settled down to brood until its partner returned. Rarely the nest was left un-

covered for short periods. The nestlings' eyes opened within two days after they hatched, and their pinfeathers sprouted rapidly. The parents cleaned the nest by swallowing their droppings.

On the morning when the nestlings were six days old I found both of them bristling with long pinfeathers. The true feathers of one of them, apparently that which was the older by a few hours, were already escaping from the ends of the sheaths. The parents were bolder than ever before; while I was at the nest they circled around me and alighted in the small nest tree only a few feet away, calling loudly. As they made darts which brought them close to my head they uttered a harsh, threatening *grrr* and at times snapped their strong bills with a loud *clack*. Whiteface far outstripped his mate in these demonstrations, venturing much closer to me and voicing louder complaints.

Later that same day the older nestling jumped from the nest as I approached, and climbing quickly down through the thorny branches, it finally dropped to the ground. It hopped out of the circle of bare earth which surrounded the tree and pushed through the tall grass beyond until it vanished completely. I searched until, fearing that I might step upon the youngster unseen amid the herbage, I abandoned the fruitless quest. The other nestling had so far clung to the nest; but when I returned to see whether it had remained at home while I was searching for the truant, it, too, climbed out and hopped along a branch, but it stopped short after going about a foot. All the while the parents displayed the greatest excitement.

Leaving the youngsters where they had betaken themselves, I disappeared into my blind to await further developments.

In Panamá I had seen featherless nestlings of the Smooth-billed Ani climb from their nest and crawl through the grass in the same manner. I had read of Hoatzins *(Opisthocomus hoazin)*, queer, primitive birds which live in thickets bordering the lowland rivers and tidal estuaries of South America. Their fuzzy, flightless nestlings, when alarmed, precipitate themselves into the water beneath their nests, and when everything is quiet climb back to them, employing bill and feet and hooked appendages on their wings to raise themselves from twig to twig (Beebe *et al.*, 1917). Herrick (1910) states that young Black-billed Cuckoos climb from the nest at about the same age and stage of development as the anis. But nearly all other altricial nestlings, especially those reared in trees, cling tightly to their nest in the face of danger until their feathers have expanded and they can fly or at least flutter away. It is not that these nestlings are immune to alarm until they have well-developed plumage, but until they can use their wings a threat only makes them cling more tightly to their nest.

Meanwhile Whiteface and Blackface were becoming more composed. They flew about, constantly calling, and looked through the branches of the orange tree and the grass beneath it for the lost

nestling, which remained quietly in hiding. After ten minutes Blackface sat upon the empty nest while the other nestling perched in plain sight before her, but soon she left again to resume her searching and calling. Some minutes later the younger nestling moved back to the edge of the nest. Blackface soon returned and pecked at the leaves which lined the bottom, as though she expected to find her lost youngster hidden beneath them, but not succeeding in this quest, she abandoned it and moved over to brood the other, not in the nest but beside it. Later Blackface came back for another search among the leaves that lined the nest, now all brown and dry, for no new ones had been brought for a week. Then she flew off and found a small insect which she brought to the nestling in the tree. After about an hour this youngster finally entered the nest and was fed and brooded by both parents in the regular manner.

By this time the parents had become calm again. The truant nestling, after an hour and a half of quiet secrecy amid the sheltering grass, now at last emerged into the edge of the bare circle at the base of the orange tree and began to cry in a weak, infantine voice. Blackface, who at this time was brooding the other nestling seven feet above, seemed not to notice its cries; but Whiteface on returning discovered it at once and gave excited calls which immediately brought his mate from the nest. Both flew around and above the youngster, calling and making low, cackling sounds, evidently trying to coax it up into the tree. Yet they were powerless to help it, and Whiteface soon returned to brood the other nestling. For almost an hour the young ani on the ground moved about in the grass, climbing up the stalks and stretching up as far as it could toward the low branches of the tree, from which its parents looked down as though to encourage it. At intervals it peeped softly. Finally it moved over to the trunk and attempted to climb up. But the bare, smooth column, which rose a foot to the lowest branch, proved too much for its slight scansorial powers; and it repeatedly slipped back from the flaring base. After ten minutes of fruitless effort it returned to the grass, where the lowest limbs were tantalizingly close above it.

Although the parents continued to be much concerned about the youngster on the ground, the stay-at-home received most of their attention. The latter was brooded, and fed seven times in two and three-quarters hours, while I saw the former receive only a single morsel. It is possible that it was given a few more meals, for sometimes when its parents approached it was so low in the grass that I could not see just what happened. At least they were far more attentive to their fallen offspring than the Robin *(Erithacus rubecula)*

who, as Hudson (1903) relates, let her own nestling starve slowly before her eyes while she continued to brood the young Cuckoo which had thrown it from the nest. At length, tired of being left alone and more or less neglected, the young ani climbed as far as it could up a grass stalk, beat its wings and launched itself into the air. Needless to say, it promptly fell to the ground; but its attempt to fly was not as ludicrous as it seemed to me at the time. I had not examined the young ani since the morning and remembered it as a nestling that bristled with long feather-sheaths, from which the feathers had just begun to protrude. When finally, convinced that it would not regain the nest without my help, I went to pick it up, I hardly recognized it as the same individual. The feathers had escaped their sheaths with amazing rapidity and it was already well clothed. Its back and under parts, save for a naked line along the middle of the latter, bore soft, downy, black plumage. The flight feathers of both tail and wings now had broad expanded tips, the most advanced of which were from one-half to three-quarters inch in length; so that when the youngster beat the air its wings did indeed exert a lifting power, albeit insufficient for its needs. As I returned it to the nest, Whiteface struck me twice on the back, but not hard enough to cause pain. But the restless youngster would not stay at home, and this time it began to ascend among the branches. I left it to follow its fancies, and later it returned to the nest of its own accord. At dusk I found Whiteface quietly brooding his two restless youngsters.

Next morning both young anis, now well feathered, climbed out of the nest as soon as they saw me approach. Instead of dropping to the ground as one had done on the preceding day—which, as I learned later, is by no means their usual procedure—the week-old anis turned their courses upward and went hopping vigorously from twig to twig, sometimes hooking the bill over a branch to catch themselves when they came a trifle short in a leap. The stronger nestling gained at least three feet above the nest and jumped when I tried to capture it. It went hurtling down through the thorny boughs, in imminent danger of impaling itself on those cruelly sharp spines, until finally it caught hold of one of the lower branches. When I took it in hand it protested with sharp, rasping sounds that resembled the parents' calls of anger. I set it down in the path, where it hopped along at a good pace and finally gained the long grass, in which it tried to conceal itself. After recapturing it, I offered it an outstretched finger as a perch. For a minute it seemed to forget where it was and spread its newly feathered wings with its back toward the morning sun, a miniature of the adults. But soon it remembered me again and, jumping

down, attempted once more to escape. As I returned it to the nest one of the parents—Whiteface, I believe—gave me a good bump on the back of my head. After I left, both youngsters settled down in the nest and were brooded as though they had never been beyond its rim.

Whiteface brooded them for the last time that night, when they were between seven and eight days old. The following two nights they remained in the nest tree but did not return to the nest to sleep. They could not yet fly and had entered a half-scansorial, half-terrestrial stage of their development. When they were ten days old I tried to catch them for a photograph, but they hopped from limb to limb with such agility that, protected as they were by the sharp thorns, I was unable to capture them. Finally I went for a ladder to try to reach them in the top of the tree; but while I was away the parents, who had been interested spectators of the chase, spirited them off to a smaller orange tree about fifty feet distant. Since they were still incapable of sustained flight, they must have crept through the tall grass, which they could do very well, and hopped up to the low branches of the tree. They were now so adept at concealing themselves at the roots of the grasses and at clambering into the densest foliage of bushes that it was extremely difficult to find them.

At the age of 11 days the young anis could make short flights from branch to branch of the same bush or tree. Their bills were smooth, without grooves, and their cheeks were bare of feathers.

The Second Brood

Nest building.—On August 11, three weeks after their nestlings left the orange tree in which they were hatched, Whiteface and his partner began a second nest in a small lime tree 25 feet distant from the site of their first nesting. Of the identity of Whiteface I have no doubt, for his distinguishing marks were still prominent. The faint white stain on his mate's breast, if she was in fact the same individual, had disappeared; but in the absence of contrary evidence I may be permitted to call her Blackface. The two had been too strongly attached to be easily separated. From my blind I watched them building, but they worked in a desultory, half-hearted fashion. Whiteface brought most of the material, consisting of green leaves and sticks in about equal numbers, to Blackface, who sat in the nest to receive and arrange them. Whiteface sometimes undertook this work, too, and occasionally the two were on the nest together for brief periods. The leaves which they brought could not possibly have been intended for the lining of the nest, for it was still no more than a frail platform which

had not yet begun to acquire the form of a bowl. Thus the nest was becoming a pile of mixed sticks and leaves. Doing things in a definite, stereotyped sequence is not the way of the Groove-billed Anis. They line their nest before it is built, then often continue to build it after it has been lined and the eggs have been laid. While with many kinds of birds each stage in the complex series of reproductive activities leads to another and its characteristic activities seem then to be forgotten, the anis sometimes anticipate stages which should come later, or revert to activities which belong to an earlier phase.

After the third day, I no longer saw the pair at this nest and found no more fresh leaves in it. They seemed to have wholly abandoned their half-finished structure, probably because they discovered that it was in a position more than ordinarily exposed. A few days later I discovered Whiteface carrying a green leaf to the old nest in which the first brood had been reared. Later he and his mate brought more leaves, which they laid over the old ones on the inside of the nest, and sticks, which they employed to build up the rim. Many of the latter were taken from the unfinished nest in the neighboring tree, which fast dwindled away.

Egg-laying and identification of the sexes.—They devoted four days to putting the old nest in order, then the first egg was laid in it. For two months I had been calling Whiteface the female because "she" warmed the eggs by night; but when I saw that in building the nest Blackface sat in it to arrange the material which the other brought, I began to doubt the correctness of this view, and I resolved to determine their sexes beyond all doubt by observing which laid the eggs. Early the following morning, I entered my blind to watch for the appearance of the next egg. Both birds sat on the single egg for intervals not exceeding fifteen minutes. They brought a few sticks and leaves to the nest, but neither laid another egg. The second day passed like the first. On the third day I resumed my vigil in the early morning, feeling certain that at last I should witness the laying of the egg. Both Whiteface and Blackface sat in the nest, but the latter more than the former. In the middle of the morning, while Blackface sat, Whiteface worked harder than I had ever before seen either partner work. In 21 minutes he brought 13 sticks, some of which were transferred from the remnant of the unfinished nest in the lime tree, while others were picked up from the ground beneath the nest now in use. Many of these sticks were much longer than the bird and he had much trouble in pulling them up through the close-set, spiny branches of the orange tree. All were given to Blackface, who arranged them on the nest.

When I left the blind at 11:10 a. m. there was still a single egg. I returned from lunch at 12:30 p. m. and was chagrined to find that the anis had stolen a march on me and laid the second egg in my absence. I had spent the better part of two and a half days, in the main very monotonous because the anis were out of sight, sitting on a hard box in a stuffy blind, and in the end I had missed the event I had waited so long to see. But at least I now knew in what part of the day it occurred, and with this knowledge it should be relatively easy to observe the laying of the third egg. The chief difficulty was that the interval between the deposition of successive eggs was irregular, and it appeared to vary from one or two to four days.

On returning to the nest the following morning, I found one member of the pair sitting in it, but the eggs had vanished and only some fragments of shell lay on the ground beneath. I began to despair of ever solving the question of Whiteface's sex; but the birds were not so easily discouraged and turned their attention again to the dismantled second nest, of which only a few sticks remained in the crotch of the lime tree. The very next day they resumed work on it, bringing more sticks and leaves. I noticed this time that the sticks were not always picked up from the ground. I saw the anis break with their bills long, slender, dead twigs from the eucalyptus trees that grew close by. Such was their industry that three days after their eggs had been destroyed the new nest was ready to receive its first egg, which was laid between 12:45 p. m. and sunset on August 29.

At a few minutes before twelve o'clock on September 1, I entered my blind before the new nest, which still contained its single egg. Just before noon Blackface flew up with empty bill, calling, and entered the nest. While she sat Whiteface brought sticks and green leaves which she arranged in the nest. After 18 minutes Blackface left the nest and I hurried up to look in. A second spotless white egg lay beside the first on the bed of dark green leaves. So Blackface was the female, and Whiteface, the bird who incubated every night, who was the bolder in defending the young, and brought sticks and leaves to the nest while the other sat in it—Whiteface to whom for nearly three months I had applied the feminine pronoun—was the male!

I might at any time after the first nesting have settled this point by shooting either member of the pair and performing a dissection—a matter of ten minutes instead of the several days it cost me. But there were many considerations which weighed against the latter course, the first and most irrefutable of which was that of sentiment. A large share of the joy which this discovery brought to me arose from the circumstance that I had accomplished it without the sacrifice

of life, after having worked out an appropriate procedure. Moreover, if in this instance I had chosen the easier way of learning Whiteface's sex, I should have missed some of the most exciting revelations which this family made to me.

Three days had elapsed between the laying of the first and second eggs at this nest, but only two intervened between the deposition of the second and the third, and two more between the third and the fourth. The fact that Blackface had laid six eggs in practically unbroken succession (only four days had elapsed between the deposition of the second egg in the rehabilitated old nest and of the first in the new nest) when the normal set consists of only four eggs, is but one more example of a bird's marvellous power to control an intricate physiological process in response to unforeseen external events.

Again Whiteface assumed responsibility for the eggs during the night. I believe that he might have sat through the night before the last egg was laid, but when I approached close enough to see whether he was on the nest, he flew off through the twilight to join his mate in the bamboo grove where she roosted. Birds so sociable and affectionate as the anis must feel keenly the loneliness of passing the night on the nest far away from their companions, who sleep in some dense vegetation at a distance; and at the outset of incubation any excuse to desert their eggs and fly to their comrades, while there is still enough light to find them, is taken as a good one. The following evening, too, Whiteface flew from the nest as I was entering the blind and would not return, although it was still quite light. But later, when he had become more attached to the nest, he would return even if driven off in the dusk, provided that I retired to a reasonable distance, or slipped into the blind, before it was quite dark. I subjected him to these annoyances because I wished to make certain that it was always he who covered the eggs by night.

Years later, in Panamá, I studied a nest of the Smooth-billed Ani attended by three adults, which I had marked with paint by the method I used in the case of Whiteface. One day two of these birds each laid an egg between 12:30 and 1:53 p. m. Since these females laid fertile eggs, the third member of the group was evidently a male. He, too, occupied the nest by night, while his partners roosted in some bushes on the neighboring shore of Gatún Lake. Anis resemble pigeons and doves in that the male brings building materials to the female while she sits on the nest arranging them, in the occasional reversal of the roles of the two sexes in nest construction, and in their occasional spurts of concentrated building while incubation is in progress. But in pigeons it is always the female who takes charge of the nest through the night.

A juvenile helper.—The home life of the Groove-billed Anis is beautified by the affection which persists between all the members of

the family. One of the two youngsters of Blackface's first brood was the constant companion of his parents while they were busy with their second brood. There could be little doubt as to his identity, for although he was nearly as large as the parents, his bill, except for the faint beginnings of grooves at the base, was smooth. I do not know what fate befell the other youngster. The surviving one frequently rested on the nest's rim while a parent warmed the eggs. Once, while Blackface sat, I saw him fly to the nest with a roach in his bill. I thought that I was about to behold something wholly unprecedented in my experience with birds, a youngster feeding its parents. Doubtless if it were the habit of the female ani, as of the female of the Brown Jay *(Psilorhinus mexicanus)* and many other birds, to be fed by her mate while she incubates, she would have accepted the roach from her offspring, for he held it in his bill a full minute before he swallowed it himself. Later, while Whiteface was in the nest, the young ani arrived with a small lizard. He held it within reach of his father, possibly offering it to him, but the latter was not interested in it. The youngster carried it away only to bring it back a minute later. Still Whiteface showed no desire for the lizard, and the young ani finally ate it himself. I never saw a breeding ani go to the nest with food in its bill while its mate incubated. Sometimes Whiteface and the youngster perched side by side nibbling each other's feathers in the fashion of the adults. When I approached the nest, the young bird flew around me with his parents, sharing their excitement and adding to theirs his shrill calls of protest.

On September 18, three of the four eggs hatched. The one which was deposited last hatched 13 days after it was laid; if it had been warmed during its first night in the nest, it might have hatched in 12 days. Davis (1940) found the incubation period of the Smooth-billed Ani to be about 13 days, although sometimes it was as long as 15 days. The eggs of the parasitic Cuckoo of Europe hatch in 12 or 13 days.

From what I had seen of the young ani's actions while his parents incubated their second set of eggs, I was hardly surprised when I first saw him, at the age of 72 days, give a small lizard to one of his younger brothers and sisters—on the contrary, for some weeks I had been eagerly waiting to see this happen. Yet this occurred long before I saw a Brown Jay's nest, and such precocious participation in parental offices was wholly new to me. The youngster fed the nestlings regularly, although not as often as the parents. In four and a quarter hours, Whiteface, always the more attentive parent, brought food to the three nestlings 29 times, Blackface 14, and their young assistant 8.

The young bird not only fed the nestlings but was zealous in protecting them, flying up close to me and uttering an angry *grrr-rr-rr* whenever I went near them. In the absence of the parents he attempted to defend them alone. He was already a more spirited guardian of the nest than Blackface, and from this early ardor I surmised that he was a male; for his father had shown himself to be so much bolder than his mother when their family seemed to be in danger. In the Smooth-billed Ani, too, juveniles of the first brood sometimes feed nestlings of the second brood, and Davis saw one youngster do this when only 48 days old. A hand-reared youngster of this species engaged in building activities when about six weeks old (Merritt, 1951).

Of the further history of Whiteface's family there is little to record. When the three nestlings were nine days old and covered with feathers, they left the tree in which they were hatched. The identifying marks gradually faded from the parents, and if I saw them again I could not distinguish them from others of their kind.

OBSERVATIONS ON JOINT NESTS

Social relations prior to nesting.—Through the early months of the year, from February to May, when neighboring birds of other species are mating and building their nests, the Groove-billed Anis live together in small flocks and give no indication of being paired. Two often perch in contact, each in turn billing the other's neck; but even more frequently one sees three birds sitting in a compact row, and these little coteries seem not to be founded on the attraction of opposite sexes. In May and early June, however, the anis pair off and are then seen two by two instead of in the larger groups which prevailed earlier in the year. The mated birds are inseparable, foraging together, perching side by side, preening each other's feathers, and calling persistently to each other if they happen to become separated. They give every indication of being monogamous, and one rarely sees mates more attached.

Construction of joint nests.—In June, 1932, I watched the construction of a joint nest in a small orange tree behind the plantation house at "Alsacia" in the Motagua Valley of Guatemala. From the first, three pairs certainly participated in building this nest, and possibly there were five pairs, for I sometimes saw this number in the vicinity. But I could not distinguish all these birds individually, and they never all remained in sight long enough for me to be sure that the five pairs worked at the nest. Yet whether there were three pairs or five their conduct was fundamentally the same, for they worked in

pairs and never all together. The mated male and female flew up to the nest tree together, sometimes with one in advance, sometimes side by side, calling *pihuy pihuy pihuy*. One bird took its place on the little pile of dry weed stems and leaves in a crotch of the tree which was the beginning of the nest, while the other perched close by, or at times actually sat beside its mate on the incipient structure. They often tarried quietly in either of these positions for many minutes, doing no work; but at other times the partner on the nest arranged the materials with her bill, or shaped it with her body. More rarely, when they approached the nest one bore a stick or a green leaf in his bill. After his mate had settled on the nest, he gave it to her to be worked into the growing structure. I use these pronouns advisedly, because, in the case of the solitary pair that I had previously watched, it was usually Whiteface, the male, who brought the materials to his mate as she sat on the nest.

While one ani remained on the nest, the other brought sticks and green leaves to her. The sticks were often found in the nest tree, where they had been dropped among the close-set branches on some earlier occasion; but many were picked up from the ground, or broken with the bill from a bush in the neighboring pasture. The dead, much-branched inflorescence of a shrubby composite was frequently pulled off to be used in the nest. However acquired, the material was taken to the partner on the nest and she put it into place. The green leaves were usually plucked from the nest tree and mixed at random with the sticks, even when the nest was in its earliest stages, although they could be of no particular use until the cup of sticks had been completed and was ready for its lining. The males disliked to add sticks to the nest in the absence of their mates. Once, when a supposed female happened to leave the nest just as her partner approached with a stick in his bill, he followed her still carrying his burden and dropped it at a distance. At another time, I saw an ani break a dead flower stalk from the composite bush in the pasture, fly up with it to his mate perching in the hedgerow, then proceed to the nest, evidently expecting her to follow. When he reached the orange tree he found that she had not budged, so he took the stalk back to her, then returned again to the nest, calling to her as he went. Finding that she was still not inclined to come, he placed his burden on the nest and rejoined her in the hedgerow.

Groove-billed Anis seem almost incapable of quarreling among themselves. The three or more pairs worked together in the greatest harmony. There was not the least display of jealousy among them, and two or more pairs often perched quietly in the same bush. Each

pair preferred to work alone at the nest; and if a second pair flew into the nest tree, the first often quietly withdrew. But this was not always their behavior, and sometimes one member of the second pair (probably the female) settled on the nest beside one of the first pair, while their two mates perched near by, or else brought them sticks. Rarely three pairs were in the nest tree simultaneously. Once three birds tried to sit on the unfinished nest together; but these, I believe, were the male and female of one pair and the female of a second pair. Whiteface and his mate, working alone and in a hurry, had built a serviceable nest in three days; but these three pairs, beginning early and proceeding at their leisure, were about three weeks in building theirs. At the end of a month, when I was obliged to leave them, there were still no eggs, although the birds continued to take an interest in the nest and to bring fresh leaves to the lining.

In Chiapas, México, Alvarez del Toro (1948) watched nest construction by a group of Groove-billed Anis consisting of one male and two females, but he did not state whether this deviation from monogamy was caused by the isolation of these three birds, which made it impossible for each of the females to find a separate mate. This was the case with the three Smooth-billed Anis which in Panamá nested in a small clearing separated by wide expanses of forest and water from others of their kind. Here the polygynous relationship appeared to be an adjustment to the disparity of the sexes in the small, isolated group. According to Davis (1940), in Cuba this species exhibits monogamy, polygyny and polyandry all in the same neighborhood.

Egg laying.—One of the joint nests of the Groove-billed Ani most satisfactory to watch of all that I found was situated in a small orange tree at Birichichi, beside the Río Ulua in Honduras. It was constructed largely of tufts of grass, straws and stems of herbaceous plants, many of them with the roots attached, suggesting that they had been pulled from the earth by the birds. Few woody sticks were included in it because the nest tree stood in a field where few were to be found, and the ani, being an adaptable bird, manages to use what is closest at hand. Since this nest was too far away for me to visit it daily, the man who showed it to me kindly made a record of the dates on which the eggs were laid, which of itself, when it is recalled that a female ani usually deposits her eggs at intervals of two days or more, shows that at least two individuals produced them:

July 22—1 egg	July 26—5 eggs
July 23—2 eggs	July 27—6 eggs
July 24—3 eggs	July 28—6 eggs
July 25—4 eggs	July 29—8 eggs.

I found that I could arrange these eggs in two sets of four by their

shape; those of the first set were relatively long and narrow, those of the second shorter and broader (Plate 11).

Incubation.—A week after the last of these eggs was laid, I set about to mark the attendants of the nest with white paint, or rather to make them mark themselves, in the same manner that Whiteface had acquired his distinguishing characteristic. At length three of them touched the paint-soaked brush, acquiring white blotches adequate for their identification; and there was still a fourth whom I did not consider it necessary to bedaub. All four of these anis took turns at warming the eggs, but their shifts on the nest had no regular order and no fixed duration. Sometimes one bird had been on the nest for less than a minute when another came up and sat beside it. The first always departed very quietly almost at once, leaving the latest arrival in full possession. The longest interval that I saw two individuals cover the eggs side by side hardly exceeded a minute. The ani prematurely displaced by another gave no indication either of anger at having what it might have felt to be its rightful turn taken away from it, nor of pleasure on being so soon relieved of a possibly boring task. Many times it stayed quietly in the nest tree while the newcomer incubated. In the afternoon, one ani warmed the eggs for an hour and 18 minutes, with only a single short break when it jumped off the nest to chase a small lizard which came close to it. This was longer than I saw Whiteface or Blackface incubate, although one would have expected the turns on this nest to be shorter, since four birds shared them. On the other hand, the following morning, just after I had entered the blind leaving the anis greatly excited, each of the four took a short turn on the eggs in a period of less than ten minutes. At night, one ani covered the eggs alone.

At another nest near by, also belonging to two pairs, two anis were busy bringing pieces of dead vines and the dried bases of grass tufts to be arranged in the nest by a third individual, who covered the eight eggs. This was a very belated spurt of nest building, for the next day the first egg hatched. These birds managed to hatch all eight of their eggs, although the last nestling was born four days after the first and was wholly naked while its elder nest-mates bristled with long pin-feathers. The eight nestlings were brooded at night by a single parent.

Care of nestlings.—Just as the parents co-operate in incubating the eggs, so they all join in caring for the nestlings. I have watched three nests, each belonging to two pairs, while they contained young. Two of them, I made quite sure, were attended by four adults; but at the other I could not convince myself that there were more than three

attendants. Possibly some calamity had befallen the fourth member of this association, or possibly also I failed to recognize it, since the anis at this nest were unmarked and indistinguishable. I found it almost impossible to make the parents rub against a paint brush except while they were incubating their eggs. If a brush were stuck into a nest which held young, they chewed on it, attempting to swallow it in their insatiable hunger. At one of the nests I became familiar, after a little practice, with all four of the parents individually; for their tails had become much frayed by foraging in the grass and many feathers were broken off near the end, those of each bird in a characteristic fashion.

The nestlings, when hungry, make a loud, sizzling noise, as of something frying in hot grease, and attempt to swallow everything in sight, a finger if it is presented to them, a stick, or a thorn projecting above their nest's rim. At the age of five or six days they scramble out of the nest and hop away through the branches of the tree when alarmed. Since they can support themselves hanging by one foot, they do not usually fall to the ground. While they try to escape, the parents may vigorously buffet the head of a human intruder, continuing this as long as he remains by the nest and at times almost knocking off his hat. At some of the joint nests I received far more bumps than at Whiteface's nest. Except when the nestlings are very small, the parents do not clean the nest in the manner of passerine birds, but the young anis squirt their excrement over the side. Thus the provisions for the sanitation of the nest are essentially the same as in hummingbirds, in which also the parent removes with her bill the droppings of very small nestlings, while older ones eject their excreta over the rim. But whereas this method suffices to keep the hummingbird's tiny cup perfectly clean, the long, projecting sticks of the ani's nest are befouled by the ejected droppings. Thus a nest with young soon acquires a characteristic odor by which it is possible to detect its presence.

The anis are late to begin their day's activities, for they dislike to wet their plumage by foraging amid herbage still heavy with dew. While early birds are busy stuffing their young, the anis prefer to rest on some exposed perch, spreading their wings to the slanting rays of the rising sun. Meanwhile, one of the parents remains quietly brooding the little ones in their nest. It is eight o'clock or later when they begin to feed their nestlings in earnest, but then they do so with great energy. The three (or possibly four) attendants of the nest mentioned above brought food to their eight nestlings 66 times in two hours, or at the rate of about 4.1 meals per nestling per hour. In

their eagerness to be fed, unfeathered young often climb upon the rim of their nest, trying so to gain an advantage over their nest-mates. Their food consists principally of grasshoppers, but includes cockroaches and other insects, spiders, an occasional small lizard and a rare berry. Very small nestlings manage to swallow surprisingly large grasshoppers; but sometimes two of the parents, standing on opposite sides of the nest, prepare a particularly large one by pulling it apart between them, and each gives its half to a youngster. Although parent birds of many kinds try patiently for minutes together to induce a nestling to swallow something beyond its capacity, very few co-operate with their mates to reduce the size of such an article, in the manner of the anis.

The efforts of the parent anis to separate a lizard into swallowable portions are not always successful. Once I saw an ani bring to the nest a lizard of moderate size, already dead, and offer it to a nestling, whose best efforts to swallow it were of no avail. The parent took it up again and perched with it in the nest tree, calling for help, until another attendant arrived. Standing on the rim of the nest, the two tried to tear it apart between them, but they succeeded only in pulling it out of each other's bills in turn. Then one again presented it to a nestling, with no better result than last time; so it carried the victim to a clear space on the ground and struggled for ten minutes in a vain attempt to shake and beat it into pieces. Tiring of this fruitless effort, it again took it to the nest and offered it to a nestling; but it had scarcely diminished in size and none of the brood could swallow it. Now a second parent returned to the ground with the reptile and tried to accomplish what the first had failed to do, but after five minutes it abandoned the attempt and brought it to the nest a third time. Now a nestling made a brave effort to swallow the lizard, but this was physically impossible; a parent took it away and flew off with it, and I saw it for the last time. Sometimes a youngster manages to gulp down all of a small lizard but its long tail, which then projects into the air and waves from side to side with the nestling's movements, until it finally disappears.

RELATIONS WITH THE SMOOTH-BILLED ANI

For some obscure reason, anis have not colonized the rapidly expanding clearings in the valley of El General in Costa Rica as rapidly as many associated birds of open country have done, and of all the agricultural districts of Central America at lower altitudes with which I am familiar, this has the sparsest population of Groove-billed Anis. As already mentioned, I have found here only a single completed nest

in the past twenty years. Strangely enough, the Pacific side of southern Costa Rica, where the Groove-billed Ani—the common species of Central America—is so scarce, is the only part of the mainland north of the Isthmus of Panamá where I have met the Smooth-billed Ani, a rare straggler in most of Central America. In 1947, in the coastal lowlands between the mouth of the Río Térraba and the Golfo Dulce, I found the Smooth-billed Ani but not the Groove-billed, and a nest of the former species was discovered on September 18. In the valley of El General, however, the Groove-billed Ani is the more abundant of these two species. In 1940, I found both of them together in a pasture with scattered bushes beside the Río San Antonio, an affluent of the Pacuar near the head of the Térraba Valley. The concurrence of these two kinds of anis must be not infrequent in Venezuela, Colombia and Ecuador west of the Andes; but this is the only point where I have enjoyed the opportunity to observe their interactions.

On March 12, I recorded the presence of four Smooth-billed Anis—the first I had seen in El General—following cattle in the pasture beside the Río San Antonio. During the next month I had little time to devote to these birds, but on April 8 I was surprised to see one chasing another and to hear the unmistakable soft *pihuy pihuy* of the Groove-billed Ani coming from the fugitive, while the pursuer voiced the whining *ooenk ooenk* of the Smooth-billed Ani. While the latter continued to drive the Groove-bill away, two other Smooth-bills rested in a bush; and here the third came to join them after the fugitive had fled to a satisfactory distance. Two perched side by side, by turns preening each other's plumage. But the soft-voiced Groove-bill did not wish to be deprived of the company of the only other anis on the farm and persisted in attempting to join them. Every time it came near, one or another of the Smooth-bills (I could not tell whether it was always the same) drove it off again, and it fled voicing the soft calls so different from the notes of the pursuer.

Through the remainder of April and most of May, or over a period of no less than six weeks, the lone Groove-billed Ani persisted in its efforts to attach itself to the little flock of Smooth-bills, but it was ever as ungraciously repulsed. Meanwhile, I had found a party of about seven birds of the former species high up on the slope of the mountain at whose foot this little drama of thwarted affections was enacted. A belt of forest possibly a thousand feet in width, in addition to some open fields, separated this group of Groove-billed Anis from the solitary individual of their kind and the three Smooth-bills. Since anis are poor fliers and avoid forest, it seemed most improbable that the isolated bird would soon find the others of its own species.

A long and circuitous course might have taken it to the flock of seven without the necessity of passing through or over the woodland, but I had no great hope of its repatriation.

Day after day the lonely Groove-bill hovered in the vicinity of the three Smooth-bills and was driven off innumerable times. Once I saw one of the latter take over the chase of the unwanted one after another had grown tired; hence it aroused the antagonism of more than one of the trio. But the Smooth-billed Anis were even poorer fliers than the Groove-bill, who easily eluded the pursuers, and ever and again circled around to rest once more in their neighborhood, and to be driven off when it ventured too near. In the evening, I would sometimes find it perching all alone in a bush in the pasture, after the others had retired to sleep together amid the denser shrubbery beside a brook. A bird of companionable disposition, it yearned for company at the roost, but could find none. It symbolized the tragedy of a social creature unable to find others of its kind.

At the end of April a fourth Smooth-billed Ani arrived and I saw it perching near the other three, while the soft-voiced outcast hovered in the offing, and was driven off whenever, uttering its alien call, it attempted to come too near. That evening, while watching the flock go to roost, I learned that the fourth Smooth-bill had not been wholly accepted as a member of the little flock. After considerable moving about, three of the Smooth-bills retired into a small, loose clump of bushes and young trees in the midst of the open pasture. When the fourth individual of their kind tried to join them there, one of the others sallied forth from the clump and chased it beyond the rivulet a hundred yards away, then returned to its companions in the clump, while the chased bird remained out of sight amid the bushes. The preceding day I had noticed signs of antagonism between the Smooth-bills, yet they seemed to be getting along together better than with the Groove-bill.

The Groove-billed Ani, who as usual had been driven about during the late afternoon, perched quietly on the top of a small shrub, while the three Smooth-bills settled down for the night after driving away the fourth. Then, flying from bush to bush, sometimes calling its soft *tiho tiho* as it went, it gradually approached the clump where the three it wished to have as companions rested. When it had nearly reached the bushes, one of the Smooth-bills came out and chased it back to the rivulet. Among the bushes on the steep slope bordering the brook the pursuit continued, the Smooth-bill persisting in the chase of the Groove-bill, who now stubbornly refused to retreat farther, but merely circled and doubled around, easily eluding the chaser.

Sometimes the Smooth-bill came to rest in the same bush where the fugitive had paused; for a brief period both of the black birds would catch their breaths while perching close together in apparent amity; then the Smooth-bill would renew the pursuit as before. I never saw one strike or grapple with the other.

After a good deal of this circling about among the bushes along the rivulet, the Smooth-billed Ani desisted from the useless pursuit and returned to the clump where the others were resting. Now the Groove-bill perched conspicuously on top of a bush and gave voice to soft, mournful notes, full and continuous, unlike any utterance that I had ever before heard from an ani. After a long pause here, while the light was fast fading from the sky, it began to approach the clump by slow degrees, flying from bush to bush, pausing on the top of each to look around and consider and repeat its mournful notes. By this slow approach it had almost reached the clump where the others roosted, when one of the three flew forth and drove it away. This time, pursuit was not long continued; the assailant soon turned back to the clump, leaving the solitary Groove-bill perching atop a low shrub at no great distance. But after this latest rebuff the poor bird had no heart to make another attempt to join the exclusive Smooth-bills. After pausing here a while in the failing light, it turned about and flew down to sleep alone among the bushes by the rivulet, calling *pihuy* softly as it went.

As so often happens in such cases, the ani would not, or could not, disguise the feature in which it differed most conspicuously from those with whom it wished to associate—in this instance, its voice. For a long while I suspected that it was not permitted to join the three Smooth-billed Anis because it was of a distinct species and spoke a different language. But later, when the fourth Smooth-bill was repulsed, it became evident that these anis were clannish to a degree which I had not suspected of them. The Groove-billed Ani was in much the same situation as another Smooth-billed Ani who had not been accepted as a member of the flock.

ORIGIN OF COMMUNAL NESTING AND ITS RELATION TO BROOD PARASITISM

There has been much speculation on the origin of the communal nesting of anis, and attempts have been made to relate it to the parasitic habits of the European Cuckoo and other members of this family. Some writers have detected in the absence of sharply delimited stages or phases in the nesting cycle a predisposition to other irregularities. We have seen how slowly the Groove-billed Ani works up to full constancy in incubation, and how it may lay its eggs before its nest is

finished or build up its nest when the eggs are about to hatch. However, by no means all birds, even of species in which the strictly monogamous pair breeds in solitude, complete their nest before they start to lay and cease to add to it after incubation has begun, as seems usually to be the way among oscines. In the Passeriformes, many of the Tyranni, especially ovenbirds (Furnariidae) with their often bulky nests, continue to build until the eggs hatch, and even a few Passeres do this, as, for example, certain titmice and wrens. Yet the absence of sharply delimited phases in the nesting operations does not lead to communal nesting or parasitism in these groups.

As we have seen, Groove-billed Anis are usually monogamous; even at joint nests there is strong evidence that monogamy prevails. Moreover, an isolated pair is quite capable of rearing a brood, and about half of the nests belong to such single pairs. Social nesting appears to have arisen simply from the strong social attraction among anis and the absence of territorial defense. Although I have watched Smooth-billed Anis chase an individual of their kind who was not a member of their flock, and Davis (1940) reported vigorous territorial defense by the flock in this species, I never saw a Groove-billed Ani pursue or quarrel with any other Groove-billed Ani. Many highly gregarious birds, such as swallows, preserve an "individual distance," in some cases determined by the reach of their bills while they perch, within which they do not tolerate another individual of their own kind, and which even the future mate is not permitted to enter until by appropriate ceremonies the mutual distrust of the two individuals has been overcome. But the anis do not even attempt to preserve this small individual "territory" which moves about with them. They show not the slightest aloofness from each other, but seem never so content as when they perch in a compact row and nibble each other's plumage. Since the group does not break up at the onset of the breeding season, but its members merely pair off within the flock, it will often happen that two or more pairs are attracted to the same nest site, or perhaps are led to prefer it by the imitativeness so widespread in social animals. The anis seem to be equipped with no aggressive or defensive displays which the pair first in possession might employ to repel their neighbors who trespass on the site of their choice, and the attraction of a superior site readily leads to building and laying in it by more than one pair.

The peculiar nesting habits of the anis, their lack of a territory held by a single pair, are worthy of consideration from both the ecological and the psychological viewpoints. From the former, we wish to know whether the joint nests are more or less efficient in pro-

ducing offspring than those attended by a single pair, and if more efficient, up to what number of co-operating pairs does their efficiency increase. Likewise, we wish to know how the communal habit affects the density of the population. Unfortunately, we possess few data which might help to answer these questions. I know of two instances in which Groove-billed Anis succeeded in hatching all eight of the eggs in nests belonging to two pairs, and a case in which 13 of 15 eggs hatched was reported to me by a reliable observer. Groove-billed Anis seem rarely to lay more than 12 eggs in a nest. On the other hand, Smooth-billed Anis sometimes lay twice this number or even more, yet Davis (1940) never knew more than eight eggs to hatch in one nest. Probably in both species a larger proportion of the eggs hatch in the smaller sets, which can be more efficiently incubated: although the great resistance of anis' eggs to chilling (as I have seen especially in the Smooth-billed Ani) would permit many to hatch even if they were not constantly and uniformly warmed by the single bird that sits on them at one time. But the less efficient incubation at the joint nests with a large number of eggs, and the tendency of eggs to be lost from such nests, may be offset by the more efficient defense against predators. We have seen that Groove-billed Anis are very bold in attacking men who molest their nests; but unfortunately we do not know how they deal with snakes, hawks, small mammals and other predators, nor how often they succeed in protecting their eggs and young from them. One cannot infer from a bird's behavior in the face of one kind of potential predator how it will act toward another, and some birds very timid where man is concerned are bold enough in attacking snakes or other animals.

One of the functions ascribed to territory is the regulation of the density of the breeding population and keeping it in balance with the supply of food; but its efficacy in this connection has been questioned by Lack (1954) and others, largely on the ground that territories are in some species highly compressible in the face of competition for them. However, since this compression is usually not effected without more or less strong resistance by the pairs already established, and as the resulting strife will in many instances reduce the period which the birds devote to actual nesting and the number of broods they can rear or the number of renesting attempts they have time to undertake, even unsuccessful efforts to maintain territories should at least slightly decrease the rate of reproduction; and in the long run this slight depression may be of some importance. The observations of Beer and his colleagues (1956), showing that on small islets isolated pairs of certain songbirds may reproduce in areas far smaller than

they defend when in contact with other pairs of their kind, make it seem probable that some birds hold territories considerably larger than they require as a source of food; and this would act as a check on the density of the breeding population which is independent of the supply of food at the season when it is most abundant.

In anis we should expect that the higher the density of the population the more joint nests there would be, or the more participants each such nest would, on the average, have. We should look for this effect if only because the more abundant food in areas unoccupied by anis, or thinly populated by them, would counteract their strong sociability and lead them to disperse. And if, as seems true, joint nests with more than two or three participating pairs are less efficient than nests with fewer eggs, the very lack of territory held by single pairs would in these birds produce one of the results which have been ascribed to territory—that of placing a check upon the rate of increase. Nature has many means of accomplishing the same end.

In my opinion, there is no connection between the communal nesting of anis and the brood or "social" parasitism of certain other cuckoos. The anis do not represent a stage along the road to such parasitism. Even if, as Davis (1940) believed to be true of the Smooth-billed Ani, some individuals fail to attend, or attend laxly, nests in which they have laid eggs, it is difficult to understand how parasitism of the sort exemplified by the cowbirds and the European Cuckoo could develop from this propensity. If reproduction is to be successful, any deficiency in the strength of the parental instincts of some of the individuals which have laid in a nest must be compensated by increased attentiveness on the part of certain others. Even if there exist in the species genetically determined propensities toward greater and less participation in parental offices, they could hardly, by any known mechanism, be segregated, yielding a species with strong parental impulses and another species devoid of them, without the isolation of these two strains; and this would promptly lead to the extermination of that strain which depended upon the other to rear its young. To take the first step toward brood parasitism, anis would have to deposit their eggs rather frequently, not in nests belonging to other individuals of their own species, but in nests of other kinds of birds. Although such laying in foreign nests occurs from time to time in North American species of *Coccyzus* and certain other non-parasitic cuckoos, it seems hardly ever to occur in the case of anis. Miller (1946) discussed the relation of scattered eggs to parasitism.

Davis (1942), who believed that the "Crotophaginae represent not a stage in the development [of parasitism] but an offshoot," thought

also that these birds are "indolent in the care of the nest." This is certainly not true of the Groove-billed Anis. If at times they build their nest in a desultory fashion, the same applies to many other tropical birds which start their nests long before they are ready to lay and so can afford to construct them at their leisure. In case of necessity the anis can, as we have seen, complete a nest quickly enough. They are slow in warming up to the task of incubation, yet finally they keep their eggs almost constantly covered (which many other tropical birds of which the two sexes share incubation fail by a great deal to achieve); and the adequacy of their attentiveness to the eggs is attested by the incubation period, which is shorter than that of many passerines of similar size. In the defense of their young against man, they are more zealous than any other tropical American birds that I know, except a few of the antbirds. In short, the Groove-billed Anis reveal not the slightest weakening of any of the "instincts" concerned with reproduction save that of territorial defense; they may, like the Smooth-billed Ani, defend a territory belonging to the flock as a whole against others of their kind, but I saw no indication of this. It seems to me that the social nesting of the anis is not even an offshoot of the parasitic habit, but a wholly independent development in an ancient, widespread and highly diversified family; just as colonial nesting and brood parasitism are independent developments in the Icteridae. If it is absurd to suppose that the colonial, polygamous oropéndolas and caciques, with their extraordinarily elaborate nests, represent a stage along the road to the cowbirds which build no nests, it is equally unlikely that the anis, with their strong parental instincts, are in danger of degenerating into brood parasites.

SUMMARY

Groove-billed Anis need trees or bushes for roosting and nesting and open areas covered with low herbage for foraging, but they are tolerant of a wide range of ecological conditions. They inhabit clearings in the rain-forest, semi-desert areas with cacti and thorny scrub, and even extensive marshlands, if there are a few outstanding trees or bushes. In Central America they range from sea level up to about 5000 feet in Guatemala and 7500 feet in Costa Rica, but they are most numerous at lower altitudes.

Exceedingly sociable, they live most of the year in flocks containing 10 to 20 birds. They often perch in closest contact, alternately preening each other's feathers. They were never seen to quarrel or disagree. Disliking wetness and coldness, they often sun themselves with expanded wings.

Their diet consists largely of insects, varied by lizards and small fruits. They forage much amid low herbage, where they either hop with the feet together or run advancing their feet alternately. They follow grazing animals and seize the insects stirred up by them, and sometimes they gather around army ants for the same purpose.

Their breeding season begins late and is at its height in the wet months of July and August. As it approaches, the anis form pairs and often perch two by two, the mated birds in closest contact. Yet many of these pairs remain within the flock and two, three, or rarely more build a joint nest. About half the nests belong to single pairs.

The nest, an open bowl of coarse sticks, weed stems, straws and the like, lined with green leaves, is placed from 2 to 25 feet up in a tree with dense foliage, preferably an orange, or in tangles of vines. In arid regions it is often built in organ cacti and opuntias. Rarely an abandoned open nest of some other bird is refurbished by the anis.

In building, male and female carry and arrange material, but there is a strong tendency for the male to bring sticks and leaves to his mate, who sits on the incipient nest arranging them. When several pairs unite to build a nest, each pair prefers to work alone; but sometimes two pairs are at the nest, and members of both may sit on it simultaneously at this stage.

The eggs are laid around or soon after noon, and at intervals of two or three days. Each female usually lays four eggs, sometimes three or five. Nests containing eight eggs belong to two pairs, those with twelve to three pairs. Nests with more than eight eggs are rare, but one with 15 was recorded.

Incubation is performed by both sexes of all the participating pairs, but two individuals were not seen sitting simultaneously except for a very brief period as one replaced another. At night, a single *male* covers the nest. The anis work up slowly to full constancy in incubation, but in the latter part of the incubation period they keep their eggs almost constantly covered, each bird sitting until replaced by another. At a nest belonging to two pairs, all four of the anis took turns on the eggs within ten minutes when excited, but at this same nest one bird once remained in charge for 78 minutes. The anis continue to bring green leaves and sticks to their nest while they incubate, and they may build actively just before the eggs hatch.

At one nest the incubation period was 13 days.

The nestlings are fed and brooded by both parents or, in the case of the joint nests, by all the co-operating members. Active feeding begins late in the morning, after the herbage has dried, but then it may be rapid. At one nest, eight young were fed 66 times in two

hours by three or four attendants. Large articles are pulled apart between two of the parents, but this method is not always successful with lizards. The parents, especially the males, are bold in defending their young, frequently striking the back of a man's head. They remove from the nest droppings of very small nestlings, while older ones try to eject their excreta over the rim but are not always successful, resulting in the fouling of the outside of the nest.

Hatched without any vestige of down or feather rudiments on their black skin and with tightly closed eyes, the young develop rapidly. When five or six days old they bristle with long pinfeathers. At this stage they leave the nest when alarmed and climb or hop away through the surrounding boughs, often hooking the bill over a twig to avoid falling. When all is quiet, they return to the nest and are brooded. Sometimes they fall to the ground and then they are adept at creeping and hiding in the herbage. Parents fed a fallen flightless nestling, but less than one which remained in the nest.

When the young are six or seven days old their feathers escape with great rapidity from the long, horny sheaths, and a single day brings about a transformation in their appearance (Plate 10). They now enter a half-scansorial, half-terrestrial stage of existence. At one nest the young were last brooded by night when between seven and eight days old. They remained in the nest tree two days longer but did not return to sleep in the nest. Then they were led away by their parents, although they could still scarcely fly. When 11 days old, they could make short flights between the limbs of the same bush.

Two broods may be produced in a season, and the young of the first brood stay with their parents while they rear the second brood. One young ani fed nestlings of his parent's second brood when 72 days old. He also defended the nest.

A Groove-billed Ani, isolated from all others of its kind, tried for more than six weeks to join a flock of three Smooth-billed Anis, but was always driven off by them. They also chased away a fourth Smooth-billed Ani.

Groove-billed Anis show no weakening in any aspect of parental behavior and are exceptionally zealous in the defense of their young. Their communal nesting seems to result merely from their intense sociability. It appears to be not a stage along the road to brood or "social" parasitism, nor an offshoot of such parasitism, but a wholly independent development in a very ancient and diversified avian family.

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BENT'S LIFE HISTORIES OF NORTH AMERICAN BIRDS

The Smithsonian Institution has accepted for publication as a Bulletin of the United States National Museum the first volume of "Life Histories of North American Cardinals, Grosbeaks, Buntings, Finches, Towhees, and Allies," written by A. C. Bent and a large number of collaborating authors. This volume comprises the species in the genera *Richmondena* through *Pipilo,* following the order of the 1957 A.O.U. Check-list. Over fifty authors are engaged in preparing a second volume, which will complete the *Fringillidae*—and the Bent series.—WENDELL TABER.