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YOUNG SAPSUCKERS IN CAPTIVITY.

BY FRANK BOLLES.

As READERS of 'The Auk' may remember, I spent much time during the summer of 1890 in watching Yellow-bellied Woodpeckers at work in their 'orchards' near Mt. Chocorua, N. H. From my observations I drew the following conclusions ('The Auk,' July, 1891, p. 270), that "The Yellow-bellied Woodpecker is in the habit . . . of drilling . . . trees for the purpose of taking from them the elaborated sap, and in some cases part of the cambium layer; that the birds consume the sap in large quantities for its own sake and not for insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird."

These conclusions differed so radically from opinions held by many ornithologists that some persons, who either doubted the sufficiency and unimaginativeness of my observations, or who read my conclusions without scrutinizing my statements of fact, were unwilling to admit that I had proved the Yellow-bellied Woodpecker to be a sap-drinker. In order to present additional and different evidence in the case, I determined to secure several living Sapsuckers, to cut them off as completely as might be practicable from insect food, to feed them if possible upon concentrated maple sap, and to see whether a diet of that kind would

sustain life. It was possible that they might refuse to eat anything, that they might eat the offered food but die in a few days, that they might live for a time but show distress and inability to digest the food. On the other hand it was possible that they might take kindly to the diet, thrive upon maple syrup, and live for weeks, perhaps months, in a manifestly healthy condition. I had confidence enough in my previous observations to believe that the birds would relish syrup, and would live upon it for a sufficiently long time to induce those who still considered the birds insect eaters only, to admit that a contrary presumption had been raised.

It was first necessary to secure the birds. Having failed in 1890 to catch old birds by making them tipsy, I decided to secure a nestful of young birds before they took to the wing. Searching the forest near 'Orchard No. 1' I found, on July 1, a nest filled with noisy fledglings whose squealing sounded afar in the otherwise silent woods. The hole was on the south side of a living poplar, about twenty feet from the ground. Two old holes scarred the trunk. The parent birds came frequently to the tree, and their arrival was always greeted by more vigorous crying from the young. On the 6th I visited the nest again and found both old birds feeding the young which were now much nearer the mouth of the hole. The old birds scolded me on my approach, and the young remained silent for a long time after hearing the warning notes of their parents.

On Tuesday, July 7, at noon, I raided the nest. The poplar was felled so that its top caught in a tree near by, preventing any shock to the young birds. In spite of the resounding blows of the axe the old birds continued to come to the nest, and in the intervals of chopping they fed the young. Moisture glistened on their bills, and I was not sure that they brought insects in any instance. One young bird flew before the tree fell, a second took wing as the crash came, but the third remained in the nest until taken out by hand. I named them Number One, Number Two and Number Three, corresponding to the order of their entry into active life. Their coloring varied sufficiently for me to recognize each with certainty after his transfer to a cage, and as weeks passed by they became more and more dissimilar both in coloring and conduct.

Their cage was an oblong pine box containing about three

cubic feet. Its floor was covered with sawdust, its face was closed by fine wire mosquito netting, and apple and alder branches were arranged for perpendicular and horizontal perches. A sliding door allowed me to handle the birds when necessary. During the afternoon of the day of their capture I fed each bird four times with sugar and water. Holding each little creature in my left hand I slid the tip of a small quill toothpick between its mandibles, when it quickly drank the few drops of liquid held in the half-filled quill. The second time I did this the bird opened its beak willingly. By the fourth lesson the rapid use of the long and nervous tongue in draining the quill of every particle of moisture showed that the quill was a satisfactory substitute for the parent's bill.

At 5 A.M. on July 8 the young Sapsuckers began a lively 'rat-tat, tat-ta-ta, tat-tat' on the resounding sides of their box. They were unmistakably hungry when, an hour or two later, I presented the point of the quill at a hole in the wire netting. One bird after another drank the diluted maple syrup with which I filled the tube. I repeated this process at intervals of about half an hour until evening, the birds becoming more and more expert in draining the quill and more and more prompt in responding to my offers of nourishment. Number One was the most restless and aggressive; Number Three the slowest in feeding, and the least hungry. It was also the dullest in coloring. On the 9th the birds did not begin to stir until about 7 o'clock, their cage having been darkened so as to prolong their slumber. On my presenting the quill all three tried to drink at once, and Number One was very rough with the others, striking them sharply with his beak. His violence led me to add a second room to the cage, into which the others could withdraw to escape him. I placed it directly above the other, with a round hole in the floor opposite a similar opening in the top of the first cage. None of the birds noticed the hole, either from below or from above, when put in the upper room. I placed cups of birch bark and wooden troughs filled with syrup in various parts of both cages, but the birds did not go to them. They took more syrup than on the 8th, drinking a greater number of times and more at each time. Towards evening I exchanged the quill for a slender spout of birch bark through which I let the syrup ooze. They drank from the spout, from the netting down which drops coursed, and

from the wood upon which the drops fell. Number One made his first attempt to catch a fly on the netting, but failed.

During more than half the day the birds were in motion, flying from one side of the cage to the other, hitching up and down the netting or the perpendicular perches, and pounding on the netting, boards and perches. Twice they gave the squealing note of alarm so characteristic of the wild Sapsucker. At night I looked to see how they slept. They were side by side, hanging erect upon the back wall of the cage, with their heads tucked under their wings. One by one they waked and turned with sleepy surprise to look at the lamplight glaring at the mouth of their cage.

On July 10 I made serious efforts to teach the birds to feed themselves. Catching them at intervals, I dipped their bills into the syrup in their cups, forcing them to drink. By 9.30 A.M. Number One had learned his lesson. Two hours later Number Two drank voluntarily, and a little after one o'clock the feeble and timid Number Three followed suit. Early in the afternoon Three seemed so exhausted by the blows showered upon her by One and Two that I thought she was going to die. I took her out and allowed her to perch upon the top of the cage. Suddenly she revived, slipped through my hand, flew the length of the open barn, out into the trees beyond, and was gone. After searching for her for over an hour, I gave her up as lost.

At 8 A.M. the next day I heard a Sapsucker squeal near the house, and running out found Three sitting on top of a clothes-line post. She looked bright and knowing, but did not offer to fly, even when I extended my hand to catch her. Clasping her quickly, I carried her back to the cage. She was very hungry, and went at once to a cup and drank long and often. Her brief outing had given her courage to stand up against the attacks of the others, and I had no further anxiety for her health. I filled their cups at 8 A.M., 1 P.M., 4 P.M., and at dark,—the last as a precaution against unseasonable tapping in the morning.

During the next few days I filled the cups several times a day, and the birds drank freely, and seemed happy and perfectly healthy. On July 17, being satisfied that the birds never would learn to go up and down between the upper and lower cages, I removed the upper cage and placed it on the floor beside the lower one, opening a door between the two so that the birds

could hop through from one to the other on the same level. They did this at once. I then added a third room which could be entered by a door in its side, and found that the birds quickly availed themselves of the chance to be alone for a part of each day.

One warm day I sprinkled the birds with water. They were greatly astonished, but at once surprised me as much as I had them, for they flung themselves upon the floor and went through all the head, wing, and feather motions of a bath, scattering about chips and sawdust in a most energetic way. It was their first acquaintance with water. I at once supplied them with a large dish of water, in which they bathed occasionally during the summer,—usually, it seemed to me, towards evening, and when no one was near.

The smell of maple syrup which pervaded their cage of course attracted insects, which crawled up and down the outside of the wire netting, occasionally finding a crack in the cage and entering. The young birds were always on the alert to catch one of these intruders, and made a great fuss eating it,—squealing, and crowding into a corner to hold it securely between their breasts and the boards until they could swallow it in just the right way. The number of insects caught by them in this way was small, and I do not think amounted at any time to ten per cent of their food.

Within a week after the birds' capture I felt sure that Number Two was a male, because red feathers appeared on his throat. I surmised that Number Three was a female, partly on account of her more subdued coloring and partly from her gentleness. Number One bullied both Two and Three and was more noisy than they. By July 20 I had reduced the number of their syrup cups to one — a large earthern saucer which I filled once a day, sometimes twice. If I allowed the saucer to become dry, the Woodpeckers drummed more and more vigorously until I supplied their needs. Sometimes all three birds would drink at once. They were astir by 5.30 A.M., and still noisy at 8 P.M. On July 20 my notes say, "They are perfectly healthy and happy."

About noon on July 23 the door of the Woodpeckers' cage was opened by mistake, and not long after I discovered that

Three had escaped for a second time. I searched for her in vain. The next day rain fell in torrents all the forenoon. About one o'clock the cry of a Sapsucker was heard through the closed windows of the house, and Three was discovered clinging to the piazza railing just in front of my study window. She was wet and dismal. I tried to catch her with my hand but she flew to the nearest tree trunk, where I secured her by throwing a piece of soft mosquito netting over her. The moment I placed her in the cage she fastened herself beside the cup and drank many times. After satisfying her hunger she retired to the darkest corner of the cage to dry and doze. The other birds paid no attention to her.

On July 25 two Downy Woodpeckers were working in my orchard. Taking a trout rod and line, I made a small slip-noose at the end of the tip joint and poked it into the tree where one of the Woodpeckers was inspecting the bark. He watched the rod and seemed puzzled by it, but did not fly. Slowly lowering the noose I let it settle around his neck, and then by a slight jerk drew it tight. He flew in small circles round and round the tip of the rod, held by the noose, and slightly choked by it. A minute later, freed from the line, he was in the Sapsuckers' cage.

He was a young bird, like the Sapsuckers, and I supposed that the latter would not notice that he was not one of their own family. I thought it possible that he might follow their example and drink syrup from the cups, for I had once seen a Downy Woodpecker dipping at one of the Sapsucker's 'orchards.' Unhappily, however, the stranger was not welcomed kindly, and as I was called away for the day, he had no defender. The Sapsuckers pursued him from one corner of their cage to another, striking him fierce blows on his head and over his eyes until he fell to the floor exhausted. Reviving, he again attracted their notice and attack, but his second fall was his last.

About August 1 it seemed to me that the Sapsuckers were unusually restless; they whined and scolded a great deal and went from room to room incessantly. I think that at this season the wild birds begin to frequent their 'orchards' less regularly than in May, June, and July. The captives tapped a great deal, and I gave them a variety of things to play upon, as, for example, a sweet-toned glass tumbler, thin sheets of zinc, and resonant pieces of wood arranged to give out various tones. They tested

these things, but seemed to prefer the sides of their cage, especially portions walled with clapboards, which yielded a great volume of sound to their blows. I spent many hours in noting down the number and order of their taps, in order to see whether they constituted distinct signals. At first it seemed to me that Number One liked to tap in twos and fours, that Number Three was more apt to make threes, or threes and fives, than other combinations, and that Number Two mingled fives and twos. The longer I listened the more combinations I found them making, and at last I decided that with these birds it was mere chance whether they said - - - - -, or - - - - - -, or - - - - - - - -. They seemed to pay no attention to each other's performances, and to mean nothing by their own tappings. If they tapped at all, it was necessary to make some number of taps and to space those taps in some particular way. If in a large number of such series, ones, twos, threes, fours and fives came equally freely and frequently — as they seemed to — there appeared to be no ground for imagining that the different combinations indicated different feelings or impulses. Nevertheless I think the old birds at Orchard No. 1 during July, 1890, called each other by tapping, and I do not feel at all sure that closer study than mine might not work out a Sapsucker code.

On August 9 I noted that the birds were "as noisy as a boiler factory," and that One and Three were showing reddish coloring on their heads. Three I speak of as "gentle and refined," but One is constantly alluded to as rough, noisy, and restless. I tested their color sense by placing some flaming nasturtiums in the front of their cage. They did not even look at them, but trampled back and forth over them until the flowers fell.

On August 13, a very warm day, I saw one of the Sapsuckers bathing at 7.30 P. M. when it was nearly dark in the cage. On the 14th — a rainy day — one of them bathed about 6 P. M. When the sun fell upon their cage in an afternoon the birds often sought the sunlight, and standing in it drooped their wings and opened their mouths as though suffering. They could readily have avoided its heat.

On August 17 I was away all day, and the Sapsucker's syrup dish became dry. Early on the 18th the birds began pounding so furiously that, as my notes say, "they could be heard a quarter of a mile away." When I filled their dish they crowded

around it, and all three drank at once. They consumed more than a tablespoonful of the diluted syrup between 7 and 11 A. M. Ordinarily they disposed of eight teaspoonfuls each during the twenty-four hours. Part of this evaporated, and part was probably secured by black ants which visited the cage by night. On August 25 I did not give the young Woodpeckers any syrup until late in the day. Then I offered syrup and insects at the same time. They ignored the insects and drank long and often of the liquid. Later they ate the insects. I kept a dish of water in their cage all the time, but they were seldom seen to drink from it.

On September 4 I placed the Woodpecker's cage in a finished room in the barn and opened their door to see what they would do with limited liberty. Number Three showed the effects of former freedom by coming first to the doorway and perching in it. After a moment One flew out past her and bumped against the window pane. Ten minutes elapsed before Two came out. Then they flew back and forth from window to looking-glass, curtains to woodwork. I handled them freely, and they seemed to have no feeling of fear. They clung to my fingers, and perched upon my shoulders. All the interior finish interested them, and they hammered wood and glass, paint and plaster with vehemence. One of them hopped back and forth over the board floor, striking it now and then as if it had been a great log, prostrate. Three caught a few of the many flies in the room, but showed no eagerness over them. The others scarcely tried to catch them. That night they slept in separate corners. In the night I lit a candle and looked at them. They awoke, squealed, and Three came to the syrup and dipped twelve times. The red on her head seemed brighter day by day. I also noted that Two was growing more yellow below. On September 6 I noticed that One and Three were together while Two remained much alone. He seemed to be moulting. During the next fortnight I let the birds out once or twice each day and watched them closely. Three was the only one which seemed to care much about catching house flies, and she secured very few. Black ants visited the cage at night, and occasionally I heard the birds moving about a great deal although their cage was as dark as it could well be made. By September 11 Three had transferred her affections from One to Two. The latter's plumage had by that time be-

come quite brilliant; the yellow and black below, and the red on head and throat making him a decidedly distinguished looking bird. He made up for all Number One's earlier bullying and brow-beating by scolding him and driving him from perch to perch. When free in the room, Two and Three spent most of their time upon a great horizontal timber, a portion of the framework of the barn, which ran through the upper part of the room. It had been rough-hewn by the sturdy hands which had framed the barn many a long year before, and patches of bark still clung to its surface. The devoted couple ran up and down the upper surface of this beam, tapping from time to time upon its flat face, never upon its edges. One stayed in the cage much of the time when Two and Three were together. He seemed jealous and far from cheerful. None of them ever went back to the cage voluntarily, and as time passed they did their best to avoid me when I was ready to lock them up.

On the evening of September 12 the birds were very restless. Between eight and nine they were drumming furiously. The night was dark, and not a ray of light found its way into their cage. On September 16 they continued their hammering until 10 P.M. They took less syrup than usual at this time and caught practically no insects. On September 21 my notes speak again of the small quantity of syrup consumed by the birds. On September 26 the birds were brought to Cambridge in a small box. They were fed in the usual way, and drank frequently from their dish while the train was at rest. The next day they were given a room to themselves. It was eight feet by five and was lighted by a window looking into an upper entry. Opposite and above the window was a large skylight through which sunlight streamed into their room for several hours each day. They promptly chose the curtain roller at the top of the window as their favorite perch, and to this I attached their syrup dish, which they recognized and used at once.

For several days they seemed perfectly well and contented. They hammered the woodwork, cut holes in the plastering until they reached the laths, and drilled small holes in the floor. Absolutely no insects gained access to their room. On October 4 I state in my notes that they never seemed more happy or more energetic. They bathed freely at this time while I was in their room, and seemed to enjoy the water greatly,

On October 11 I recorded the fact that Three seemed dull and allowed me to catch her without opposition. On the 12th she was evidently feeling far from well and stayed on the floor, but Two and One were unusually cheerful. On the 13th Three showed alarming symptoms. As early as 7 A. M. she had a convulsion, throwing herself upon her back and struggling violently. Reviving, she drank some syrup and seemed better, but the spasms recurred at frequent intervals during the day. She kept her head moving up and down a great deal of the time. When a spasm was imminent she turned her head far around to the left and, with her neck thus twisted, spun around towards the left seven or eight times, then fell upon the floor and beat her head upon it. After most of these spasms she drank from her cup, and during the day she ate four flies which I gave her. The last attack was at 5.30 P. M., and not long after she was found dead. I placed her body in the hands of several graduate students in biology at the Museum of Comparative Zoölogy, and received from one of them, Dr. Thomas G. Lee, the following statement: "We found the intestines quite empty. In the stomach, which was deeply bile-stained, was a ball composed of cotton fibres and containing fragments of insects. The liver was very large, deeply bile-stained, and very soft. The other organs were apparently normal." The body was plump, and large deposits of fat covered the abdomen.

On Sunday, October 18, Number One, who had been dull for a day or two, showed symptoms similar to those of Number Three. He had several convulsions and was weak after them. I gave him lemon juice. For several days I had been trying to change the diet of the surviving birds, but they refused everything except their syrup and a fly or two which they seemed to care for but little. Among the things offered them were a sweet apple, a pear, a peach, grapes, and earthworms. I diluted their syrup more than usual, and put lemon juice with it. Number One's condition was such on the evening of the 18th that I had no hope of finding him alive on the next morning. He survived, however, although in a most pitiful condition; his eyes winked frequently, he seemed to see little, and that little in such a way as to confuse distances; his breathing was unnatural and he trembled constantly. Monday passed, and while One grew no better, Two became seriously ill. On Tuesday morning both birds

were alive, that was all. At eight o'clock Two had a violent convulsion and never recovered from it. A few moments later One, who had clung to life with such tenacity, died in the same way — maintaining to the last the advantage which he had first claimed in the nest. Number One was examined by an expert physician in Cambridge, who pronounced his liver enormous and in a diseased condition. It nearly filled the abdominal cavity, crowding other organs. It was soft and greenish. Number Two was forwarded to the Department of Agriculture which reported that the bird "had enlargement and fatty degeneration" of the liver. The most probable cause of this enlargement of the liver, which seems to have been the reason for the death of the three Sapsuckers, was an undue proportion of sugar in their diet. In a wild state they would have eaten insects every day and kept their stomachs well filled with the chitinous parts of acid insects. Under restraint they secured fewer and fewer insects, until, during the last few weeks of their lives, they had practically no solid food of any kind. Two of them lived in captivity exactly fifteen weeks, and the third fourteen weeks. During that time they subsisted mainly upon maple syrup diluted to half its strength with water. This diet was not refused nor disliked by them at the outset; quite the contrary, it was adopted readily. It did not cause speedy death, nor even indigestion. The birds did not mope and pine; they enjoyed life, changed their plumage as much as caged birds could be expected to do, and until nearly the time of their deaths manifested no abnormal condition. In fact they throve upon maple syrup and were in an apparently healthy condition for more than three months.

Summary. From these experiments I draw the following conclusions: (1), that the Yellow-bellied Woodpecker may be successfully kept in captivity for a period corresponding to that during which as a resident bird he taps trees for their sap, sustained during this time upon a diet of which from 90 to 100 per cent is diluted maple syrup; (2), that this fact affords evidence of an extremely strong character, in confirmation and support of the theory that when the Yellow-bellied Woodpecker taps trees for their sap he uses the sap as his principal article of food, and not primarily as a bait to attract insects.