

LIFE HISTORY NOTES ON PUFF-BIRDS

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THE Bucconidae, or puff-birds, are a family of about 30 species of small or middle-sized arboreal birds confined to the tropical American mainland. Abundant loose plumage, relatively big heads, and short tails give many of the species a stout, "chunky" appearance. The puff-birds are rather somberly colored in shades of brown and deep grays, often conspicuously spotted and streaked, or with boldly contrasting areas of black and white. The bill is short or medium, often notably stout, terminally decurved or more or less strongly hooked. The feet are zygodactyl—with two toes directed backward. The family is best represented in the Amazon Valley and northern South America, and only three species occur in Central America, north of Panamá.

Despite infinite searching through the forests of Central America, I have found but two nests of puff-birds, one of the Black-breasted Puff-bird and one of the White-whiskered Soft-wing; both were destroyed before life history studies could be completed. But in view of the paucity of our information on the breeding habits of this family, it seems desirable to publish my notes (though more or less fragmentary) on these two nests. In an attempt to round out a picture of this interesting family, I present also brief notes on two puff-birds of South America: the Black-fronted Nun-bird and the Swallow-wing.

BLACK-BREASTED PUFF-BIRD

Notharchus pectoralis (Gray)

The Black-breasted Puff-bird is of medium size—about eight inches in length. In both sexes the plumage is predominantly black, with conspicuous areas of white on the auricular regions, on the chin, throat, and hind neck, and on the abdomen. A black band across the breast extends upward between the white of the auricular regions and the throat. The black feathers of the head, upper back, and breast are glossy, with a bluish tinge; those of the lower back, rump, upper tail coverts, tail, and wings are duller, more slate-colored than black, many of them with narrow white margins at the tips. The eyes are dark, the bill heavy and black, the legs and feet dusky. The bird is well illustrated by F. L. Jaques (in Sturgis, 1928:pl. 14) and by Sclater (1882: pl. 24). It inhabits a restricted area of lowland forest extending from the Canal Zone to central Colombia.

I have found the Black-breasted Puff-bird only on Barro Colorado Island, Canal Zone, and even here I saw it only rarely except while I was watching at a nest. Apparently it remains most of the time well up in the trees, where it is seldom seen from the ground; the nesting pair that I watched, when approaching or leaving the nest, flew

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through or even above the treetops, but the woods of the nest area were low. Like other puff-birds, the Black-breasted Puff-bird sits for long periods on the same exposed bough, its feathers fluffed out, a picture of stupid lethargy. But although outwardly motionless, it is ever alert. Let any edible insect appear, whether flying in the air or crawling over leaf or bark, the "stupid" puff-bird darts swift and straight, seizes the insect in its strong bill, returns promptly to its perch, and pounds the victim loudly against the branch before gulping it down. Then the bird remains quietly perching until another morsel tempts it into action.

Voice. Even with its voice, the puff-bird appears never to expend its energy unnecessarily. The construction of the nest calls forth outbursts of song from many birds, especially from the related jacamars; but my pair of Black-breasted Puff-birds voiced only low, whispered *peep's* while so engaged. This, and a nasal sound uttered when they were disturbed at the nest, were the only notes I heard from them during many hours of watching.

Nest-building. While wandering through an area of second-growth woodland on Barro Colorado Island on March 28, 1935, I heard a low tapping sound which led to the discovery of my first pair of Black-breasted Puff-birds. They were digging into the side of a very large black nest of termites (the species was determined by Dr. A. E. Emerson as *Nasutitermes pilifrons*), which was situated about 30 feet above the ground, far out on an ascending branch of a small tree that was leafless but apparently living. The tree grew beside a narrow open space amidst the woods, which facilitated subsequent observations. Since the morning was already far spent, I went away, after noting that the birds had made a very shallow depression in the side of the termite. Evidently they were just beginning to excavate their nest-chamber.

When I returned next morning at a few minutes before eight o'clock, I failed to find the puff-birds in the vicinity; I wandered about but at 8:45 heard tapping and returned to the observation post that I had already chosen, a fallen log from which I had a good view of the termite. I found the pair perching quietly on a slender, leafless branch in front of their hole in the side of the black mass. They appeared not to notice my approach, although I made no attempt to conceal myself. Soon one flew to the excavation and clung to its rim; it clutched the lower edge of the shallow depression in the side of the termites' nest, its short black tail propped against the outside of the nest, and its head bent forward into the hole, so that from my position on the

ground I could not see it. In this attitude it remained almost motionless, but at fairly long intervals took a few pecks at the termitary. Four taps were the most that I heard at a time; and each short spurt of activity was followed by a relatively long period of silence and immobility. I could not see the head of the bird, and it is possible that it was devouring the termites which came out to defend their nest. After clinging in this manner for about 15 minutes, the bird flew out and rejoined its mate on the leafless branch. A few minutes later the mate flew to the termitary and behaved as the first had done. It hammered audibly at the structure more frequently than the first, yet still very little. It remained only six minutes and, upon leaving, darted to the trunk of the tree, plucked an insect from the bark, and flew with it to a horizontal swinging vine not far distant. It knocked the insect against the vine, then swallowed it. Six minutes later the first bird returned to the termitary. So long as I watched them (8:45-10:12 a.m.), the two thus alternated, remaining from less than one minute to as much as 12 minutes clinging in front of their excavation. Sometimes they hammered more, sometimes less; but always their tapping came between long periods during which, so far as I could see or hear, they were inactive; and neither tapped more than four times together.

The member of the pair not at work usually sat motionless on the bare limb with feathers puffed out in characteristic fashion. At intervals it made a long dart to pick some insect from a distant branch or leaf. Both members of the pair were perfectly silent, except for a low, whispered *peep* that I heard at times. At 10:12 the bird which had been at the termitary flew out and away, and five minutes later the mate followed. What a contrast these stolid birds made with alert and lively jacamars, timid trogons, noisy kingfishers, hard-working woodpeckers, and all other birds I have watched dig their nest-chambers in earth or wood or termites' houses!

By April 3 the hole in the side of the termitary had become so deep that when the puff-birds were at work in it the tip of the tail just reached the rough black outer surface of the structure. They devoted long hours to their task, and I found them at the termitary both morning and afternoon. They flew away just as I approached at about 8 a.m. on April 3, but their departure was evidently spontaneous, since they seemed completely indifferent to my presence. In 15 minutes one of the pair returned and went promptly to work, while a moment later the second arrived on the perch where they always awaited turns at the task. They alternated at the work as before, but one spent considerably more time in the termitary than the other. Between 8:15 and 9:53 this bird gave 57 minutes to the task, while the mate, which I could distinguish by a disarranged tail feather, remained at work a total of only 30 minutes. The greater time given by the first was accounted for

by two long shifts of 16 and 17 minutes, respectively. The other periods of work of this bird were of 5 to 7 minutes' duration, and those of the mate lasted from 2 to 6 minutes.

While at work, they frequently uttered the low, soft peeping, which was the only vocal sound that I had so far heard from them. The bird waiting outside sometimes darted after insects, often to a considerable distance; but there was no courtship feeding. During the longer shifts, the puff-bird sometimes emerged from the cavity and rested for a short time while it clung to the lower edge of the hole. Perhaps when I first watched I had underestimated the amount of work that they actually performed while inside the cavity. With my ear pressed against the trunk of the supporting tree, I could hear sounds from within the termitary which were otherwise inaudible to me. The tapping was far more frequent than I had supposed from the louder taps which alone had reached me where I had been sitting. There were also sounds which seemed to indicate that the puff-birds crunched or tore at the substance of the termitary, in addition to pecking at it.

Returning between four and five o'clock that afternoon, I found the puff-birds at work. They stayed in the termitary for briefer periods than in the morning, and changed about more frequently. In the morning I had been obliged to watch the birds against the sun, but now I had the sun behind me and received a far more striking impression of their contrasting white and glossy bluish-black plumage.

The puff-birds were still working at their hole in the termitary in the middle of the afternoon of April 10, at least 14 days after they had begun it. On April 13, I managed to reach the nest. I nailed cleats to the trunk to facilitate frequent visits; and since the branch that supported the termitary seemed too slender to bear my own weight in addition, I braced it with a rope tied to the central trunk. Even after I had climbed to the termitary I could not see into the puff-birds' nest, whose entrance opened on the outer side, away from the trunk. To overcome this difficulty, I laid a stout pole between the nest-tree and the crotch of a neighboring tree. Then, standing upon the horizontal beam and steadying myself with one hand upon the branch that supported the termitary, I could at length look into the opening. The next day I noticed that the termites were eating away the supporting rope and the lashings, and I replaced all the cordage with wire for greater safety.

When examined on April 13, the puff-birds' nest-cavity seemed to be completed. A narrow, horizontal tunnel, about 7 inches in length by $1\frac{7}{8}$ inches in diameter, led into the top of a spacious, neatly rounded chamber in the heart of the termitary. To see anything in the dark interior it was necessary to use artificial illumination, in the form of a small electric bulb attached to the end of wires leading to an electric

torch that was hung close by. A small mirror, pivoted transversely on the end of a long handle, revealed portions of the chamber that could not be viewed directly.

When I began to nail the cleats to the trunk of the tree, the puff-birds, which were resting on their favorite perch in front of their nest, remained where they were until the vibration as I advanced higher drove them away. During the next 10 days I visited the nest on alternate days. I usually found one of the pair of puff-birds standing guard on the perch in front of the entrance. Despite the shaking of the slender branch as I climbed toward the bird, it stayed quietly where it was until I came within two or three yards of it, when it flew silently away. Twice I chanced to find a bird in the nest, where it remained, considerably shaken by the swaying of the termitary caused by my movements, until I had seated myself on the cross-piece in front of the nest and begun to arrange the lighting apparatus, when it flew out past my ears, uttering a nasal sound.

The eggs. On April 23 I was delighted to find that the first egg had been laid. It was placed so near the back of the chamber that when I put in the light I could see it without the mirror. The egg seemed small in proportion to the puff-bird. It was pure white, with a beautiful glossy shell, and resembled the egg of a woodpecker. It reposed on some chips of the hard black substance of the termitary, which had not been removed; no material of any kind had been brought into the chamber to line the nest. On April 24 I found the second egg; and the third and last was laid on April 26, indicating that the eggs were deposited at two-day intervals. During the period of egg-laying one bird stood guard in front of the nest, as during the 10-day interval between the completion of the nest and the deposition of the first egg. I made all my visits during the afternoon, in order to be less likely to disturb the female while she was laying.

Incubation. On the morning of May 3 I took up a position in view of the nest at 5:45, just as the darkly overcast sky was beginning to brighten from black to gray. At 6:16 the puff-bird which had passed the night on the eggs appeared in the doorway of the nest. The pure white throat was the only part of the bird which was plainly visible as it paused in the entranceway to look out upon the forest dripping after the night's hard showers and still dim beneath a dense mantle of clouds. After a minute's delay, the bird launched forth and flew with short, swift wing-strokes over the treetops and beyond my range of vision. At 6:33 a member of the pair arrived and, after a brief survey of the immediate surroundings, entered the nest. It was impossible to tell whether this was the bird which had left 17 minutes earlier or (which

is more probable) the mate. This bird sat in the nest for nearly three hours while I watched, drenched by the heavy showers that had meanwhile begun to come down. At 9:15 it came to the doorway, looked about with its head framed in the round aperture, then flew forth. It paused for many minutes among the branches near the nest, then flew out of sight over the low trees. Since, without seeing one bird relieve the other, I could not make certain whether one or both incubated, I decided to leave. Just as I was passing beneath the nest, at about 9:30, a puff-bird arrived to enter it. I stood still to watch, but I was too near, and after a little hesitation the bird flew away again.

Arriving at the nest at 1:57 p.m. on May 5, I found a puff-bird perching quietly in front of it. Here it remained for half an hour, sometimes stretching its wings, and once catching a big flying insect, but mostly it sat motionless. The record of the following hour and a half is given below:

- 2:30 The puff-bird entered the nest.
- 3:03 It left, paused a few minutes on the perch in front of the nest, then joined its mate in the next tree.
- 3:25 After pausing for some time in the vicinity of the nest and catching two insects, a bird entered.
- 3:32 It left and rested in front of the nest.
- 3:50 It entered again.
- 4:01 It left and perched in front of the nest.

This was most erratic behavior on the part of birds that had been incubating their eggs for nine days and that were capable of sitting nearly three hours at a stretch. I decided to look into the nest and see whether anything was amiss. The puff-bird that had just left the nest remained perched in front of it while I climbed the tree. When I was only about six feet away, it flew to a more distant perch in the next tree, and sat, silent and stolid, only turning its head from side to side as it watched me, during the entire time I was at the nest.

The electric light revealed the eggs safe and sound in their usual position. A few small black ants were crawling around the interior of the chamber, and in and out through the entrance tunnel, but they had been present since before the eggs were laid and were, moreover, perfectly innocuous. I could see no cause at all for the puff-birds' uneasiness.

Upon reaching the nest on the afternoon of May 6, I found one of the pair perching quietly on the pole that I had fixed transversely in front of the termitary. The bird retained its position despite shaking until I came within six feet. At this distance I paused to look at the chubby little creature, so oddly marked with black and white, and

to gaze into its large, alert dark eyes. Only when I began to move closer did it take wing and dart over to a perch in the next tree, about 12 or 15 feet away, where it remained to watch my proceedings. The eggs were not in their usual position, where I could see them the moment I switched on the light. I stuck in the mirror, and turning it and the electric bulb from side to side, explored all the darker portions of the chamber to learn whether the eggs had been displaced there. But the result of all my searching was negative. I spent about half an hour at the nest; and all this time the puff-bird that was present when I arrived lingered in the same spot, intently and silently watching me, turning its big head at intervals from side to side. Before I descended, the mate arrived and perched near the first bird.

I had hardly reached the ground when one of the puff-birds flew to the perch in front of the nest, where it was soon joined by the mate. Then the first bird flew to the entrance of the nest and clung there, apparently wanting to enter, yet fearing to do so. It pushed its head in a little way, then backed out, then pushed in again, a little farther. It was plainly torn between two conflicting impulses. At length, without having penetrated to the nest-chamber, the bird retreated and joined its mate on the perch. The latter then went to the entrance, repeated the same performance, and came back without having entered. Then the first flew again to the doorway, but was no more courageous this time than last, and rejoined its mate on the branch in front of the nest. Finally the second puff-bird went the second time to the entrance and, slowly and cautiously, sometimes advancing, sometimes retreating, arrived at last at the chamber. While these explorations were in progress, the two birds uttered occasional monosyllabic *peep's*, somewhat louder than I had heard them voice before, but still not loud.

After a minute the puff-bird came out head first, proving that it had gone all the way into the chamber, where alone there was room to turn around. It joined the mate on the perch, and after four minutes the other went inside, though not without considerable hesitation. This was its third attempt to enter. It remained within for two minutes, then emerged head first, as the other had done. Then the second, which meanwhile had withdrawn to a more distant perch, flew again to the entrance, uttering a peculiar, low, nasal sound as it went past its mate, which had remained on the branch in front of the nest. It went inside, came out after a minute, then after a pause went in once again, making three times in all. After its third exit it flew off to a more distant perch. The first puff-bird went yet again to the entrance, where it clung and called with weak *peep's*, then flew off to join the mate, without having entered the nest. The birds devoted 40 minutes to their apparent hunt for the vanished eggs, before at last they flew off over the treetops.

And what could have taken the eggs? No hawk nor owl nor toucan could have entered the chamber, nor reached the eggs through the long, narrow entranceway. Any mammal slender enough to creep in would have been too small to remove the eggs in its mouth, and must have devoured them where they lay, leaving tell-tale particles of shell. But a snake could easily have slipped in and engulfed them whole, leaving no trace of its visit.

Bitterly disappointed by the loss of the puff-birds' eggs on May 6, I did not revisit their nest until May 30, when other business took me into that part of the forest. To my great surprise, the nest was occupied again. Despite the rather violent shaking caused by my climb up the slender supporting branch, the puff-bird that was sitting in the chamber did not dart out until I actually reached the termitary. Pushing in the electric light, I saw three eggs resting where the first three had lain. Instead of being immaculate white, as the first set had been when newly laid, these had become soiled and were covered with blackish speckles. Apparently they had been deposited a number of days earlier. Trogons' eggs laid in termitaries also become heavily soiled.

I had only two days more to remain on Barro Colorado, and in a last-minute effort to answer the question whether one or both members of the pair incubated, I watched again late on the afternoon of May 31. This time I was successful in witnessing the replacement of one by the other. One puff-bird was within when I began my vigil at 3:40 p.m. I observed no sign of activity at the termitary until 4:23, when the mate came flying through the treetops and settled on a high bough about 20 feet from the termitary. I was more than 40 feet away and heard no sound, but the puff-bird in the nest evidently did, for it came to the doorway. Here it paused a minute or two, looking out, then flew forth and alighted on a twig in front of the nest, where it delayed for several minutes, puffing out its feathers and uttering low *peep*'s. Next it went to a more distant perch and delayed longer, before at last it winged away over the treetops. The new arrival lingered where it had first come to rest, then flew to the perch in front of the nest and delayed still more, knocking the sides of its bill alternately against the branch. Finally, 23 minutes after its arrival, it entered the nest to stay—and at last I knew that the two sexes of the Black-breasted Puff-bird share the incubation of the eggs. It sat in the nest for 78 minutes (until 6:04), when it came out and lingered for 19 minutes on the perch in front, then flew away through the treetops. At 6:50 this bird or, more probably, its mate came out of the forest and after hesitating a minute or two entered the termitary, when the fading light had become so dim that I could hardly distinguish it. This was my last glimpse of a Black-breasted Puff-bird.

I had watched this nest for a total of 7 hours while incubation was going on. The 5 sessions on the eggs which I timed ranged from 7 to 162 minutes and averaged 58.2 minutes. Five periods when the eggs were unattended ranged from 17 to 46 minutes and averaged 25.2 minutes. The nest was occupied by one member of the pair or the other for only 70 per cent of the 7 hours. In their manner of incubation these puff-birds much resembled such toucans as the Blue-throated Toucanet (*Aulacorhynchus caeruleogularis*) and Frantzius' Araçari (*Pteroglossus frantzii*). The toucans, like the puff-birds, take sessions of very irregular length, now fairly long, now very short, and often go off before the mate arrives to replace them, leaving the nest unattended, so that one must watch long and patiently to assure himself that both members of a pair share the task of incubation. One of my Black-breasted Puff-birds sat once for a period much longer than I timed at nests of either of these far bigger toucans, and the sessions of the pair also averaged longer. Jacamars keep their eggs far more constantly covered.

The Black-breasted Puff-bird's habit of nesting in a termitary is not unique in the family. Cherrie (1916:321) found a nest of the Two-banded Puff-bird (*Hypnelus bicinctus*) in a termitary at Caicara on the Orinoco. An entrance tunnel about 8 centimeters in diameter led to a spherical chamber about 15 centimeters in diameter, hollowed out of the heart of the termitary. He records that one of the parents remained in the cavity, covering the single fresh white egg, while he cut and hacked at the hard, tough structure and the insects swarmed out everywhere over the nest in countless numbers. There was no lining in the chamber; the egg was deposited on the debris at the bottom of the nest-cavity. Because I did not cut into the termitary that contained the Black-breasted Puff-birds' nest, I saw practically nothing of the insects; they had sealed off the innumerable passages leading into the part of their dwelling occupied by the birds. The same thing occurs when trogons carve their nest-cavity in a termitary.

WHITE-WHISKERED SOFT-WING
Malacoptila panamensis Lafresnaye

The Soft-wing is a stout bird about seven inches in length. Its soft, loose plumage is colored with many blended shades of brown, chestnut, tawny, and buff which in aggregate give the bird at a distance a bright reddish-brown hue. From close by it is seen to be profusely spotted and streaked with tawny and pale buff on the upper plumage, and, on the under parts, broadly streaked with brown and dusky. *M. p. panamensis* is more liberally streaked than the northern

race, *inornata*. At the base of the bill are mustache-like tufts of white or whitish feathers, for which Sclater (1882:119, and pl. 40) called the bird the "White-whiskered Soft-wing" (the substantive a loose translation of the generic name)—a most appropriate English appellation which has been strangely ignored by later authors. The bird's eye is large and red; its bill rather long, stout, slightly curved, and dark above; its legs and feet yellowish gray. The coloration of the female is much less bright than that of the male, but in the dim light of the woodland it is not easy to distinguish the two.

The species, as a whole, ranges from western Ecuador to southern Mexico. On the Pacific slope of southern Costa Rica I have met the bird as high as 4,700 feet above sea-level, but it is much more abundant below 3,000 feet, and in general throughout its Central American range is known only from the Tropical Zone. A species of the rain forest, northward of Costa Rica it is largely if not wholly confined to the Caribbean side. In the forest the Soft-wings are usually seen within 15 or 20 feet of the ground; but I suspect that they spend a good part of their time at considerably greater heights, although because of their habitual immobility they are not often discovered among the taller trees until one becomes familiar with their voice. Not infrequently they wander from the primary forest into neighboring areas of older second growth, and occasionally I see them in the shady pasture in front of my house, hard by the forest. Like other forest birds, they seem often to come to the edge of an adjacent clearing in the twilight, apparently to enjoy a slightly longer period of daylight and to hunt food at a time when the illumination beneath the tall trees is too dim for this activity. Usually I have found Soft-wings singly, but not infrequently one individual will attach itself to a mixed flock of small birds of other species.

My notebooks contain no better word-picture of the Soft-wing's behavior than that which I wrote many years ago after my first meeting with the species. On the afternoon of September 4, 1930, John T. Emlen and I were following a trail through tall second-growth woods, in the Lancetilla Valley near the Caribbean coast of Honduras, when we met a Northern White-whiskered Soft-wing (*inornata*) resting upon a small bough 10 feet above the path. It permitted a close approach and sat motionless, very upright, while we examined the details of its plumage through our field-glasses (although most were clearly visible to the naked eye) and described them minutely to each other in voices perfectly audible to it. It was quite silent during the quarter of an hour or more that we had it in view, and while perching was motionless except that several times it rapidly about-faced on the branch, thus alternately exposing its front and back to our close scrutiny. While it appeared dull and stupid, it was by no means asleep, for its

eyes were ever watchful for creatures crawling over the surrounding foliage. When it espied its prey, usually below the level of its perch and at a distance of 10 or 15 feet, it darted out rapidly, and we distinctly heard the loud *clack* of its heavy bill as it closed upon the booty. Then it returned to a perch, usually the same, to sit quietly until some other suitable morsel presented itself. Once it shot straight toward us and picked up some insect in the grass beside the trail, not 10 feet from where we stood. In its habit of sitting motionless, scanning the foliage for insects, its rapid darts upon the prey and return to the same perch, and its habitual silence, it greatly resembled the Turquoise-browed Motmot (*Eumomota superciliosa*) of the same region, but permitted an even closer approach than the latter. After we had proceeded on our way and crossed the river we saw another Soft-wing, or perhaps the same again, perched low above the trail; and in the dim light of evening, I almost bumped into it before it took flight.

Because of its habitual fearlessness of man, and its habit of remaining motionless like a heron or kingfisher while keeping a sharp lookout for its prey, this puff-bird and many others of its family are frequently called "stupid," especially by collectors.

Voice. The Soft-wing is no more gifted in voice than the other puff-birds I know. The only notes that I have ever heard from it are thin, weak whistles or *peep*'s, but these vary considerably in length and intonation. While I sat in a blind amidst the forest on Barro Colorado Island in the Panamá Canal Zone, watching a nest of an antwren, a Soft-wing perched motionless for more than a quarter of an hour on the low twig of a sapling about 20 feet away, and repeated low, peeping notes which even at this distance were scarcely audible. At other times I have heard the bird utter a high, thin, sibilant whistle. One afternoon in May, in the forest in the basin of El General, Costa Rica, I watched a Soft-wing as it perched on a lower bough of a tall tree and delivered repeatedly a long-drawn, thin, sharp, high-pitched *tzeeee tzeeee*. As he voiced these notes, he twitched his tail far to one side, then far to the other, holding it motionless for a few moments at the extremity of each beat. I have often heard notes of this character floating down from somewhere above me in the heavy forest, but usually without being able to pick out their author with my eyes.

Nesting. On June 8, 1943, I found in the forest close by my house in El General the only nest of the White-whiskered Soft-wing that I have ever seen. It was in a burrow on a hillside which, although steep, was by no means precipitous—a horse could have climbed straight up. The forest was high, with a lofty closed canopy, and the undergrowth of bushes and saplings open and easy to walk through.

The ground, carpeted with fallen leaves and other litter, bore only a sparse, scattered cover of low ferns and saplings. The burrow descended obliquely at an angle of about 30 degrees with the horizontal. It was about $2\frac{1}{4}$ inches in diameter, perfectly straight, with a roomy chamber at its lower end. The total length from the entrance to the back of the burrow was $20\frac{1}{2}$ inches. The chamber was lined on bottom and sides with large pieces of dead leaves, upon which rested two pure white eggs. The mouth of the tunnel was surrounded by a low pile of decaying twigs, some thorny, and dead leaves. On top of these were three big whole leaves, the largest 12 inches long by 4 inches wide. The edges of these leaves just touched the mouth of the tunnel. Although I thought the burrow had been dug by the birds, there was no fresh earth visible below it. Possibly when excavating, the Soft-wings carried the loose earth away in their bills, as chickadees and barbets remove the chips when carving their nest-cavity in wood; but if they actually did this, the excavation of the burrow must have been a long and laborious task. The nest was so well hidden, its mouth closely surrounded by dead leaves in the midst of the long, leaf-strewn slope, that I might have passed over it without becoming aware of its existence if a bird had not flown out as I walked by.

The two immaculate white eggs formed the complete set, for on subsequent days the number did not increase. I wanted to study the pattern of incubation at this nest, but because of the steepness of the slope and the positions of the neighboring trunks, the only point which offered accommodation for a blind was close in front of the burrow. I feared that alterations in the surroundings so near the nest might reduce its chances of escaping predatory animals.

On my subsequent visits to the nest, I almost always found a puff-bird in charge. As I came near, it would emerge, fly to a bough above my head and repeat over and over its high, thin, long-drawn whistle. Then it would rise into the crowns of the trees and vanish. Or sometimes it would, upon leaving the burrow, fly without stopping into the upper levels of the forest, whence the whistles floated down from the unseen bird. But if I approached very softly and cautiously, I might throw in the beam of my electric torch and surprise the Soft-wing in the nest. It would always be facing outward as it sat on the eggs, and the large, deep red eyes shone brightly in the beam of light. As soon as I extinguished the light and stood to one side of the doorway, it would emerge and fly swiftly out of sight. Sometimes, upon looking into the tunnel after the bird's departure, I would see a number of dark-colored flies, as big as house flies, resting upon the white eggs.

When I approached the nest at 10 o'clock on the morning of June 17, both parents repeated their thin whistles almost continuously, but they were well up among the trees where I could not see them. Looking into the burrow with the electric torch, I saw that the eggs had

hatched. The nestlings were pink-skinned, completely naked, and had tightly closed eyes. Their short, sharp bills curved downward at the tip; the lower mandible did not exceed the upper in length, as with newly hatched woodpeckers, kingfishers, and jacamars. I could not see the nestlings' feet and did not wish to open the burrow and remove the birds for a closer examination, knowing that such interference would diminish their slender chances of living to fly from the nest. The young Soft-wings moved around rather actively upon their leafy bed, apparently trying to escape the light.

Two days later the nestlings had vanished, although the burrow and its surroundings were unaltered. I believe that only a snake could have entered to swallow the nestlings. I heard the parents whistling in the vicinity but could not see them; and if later they made another nest in that part of the forest, it escaped my search.

I have not seen any published description of the nest of the White-whiskered Soft-wing (*Malacoptila panamensis*), but Arbib and Loetscher (1935:327) report having found it breeding in the Panama Canal Zone during July and August. Todd and Carriker (1922:227) describe briefly a nest of the closely related Mustached Soft-wing (*M. mystacalis*) discovered in the Santa Marta region of Colombia: "The nest is placed at the extremity of a hole in a bank of earth, excavated by the birds to a depth of nearly two feet (in the case of the one examined). The tunnel proper is from two to three inches in diameter, while the nest-chamber at the end is enlarged to be about six inches across and four inches high. The nest is very slight—merely a few twigs and dead leaves. The one examined was in a bank by the roadside, where people and animals were passing daily; it contained one young bird, nearly fully fledged."

BLACK-FRONTED NUN-BIRD

Monasa nigrifrons (Spix)

The most memorable event of my visit on October 6, 1940, to the Río Yavarí, a southern tributary of the Amazon which forms part of the boundary between Perú and Brasil, was a meeting with a flock of Nun-birds. While we examined a rubber tree in a riverside plantation, a small flock of these birds perched in the boughs close above us. They were very tame and allowed us to see them well. They were dark on all the upper parts, wings, and tail, and their under plumage was dark gray. Their only bright color was on the strongly tapering bill, which was brilliant orange. Cherrie (1916:322) states that in Venezuela a related species (*M. niger*) has a poppy-red bill and is called *pico de lacre* (sealingwax-bill), a name which would equally well fit the Peruvian bird. Their eyes were large and dark, their feet blackish. While perching quietly above us they voiced soft musical murmurs, the while twitching their black tails from side to side.

The Nun-birds appear to be more sociable than the majority of the puff-birds, and a careful study of their habits might reveal some interesting relationships. But we are fortunate in having a description of a nest of the Black Nun-bird (*Monasa niger*) found by Cherrie (1916:322) in the Orinoco region of Venezuela on May 27, 1907. This was in a burrow situated in a belt of heavy timber bordering the San Feliz River. The tunnel was about 7.6 centimeters in diameter and 1.5 meters in length, and went down into the level ground at an angle of about 45 degrees with the surface. Covering the entrance was a pile of coarse and rotten dead twigs, as large as a half-bushel measure, and "unquestionably of recent construction." The mouth of the burrow itself was reached through a rounded tunnel which ran along the ground beneath the pile of sticks. So cleverly concealed a nest would not have been discovered had not the cries of the well-grown young, issuing from beneath the brush pile, drawn Cherrie's attention. In the presence of a pile of dead vegetation over the entranceway, the burrow of the Nun-bird resembles that of the Soft-wing, but in the Nun-bird this feature was far more strongly developed; the Nun-bird likewise left no loose earth about the entrance.

SWALLOW-WING

Chelidoptera tenebrosa (Pallas)

While voyaging with a rubber survey party over the waterways of eastern Perú in the gun-boat *Amazonas*, I saw much of the Swallow-wings along the shores of the Amazon, the Marañon, and their great tributaries, the Huallaga, Ucayali, and Napo. Swallow-wings are about the size of a large swallow, but stouter of body and with a bigger head. In plumage they are chiefly black, but with the rump pure white, the abdomen rufous, and the under tail coverts dull white. The pointed tips of the long wings, when folded, reach almost to the end of the short tail. The bill, fairly stout at the base but tapering to a sharp tip, is black and markedly curved. The feet are blackish and the eyes dark.

These birds rested, generally in pairs, on the topmost leafless twigs of tall, dead or dying trees along the shores, whence they made long aerial sallies in pursuit of insects, returning usually to the same high lookout to devour their victims and await another capture. It did not occur to me that these "flycatchers" might be puff-birds until months afterward, when I found them depicted among other members of this family in Goeldi's "Album de Aves Amazonicas." But when one gives thought to the matter, it is clear that the Swallow-wing has only developed to a higher degree the insect-catching arts of its relatives *Notharchus* and *Malacoptila*; it pursues the insects above the trees rather than among them, with a corresponding increase in

radius of action and ease of flight. The only note I heard from these Peruvian Swallow-wings was a weak whistle. From the Amazonian plain I traced them upward into the Andean foothills; the highest seen was near San Ramón Chanchamayo, at about 2,700 feet above sea-level.

Like the Soft-wings and Nun-birds, the Swallow-wings nest in burrows in the ground. According to Cherrie (1916:323), who found the species not uncommon along the Orinoco, frequenting open glades in forested regions or the light woodland bordering savannas, they may dig their tunnels either in the bank of a stream, like a Bank Swallow, or in level ground. The straight shaft slants downward at an angle of about 30 degrees with the horizontal and varies from about one to two meters in length. At the nether end is a slight enlargement where the eggs, pure white and generally two in a set, rest upon the bare ground or on a few bits of dead grass. The birds apparently carry off in their bills all the earth they excavate, for no loose dirt was found about the mouth of the tunnel. No mention is made by Cherrie of a pile of leaves or sticks over or around the orifice of the burrow, as with those of *Monasa* and *Malacoptila*. The young Swallow-wings are hatched perfectly naked, like the nestling Soft-wings, but their skin is slate black instead of pink. When they are about half grown and their pin feathers begin to appear they are said to creep out to the entrance of the burrow, where they sprawl in the sun while awaiting the visits of their parents with food. If suddenly alarmed, they scuttle backward into their burrow, never pausing even long enough to turn around. The bottom of nests containing older young swarm with maggots that thrive in the excrement and cast-off parts of the insect food—chiefly small beetles—with which the young are nourished. Cherrie records that he found four nests between March 2 and May 8.

SUMMARY

The Black-breasted Puff-bird (*Notharchus pectoralis*) lives among the crowns of the trees in the lowland forests of eastern Panamá and northern Colombia. It perches motionless much of the time, breaking its long periods of immobility by sudden darts to snatch insects from the vegetation or from the air.

The only notes heard were a low, weak *peep* and a nasal sound uttered when the birds were disturbed at their nest.

On Barro Colorado Island a pair were discovered carving a nest-chamber into a big, black, arboreal termitary on March 28, 1935. The sexes alternated at this task, and they worked hard through much of the day over a period of two weeks before the nest was completed.

During the 10 days which elapsed between the apparent completion of the chamber and the laying of the first egg, one or the other member of the pair guarded the nest much of the time. It rested quietly in front or at times sat within.

Three pure white eggs were laid at two-day intervals.

Male and female took turns at incubation, but usually one flew away before the other arrived to replace it. Their periods of sitting were most variable, those timed ranging from 7 to 162 minutes. During 7 hours of observation the eggs were covered only 70 per cent of the time.

The eggs vanished before hatching, apparently taken by a snake. The parents made repeated inspections of the nest after their disappearance.

After a few weeks a second set of three eggs was found in the same cavity.

The White-whiskered Soft-wing (*Malacoptila panamensis*) dwells chiefly in lowland forest, but at times is seen in adjoining areas of older second growth and even in shady pastures. In its manner of catching insects it greatly resembles the Black-breasted Puff-bird.

Its notes are weak *peep's* or high, thin whistles.

A nest was found, on June 8, 1943, in a short burrow going obliquely down into a steep hillside covered by tall forest. The chamber at the lower end was lined with dead leaves, and a little heap of twigs and dead leaves surrounded and concealed the entrance. Although the burrow was apparently dug by the puff-birds, no excavated earth was found near it.

Two white eggs formed the full set.

The nestlings hatched quite naked. They vanished, apparently taken by a snake, when two days old.

The Nun-birds (*Monasa*) appear to be more gregarious than other puff-birds. Their nests in burrows (as described by Cherrie) have points in common with those of the Soft-wing.

The Swallow-wings (*Chelidoptera tenebrosa*) rest in pairs on the exposed tops of tall trees, whence they dart out or up in spectacular fashion to catch flying insects. Their notes are soft whistles. They nest in burrows in the ground, and the young are born naked.

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FINCA 'LOS CUSINGOS,' SAN ISIDRO DEL GENERAL, COSTA RICA