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LIFE HISTORY OF THE MARBLED WOOD-QUAIL

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The Marbled Wood-Quail (*Odontophorus gujanensis*) is widely distributed through the forested regions of northern South America, but in Central America it ranges no farther north than southwestern Costa Rica, where it is represented by the Chiriquí race (*O. g. castigatus*). Birds of this species are stout, compactly built, and somewhat larger than the familiar Bob-white of North America. A formal description of its plumage is necessarily so long and intricate that it can leave no distinct picture in the reader's mind; suffice it to say here that at a distance the bird appears to be clad in fairly bright brown, but close at hand it is seen to be beautifully variegated with browns and buffs, of a bewildering variety of shades all exquisitely blended together, and flecked and vermiculated with black. The breast and abdomen are finely and irregularly barred with buff or cinnamon-brown and blackish. There is an erectile crest of long, deep brown feathers. The lores and region about the eyes are bare of feathers, displaying bright orange-red skin, more extensive and somewhat deeper in hue on the male than on the female. The male is also slightly larger than the female. In both sexes the eyes are dark, the bill blackish, and the legs and toes plumbeous.

This wood-quail inhabits the lowlands and foothills of the Pacific side of Costa Rica, south of the Gulf of Nicoya, and adjacent portions of the republic of Panamá. In the basin of El General at the head of the Térraba Valley it is fairly abundant between 2000 and 3000 feet above sea-level, and nests at least as high as 3000 feet. It is found chiefly in the dimly lighted undergrowth of the lofty rain-forest of this region, but it often wanders out into adjoining areas of tall second-growth woodland, and at times, especially while the sun is low, even into neighboring plantations. Gregarious at all seasons, these birds roam through the woodland in small coveys containing from five to eight well-grown birds—never, in my experience, more. Often they travel in single file.

When alarmed by the approach of a man, the quails prefer to escape by walking or if need be running rapidly over the ground rather than by flying. They use their wings with great reluctance; but if surprised at close quarters, as when one suddenly comes upon them at a bend in a forest trail, they rise with a rapid burst of wing-beats, ascend rarely higher than a man's head, and fly a short distance to disappear in the dense undergrowth. Carriker (1910:387) states that when thus driven to take wing, they "usually alight in the low trees and sit perfectly still for some time before flying off again." I myself have never seen them do this. Sometimes when alarmed they "freeze" on the ground. One morning in January, while I roamed through the forest near my house, a quail suddenly flew up from the ground a short distance ahead of me. Suspecting that it had left a nest, I searched through the undergrowth, but found nothing. After a few minutes, a second quail of a sudden rose into the air only a yard or so from where I stood. Apparently it had squatted motionless on the brown leaf litter, with which it blended so well that I had failed to see it until it moved. With a violent and apparently strenuous

effort it rose about two yards, then descended gradually amid the bushes. I have also seen the quails squat motionless on the ground when suddenly alarmed by a squirrel.

FLOCK BEHAVIOR

As a rule, when I have tried to stalk a covey of Marbled Wood-Quails, they have walked off through the dark underwood more rapidly than I could force my way through the tangled growth of bushes, vines and the climbing fern *Salpichlaena volubilis*. During my first year in El General, I glimpsed the quails only as dark figures which faded away through the underwood before I could see enough of them for identification. But in subsequent years, in lower parts of the valley, I found them less shy, and on a few occasions amazingly fearless of me. Then I was able to watch them for substantial periods at a range too close for the use of binoculars and to learn something of their behavior as a group.

The first of these memorable encounters took place on February 19, 1939, near the Quebrada de las Vueltas about two miles from the village of San Isidro del General, and was described in detail in my journal that same evening. Late in the afternoon, while roaming through a grove of bananas, plantains and coffee bushes shaded by *Inga* trees, I met a covey of five wood-quails beneath a close-set mat of bananas. They went off unhurriedly, then paused at no great distance to forage among the dry dead leaves that littered the ground. They were probably a family group; but all were well grown and not to be distinguished by their plumage; and the slight differences in size between them, to be noticed only when they were close together, might have indicated differences of sex rather than of age.

The quails scratched away the fallen litter with long, deliberate strokes of their plumbeous feet, using either the right or the left, but only one at a time; then with their short black bills they picked up whatever edible particles the removal of the leaves revealed. They were not shy, for I stood watching them at a distance of only four or five yards, and very inadequately concealed by the intervening vegetation. From time to time one would look at me with large, dark eyes set in areas of bright orange-red skin which gave an expression of alertness, and raise into a crest the long, dark brown feathers of the crown; but after a few moments of this inquiring attitude it quietly resumed its foraging.

When, after many minutes, the flock moved off through the grove to forage in another spot, I quietly followed; and so for the space of an hour or more I watched them continuously at no great distance. Once, in an open space, I approached to within about three yards of where they fed, without alarming them. Usually the five fed in a compact group, but at times one or two would wander off a few yards from the rest. They appeared to live in the most perfect amity; no objection was raised when one approached to pick up morsels in a space which another had cleared, standing close beside the first or even in contact with it, and plucking the food almost from beneath its body. When one quail found something too big to swallow at a gulp, such as a small dry banana, it did not scurry off with its prize to escape the pecks of greedy neighbors, in the manner of domestic chickens, but ate in peace where the food happened to lie, or amicably allowed its companions to share it. If it did pick up and carry a large piece of food, it was to follow its friends as they moved forward to new ground. As they hunted, the quails constantly murmured low, soft, liquid sounds.

The birds foraged for a good while close about the remains of fallen bunches of bananas, too small and meager to have been worth the owner's time to carry them home. Doubtless they found a variety of insects which had been attracted by the decaying vegetable matter, but they also ate eagerly the remnants of the pulp of green bananas

which had dried hard and white during many rainless weeks, pecking it industriously out of the black and shrivelled skins.

While I watched them pecking at the remnants of a raceme of bananas long since fallen, a squirrel in the crown of a neighboring banana plant noticed me and shouted harshly in alarm. Instantly four of the quails squatted down on the dry leaves in plain sight of me, while the fifth ran off behind the mat of bananas. I stood without moving, and soon the birds rose up again and resumed their eating. The squirrel, becoming bolder, descended to the ground and approached the blackened remains of the raceme, for he also was fond of the hard white remnants of unripe banana pulp. The quails scarcely feared him. When the mammal had approached within a foot of the nearest, it directed a peck toward him and he drew back slightly. When he again advanced, the nearest struck out with a wing in his direction and retreated a few inches; the squirrel stopped short and the birds continued to eat. After they had moved on, the squirrel nibbled at what they had left.

The birds moved over the ground by little runs with the neck stretched forward. I followed them until they circled back to the edge of the forest in the failing light. They foraged for a while along the forest margin, then drew farther inward where the tangled bushes and vines made it difficult for me to follow. I had hoped to keep them in view as the dusk deepened on the chance that they would deliver the full, mellow note, long-continued with an undulatory movement, which I had so often heard coming out of the dark undergrowth of the forest as night drew down, but had never traced to its source.

A second entry in my journal, written on March 5, 1943, when I was living on my farm beside the Río Peña Blanca in the basin of El General, gives a somewhat different picture of the behavior of the wood-quails. In the morning I came upon a covey of six or seven in the tall second-growth woods adjoining the riverside pasture. They were all well grown, if not mature, and were scratching among the fallen dead leaves at the very edge of the grove, now with one foot and now with the other, all staying close together in friendly fashion. As they searched for food they uttered soft, melodious, contented notes. After a while one jumped upon a log, and soon another hopped up beside him. The second then bent down and billed the legs and the feathers of the abdomen of the first. After it had repeated this a few times, the first hopped upon a slender inclined trunk, then walked up to a point where this was horizontal, about a yard above the log. The other promptly joined him here; and they perched close side by side, alternately preening their own and the other's feathers. Each billed the plumage of its companion's head, and of the abdomen between the legs, and sometimes seemed to run its bill over the legs as well. Repeatedly each bent forward to perform this service for its companion. After a while a third joined the two on the stem and proceeded to preen as they did. The one in the center, in addition to its own, billed the feathers of both its neighbors, and received this attention from each in turn. One of the end birds sometimes reached past the middle one to bill the legs of that on the other end. Presently a fourth joined the preening party on the slender trunk, while two more on the ground helped each other attend their plumage. The head and neck, the abdomen between the legs, and the legs were the parts where the quails chiefly billed their neighbors. Although I have seen birds of numerous kinds bill the feathers of their mate's head and neck—I watched a Swainson Toucan do this the other evening—I cannot recall having ever before seen a bird preen another's under parts. Apparently these stout quails find it more difficult than most birds to reach the lower regions of their own bodies. Also, being terrestrial, they must have been greatly annoyed by the red-bugs or chiggers which during the preceding week of somewhat drier weather had become unpleasantly abundant in the forest. Probably the abdominal preening was the result of this irritation.

These quails were no shier than those of the covey I had followed four years earlier and allowed me to watch them close at hand, scarcely concealed by the foliage. When they had completed their toilet, they walked slowly away, scratching for food as they went. I never saw one peck at another as domestic chickens do.

Recently there have been published numerous observations on the "peck-order" of domestic chickens and other birds; and the question of dominance among birds, both social and asocial, has received much attention from ornithologists and students of animal psychology. The domestic fowl with which studies of this character are so often made are birds whose natural traits have been greatly modified by domestication; the strains commonly bred in the Western Hemisphere are, for example, unable to survive without human care, even in regions where conditions are more or less similar to those of their ancestral home in the Old World tropics; and one cannot help but feel that through artificial selection many of their original characters have been lost. The genus *Odontophorus* is now classified in the family Phasianidae, which includes also *Gallus*; and since it is not often that one can follow closely the movements of the wild members of this family, I was particularly interested to see whether the wood-quails would exhibit any behavior comparable to the "peck-order" of their domestic relatives; but I saw nothing of the kind.

In other Central American birds, too, I have found slight indications of the "dominance" of one individual by another, and none at all among those most highly social in their habits, among which are Groove-billed Anis, Banded Cactus Wrens, White-tipped Brown Jays and Black-eared Bush-tits. Recently Schneirla (1946:396) has insisted "that dominance theory is an inadequate basis for the study of vertebrate social behavior." Because "dominance" is a manifestation of aggression on one side and withdrawal on the other, it is disruptive and "more or less counteractive to factors which hold the group together." He believes that dominance is most often manifested when "positive unifying factors are relatively weak but are somewhat artificially reinforced by special conditions, such as food scarcity or sexual receptivity (which serve to heighten reactivity to specific stimuli from other individuals), or by physical confinement of the group." The majority of studies of dominance among birds have been made either with captive individuals or at feeding-shelves, where the presence of abundant rich food causes an abnormal concentration of the birds, and where also they may often be under tension because they are more accustomed to alight upon a bough than upon a board.

As a more promising basis for the study of social integration, Schneirla suggests the extension to the vertebrates of William Morton Wheeler's concept of "trophallaxis," originally applied to social insects, where it signifies the reciprocal exchange of food or of equivalent tactual and chemical stimulation among the members of the colony. Among birds it is possible to recognize a number of relations which exemplify trophallaxis in its more extended sense. Some of these are:

1. Mutual assistance in finding food.
2. Reciprocal preening. In the most highly social birds, individuals other than mates may preen each other; with less social species, mutual preening appears to be limited to members of the mated pair; while the majority of birds, I believe, preen only themselves. (References to preening are scattered incidentally through a vast amount of literature, and no one, so far as I know, has gathered them together; this effort might lead to interesting conclusions.)
3. Roosting together. Among the most social birds, a number may build and sleep in a single nest for mutual warmth; at a lower degree of sociability, the mated pair may sleep together, or the mother with her fledged young; the least social birds sleep singly, not in contact with each other, although they may huddle together under stress of se-

verely cold weather. The whole series is exemplified by such families as woodpeckers and wrens (Skutch, 1940 and 1943).

4. Co-operation in the care of the young. Numerous examples of this have been recorded; some are given by Nice (1943:242-243) and Skutch (1935).

5. Companionship. Among highly social animals, this is seemingly sought for its own sake. The animal feels distressed when alone, and if it cannot find companions of its own kind, may form the most incongruous friendships. Instances of this will be familiar to everyone from personal experience or from reading; some unusual ones are given by Dobie (1945:9-12).

Among the Marbled Wood-Quails, the bonds between the members of a covey are strengthened by mutual assistance in finding food, by reciprocal preening, and apparently also by need of companionship. Unfortunately, we know nothing about their way of sleeping; possibly they sleep on the ground in a compact group, as Bob-whites do. Observations which will be given later indicate that the whole covey takes an interest in the young.

VOICE

I have never had the good fortune actually to watch the quails while they sang, but from a good deal of indirect evidence I believe that I am correct in attributing to them a uniquely beautiful call which I have heard countless times amid the forest of El General, sometimes issuing from the underwood where I had seen these birds disappear; but always they have stopped before I could come in sight of them. The song is an amazingly rapid, continuous flow of full, mellow, liquid notes, rhythmically rising and falling in pitch, and sounding, as nearly as I can paraphrase it, like *burst the bubble burst the bubble burst the bubble . . .*, repeated many times, until one wonders how any living creature can maintain so rapid a tempo for so long a period without being forced to pause from lack of breath. Although the song may be heard at any hour of the day, most commonly it rings forth in the evening twilight, after most other bird voices have been hushed for the night. Sometimes I have heard it break out in the dead of a moonlit night, and more rarely during a dark and moonless night. It is one of the forest sounds of the dry season, which in this region covers the first quarter of the year, and is far less often heard during the months when rains are heavy. Under any circumstances the wood-quail's song would be an arresting performance; but the hour at which it is heard, the virtual impossibility of ever glimpsing the performers amid the dense underwood of the darkening forest, the feelings of urgency and excitement which so rapid an utterance inevitably evokes, all surround it with an air of mystery and unreality which enhance its strange beauty.

Chapman (1929:275) paraphrases the song of the related Colombian Marbled Wood-Quail (*O. marmoratus*), as he heard it on Barro Colorado Island, as *corcorovado, corcorovado, corcorovado*; and sometimes I can imagine that the quails in El General are saying the same thing, although more often the four-syllable *burst the bubble* seems to fit their song more closely. In an aviary he watched two wood-quails, presumably male and female, which faced each other at a distance of a foot or two and sang a duet in perfect unison. "As one called *Corcoro* the other added *Vado*. The syllables were uttered rapidly, the timing was perfect, and the performance clearly revealed the method by which the song of this species is produced." Doubtless the wood-quails of the Chiriquí race perform in the same antiphonal fashion; but as with some of the wrens, the articulation of the two parts is so perfect, that unless the hearer stands between the performers, he would never suspect that the song came alternately from two throats.

The Marbled Wood-Quails have many utterances in addition to their song. Sturgis (1928:30) mentions the "many lovely, sweet and liquid whistling notes" of a pair of

the Colombian race which she kept in captivity for three weeks. I have already mentioned the low, soft, liquid sounds, suggestive of contentment, which were constantly murmured by the coveys that I followed closely. A female which I watched incubate would walk toward her nest, and sometimes away from it, uttering low, musical, liquid, undulatory notes, *witty witty witty witty . . .*, long-continued and at intervals punctuated by a low, somewhat whining sound. Her mate, when he came to call her from the nest or escorted her back to it, delivered a long-drawn *caaa caaa caaa* (the *a* as in *draw*), which seemed to come from some distant source even when its author was close by. At times the female replied from the nest with a whispered version of the same note. Under stress of greater excitement—as on the morning the chicks left the nest—the male quail interrupted his usual *caaa's* to deliver a low, deep *cahoo*. Another frequent utterance of this pair was a liquid *quit*.

NEST AND EGGS

On the afternoon of January 12, 1937, while I dwelt in the straggling settlement of Rivas on the northern side of the basin of El General, Everardo, the little boy who brought me eggs for the table, announced that he had found eggs of another sort—those of a wild bird, for which I paid a higher price, provided that they were shown to me where they had been laid, without being touched. He said that they belonged to some very rare bird whose name he did not know, which was not surprising, since the wood-quail, like most other species of birds in El General, has no local name. Insisting that I go at once to see the nest, he led me along the path which wound steeply upward through the forest to the *campo santo* on the level summit of the eastern ridge, then across the burying ground into the woods on the farther side. Here the Indians had long ago buried their dead; and the ground between the trees was everywhere broken by deep pits dug by those of the present inhabitants of the district who hoped to find some of the golden ornaments which the aborigines at times placed in the graves of their deceased. To add to the confusion and difficulty of walking through this tract of forest, a number of the trees had been recently felled for lumber, and their trunks, lopped-off branches, and other smaller trees borne down by the great ones in their descent, littered the ground and greatly impeded our movements. In a section where the canopy of trees was thin and the undergrowth correspondingly dense, we reached the nest. Although my guide pointed it out to me from a distance of two or three yards, it was so inconspicuous and well concealed that he was obliged almost to touch it before I could distinguish it. He had discovered it by frightening up the birds as he worked his way through the undergrowth, and he said that two had fled from the nest, or its immediate vicinity.

The nest was in a depression in the ground at the base of a mound of earth raised up by the roots of an uprooted tree, close beside the prostrate trunk. The hollow was completely roofed over with dead leaves, supported by small sticks intermixed with them, forming a spacious, well-sheltered nest chamber with a round entrance on the side that faced outward from the mound. A slight litter of fragments of dead leaves, bits of fine sticks and other particles of vegetation covered the bottom of the depression; and upon this scant carpet rested two white eggs, considerably below the level of the ground in front of the doorway. The leaves which covered over the nest blended with those scattered about over the ground and made it difficult to detect the structure. The foliage of some low bushes growing in front screened the doorway and added to the security of the cleverly concealed nest. The altitude of this point was about 3000 feet above sea-level.

The white surfaces of the eggs bore dark strains from the dead leaves upon which they rested, and these seemed to indicate that they were already several days old. They were cold when I first saw them; and when, on visits during the two succeeding days, I likewise found them cold and deserted, I concluded that the nest had been definitely

abandoned, probably because the owners, whatever kind of bird they were, had been frightened away by the noise of sawing a hundred feet distant.

But a week later Everardo sent word that there were now four eggs in the nest; and when I visited it on the morning of the next day, January 20, I found the four there, but they were again cold. The two more recently laid could be distinguished from the first two by their unstained, immaculate whiteness, suggesting that the four eggs which formed the set had not been laid at uniform intervals. All four were of distinctly ovoid form, rather sharply pointed at the narrower end and without much gloss. They measured 38.9 by 27.8, 38.5 by 27.8, 40.5 by 27.4 and 38.5 by 27.4 millimeters.

In spite of much searching through the forests of El General during the next decade, I have found only one other nest of the wood-quail. This second nest was discovered on my farm on April 16, 1946. It was situated at the foot of a gentle slope, beside a little-used roadway, in tall second-growth woodland but not far from the primary forest which the lighter woods adjoined. From the outside the structure appeared to be a low mound of large dead leaves and coarse sticks, with an admixture of small green grass plants pulled up by the roots. It was difficult to distinguish from the surrounding litter of fallen dead leaves, with which it blended. In the side facing down the slope toward the roadway was a round entrance, leading into the deep chamber lined with dead leaves, and covered by the thick roof of sticks, leaves and green grasses. From front to back this chamber measured 10 inches, from side to side 5 inches, from floor to ceiling 5 inches, while the doorway was 4 inches in diameter.

The nest was empty when found. During the next week it remained without an egg, and I never saw the owners in the vicinity. At about two o'clock on the afternoon of April 23, I for the first time found the quails at the nest. Walking rapidly along the roadway, I surprised one standing ahead of me directly in front of the nest. For perhaps a minute, it remained quite motionless, in statuesque attitude, less than a pace from my feet. Then it walked deliberately off into the woods, voicing low, soft notes. Pretending not to see the nest, I continued down the roadway, then, after the quail had vanished, returned to look inside. As I stooped to the low doorway, a second quail burst out and walked rapidly off, uttering notes louder than those of the first. There was a single egg in the nest. Two days later, on April 25, the second egg was laid. The following afternoon the eggs had vanished, shells and all, probably taken by a snake.

INCUBATION

All that I know about incubation was learned at the first nest, found in 1937. It will be recalled that I first saw the full complement of eggs in this nest on January 20. On the following day I visited the nest at ten o'clock in the morning. For the first time I found it occupied by a bird and was able to confirm what I had from the first suspected, that it belonged to a wood-quail. The quail sat perfectly motionless while I approached and looked in at it, with my head only about a yard from the doorway. When I had seen all of its plumage that it was possible to discern in the covered nest, I stole away without molesting it.

On subsequent visits, I found the quail as brave and faithful to its nest as when I first met it there; and always I could look in at it with my head only two or three feet from the doorway, without causing it to move. If I visited the nest much before ten o'clock in the morning, I always found the bird absent and the eggs cold; but after ten o'clock I could depend upon finding the eggs covered. I noticed that the hollow in the ground which contained the eggs was of such depth that the eyes of the sitting bird came just about to the level of the surface in front of the doorway.

On January 23, at 10:20 a.m., I found the quail in the nest and decided to attempt to place upon its plumage a mark which would serve to distinguish it from the mate,

since the male and female of these wood-quails are difficult to distinguish by their natural coloration. I wrapped a small tuft of cotton about the end of a slender stick a yard or so in length and soaked the cotton in white enamel. The quail sat perfectly immobile while I touched her with the paint-saturated cotton and rubbed it around to make a conspicuous white mark upon the finely pencilled feathers of the breast. Since upon subsequent visits I saw only this marked bird in the nest, I concluded that this was the female.

On the following morning, at 9:45, I arrived with my brown wigwam blind and found the marked quail in the nest. She sat perfectly still, watching me fixedly, while I put up the wigwam only eight feet away from her. She did not even move when I cut or pushed aside some of the vegetation immediately in front of her, which was obstructing the view; nor when, with the end of a slender stick, I raked away a dead leaf which was almost touching her breast and concealing the white mark.

Watching at close range the behavior of a bird so shy and elusive as this wood-quail was one of the memorable experiences of many years of bird-watching. I devoted a total of about 26 hours to observation from the blind, before the eggs hatched, and believe that I can best convey to the reader the interest of these vigils, and what they taught me about the life of the wood-quail, by repeating the story as nearly as possible in the form in which it was recorded in my journal each day, while still fresh in mind.

January 25, 12:50 p.m.—I arrive and find the marked bird in the nest. The lower half of the doorway is filled with curled dead leaves loosely placed. They screen the foreparts of the bird, making it very difficult to see aught but her head, and that but dimly. These leaves seem to have been placed here by the bird herself since yesterday and add to her concealment. Looking into the nest from directly in front, at a distance of three yards, I now, in the bright middle of the day, see only a black, semicircular opening among dead brown leaves. Of the bird herself, I can with difficulty discern only the shining ridge of her black bill and the red skin of the lores. These points fit into no pattern, and are so indistinct that I should probably overlook them if I had not foreknowledge of the presence of the quail.

2:10.—A hard shower descends, but the rain soon slackens.

Now that it has become darker, the quail in the nest is quite invisible to me except when she turns her head sideways. Then I can see the broad zone of bright red skin which surrounds her shining eye.

The rain soon stops, but the afternoon remains cloudy.

5:50.—In the gathering dusk, I leave the marked bird invisible in her nest.

January 26, 6 a.m.—Returning to the nest as the forest begins to become light, I find that the quail has gone from the nest, which has been somewhat torn and disarranged during the night. In particular, the forepart of the roof has been torn away. The eggs, although cold, have not been injured. A few small feathers have been scattered about the entrance. It looks as though the quail has been attacked during the night; but the absence of blood, and the fewness of the feathers, give me hope that she escaped without serious injury.

I wait for about an hour in the blind, but since the bird does not return, I leave.

2:00 p.m.—The marked bird has returned to the nest. She sits far more exposed than she did yesterday.

January 27, 5:50 a.m.—I arrive at the nest in the dim early-morning light. In the beam of the electric torch, I find the quail with her head turned back among her feathers, asleep.

6:02.—She awakens, and I see the red skin about her eyes in the dimly lighted nest.

6:07.—While I am looking elsewhere, I hear a rustling of leaves in front of the blind, then a whirl of wings. The quail has suddenly departed the nest, without my seeing her go.

The day brightens, and the sun slowly rises into a fair blue sky. Some Swainson Toucans sing among the branches above my head. The male Salvin's Manakins call and make explosive *snaps* with their wings in the undergrowth to my right, where they have their courts—little circles of bare ground amid the close-set saplings. The Wood Wrens repeat many times their clear whistled call. A pair of Orange-billed Sparrows move around me in the tangled undergrowth. A Gray-headed Tanager perches in a bush just outside the right window and repeats a whining note. A Sulphur-rumped Myiobius works at her nest, just begun at the tip of a slender, leafless, hanging twig twelve feet above the ground, where I can watch her through a side window of the wigwam.

9:10.—I hear a low, musical, liquid, undulatory calling, *witty witty witty witty . . .*, long-continued and at intervals punctuated by a low, somewhat whining note, and soon notice the quail approaching through the dense undergrowth to my right, walking unhurriedly over the dead leaves. She enters the narrow clear space in front of the blind, and as she walks steadily away from me toward the nest I have my first good view of her beautifully variegated upper plumage, colored with browns and buffs in a multitude of shades wonderfully blended. She appears larger than one would judge she could possibly be from watching her as she sits in the nest; and the bare skin around her eyes, which seemed red as I watched her in the nest, now, in the full light of the open, has a distinct orange hue. She continues without pause to the nest, stoops as she enters the low doorway, turns around and at once settles on the eggs, which have become quite cold during her long absence of three hours and as many minutes. As she snuggles down facing outward, I notice the conspicuous white spot which four days ago I placed upon her finely pencilled breast.

After she has become adjusted to her nest, I for the first time notice her mate, who moves around quietly, about twelve or fifteen feet distant in the dense undergrowth. He accompanied her only this far as she returned to her eggs, and now, without coming nearer the nest, he silently vanishes. This is the first time that I have seen the male, although Everardo told me that the pair were together at the nest when he found it. But now the male quail never comes near the nest.

12:30 p.m.—The marked quail has sat quietly on the eggs through the remainder of the morning. Without leaving her eggs she watches me take down the blind. She sits steadfastly while I place more dead leaves upon the roof above her, and arrange others in front of her, to screen her as well as I found her two days ago, before the nest suffered from the nocturnal attack. Once, when my hand comes very close to her, she gives a sudden start, but checks herself before she has risen from the eggs. I go, leaving her in the nest.

February 7, 5:45 a.m.—I arrive while the light is still dim beneath the trees and enter the blind, which was set up again during the quail's recess yesterday morning. I find the marked bird in the nest.

At about six o'clock I hear an unfamiliar, mysterious bird call, which I guess to be the voice of some big bird calling from afar, a long-drawn *caaa caaa caaa caaa*. After a while its source apparently moves around me from right to left.

6:15.—The quail steps from the nest, walks several feet straight toward me, then with a sudden whirr of wings rises steeply into the air and flies over the wigwam.

A minute later I am attracted by a rustling of the fallen leaves to something which moves over the forest floor to my left. Two quails, my bird and her mate, one following the other, walk past the wigwam at a distance of only a few feet, and pass beneath a fallen trunk which does not rest evenly on the ground, and which I can touch from where I sit. A sound uttered by the leading quail betrays him as the author of the strange calls which I have been hearing. His long-drawn *caaa* sounds far away even when he is less than three yards distant. The birds also utter a liquid *quit*.

6:20.—The first horizontal rays of the rising sun filter through the forest on this steep, narrow ridge.

7:55.—I hear a low *caaa caaa* (much more subdued than at daybreak) as the male and female quails approach together, walking through the undergrowth to my right. Then I hear a few liquid *quits*. The male stops short about five yards from the nest, while the marked female advances, walks into the clear space in front of the blind, then turns sharply to her right and goes to the nest. She utters the rapid *witty witty witty . . .* as she advances. She stoops to enter, turns around, and settles down to incubate. Her mate silently vanishes.

9:15.—As I leave the blind, I approach to take a close look at the marked bird in the nest, and find many small brown ants crawling over her head. She seems not to mind, and does nothing to relieve herself beyond blinking her eyes when they walk over her eyelids.

February 8, 5:48 a.m.—I arrive at the quail's nest. The doorway of the nest is so obstructed by dead leaves that only the head of the quail, narrowly framed in an irregular aperture, is visible in the beam of my flashlight, which does not appear to disturb the bird.

6:10.—I hear the subdued *caaaing* of the male in the distance. The marked female arises and steps from the nest. As she does so she picks up with her bill some of the dead leaves which litter the ground in front of her, and with an upward toss of her head throws them over her back so that they fall upon the roof of the nest behind her. When she has thrown back a number of leaves, instead of walking a few feet from the nest and then taking wing, as she did on the two previous mornings that I watched, she turns to her right and walks slowly around the mound of earth at the base of which the nest is situated. When out of my sight she begins to answer her mate, who has continued to call, in similar but lower tones. Soon I hear low liquid notes, which I interpret as the quails' greeting to each other as they meet amid the undergrowth. Then I neither hear nor see them longer.

I examine the eggs and can detect no indications that they are about to hatch.

9:04.—I hear the low *caaa caaa* repeated over and over in a very subdued voice. In a few moments I glimpse the female among the bushes ahead of me, to the right of the nest. As she approaches slowly,

probably because her way is obstructed by bushes and litter (I can not see her now), she continues her liquid *witty witty* . . . , as always when she returns to her nest. The male continues to voice the low *caaa* in the bushes beyond the nest until the female has settled down upon her eggs and ceased to murmur; then I hear him no more. He did not once come within my very limited range of vision of objects on the floor of the forest.

When the female has composed herself upon her eggs, facing outward as always, she is almost completely screened in front by the dead leaves which she threw with apparent carelessness over the roof of the nest.

9:15.—I leave the marked quail in the nest.

February 9.—This morning, when I visited the wood-quail's nest a few minutes before nine o'clock, I found that she had already returned from her recess and was incubating, with her foreparts well screened by the loose leaves in the entrance. I decided that in spite of her presence in the nest it was important to see the eggs, to learn whether they are about to hatch. I advanced very close and in a tentative way touched a dead leaf within two inches of her head. After this tentative advance, I boldly extended my fingers to touch her head, about the only part of her body which her well-closed nest left free to be touched. When I had almost made contact, she dashed forward with a terrific burst of wing-beats which I was afraid might lift the roof off the nest. But about two yards away she came to earth and began to walk deliberately off, with the long, dark feathers of her crest raised up, and uttering the same liquid notes which she voices as she approaches her nest after a recess. Thus she vanished amid the undergrowth.

Her nest did not suffer damage from her rapid departure, beyond the displacement of a few loose leaves which I readily replaced. The shells of her four eggs showed not a chip; and holding them to my ear one by one, I listened in vain for the tapping of the little birds trying to escape.

February 12.—Yesterday morning, when I visited the wood-quail's nest at 7:55, I found that she had already returned from her recess. Her breast was so well screened by the dead leaves which lay in front of it that I could not see the white paint mark. To reveal this and make certain of her identity, I began to push the leaves aside with a short, slender stick. While I was so engaged, she suddenly flew from the nest, but alighted a short distance off, voiced her soft, liquid *witty witty*, and walked out of sight among the bushes. Then I examined the eggs and found them chipped, all in the same degree. The little quails had fractured the shell in just one spot, and pushed the fragmented portion slightly outward, but had not yet actually broken through. Holding the eggs to my ears, I could hear the tapping of the occupants, and their occasional weak peeps. Then I returned them to the nest, set the blind in its former position, and went away.

I returned to the blind at 2:15 p.m. and sat watching until 5:30. All this while the quail remained quietly on her eggs, well screened by the loose dead leaves in front of her. Her mate did not come within sight or hearing.

At dawn this morning I resumed my watch at 5:50 a.m. The quail is so well screened by loose dead leaves that very little of her is visible in the nest, even with the electric torch.

6:09.—Now I first hear, off to my right, the subdued *caaa caaa caaa* of the male. He usually delivers this note three times, then pauses, then repeats it three times more; but occasionally he groups four calls together. He continues to call for several minutes while the female remains screened behind the leaves. Then she arises and pushes up the leaves in front of her as she moves forward. When half-way out she pauses, picks up one by one the leaves which have been screening her (some of which I placed there yesterday to conceal her the better from possible enemies) and tosses them backward on to the roof of the nest. She also throws back a few which she picks from the ground farther ahead. Then she walks slowly forward, and when several feet from the nest begins to voice her usual *witty witty*. She turns to her right, and among the undergrowth begins to call *caaa*, four times over, each note slightly higher than the last. The male appears from the undergrowth on my right, passes behind the blind scarcely a yard away, and walks toward her on my left. The area of bare red skin around his eyes is more extensive, and possibly brighter, than on his mate. He is followed by a third quail, who is more cautious and passes behind the blind at a considerably greater distance. The male joins his mate, and the third quail follows. They utter pleasant, murmurous, liquid notes as they go off together.

Going now to the nest, I find that all four eggs have been fractured over an area far more extensive than yesterday, but none has been pierced. The chicks within hammer vigorously and peep much.

8:32.—The female approaches the nest. As she comes within my range of vision in a clear space among the bushes, she picks up something from the ground and eats it, and afterwards wipes her bill several times from side to side upon the fallen leaves. Then she walks to the nest, voicing first the liquid *witty*, then the low *caaa* in rising sequence, as before. This is the first time I have heard her deliver the *caaa* as she returned to the nest. As she settles on the eggs, a second quail, who has followed her, passes behind the mound of earth at the base of which the nest is situated; while I hear the low calls of a third, probably her mate, farther off to the left. Then they cease, and the female is left alone

with her hatching eggs. Since she has removed the leaves which screened her, she is much more exposed as she sits.

To summarize what I learned about the rhythm of incubation, I found only the marked female on the nest, both during my longer vigils and on a number of brief visits. She sat continuously except for one long recess each morning. On four mornings, she left the nest at times ranging from 6:07 to 6:15 a.m. Her absences varied from 1 hour, 40 minutes (6:15 to 7:55) on February 7, to 3 hours, 3 minutes (6:07 to 9:10) on January 27. On four mornings she returned at 9:10, 7:55, 9:04 and 8:32. She generally left her nest by walking; after proceeding a few feet over the ground she might fly (possibly because she was confronted by the blind which was still unfamiliar to her), or she might continue to walk until out of sight of the blind (this was her usual way during my later vigils). As she walked from the nest she might pick fallen dead leaves from the ground and throw them back over her body, so that some fell upon the roof of the nest and others before the doorway. This usually added materially to the already good concealment of the nest, but sometimes had the opposite effect, for she threw farther back the leaves which had been screening the doorway. The male would come to call the female from the nest at about sunrise or a little before, and escort her on her return; but he always stopped short several yards away. Toward the end of the period of incubation, I noticed that the male on his visits to the vicinity of the nest was accompanied by a third wood-quail, whose relationship to himself and his mate was unknown. During much of the period of incubation, the business of chopping logs and ripping them into boards at a nearby scaffolding was continued; but the noise appeared not to upset the incubating quail.

The female wood-quail kept her eggs covered for from 75 to 86 per cent of the approximately twelve hours of daylight. This degree of assiduity in incubation is approached or even exceeded by some of the small birds whose separate sessions, rarely as long as an hour, alternate with frequent short recesses.

HATCHING AND DEPARTURE OF THE CHICKS

The long-watched-for event took place on February 13; on this morning I saw the wood-quail lead her chicks from the nest. When I arrived at ten minutes before six, while the light was still very dim beneath the trees, I found her sitting quietly, but with her head and foreparts far more exposed than yesterday morning, before she had removed the dead leaves which screened her, I entered the blind and quietly waited.

At five minutes past six I began to hear the low, subdued *caaa caaa caaa* of the male quail, who moved about somewhere off amid the undergrowth, where I could not see him. Since his mate in the nest neither moved nor answered, he continued his discreet calling for many minutes. Although I could tell by the voice and the sound of rustling leaves that he moved about beneath the bushes, he did not once reveal himself near the nest. While he called, and I strained my ears to detect an answering note, a Boat-billed Flycatcher in one of the trees above me persisted in voicing its long-drawn, disagreeable whining *churr*, which, to one with auditory faculties alert to catch other sounds, was most annoying.

After twenty minutes, the male quail's calls became less frequent; but he continued to move about in the undergrowth beyond my sight, and to call from time to time. At half past six the first level rays of the rising sun passed between the tree trunks and cast bright circles of light here and there upon the foliage in front of me. A Gray Thrush overhead proclaimed himself in triumphant song. The male quail began to call more frequently again. Soon he introduced into his calling a new note, that I had not heard before, a low, deep, *cahoo cahoo* which punctuated the more numerous *caaa*s. The fe-

male, who had remained quietly in the dark recess among the dead leaves, altogether invisible to me, now began to move slightly, and at times held her head in a position which revealed to me the bright orange-red skin around her eyes.

At forty minutes past six, after the male had been calling, and waiting patiently in concealment for a reply for a full thirty-five minutes, his mate at last gave him a sign of acknowledgement. She whispered a *caaa*, then murmured softly in a liquid voice. Her mate now became very much excited, and I could tell by the rustling of the dead fallen leaves that he moved more rapidly among the undergrowth. Then, for the first time, he revealed himself, and passed quickly behind the mound of earth, closely followed by the second quail, who accompanied him yesterday.

Now the female quail, with more low murmuring, rose and pushed half-way out of the nest. The chicks, which had escaped from the shell since her return to resume incubation yesterday morning, needed no urging to bring them from the nest. One pushed out beneath her while she paused in the doorway. She began to pick up dead leaves and even sticks from the ground in front of her and to toss them backward upon the roof of the nest. Then she stepped forth quite clear of the nest, and four downy chicks tumbled out around her. As she advanced, uttering her low, liquid *witty witty witty*, she continued to pick up dead leaves from in front of her and to toss them backward. She continued to toss back the leaves until she had advanced at least four feet from the nest, much farther than I had ever seen her do this before.

The chicks were tiny, chubby creatures, clad in soft down which was marked in a pattern of black and buff. The top of the head and back were black, or at least blackish, with a narrow white line along either side of the back, and the cheeks and sides of the neck were buff. I could not distinguish the pattern on their underparts. As their mother moved slowly forward uttering her liquid notes, they easily followed, although with an uneven, jerky movement compounded of short forward runs and brief pauses. The male, murmuring excitedly, advanced into the clear space to meet his family. The third quail took less interest in the proceedings.

The mother turned to her right and crossed a long, low, decaying log which lay before her. After a few ineffectual trials, three of the chicks managed to scramble up its sloping, uneven side, and dropped down to the clear, level ground beyond. But the last found difficulty in passing the barrier which blocked its advance, stretching for a long distance both to the right and the left. Apprised by the chick's weak peeps of its distress, the father returned to look after it, while the mother continued slowly forward with the other three. He stood upon the log, looking down, while the chick struggled along the barrier first to one side and then to the other, until at last it found a place where the irregularities in the decaying surface enabled it to scramble up and over. Then, following its father, it hurried after the rest of the family.

As they crossed a level area carpeted with dead leaves, the male quail scratched the litter aside and called to his chicks, but they did not attempt to pick anything up. All too soon they passed beyond my narrow circle of vision and were swallowed up by the dense undergrowth.

The period of incubation can be given only approximately. There were two eggs in the nest on January 14, four on January 19. If the eggs had been laid at daily intervals, the last was deposited not earlier than January 16. The four eggs hatched on February 12 or during the early hours of the morning of February 13. Accordingly the period of incubation was not less than 24 nor more than 28 days. That of the Bob-white is generally given as about 24 days.

After leaving the nest the downy young are led through the forest by their parents, often in company with the covey. I have on several occasions seen recently hatched

chicks travelling along with as many as five or six grown quails. When accompanied by young the adults are shy and it is difficult to watch them; but it seems likely that the little ones are aided in their search for food by the scratching of all the grown members of the flock. If a man approaches a group of quails accompanied by chicks, one of the adults remains behind, running back and forth through the undergrowth at no great distance from the intruder and seeming to try to draw attention to itself without incurring too much risk, while the others lead off the downy ones and quickly vanish amid the vegetation. Of if a chick lags behind or is cut off from the flock, usually a single adult will stay and try to lead it to safety, while the rest quickly walk out of sight with the other youngsters. This strategy usually works, and it is exceedingly difficult to catch the downy chicks. At times the conduct of the adults has told me plainly that they were accompanied by young; yet I have searched over the ground in vain for them; and all the while a grown bird has moved around just beyond reach, manifesting the greatest solicitude for the offspring I could not see. From the behavior of the pair which I watched as they led their downy brood from the nest, I believe that it is the female who walks off with the chicks, while the male lingers in the rear to distract the attention of hostile eyes and look after the laggards.

DISCOVERY OF THE THIRD NEST

With a record of two nests and one completed set of eggs of the wood-quail discovered during ten seasons, it did not seem likely that I should soon find another. But soon after this paper was sent off for publication, the unexpected happened and I encountered my third nest. I was led to the discovery of this nest by recalling certain facts that I had learned in my study of the first nest.

I passed the morning of June 3, 1947, in a blind watching a nest of the Tyrannine Antbird (*Cercomacra tyrannina*) in which both members of the pair were incubating their two eggs. This was on a low ridge in the forest, but close by its edge where it bordered a fallow field devoted to animal crops and now overgrown with tall weeds, bushes and vines. At about 6:45 I noticed three grown quails resting on a slender horizontal dead trunk about a yard above the ground, down the steep slope to my right and between me and the forest's edge. Intervening foliage prevented a complete view of them, but I could see that they were moving around a good deal and apparently preening. One sang snatches of the *burst the bubble* song. Then they walked up the steep incline toward me, going single file and scratching here and there with their feet. They passed within a yard of me, then almost directly beneath the antbirds' nest, but without disturbing the blackish male antbird which was sitting in the swinging pouch less than two feet above them. After passing out of sight they sang again and were answered by other wood-quails farther off in the forest. At 8:30 the three quails returned from the direction in which they had disappeared about an hour and three-quarters earlier, walking single file close behind the blind. One raised its long crest quizzically as they passed me. They continued down the slope toward the point where I had first seen them on the trunk and vanished amid the undergrowth.

The return of these quails to what appeared to be a definite point near the forest's edge, and the hour of their going and coming, suggested the presence of a nest. I surmised that one of the trio was incubating, while the other two had gone to call her from her eggs at about sunrise and to escort her back to them later in the morning, just as had been the custom at the nest I had studied more than ten years earlier. In the afternoon of the same day I searched for the quail's nest amid the entangled vegetation on the steep slope that led down to the forest's edge. For about an hour I worked laboriously through the bushes and vines, drifting farther and farther from the point where

I had first seen the quails but where no nest was found. My search led me beneath a huge fig tree, whose trunk at a height of about thirty feet began to divide into a number of separate twisted columns, some of which stood out from the main mass like the flying buttresses of a Gothic cathedral, so that I had ample space to pass between them. Where the partial trunks met the ground they sent out great roots that formed irregular ridges of wood rising a foot or so above the leaf-strewn surface. While I was engaged, not without unpleasant thoughts of lurking snakes, in hunting for the quail's nest in the cavern-like base of the fig-tree trunk and between the woody ridges of the roots, a dog came running up, and with a whirr of wings the quail rose up almost under her nose, but behind me! I had passed in front of her nest at a distance of less than two yards without noticing it and without causing the bird to flee.

Brown dead leaves had drifted deeply into the narrow, sloping space between two great protruding roots of the fig-tree. Into the mass of leaves a cavity extended obliquely downward for a distance of nine inches. Round in cross-section, the tubular hollow measured about $5\frac{1}{4}$ inches in diameter. There was a slight lining of finer leaves in the bottom; but apparently the quail had done very little nest-building and had merely burrowed down into the accumulated leaves and perhaps carried in a few pieces of finer leaves to line the bottom. The interior of the nest was warm and dry in spite of the rain which had fallen in the morning and soaked all the ground litter of the forest. Here lay four unmarked white eggs, slightly stained from contact with the leaves, and so well hidden in their deep nook that one might pass by them a hundred times without suspecting their presence. They measured 38.9 by 27.8, 38.1 by 28.6, 38.1 by 27.8 and 37.3 by 27.8 millimeters.

The departure and return of the wood-quails by almost the same route suggested that they might have a definite path for leaving and going back to the nest. To investigate this point, I spent the early part of the following morning in the blind, watching the antbirds and keeping a lookout for the quails. But I neither saw nor heard the latter. On ending my vigil at 9:45, I went directly to the quail's nest and found her sitting, doubtless having already taken her morning's outing with her two companions, but going and coming by a route distinct from that they had followed on the preceding morning. As I drew near, she shrank back farther into the nest, making herself very inconspicuous in her nook beneath the leaves; and I went away without disturbing her. On the next day, June 5, the quail was absent and the eggs cold at 8:10 a.m. A big yellow leaf covered and concealed the doorway of the nest, and I wondered whether it had been placed there by the bird herself. Returning at nine o'clock, I found her sitting beneath the leaf and almost invisible in her cavity. At 1:15 p.m. on June 5 and 11:05 a.m. on June 6 I also found the quail sitting beneath the concealing leaf and did not disturb her. At 7 a.m. on June 7 I found the nest destroyed. The leaves that had formed its walls and roof were scattered among the surrounding dead leaves and could not be distinguished from them, with the result that the nest was quite unrecognizable. Fragments of shell scattered around pointed to a mammal rather than a snake—which would have swallowed the eggs whole—as the predator. There were no feathers, whence I inferred that the quail had escaped unharmed.

SUMMARY

In the basin of El General in southern Costa Rica, Chiriquí Marbled Wood-Quails dwell on the ground beneath heavy rain-forest, whence they venture forth into adjacent areas of tall secondary woods and at times into shady plantations.

They travel in coveys of eight individuals or fewer, usually walking in single file. No indication of the existence of "peck-order" or "dominance" has been observed. Mem-

bers of the covey hunt food in closest co-operation and preen each other's plumage, especially on the head and abdomen.

The wood-quail's vocabulary is richly varied. Members of the covey constantly utter low, soft notes as they forage together. The beautiful, loud, rapid song, most often delivered in the evening twilight, is apparently produced by the male and female singing alternately with perfect timing.

Three nests were found during a decade. All three were well-enclosed chambers, roofed with dead leaves, twigs, grasses and the like, with a round doorway in the side. They were situated on sloping ground, or at the base of a mound in the woods, or in the narrow space between protruding roots of a fig tree.

Eggs were laid in these nests in January, April, and probably May; the April set was lost, apparently before completion. The other two sets consisted of four white, unmarked eggs.

At the January nest the sitting bird was marked with paint; and throughout the study only this individual, without much doubt the female, was seen on the eggs. She sat continuously except for one long recess each day. This began every morning at very nearly the same time, soon after six o'clock, and lasted from 1 hour, 40 minutes to a little over 3 hours.

As the female quail walked from the nest to take her recess, she would sometimes pick dead leaves from the ground in front of her and toss them over her back, so that some fell on the roof of the nest and others in front of the doorway. This procedure usually resulted in increasing the already excellent concealment of the nest and the sitting bird; but sometimes it had the opposite effect, for it removed the leaves that screened the doorway.

Each morning a little after six o'clock the male would come and call his mate from the nest, and at the end of her outing he would escort her back to its vicinity. But he regularly stopped short several yards from the nest. Toward the end of the incubation period the male was accompanied by a third grown quail, whose relationship to the mated pair remained unknown.

The female quail led the chicks from the nest when they were less than 22 hours old. She made her final exit about half an hour later than her customary time for beginning her recess when she incubated.

On the morning the chicks left, the male came at his customary hour but remained out of sight amid the undergrowth, repeatedly calling, until the female began to move from the nest. Then he advanced to meet the family and looked after a laggard chick, while the female led away the other three. The third grown bird was present but showed less interest in the proceedings.

The period of incubation at this nest was between 24 and 28 days.

Downy chicks have been seen travelling with coveys of five or six grown quails.

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