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LIFE HISTORY OF THE RUDDY QUAIL-DOVE

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A glance at the Ruddy Quail-Dove (*Oreopeleia montana*), amid the dark undergrowth of the forest where it dwells, reveals it to be a pigeon of marked personality. Its fairly long and slender bill does not extend nearly straight forward, as in most members of the family, but is tilted strongly downward, forming an angle of almost forty-five degrees with the rather flat crown, thus giving the stout bird a most peculiar aspect. In coloration, too, this dove is noteworthy. The upper plumage of the male is chestnut or rufous-chestnut, fading to cinnamon-rufous on the forehead, and glossed with metallic reddish-purple (very rich in direct sunlight) on the hind neck and back. A broad stripe of light pinkish-cinnamon extends from the chin below the cheeks to the ear coverts. Beneath this a band of the reddish-brown of the upper parts projects from the sides of the neck toward the throat. The foreneck and chest are vinaceous fawn-color, which fades to warm buff on the posterior under parts. The anterior margin of the folded wing is whitish, forming a narrow but conspicuous vertical bar on each side of the dove. The female is a far duller bird with her light or dark olive-brown upper plumage that changes to dull cinnamon-buff on her forehead and superciliary region. The light stripe from the base of her bill to her ear coverts is of the same color as the forehead. Beneath this there is a darker band of cinnamon-brown. Her foreneck and chest are dull cinnamon or brown, her abdomen and under tail coverts buff. In both sexes the bill is dark horn-color at the tip, at the base becoming red, which is also the color of the bare skin on the lores and surrounding the eyes, and of the legs and the feet. On the male the red of these featherless parts is deep and sometimes of a purplish cast, on the female it is paler. The eyes of both sexes are yellow, brownish-yellow or reddish-brown.

The Ruddy Quail-Dove inhabits the Greater Antilles and almost the whole extent of continental tropical America from the state of Veracruz in México to Bolivia and Paraguay. It is a lowland species which extends upward, in widely separated parts of its vast range, to 3000 or rarely 4000 feet above sea-level. In southern Costa Rica I have seen it occasionally at 3000 feet, but it becomes more abundant as one descends from this altitude; it has been recorded at 3500 feet in México and on Mt. Roraima in British Guiana, and at 4000 feet on the Volcán de Chiriquí in western Panamá (Ridgway, 1916:481-483). Everywhere it dwells in the heavy forest or at times beneath the taller second-growth, where alone or in company with a mate it walks over the ground in the deep shade, bobbing its head in typical pigeon fashion. Sometimes while I have followed a narrow path through the woodland one of these doves has walked rapidly ahead of me for a considerable distance, then at last veered aside to vanish amidst the undergrowth. Although as a rule they prefer to walk off when disturbed, if surprised they may fly up to some low perch, rarely more than four or five feet above the ground, where they pause to survey their surroundings, then dart off into the undergrowth again.

They are shy and rarely allow the bird-watcher more than transitory glimpses of themselves.

FOOD

The Ruddy Quail-Dove picks most if not all of its food from the ground. Gosse (1947:321-323) mentions that in Jamaica it eats the fallen berries of the pimento, the physic-nut and other oily seeds, berries of the sweet-wood, and small slugs, and that in captivity it thrives upon maize.

VOICE

The call of the Quail-Dove is a soft deep *coo*, usually delivered while the bird rests upon the ground—a mournful sound often heard amidst the forests of the Valley of El General from March to June. Gosse states that in Jamaica this dove utters its “sad moan” in March and April, usually from the ground, but at times while perching in a tree.

THE NEST

In the basin of El General in southern Costa Rica, where the following observations were made, the Ruddy Quail-Dove begins to nest in April, after the forest has been soaked and refreshed by the returning rains. The breeding season is at its height in May and June, but late nests are occupied in July and even early August. Beebe, *et al.* (1917:213-214) state that in British Guiana the main nesting season was during April and May, although possibly it started earlier. Gosse found a nest in Jamaica in June, and Carriker (1910:405) found one containing a nestling at El Pozo in Costa Rica late in the same month.

The slight, frail nest is placed amid the undergrowth of the primary forest, or of tall second-growth woodland, at no great height. Beebe gives the height of those he found in British Guiana as from one to five feet. Six that I have seen in Costa Rica ranged from 2½ to 7 feet; while three discovered by Belcher and Smooker (1936:7) in Trinidad were at about eight feet. Almost anything that will hold a broad, flat nest with slight internal cohesion is used by the doves as their site. Of those that I have seen in Costa Rica, two were on the flat tops of old decaying stumps overgrown with ferns, aroids and other epiphytic growths whose foliage screened them; two were on the gathered terminal pinnae of great fallen fronds of the chonta palm (*Iriartea*) which had lodged in a more or less horizontal position among the bushes and vines about two yards above the ground; two were on fallen dead branches held in a leaning or upright position by the surrounding bushes. One of the last rested upon the bases of the long, stiff leaves of an epiphytic aroid growing attached to the fallen bough, which had lodged upright beside a low, spiny palm. Beebe's nests in British Guiana were on “the head of an old rotted stump or the fork of a low overhanging branch, or possibly the horizontal surface of an old gnarled liana that ran close to the ground.” Those of Belcher and Smooker in Trinidad were “placed near the far end of a horizontal branch.”

The Quail-Dove's nest is a slightly concave platform or mat of coarse dead twigs, covered with small leaves which may be either green or brown, but are apparently brought while at least partially green and later wither in the nest. If supported on a stump or other firm base, the scant nest may consist of barely enough sticks and leaves to keep the eggs from touching wood or rolling off.

THE EGGS

At a late second-brood nest (6b) I learned some of the details of the laying of the two eggs. The second nestling of nest 6a had left on June 17, 1947. On July 19, the old nest had been covered with a few freshly gathered leaves, some green and others dead. At 7:30 a.m. the nest contained a single egg, cold and unattended. Although

most pigeons, so far as I have observed, keep their nest almost constantly covered in the interval between laying the first and second eggs, this was not true of this pair of Quail-Doves. During the remainder of July 19, I made three visits to the nest and three more on the morning of the following day, always finding the single egg uncovered, cold and, early in the morning, also wet, indicating that it had not been incubated during the night. As I approached the nest at 12:20 p.m. on July 20, the female rose from the ground close by, and the egg, although uncovered when I came within sight, was warm. Returning at 3:15, I found the female covering two eggs, the second having been laid during the early half of the afternoon. At an earlier nest I had found the first egg uncovered and cold at midday.

The time of laying by pigeons is a most interesting subject on which it is desirable to have more information. Whitman (1919:45, quoted by Nice, 1922) found that captive Mourning Doves (*Zenaidura macroura*) laid the first egg of a set between 4 and 6 in the evening, while the second egg was laid early in the morning of the second day following, between 6:30 and 9:00. The Ring Dove (*Streptopelia decaocto*), according to Schooley and Riddle (1944), laid the first egg of a set late in the afternoon, at about 5 o'clock, the second on the morning of the second day thereafter, at about 8:45. As the period of daylight lengthened from winter to summer, the hour of depositing the first egg became correspondingly later in the afternoon. Likewise there was a tendency for the second egg to be laid earlier in the morning. On cloudy days the first egg was deposited about 30 minutes earlier in the afternoon and the second egg about 45 minutes later in the morning. A White-fronted Dove (*Leptotila verreauxi*), whose nest already contained one egg when I found it, laid her second between 8:00 and 10:30 the following morning. A Red-winged Talpacoti Dove (*Columbigallina talpacoti*) deposited her second egg between 6 and 9 in the morning; and a Blue Ground Dove (*Claravis pretiosa*) laid the second egg between 7:00 and 10:00 a.m. But Anderson and Anderson (1948:153) record that an Inca Dove (*Scardafella inca*) laid her second egg in the afternoon, two days after they found the first. Thus, the Inca Dove and the Ruddy Quail-Dove differed from the other species mentioned here in laying the second egg after midday.

The Ruddy Quail-Dove regularly lays two eggs in a set. Although nearly all pigeons' eggs are pure white, these are pale buffy, cream-buff, or (Beebe, 1917:213) dark cream-color. Ten eggs measured at the nest in Costa Rica averaged 27.6 by 20.2 millimeters. Those showing the four extremes measured 29.4 by 19.4, 28.6 by 21.4 and 26.2 by 19.8 millimeters. Beebe gives the average measurements of eggs from British Guiana as 26.5 by 19.5 millimeters.

The distribution according to month of laying of the seven nests found in the basin of El General, Costa Rica, at 2000 to 2500 feet above sea-level, was as follows: April, 1; May, 3; June, 2; July, 1.

INCUBATION

The pattern of incubation of the Ruddy Quail-Dove is much the same as with other pigeons. The male sits through most of the day. The female replaces him in the afternoon, passes the night on the nest, and remains there until the male returns next morning. The second-brood nest (6b), where the second egg was laid early in the afternoon of July 20, was near my house and I gave much attention to it during the period of incubation, making numerous visits at all hours of the day to see which member of the pair was covering the eggs, and watching six exchanges of duty from the blind. Other nests less conveniently situated were studied less carefully, but I saw at them nothing to suggest that the doves' manner of incubation differed materially from that at the late nest.

On July 21, the day after the second egg was deposited, the male of nest 6*b* at 7:20 a.m. was already sitting on the slight nest on top of the low, decaying stump. But after incubation was well advanced he arrived considerably later. On July 26, when I watched from a blind, he came at 8:08, on July 27 at 8:02, on July 28 at 8:06. Then, as the eggs neared the point of hatching, he came earlier again. At 7:51 on July 29 he was already sitting; on July 30 he was present at 6:35; and on July 31, the last day of incubation, when I again watched from the blind, he came at 6:54. On June 7, the last day of incubation of the previous brood at this nest, I had found him present at 6:40 a.m.

On July 20, at 3:15 p.m., the female dove was covering two eggs in nest 6*b*, the second of which she had laid within the preceding three hours. On July 26, watching from the blind, I saw her arrive at 4:13, and on July 27 at 4:58. Through most of the incubation period she came between 3:30 and 5:00 in the afternoon. But when the eggs were about to hatch she came earlier again, just as the male did; on July 31 she was already on the nest at 2:40. Thus, both parents, before the eggs actually hatched, began to change to a schedule of early arrival, which would be their schedule after the nestlings were hatched.

In the middle of the incubation period the male's daily session on the eggs lasted between eight and nine hours. On July 26 he was on the nest for 8 hours and 3 minutes; on July 27 for 8 hours and 55 minutes. Although my watches of the nest were not continuous, his habitual presence when I came, and analogy with other pigeon nests that I have watched throughout the day while incubation was in progress, lead me to believe that if undisturbed the male Quail-Dove did not interrupt his single long daily session.

Each member of the pair normally continued on the eggs until it saw the mate approaching over the ground. Often it saw the other before I, watching from the blind, became aware of its arrival. Then it would slowly rise from the nest, step to the edge of the stump and fly away, going swiftly in an almost horizontal course, low over the ground, until lost to view among the trees. The new arrival would continue to approach, walking slowly over the ground until two or three yards from the base of the stump. Here it would pause briefly, then fly up to the nest and settle on the eggs. The observed intervals between the departure of the female in the morning and the actual arrival of the male on the nest were two minutes, eight minutes and less than one minute. The observed intervals between the flight of the male in the afternoon and the actual beginning of incubation by the female were two minutes and one minute. The exchange of duty at the nest was always effected in perfect silence.

Usually the dove arriving to take its turn at incubation brought something for the nest—a green or dying leaf, more rarely a petiole or twiglet. Of the four times that I watched the male come to replace the female, he brought something for the nest three times. Once when I chased him from the nest and then entered the blind, he picked up a leaf as he walked back and laid it on the nest. The female brought a leaf both of the times that I watched her come to replace the male. When driven from the nest by me soon after he had begun to incubate in the morning, the male once returned after 33 minutes; but another time he stayed away more than 75 minutes.

I have not seen pigeons of other species bring contributions to the nest when they came to take their turns at incubation. But I have watched females of both the Red-winged Talpacoti Dove and the Blue Ground Dove carry straws or the like to the nest in fairly rapid succession while their mates covered the already well incubated eggs, between nine and ten o'clock in the morning. This activity of the females in building up the occupied nest was most unexpected, because with both of these species, and

apparently in the pigeon family in general, the material for the original construction is brought chiefly if not wholly by the male, who alights upon his mate's back and deposits his burden beside her, while she sits quietly on the nest-site and arranges what he has brought.

One afternoon while I sat in the blind awaiting the female Quail-Dove's return to the nest, I saw a dove in the distance, walking toward the stump from the direction whence the female usually approached. I wondered why the male dove, who usually saw his partner and flew from the nest before I caught a glimpse of her, continued to sit motionless this time. The approaching dove walked deliberately past the nest and vanished amid the undergrowth to my right. When it came closer, I saw that it was not a Ruddy Quail-Dove at all, but a Cassin Dove (*Leptotila cassini*). Although I had been at first deceived by a general similarity of appearance between the two species as seen at a distance in the dimly lighted undergrowth of the woods, the male Quail-Dove had not. Forty minutes later his mate arrived and he flew away.

The Quail-Doves in general sit steadfastly and allow a man to come close before they fly from their eggs or nestlings. The present pair would from the first permit me to come very near, and before their eggs hatched they would remain covering them while I slowly advanced to within a yard of the male, and within four feet of the female. When they saw me coming, they would crouch forward on the nest, lowering the breast and head, elevating the tail, and at the same time compressing all the feathers of the body and making themselves appear far more slender than usual. In this posture they would remain motionless until I came so close that they fled. Then they would fly more or less sharply down to the ground and walk away. At times, especially as the eggs neared the point of hatching, they would display in a spectacular fashion after reaching the ground, but they were not consistent in this. The male dove was more assiduous than the female in trying to distract my attention from the nest. On the morning of July 30 he allowed me to come within a yard before he flew from the eggs on a downward course, to reach the ground about fifty feet away. Then he walked deliberately off with his wings spread and flapping loosely as though not entirely under his control. He continued this until he passed from view amid the undergrowth, a hundred feet or more from the nest. But at noon the following day, when the eggs were pipped, he flew off at least fifty feet and disappeared without displaying. That evening at five o'clock, when the eggs were nearly ready to hatch, the female dove continued to cover them until I approached within four feet, then flew off without "feigning injury."

At this nest the second egg was laid between 12:20 and 3:15 p.m. on July 20, and both eggs hatched between 5:20 p.m. on July 31 and 5:40 next morning. Hence the incubation period was not less than 11 days and 2 hours nor more than 11 days and 18 hours; or we may write it as 11 days 10 hours \pm 8 hours. At an earlier nest the second egg was laid between noon on May 22, 1942, and 4:30 p.m. next day, and both had hatched by 5 p.m. on June 2. On the assumption that the second egg was laid in the morning (of May 23), I reported in an earlier paper (Skutch, 1945:15), that the incubation period was 10 days. It would have been more correct to have stated it as 10 or 11 days. Even the second is amazingly short for so large an egg. We may compare it with the period of 12 or 13 days for the smaller Red-winged Talpacoti Dove; 13 days for the Inca Dove (Anderson and Anderson, 1948:153-154); $14\frac{1}{8}$ to $14\frac{7}{8}$ days for captive Mourning Doves (Whitman, 1919:465, *vide* Nice, 1922); 13 or 14 days for captive Turtle Doves (*Streptopelia turtur*) and 16 to 19 days for various species of *Columba* in the British Isles (Witherby, *et al.*, 1940:129-146).

THE NESTLINGS

Newly hatched.—At nest 6b, both eggs were well fractured at 5:20 p.m. on July

31. The following morning I entered the blind at 5:40, while the light was still dim in the woodland. The female dove was sitting and remained quietly until the male approached at 6:33, twenty minutes earlier than he had come the preceding day. After she flew off I saw the heads of the two nestlings, which had hatched during the night. The male dove, who had brought a petiole, promptly flew up to the nest, placed it beside the nestlings, and settled down to brood them. He remained almost motionless until 9:10, when I left the blind and advanced to the nest for a closer view of its new occupants. After I had come within a yard the male flew down, landing about twenty feet from the base of the stump. Then he walked off, not beginning to wave his wings in the "lure-pattern" (Williamson, 1948:95, footnote) until he had gone several feet over the ground and was almost screened from me by rocks and foliage.

The nestlings, not over thirteen hours of age and probably a good deal less, were already dry and could sit up. Their pink skin was well shaded, but by no means concealed, by rather long, straw-colored, hair-like down. The bill was dusky, becoming blacker toward the end, but the tips of *both* mandibles were whitish and each was equipped with a hard, light-colored egg tooth. Their tightly closed eyes were mere blackish bumps on the sides of the head. Their legs and feet were flesh-color. The shells of both eggs had quite vanished. Because I had seen nothing of them while watching the nest continuously since there had been enough daylight to distinguish anything, I concluded that the female had disposed of them by eating or carrying them away during the night, or more probably in the dim light of early dawn.

After this examination of the nestling doves, I promptly returned to the blind. At 9:22 I saw the male approaching over the ground. While still some distance from the nest he stopped behind a log and stood for two minutes surveying the situation with only his head visible to me. Then he resumed his march toward the nest, where he arrived at 9:27 after an absence of 17 minutes. He brought nothing in his bill. At 10:08 he began to feed a nestling, in all probability its first meal. Certainly, during the few minutes he was out of my sight he could not have gathered enough food for this meal and all those which now followed. Unlike male birds of other families, he did not need to see the nestlings, or at least to see his mate gather food for them, before he was prepared to feed them himself. He already had food for them when he came in the early morning before he had ever laid eyes on them. The production of "pigeon milk" in his crop had been synchronized with their hatching.

During the next half-hour the male dove fed the nestlings at least four times more, each feeding lasting from a fraction of a minute to $6\frac{1}{2}$ minutes. The male always sat with his head away from me, making it impossible for me to see the details of feeding. At 10:33 I left the blind. I already had a better record of the care of recently hatched nestlings, made at an earlier nesting of this same pair. At 12:10 p.m. I returned and found the male dove still giving frequent meals to his offspring. During the next half-hour he fed the young by regurgitation four times, the meals lasting from about one to five minutes. After 12:37 no more food was passed, although the dove continued to sit quietly on the nest.

At 1:57 the female dove came walking from the east, paused near the nest, then circled around and approached by a crooked course from the north. The male, contrary to his usual custom, did not move, although he could hardly have failed to see her. She stood for several minutes motionless on a rock about five yards from the nest, then walked nearer. Her mate at last began to stir, but was slow in leaving. At 2:11 she flew up to the stump, arriving just as he was taking wing. This was the only time at this nesting that I saw one member of the pair reach the nest before the other had flown. At 2:15 I left the female brooding.

Returning next morning, I was dismayed to find that the nestlings had vanished. Many of their mother's feathers were scattered over the stump and the surrounding ground. I found only one flight feather and no blood. While watching from the blind the preceding day, I had seen a tayra and an opossum prowling in the vicinity. Either of these omnivorous mammals might have eaten the newly hatched doves.

One and two days old.—For a more complete picture of the care given to the nestlings and their development we must go back in time to the first nest (6a) on the same stump. On June 5 we found two eggs on this stump, far advanced in incubation. They hatched on June 7 between 6:40 a.m. and 1:00 p.m. I then set up the blind and returned to it at dawn the following morning, when the nestlings were less than twenty-four hours old. At 5:45, while the light was still dim, the male silently arrived and flew up to the top of the stump, whereupon the female left at once. For the next two hours and fifteen minutes he sat nearly motionless facing away from me, but at 8:00 he turned to face me. He backed off the center of the nest and picked up the main part of an empty shell, which had lain in the nest for nearly if not quite twenty-four hours after the nestling escaped from it. The other empty shell had been inadvertently thrown to the ground by the male as he flew from the nest when I visited it just after the nestlings hatched the preceding day. Now he promptly let the remaining shell drop from his bill back into the nest. Soon he picked it up and dropped it again.

At 8:03, after he had been on the nest for well over two hours, he gave a nestling its first meal of the day. Then for the next three-quarters of an hour he continued alternately, and at times even simultaneously, to be busy with feeding the nestlings and trying with more or less success to eat the shell; and this dual occupation led to some amusing situations. For the first half-hour after he had begun to be interested in the shell he repeatedly picked it up only to drop it again. Sometimes he took it in his bill as far up as it would go, and at times he dropped it when a nestling insistently stretched up its head for food. Although he billed the shell so often, he did not seem actually to eat any of it until about 8:30, when holding the main part of the empty egg as far up in his mouth as the closed bottom of the shell would permit, he broke off and ate small particles from the ragged edge. After ten minutes of this occupation had materially reduced the size of the shell, he made heroic efforts to gulp down the fairly large piece that remained, continuing this for five minutes. While he was so engaged, a nestling became hungry and stretched up for food. Still holding the shell in one side of his mouth, the dove took the nestling's bill in the other side and for two minutes regurgitated "pigeon milk" to it. Then he dropped the nestling's bill but continued to hold and eat the shell. Finally he gulped down the remaining piece. He had devoted no less than three-quarters of an hour to feeding on that shell!

Since the dove alternately ate shell and fed the nestlings, I wondered whether he did not regurgitate to them part of the shell, which seemed a harsh diet for day-old doves. Similarly, at this and other nests I saw the parent Quail-Doves eat the nestlings' droppings a short while before feeding them. Years earlier, I watched a male Cassin Dove (*Leptotila cassini*) eat the droppings which had accumulated on the nest during the night before proceeding to give the nestlings their breakfast. In these instances, is the waste material fed back to the youngsters, or is there some arrangement of by-passes in the pigeon's alimentary canal which prevents this?

The feeding of the nestlings occurred intermittently over the period from 8:03 to 10:26, during which their father regurgitated to them 14 times: 6 times from 8:03 to 9:00, 5 times from 9:00 to 10:00, 3 times between 10:00 and 10:26. Nearly always a single nestling received food at a feeding; yet once he fed them alternately, then apparently simultaneously, but with the bills of both in his mouth on the *same* side—not on opposite sides as when the nestlings are older—and continued this for about a minute. On this first morning the male dove invariably took the nestling's bill into the left side of his own mouth and held it there from about $\frac{1}{2}$ to $2\frac{3}{4}$ minutes while regurgitating. The nestling's bill went into the parent's mouth up to the eyes. In regurgitating food, the parent expanded his thorax strongly, then contracted it, doing this repeatedly, but not continuously, during the whole time he kept the nestling's mouth in his. Intervals of rest appeared to alternate with active pumping up of aliment. From 10:26 until 12:00 the male dove rested almost motionless brooding the nestlings, without further feeding. At noon observations were stopped.

Returning to the blind at 12:50 p.m., I found that the female dove had during my absence replaced the male on the nest. The sky had become clouded. After an hour a drizzle fell and slowly

increased in intensity. The female continued to cover the nestlings, scarcely moving save now and then to pick up and eat their droppings. Finally, at 3:19, a nestling stretched up its head and she at last began to feed it, continuing for about 6 minutes. Two minutes after the termination of this feeding she delivered food again, beginning with a single nestling; but soon the other managed blindly to insert its bill into her mouth on the opposite side, and she regurgitated to both simultaneously. This feeding lasted for 3 minutes and 10 seconds. During the next 10 minutes she fed twice more, a single nestling each time, first for 3 and then for 1½ minutes. Thus, between 3:19 and 3:44 she fed the nestlings 4 times. Then for the next hour she brooded quietly with the nestlings resting quietly beneath her. At 4:52 one of them pushed its head out from beneath her breast and bobbed it about as though hungry. The mother billed the back of its head but gave it no food, and after a few minutes it returned beneath her. But an hour later, when the light beneath the woodland had become so dim that I had difficulty in seeing what she did, the female began another series of feedings. The first of these started at 5:55 and lasted 5 minutes; then followed 3 more feedings lasting about 2 minutes, 2 minutes and 1 minute, the last of these terminating at 6:10, when even through the binoculars I could hardly distinguish details. If still other meals followed, they were hidden from me by the dusk.

On June 9 I entered the blind at 11:50 a.m. to watch the nest during the hour when I had been absent the preceding day. The male dove was covering the nestlings and remained until 12:34 p.m., when he flew from the stump as his mate came to rest on a swinging vine close beside it. After a delay of 7 minutes here she jumped to the top of the stump and settled down with the nestlings in front of her. Although she billed them gently, they did not rise up for food. A few minutes later she again touched them with her bill and both stretched up their heads to receive their meal, placing their bills into her mouth from opposite sides. This feeding, which began at 12:50, was the first of 5, which ranged in length from 4 to 13 minutes, and in aggregate occupied 33 minutes. The last and longest ended at 1:32, after which the nestlings retired beneath their mother and remained out of sight. Most of the time the two-day-old nestlings were fed simultaneously, with their bills entering their mother's mouth from opposite sides. At times the bill of one would drop out, and it would grope blindly around until it stuck it in and continued to receive food.

The nestlings had grown enormously during the two days since they had hatched. The skin covering the body had darkened somewhat during the interval and appeared more naked because as it expanded with their growth the filaments of natal down became more widely separated. Their feet and toes had become considerably darker. Both nestlings kept their eyes closed except when touched or otherwise disturbed, when they would open them partly. The one which was apparently slightly older could open its eyes about half-way; the other, which experienced more difficulty in keeping its bill in its mother's mouth at meal-time, for only a narrow slit. When they felt themselves slipping from my hands, the young doves hooked their bills over my fingers and tried to draw themselves up.

Four days old.—By June 10, when the nestlings were three days old, their pinfeathers were sprouting and those of the remiges had already become long and conspicuous. On June 11, when the young doves were four days of age, I watched the nest continuously from daybreak until nightfall. The female dove was on the nest at the end of the night and flew off at 6:03. Three minutes later the male came walking over the ground but passed close by the stump that held the nest. A minute later he flew up to it, and three minutes after his arrival began to give the nestlings, both together, a meal which lasted nine minutes, from 6:10 to 6:19. A second feeding lasted four minutes, from 6:25 to 6:29; and a third two minutes, from 6:31 to 6:33. In these fifteen minutes of regurgitation the male dove apparently exhausted his supply of "pigeon milk"; when two hours later a nestling rose up and ran its bill over its father's bill and face, it received nothing. From time to time the parent picked up and swallowed the droppings which the little ones had deposited on the side of the nest.

The male continued to brood the nestlings for nearly five hours. Mosquitoes were abundant in the woodland and hovered in a restless swarm above the brooding dove's head, causing him to keep it in continual jerky movement, at the same time blinking his eyes with great frequency, in an effort to keep them from settling down. During the morning I enjoyed several opportunities to observe the dove's behavior in the face of

disturbances and alarms of various sorts. A squirrel jumped to a neighboring trunk at a point only a foot from the nest, passing rapidly and appearing not to notice it. As the animal went by, the bird depressed the foreparts of his body, just as he and his mate were in the habit of doing when I came near. He likewise lowered his head and breast when domestic chickens scratched in the woodland only fifty feet away. Somewhat later in the morning the dove again assumed this crouching attitude, but now in a form more exaggerated than I witnessed at any other time. His breast was pressed down against the nest and his posterior parts elevated until his tail pointed almost straight upward. He remained motionless in this peculiar pose for a number of minutes, and at first I could discover no cause for it. Finally, I noticed four red-billed Frantzius's Araçaris (*Pteroglossus frantzii*) in the trees above us. When the great-billed nest-robbers discovered the blind in which I sat, they called out in great excitement, repeating high, sharp notes that seemed weak for birds so large. After a while they drifted away, and the dove gradually resumed his normal sitting posture, his head bent slightly downward, body nearly horizontal, and tail inclined only slightly upward.

Years earlier I had seen a Cassin Dove assume a similar pose when Rainbow-billed Toucans (*Ramphastos sulphuratus*) passed through the tree-tops above the nest where he brooded his nestlings. The dove lowered his head and neck like the Quail-Dove, but instead of elevating his tail so prominently he partly spread his wings, as the latter did not do. Later, when a troupe of white-faced monkeys passed over this same nest, the female did not, as I had expected, depress her foreparts—although I have first-hand evidence that white-faces are nest-robbers like toucans. Both Cassin Doves and Quail-Doves are forest-dwelling species which have the forehead, foreneck and breast much lighter in color than the crown, back and wings, and their action in lowering the foreparts of the body when enemies approach renders them less conspicuous, especially from above.

At 8:13 a female Ruddy Quail-Dove, doubtless the mate of the brooding male, walked close by the nest, but without stopping disappeared in the undergrowth. The male covering his nestlings seemed not to notice her. (It was most exceptional to see either member of the pair in the vicinity of the nest except when it came to feed or brood the nestlings.) At 10:48 the male swallowed droppings and flew away as his mate came walking toward the nest. When about two yards from it, she stopped. For the next two and a half hours she remained standing on the same spot of ground, immobile, or at times preening. She did not move when an agouti hopped by only three yards from her. Finally, at 1:14, she stretched her legs, then walked forward two feet, delayed here four minutes more, then vanished behind the stump on which the nest rested. After remaining here out of my sight for nearly half an hour, she went to the nest by way of the vine that swung close beside the stump. Within a minute of her arrival on the stump she began to feed both nestlings together, keeping their bills in her mouth for 15 minutes while a light rain began to fall. This was followed after a short interval by a feeding which lasted 8 minutes and then by another of 4 minutes' duration.

I continued to watch for the remainder of the rainy afternoon, staying constantly in the blind except for a period of a quarter of an hour, when I was driven to a more distant observation post by a horde of army ants, which invaded my retreat and swarmed over its walls of brown cloth. I feared that they would discover the nest and abruptly terminate my study; but fortunately they passed it by; and when they had moved on, I resumed my more comfortable seat in the blind. The female dove, who all this while had continued quietly to cover her nestlings without feeding them again, at last flew off spontaneously, at 4:57. During her absence of 28 minutes rain fell hard.

Returning at 5:25, she settled over the nestlings with her tail toward me. This unfavorable position made it difficult to follow what she did; although I continued to watch her intently through the rain and the gloom, I saw nothing to suggest that she fed the nestlings again at nightfall, as she had done on the day after they hatched.

Seven days old.—On June 14, when the nestling doves were seven days old and the plumage beginning to expand on their bodies and wings but not on their heads, I again spent the whole day watching them from the blind. At 5:40 a.m., when the light was still dim beneath the trees, the female flew from the nest on which she had passed the night. At 5:58 the male came walking over the ground, but instead of going to the nest passed it by and continued until lost from sight. I did not see him again until 7:49 when he returned, again walking, and when two yards from the stump flew up to the nest and began at once to give the nestlings, both together, a meal which lasted ten minutes. At the end of the feeding he shook their bills from his mouth; when they rose up begging for more food, he turned his head away. At last they sank down with their heads beneath his breast. He did not stay long to brood them; only seven minutes after the single feeding he ate the droppings that had been deposited beside the nest, then flew away, at 8:06.

Now for more than three hours the partially feathered nestlings were left quite alone. At times they preened a little, but mostly they drowsed with their heads down. When toward noon a spot of sunlight slipping through the high woodland canopy fell upon the nest, one youngster stretched its head high and panted violently, moving around a good deal. At 11:35 the female approached, walking over the ground as usual, but stopped when four feet from the base of the stump. Here she stood motionless as she had done three days earlier, but not for so long a time. Just at noon, after only 25 minutes of immobility, she flew up to the vine that swung beside the nest, thence to the nest itself. The youngsters appeared not to be eager for food but continued to lie inert in front of their mother, who did not cover them. Almost an hour and a half passed before, at 1:24, she suddenly began to feed both together, continuing for six minutes. Then one nestling stuck its head beneath its mother's breast, leaving the hindquarters exposed. The other reached up for more nourishment, but received nothing. After an hour, however, both were fed again for six minutes.

Soon the usual afternoon rain began to fall, causing the nestlings to retire beneath their mother, who sat very high, puffed out all her feathers, and rested her bill against the swelling plumage of her chest. The rain collected on her back and wings in shining drops which rolled off without penetrating her feathers. At times she twitched her head forward, apparently to shake off the drops. At 4:50, when the rain, not so hard as on most afternoons at this season, had diminished to a mere drizzle, the dove flew from the nest and remained away for half an hour. After her return at 5:19, the nestlings rose up to beg for food; but although I watched until they faded from view in the rain-drenched dusk, they received no more nourishment that afternoon.

Summary of observations at nest 6a.—As the nestling doves grew older, they were fed less frequently but seemed to receive more at each feeding. On June 8, the day after they hatched, the two nestlings were fed 14 times by the male and 8 times by the female—a total of 22 feedings, counting as a single feeding each time the parent took a nestling's mouth into his own. The feedings fell into three series: by the male between 8:03 and 10:26 a.m. and by the female between 3:19 and 3:44 p.m. and between 5:55 and 6:10 p.m. With rare exceptions the nestlings were fed one at a time, and single feedings lasted from a fraction of a minute to 3 or 4 or rarely 5 or 6 minutes. (From observations made on the succeeding day, I doubt that the nestlings were fed during my absence of fifty minutes on this day.)

On June 11, when 4 days old, the two nestlings were fed 3 times by their father and 3 times by their mother, a total of 6 feedings. The male fed between 6:10 and 6:33 a.m., the female between 1:46 and 2:22 p.m. The two nestlings were regularly fed simultaneously, with their bills on opposite sides of the parent's mouth. The feedings by the male lasted 9, 4 and 2 minutes; those by the female 15, 8 and 4 minutes.

On June 14, the seven-day old nestlings were fed once by the male and twice by the female, a total of 3 feedings. The male fed between 7:49 and 7:59 a.m.; the female

between 1:24 and 2:35 p.m. The feeding by the male lasted 10 minutes, those by the female 6 minutes each.

An effort was made to determine the total number of minutes devoted to meals. The intervals when the nestlings' bills were held in the parent's mouth were timed with a watch. On the day after they hatched it was sometimes difficult to see them plainly when the parent sat with its head away from me, and it was not possible to measure the periods of feeding with exactness. On this day the 14 feedings by the male lasted a total of about 21.5 minutes, the 8 feedings by the female 23.5 minutes. By both parents the nestlings were fed for about 45 minutes. When 4 days old the nestlings were fed a total of 15 minutes by the male and 27 minutes by the female, giving 42 minutes by both together. When 7 days old they were fed 10 minutes by the male and 12 by the female, or 22 minutes in all. In considering these figures, it should be remembered that the day-old nestlings were with rare exceptions fed one at a time, while from their fourth day onward they were regularly fed simultaneously. Assuming that on the day after hatching the two nestlings were nourished more or less equally, when one day old, each was fed about half as long as when they were four days old; but when they were seven days old, the time they devoted to taking food fell to what it had been on the day after they hatched. Even while the nestlings' mouths were within that of the parent, they did not appear to receive food in a continuous stream, but rather intermittently.

The amount of time which the parents spent at the nest diminished as the nestlings grew older. On the day after the eggs hatched the parents were continuously present. When the nestlings were four days old, the male flew off when his mate arrived at 10:48, then for nearly three hours the nestlings were left without close attendance while their mother rested on the ground near the nest; she did not actually go to the nest until 1:45 p.m. Late that same afternoon she left the nestlings exposed to a hard rain while she took a brief recess from 4:57 to 5:25. When the nestlings were seven days old their mother, who had formerly waited on the nest until the male arrived to replace her in the early morning, flew off at 5:40; he did not appear until 5:58 and did not actually go to the nest until 7:49, with the result that the nestlings were left alone for slightly more than two hours. A few minutes after he had finished feeding the nestlings he flew away, and they were unattended for nearly four hours, from 8:06 until their mother's arrival at 12:02. That same afternoon she took a recess of almost half an hour, from 4:50 until 5:19. Thus, the week-old nestlings were left alone for 6½ hours, or slightly more than half of the day.

Care of older nestlings at other nests.—At the two nests of the Ruddy Quail-Dove which I watched briefly in 1942, the behavior of the parents was essentially the same as at the nest studied in 1947; yet there were some interesting variations.

One of these, nest 3, had been built in a forest upon a fallen palm frond that had been caught up by bushes and vines seven feet above the ground. On June 8, when the nestlings were six days old, I watched their nest from daybreak until 11:30 a.m. The female had passed the night on the nest. At 5:35, while the light was still very dim beneath the high forest, I was made aware of the approach of the male dove by hearing soft, deep cooing from the undergrowth. He stood in one spot on the ground, close in front of the blind, and cooed repeatedly, then advanced a few paces and cooed more. At the nest I studied in 1947 the parents always approached in silence. The female then flew from the nest, and almost at once the male flew up to it. Without delay he took the nestlings' bills in his mouth, one on each side, and held them there for 25 minutes, although only a fraction of this period appeared to be occupied by the intermittent acts of regurgitation, made evident by the strong movements of the parent's head and body, and separated by longer intervals of repose.

Nest 2, found in the forest near my house on April 27, 1942, contained two nestlings which were fairly well feathered except for their heads and appeared to be seven or eight days old. They remained in the nest at least four days more, and my studies made during this period give a picture of the care

of nestlings somewhat older than those watched in 1947. On the morning of April 29 the male arrived at 5:45, announcing his approach through the undergrowth, as at nest 3, by low, deep-voiced coos. Feeding followed. The next morning he came silently, fed the nestlings for seven minutes, and left. The nestlings remained alone until the female winged-up silently at 8:52 and fed them continuously for 3 minutes. Then for nearly two hours she sat at the side of the nest with the nestlings in front of her; but at 10:40 she flew off, leaving them alone for the rest of the day. The nestlings from time to time stood up and vigorously flapped their wings, which bore rapidly expanding plumes. They took this exercise after each meal; and during the afternoon, when they remained all alone in the intermittent rain, the impact of the first heavy drops of each shower stimulated them to energetic wing-flapping. At the beginning of a shower one walked out on one of the flat aroid leaves that supported the nest, but soon returned to rest beside the other. The little spurt of activity caused by the first rain drops would soon die away; and the nestlings would then passively endure the continued downpour, with their feathers all puffed out and heads drawn in. At the end of the long, wet afternoon the female dove returned at 5:31, when the light was growing dim. For three minutes she fed the wet youngsters, then carefully removed their droppings from the nest, swallowing them. She tried to brood the nestlings but found them too big to be covered. They stuck their heads beneath the ruffled feathers of her breast, leaving their feathered bodies exposed to the rain; and in this attitude I left the trio in the dripping forest when I left in the dusk. It is noteworthy that at this nest the female gave well feathered nestlings a second feeding at the end of the day, whereas at the 1947 nest this late feeding was observed only when the nestlings were one day old.

Comparison with other species.—In the great family of pigeons considerable uniformity appears to prevail in the pattern of incubation, the male sitting through much of the day, the female covering the eggs from some time in the afternoon until her mate returns next morning. There are differences among genera, however, in the mode of caring for the nestlings. Here we have space only to point out something of the range of variation. At a nest of the Cassin Dove (*Leptotila cassini*), young in pin feathers, still attended almost continuously by their parents, were fed only thrice in a day, by the male when he came to brood them at about 9 in the morning, by the female after she arrived to replace him at 4:30 in the afternoon and again by her, quite briefly, three-quarters of an hour later. Although this nest had not been found and studied before the eggs hatched, the parent doves appeared to have continued the same schedule of attendance which they had followed during the course of incubation; and each fed the nestlings copiously when it came to take its turn at brooding, with perhaps an additional snack during the ensuing hour.

More often, apparently, the parent pigeons, soon after the eggs hatch, change the time of their visits to the nest. At a nest of the Blue Ground Dove (*Claravis pretiosa*), the parents maintained, during the first three days after the nestlings hatched, essentially the same schedule of attendance as they had earlier followed while incubating the eggs. During their first few days the nestlings received, through most of the day, numerous feedings from whichever parent was present. By the time the young Blue Ground Doves were six days old, the parents had made great changes in their attendance. The nestlings were now left alone most of the time. The male came twice during the morning, at each visit simultaneously giving both nestlings a single substantial feeding and then flying away. The mother likewise came twice, but during the afternoon. On her first visit early in the afternoon she gave both nestlings together a single good meal, then flew away. Returning again in the middle of the afternoon, she gave the nestlings a three-minute feed, then remained with them until nightfall, giving them three additional shorter feedings during the next hour and a half.

At a nest of the Talpacoti Dove (*Columbigallina talpacoti*) likewise, the parents continued to follow essentially the same schedule of attendance during the first days after their eggs hatched as during the course of incubation. In contrast to the schedule of feeding followed by the Quail-Doves, at nests of both the Blue Ground Dove and the

Talpacoti Dove each parent came twice daily to attend the nestlings when they were about a week old; but with the Blue Ground Dove the male came twice and then the female came twice, whereas with the Talpacoti Dove the parents alternated in their visits.

At both of these nests feedings became fewer but undoubtedly more copious as the youngsters grew older. Likewise at both, the nestlings were at first fed singly, or only exceptionally both together; later they were usually fed simultaneously, with their heads on opposite sides of the parent. The change from single to simultaneous feeding occurred at about the time the nestlings' eyes opened, at the age of about three days for the Blue Ground Dove, four days for the Talpacoti Dove. So long as the young were sightless, sticking their bills into their parent's mouth at the same time was a matter of blind luck and did not often occur; after they could see, they experienced no difficulty in sharing each meal, except at times when only one was hungry.

Greatly in contrast to the manner of feeding the nestlings that I have observed in *Oreopeleia*, *Leptotila*, *Claravis* and *Columbigallina* was that at a nest of the Band-tailed Pigeon (*Columba fasciata*) studied by Neff and Niedrach (1946:74). Here the female was not seen to feed the nestling until after it was twenty days old. During its first week the male delivered food thrice daily, between noon and three o'clock in the afternoon. During the second week the number of meals was reduced to two, given by the male each day between noon and 1:30 p.m.

Although exceptional, pigeons are not unique among birds in feeding their young less often as these grow older. According to Tanner (1941) a pair of Ivory-billed Woodpeckers (*Campephilus principalis*) fed newly hatched young about 30 times a day, but later decreased the rate to 15 times. The Gray Woodpeckers (*Picus canus*) studied by Bussmann (1944) increased the rate of feeding from 9 on the first day to 26 on the seventeenth day, when the young reached adult weight; thereafter the rate dropped to 15 feedings per day at the time the young left the nest. Woodpeckers of the genus *Picus* resemble pigeons in regurgitating food in the form of a milky paste. Reduction in the number of feedings is, however, by no means invariable among birds that deliver food by regurgitation, and perhaps not even general. Among hummingbirds (*Colibri*, *Hylocharis*) and the aberrant honeycreeper *Diglossa*, I observed an increase in the rate of feeding as the young grew older.

DEPARTURE OF THE NESTLINGS

It may be recalled that at the nest found in 1947 atop a stump, the nestlings' eyes began to open when they were two days old. A day later they bore sprouting pinfeathers, those of the remiges longest and most conspicuous. When the nestlings were seven days old their plumage began to break out from the ends of the horny sheaths and to expand. The expansion of the feathers of the wings, both remiges and coverts, was particularly rapid, and when only eight days of age the young doves appeared to be fairly well clothed with plumage so long as they kept their wings folded, but were rather naked when they lifted them. The contour feathers of the body had just begun to expand and those on the head were all still tightly enclosed in their sheaths.

When I touched these eight-day-old doves and gently lifted their wings, they made no move to escape. A little gray fly flew out from their plumage where it had been lurking and alighted on a neighboring leaf. Thoughtlessly I made a brusque movement to catch it, and this caused one of the youngsters to hop from the nest. I at once captured it; but as soon as I set it down beside its nest-mate on top of the stump, it jumped off again and started to walk over the ground in the most competent fashion, as though it had long been in the habit of taking solitary promenades. Again I overtook it and replaced it on the nest. This time it stayed. But when I returned less than an hour

later it had gone, leaving alone the nestling that was the older by possibly a few hours. This youngster lingered two days more, leaving the nest between nine o'clock and noon on June 17, when ten days of age.

The following morning I found one of these young doves on the ground close by the stump where it had grown up. As I approached, it took wing and flew low over the ground for possibly ten yards, then walked rapidly off. When I followed, it rose again, flew about 25 yards and vanished amidst the undergrowth. At the age of only eleven days it was well able to keep out of harm's way.

At nest 3, found in 1942 on a dead palm frond, the nestlings departed in somewhat different fashion. Approaching this nest on the morning of June 12, I found the female sitting on it, with the two nestlings resting beside rather than beneath her. She remained motionless until I came within three or four feet, then suddenly flew off. Almost at the same instant, the two nestlings also took flight, and each of the three went in a different direction. The young doves, only ten days old, flew amazingly well and were soon out of sight amidst the undergrowth. It seemed incredible that the egg from which one of these doves hatched had been laid no more than 21 days before. No other bird that I have ever studied flies so well at so early an age, whether counted from the date of laying the egg or the date of hatching. Other birds which fly equally well upon leaving the nest remain longer in its shelter, after longer periods of incubation. Hummingbirds linger in the nest from 18 to 24 days, after 16 days of incubation; kingfishers and motmots a month more or less, after at least three weeks of incubation; woodpeckers a month or more, after 13 or more days of incubation; trogons from 15 to 30 days, after 18 or 19 of incubation. Even passeriform birds develop less rapidly. Swallows, which as a rule fly well when they depart the nest, are three or four weeks old, and hatch from eggs incubated about 15 days; tanagers to fly well must linger in the nest from 16 to 24 days, after 13 or 14 of incubation. One might proceed indefinitely to cite examples of far slower development than that of the Ruddy Quail-Dove, among birds placed higher in the evolutionary scale. Mound-birds of Australia, on the contrary, are said to fly the day they hatch; but their period of incubation is longer than the combined incubation and nestling periods of the doves. Thus, their flight is preceded by a longer period of development.

At nest 3, it seemed that the female Quail-Dove's abrupt departure, rather than my own approach, was the signal for the flight of her nestlings. Some years earlier I had seen almost the same thing at a nest of the White-fronted Dove (*Leptotila verreauxi*): When I approached the brooding parent, it jumped from the low nest and fluttered over the ground as though injured, and then the well-feathered nestling flew off in the opposite direction. In this manner the parent pigeon may help the nestlings to escape in the face of danger. Also, if the nestlings are too young to flee, the parent might defend them against a predator by striking vigorously with its wings in the usual columbine fashion. Thus, the long periods spent on the nest by the parent Quail-Doves, especially the female, when they do not actually cover the older nestlings, might be interpreted as guarding rather than brooding. They are guarding while they sit on the nest beside the nestlings just as Brown Jays (*Psilorhinus mexicanus*), Boat-billed Flycatchers (*Megarhynchus pitangua*) and other birds guard while standing beside it. The nestling Ruddy Quail-Doves at the first nest found in 1942 allowed me to come and stand beside them after they were more fully feathered, and presumably older, than the two which with their mother flew from the nest as I approached. This was apparently because at the time of my visits neither parent happened to be present to stir them by its own abrupt departure.

It is instructive to compare the 10-day nestling period of the Ruddy Quail-Dove

with the 12 or occasionally 14 days of the Talpacoti Dove; the 14 or 15 days of the White-fronted Dove; 12 days for the Inca Dove (Anderson and Anderson, 1948:153); 18 days for the Turtle-Dove and 26 to 35 days for British species of *Columba* (Witherby, *et al.*, 1940:129-146); 30 days for the Band-tailed Pigeon (Neff and Niedrach, 1946:74).

At the time of quitting the nest, the Ruddy Quail-Doves wore a plumage different from that of either parent. The feathers of back and wings were deep olive-brown, with deep buffy-brown tips that contrasted sharply with the ground color. Their eyes were dark brown and their queerly down-bent bills blackish. Their heads were still naked except for the bristly natal down and the sprouting pin-feathers. After their departure their nest was quite clean, unsoiled by the droppings which accumulate on the nests of many kinds of pigeons. The parents had removed and eaten all waste matter.

ADAPTATIONS OF THE RUDDY QUAIL-DOVE FOR LIFE IN THE FOREST

Whole families of the most abundant and characteristic birds of the neotropical region are absent from the Antilles, and few small land birds are common to the mainland of tropical America and the West Indies. The Ruddy Quail-Dove is an exception. It is present, with only slight racial variation, throughout nearly the whole of the forested lowlands of tropical America, continental and insular (except the Lesser Antilles). In what respects is *Oreopeleia montana* particularly fitted for life in the lowland forests? Although pigeons of numerous species inhabit tropical America, most of them dwell in open or bushy country; and of those that live in the forests the majority frequent the tree-tops. Relatively few inhabit the dimly illuminated forest floor where the Ruddy Quail-Dove is at home. How does this pigeon differ from those which live in sunnier situations?

Although in the sunshine the Ruddy Quail-Dove, particularly the male, appears brightly clad in his rich rufous-chestnut glossed with reddish-purple, in deep shadow both sexes are dull and blend well with the brown carpet of fallen leaves, readily escaping notice so long as they remain motionless. Habitually quiet and retiring, upon the approach of a man they steal discreetly away and are difficult to detect. Their nest, even slighter and more frail than that of most pigeons, is usually well concealed by the surrounding vegetation, and the mingled green and brown of the leaves which enter so largely into its composition assimilate it into the adjacent foliage and bark. The buff-colored eggs are likewise less conspicuous than the shining white eggs of nearly all other pigeons. Although some pigeons, including species of *Columbigallina*, *Leptotila* and *Claravis*, keep their first white egg rather constantly covered until the second is laid and incubation regularly begun, the Ruddy Quail-Dove leaves its buffy egg exposed during this interval. Apparently the tinted egg is less likely to attract a predatory eye, and there is less need to keep it concealed beneath the sitting bird.

In the tropical forest where an amazingly high proportion of all eggs and nestlings are taken by predators, the rapid passage of the developing bird through these vulnerable stages is of the greatest importance to the survival of the species. Antbirds and manakins, whose nests are among those most frequently found in the undergrowth of the forest, have, for small passerine birds, long incubation periods but short or moderately long nestling periods, those of some of the antbirds being particularly short. But the Ruddy Quail-Dove is by its rapid development even better fitted to pass through the perils of the tropical forest, for both incubation and nestling periods are exceptionally short, not only for pigeons but for birds as a whole. After only eleven days of development within the shell and eight more as a nestling, the young dove can walk in a competent fashion; and two days later it can fly too well to be captured by a man.

By keeping their nests perfectly clean, the Quail-Doves also appear to increase the probability of escaping predation. Although a few other pigeons, including species of *Leptotila* (some of which dwell in the tropical forest), likewise remove all excrement from the nest, attention to the sanitation of the nest appears to be exceptional in the family. The Scaled Pigeon (*Columba speciosa*) and Red-billed Pigeon (*C. flavirostris*) keep the nest clean for a number of days after the nestlings hatch, but afterwards neglect to remove droppings; while Talpacoti Doves and Blue Ground Doves are at all times careless of cleanliness, with the result that their nests become very foul.

SUMMARY

The Ruddy Quail-Dove (*Oreopeleia montana*) inhabits humid lowland forests, up to 3000 or 4000 feet above sea-level. It forages over the ground, eating fallen fruits and small invertebrates, and unless closely pressed prefers to walk rather than to fly.

North of the Equator it appears to breed chiefly from April through June. In the basin of El General in southern Costa Rica, seven sets of eggs were found between April and mid-July, but only one of these sets was laid later than June.

The nest is placed amidst the undergrowth of the forest at heights of from one to eight feet, in a bush, atop a stump, or on any flat surface that will support it. The slight platform consists of coarse twigs and leaves, many of which are green when brought by the doves.

The full set consists regularly of two eggs, which are buff or cream-color rather than pure white as with most pigeons. Unlike many pigeons, the Quail-Doves do not keep the nest covered during the interval between laying the first and second eggs.

Incubation is carried on by both parents. The male covers the nest most of the day; the female replaces him about the middle of the afternoon and sits until he returns next morning. At one nest the male arrived later on succeeding days, until at the middle of the incubation period he would come at about 8 o'clock; then as the eggs neared the point of hatching he came earlier again, between 6:30 and 7:00 on the last two days of incubation. Through most of the incubation period the female arrived to relieve the male between 3:30 and 5:00 p.m., but when the eggs were about to hatch she came earlier, just as the male did. In the middle of the incubation period the male's daily session on the eggs lasted from 8 to 9 hours.

The doves approached the nest by walking over the ground. When coming to take a turn on the eggs, they usually brought a twiglet or a green or dying leaf for the nest.

When danger threatened, the doves, whether covering eggs or young, would lower head and breast and elevate the tail, at the same time compressing their plumage to make themselves appear smaller. This attitude was taken in its extreme form when toucans passed overhead.

At one nest the period of incubation of the second egg was 11 days 10 hours \pm 8 hours, at another it was 10 or 11 days.

One male with great effort disposed of an empty shell by swallowing it.

Both parents fed the young. During the first day after hatching the nestlings were fed one at a time, but when two days old they inserted their bills at opposite sides of the parent's mouth and were fed simultaneously, this method then prevailing until they left the nest.

Day-old nestlings were fed 22 times in a day, but as they grew older they received fewer meals per day until when about a week old they were given only three. The male then fed once daily, generally before sunrise, and soon after delivering the meal flew away, to remain out of sight until the following morning. The female, who generally fed older nestlings twice daily, was less regular in her schedule, feeding twice in the

early afternoon, or at another nest once in the middle of the morning and once late in the afternoon. The feedings of recently hatched nestlings lasted from a fraction of a minute to 3 or 4 or rarely 5 or 6 minutes. Older nestlings sometimes kept their bills in the parent's mouth for 10 or 15 minutes continuously, and once for 25 minutes.

The parents kept the nest perfectly clean at all times, swallowing all droppings after feeding the nestlings or, with younger nestlings, in the intervals between feedings.

When frightened, an eight-day-old nestling jumped to the ground and walked off in a competent fashion. Three other doves departed at the age of ten days, when they could fly amazingly well.

One pair, which reared a brood of two young at least to the age of nest-leaving, laid a second set of eggs on the reconditioned nest, a month after the departure of their first brood.

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