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LIFE HISTORY OF THE MEXICAN TROGON

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Plates 10, 11

FROM Bent's recent volume of life histories of North American birds,[1] it appears that little is known about the habits, especially the breeding habits, of the Coppery-tailed Trogon, the only member of the family that occurs within the limits of the United States. The trogons as a family are intolerant of cold, and only a few species venture beyond the Tropics. These superbly beautiful birds of decidedly 'tropical' appearance are found in the warmer portions of the eastern as well as the western hemisphere; but the species are most numerous on the tropical American mainland. In Central America they are abundant both as species and as individuals; and here the bird-watcher enjoys exceptional opportunities for studying their habits, thereby supplementing the scanty information recorded for the single species that reaches, rather sparingly, the extreme southern portion of our own country.

During the last eleven years, I have found nests of eight kinds of trogons: the Black-headed Trogon (*Trogon m. melanocephalus*), Citreoline Trogon (*T. citreolus*), Mexican Trogon (*T. mexicanus*), Jalapa Trogon (*T. puella*), Massena Trogon (*Curucujus m. massena*), Graceful Trogon (*Trogonurus curucui tenellus*), Gartered Trogon (*Chrysotrogon caligatus*), and the Quetzal (*Pharomachrus mocinno costaricensis*); also unfinished nests of Baird's Trogon (*Trogon bairdi*). Some of these I have had opportunities to study in considerable detail, but none more thoroughly than the Mexican Trogon (*Trogon mexicanus*), a species inhabiting the highlands of southern Mexico and northern Central America. In Guatemala, where alone I know the bird at first hand, I have found it ranging from 3000 to 10,000 feet above sea level. It was quite abundant on the Sierra de Tecpán, in

[1] Life Histories of North American Cuckoos, Goatsuckers, Hummingbirds, and their Allies, by Arthur Cleveland Bent. Bull. U. S. National Museum, no. 176, 1940.

NESTLING MEXICAN TROGONS: (above) AT AGE OF TEN DAYS; (below) AT AGE OF TWELVE DAYS.

the Department of Chimaltenango in west-central Guatemala, where I spent the year 1933 studying the birds and vegetation. I purpose here to give the results of my studies of the Mexican Trogon made at that time, then to compare its life history briefly with that of other species I have watched elsewhere, or of which published accounts have been available to me.

HABITAT AND APPEARANCE

The highlands of Guatemala are a region of stimulating contrasts in both flora and fauna. Here, on the one hand, we find a large representation of North American types of animals and plants, many belonging to species that range southward from the United States; and on the other hand, a liberal admixture of organisms whose nearest relations are at home in the tropical lowlands. On the Sierra de Tecpán, a mountain complex rising above the plateau of Chimaltenango, itself 7000 feet high, the most abundant trees are oaks of half a dozen kinds, alders (*Alnus arguta*) exceeding a hundred feet in height, low arbutus trees (*Arbutus xalapensis*) with cinnamon-colored bark, towering pines of several species, and the lordly cypress (*Cupressus benthamii*). There are many kinds of trees more decidedly tropical, just as there are numerous shrubs and herbs representing families and genera widespread in the lowland Tropics; but these trees of familiar northern types dominate in the woodlands, just as well-known herbs like violets, buttercups, dandelion, speedwell and self-heal make the visitor from the North feel at home in the clearings. Oak, alder, pine and arbutus are the chief trees on the lower two-thirds of the Sierra de Tecpán, between 7000 and 9000 feet; while the upper third of the mountain, from 9000 feet to its summit at 10,000 feet, is largely covered with forests dominated by great cypress trees that attain 150 feet in height and seven feet in diameter. Oaks are absent from these cypress forests. In this setting, resident, breeding birds of north-temperate origin—juncoes, towhees, siskins, golden-crowned kinglets, jays of three kinds, bluebirds, brown creepers, flickers, hairy woodpeckers—mingle with such distinctively Neotropical birds as guans, parakeets, motmots, toucanets, ant-pittas, woodhewers and honey-creepers. In such an environment, among such bird neighbors, lives the Mexican Trogon.

Of all the birds on the Sierra de Tecpán, the Mexican Trogon is the most splendid in plumage, and did most to remind me that these cool forests of oak, pine and cypress are in fact within the Tropics. The glitter and brilliance of its attire suggest the exuberant life of the lowlands rather than these sterner and more sober heights: indeed,

most of its relations are birds of the hot regions; in Guatemala it is the only member of the family to make its home so high. The Quetzal, Guatemala's national emblem, it restricted to heavy forests at middle altitudes; and I never had the pleasure of encountering one of these magnificent birds on the Sierra de Tecpán, not even at the base of the mountain. But the Mexican Trogons live in fair numbers even in the cypress forests of the summit, 10,000 feet above the sea. They are birds of medium size, with a rather short, stout body and long tail. The bill is short, broad and thick. The male wears a coat of brilliant, metallic green, with a bright red belly separated from the green chest by a broad white bar. The female is clad in sober brown; the red of her belly is neither so brilliant nor so extensive as that of her mate, for there is an additional belt of brown below the white band over her breast. Locally this bird is called the Aurora, perhaps in allusion to the hues of "the rosy-fingered dawn," which are rarely so intense as the red of the male's belly. At all events, it is a pretty name, at once more suggestive and more distinctive than the merely generic 'trogon'; and I think we can do no better than to continue to use it in this account.

By February, the Auroras had begun their love calls; and the full, mellow *cow cow cow* of the males, ringing through the woods where oaks and alders were burgeoning, helped to intensify the impression of spring. If I disturbed a bird by my approach, he ceased his pleasant *cowing,* and showed his annoyance by uttering in its stead the low *cuk cuk cuk* so typical of trogons. As these syllables were delivered, he slowly raised and depressed his tail, at the same time slightly spreading it to reveal the broad white tips of the black outer feathers. If I continued my approach, he retreated with undulating flight farther into the woods, uttering a sort of frightened cackling as he flew. These indiscreet habits, coupled with their brilliant plumage, made the Auroras very conspicuous.

NEST AND EGGS

In a region of strongly marked seasonal contrasts like the highlands of western Guatemala, the breeding season of the majority of the birds is far more sharply delimited than in the lowland Tropics. On the Sierra de Tecpán, the date given for the beginning of the dry season is mid-October; for its end, mid-May. This agrees approximately with my own experience in 1933. During the dry winter months, frost formed on the open fields every clear, calm night, and was quite conspicuous at dawn on the close-cropped pastures and the bare roadways. About the dwelling I occupied, at an altitude of

8500 feet, I noticed the last frost of the spring months on April 2; then I saw no more until November 2, after the dry season had begun. The great majority of the birds—hummingbirds and honeycreepers (*Diglossa baritula*) excepted—nested during the brief period of dry, frostless weather covering April and the first fortnight of May. Since this interval of a month and a half was too short for all to bring forth their nestlings—especially if they had lost a first nest—many were caught by the first rains with unfledged young, and these strove bravely to bring them through alive. But few birds, except some wet-season breeders like the Nightingale-Thrush (*Catharus frantzii*) and the White-breasted Blue Mockingbird (*Melanotis hypoleucus*), started new nests after the first vigorous onslaught of the rains in mid-May.

Like that of most birds of the region, the breeding season of the Auroras centered in the dry, frostless period between the beginning of April and the middle of May. They began to breed somewhat earlier than many of the smaller birds, a short while before the cessation of the nocturnal frosts; for on March 21, I found a nest in which incubation was already well advanced. Two more nests with eggs were found early in April.

All three of these nests were carved into the sides of low, rotting stumps or stubs of branches, the two lowest only 33 inches above the ground, the highest 49 inches. The nest-chambers were of rather irregular form, and measured from 8 to 11 inches in height by from 3.75 to 5.5 inches in diameter. Their irregular, vertically elongated entrances were high and wide, revealing much of the birds as they sat in the nest. The Auroras, in common with other trogons, carried into the hole no soft material to serve as a bed for their two pure white eggs, which rested merely upon a shallow layer of fine fragments and debris of the decaying wood out of which the cavity was carved. I did not have the good fortune to witness the excavation of these nests; but two at least were freshly carved, as attested by the abundance of newly removed particles of wood on the ground below; and I have not the slightest doubt that the Auroras made the cavities themselves, rather than use old woodpeckers' holes—which are rarely so low—or hollows of natural origin. Most probably male and female coöperated in the work, as is true of three other species of trogons that I watched while they excavated their nest holes.

As I roamed through the woods on the Sierra de Tecpán in April, I came upon literally scores of places where the Auroras had recently tried their bills on decaying trunks, apparently in fruitless attempts to carve out nesting holes. Usually the excavations were in low, half-

rotten stumps; but I found some as high as twelve feet above the ground. Many times, after penetrating the soft outer layers of the wood, the birds had found the interior too solid for their bills, and so had been obliged to abandon the work. In other cases the wood had been too rotten; or else they had erred in judging how much to remove, and so had broken through the side of the chamber and ruined it. Wood in which they are able to work must be so softened by decay that a man might dig a hole in it with his fingernails; in such wood were carved all three of the occupied nests that I studied. When the wood reaches this advanced stage of decay, the trunk, unless it be very thick and have a more solid core, is so shaky that a push or a kick would overturn it; and in studying the nests one must be careful not to push or lean against the stumps that contain them. Several cavities that I found were apparently completed and seemed serviceable, yet the makers never nested in them.

Nature has been particularly unkind to these splendid birds, for she has neither given them a tool suitable for working in wood, like the bill of a woodpecker, nor instructed them how to make nests of stems and fibers. Indeed, their bills are as poorly adapted to the one purpose as to the other. Some of the lowland trogons take advantage of the big, black nests of termites, composed of thin, hard plates which they can more readily break with their heavy bills, and excavate a nesting chamber in the heart of the termitary. Others, like the Gartered Trogon, dig into the papery substance of a large wasps' nest to form their nest chamber. But the highland trogons find none of these termites' nests, nor any big wasps' nests, and must carve their breeding chambers into wood. With their blunt bills they are quite unable to chisel into sound wood, and are reduced to the extremity of nesting in rotting, insecure stubs and low stumps, exposing themselves and their offspring to the risk of being caught in a falling tree, or else to the danger of attack by purely terrestrial creatures.

INCUBATION

The nest to which I devoted most attention was excavated in the short, half-decayed stub of a thick branch of a small arbutus tree growing at the edge of an oak wood (Plate 11). It was scarcely a yard above the ground, and contained the full set of two eggs when found on March 21. A few days later, I came in the afternoon to set up my cloth blind among some young pine trees growing in front of the nest. The male Aurora, which was incubating at the time, watched me at work from his position on the eggs, twenty-five feet distant.

I returned the following morning as the stars were fading and the three great volcanoes, Agua, Fuego and Acatenango, far across the plain, stood sharply silhouetted against the first rosy glow of dawn. Entering the grove of young pine trees, I looked in vain for my wigwam of brown cloth, although I had taken pains to remember its exact location. After some searching with the aid of an electric torch, I found it lying on the ground, overturned by the gale that had blown during the night. With the utmost caution to be noiseless, I reset it on its three poles and ensconced myself within. It was still too dark beneath the shade of the trees to distinguish aught but vague forms. The doorway of the Auroras' nest faced west and was a hole of solid blackness in the side of the stub, into which I peered eagerly through my binocular without being able to detect the least suggestion of a bird. Was the trogon still on her eggs, or had I frightened her from the nest as I righted the fallen blind? I passed some anxious minutes as the light slowly grew stronger. A Pink-headed Warbler (*Ergaticus versicolor*) sang sweetly just outside my wigwam. At length I discerned, or thought I could discern, in the lowest part of the aperture of the nest, something a trifle lighter in color than the utter blackness that prevailed in the remainder of the hole. Could this be the Aurora still sleeping on her eggs? Then, as I continued to watch through the glasses, with a start a head appeared from the indistinct form. She had suddenly awakened and withdrawn it from beneath her right wing; and in the obscurity I could barely distinguish the white crescent behind her eye.

As the daylight waxed I could distinguish details of the female Aurora's position in the nest. She sat facing invariably outward, usually with her short, thick, dark-gray bill just showing above the sill of the doorway; but at times she sank so low that her bill was largely concealed by the rim, although I could still see her dark brown eye. She held her tail sharply upward against the rear wall of the cavity, with its extremity bent forward under the ceiling until it almost reached the upper edge of the entrance. Her plumage, at least all that was visible to me, was a soft brown, for the white bar across her breast and her red belly were hidden in the cavity. The white crescent behind each eye gave her a startled expression, as though she were constantly on the point of darting out of her nest and flying away; but in reality she was quite at ease and apparently unconscious of my presence before her. Her only movement was to shift her head at intervals slowly from side to side.

She sat steadily through the early morning hours, while the strong

wind soughed through the pine trees above. The Pink-headed Warbler sang cheerily near us; a White-eared Hummingbird (*Hylocharis leucotis*) poised at intervals before the few red salvia blossoms that remained so late in the season, so near the tent that I could hear the humming of its wings; rarely a Brown-backed Solitaire (*Myadestes obscurus*) sounded its wild pipings among the oaks down the mountainside. Periodically the Aurora became restless, and shifted and squirmed about in the nest. To turn her eggs she rotated sideways, since the chamber was wider from side to side than from front to back, and in this position she enjoyed more freedom of movement. Once a dead branch near by crackled sharply in the wind. Alarmed, she rose up and moved forward into the doorway until the white bar across her breast was just outside, and the tip of her forwardly turned tail barely projected beneath the upper rim. In this position she enjoyed a wider outlook, and peered from side to side, looking for further signs of danger; but since she saw nothing to excite her suspicions, after two minutes she was reassured and very slowly sank back into the nest. This behavior was characteristic of both the female and her mate: upon hearing an alarming sound, or even when they saw me approach the nest from directly in front, it was not their custom to dash madly away, but rather to move into the entrance where they could command a view to the sides as well as in front, and there make a careful survey of their surroundings. According to the results of this reconnaissance, they either returned to the task of keeping the eggs warm, or else sought safety in flight.

In spite of the monotony of her long and solitary session, the Aurora never ceased to be alert. When the whistle of a man sounded faintly in the distance, she lifted up her head, suspicious. Yet the blasting in a lime quarry half a mile distant, a far louder sound as it reached us, did not cause her to move in the least, or to give any indication that she had heard it.

As the sun neared the zenith, the wind died away and the birds ceased to sing. The male Aurora had not appeared all morning; but a few minutes after noon I heard him call softly in the distance. Then he flew up and perched low in the bushes in front of the nest, very near my place of concealment. His mate gave him no sign of recognition, although I think he had come to relieve her in the nest; and after a few minutes he departed. As the sun fell westward, its rays struck through a chink in the side of the nest and illuminated the tail of the sitting bird. At 1:10 p. m. she spontaneously left her eggs, on which she had been sitting without a recess,

and without a bite of food, since late on the previous afternoon, some nineteen or twenty hours in all. In fifteen minutes she returned, perched on a dead branch above the nest and devoted several minutes to a careful scrutiny of her surroundings, turning her head slowly from side to side to see in all directions. Then she dropped down and clung upright in front of the entrance, where she continued her cautious spying. Satisfied at length that there was no danger, she went in, turned about-face at once, and settled down looking outward.

At 3:23 p. m. she left the nest again. In about ten minutes the male approached, perched on a low branch not far from the nest, and called many times in a low, mellow voice, moving his tail ever so slightly up and down as he uttered the notes. Then he flew to the nest and clung upright at the entrance just as his mate had done. How his splendidly metallic green back and neck glistened before my eyes, while bronzy reflections played over them as the slow turnings of his head changed the angle of incidence of the light! Assured that all was well, he at length slipped in, turned about at once, revealing as he did so the bright red of his belly, and settled on the eggs facing outward. His entire head was visible above the sill, and with his glistening green crown, rings of deep red bare skin surrounding his dark brown eyes, and clear yellow bill contrasting with the black forehead, cheeks and throat, he was far more conspicuous in the cavity than his mate had been.

As the sun sank lower, the afternoon became quite chilly; and I was uncomfortably cool as I sat motionless in the tent. After the male Aurora had been nearly two hours on the eggs, his mate silently returned and perched on a dead limb in front of and above the nest. He then pushed forward until the red of his belly showed beyond the sill, and delayed a minute or so in this position, then very slowly came out and flew away. After the usual slow survey around and inside the nest, the female entered for the night. I thought that I might see her end her day by tucking her head among the feathers of her back; but as the nest hole dimmed to a solid black in the twilight, she gradually faded out of sight until I could discern only the white crescent behind one eye; then this, too, was swallowed up by the blackness. I waited a few minutes longer, then cautiously stole forth from the wigwam and ended my day with the Auroras.

Although at this nest the female performed by far the greater share of the incubation, it was not entirely the male's fault, for we have seen that she did not always make way for him when he came to relieve her. The following day he went on the nest earlier and sat for nearly

three hours during the afternoon (2:40 to 5:30). On the next day I found him sitting at 12:50 p. m., but I did not wait to see how long he would remain. I never found him covering the eggs during the forenoon.

I devoted another day to watching the nest of a second pair of Auroras, situated breast-high in a slender, tottering oak stump in heavy forest. These birds, also incubating two eggs, arranged their time on the nest in a far different manner. Calling loudly, the male arrived at dawn, so early that there was still insufficient light to distinguish his mate in the cavity. For several minutes she seemed indifferent to his summons to come forth, and did not budge from her position on the eggs. At length she raised her head slightly, paused in this attitude, then advanced until her head and breast were beyond the doorway and delayed longer. She seemed very reluctant to go, but finally she darted forth for breakfast. Then the male, after clinging upright before the nest and making the customary survey of his surroundings, entered and settled on the eggs. When he had warmed them for forty minutes (6:15 to 6:55) he suddenly came out and called, then flew off in the direction whence he had arrived. Ten minutes later he returned and sat for forty minutes more (7:05 to 7:45), when he again left without apparent reason. Compared with the female Aurora, he was a most impatient sitter.

Soon after his second departure, the female returned to her eggs. It was then a few minutes past eight; and she remained without important incident for the next four hours (8:07 a. m. to 12:30 p. m.). Then the male began to call persistently in the distance, his clear voice coming gradually nearer and nearer, while his mate answered with a very low *cow cow* from the nest. She flew off and continued to call from the woods, while he settled down to incubate. This time he remained in the nest for an hour and a half (12:35 to 2:10 p. m.), when he again departed abruptly without waiting to be relieved. Returning twenty minutes later, the female warmed the eggs for the greater part of the afternoon (2:30 to 5:15). The male came to relieve her as the sun sank low, but after occupying the nest for half an hour (5:17 to 5:50) he became bored and left the eggs unguarded. As the dusk began to gather beneath the forest canopy, the female returned (at 6:15) to pass the night in the nest; and I stole away down the mountainside. During the course of the day, the male had taken three rather short turns on the eggs, in the early morning, in the early afternoon, and at the close of the day; while the male of the arbutus-tree nest took only one turn.

The male of a third nest had the habit of taking a brief turn on the two eggs during the early morning and a longer one occupying most of the afternoon. Yet at all three nests the female was chiefly responsible for keeping the eggs warm during the day, as well as by night. This is very different from the arrangement followed by a pair of Black-headed Trogons that I watched in the Motagua Valley, and one of the Graceful Trogons I kept under observation in Panamá. The males of these species sat continuously for seven or eight hours during the day.

THE NESTLINGS AND THEIR CARE

The period of incubation, as determined at one nest, was nineteen days. The newly hatched nestlings were blind, pink-skinned and quite naked; but the sheaths of the flight-feathers protruded very slightly, and the dark rudiments of many of the body-feathers were visible through the transparent skin. The heels, like those of nestling woodpeckers, toucans, kingfishers, motmots, jacamars and other birds which rear their young in unpadded cavities, were covered with numerous, prominent, sharp papillae, to protect them from abrasion as the little birds moved around on the woody floor of their nursery. Two of the toes pointed backward, like those of the parents.

The two eggs in the arbutus-tree nest hatched on April 1 and 2, respectively. I devoted the morning of April 4 to watching the parents take care of their naked nestlings in the rotten stub. The day was overcast and cool, and the parents brooded almost continuously. The male and the female alternated in this duty; but the latter, being always the more eager to return, occupied the nest somewhat more than her mate—174 minutes against his 135. Upon returning with a morsel of food in its bill, the bird which had been foraging summoned the mate to come forth from the nest. On these occasions, the male always called in his usual loud, mellow voice, while the more prudent female called in an undertone. The one leaving the nest always made a rather lengthy survey, with its head well beyond the entrance, before it darted out. They were apparently aware that a sudden departure from the nest in the presence of an enemy might betray its position just as surely as their approach. Once while the male, in response to the summons of his mate, was pausing half-way out of the cavity and looking around preparatory to leaving, a squirrel began to climb about among the low bushes some twenty feet in front of the nest, noisily rattling the dry leaves as it searched for food. The Aurora remained motionless for a minute or so, then very gradually and stealthily backed into the

cavity again. Here he remained until his mate, who had waited ten minutes, without moving, for his departure, became impatient and called again in an undertone. Meanwhile the squirrel had departed; and after another survey with his head stuck forth, the male darted away. Then the female entered to deliver her grub to the nestlings, which were crying to be fed. Excessive caution characterized all the actions of these birds in the vicinity of their nest; they neither approached nor left without a protracted scrutiny of their surroundings. Although the female was the more prudent of the pair, the male was by no means lacking in caution.

The nestlings were given larvae both white and green, moths, and other insects. Upon returning with food in its bill, the parent first settled down to brood, then, after an interval, rose up and bent down its head to place the morsel in one of the opened mouths stretched up in front of it. At least, this was the female's behavior; but the male acted most queerly indeed. He first appeared that morning bearing in his bill a small insect of unrecognized kind, and settled in the nest with it. He quite neglected to deliver the food, but sat holding it stupidly in his bill; and when at length the female returned at the end of an hour to call him forth, he flew away still carrying the insect! After a quarter of an hour he returned with a big gray moth, and called his mate from the nest. As he clung before the entrance to look around before climbing in, the nestlings cried hungrily; but even these repeated pleas failed to stimulate him to deliver the food. Again he held the moth until his mate returned with a white grub and called him out. This was the time when the squirrel delayed his departure; upon beginning to leave the second time he seemed suddenly to remember why he had brought the moth that he had held so long, backed up in the nest to allow the nestlings to rise in front of him, and delivered it to one of them. When he next appeared at the end of an hour, he had a large green caterpillar in his bill, which again he quite neglected to deliver, but still held when the female called him out of the nest. After five minutes he came back to cover the nestlings, still bearing a green larva which appeared to be the same he had carried away, sat holding it for ten minutes, and carried it away the second time upon his mate's return! During the course of the morning, each parent brought food five times; the female gave the nestlings everything she had brought for them, but the male only once delivered what he carried in his bill. If the female's instincts had been so imperfect, the nestlings would probably have died of starvation.

But the male Aurora, although his instincts were imperfect, was not incapable of learning. Two days later I watched again before the same nest, and found that he now delivered fairly promptly the insects he brought, and no longer held them in his bill while he brooded, nor carried them away when he left. It would be exceedingly interesting to know *how* he learned to feed the nestlings, for with him it was evidently not merely the manifestation of a perfected instinct. Whether he discovered what was to be done by watching his mate, or whether he divined from the cries and attitudes of the nestlings what they required, I could not decide. During these two days there was also an interesting change in the manner of delivering the food. Instead of entering the nest with the food in their bills, then rising up to put it into the mouths of the nestlings beneath them, both parents now usually passed in their insects while clinging in front of the nest, even when they would enter to brood the little ones immediately after feeding. The latter, still blind and naked, required frequent warming.

I tried to photograph the parents as they came to the nest with food, but they were too wary. It was of no avail to conceal the camera behind leafy boughs; I could not cover over the lens, and as long as that eye of Polyphemus remained staring at them, they would not come near their young. The female approached several times, but always remained at a very safe distance from both nest and camera, uttering her throaty notes of alarm as she raised and depressed her tail. The male appeared only once, noticed the glassy eye of the camera while pausing for his usual survey well behind the nest, and fled away immediately. He did not again come within sight of the blind, but called from a distance. On my fourth attempt at photography, I left the camera in place for three hours, at a distance of fifteen feet; but the cries of their hungry nestlings could not draw the parents within its range—longer than that I did not wish to deprive them of nourishment. Later, in Costa Rica, I succeeded in photographing Quetzals at a low nest with both the camera and the photographer perfectly exposed. The Quetzal is larger than the Mexican Trogon, and one would expect it to be more shy; but the Quetzals I studied lived in a wild, scarcely inhabitated region, while here in Guatemala the Indians had, during the course of centuries of persecution, taught the birds to be cautious.

The nestlings were a week old before their eyelids began to part and their feathers to escape from the long sheaths. Two days later they for the first time crouched down in fear at my approach, utter-

ing a quavering hiss. The older could now just manage to hold itself erect on a perch. With their short, stout bills, stubby bodies, and queer alternation of lines of fluffy feathers and areas of bare skin, they were indeed 'ugly ducklings.' But by their twelfth day they had become as pretty and attractive as they had been homely a few days past. They were most winsome little creatures—but what nestlings are not when they acquire a decent clothing of feathers and begin to look about and take an interest in their surroundings? They now preened themselves when at ease, called in a small appealing voice when hungry, and uttered a rather nasal buzzing cry when afraid. With their short, stubby form—the older measured only four inches from bill to budding tail—their short, thick bills, their taillessness coupled with the advanced development of their wing plumes, and above all their brown coloration, they strongly suggested a young partridge or grouse; only the shortness of their legs detracted from the resemblance. In a very general way they resembled the adult female in coloration, the most conspicuous differences being the very evident buffy spots of their wing-coverts (which the adults quite lack), the rings of bare yellow skin surrounding their eyes, and above all their buff-colored bellies in place of the red bellies of the parents.

It is of no little interest to contrast the rapid feathering of the young Mexican Trogons with the slowness with which the nestling Black-headed Trogons acquire their covering of plumage. The feathers of the latter remain enclosed in their protective sheaths until the birds are two weeks old, when they bristle like little porcupines. Then the sheaths are very rapidly ravelled off; and in the course of a day or two the nestlings undergo a marvellous transformation and become completely clothed with feathers. For these children of the warm lowlands, whose nursery is the interior of a termitary reeking with humid heat, this slow feathering is an advantage, for it protects the plumage from the deleterious effects of excessive moisture until it is needed. But the little Auroras, raised in a drier and more open nest in a far cooler climate, have earlier need of their covering of feathers, which begin to escape the sheaths when the nestlings are a week old. A comparison between the rate of feathering of the Blue-throated Motmot (*Aspatha gularis*) of the highlands and the Turquoise-browed Motmot (*Eumomota superciliosa*) of the lowlands shows an exactly similar acceleration in the species inhabiting the colder climate.

The bottom of the Auroras' nest became very dirty, for the parents gave not the slightest attention to its sanitation. They did not even

remove the empty shells, which practically all birds take the trouble to do, whether or not they carry away the excreta. Despite the slovenly condition of their nursery, the occupants remained as clean and unsoiled as the nestlings of any passerine bird, for after their feathers began to sprout they always stood on their toes and padded heels, and thus avoided soiling their plumage. When I approached the nest, the parents never made any feint of attack, nor any ruse to lure me away. They remained perching in the trees at a safe distance, uttering their throaty notes of alarm, each accompanied by an upward twitch of the tail through a wide arc. At intervals they dashed suddenly, as though in panic, from branch to branch, delivering an indescribable, high-pitched, rapidly repeated note as they went. I have never known any trogon to attack or make a feint of attack when I visited its nest.

DEPARTURE FROM THE NEST

On what turned out to be the young Auroras' last night in their nest, I went out with an electric torch to pay them a visit. I had not expected to find their mother in the nest, or rather in its entrance, for her head protruded from the lower end and her tail from the upper, and she appeared to be sleeping in an exceedingly uncomfortable position. The large size of her now well-feathered nestlings made it impossible for her to cover them; but her body filled the doorway and kept out the cold night air. At this altitude, nestlings of many kinds seem to require protection from the cold even after they are completely feathered and too big to be brooded comfortably. I tried to steal away without frightening the parent from the nest; but the moment I removed the blinding electric beam from her eyes she darted out into the dark woods. It was then only a little past nine o'clock and the night proved cold; but the following morning the nestlings seemed to have suffered no ill effects from being left uncovered.

That morning I again watched the nest from the blind, for I expected that the little Auroras would fly away and I wished to witness their departure. Although neither of the parents had ever paid much attention to my brown wigwam on previous occasions, and both had sat for many hours in the nest in front of it, this morning they were unusually excitable and wary, and hesitated long among the trees, clucking nervously and darting back and forth with undulating flight, before at length they gathered confidence to go to their nestlings. The male was the first to approach. Clinging upright in front of the doorway, he gave a big white moth to the

younger nestling, which accepted it with a sort of hissing sound and swallowed it whole, wings and all. The nestlings now sat so high that their heads and breasts were visible in the entrance. The older, now sixteen days of age, claimed the center of the stage, and pushed its younger nest-mates well to one side, where it was scarcely visible from the front. It was restless and devoted much attention to preening its feathers. Upon hearing the calls of the parents as they returned with food, it climbed up on the sill, and answered with a low *cup cup cup,* at the same time continuing to preen while it awaited their arrival. The male parent again clung below the doorway just long enough to deliver to the older nestling a large brown mantis, which was swallowed at once. The delivery of food, which formerly had been a somewhat protracted business, was now accomplished in an instant. There was no longer any pausing to look around after the parent flew up to cling before the nest; the food was passed inward in a trice, and the parent was gone again in less time than the survey would have required.

Soon the female parent arrived with some lanky insect, and entirely disregarding the older nestling in the doorway, pushed past it to deliver the meal to the younger one inside the nest. As though insulted by this slight to its superior strength, and determined to assert itself still further, the older nestling at once became more restless, and in a minute spread its wings and rose into the air, covering about twenty feet on this first flight, and rising about five to perch in some bushes. Here I lost sight of it; and the parents must have led it at once farther into the woods, for they were out of sight during the next three hours, and I never, so far as I know, saw this youngster again.

While the parents were busy attending the wants of their older fledgling, the younger was entirely neglected in the nest. At first it preened much and flapped its wings, but soon, becoming hungry, it began to call, uttering its soft little *cups* almost continuously, at intervals of a few seconds. After an hour or more of this, the calls changed in character and became more frequent. Meanwhile the voices of the parents sounded from such a distance that I am sure they could not hear the nestling's weak cries. Then, a few minutes before noon, the *cow cow* of the male parent became louder and stronger; and the little one attempted to imitate him. It succeeded quite well in reproducing the tempo, although its voice was still far too weak to imitate the tone.

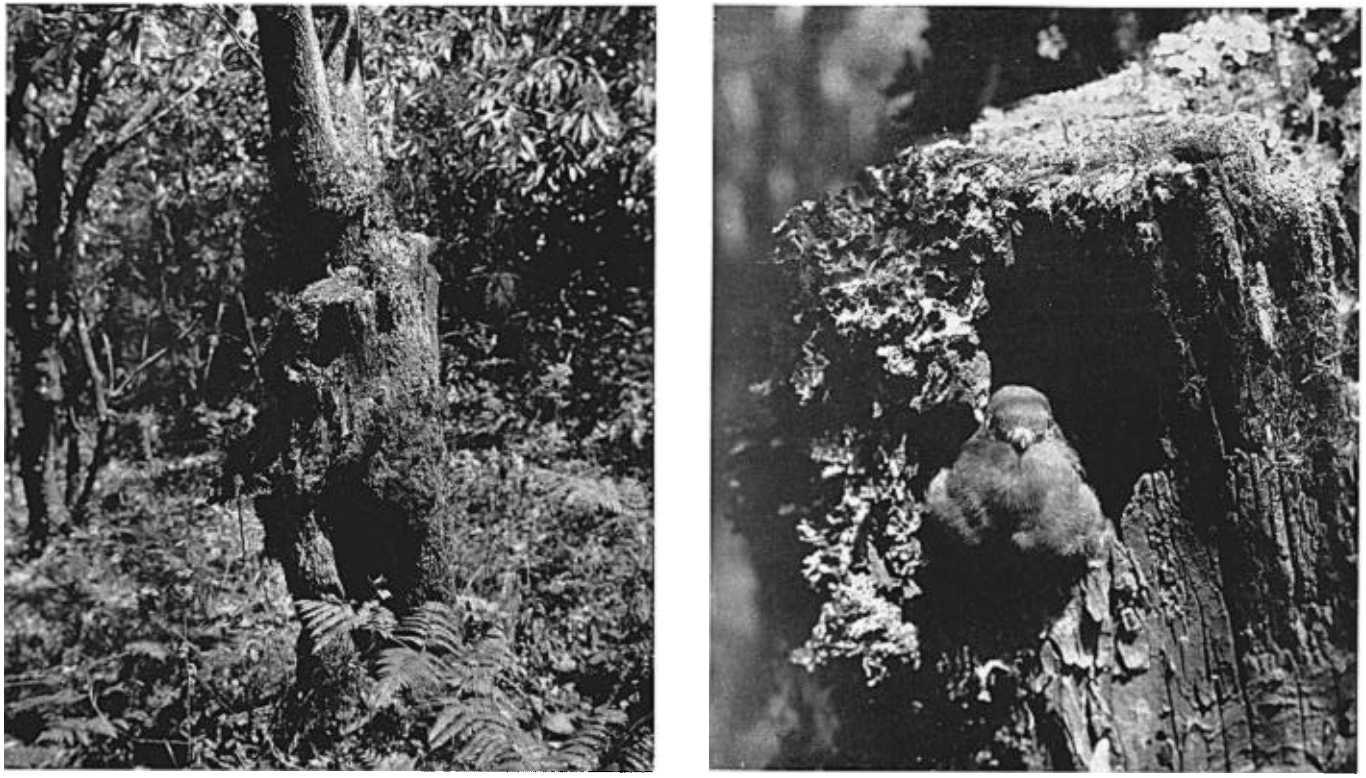
Finally, when noon had passed, the male parent returned in the

greatest excitement. For ten minutes he called continuously, swinging his tail most violently. I could imagine that he urged *"Come out, come out, come, come, come!"* and that the weak little monosyllables by which the stay-at-home at intervals answered were "No! No!" At length the male flew to the doorway and gave the nestling the fat green larva he had brought—the first morsel of food in three hours. This offering seemed to satisfy it for an interval, for it cried much less after swallowing it. I, too, was beginning to feel hungry by this time, so I stole away for some lunch.

When I reurned late in the afternoon, I found that the younger fledgling had also flown from the nest, at the age of only fifteen days. None of the family was in sight; but I waited in the blind to learn whether the youngsters would perchance return to the shelter of the nest cavity for the night, and perhaps even be brooded again. But not one of the Auroras appeared as night fell. The nest, which had been a shrine before which I passed so many silent hours in a spirit akin to worship, and had seen a miracle performed, had become only a dirty cavity in a decayed stub.

All of the Auroras did not have such good fortune with their nests as the pair whose history we have been following. On revisiting a nest in a low pine stump, in which there had been two nestlings a few days old, I found many downy gray feathers, some tipped with brown, others with vermilion, scattered about on the ground, proof that the female had meet disaster at the same time as the offspring. A week later, roaming through a different part of the woods, I came upon what had once been an Auroras' nest, only twenty inches from the ground in a rotten stump. There were remains of eggshells in the cavity, and about the base of the stump were scattered so many feathers of the female that I felt sure she did not come alive out of that encounter, whatever it was. Probably both of these female trogons, in their low nests, had fallen prey during the night to some marauding mammal. I do not believe that the birds use such low nest-sites from preference, but rather from the scarcity of higher decaying stubs, in these woods from which most of the dead trees were removed for firewood.

In early June, I witnessed a tragedy of a very different nature. For two days I had heard a young Aurora, still in the fledgling plumage and only half-grown, call incessantly in pleading tones to be fed. As it called it perched motionless in some pine or alder tree, and moved only when I came fairly close. Apparently it had lost its parents; and no other Aurora would heed its calls of hunger. On the



MEXICAN TROGON: (left) NEST-CAVITY IN A LOW STUB OF AN ARBUTUS TREE; (right) FLEDGLING ABOUT TO FLY FROM NEST.

third day, I happened to see the tragic outcome of its sad plight. It was hanging limply in the hand of an Indian boy, who assured me that he had not killed it; and since for a wonder he was without a slingshot, I believed his story. Evidently the bird had become so exhausted from hunger that it fell dead while trying to escape the boy's pursuit. I told the lad that there was nothing to eat on the poor emaciated creature, but he seemed to think otherwise, and carried it along for the pot.

The Mexican Trogons on the Sierra de Tecpán raised only a single brood in 1933. After the rains began in mid-May, the males soon became silent and rarely uttered their melodious *cow;* but a fine, clear day in the wet season might inspire them to call a few times. The young birds early began to acquire the adult plumage, the first conspicuous sign of which was the appearance of vermilion feathers on the belly, which I noticed on certain individuals as early as the beginning of June. Young birds practically full grown and molting still continued with and were fed by their parents. The young of both sexes acquired the plumage of their respective parents—in its broader features, at least—by means of this first molt. The last conspicuous signs of immaturity to persist were the buffy spots on the wing-coverts; but after August I saw no Auroras which bore even this distinguishing mark, and young birds seen on the wing looked exactly like the adults. By this time they had learned to fly against the foliage or the bark of a tree to snatch off insect or caterpillar without ever alighting, in the spectacular manner by which trogons, both highland and lowland, secure their food.

I am not sure whether the Auroras remain in pairs after their offspring are able to provide for themselves. Male and female certainly do not remain inseparable, in the manner of so many tropical birds, nor, so far as I could discover, do they sleep together after the fashion of their neighbors, the Blue-throated Motmots. During most of the year Auroras are encountered singly more often than with others of their kind. But I think it not improbable that the two birds who have shared the duties of the nest continue to occupy the same area of woodland, and maintain some loose association until the following breeding season draws them more closely together again.

COMPARISON WITH OTHER TROGONS

The life story of any single pair or species of birds may yield us pleasure and instruction. Considered in relation to the life histories of allied species, it helps us form broad generalizations, and opens the way to the wider understanding of the problems and conditions

of bird life. What we may call the 'comparative life history' of birds is a subject that has not received the attention it merits. It may supply data no less useful than the facts of anatomy in classifying birds according to their natural relationships: anatomy deals with the grosser details of structure; habits are the outward expression of the finer, sub-microscopic structure of the nervous system and endocrine glands, which jointly determine behavior. While we rely chiefly upon anatomy for the arrangement of birds in their broader taxonomic groups, in orders and families, habits are an important but too often neglected guide to the finer degrees of relationship, of genera and species.

General habits.—The trogons known to me in the field, about a dozen species, are birds of wooded country, dwelling in the forest or in clearings with scattered trees. Some, like the Graceful Trogon and the Massena Trogon, seem reluctant to leave the shelter of the unbroken forest; while others, among them the Black-headed Trogon and the Gartered Trogon, are more often met among the scattered trees of the clearings, frequently nesting in such situations. While chiefly birds of the warm lowlands, a few kinds, such as the Mexican Trogon and the Quetzal (in Costa Rica), breed at altitudes 9000 or 10,000 feet above sea level.

When at rest, the trogons perch in a very upright position, with the tail directed almost straight downward, or even slightly inclined forward beneath the perch. Their wings are short, reaching about to the ends of the tail-coverts where these are not abnormally elongated; and their flight is as a rule strikingly undulatory.

Trogons eat both insects and small fruits. Their method of catching their food, whether insect or vegetable, is characteristic. They perch quietly until they espy a morsel that tempts them—a berry, a caterpillar crawling over a leaf, or a moth quietly resting among the foliage—make a sudden, swift dart to snatch the berry from its stalk or the caterpillar from its leaf, then return to a convenient perch to swallow it and await a fresh capture. The actual seizing of the food is almost invariably done while the bird is on the wing rather than at rest; and frequently they snatch flying insects from the air, flycatcher fashion. The Quetzal, biggest of the trogons, varies its diet with such creatures as small frogs and lizards.

The conduct of trogons is always quiet and dignified. Their upright posture, their well-modulated, often subdued, voices, and gentle manners, entitle them to be considered the perfect gentlemen of the tropical bird-world, just as the boisterous, nest-robbing toucans are

its buffoons. I can not recall ever having witnessed two trogons clutching in a fight; and I have never seen them persecuting smaller birds or robbing their nests.

Social life.—The Mexican Trogon is not a social or gregarious bird, and except during the breeding season is encountered alone more often than in company with others of its kind. In this it agrees with all other kinds of trogons with which I am familiar. At the outset of the breeding season, a number of males will sometimes congregate to call in the same part of the forest; but these are rivals rather than members of a flock. In the Costa Rican highlands, one hears of flocks of Quetzals; but during the course of a year passed in a region where these magnificent birds were fairly numerous, I failed to see a flock of them. Four was the greatest number I ever saw at once. This was at the beginning of the breeding season; and the birds seemed to be disputing the same territory. I have not found satisfactory proof that trogons of any species remain in pairs during the season when they do not nest.

Nest site.—All trogons, so far as I know, nest in cavities of some sort; but the substances in which the nest chamber is excavated are of surprisingly varied character. Perhaps the most usual site is a decaying trunk or stub. In addition to the Mexican Trogon, dead wood is chosen for the nest site by the Graceful Trogon, Jalapa Trogon, Baird's Trogon, Coppery-tailed Trogon, Haitian Trogon, Quetzal, and by some of the Old World trogons. The cavities made by the Graceful and the Jalapa Trogons are shallow, with vertically elongated entrances which allow much of the sitting bird to be seen from the front, just as with the Mexican Trogon. But some half-dozen nests of the Quetzal I have seen had round doorways and were much deeper than those of the other species mentioned. The female Quetzal while sitting is completely concealed in the hollow; and so is the body of the male. But the two greatly elongated, metallic-green plumes of the male's tail-coverts, bending upward and outward, press against the upper edge of the doorway and project into the open for a distance of six or eight inches, waving gracefully in every passing breeze. The story almost universally repeated in Guatemala, to the effect that the Quetzal makes a nest cavity with two doorways, on opposite sides, which allow the male to sit on the eggs without bending and damaging his gorgeous train, is, according to my experience in Costa Rica, pure myth. The nest has a single doorway. The male's train is doubled back; and by the end of the nesting season the longest plumes are often broken off short by bending and friction on his innumerable passages in and out of the nest.

According to Hume,[1] Indian trogons of the genus *Harpactes* (*H. erythrocephalus, H. fasciatus* and *H. oreskios*) also nest in hollows in soft, decaying stumps or branches. While the cavity may be located in the side of a stump and accordingly is roofed over, at times the birds lay their eggs in a cavity in the top of a truncated rotten stump, or "in mere hollows scraped or worn away in decayed branches or stumps of trees," where (if I correctly interpret Hume's descriptions) the sitting bird must be exposed to the sky. None of the Neotropical trogons, so far as I am aware, raises its family in a position so exposed.

A large termites' nest built in a tree or bush is chosen by certain species of trogons as their nest site. The substance of these termitaries is dark brown or black and very hard; but their porous structure, which allows the birds to grasp the thin plates in their strong bills and so to break them away, greatly facilitates the labor of carving into them. The excavation made by the trogons consists of a short, upwardly inclined entrance-tube, leading into the top of a rounded or ellipsoidal chamber in the very heart of the termitary. The birds frequently—perhaps always—select an occupied termitary, and probably eat the soft-bodied white insects as they carve into their home. On several occasions, I have known the cavity made by the trogons to be sealed up by the termites after the birds had finished their nesting. The Massena, Black-headed and Citreoline Trogons choose a termitary for their nest site. Trogons are not unique among birds in selecting this odd position for their nests. The Black-breasted Puffbird (*Notharchus pectoralis*) and some other members of this family, parakeets of the genera *Brotogerys* and *Conurus,* and the Nicobar Kingfisher (*Halcyon occipitalis*) dig cavities in termitaries in which to lay their eggs.

Perhaps the most unexpected place for a trogon's nest is in the heart of a wasps' nest. Apparently the Gartered Trogon always selects this queer site, for the seven nests of this species I have seen were all in wasps' nests. The birds generally choose a lofty nest, of the kind suspended by its top from a slender branch, and tapering downward to a pointed or rounded lower extremity. The first step in taking possession is to evict the fiery builders of the nest. This the trogons accomplish by perching near the nest and darting back and forth to snatch up the insects on the wing, or else dash up to the side of the nest to pluck off the wasps crawling over it. The cool early-morning hours, before the sun has heated the air, is the pre-

[1] Nests and Eggs of Indian Birds.

ferred time for this wasp-snatching, because then the insects are least active and dangerous. The adult wasps eliminated, the birds proceed to hollow out a chamber among the brood-combs in the heart of the high, papery structure, doubtless devouring the larvae as they work. The nest chamber of the Gartered Trogon in a wasps' nest is sometimes captured by a pair of Striped Flycatchers (*Legatus leucophaius*) and used for their own brood.

Another kind of nest site which has been recorded for trogons is a hole in a bank. According to Mrs. Bailey (quoted by Bent, *op. cit.*), the Coppery-tailed Trogon may nest either in cavities in trees or holes in banks. I know of no other species of trogon which nests in the ground, nor any other so versatile in its choice of a nest site.

So far as my own observations go, trogons never take any soft lining into their nests, but deposit their eggs directly on the particles of wood, or of the hard black substance of the termitary, which happen to remain in the bottom of the cavity when they have finished carving it out. Bent records nests of the Coppery-tailed Trogon collected in Mexico "made of various materials, such as hay, straw, trash, moss, wool, down, feathers, vines, and thistledown." To one who has had long acquaintance with the tropical species of trogons, this is indeed a most surprising assortment of material to find in a trogons' nest. Possibly other hole-nesting birds, such as wrens or flycatchers (*Myiarchus*), took this material into cavities which were subsequently occupied by the trogons.

Building the nest.—I have watched Black-headed Trogons excavate their nest chamber in a termitary, Gartered Trogons dig into a wasps' nest, and Baird's Trogons carve into the side of a decaying trunk. In each case, male and female worked alternately; and the male was often the leading spirit in the undertaking. Although there are reports of trogons (e. g., Coppery-tailed Trogon, Haitian Trogon and Quetzal) using old woodpecker holes or natural cavities, I believe that more often they carve their own nest holes, whether in wood or other material. Although I have not actually watched Quetzals excavating their nest cavities, I feel certain that they must do so, for except at the lower edge of their breeding range, there is no woodpecker that makes a hole big enough to accommodate them.

Trogons work at digging their nests only when the pair are together. One bird, frequently the male, may arrive first at the nest site, and call until the mate appears, when work is begun. If one of the pair should fly off while the other has its head in the cavity, the latter will stop work as soon as it finds itself alone. The same

is true, so far as my observations go, of motmots, kingfishers, jacamars and puffbirds; but either male or female woodpecker will carve away at its nest cavity in the absence of its mate.

Incubation.—Sets of trogon's eggs vary from two to four in number. Sets of four are recorded for the Coppery-tailed Trogon and the Red-headed Trogon (*Harpactes erythrocephalus*) of India. Central American trogons, so far as I know, lay only two or three eggs. In color, the shells vary from white or café-au-lait to decidedly blue in the case of the Quetzal.

Incubation by both sexes appears to be the rule in the family. This is true, according to my own observations, of the Mexican Trogon, Quetzal, Jalapa Trogon, Massena Trogon, Graceful Trogon and Black-headed Trogon. According to Hume, both male and female of the Malabar Trogon (*H. fasciatus*) incubate. Long sessions are the rule, as with most phlegmatic birds. The female takes charge of the nest by night; but the male may warm the eggs during half or more of the day. With the Quetzal, if two nests which I watched carefully are typical, the male takes a long session of two to four hours in the morning and another in the afternoon—the two totalling half or more of the hours of daylight—while the female sits during the middle of the day. In some species, as the Black-headed and Graceful Trogons, the male may take a single long session covering the greater part of the day. But as we have seen in our study of the Mexican Trogon, the pattern of incubation may show considerable variation even among neighboring pairs of the same species, and to a certain extent from day to day in the same pair.

Records of the incubation period of trogons are not numerous, and the following are the only ones known to me:

Mexican Trogon—19 days (one nest, two eggs)
Black-headed Trogon 19 days (one egg)
Quetzal—18 to 19 days (one nest, two eggs)

Nestlings.—All the newly hatched trogons I have seen are, like the Mexican Trogons, blind and naked. It seems to be the rule for both parents to feed and brood the nestlings—indeed, this is to be expected from the fact that both incubate. I have watched the care of the young of the Black-headed, Mexican, Gartered and Jalapa Trogons, and the Quetzal; and in every case the male took a substantial share in feeding the nestlings. Hume states that both male and female of the Red-headed Trogon assist in rearing the young. In 1938, I watched a late (second brood) Quetzals' nest, at which the female parent for some unknown reason ceased to attend the young

before they took wing; and during their last week in the nest the male alone brought them food.

While the nestling Mexican Trogons received—so far as I saw—only insect food, young Quetzals are given, in addition to mature insects of many kinds, caterpillars, frogs and small lizards, such a quantity of the large, big-seeded, green fruits of certain lauraceous trees that the regurgitated seeds come to form a deep deposit in the bottom of the nest; and the nestlings, resting upon them, each day stand higher in the cavity, nearer the doorway. The Quetzals, like the Black-headed and Mexican Trogons, neglect to remove waste material from their nests.

Mexican Trogons, as we have seen, fly from the nest fully feathered at the age of sixteen or even fifteen days. Three young Black-headed Trogons quitted their nursery in a termitarium in the Motagua Valley in Guatemala at the age of sixteen or seventeen days. The bigger Quetzals linger in the nest much longer. Two raised in a low nest departed at the age of twenty-three days; but two others, hatched in a hole about fifty feet high, delayed in its shelter for at least a month.

I feel fairly certain that the Mexican Trogons on the Sierra de Tecpán raised only a single brood, at least in the exceptionally wet year 1933. Three pairs of Quetzals that I kept under observation at Vara Blanca, Costa Rica, in 1938, raised each two broods, where possible nesting both times in the same cavity. This was at an altitude of 5500 feet, in an excessively wet climate. I have no evidence that any other trogon attempts to raise a second brood if the first nesting has been successful, although this may possibly happen among some of the lowland species. Hume states that in India the Red-headed Trogons "breed only once a year."

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