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Berkeley
California

NOTES ON THE CHIMNEY SWIFT

BY C. BROOKE WORTH

FLIGHT

DURING the course of my banding work among Chimney Swifts (*Chaetura pelagica*) at Swarthmore College, I discovered three occupied chimneys on Beardsley Hall and made the following observations. These chimneys were closed at the top by large overhanging stone slabs, and the birds had to enter through 'windows' in the four sides of the chimneys. Inasmuch as swifts usually roost and nest in chimneys which are open at the top, it was necessary for these birds to modify their usual mode of entry.

The open-top chimney requires the following maneuvers for aërial ingress. The birds often circle over it in narrowing, descending spirals, as on the surface of an imaginary inverted cone. Arrived at the apex, just over the entrance to the chimney, they check the speed of their descent almost to zero, raise their wings to an angle of about forty-five degrees above the horizontal, and, holding them rather rigidly in this position, descend into the hole in an oscillating flutter, similar to the fall of a leaf or scrap of paper through a calm atmosphere. Sometimes the spiral part of the course is omitted, the birds flying directly over the chimney, checking speed, and then oscillating downwards at once.

Such a complicated evolution of flight would seem very difficult to modify for entry into a chimney opening at the side. It was accomplished, however, by the swifts' omitting the spiral part of the maneuver entirely and using the 'oscillating flutter' at the peak of an upward and forward movement. To clarify this statement, let me describe what happened.

The swifts flew several hundred yards from the building and then, turning, dashed rapidly toward it at a height only a few feet from the ground. At a suitable distance away, they almost ceased beating their wings but turned them upward so as to glide forward and upward in an arc whose convexity was toward the wall of the building. Of course their speed diminished rapidly both forward and upward but they gauged their progress so that at the peak of the rise (when, of course, all upward motion was lost) there was still a remnant of forward movement. At this point they turned sideways and oscillated in the customary manner, so that by 'lateral translation' they were carried almost horizontally into the chimney window. This maneuver was apparently more difficult to accomplish that that required for the open-top approach, and on windy evenings it was attended by many failures. Three or four attempts were sometimes made before some of the birds succeeded in arriving properly at the windows.

BEHAVIOR

I constructed traps of wire frames covered with mosquito netting, suitable for catching swifts in this type of chimney. After dusk I went onto the roof to put the traps in position. As I worked at each chimney, I heard the roosting birds make a loud 'clapping' noise with their wings. The sound would be made once—a single 'clap'—by each bird when I arrived at the chimney, and it was not repeated unless I made a particularly disturbing noise myself. It sounded as if each swift, clinging by feet and tail, raised its wings over its back and then brought them down sharply against the sides of the chimney.

Such a habit might conceivably have arisen as a warning signal—perhaps to communicate a sensed danger to other swifts in the same chimney or to the brooding female; but, judging by the effect it had on me, I should say that the clapping would be more effective in startling intruders, possibly frightening them away. For unless I had known that swifts were present, I could scarcely have suspected that this sound emanated from a bird; the single, sharp clap had no suggestion of the fluttering of a bird in it; though what else could have made such a noise I do not know. Thus the mystery must be complete to the prowling predator or silent, gliding owl.

It is possible that the noise is incidental to the swifts' seeking a lower stance in the chimney, more effectively to escape danger threatening at the top. They may loosen their hold and drop a few feet with wings outstretched; and, on grasping the wall again, they may involuntarily make the clapping sound in bringing their wings back to the clinging position. But if this be so, one would expect a slight, accompanying fluttering noise, and from its lack I judge that the clapping is produced at rest, voluntarily, and for some protective reason. It is not accompanied by any vocal sound or bill-snapping; except for the single clap of each bird, the chimney remains strangely silent.

On the following morning I found that one of my nets had been blown away by the wind; the swifts had flown from this chimney. Another net had been partially dislodged, providing a horizontal crack about two inches high and as wide as the chimney-window through which the birds might have escaped, but apparently the feat of squeezing through this aperture in flight, without the headway of normal flying speed, was more than this species of bird could accomplish, for the swifts were fluttering ineffectually in the net or clinging helplessly to its sides. In the latter position they seemed to have no scansorial ability, finding it necessary to fly in order to get from one point on the netting to another. They were easily tired by their fluttering and frequently came to rest, sometimes returning to the interior of the chimney to do so. When they did this I 'shooed' them out by lowering a block of wood into the chimney on a long string and then vigorously pulling the block up and down. They would usually flutter out with normal composure following such treatment. The Chimney Swift has been harassed by man so seldom that it does not share in the terror which permeates most wild creatures. Its reactions resemble more those of the tame inhabitants of isolated regions such as the Galapagos Islands, where man

is comparatively a newcomer and his deadly attributes have not yet become grafted upon the animals' comprehension.

It was now long past sunrise. Many swifts were abroad, circling low over Beardsley Hall and showing a mild degree of interest in the imprisoned birds. Now, at last, I heard an occasional twittering from the birds in the chimneys, though they still gave an infrequent 'clap' as I went about my work.

In my hands I found the swifts much more docile than are most captured birds. They became 'hypnotized' almost as soon as I picked them out of the nets, and almost invariably kept their eyes closed throughout the banding process. It was as if they had exhausted their whole repertoire of protective devices with their cavernous clappings and were now so totally overcome as to make no pretense of ferocity or intimidation whatsoever. Deprived of wing-power, with which they feared no living form of pursuit, they gave up wholly to defeat.

So completely convinced of their impending annihilation were they, that I was able to band several and lay them on their backs in a row, with their eyes still tightly closed, before one sensed its freedom and struggled into the air. The disturbance aroused the others, and they all quickly made off. As they sprang up, they made relatively slow progress for the first dozen wing-beats. Then, as they got more fully under way, the efficiency of their efforts suddenly increased and they zoomed off like bullets. It seemed to me that their wing structure was so designed that full mechanical advantage was realized only at high speeds. An analogy might be drawn to an automobile starting from rest in high gear, chugging at first, but suddenly 'taking hold' at about fifteen miles per hour and then shooting forward with great acceleration.

STRUCTURE

While the swifts were in my hands with their eyes closed, I had an opportunity to examine their remarkable eyelids. The eyes themselves are rather protuberant. This prominence is undoubtedly a convenience for a bird of pursuit and of rapid, doubling flight, and it is probably also a consequence of the development of a wide, gaping mouth, for this has displaced the adjacent structures of the head above it. But large protruding eyes in a bird such as a swift need more adequate protection than would be the case among less aërial species, and such a protective function is discharged by a modification of the lids. These are very large and loose; both the upper and lower ones are increased above the usual size. I was able easily

to push each one into the other's 'territory,' so that the entire eye was covered by a single lid, one or the other.

One can imagine that any object striking the swift's eye, even if the bird blinked in time, could do considerable damage to the eye because of the customary hurtling velocity of the swift's flight. But an oversized and very flexible pair of lids might serve to divert the object by causing it to roll over the convexity of the eye; and with either lid capable of complete extension over the entire eye, the object could be directed, or allowed to slide, across the shielded eyeball in any quadrant. Such eyelids would also make it difficult for stinging insects, upon which the swifts may feed, to inflict injuries on eyes.

There is a further protection to swifts' eyes which seems to be in excess of birds' ordinary equipment. I found that if I separated the eyelids, the eyes would often still be completely covered with a large nictitating membrane. This is the most highly developed membrane of its sort that I have seen. It appeared to be semi-transparent, but whether of use in flying, particularly during storms (when it would be thoroughly moistened externally), I cannot say. It is suggestive, however, to remember that swifts do not seek cover in advance of thunderstorms as most other birds do, but may be seen against the black clouds, darting about with incredible speed, apparently reveling in the high wind's provision for unusually keen sport.

A less anthropomorphic explanation of the swift's storm-flying would take account of W. H. Hudson's observations on the subject. In Argentina he noticed that various insects often take to the gale which sweeps ahead of a storm, apparently trying to outdistance the deluge which will beat them to the ground. This may be true of insects in our climes, and the Chimney Swift may be taking advantage of the particularly good hunting which it has learned to expect at such times. If so, the fact still remains that the swift, by virtue of its superior flying ability, is able to profit by a meteorological phenomenon which causes many birds to suspend their activities; and were it not for the possession of an exceptionally well-developed nictitating membrane, the swift, too, might have to seek shelter during storms to avoid catastrophe.

Swifts' legs and feet are always surprising to see and feel. When the birds are held in one's hand, their feet are clenched tightly and resemble the deformed fists of a paralytic. Their legs, small and weak, are covered with thin, pink skin and have a peculiar, fleshy appearance, due to the absence of scutes which give most birds' legs

a scaly or reptilian appearance. Because of this lack of armor they feel warm and soft, quite unlike the legs of any other birds I have handled.

FOOD

The swifts left their droppings in my mosquito-netting traps, and I afterwards examined these carefully for any light they might throw on the birds' diet. The droppings were of two sorts—a semi-liquid one which stained the nets, and a very dry solid one which I thought at first might be 'insect-castings' comparable to the pellets regurgitated by owls, hawks, and some other birds. But I was able to detect intestinal molding in the dry droppings, which designated them as being of fecal nature. Besides, there were no entire insect skeletons among them, as might have been expected in a casting; rather, they consisted of a great many flakes and fragments of desiccated and compressed chitin, so fine that it was not possible to identify any of the insects or even insect parts.

At the very center of one of these dry droppings I found a small pebble, smoothly rounded, measuring 2 x 1.5 x 1 mm. This surprised me greatly at first, for I could not imagine how a swift could obtain a stone. One knows of swifts' twig-gathering habits on the wing, but one can scarcely credit the bird with the ability to gather pebbles in the same way. Nor can one conceive of a swift alighting on the ground to pick up 'hen's teeth,' though it seems reasonable to suppose that gravel would be useful to the bird's crop in grinding the larger and more resistant insects. As I looked at the pebble, however, it came to me that it was of the sort which is commonly found in mortar such as is used in building brick chimneys, and I felt that I had hit upon the correct origin of the material. It was still a tax on the imagination, however, to picture the swift at roost in its chimney, pecking at the mortar with its most unwoodpecker-like bill. Perhaps it normally nibbles over a large area of the inside of the chimney for the sake of rare, loose sand-grains. It must be so; otherwise I cannot account for the 'pearl in the oyster.'

LONGEVITY

Among the swifts which I trapped on Beardsley Hall in 1937 there was one bearing a band which I had placed around its leg seven years before, in the spring of 1930. The bird was an adult at that time and was therefore at least a season old. Now, in the spring of 1937, that swift must have been at least eight years old. It looked just like any other swift, albeit it had carried its band, C-32705, into

its secret winter home seven times. Looking at this small bird—one of the 'lower animals,' I had a sense of being hopelessly and unutterably earth-bound.

Swarthmore College
Swarthmore, Pennsylvania

ORIENTAL FORMS OF THE PYGMY WOODPECKER

BY JAMES C. GREENWAY, JR.

THE gray-headed forms of the pygmy *Dryobates* (*D. canicapillus*) of the eastern Asiatic mainland form a complex analogous to a superspecies. The larger, darker birds inhabit China; the smaller and paler ones inhabit Burma, southern Siam, southern Annam and Cambodia. Within these two larger groups, which cannot be indicated by our trinomial system, there are many geographical races, all of which are more or less ill-defined, unsatisfactory forms. The Philippines, Sumatra and Borneo contain well differentiated insular subspecies. There are only five characters to be used for racial diagnosis. They are: (1) size, (2) relative amount of red on occiput of males, (3) relative number and size of spots on the upper tail coverts and central rectrices, (4) relative size of spots on secondaries, (5) relative color tone of body plumage (either black or brownish black above, with streaks below darker or paler).

This last character is subject to marked seasonal variations; birds taken in the months of April to September are, in general, paler and browner than those taken between September and May. But this seasonal variation is much more apparent in the southern forms than in the northern. The situation does not appear to be confused by any considerable post-mortem change; the darker forms of China have not become browner, less black, in museums.

Birds of the year can be identified by the first primary, the outer web of which is not attenuated at the tip. This feather is sometimes longer, but not always so. They sometimes have less well defined, rather darker, streaks below, but this character is obscured by seasonal variation, particularly in Malayan populations. The red occipital streaks which distinguish males appear in a nestling specimen.

In Malaya and perhaps Borneo this gray-headed species (*canicapillus*) breeds in the same localities as a considerably smaller, brown-headed form (*D. moluccensis moluccensis*), which I consider to be a geographical representative of the small, brown-headed forms of the Indian plains (*D. m. nanus, D. m. hardwickii,* etc.). *D. canicapillus*