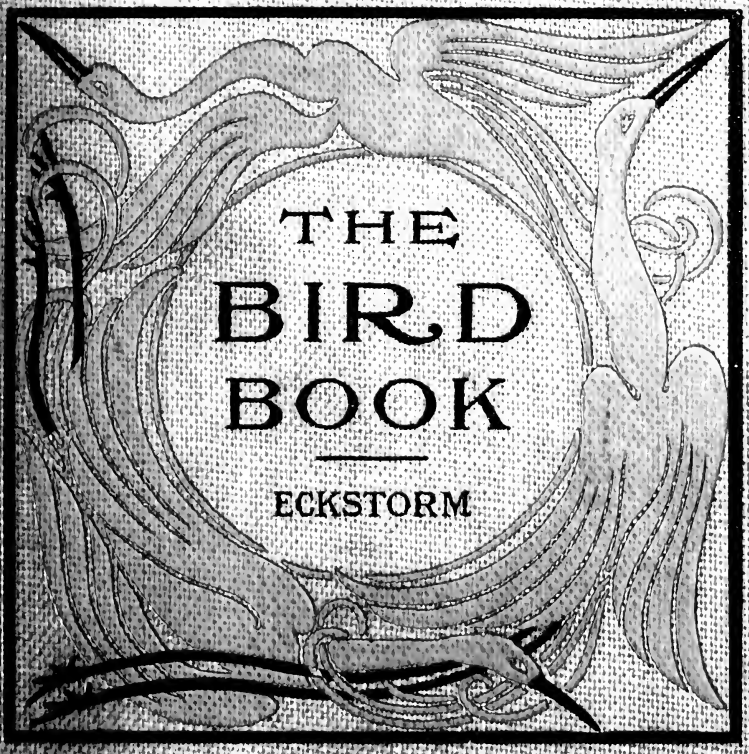
THE
BIRD
BOOK
ECKSTORM

THE BIRD BOOK

BY

FANNIE HARDY ECKSTORM

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PREFACE.

Science is the green pasture of enthusiasms, and in the study of it there is no denying Shakespeare's dictum, —

"No *profit* grows where is no pleasure ta'en."

So if we adopt bird-study as the representative of zoölogical science, as we seem likely to do, it must be not only because it is fairly illustrative of zoölogical principles, and because its materials are abundant and easily referred to, but because it is pleasurable to beginners.

Bird-study, or any other special science, is justified in demanding an educational hearing if it contribute generously either to a knowledge of the principles and methods of science in general or to the training of the powers of observation.

As far as possible I have tried to open opportunities for work in both directions, dwelling upon what to see and how to see it, but not neglecting those larger problems which are, after all, the non-personal end of all observation; and I have tried to do this in such a way that the pupils might be led to work independently and intelligently if so minded, or, at the least, to acquire, even if unconsciously, some notion of scientific method.

To keep the nature study free from memorization of any text-book, however good, to deliver it from the incubus of ranking *per centum*, to put a premium upon the child's own efforts at discovery, is to make the nature work effective. If the author has a message, it is that a child's value, or a man's value as for that, is rated by his self-reliance, — not by what

he guesses he knows, but by what he *knows* he knows, which for most of us does not so very much exceed the limits of what we have seen and experienced. To have seen something clearly, to be able to tell about it with precision, to have done something as well as it could be done, even if the sight, the tale, the deed, were not notable, gives power and poise. All studies that increase this effective force of the student are profitable. Theoretically, all studies do increase it, — but not for all students. But nature study, under any except the poorest instruction, must give a first-handed acquaintance with facts and an assurance of knowledge.

It should be remembered, too, that the collection and study of facts by direct observation is scientific work. The comparison and analysis of them also is scientific work. Observation and comparison — not learning hard names — is science. Therefore the pupil who can tell one new fact about a bird has done more real work of the kind that counts than the other pupil who has learned all its Latin names.

Yet I am not discouraging the acquisition of the scientific terminology. Intelligent children find the Latin names as easy to learn as the English, and, with a little assistance, can master all the commoner botanical, or ornithological, or entomological names. This, however, is not the science that the teacher is supposed to teach, and it should not be required, but only permitted to those who desire to do extra work.

It has been urged against many books on birds that they are New England treatises. In making this one, special care has been taken to have a book that could be used in any part of the country. It is true that the author has frankly "harked back" to a childhood spent in Maine, —

> "East, West,
> Hame's best;" —

but all the birds selected for special study, with the exceptions of the sooty grouse and the pine grosbeak, are birds that are

well-known, abundant, easily observed, and resident in nearly all parts of the country.

The arrangement of the book has two ends in view: to adapt the study to the school year, and to present it so that when the pupil begins field work he shall be able to do it with some general idea of what is worth observing. The study of unfamiliar types gives some notion of the breadth of the subject, — its extent; and it furnishes a store of facts to be applied to its intent, the study of comparisons, in the next section; it also helps to fix in mind the definite relation between a living organism and its environment, which, treated from the evolutionary standpoint, forms the subject of the third section. When spring appears the pupil is ready for field work, which can be successfully begun only when the birds are in full song and full plumage; he comes to it as an unhackneyed subject, but one concerning which he already has a store of knowledge.

The authenticity of the text has been an object of solicitude. Whatever is not my own — and most of it is mine — is given on the authority and by the permission of some of our best field naturalists. For such permissions I am indebted to Mr. William Brewster, whose admirable treatise on migration I have quoted freely, because his words could hardly be either condensed or simplified; also to Mr. A. W. Anthony, Mr. Chase A. Littlejohn, and Captain D. P. Ingraham, by whose courtesy several valuable papers are quoted almost entire. Some lesser obligations are noted in their places. The manuscript was read by the well-known author and ornithologist, Mr. C. J. Maynard, to whom hearty thanks are due.

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PART I.

WATER-BIRDS IN THEIR HOMES.

LITTLE STUDIES IN ENVIRONMENT.

"His interest in the flower or the bird lay very deep in his mind, — was connected with nature, — and the meaning of nature was never attempted to be defined by him. He would never offer a memoir of his observations to the Natural History Society. 'Why should I? *To detach the description from its connections in my mind would make it no longer true or valuable.*'"

— EMERSON on *Thoreau.*

THE BIRD BOOK.

AMONG THE REEDS AND RUSHES.

THE GREBE.

"Dear marshes! vain to him the gift of sight
Who cannot in their various incomes share.
* * * * * * *
In spring they lie one broad expanse of green,
O'er which the light winds run with glimmering feet:
Here yellower stripes track out the creek unseen,
There darker growths o'er hidden ditches meet;
And purpler stains show where the blossoms crowd,
As if the silent shadow of a cloud
Hung there becalmed with the next breath to fleet."

—James Russell Lowell,
An Indian Summer Revery.

Birds that cannot fly we may have heard of, but did you ever hear of birds that cannot walk? Here is a picture of one of them. I am sure it cannot walk, for I once had one for a short time as a pet, and it never made an attempt to escape. Had I left it over night on a table, I should have found it in the same place in the morning. No worse accident could happen to this poor bird than to be dropped on the land a little distance from water; she could not rise from the land to fly, and she could not reach the water unless the slope toward it were steep. Most birds would die if they had to spend their whole life in the water, but the grebe would die on the land.

Would you like to see her at home? Then early some summer morning, if you live near a meadow stream that wanders off behind beds of bulrushes and thickets of alders, and widens out between broad, grassy meadows, take a little voyage in your boat up the stream, paddling slowly and quietly. There are carpets of lily leaves, both the round pad of the white water-lily, dark green above and red beneath, and the long, lighter green leaves of the yellow "cow-lily," or spatterdock; by the water's edge there are scattered spears of arrow-head with its white blossoms and clumps of tall *pontederia*, which in Maine we call both "pickerel-weed" and "moose-ear," the latter name being given because its long, pointed leaves look like the ears of the moose. Its blue spikes of gold-spotted flowers draw the insects to it, and the ducks love to hide in the thick cover of its leaves.

Perhaps from behind the ranks of tall moose-ear that stand up off the end of yonder point our grebe may come swimming out. Perhaps we may see her settle slowly into the water among that patch of floating water-target that spreads its little oval pads like a carpet. Perhaps she may be up the side-run, whose course is marked by a line of the tall red thoroughwort, and by waving ribbons of cat-tail leaves.

Watching motionless, we may sometime see her glide out from such a place as this, floating like a little duck, for which you would at first mistake her. She picks up an insect from the water, or rises to snatch one from the stalk of some water-plant. Many a gauze-winged blue and green dragon-fly goes to satisfy her appetite. For insects form by far the larger portion of her diet, though she sometimes eats fish. Indeed, in the West, the grebes are often found in alkaline ponds where no fish can live. But why does the grebe swallow her own feathers? The gizzard of the grebe as commonly con-

FIG. 1. — PIED-BILLED GREBE.

Facing page 4.

tains a small mass of feathers as that of the domestic fowl contains gravel. The fact is known to every naturalist, but no one is sure of the reason for it.

The commoner grebe of our streams and ponds is a plain little brown-eyed bird, grayish brown above, and grayish white below. In the spring, for a few weeks, a black band encircles the bill, which gives it the name of "pied-billed"; and it has then a throatpatch of jetty black that also disappears later in the year.

The other grebe, not so common as this except in the North, is a red-eyed bird with a grayish black upper and a pure white under surface. In the spring this bird also puts on a bridal dress, which entirely alters its appearance. Above it is glossy black; the throat and front of the neck become rich chestnut, which follows down each side in a stripe near the wings; around the head, back of the eyes, springs a great muffle of black silky plumes that stand out like the frill to a bonnet, and long, buffy-brown plumes start out near the ears. These feather ornaments give the bird its name of "horned" grebe. All the grebes put on a gay breeding dress in the spring. It is odd that after wearing these fine feathers only a few weeks, they should shed them and put on their plain everyday dress. In the West the horned grebe is replaced by the American eared grebe, with golden tufts instead of brown ones.

It is scarcely likely that you will learn much about the colors of the grebe in one trip or in two or three; probably you will not be able to decide which species you are observing, for she is a suspicious little body, and if she does not like your looks she will glide back under the cover of the plants, or will sink slowly beneath the surface of the water. If you do not watch her every moment, she will disappear

without leaving a ripple, and you may never see her again; for she can swim a long way with only her bill out of the water. If she is suddenly alarmed, she will plunge in with a splash, head down and heels up, and so quickly that she can dodge a bullet after she sees the flash of the gun. So the commonest names of the grebe are "devil-diver," or "hell-diver," or "water-witch."

The grebe builds her nest in the water, making it of rushes and water-plants, which she nips off with her sharp bill and piles together, either upon the bottom, upon the shore close to the water's edge, or around some tall reed which securely moors the little floating nest. On leaving the nest she covers it with grass and weeds, so that it may be less easily detected. The nest is usually wet, and often the eggs lie partly in the water that gathers in it. But this seems to make no difference to the little grebes, who, as soon as they are hatched, are ready to sail off after their mother. What a very damp life a grebe must lead, always in the water, whether asleep or awake, and even when in the shell hatched in a leaky cradle!

Yet it is not an unpleasant life. The grebe has few enemies, and the most of these she can escape by diving. Food is always abundant. Those pleasant little excursions among the giant bulrushes and the fields of lily-pads bring her many a gay dragon-fly and dancing may-fly and swift water-skater. It is fun for her to follow a school of minnows, nipping them right and left. Besides, she has many games with her mates, running upon the water and diving just for the fun of it.

The grebe's nearest neighbors among the rushes are two solemn, long-legged fellows called the heron and the stake-driver, or bittern, who fish in the shallow water; a family of wood-ducks that paddle around among the pads and cat-tails,

or sit sunning themselves on a slanting drift-log; a big gray bird called a coot and his smaller cousins, the rails, that come stealing through the tall grass, or walk out on the lily-pads with slow placing of their long-toed feet, or when they are invisible, grunt and whistle among the fowl meadow-grass and wild rice jungle; and two kinds of busy, scolding marsh wrens, which make the snuggest little round nests you ever saw, and hang them among the stout stalks of bulrushes, cat-tails, and tall grasses. These nests are made of coarse grasses, reeds, and flags, and some of them are woven most curiously out of the flat, dry leaves of the cat-tail. They are as waterproof as our own houses, for the nest is spherical and the doorway is a little round hole in the side.

Such are the life and the home surroundings of the grebe. She is fit for no other. Her broad, flat breast and long body make her float like a little boat, and her silky, elastic feathers, with a full undersuit of thick down, keep her warm and dry in all weathers. To keep out of the rain she need only go beneath the surface of the water! She can swim under the surface as well as above it, and her feet, affixed at the very end of her body, serve both as rudder and propeller. Strange feet they are; they look as if the grebe had once been like other birds, but its feet had afterward been laid down sidewise and stamped upon. They seem to be crushed flat. The toes are thin, the shank is like a knife-blade, and the flattened toenails seem to have been driven into the flesh. The whole foot is neither horny like a crow's, nor plump and fleshy like a duck's; but a smooth-scaled, fleshless, unnatural foot. It always seems to me to feel "fishy." Yet for its use it is admirable. How swiftly it drives the bird ahead, cutting the water with the least possible resistance! How well it enables the bird to run upon the surface or to dive beneath!

But the grebe cannot fly well. Her wings are small, her breast muscles very weak, her body so badly balanced that when she is getting upon the wing it drags down like that of a hornet until she is fairly under way; after that, with neck straight out in front, and legs as stiffly stretched back to steer her, she flies fairly well. Even then she cannot fly under all conditions: she must get her start by flapping and spattering along the surface, working with both wings and feet; and she must have some space to run in, and a breeze to run against, or she cannot mount upon the wing.

Indeed, but for two circumstances, we may suppose the grebe would never fly at all. In the fall of the year she sees that she must leave her summer home. Soon the ponds will be frozen, and her food supply will be killed or covered with ice. If she is not frozen to death, she will be starved, unless she leaves before winter. So when a breezy day comes the grebes mount and are off — the pied-billed grebes to southern quarters, the horned grebes to the ocean which never freezes. But with the spring back come the grebes. For those that winter in the ocean this is almost as necessary as their going south. Nor is it hard to see why it should be so. As the grebe cannot walk she must always nest close to the water's edge. But at the seashore the water's edge at high tide may be half a mile away from the low-tide mark. Even where there are but a few rods between the two the grebe would have to take her choice between a day on the nest and a day in the water, as it is twelve hours from tide to tide. So if she would raise a brood, she must fly to some pond or inland lake where there is no tide to incommode birds that cannot walk. Therefore, while the grebe lives in the North in summer she must be able to make these journeys. To be unable to fly would mean the extermination of the race by cold and starvation.

THE LOON.

"Pale fireflies pulsed within the meadow mist
Their halos, wavering thistledowns of light.
The loon that seemed to mock some goblin tryst,
Laughed, and the echoes, huddled in affright,
Like Odin's hounds, fled baying down the night."

—JAMES RUSSELL LOWELL,
The Washers of the Shroud.

THE loon can fly more easily than the grebe, though it needs a breeze and a run on the water before it can mount unsteadily on its short and narrow wings. Though it cannot walk at all, it has a shuffling movement on land that is better than the grebe's utter helplessness, and it can get on shore and build a nest out of reach of the water.

Unlike the grebe, the loon does not nest on a raft of grass, but on "a right little, tight little island." Those on which I have known loons to nest were islets a rod or two across, sometimes marshy, but more often dry and rocky and covered with a thick growth of grass. All Mother Loon asked was grass enough for a nest, and to conceal herself while sitting. The nest is not very well made, but there is a slight hollow that holds the two big mud-colored eggs dotted with dark brown spots. In time there come out two of the smuttiest-colored little youngsters you ever saw, about the size of goslings, dusty black all over at first but later with a whitish belly and with comical little bills entirely unlike their mother's.

But perhaps you are not acquainted with Mother Loon. She is a large bird, as big as a Christmas turkey; that is, she will weigh ten pounds if in good condition. It always seems to me that there is something very motherly about her stout, heavy body, squatting close down upon her big feet, with her wise old green head, as soft as the softest plush, and her two white

striped collars at the throat; a much milder-looking, more domestic bird on her little island than when she is sailing around in the big lake, hallooing to wake echoes.

She is very fond of her little loon chicks, and has more worries than most land-birds. We hardly realize the number of their enemies. Hawks are always ready to devour them (and whatever may be said in favor of hawks, they leave many feathers along the pond sides where they have picked and eaten water-fowl). The old herring gulls would not hesitate to stoop and take one, for fat young loon is a delicious morsel to them. Then the big pickerel in the lakes often catch young birds, much oftener than you imagine. The great bull-frogs of the Northern ponds also gobble up little ducks. (Do not be surprised; for if you ever saw one of those great frogs, you would readily believe the statement, and I know it to be true.) The great mud-turtles that root about in the ooze of the pond bottoms, huge fellows, that will walk off with a man standing on their back, eat many water-fowl; and there are mink and otter and men as occasional dangers, so that the poor Mother Loon has a constant worry for a few weeks. Still, every other water-bird has just the same, and most of them have more children to look after.

Mother Loon has a great advantage over other birds, in her size and courage. She is afraid of nothing, can swim better under water than upon the surface, and is armed with a terrible bill that can be driven entirely through the body of the largest fish in the lake.

She eats nothing but fish, and is very expert at catching them. As it often is not convenient to swallow a fish tail foremost on account of its fins and spines, she is clever in tossing them in air and catching them head first, so that they slide down her throat as smoothly as if they were sardines.

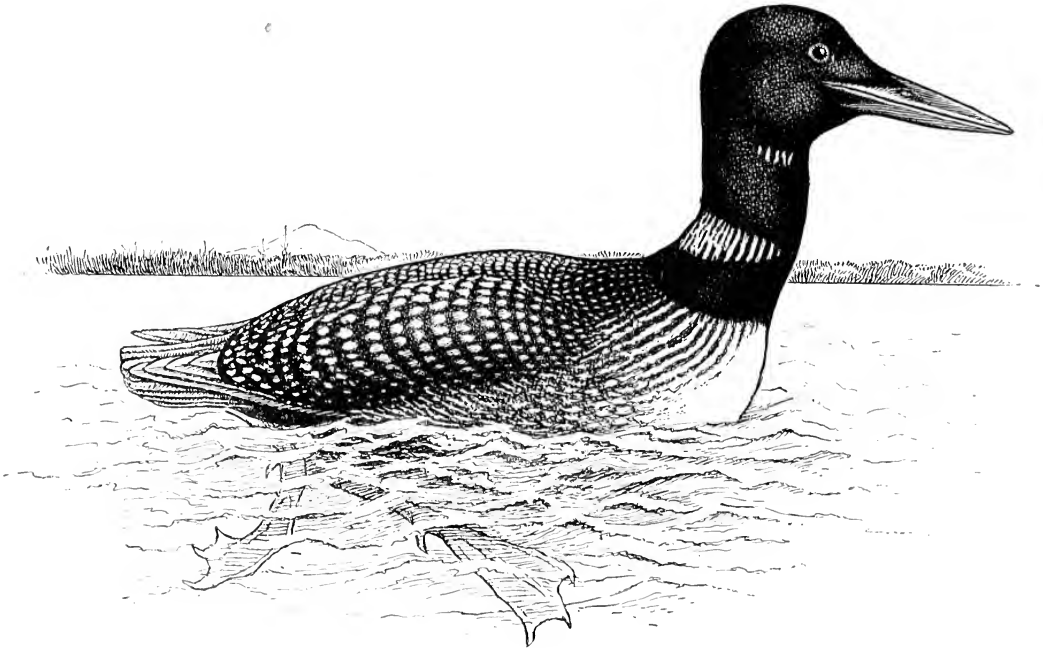

FIG. 2. — LOON.

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Though there are several species of loons in North America, only one is common in the United States, and this one varies so much in color with age and the season that we might easily suppose that we had seen two kinds of loons. Young and winter birds are gray above, indistinctly spotted, and the white of the breast runs up to the chin, while the head and neck are no darker than the back. The "gray loon" of the fishermen is a smaller species, the red-throated diver, which lives farther north, and comes as a winter visitor to the seacoast of the United States.

If you ever get well acquainted with the loons you will always be wondering whether they are the jolliest people afloat, or the most lonesome maniacs that ever lived outside an asylum. Sometimes they have little parties with races run from a given starting-point to a set goal. Great is the shouting and clamor as they run on the water, feet and wings both helping, each one plainly doing his best to get first to the winning post — an imaginary post of course, but it will be noticed that all stop at just the same point. Then they put their heads together and talk it over with merry *ha-ha-has* and chucklings that set the observer to laughing too, and all swim slowly back to the starting-point to run once more.

Often when alone the loon laughs to himself, and often, lifting his head, he gives his long, wild call — "not his laughter, but his looning," as Thoreau puts it in his book on the "Maine Woods." Except when he is at play with others the loon's heart never seems to be in his laughter; and you wonder if this terrible crazy yell, hollow, mad, and meaningless, echoed back by the woods and mountains that surround the lake, does not better tell you what a desperately lonesome and demented creature he is. "As crazy as a loon" is a current Northern saying. Yet of all the mad noises the bird can make, nothing

compares with the hoarse *haw-haw-haw, haw-haw-haw*, of a flock of loons flying in a strong breeze.

I well recollect a trip we once made down Caucomgomoc Lake in the northern Maine wilderness. The morning broke squally and threatening more wind, but as we had been detained by heavy rains, and as the wind was aft, we hoped by starting early to make the run before the sea rose dangerously. In that we did not succeed. The clouds flocked thicker, the waves ran white as sheep, and before we were halfway over they were washing level with the gunwales of the canoe, and slopping in-board, to remind us that there would be worse ahead. The land-line began to waver in the rising steam until we could not tell whether it was near or far away. The sun, "drawing water," sent down a great fan of purple bars edged with coppery reflections that made both sky and water black.

It was a wild-looking lake and sky, and for us every moment was worse than the last. We were not only driving into a heavier sea, but in making the outlet we must cross a half mile or more of shoal ground, where on our trip up the lake we had seen many sharp rocks sticking above the water and more just beneath the surface. The waves were now running so high that as the canoe rode over them she split them, and they stood in hills of water above either rail. The canoe grew hard to handle in such a flawy wind and broken sea, and we could get no clew to the dangers hidden where we knew we must run.

Meanwhile, three loons had mounted and were racing on the wing. A fiendish glee seemed to fill them. Under the black sky they looked as black as ink. Round and round they coursed, necks and legs extended, their pointed wings beating a double quick, as they cackled their malevolent laughter, and called for more speed and a better breeze. It was a witches'

carnival in broad day, and under its spell the stormy lake seemed to grow more tempestuous. But we drove through all right, just dodged the upright fluke of an old anchor left by the river-drivers in the outlet, rounded in beneath the lee of a bank, and safe in a sheltered nook where no wind disturbed the calm, blew the water from our noses and wiped it from our eyes with much love of the land.

The loon is the spirit of the lake. Nothing in our Northern waters so entirely fits the framework of the wild, mysterious forest that hems them round. To hear the loon's cry at night is almost as if the lake were speaking.

Once, while camping on the shores of Chesuncook Lake in Maine, I witnessed an impressive incident. It was late afternoon before a rain, and I had stepped down to the shore and stood looking at Big Spenser Mountain across the lake, feeling the quiet and grayness and flatness that falls upon a landscape with an approaching storm. There was no sound but that of a cricket; no ripple on the great smooth lake; nothing had moved recently enough to leave a circle on its surface within half a mile; yet, slowly, not five rods from me, out of the heart of the quiet water, rose the green head and neck of a loon. I could see its velvety softness, every white line on its little collars, the keen bill and the keener red eye, a head without a body, alone in the vastness of the great lake. Then it sank, slow, noiseless, mysterious, without a wake. So sank the sword Excalibur when Sir Bedivere at Arthur's bidding cast it in the lake.

> "Then with both hands I flung him, wheeling him;
> But when I looked again, behold, an arm,
> Clothed in white samite, mystic, wonderful,
> That caught him by the hilt, and brandished him
> Three times, and drew him under in the mere."

AN ALASKAN ISLAND.[1]

"There dark they lie and stark they lie — rookery, dune, and floe,
And the Northern Lights come down o' nights to dance with the houseless snow,
And God who clears the grounding berg and steers the grinding floe
He hears the cry of the little kit fox and the lemming in the snow."

— Rudyard Kipling, *The Rhyme of the Three Sealers.*

THE ANCIENT MURRELET.

The Ancient Murrelet, or the "Old Man," as the Russians call him, is one of the sea-birds of the Alaskan and Siberian coast. The following account of his habits is so good that we may make place for him: —

We were about one hundred and eighty miles east by south from Unga (a small island off the Alaskan peninsula) when these hardy birds were first seen. At first one would think they were amusing themselves, for they would fly a short distance ahead of the ship, dropping into the water, and swimming so as to be near the vessel's bows as she passed; then diving beneath the hull and coming up just under the stern. After they had dropped astern a few hundred feet, they took wing and repeated this manœuvre with unvarying precision throughout the entire day. By close watching I found that it was not for pleasure they did this, but that they were feeding on small invertebrates, such as are found on ships' bottoms.

By June second their nesting grounds were reached, but no birds were to be found, and to one unacquainted with their

[1] Abridged by permission of the author, Mr. Chase Littlejohn, from an article published in *The Auk.*

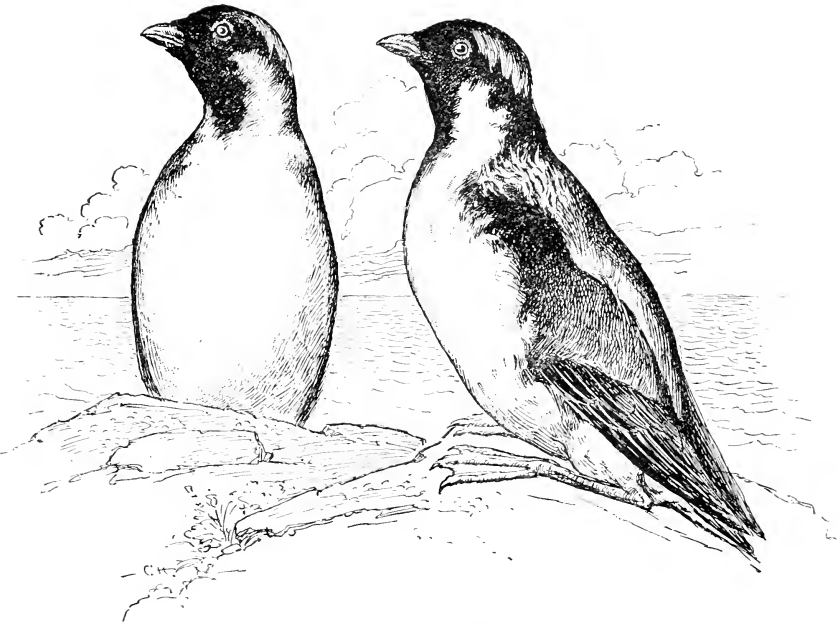

FIG. 3. — ANCIENT MURRELETS.

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habits there was no sign of their having arrived. Nevertheless, we land, pitch our tent, and wait until the close of that long twilight which is found only in the far North; and just as it merges into the night we see a bat-like form flit by, and presently from somewhere in the gloom comes an abrupt and starting *kroo-kroo-coo*, which is at once answered with a like call, or with the nerve-destroying *kweé-ké-ké-ké* in a very high, shrill key, the call note of the Leach's petrel.

Presently we hear a whirr of wings in different directions, then more voices, pitched in various keys, and before we are fairly aware of it, both heaven and earth seem to vibrate with rumbling noises and whirring wings.

As we step out of our tent perfectly astonished at this sudden change, and move to the foot of a small knoll near by, listening to the violent outburst of noises, a muffled sound comes from right under our feet. We stoop and discover a small burrow in the earth, and from it come the cooing love-notes of a petrel, *k-r-r-r, k-r-r-r.* This is its home.

From a somewhat larger burrow, only a few feet to our right, comes another sound, and moving cautiously in this direction we listen to the love-notes of Cassin's auklet, which remind me of the sounds produced by a squeaky saw while passing through a hard knot, somewhat like *kwéé-kew, kwéé-kew,* which fortunately lasts only for three or four hours each night. These noises, coming from hundreds of auklets and thousands of petrels, become almost distracting, and effectually banish sleep for the first few nights on the island.

These, then, are some of our murrelet's neighbors, but where is he? We listen in vain for some note of his, but hear none. As we walk on a little distance among the tall grass of last year's growth, we notice a small dark object flapping about, and after a short chase we manage to capture it, and discover

our Old Man, but fail to locate his nest. We did not then know the places — under rank, matted grass — which are mostly preferred by the murrelet for nesting sites.

We remained on this desolate, wind-swept island for two weeks. After losing about a week's sleep, owing to their squeaking, I, at least, felt like choking the whole lot. As if not satisfied with the constant babble of their neighbors, the murrelets took especial delight in alighting at the foot of our A-shaped tent, toe-nailing it up to the ridgepole, resting there a moment, and then sliding down the other side. This exercise seemed to amuse them, and it certainly did us until the novelty wore off.

In a short time after the first birds arrive on their breeding grounds, and before one has time to realize it, the entire surface of certain favorite islands is literally alive with murrelets and auklets, and both Leach's and fork-tailed petrels. When one walks about at this time the murrelets and auklets become frightened, running, flopping, and flying about in such numbers that one has to be careful when he steps lest they be crushed under foot.

If it is windy, and it usually is, they are on the wing as soon as disturbed; but when a calm prevails they have to flop to the side of a steep bank, from which they can jump and thereby gain sufficient headway to keep on the wing. In their frantic efforts to be off, they become bewildered and are as apt to fly in one's face, or against the cliffs, as anywhere.

We soon discovered that the murrelets were not especially particular in the selection of a nesting site. An abandoned burrow of Cassin's auklet, a deep crevice in the cliffs, under large broken rocks which had fallen from the latter, or under rank tussocks of grass, with which the higher portion of the island was covered, would answer equally well. Under these

almost solid bunches (the grass remaining from many years) the murrelets would force their way, leaving only a slight hole in the mass, which was usually very hard to detect. After once gaining an entrance into this matted vegetation, and working their way in for two or three feet, a shallow cavity about five inches in diameter and two or three inches deep was scratched out. This was nicely lined with dry grass of last year's growth, carried in from the outside, making a neat and snug home in which two beautiful eggs, comprising a set, were deposited.

Some of their nests were found fully two hundred yards from the water. In the other situations mentioned little and often no nest is made, and the eggs are deposited on the bare rocks, in soft sand, or on the wet, muddy soil. I even took several sets on the bare ice at the bottom of some auklets' burrows, the ground being still frozen immediately beneath the grass and moss on July third, when I left the island.

Like the auklets, they exchange places nightly, and while one attends to the home cares, the other is usually a number of miles out at sea on the feeding grounds. What their food consists of at this time of the year I am unable to say.

Great numbers of these birds are taken by Peale's falcon. As I have already stated, the murrelets are mainly found at some distance from land during the day; and here, too, this falcon pursues them, watching for a chance to seize any murrelet he succeeds in driving from the water. After having secured its prey, the falcon circles about for a short time, and then partakes of its meal. To do this he hovers, remaining almost stationary for several minutes at a time; in the meantime the prey is raised well up to the beak with both feet and promptly devoured. When the murrelets return to land at nightfall, the falcon is there also to meet them, and soon again secures his nightly repast.

OFF GRAND MANAN.

"From gray sea-fog, from icy drifts,
From peril and from pain,
The home-bound fisher greets thy lights,
O hundred-harbored Maine!"

—JOHN G. WHITTIER, *The Dead Ship of Harpswell.*

JAEGERS.[1]

THE life of the great sea is not to be realized from the deck of an ocean liner. You must be close down to the heave of the ocean, tossed by it, and fully at its mercy, to know the sea.

Suppose some day we were to join the porpoise fleet of the Passamaquoddy Indians as they set out at sunrise in their birch-bark canoes from the summer camp at Grand Manan Island — the great bluff island off the mouth of the St. Croix River. Theirs is a dangerous trade, but there are no bolder or more skilful navigators of small boats in the world than these Indians, who take the risks of a rock-bound coast, with sunken ledges, sudden storms, the densest fogs, and a tide of almost incredible height, that rushes through the narrows and sets in motion great tidal currents and whirlpools. All sailors meet hardships and see strange sights, but these Indians, hunters of the ocean, see and know more strange and wonderful things and take greater risks than the ordinary seafarer.

What might befall us if we started with them some summer morning at sunrise, when the surface of the sea is smooth and

[1] Pronounced *ya-ger*, with *g* hard; also spelled *jäger*.

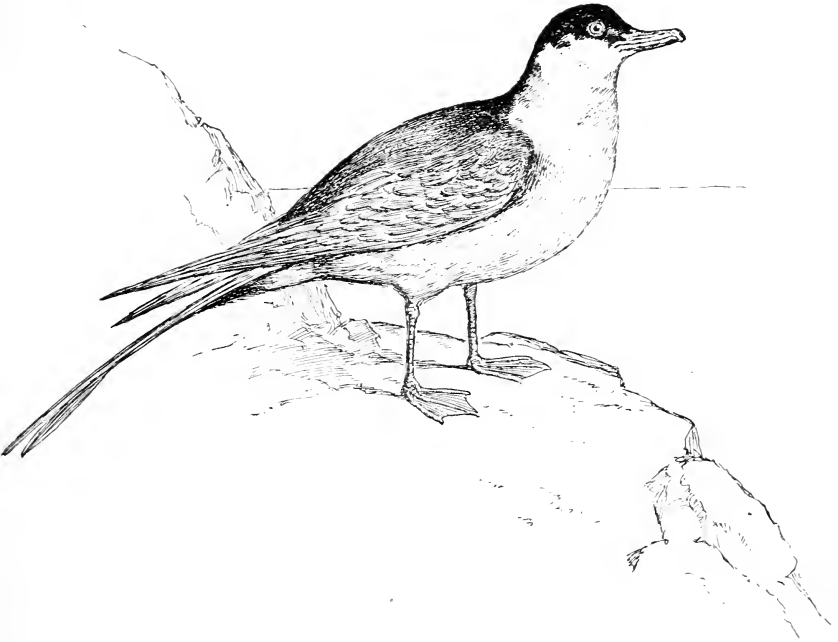

FIG. 4. — JAEGER.

Facing page 18.

oily-looking, and a morning fog hangs over it, smoking in thin curtains that narrow the horizon to a little circle, and make the sun a bright blur in the mist?

Mile after mile we are paddled, steered by the compass, breaking the fog before us and seeing it close in behind, lifted on the long ocean rollers that pulse in from outside as smooth as glass, twenty feet from trough to roll, — the slow, long heave of the slumbering ocean. This "old swell," which follows a blow or rolls in from a distant oceanic gale, is rarely absent from the open sea on our Eastern coasts. It throbs continually even in the calmest weather, and the "rote" of it as it breaks against the cliffs, or drags down the rounded stones upon the seaward beaches and rolls them up again, is a ceaseless din.

The long swells, green and bubbly like thick glass, as you look into them under the shadow of the rosy fog, make no noise, for they do not break; but out of sight in the mist we hear them thunder upon a sunken ledge.

We hear, too, the snuffling and snarling of the seals fishing in shallow water, which the Indian always regards as a warning to "'Ware there!" For the seal spends most of his idle time lying upon the ledges, or else swimming around, waiting for the tide to go down and uncover some half-tide rock. A black guillemot — a "sea-pigeon," an Indian or fisherman would call him — bobs upon the surface, or flies by on short, quick-moving wings that, being party-colored, look like two pairs of wings, one white, the other black. He is a useless, harmless, confiding little bird, with his red feet and pretty, soft, mottled feathers, one of the auk family, and the only one common along this coast in summer.

Perhaps there is a tide streak where opposing currents throw up a line of seaweed and ocean-drift in a long, winding

ribbon; and on this we may at times see a flock of Bonaparte's gulls sitting quietly on the water like white doves, or a troop of phalaropes feeding with nervous, uncertain actions. These tiny creatures, dainty in all their ways and colors, stretch up their necks to an astonishing length, suspicious of our intentions. We see now why the fishermen call them "sea-geese," though they are no more geese than they are robins.

Gulls and terns pass and repass continually, growing out of the mist and melting into it; and perhaps a shark's fin cuts the water, or we hear the puff of a porpoise off under the fog; or, of a sudden, a roller larger than the rest, and rising from a deeper trough, trips on a sunken ledge, and rears a straight wall of water with a comb of foam, before it thrashes down roaring. This is one of the dangers of a sealer's life; and no peril of storm or wreck is more dreaded by the fishermen than these "blind breakers," unless it is the sudden looming of a steamer's sides above them in the fog.

While paddling in this way over a smooth, almost silent sea, suddenly a little group of gulls dashes across the opening in the fog, screaming wildly and hurrying at top speed. Behind them, silent but swifter of wing, darts a blackish bird of medium size. We may see a glimpse of yellowish about the throat and catch sight of its tail, carried fully spread, with the two middle tail feathers sticking out beyond all the rest but held close to each other. The Indians call it the "gull-hawk," because it chases the gulls as hawks do smaller land-birds. Indeed, he resembles a hawk not only in his habits, but in his bill, which is hooked at the tip and provided with a cere, or waxy plate, at the base. This bill serves at once to distinguish him from all the gulls and terns with which he associates. The books call him the jaegar (which means hunter), or the skua; the fishermen name him the "marlingspike," from his long middle tail

feathers. He is the gull's robber cousin, a dreaded foe of theirs, the pirate of the sea. It is interesting to know that the jaegers, or jägers, from whom the birds get their name, were not peaceful hunters, but a wild tribe of robbers who lived in Germany centuries ago, and got their living by plunder.

The jaeger well deserves the name of pirate. He is perfectly able to get his own living, but all observers agree that he seldom if ever fishes for himself, although he is reported to pick up worms and mollusks. It would seem far easier to get an honest living than to follow the trade he does, for every fish he obtains by robbery means a long chase.

The terns may be fishing together, plunging and screaming, without thought of interruption, when suddenly this black robber, swift and silent, is seen among the flock, following the one that has just caught a fish. If the fish is already swallowed it makes no difference to him, and he never mistakes an empty bird for a full one.

How, when he appears so suddenly, so unexpectedly, he can always tell just which birds have been successful, has been a puzzle to observers, but it seems easily answered. There is no panic except among the terns that have just caught fish, and perhaps their terror reveals their secret to the pirate's quick eye. Having once selected his victim, he pursues that one and no other, flying now above him, now beneath him, threatening him with his bill until the frightened tern at last disgorges what he has eaten, and the victorious jaeger snatches it up as his prize. So quick is he that he often catches the coveted morsel before it can reach the water.

The jaeger is not a mild or a docile bird. His disposition is naturally fierce and his temper intractable. Something in his look, aside from the hooked beak, reminds us of the birds of prey. Therefore it is probable that, loving the chase for its

own sake, and for the excitement it brings, the jaeger has taken up his parasitic habits, not because they secure him an easier livelihood, but because they gratify his love of the chase.

One very curious fact which characterizes some families of sea-birds, but is rarely observed of the land-birds, must be noted of the jaegers. The species have two different colorations or "color-phases." Some birds will be dark all their lives, others will be light-colored for life. They are the same bird in everything but color, although some are almost as light as a sea-gull, and some look nearly black. The light birds much resemble gulls, except in having more or less pale yellow about the throat and head, a darker upper surface which is not a "mantle," as in the gulls, but extends down over the rump and tail end, and a dark crown, which no gull has. The elongated middle tail feathers are a sure mark, as is also the habit of carrying the tail spread. The dark phase is a sooty brown, sometimes, but not always, with a little yellow about the head. The younger birds are mottled brown and white.

There are three species of jaegers found in the United States, and while not often seen, even offshore, they sometimes travel in winter far to the south along the coast, and are occasionally seen about the Great Lakes and down the Mississippi Valley, always the same bold pirates that we met off Grand Manan.

THE HERRING GULL.

"The low bare flats at ebb-tide, the rush of the sea at flood,
Through inlet and creek and river, from dike to upland wood;
The gulls in the red of morning, the fish-hawk's rise and fall,
The drift of the fog in moon-shine, over the dark coast-wall."

—JOHN G. WHITTIER, *Marguerite.*

THE best known of all sea gulls is the herring gull. He ranges from the warm regions in winter to the Arctic Circle in summer, inland and coastwise, in both eastern and western hemispheres.

On the Pacific the American herring gull is duplicated by a relative, so nearly similar in size and color that only a scientist could mark the difference, and he associates with the Western gull, of the same size and appearance but with a slightly darker mantle.

Even those who live in the largest cities know the herring gull as he flies up and down the channels among the shipping, or floats lightly in the city reservoirs, a winter visitor who finds it easier to make a living near city wharves than in the open sea. In summer he is up and away, far to the North, to the ledges along the coast of Maine and Labrador, or to the Great Lakes in the interior. Along the Maine coast, however, there is usually an abundance of herring gulls in summer, and at one place their numbers have become a proverb. "As thick as the gulls at Eastport" is not an uncommon saying for numbers beyond computation.

Indeed, it is a beautiful sight at times to see the immense numbers of gulls that throng "Quoddy Bay," as Passama-

quoddy Bay, on the eastern coast of Maine, is usually called by the people living coastwise. The sun shining on them lights every bird, so that even when two miles away you can see them filling the air like a snowstorm, rising, falling, hovering, settling, a cloud of white flakes. There may be ten thousand, or there may be a hundred thousand of them, but the mind does not grasp the number, and any estimate is a guess. Nearer to the flock, instead of a cloud of silent white flakes, we discover a busy, screaming tangle of birds, each intent on looking out for himself. All is excitement, and their enormous appetites make them able to find fun in their fishing long after it would seem they must be gorged with food.

The gentle little Bonaparte's gull loves to sit and rest on the water for long intervals; the kittiwake will often float and eat what is floating beside him; but the herring gull, when in large flocks, is nervous and fierce, and rarely rests long, but takes its prey while on the wing, patting the water with its feet, arching its neck down to the water level while its uplifted wings hold it steady above the waves. Unlike the terns the gulls do not dive. While there usually are exceptions to all rules, it is almost certain that an uninjured herring gull never dives.

If you were to ask what brings these great numbers of gulls together, and I were to tell you that the tides do it, the answer, though correct, would seem frivolous. The tides of Eastport are the highest of any place upon the seacoast of the United States — twice as high as those of Boston, five times those of New York, and seven times those of San Francisco.

In filling and emptying this great bay twice a day through narrow channels, tremendous whirlpools and currents are formed, and immense quantities of fish are borne back and

forth with the tides. Incalculable numbers of little herring are swept along, and these are followed by the larger fish and by the gulls that feed upon the herring. At times the water boils with the rushes of great armies of young herring trying to escape their enemies, while the pollock striking them from below or leaping out of the water, until the sea seems planted with fishes standing on their heads, and the screaming gulls dipping from above to seize the little fish as the pollock drive them up, make a scene not soon forgotten.

Nor are the birds and fishes the only enemies the little herring have to fear. Thousands of hogsheads of them are taken in the nets of the fishermen and become sardines in oil or sardines in mustard. The chief industry of the towns upon Quoddy Bay is packing sardines.

The gulls nest both inland and along the ocean shore. While canoeing on the great lakes of Maine, I have found their nests on the ledges far out from shore. The prettiest were little rims of reindeer moss laid upon a bed of the same dainty material, surrounding three dark eggs, larger than a hen's eggs, blotched with darker brown. Along the seacoast the nest is made of dried seaweed. It is the habit of gulls to nest upon the ground, but when robbed and persecuted, they both build and roost in trees.

The herring gull is one of our wariest and most suspicious birds, its only superior in these traits being the great black-backed gull, which can scarcely be snared, trapped, shot, or poisoned. So alert are the black-backed gulls that even the wary black ducks, themselves among the shyest and most cautious of birds, sometimes have a black-backed gull act as sentinel for them, and warn them of danger while they sleep or feed.

When Pau-Puk-Keewis, in the story of Hiawatha, kills the

birds, and flings their bodies down the crag, it is Kayoshk, the sea gull, that discovers them and gives the alarm.

"Till at once Kayoshk, the sea gull,
Perched upon a crag above them,
Shouted: 'It is Pau-Puk-Keewis!
He is slaying us by hundreds!
Send a message to our brother,
Tidings send to Hiawatha!'"

The poet makes a mistake when he says that the gull makes his outcry "from a crag"; it is his custom to give the alarm *on the wing.*

But nothing could be more appropriate than choosing the sea gull to raise the alarm. Many a time the Indian seal-hunter creeping over the tide-ledges of the bay, with every advantage of wind and sun, hears the harsh scream of a gull or tern flying over, and curses Kayoshk for betraying him. Every bird and beast about the seashore knows that warning, just as in the woods every creature halts and scurries off when the little chipmunk raises his sharp alarm. "A man! a man!" he seems to say; "run! run! a man!" and the old crow, flapping over, adds gruffly, "Go! go! go!" Thus it is that the birds and beasts stand guard for each other.

Again Longfellow speaks of the sea gulls as they work upon the carcass of the great sturgeon within which Hiawatha is imprisoned, and in the description we mark two fine points and one little error.

"Then he heard a clang and flapping,
As of many wings assembling,
Heard a screaming and confusion,
As of birds of prey contending,
Saw a gleam of light above him,
Shining through the ribs of Nahma,
Saw the *glittering eyes of sea gulls,*

Of Kayoshk, the sea gulls peering,
Gazing at him through the opening,
Heard them saying to each other,
'Tis our brother, Hiawatha!
* * * * * * *
And the wild and clamorous sea gulls,
Toiled *with beak and claws* together."

This vigorous and truthful picture is not at all what we who are not poets would have imagined. Because of its whiteness most of us think the gull the emblem of purity and gentleness, and would not have written —

"As of birds of prey contending."

Yet that just describes the fierceness and rapacity of sea gulls. Few of our most savage hawks are more bloodthirsty than sea gulls, just as the crow is hardly more shrewd and ingenious, and as no bird is at once so bold and so wary.

Nor is the error in the line —

"Saw the glittering eyes of sea gulls;"

for the kind the poet is describing — the kind he must be describing, both because his words fit that and no other, and because it is the gull he used oftenest to see when he was a boy and man along the Portland shore and up the river Charles — has *yellow* eyes that are as fierce and unflinching as a hawk's. (The eyes of young gulls and of the smaller species are brown.)

But does the gull work with his feet? Not unless he braces with them to get tearing-hold. His nails are not made for scratching, and his thumb or fourth toe is too high up on his leg to help him grasp any object. This is the touch overmuch in the description, something the poet remembered incorrectly, or added from his imagination. But there are few naturalists equal to the poets.

When we are at the seashore we may be puzzled to see so many different kinds of gulls. But while there are very many species of gulls, it is rare for more than three or four to be seen in one locality, and these may be better distinguished by their size than by their colors. Adult gulls are always pure white, with or without a pearl-gray "mantle" on the back and upper surface of the wings, and with or without black wing-tips. Adult gulls never show any other colors except upon the bill and feet, which may be flesh-color, red, or yellow. The only other conspicuous marking is a black or dark gray head which is seen in some of the smaller species during the breeding season, and which disappears later.

Young gulls are more or less brown according to their age, and the young of some species show a black bar across the end of the tail, a black crescent between the shoulders, or a brown mantle. These are all sure marks of immature birds.

The largest of our common gulls is the American herring gull, which is seen on both seacoasts, about the Great Lakes, and near most of the large lakes of the interior. The Western gull which largely replaces it upon the Pacific coast, is scarcely distinguishable in life. Of the medium-sized gulls — those about eighteen inches long — the kittiwake of the northern Atlantic, the black-headed laughing gull of the southern Atlantic, the ring-billed gull of the plains and interior states, and the beautiful Heerman's gull of the Pacific, with its gray body, white head, and red feet and bill, are the more conspicuous. The black-headed Franklin's rosy gull of the interior, often called the "prairie dove" by the farmers, belongs to the group of small-sized gulls, and the black-headed Bonaparte's gull is a smaller bird, everywhere well known, both East, West, and in the interior. However, we very rarely see a Bonaparte's gull with a black head, as this is the mark

of the breeding season and is worn only for a few weeks. The Bonaparte's gull is the common small species of the Atlantic coast, so often seen floating in large flocks on the water.

It is not difficult to distinguish gulls from terns, which somewhat resemble them in color. All our United States gulls are square-tailed and blunt-billed, and float on the water but never dive, while all our terns are fork-tailed, sharp-billed, and dive from the air but do not float upon the surface. The terns commonly have very brilliant red or yellow feet and bills, and in the adult plumage a black cap, but never a black head. Young terns lack the cap but do not show any brown markings like the young gulls.

ON THE FARRALONES.

FEEDING HABITS OF GULLS ON THE PACIFIC COAST.[1]

"For of all runes and rhymes
Of all times,
Best like I the ocean's dirges,
When the old harper heaves and rocks,
His hoary locks
Flowing and flashing in the surges."

— HENRY W. LONGFELLOW, *The Saga of King Olaf.*

THE Farralones are a group of rough and barren islands thirty miles out from San Francisco. No tree grows on them, and scarcely a plant, except the long, spongy weed called Farralone weed, can hold its own against the sea storms in that infertile soil. On one of the islands is a lighthouse. No other houses are there, and few men except those who gather eggs for the market ever visit the place.

Thus being comparatively undisturbed, birds nest here in vast numbers. There are great colonies of cormorants, black as midnight, stretching up their long necks; companies of tufted puffins with their gay red and green bills and yellow ear-plumes curling like a ram's horns; murres by the myriad, lifting their brown necks above their snowy breasts; pigeon guillemots, much like the "sea pigeon" of the East; Cassin's auklets and petrels mingle with them according to their natures, solitary or in companies; and everywhere the snowy

[1] Facts drawn from Dr. Walter E. Bryant's "Birds of the Farralones" and H. W. Taylor's "Story of the Farralones."

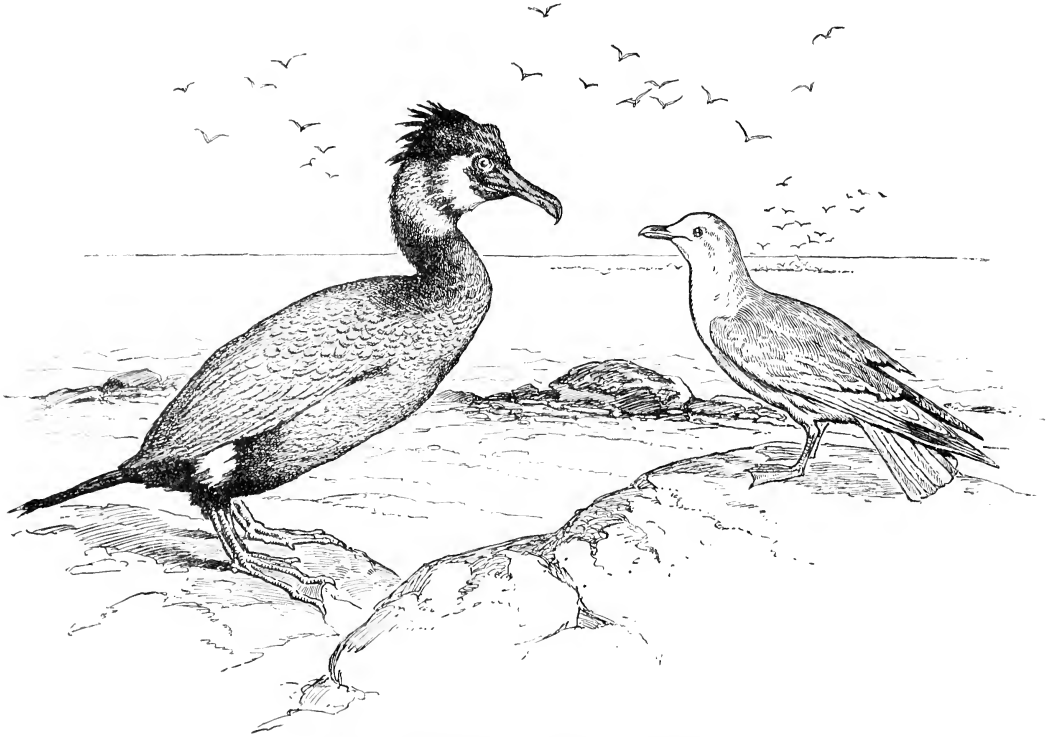

FIG. 5.—CORMORANT AND HERRING GULL.

Facing page 30.

Western gull, in size and color almost the counterpart of the herring gull of the East, stands his watch over a nest that is safer from intruders than any of the other nests.

The gull of the East is a persecuted creature. He is robbed of his eggs; he is killed by gunners for his wings and feathers, to put into feather-beds when they are not put on hats; he is forced from his chosen home, and is even compelled to build his nest in trees, contrary to his nature.

Our sympathies are too much with the gull of the East to make us inquire if he has faults; but when we see the gull of the West, free, secure, little molested, we find his honesty questionable and a trait of low cunning highly developed. The sea gull is so like our old friend the crow in his boldness, impudence, and intelligence, that it is easy to believe that he is honest only under compulsion; and that the Western gull acts out his real nature while the Eastern one lacks opportunity.

As soon as the breeding season opens the gulls begin repairing their old nests, which are large, comfortable affairs, made of the dry, ravelled Farralone weed. At the very outset they show their nature; for they steal their materials from the cormorants that nest near them. The cormorant is heavy, long-necked, ill-balanced, and awkward, so that picking up nesting stuff is hard work for him, while the active gulls can gather it as readily as any land-birds.

In their feeding we find the gulls eating their own honestly earned fish and crabs and sea-urchins, and also the fish that they steal from the nests of the cormorants. Not content with this, they eat the cormorants' eggs, and later in the season their black, bare-skinned, greasy-looking babies. It is almost incredible that a bird so spotless and dainty in its appearance can have so black a heart, but live young cormorant is part of the gull's bill of fare.

When the cormorants' eggs are all hatched, and the gull still wishes to mix a little egg with his diet, he torments the murres. Now the murres are foolish birds that bow their long, brown necks and silly heads continually, and grunt harshly, but they love their one big, pear-shaped egg. Always one or the other stays by it, hugging it between his or her long thighs and brooding over it. For all their folly they know enough not to trust a gull. As they are more than half the size of the gulls, the gulls prefer stratagem to force. A number of them combine to attack the murre in concert, and so harass and frighten her that she tries either to escape or to confront them. This is the gull's opportunity. The big egg must be exposed for a moment. While the rest keep up their clamor and feigned attacks, one of the gulls steals in and seizes the egg in his bill. It must be a very large mouthful, for a murre's egg is much larger than a hen's egg, and the gull's bill is but little over two inches long. He breaks the egg by rolling it about the rocks until dented by rough usage, after which he sucks its contents. Not only do the gulls rob the birds, but they rob the eggers. Unless the heaps of eggs which the eggers pile up are covered very closely, the gulls will work their way under the cloths and carry off every egg.

But eggs are not all their plunder. They just as willingly take the live young murres or a dead old bird. And they have a particular fondness for young rabbits. They will sit and watch by the rabbit burrows an hour waiting for the little rabbit to come out, and then will work fifteen minutes in trying to swallow him.

THE LITTLE PEOPLE OF THE JUNK O' PORK.

LEACH'S PETREL.

"Well, ah fare you well, and it's Ushant[1] gives the door to us,
Whirling like a windmill on the dirty scud to lea:
Till the last, last flicker goes
From the tumbling water-rows,
And we're off to Mother Carey
(Walk her down to Mother Carey!)
Oh, we're bound for Mother Carey where she feeds her chicks at sea!"

— RUDYARD KIPLING, *Anchor Song.*

NEAR the entrance to Casco Bay, on the coast of Maine, close by the route of steamers going into Portland, is a curious island which never fails to attract the attention of the tourist. At low tide it may show half an acre, but at high water there appears only a bluff-sided island perhaps twenty-five feet above the sea and forty feet in length, slightly curving, and on top bare of house, or tree, or bush, but green with short grass. Some facetious sailor in years gone by, remembering the fat "rounds" that were always kept in the pickle barrel of the farm-houses, called it the "Junk o' Pork." It looks very much like a piece of fat pork, twice as long as it is thick, lying rind toward you. The little island is uninhabited, and almost inaccessible by man. A few years since, and probably it is the same to-day, all that lived

[1] An island off the coast of France, whose lighthouse is the last sighted as the ship steers out into the Atlantic.

on it were birds and field-mice; and chief among the birds were the Leach's petrel, which fifty years ago was found on all our outer islands.

The Scotch have a pretty way of speaking of fairies as "the good people" or "the little people," to win their good-will; and when we recollect the superstitious respect all seafaring folk have for the petrels, or "Mother Carey's chickens," it seems quite fitting to give them the same title. That there are to-day few petrels breeding where there used to be hundreds is due to city gunners and scientists; for even a few years ago not a fisherman or island gunner anywhere along the coast could be induced to kill a petrel lest ill-luck should follow.

These "little people" are small and dark-colored and flit about toward evening like little shadows, coming from and going to their nesting-place. Dusk and dawn are their hours of greatest activity, though all day long one of the pair will be out at sea feeding, while its mate is at home on the nest. It is the custom of the petrels to lay their eggs in underground burrows about two feet in depth. In this dark chamber, when there are eggs to be hatched, one bird sits all day long sleeping and brooding; and at evening, welcoming her mate with a harsh-sounding but loving greeting, she changes places and goes out to seek her own food.

Apparently the petrels see better in the twilight than in broad day, as one might imagine from their large full eyes, which have a near-sighted look, and a pupil so large that the eye appears to be black, though the iris really is brown.

There is something wonderfully soft and dove-like about the petrels. Their plumage, though dark colored and greasy, is as full and deep as a gull's. Their manners are gentle and winning, and they do not resent being handled, but look at

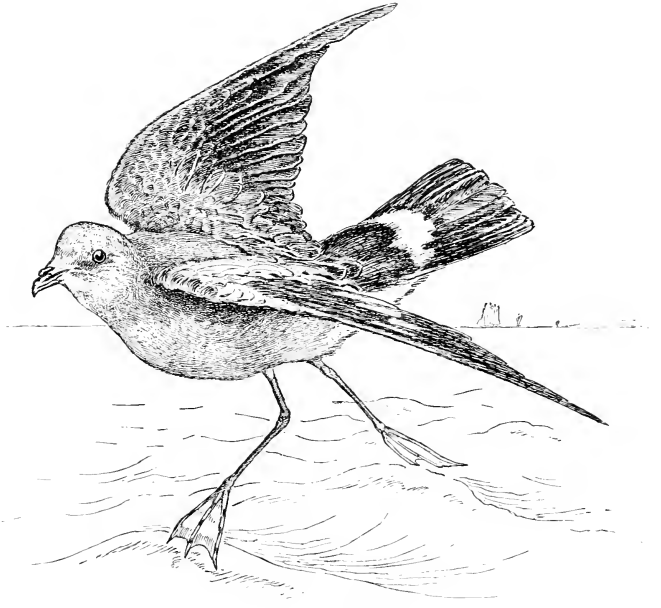

FIG. 6. — PETREL.

Facing page 34.

you with their great round, liquid eyes, or go tiptoeing about the floor with an audible patter of their soft feet.

Having no hind toe, and being unused to spreading their feet upon a level surface, they walk unsteadily on the outer joints of their toes, bending forward with awkward bobs, and partly spreading their wings to balance themselves. I have never seen one of those I have had in captivity try to fly, though I have had a dozen of them at a time moving about like dusky little shadows. But for the impossibility of getting them the proper food, and for their rank, oily smell, they would make pretty pets.

All sea-birds keep their feathers well oiled to exclude the water, but the petrels and their near relatives are provided with an oil that has an odor quite unmistakable and not attractive. In addition to what is used upon the feathers, the Leach's petrel has in its stomach from a teaspoonful to a tablespoonful of heavy, oily liquid, exceedingly limpid and of an unpleasant odor. He can disgorge this at will, and sometimes, in captivity at least, becomes much bedraggled with it. The use of this supply is hard to determine.

How the petrels with their weak, webbed feet, which seem wholly unfit for such work, can dig such holes in the hard earth of our outer islands is a mystery. Of course the holes remain from one year to another, so that unless a colony is largely increased it is not necessary to dig new ones; but I think they have a helper whose services have received little credit in books. All our outer islands are overrun with field-mice, whose holes are found on all sides. On landing on an uninhabited island, almost the first thing one notices is the scampering of mice through the short grass. It seems likely that the petrels often take possession of these mouse-holes, enlarging them to meet their own needs.

The petrel lays but one large white egg, and the parents, as we have said, share the work of hatching it. Rarely both parents are found in the burrow, and more rarely still the egg is found alone, yet it is still unknown which parent takes the responsibility. With most birds it is the mother that cares for the eggs and nestlings; but there are cases known, as among the phalaropes, where the female leaves all the work to her mate. With the petrels no one knows certainly what happens. Some naturalists report that nearly all the birds found with eggs were females and others that the majority of those they saw on the nest were males.

Out of eighteen old birds that I examined one season twelve were males, and there was a curious indication that the male did a large share of the work. Among sea-birds it is customary for the female to tear off a patch of feathers from her body just the size of the egg, so that the warmth of the body may heat the egg directly. Often the exact number of eggs can be told by the number of these "brooding spots." It is usually taken for granted that the bird with these incubating spots is the female; but in every Leach's petrel that I have examined during the breeding season, the male had the "brooding spot" and the female lacked it. However, we must know more about their habits before we can say that all the housework is left for the male to do.

Often on a sea voyage, even a short one, if it take us outside of harbors, one may see the petrels following the vessel or dancing over the waves in little groups. Their flight, which is graceful and easy, resembles that of a purple martin; and, as the birds are about the size of swallows and dark colored, it would be natural to mistake them for swallows unless we knew the habits of both birds.

When they find food the petrels gather around, raising their

wings above their backs and dropping their long, thin legs. They hold themselves stationary by fluttering their wings and pattering with their webbed feet, much as a boy balances himself on a barrel by keeping both feet and hands in motion. The name "petrel," or little Peter, is an allusion to St. Peter's attempt to walk upon the water. The Germans call them "Petersvögel," or Peter's birds, from the same pretty conceit.

Can we understand the life of these petrels? The glimpse we have had of them is their one visit to the land in all the year. After their little chick is out of the shell and able to go to sea, the petrel never comes to shore again unless driven in by storms. No birds are so near to the sailor in all his voyages nor so remote from the landsman's travels as the petrels and their near relatives. Their peculiar odor gives us a hint — and a strong one — of train oil, and whaling voyages, and long months out of sight of land. Day after day, month after month, they are alone upon the ocean.

Picture to yourself the solemn loneliness of such a life. All they eat must come by fishing, or from the ocean drift, and when they drink it must be salt water. They can never alight on anything more stable than the rocking billows. Does it storm? There is no protection to them from rain or cold unless they fly above the storm or beyond it. They sleep on the wing or on the wave, homeless wanderers, driven up and down the sea with no rest except in motion. What a solitary life, fit only for a savage bird that hates man and his own kind! Yet these houseless and homeless creatures are more sociable than solitary, more confiding than morose; they seek the neighborhood of ships, are easily caught, readily tamed; and the smaller kinds are gentle in disposition, if not affectionate. It is one of the mysteries of the great ocean, what makes its loneliness and immensity so dear to these little sailor birds.

FEEDING HABITS OF THE FULMARS OFF THE COAST OF SOUTHERN CALIFORNIA.[1]

"Sun, wind, and cloud shall not fail from the face of it,
Stinging, ringing spindrift, nor the fulmar flying free;
And the ships shall go abroad
To the glory of the Lord
Who heard the silly sailor-folk and gave them back their sea!"

—Rudyard Kipling, *The Last Chantey.*

Ten miles west of Point Loma, at the entrance of San Diego Bay, is an extensive fishing bank extending parallel with the coast for a distance of several miles. This bank is resorted to during fair weather from October first to March first by the San Diego fishermen, who obtain large quantities of rock-cod there for the markets of southern California. The fishing is all done in from seventy-five to one hundred fathoms of water. There are often large schools of small fish on the surface which attract great numbers of sea-birds, including the fulmars, and it is along this bank that fulmars are to be found if anywhere near shore.

Some time about the last of September the first of them make their appearance, the exact date being somewhat uncertain and due in a measure to the food supply, and quite possibly also to the weather. They are hardly what one would call gregarious, although several are often seen in company flying along in a loose, straggling flock. More often they are seen in

[1] Abridged, with author's permission, from an article by A. W. Anthony in *The Auk*, April, 1895.

flocks of black-vented shearwaters, one or two in a flock of fifty.

Unlike the shearwaters, however, they seldom pass a craft without turning aside at least to make a circuit about it before flying on. If the vessel is a fishing sloop, sounding on the banks, the chances are in favor of the shearwaters being forgotten and allowed to disappear in the distance while the fulmar settles lightly down on the water within a few yards of the fisherman. The next fulmar that passes will, after having made the regulation circuit, join the first, until within a few minutes a flock of six or eight of these most graceful and handsome petrels have collected, dancing about on the waves as light and buoyant as corks.

As the lines are hauled up after a successful sound, the long string of often twenty or thirty golden-red fish is seen through the limpid water while still several fathoms down, and great excitement prevails. Any fulmars that have grown uneasy and have started out on the periodical circuit of the craft, immediately alight a few yards to the windward. Those that are on the water and have drifted away hasten to the spot, with wings outspread and feet pattering along on the water.

It is more than likely that in hauling up the line one or more fish have become detached from the hooks; such fish, if loosened after having been raised from twenty fathoms, are sure to rise to the surface a few feet to the windward of the boat. The pressure of the deep water being suddenly removed, the air in the air-bladder expands so quickly that the fish is greatly distended, and rises helpless to the surface.

With a hoarse croak and wings outspread the nearest fulmar pounces upon the unfortunate cod, keeping all others at bay with threatening beak. A few hasty snaps at the eyes,

or air-bladder protruding from the mouth, convinces him that codfish are tough, and the first floater, if a large one, is abandoned for a moment for the second, should there be more than one, or for a snap at the bait on the hooks.

Their excitement by this time has attracted the attention of several Western and American herring gulls, which hover screaming over the sloop, too shy to attempt to touch the fish while it is so near. Another ocean wanderer meantime has arrived; a short-tailed albatross, sweeping along, has noticed the commotion among his lesser brethren, and with a groaning note settles down by the floating fish, keeping all trespassers away by a loud clattering of his mandibles; though not infrequently a fulmar will dispute possession for some time with an albatross before leaving a fish he has torn open, and I think a fulmar will usually rout a Western gull completely.

In attacking a fish under the above conditions, the eyes and air-bladder are first eaten, after which the abdomen is torn open, if possible, and the entire contents of the skin torn out piecemeal. I have, however, seen birds seated on the water by the side of a fish from which they had eaten the eyes, though they were unable to tear open the tough skin.

In diving the fulmars use both feet and wings, the latter only half open, the primaries seeming to be used very little, if any, but kept drawn back with the secondaries. Once under water they make good headway, seizing the fish, which is swallowed immediately upon reaching the surface.

Although mention has been made of their following fishing sloops, fish form a very small part of their diet while on the coast. In fact it is the exception. I have never found a small fish in the stomachs of those I have taken, nor have I seen them catch fish themselves, though I have no doubt regarding their ability to do so, should they fall in with a

school of small herring or anchovies; and from their associating with flocks of shearwaters I infer that they derive a part of their food from such schools of small fry when they are common.

There is, however, a large jellyfish that is usually abundant along the coast during the time of the fulmars' sojourn, and these are never disregarded by the ever hungry birds. I have often seen a fulmar sitting on the water by the side of a jellyfish, part of which it had eaten, so filled that it could scarcely move out of the way of the boat. I think the fulmars enjoy a monopoly of this diet, for I have never seen any other species eating it; nor will gulls, nor any of the sea-birds that I have observed, pay any attention to a fulmar that is eating a jellyfish, though they all claim their share if the food is of a kind that they care for.

In flight the fulmars much more resemble the shearwaters than the albatrosses, though they have the habit, common to all these families, of sailing over the water at an angle of about forty-five degrees, with the tip of the lower wing but just above the waves. The wing-beats are rapid, about as with the shearwaters; and there is at a distance little to distinguish the fulmars in the dark phases from the dark-bodied shearwaters, except the shorter, less pointed wings and heavier body of the fulmars.

In rising from the water the fulmars, shearwaters, and both species of albatross found with us (the black-footed and short-tailed albatrosses) spread the wings and run along the water for a distance to gain sufficient momentum to lift them clear of the waves. The fulmars will almost invariably, according to my observations, rise toward an approaching boat; while both the shearwaters and albatrosses always fly from anything disturbing them, and rise preferably against the wind.

THE NEIGHBORHOOD OF PERCÉ.[1]

GANNETS.

"Now, brothers, for the icebergs
Of frozen Labrador,
Floating spectral in the moonshine
Along the low, black shore!
Where like snow the gannets' feathers
On 'Brador's rocks are shed
And the noisy murres are flying
Like black scuds overhead."

—JOHN G. WHITTIER, *The Fishermen.*

You may go with me to the coast of Labrador, sailing among the bluff and dangerous islands off the mouth of the St. Lawrence in a cold wind, a chilling fog, and a short, chopping sea. This was the region that Jacques Cartier visited hundreds of years ago, and the scene is not so very different now from that he saw then. It does not take much imagination to fancy ourselves in his rude ship, beating up to the shores of this new-found and dangerous land. Still we find the rough rocks, topped with dark evergreens, stunted by the cold winds, still the same sullen sea and inhospitable climate, and still the hosts of gannets whitening the tops of the ledges —"a great and infinite number of gannets which are white and bigger than any geese," wrote Cartier, "and which bite even as dogs."

Within the Gulf of the St. Lawrence, formed by the open jaws of the bay and the great island of Newfoundland, are the

[1] Pronounced *per-say*, in two syllables, though the fishermen make but one syllable, *perse*.

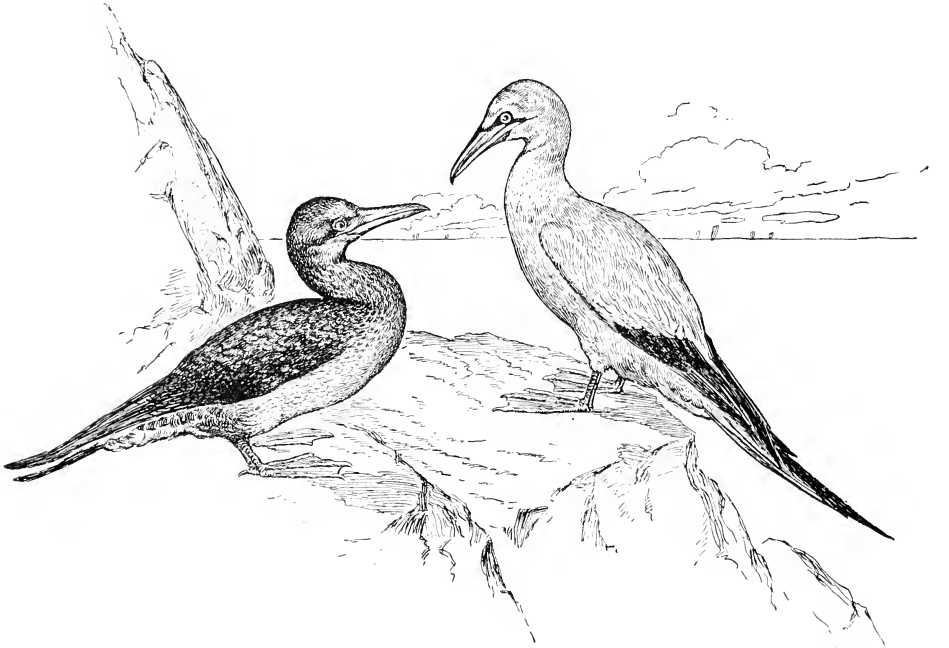

FIG. 7. — GANNETS.

Facing page 42.

breeding-places of the gannets — the Bird Rocks of the Magdalen Island group and Bonaventure Island near the Isle Percé off the north shore of the Baie des Chaleurs. "Warm Bay" it means, but we may judge the warmth of the region when the first of June sees the stunted little cattle dragging the wooden ploughs through ground hardly thawed as yet, while snow-drifts still lie in the fields. It is a bleak and sterile land, pinched with cold, and chilled with vapor steaming up from the melting icebergs that drift past in summer.

But sometimes a clear morning of midsummer comes to gladden the poor fishermen of the coast. The sea is as blue as the sky, and as calm too; the rough rocks and stunted trees bask in sunshine, and, a clear note of color in a scene usually too gloomy, shines out the red mass of Percé Rock.

Nearly three hundred feet high, steep from the sea, springs the great Arch Rock, inaccessible except to the birds that cover it. A thousand feet long, and nearly a third as wide, its broad and nearly level top harbors myriads of birds that scream and fish about. They nest there by the acre, black for the cormorants and white for the sea-gulls, sitting in colonies as close as they can huddle; and a mile off is Bonaventure, whose whiteness is the snowy backs of gannets that breed here by themselves.

The great Arch Rock, or Pierced Rock, in literal translation, gets its name from a lofty arch like a great doorway worn through it near one end — an open door, as it were, through which boats may pass, and we may see the blue water beyond. Perse Rock it is called by the fishermen, who ignore the second syllable in this as they do in the little town of Percé (or Perse) which you can find on your maps. Imagine the low rude huts of this hamlet strewn about with nets, spars, lobster traps, and fishing-gear, and the little fleet of black-hulled, broad-bowed

boats, with red, tanned sails, making ready at sunrise for a day's fishing. A fair day is a day of gladness in that region; air and sea are full of life.

At dawn the cormorants set out on heavy wings for their fishing grounds, flapping laboriously and stretching out their long necks against the flush of morning red, as black themselves as midnight spectres. To Gaspé Bay and Baie Chaleurs they go a-fishing, and with them go the white gannets from Bonaventure. There is a turmoil of gulls clamoring and barking, and the shrill screams of restless terns, ever noisy and suspicious, keeping up an incessant alarm or complaint.

On the water about the bases of the crags little guillemots bob like corks, diving and fishing, and a solitary loon comes up to shout a prolonged halloo to some invisible mate; or a big seal lifts above the water like a mermaid, and, tossing a fish in air, catches it as it descends head foremost and swallows it with a groan.

All day long the gulls wheel and scream about the Great Arch Rock, the cormorants crane their long black necks over the beetling walls, and gannets plunge about it; but in general both cormorants and gannets prefer to go farther for their fishing, to the shoal water of the bays, where the tremendous tides sweep great schools of fishes this way and that.

Neither of these birds ever tires of fishing or can ever be satisfied with eating. They will eat till the tails of the little fishes stick out of the corners of their mouths before they will stop. There is a record of a cormorant which was seen to catch and eat one hundred and eighty fishes in one and a half hours, or two fish a minute. All fish-eating birds have these insatiable appetites, and the amount they consume is beyond computation, though it should be said that they do not much disturb the species most prized by man.

Gannets are not found everywhere. Their only breeding-places in numbers, if the small breeding-ground near Grand Manan has been broken up, are in the Gulf of the St. Lawrence, although they not infrequently visit the coast of Maine, where they can be easily distinguished from gulls by their shape and habits. Their bold and beautiful action on the wing at once calls attention to them, as do their habits of flying in lines and plunging from the wing. Larger, longer-winged than a gull, longer-necked and longer-billed, with a longer tail, they more resemble gigantic terns in their graceful flight and easy evolutions on the wing. A most beautiful, bold, fierce bird is our great gannet, with his cold, white eye, and his taper, knife-edged bill that bites, not "like a dog," as Cartier says, but a great deal worse, cutting to the bone. A terrible weapon it is against man or fish, yet sometimes it brings the gannet to grief. It used to be the custom in the Bay of Gaspé to fasten a dead fish to a floating shingle or bit of driftwood just large enough to buoy him. The gannets, seeing the fish, and diving like an arrow, often from a great height, would spear not only the fish, but the board as well, and become victims to their too headlong speed.

It is the gannet's peculiar way of diving that makes such a capture possible. Most diving birds, if they wish to dive deep, spring from the water and take a header exactly as a boy would do. The loon and the cormorant dive in this way. The gull fishes from the wing without diving. But the tern and gannet dive with a splash. The gannet is incomparably the bolder and more expert of the two. He hunts on the wing at all distances above the water, but oftenest at seventy-five or a hundred feet above the surface, if the fish are swimming deep, flying in straggling flocks.

When a fish is seen the gannet draws in his wings till they

are nearly closed, thus leaving little surface to bear the body up, and, throwing himself headlong in the air, he falls like a plummet. Just above the water the nearly closed wings are flexed tight to the body to remove all resistance to the water, and, with a slight splash, the gannet cleaves the water and secures his prey. It is a bold but wise plan, for any swimmer will tell you that in diving from a great height it is absolutely necessary to take a perpendicular course in order not to "knock the breath out of one."

The gannet has a peculiar provision for his needs in the abundant and very large air cells which lie like cushions between his skin and his flesh, taking the place of the fat layer which we find on most birds. It is supposed that these break the jar of his plunge from so great a height. When the fish are swimming near the surface the gannet alters his methods of pursuit, flies low, and dives at a slant, knowing that he will not have to use much force, nor sustain any great shock, in order to penetrate the water far enough to get his prey.

The adult gannet is pure white, with black ends to the wings and a yellowish wash about the head, — the only color other than black, white, and brown, it may be remarked, that is ever found on any of the strictly seafaring birds (the eider drake only excepted), unless about their bills and feet.

The gannets of the year are a dark brown, speckled with white as if by tiny snowflakes. The baby gannet in the nest, like the cormorant's young, is a naked, greasy, helpless squab, very slow to learn how to care for itself, and therein entirely unlike the little gulls, terns, and ducks, which chip the shell only to take up active life at once. The gannets are some nine or ten weeks in the nest, and at the end of eight weeks are still covered with down and have wings only feebly developed.

So slowly do they come to the possession of their wonderful

powers of flight that we are reminded of Hans Christian Andersen's tale of the discouragements that befell the ugly duckling which was after all born a swan.

What they are at their prime we can best learn from the words of Mr. William Brewster, one of our most distinguished naturalists, who describes them as he saw them, "floating idly on the blue sea; skimming close to the waves in the teeth of a stiff breeze; hovering excitedly over schools of capelin, among which they plunged with fierce energy; and at evening stringing out in long lines against the sunset sky, as they flapped their way homeward to the rookery. But most vivid of all is the recollection of their presence on a certain occasion when our vessel was overtaken by a squall in the middle of the Gulf. At the height of the confusion, when the voices of the men struggling to take in sail were drowned by the rush of the wind, and the sea, a moment before so calm, was furrowed by furious gusts, overhead, against the black storm clouds, where lightning flashed and thunder rolled incessantly, a score of the majestic birds sailed; calm, impassive, emotionless, breasting the gale as easily as if it were the gentlest summer breeze. How often must such a group have been the sole witnesses of still wilder scenes, when vessels less fortunate than ours have foundered and sunk with all on board."

A CYPRESS SWAMP.

THE ANHINGA.

"Over their heads the towering and tenebrous boughs of the cypress
Met in a dusky arch, and the trailing mosses in mid-air
Waved like banners that hang on the walls of ancient cathedrals.
Deathlike the silence seemed, and unbroken, save by the herons
Home to their roosts in the cedar trees returning at sunset,
Or by the owl, as he greeted the moon with demoniac laughter."

— HENRY W. LONGFELLOW, *Evangeline.*

To Florida next, the home of the herons and that strange cousin of the gannet and the cormorant, the darter, or anhinga, or snake-bird, or water-turkey.

The cypress swamp is the home of these birds, who build their nests among the hummocks. To seek them we must have a boat; for these swamps are vast morasses largely overflowed in the rainy part of the year, and always threaded with black, winding creeks full of alligators and poisonous water-snakes.

The scene is semi-tropical. Vegetation luxuriates. The trees grow so tall and are so thickly leaved that the sun is shut out; and beneath the canopy of their tops, among the great gray trunks which rise like pillars, there is a gloom, solemnity, and grandeur like that of some many-columned cathedral, religiously quiet and dim. The cypress trees, rising from the water, among large-leaved water-plants, grow to gigantic size, and are draped with banners of the hanging gray *tillandsia*, which we know as "Spanish moss," or with air-plants that trail their tendrils and blossoms from trunk and branches.

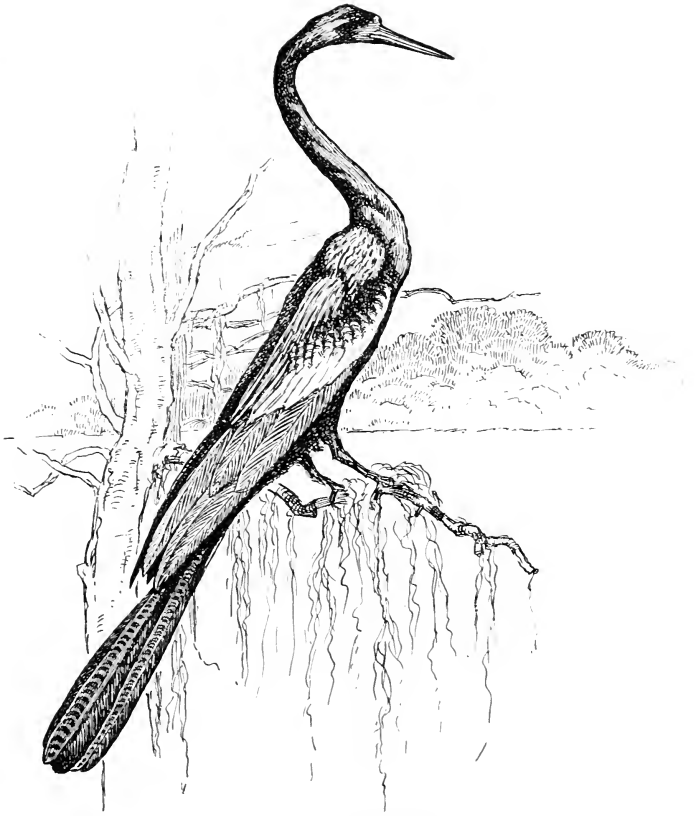

FIG. 8. — ANHINGA.

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Here and there the land rises a little above the level of the water into green mounds called "hummocks," where grow scattered palmettoes, waving their palm-like crests above the surrounding trees. Here the great ivory-billed woodpecker, the largest and most beautiful of his race, may perhaps be heard knocking with his great white beak to rout out the palmetto-borer. In the fringe of buttonwood, and other brush about the edges of the hummocks, herons breed, or did breed before they were so nearly exterminated for millinery. There was a time when hundreds and thousands of them — the great blue Ward's heron, nearly like our largest heron of the North, the medium-sized reddish egret, the little blue heron, and the little white egret, with the whole tribe of night herons — used to be here in countless numbers, building their loose platforms of sticks among the branches, and keeping their awkward guard over the beautiful blue-green eggs and squabby young. What a clamor rose! What a smell of decayed fish from the fragments dropped beneath the nests! A few remnants of the former host remain still and breed in the bushes. The fish-crows lurk about picking up the leavings on the ground, or stealing an egg or a young heron from the nest when they can. The boat-tailed grackle, — the "jackdaw" of the South, — croaks in the willows, and a Florida white-breasted nuthatch, inspecting the larger trees, threads his way up and down, indifferent which end of him is uppermost. It may be that a flock of white ibises, distinguished from the white herons by their black wing-tips and outstretched necks, a roseate spoon-bill, — the "pink curlew" of the South, a great bald-headed wood ibis, — locally known as a "gannet," — or a hoarse-voiced brown crane will pass by where they can be seen through the tree-tops.

And off in the distance, low down among the water-plants

or on the plashy border of the hummock, one hears the melancholy mourning of that gigantic rail, the limpkin or courlan, a curious brown and white striped bird, not exactly rail and hardly a crane, whose doleful wailing gives it the local name of the "crying bird" or "mourning widow."

Among such neighbors lives the anhinga, the cousin of the gannet and the cormorant of the rocks. Seeing them side by side you would not admit the relationship until you looked at their feet. For while the gannet is shapely and graceful, a heavy bird strongly built, this slender relative looks as if he were patched up out of the pieces left over after all the other totipalmate birds were made. They are alike, however, in both having the webbing of their feet extend along the inner side of the foot, from the hind toe to the inner front toe, which gives them three webs instead of two, like ducks and other swimming birds.

The anhinga has a long neck, excessively slender, drawn out into a sharp and slender bill; a light, long, thin body; wings like great fans; fully webbed feet apparently unfit for tree-perching, and a great, stiff tail, like corrugated sheet-iron. His color is inconspicuous — black for the ground color, usually glossed with green reflections, with gray stripes down the shoulders. The female has a brown neck and breast.

Concealment is easy for the anhinga. The cypress swamp is full of gloomy, half-lighted corners, and his black and slender figure fits into shadowy recesses of the forest swamp. Even the light stripes on his back, though they look conspicuous, are a protection to him, resembling as they do the ridges on the cypress bark with their light tops and darker grooves between.

But the snake-bird does not rely entirely upon his color for protection. When alarmed he drops quietly from his perch,

and the water closes over him without a ripple. If he is floating high, according to his custom when undisturbed, he will disappear like a grebe, sinking in the exact spot where he has been floating. He can swim at any depth. Sometimes the whole long neck will be above the surface, rising from the black swamp water like some venomous serpent, whence the name of "snake-bird." Often only the bill is put up for breathing, and for a considerable time he can swim under water without coming up to breathe.

In common with many other birds, the anhinga can fly under water, and will at times rise from the water-flight into the air-flight without a break in the motion. We would hardly expect that a bird so expert in the water would fly strongly and well, but the snake-bird is easy on the wing; and when seen with its broad wings and tail extended, and its slender neck and body lying between the three nearly equal lobes, it looks, as one observer says, "like an ace of clubs on the wing."

Fishing in these dark waters, flying over the hummocks, sitting with wings half outstretched to dry, in social little groups, or caring for their blue eggs in their nest that is always built overhanging the water, the anhinga is a bird of the swamps, and may be seen only in some such place as we have described.

THE LIFE HISTORY OF THE AMERICAN FLAMINGO.[1]

My first experience with these birds was in the winter of 1884–85. We were east of the easternmost Cape Sable, the extreme south point of Florida, when late in the afternoon we entered a bay about seven by fifteen miles in extent, almost every rod of which was shallow enough to be waded by the flamingo.

The bottom largely consisted of a soft, sticky clay, as though composed of fine particles of disintegrated coral, so soft that with one hand I could set a pole two fathoms down into the mud, and so sticky that one cannot wash the mud from anything without rubbing it. Although the water in these bays is so shallow, much of it being not above eighteen inches deep, it is so permeated with this soft white mud, which is stirred up by the action of the wind, that it is impossible to see the bottom, and after a day or two of more than usually heavy wind the whole bay reminds one of a large bowl of milk.

When about halfway across this bay — it being ebb-tide — our boat stuck in the mud and we could go no farther. After lowering sail, I climbed to the mast-head to learn if anything could be seen. Almost to the east of us, where the setting sun reflected the light to the best advantage, was a long line of red extending fully a half mile, reminding one of a prairie fire at night.

[1] Abridged, by the author's permission, from Captain D. P. Ingraham's "Observations on the American Flamingo," a paper presented before the World's Congress on Ornithology, 1893.

FIG. 9. — FLAMINGOES.

Facing page 52.

I doubt whether De Soto felt any more pride when he first saw the broad waters of the Mississippi than I did at the sight before me. I took off my hat and swung it, and shouted, "The flamingoes! the flamingoes!" It was then that I first recognized the import of the name "flamingo," — flame-colored. The flock was fully four miles away, and consisted of not less than twenty-five hundred birds. I had spent fully two months each of the two preceding years to find these birds; and I now felt I almost had them in my grasp — vain delusion.

For six successive days each week, and for six successive weeks, did we devise every plan that we could conceive of, every day looking out upon that beautiful flock of not less than twenty-five hundred birds. In all that time we could never get within eight hundred yards of them. Then our water supply became exhausted, and we set sail for Key West, about one hundred and twenty miles away, for new supplies; and thus ended the flamingo campaign of 1884.

The bird is related to the *Anatidæ*, or duck family, crushing its food between the mandibles, and sifting out such portions as it does not wish to swallow, as does the duck. This leads the natives in the West Indies to say that the flamingo lives on dirt. Its food is small mollusks, crustaceans, and other marine animals gathered from the mud. The peculiar shape of the beak is specially adapted to its manner of feeding. With its long legs to wade, and its long neck to reach down into the water to collect its food, it brings the upper portion of the upper mandible directly on the bottom, so that it may be almost literally said to stand on its head when it eats.

It is very interesting to see a flock feeding, especially when the bottom chances to be a little hard, so that they have to dig their food out from the earth. The water prevents their

scratching like a fowl, but they go through the same motions, only not so fast; and as their long legs go up and down it reminds one of a regiment of soldiers marking time. After they have stirred up the earth for a while, they put their heads down into the water, gather up the results of their labor, and then "mark time" again, constantly swinging around and gathering the earth up into a mound. When they are through, there will frequently be a mound five or six inches high and three or four feet across.

The nesting habits of the flamingo are peculiar. They nest in great colonies, and when not disturbed occupy the old nests the following year, — not perhaps the same bird using its own nest of the former year, but the colony as a whole occupying the same nests. I have seen not less than four thousand nests in one group, as close together as they could be placed.

The most desirable locality seems to be some very shallow and very muddy lagoon, where the nests are almost unapproachable. They are made of soft mud which is worked up into a pyramid, eighteen or twenty inches across at the base, perhaps fifteen inches high the first season, and about ten inches across on top. This mud dries and becomes exceedingly hard, so as to retain its form for years. The birds each year add a little to the top of the nest, so that the nests frequently become two feet high or more.

The nest is hollowed out a little on top, and the eggs, usually two, are deposited on the bare earth. The egg is large, averaging about three and a half by four and a half inches, and when first laid is pure white, being covered with a flaky substance, but it becomes bluish when this is removed. The bird takes a position on the nest like that of most other birds, but sits a little farther back on account of its long legs, thus bringing the eggs a little more toward the breast. It does not sit

astride of the nest, as it has so often been represented, but doubles its legs under its body like other long-legged birds.

I know of no authentic data as to the age the flamingo may reach, but I judge that its life must be fully fifty years. The bird of the first year is nearly gray, but after it sheds its first winter plumage, it assumes a reddish color. One familiar with flamingoes can easily distinguish their ages, at least to the fourth year, and it is evident that they do not reach their full brightness before the seventh year.

The natives used to be in the habit of taking large numbers of them for food during the moulting season, when the birds cannot fly, the feathers being so few and the body so heavy. The plan adopted was for a number of persons to go out with long ropes, surround a flock, drive them together in a huddle, then stretch a line of rope around them, and at a given signal rush toward the flock. The birds, in their efforts to escape, attempted to run past their pursuers, but were tripped up by the rope. When thrown down into the water it took them some moments to regain their feet, and thus their captors gathered them in.

Fifty years ago they used to be taken in large numbers and carried to Key West, where they were sold for food, and about the same time they were not uncommon in almost every suitable locality from the mouth of the Rio Grande to Cape Florida. In these days the only locality in the United States where they are common, so far as I have been able to learn, is the extreme western and southern coast of Florida.

One of the most interesting observations I made was during my last year's work. We always called it the "dress parade." We were watching a flock of three hundred or more, standing at rest some four hundred yards from shore. About an hour after sunset a few birds commenced to feed, and soon

a dozen or two of the largest males began to march backward and forward in the rear of the flock. Nearly every male soon joined in this concourse.

The line of the flock lay about parallel with the shore, and the males took their position directly in the rear in a solid body. As though at a given signal every bird commenced to march, passed to the extreme farther end of the flock, and halted, making a great noise, as if every bird in his loudest voice said, "Don't I wear a splendid uniform?" After a moment's pause, all faced about, marched back to the other end of the line, and then cried again, "Am I not a beautiful bird?" When marching back and forth, they moved in almost as perfect order as a platoon of soldiers. Thus the parade continued for nearly an hour, until one by one the birds dropped out of the ranks and began to feed again.

THE SEA BIRDS OF THE PLAINS.

PELICANS.

"The wondrous, beautiful prairies,
Billowy waves of grass ever rolling in shadow and sunshine,
Bright with luxuriant clusters of roses and purple amorphas.
Over them wandered the buffalo herds, and the elk and the roebuck;
Over them wandered the wolves and herds of riderless horses;
Fires that blast and blight, and winds that are weary with travel;
Over them wandered the scattered tribes of Ishmael's children,
Staining the desert with blood; and above their terrible war-trails
Circles and sails aloft, on pinions majestic, the vulture,
Like the implacable soul of a chieftain slaughtered in battle,
By invisible stairs ascending and scaling the heavens."

—Henry W. Longfellow, *Evangeline*.

If you were to ask me the best place in the world to study sea birds, I would tell you to go to our Western plains and prairies. It is strange, but true, that nowhere else can one find as many kinds of water-birds as in the interior of the country. Rare ducks, found on the Maine coast only in winter, breed among the Rocky Mountains; the little phalaropes that we met floating off Grand Manan, flock more abundantly to the prairies; the cormorant of the North builds her nest among the inland lakes beside the pelican of the South; and swans, cranes, plovers, sandpipers, terns, and sea-gulls breed in vast numbers about all the little ponds of water that dot the prairie. Birds that never mingle upon the coasts dwell there side by side.

It is a pretty sight to see their white plumage shining about the blue pools, the green uneven prairie behind. How shall I

make you see it — the Prairie du Coteau du Missouri, the hill and lake country of northeastern Dakota and of the British province just to the northward? The broad prairie, treeless except along the river courses, which thus outline themselves as in a map, rolls away in low, melting ridges that shut out the sky more than would seem possible to you who imagine that the prairie is as flat as the ocean. And so it is — but sometimes monotonously level like an ocean calm, and sometimes breaking in ripples and swells and ridges of green grass like the green waves of the sea, capped with the white foam of flowers.

In color it varies according to the latitude, from the gray barrens of Assiniboia, where, the last of June, the whole country is as brown as a mouse's ear, to the lively green of Dakota that at the same season ripples in grass and wheat. Not that our expectations of wheat to the saddlebow and grass above a horse's head are met there. The wheat of Dakota is shorter strawed than the Eastern grain; it has too much to do in filling its heavy head in the short summer season to grow the long stalks that we find in wheat and grass farther south.

The abundant wild flowers bloom on a level with the prairie — little striped pink and white roses scarcely six inches high, but sweet as a June morning, the light blue prairie crocus, the purple wild indigo, and a multitude of showy blossoms, among them that treacherous cactus, the prickly pear, with its yellow flowers.

An eye that knows the signs will see everywhere on the prairies the buffalo-wallows and buffalo-trails trod out in years past by millions of the great shaggy bison, of whom nothing is now left but these worn paths that led them to water, the saucer-shaped wallows where they rolled in the mud, and their white bones, lying where they fell or gathered into great heaps

to be carried to market for use in sugar refining. In a few years these too will have vanished.

Everywhere over the prairies near or far, in all the little hollows, are pools of water. Some are alkaline and unwholesome to drink; some are salt, and there grow about them the same plants that you pick by the sea-shore; some are fresh, with little streams flowing in and out. About the first two is generally a whitish rim of salt or soda left by the evaporation of the water; the fresh-water pools are oftener edged with water plants and rushes.

Here the sea birds congregate. Great pelicans spread their broad pinions in graceful flight or sit in rows with their bills upon their breasts meditating over a good meal. The gulls fly swiftly back and forth, with a strong rowing motion; terns clip past in sharp zigzags, like those of the dragon-flies they follow; ducks, grebes, and loons float on the ponds or dive for food; sandpipers and plovers trip about the borders of the pools with melancholy pipings; little rails skulk in and out of the water weeds; and great white and brown cranes stalk about over the plains like birds on stilts, eating rose-hips or dancing uncouth dances to woo their mates.

Here the birds live and breed, building nests upon the open prairies of such materials as they can find. A photograph of a Foster's tern's nest from South Dakota shows that it is built principally of sticks, some of them large and long, a much more substantial nest than the scooped-out hollow in the sand or the trivial fencing of twigs that I have found among the Eastern terns.

Their food, too, varies much from their diet in the East; less fish because fish is not always easy to find even in fresh-water ponds, and more insects of different sorts. In Minnesota, the beautiful Franklin's gull follows the plough, and picks up

grubs as a crow or a blackbird might, whence the pretty name the farmers there give it of Prairie Dove. The gulls are good grasshopper catchers, and the terns eat dragon-flies in large numbers.

But the pelican is the bird most unlike any we know in the East. His great bulky figure and fully webbed feet, his wrinkled, swinging pouch and long, flat bill, though familiar enough to city children, are quite unknown to those who do not live near parks or menageries.

Any child who lives near Lincoln Park in Chicago, where the water-birds are given full liberty, and neither confined nor maimed, but trusted to remain where they are well treated, may see them fishing in the ponds, or sitting quietly about the shores preening their feathers.

In Central Park, New York, where the birds are not so well cared for, but have their wing-tips cut off at the joint, and their liberty largely taken from them, the chief interest is to watch them fight. A gannet and crane there used to have a perpetual difference of opinion, and to carry on a most amusing duel. The long-legged, long-necked crane appeared to have every advantage of his short-legged, short-necked antagonist, which could not reach up to the crane's body. The crane would torment the gannet until the latter opened his mouth, when the crane would strike with the evident intention of spearing the gannet down the throat. But the gannet was always a little too quick, and in the end he revenged himself on the crane's legs. He used also to punish that notorious bully, the black swan, till only interference saved the swan's life. Yet the keeper said that the slow, unwieldy European pelican was the master even among these fighting characters.

In this country we have two pelicans differing much in color and in habits. The white pelican is more abundant in the

interior than on the coast, while the brown pelican is common along the Gulf of Mexico and less abundant inland. All along the Florida coast the brown pelicans may be seen soaring above the blue water, or fishing in flocks, and sunning themselves on the sand bars.

In the West the great white pelican takes its place. Their habits are rather similar, except in a single particular. The brown pelican plunges from the wing after its fish, but the white pelican hunts its prey by swimming. Often a flock will band together and drive a school of fishes into shallows, where they gather up large numbers at every scoop of their big bag. The water taken in is allowed to drain out of the corners of their mouths, and the fish are swallowed.

If the bird is fishing to feed her young, she still does the same, and afterward disgorges the fish; for she could not fly if her pouch were filled with fishes, as many books teach us, because then her body would be out of balance.

Though they live together in large flocks, the pelican so naturally seeks dreary and lonesome places that it has been taken as an emblem of desolation. "And the pelican of the wilderness shall possess it," says the Scripture, frequently choosing the pelican and the bittern, because they dwell in remote and sedgy marsh-lands, to typify utter ruin and desolation.

For centuries the pelican has been chosen as the symbol of one thing or another. An odd conceit in its natural history is connected with the days of chivalry. When knights used to ride out in full armor, each man carried a shield, and on it, partly because few could read, and partly because it was important to know friend or foe while still a long way off, each man painted some device which stood instead of his name. Usually it was a bird or an animal in a certain attitude, — a

lion rampant, a lion couchant, a pelican "in her piety," a peacock "in his pride."

In such a device the pelican was represented above a nestful of young with upturned bills, her own head turned down upon her breast. She was the symbol of fostering care and self-sacrifice, for, so the fable ran, she fed her young with the life-blood drawn from her own breast. It is a pretty tale, though untrue, and may have arisen from a curious error in observation.

Those mediæval heralds were poor naturalists, never careful to see all they might, and perhaps unable to approach very near to so shy a bird as the pelican. Thus what they thought they saw was all one to them with what they actually did see. If you notice, the pelican in her piety is usually painted with the beak and the talons of a hawk instead of with webbed feet. The state seal of Louisiana which bears a pelican in her piety does not fall into this old error — perhaps because pelicans live in Louisiana and the people there know how they look.

It may interest any child living near one of our large parks to see how the heralds made their mistake. Watch the old pelicans sunning themselves, standing erect, with their long, straight bills laid low on their white breasts, and their pale eyes squinting at you across their noses. The pelican of Europe has a pinkish bill with a bright red nail at the tip. The heralds, having seen this at a distance as it lay against the white plumage, called it a streak of blood; whence rose the fable of the pelican "in her piety." Much poor natural history has become current because men did not see things as they are.

A far more interesting and curious characteristic of our American white pelican may be observed by any child who will take the pains to make a few trips to the park. Go first in early

spring. If you are looking at our American white pelican you will see a bird without a crest, and with a yellowish bill, very flat on top. Go again in May or June and observe the same bird. He has a mane of white feathers nearly the whole length of his neck; his bill and the bare skin about his eyes are blood-red, and on the top of his bill, as seen in the picture, rises a jagged "centre-board," perhaps two inches tall and three inches long.

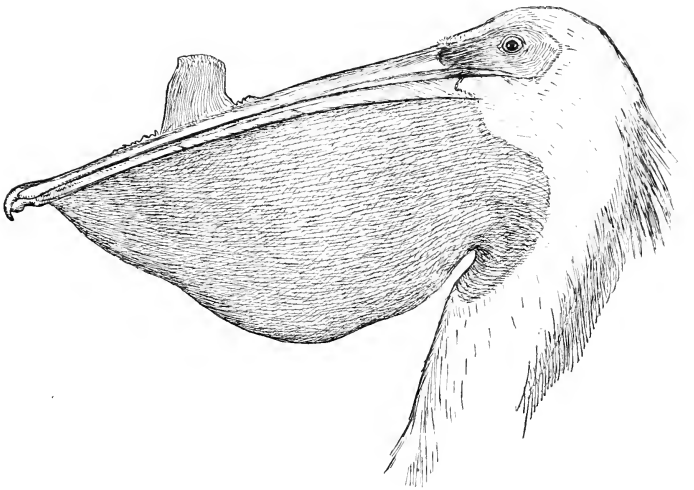

FIG. 10. HEAD OF WHITE PELICAN IN BREEDING SEASON.

Both sexes show the centre-board, the red bill, and the breeding plumes, and both lose them soon after the mating season is over. The crest and the "horn" fall off, the bill fades to yellow again, and by July or August the pelican is once more without adornment, except the little grayish crest, quite unlike his white mane; this, in turn, is shed a little later in the year.

It is hardly more than twenty years since this interesting fact

was discovered, and we cannot get a better idea of the way in which sea-birds formerly thronged the prairie than by quoting from the original discoverer, Mr. Robert Ridgway. In July, 1867, Mr. Ridgway visited Pyramid Lake, Nevada, and saw the whole beach covered "with a dense crowd of these gigantic snow-white creatures, who scarcely heeded us as we arose; as we approached them, however, they pushed one another awkwardly into the water, or rose heavily and confusedly from the ground, and flying some distance out upon the lake, alighted upon the water."

The next year, in May, when Mr. Ridgway returned, he was surprised to find most of the pelicans had a "conspicuous prominence on the top of the upper mandible, known among the white people of the neighborhood as the 'centre-board,' so called from some fancied resemblance to the centre-board of a sailboat. At this season both sexes were highly colored, the naked soft skin of the face and feet being fiery orange-red, or almost blood-red, instead of pale, ashy straw-yellow, as in all, both old and young, in August. . . . Soon the number of birds distinguished by the 'centre-board' daily decreased, while, to account for this phenomenon, a corresponding number of the cast-off ones was found upon the ground. Some of these loosened ornaments had been but recently dropped, as was plainly shown by their freshness, while others, which had been cast for some time, were dry and warped by the sun. Toward the last of the month no birds possessing this excrescence were to be seen, but the appendages themselves were scattered so numerously over the ground that a bushel could have been gathered in a short time, though upon our first arrival in the island not one was to be seen."

PART II.

STRUCTURE AND COMPARISON.

LITTLE STUDIES IN DIFFERENTIATION.

"The point of the comparative method is that it brings before us a great number of objects so nearly alike that we are bound to assume for them an origin and general history in common, while at the same time they present such differences in detail as to suggest that some have advanced further than others in the direction in which all are travelling; some, again, have been abruptly arrested, others perhaps even turned aside from the path. In the attempt to classify such phenomena the conception of development is presented to the student with irresistible force."

— JOHN FISKE, *A Century's Progress in Science.*

COMPARING BONES.

When we have plucked the feathers off our Thanksgiving turkey and have eaten the meat, there are the bones left. We do not always realize that under our own skin and flesh there

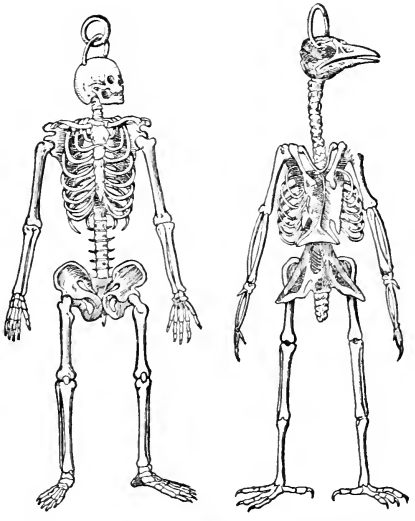

Fig. 11. Skeletons of Man and Bird.
(By courtesy of McClure's Magazine. Copyrighted, 1897, by the S. S. McClure Co.)

are bones, too. This picture of the bones of a bird and of a man, drawn to the same scale, reminds us that after all we are much like the bird. If you will save the leg-bones, the breast-bone, and the wing and shoulder bones of a cooked fowl, — a boiled

fowl is cleanest, — and also the feet which have been cut off in dressing the fowl, you will be able to see wherein your bones are like a bird's.

Let us take the leg and compare it with our own. First, we notice that there are the same number of joints, but not the same number of toes nor of bones. I am not sure, however, but you will disagree with me as to the number of the joints, and we are likely to have trouble in naming them unless we begin at the right end of the leg, — first the hip, then the knee, then the heel. But where is the bird's knee and where is his heel ?

There is an old Greek tale that the rival philosopher, attempting to make fun of Plato for calling man a featherless biped, presented a cock plucked of his feathers to Plato's students with the explanation that this was Plato's man. Thoreau's ready-witted Canadian woodchopper thought that the philosopher overlooked the fact that *the cock's knees bent the wrong way.* Most of us have the same impression — that a bird's knees bend the wrong way. But let us begin at the hip and count downward, — hip, knee, heel, — and we shall see where we find the chicken's knee. Where is his heel ? Where is a dog's knee ? a horse's ? a cat's ? and which way do they bend ? (Only remember that a four-footed creature's *fore legs are arms* and their joints correspond to the joints of our arm numbered from the shoulder.) A knee always hinges forward, an elbow backward ; a wrist always hinges forward, a heel backward. Therefore a horse's " fore knees " are his wrists, and what you have been calling the chicken's knee is really his heel.

Having determined the principal joints, we may look at the larger bones of the leg. There is the thigh-bone, which lies between the hip and the knee, the shin-bone, or " drumstick "

(called in birds the tibio-tarsus), which runs from knee to ankle, and the tarso-metatarsus (usually called the "tarsus"), which is the part of the leg between the heel and the toe joints, the part we see in life and call the "leg" of the bird. You will not find anything in your own body resembling this, though it really takes the place of the bones in your own foot and instep, and is made up by the welding together of several little bones. All you need to remember is that the name is *tarsus* and the plural of it is *tarsi*. The name is important because it means just that part of the leg between the heel and

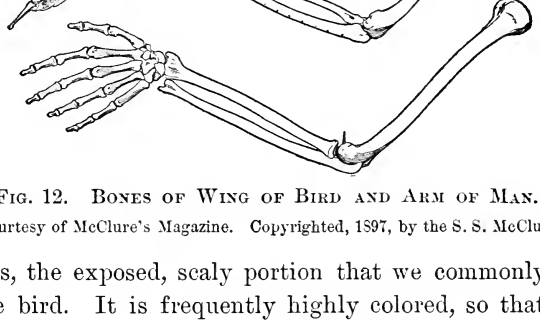

FIG. 12. BONES OF WING OF BIRD AND ARM OF MAN.
(By courtesy of McClure's Magazine. Copyrighted, 1897, by the S. S. McClure Co.)

the toes, the exposed, scaly portion that we commonly see in the live bird. It is frequently highly colored, so that books often speak of "tarsi red," or of "yellow tarsi."

We will not delay to study the chicken's foot, — except to notice that it has only four toes, — but will take up the wing, with its shoulder, elbow, and wrist joints clearly equivalent to our own, an upper arm-bone and two fore-arm bones very similar though differently modelled at the joints, and two long hand-bones unlike our five in being solidly fastened together at the end. There are three fingers in place of our five, though little nestling birds show traces of the other two fingers

which, not being needed, do not develop. The only name we need to learn here is *carpus*, the scientific name for the wrist, whether in man, birds, or mammals. As this is sometimes marked by a band of bright color, books on birds sometimes speak of the carpus, or carpal joints, or the "bend of the wing," as being brown or yellow.

Next, let us turn to the breast- and shoulder-bones. We have a breast-bone, — a little straight slip of a bone that we cannot feel distinctly, — but it has no ridge down the centre like the great keel of the chicken's breast-bone, for we have not the heavy muscles that need such a bone to support them. Do we have a wish-bone? Yes, or something that corresponds. Our two collar-bones do the same work as the chicken's wish-bone, in bracing the shoulder out. Perhaps some of you may remember what happens to the arm when the collar-bone is broken. Did you ever notice the differences in wish-bones? Collect a few of different game birds and see how they brace the shoulder in different ways. The bird has shoulder blades, much longer and narrower than our own; and, in addition, he has "shoulder blades in front," — the *coracoids*, those flat, wide, straight bones that are braced against the top of the keel to hold the shoulder up and out. Study the relation of these bones as they lie on the carcass of the fowl, and you will see how much it reminds you of the rowlock of a racing scull, heavily braced far out from the side of the boat, so as to give a greater purchase to the oar. By means of this tripod of bones the shoulder is held far enough out from the centre of the body for the muscles to get a good purchase.

We see that while the larger bones of a bird are about the same as our own in number, they are different in shape and proportions. Now we are ready to go on and learn how they are fitted to the life the bird leads and how he swims and flies.

THE FOOT OF A SWIMMING BIRD.

How do birds swim? Why do some swim better than others?

We must not think that in order to swim a bird must be web-footed The phalaropes, with only a little border of webbing along the toes, are expert swimmers; so are the gallinules, with round toes entirely unwebbed; the sandpipers, with their long, slender toes, can swim when it is necessary, and the water ouzel, a near relative of the cat-bird, plunges in boldly and dives and swims fearlessly. In the palm house of Lincoln Park, Chicago, there used to be a number of little rails wandering freely among the tropical plants and swimming in their little pool, a proof to any Chicago child who watched them that webbed feet may be a convenience but are not a necessity to a swimming bird.

Yet for birds that live much in the water, and especially for those that fly poorly, it is scarcely more important to be able to swim at all than to be able to swim well. Speed is essential. Therefore, because it is the simplest device for securing swiftness, the webbed foot is the typical swimming foot. We find the webs of all shapes and extent from the scalloped lobes of the coot and the narrow web of some terns to the extra-ample webbing of the gannets, pelicans, and cormorants, where all four toes are connected by the membrane.

If we wish to understand how a bird swims, we should think of a boat. Let us say that the bird's body is paddled by his feet just as a man paddles a boat, and we shall understand how the

bird reaches his foot forward and pulls until he has drawn his body ahead of his feet, and then (continuing the stroke but changing the kind of action) pushes against the water until his feet trail behind.

If we think of the water as less easily moved than the bird's body, we can easily understand the paddling motion. In order to paddle faster a man must take either more strokes or longer strokes in a minute, or else use a longer or a wider paddle; that is, he must displace more water in a given time. The bird, in order to swim fast, must do the same, — quicken his stroke, or lengthen it, or oppose a greater surface to the water. The bird that can do all three without exhausting his strength is an expert swimmer.

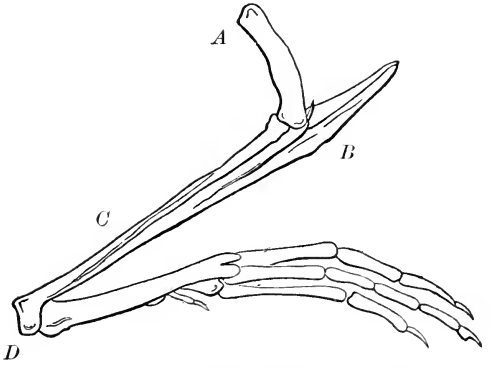

FIG. 13. LEG-BONES OF A LOON.
A Thigh-bone. *B* Knee. *C* Tarsus. *D* Heel.

If you will compare your chicken's leg-bones with this picture of the leg-bones of a loon, you will observe some marked differences in the relative length of bones, the arrangement of toes, and in that little bony spur that stands up in front of the knee joint, which the chicken does not have.

Though the loon appears to be a short-legged bird, on account of its very short thigh, we see by the length of the bones that it can swim with a very long stroke. Its large, webbed foot presses back a great amount of water. And the little bony splinter at the front of the knee is a capital device (found only in the grebes and the loons) for quickening the stroke. The tendons fastened to the point of this extension throw the foot forward with great force and quickness, as any boy can see who makes a tip-up with uneven arms, and tries to raise the long arm by strings tied at different places along the short arm. The farther from the central pivot the string is tied the less force will be required to move the arm; and so, the farther beyond the knee joint the pulling tendon is attached, the less force will be required to draw the loon's leg forward into position for the stroke. The short thigh is also an advantage in the backward stroke.

But the man paddling has one great advantage over the bird. When he has finished his stroke he carries his paddle back through the air, while the bird's foot must return through the water to make its forward stroke. The paddle meets little resistance on the return, but the foot will meet nearly as much as it created on the stroke, unless there is some special remedy. The folding of the foot, which diminishes the surface, meets this difficulty.

In all web-footed birds the toes fold close together on the return so that the webs do not catch the water; but in the loon and grebe they are not only arranged to fold one behind the other but are flattened besides, so that they make the least possible resistance. And in both the loon and grebe the tarsus is compressed until it is scarcely thicker than a knife-edge at the back, and cuts the water before it. The last device for speed is the arrangement of the legs at the very end of the body,

where they sweep past each other alternately in long straight strokes, giving the greatest possible force and efficiency.

Everything that could give speed in the water has been adopted in the grebe and the loon, and with what wonderful success! In all kinds of aquatic feats they lead all other birds. Yet at what a cost do they hold this supremacy in one particular! When we see the grebe's foot, put on at the very hinder end of the body, flattened as if crushed by a boot heel, with its toes set in the same straight line as its shank, and its flexed heels nipping close together so that the toes turn outward, we see at once that this bird cannot walk.

A perfect swimmer, fitted with all appliances for speed and endurance in swimming, he has been over-developed in one direction, and is good for nothing but swimming. He is put at the very foot of the list as the lowest organization of all, while our little bluebird and robin, that seem to have no special accomplishments but are good "all-round" birds, stand at the very top. It is a harm to a bird as well as to a man to be so much developed along one line that he is weak in other directions. So in science we say that "the most specialized" forms are the lower, and the "most generalized" forms — that is, the "good all-round" forms — are the higher structures.

THE WING OF A BIRD.

Now we will see how wings are fitted for flying.

That a good wing must be large, strong, light, and safe against accidents hardly needs to be said; and yet not until we compare a bird's wing with a bat's do we observe that a wing may have all these points and yet be an inferior wing. The great skinny hand of the bat is badly shaped for speed and it baffles with the wind, not being made to

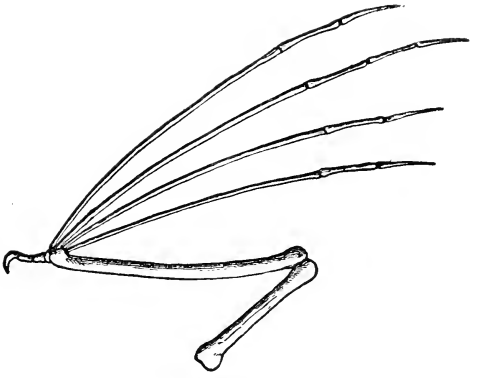

FIG. 14. WING-BONES OF BAT.

shed it on the upward stroke. The superiority of the bird's wing is that it is practically made of slats which swing in their places to let the air pass through on the up-stroke. A very simple change it seems to be, and yet to make it practical there have been a hundred and one alterations from the primitive hand-wing of the bats and of the ancient flying

lizards. The bat's wing was the simplest possible device; the bird's wing is a great invention.

The bird's wing was not made hit-or-miss, but by the nicest adjustments and by the correct solution of many problems. First of all, the use to be made of it, which decides its shape. Then, its size, which depends largely, but not entirely, upon the weight of the bird's body. Then there are the problems of making the wing strong enough to resist the pressure of the air; of making it as light as possible; of giving to the individual feather lightness, stiffness, and a firm attachment to the bone; of making the feather impervious to the air on the downward stroke; of making it shed the air on the upward beat; of providing muscles strong enough to spread these great fans and to keep them moving; of placing these

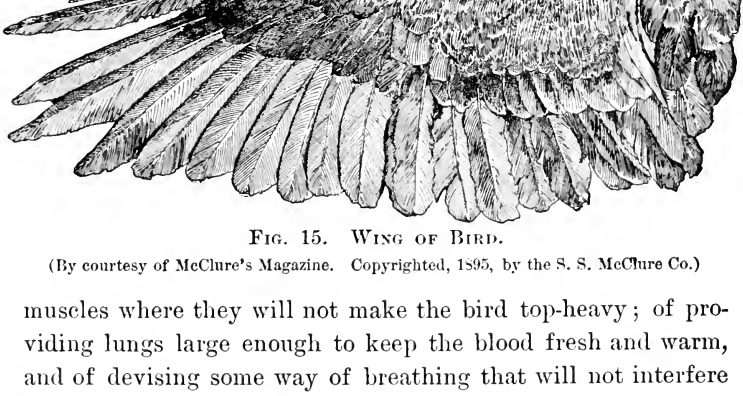

FIG. 15. WING OF BIRD.

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muscles where they will not make the bird top-heavy; of providing lungs large enough to keep the blood fresh and warm, and of devising some way of breathing that will not interfere with the motions of flying. The invention and construction of a great locomotive are simplicity itself to the skill required to make it possible for a bird to fly with a bird's wings.

The problems come under two heads, — how the wing is made and how it is managed, — which we will take up separately.

Let us study the wing as it looks in life, and see what we can discover. The one here pictured is the same from which the bones figured on page 69 were drawn and lies with the bones in the same position as in that cut.

We notice first that when the wing is spread the bones are not stretched out as straight as those in our arms when they are fully extended, but that there is a permanent crook at the elbow which is filled in with skin covered with feathers. A plucked chicken shows us that this extension is a fold of skin with a stout tendon running along the double of it like the drawstring of a bag. When the wing is closed this tendon puckers up and holds the wing neatly folded by the bird's side. When the wing is extended this skinny flap greatly increases its area, and the tendon makes a firm selvedge along the margin. Even the bat has such a membrane along the front edge of the wing, and undoubtedly it assists both bird and bat in steering their flight up or down, while it probably aids, as a jib aids the mainsail of a vessel, in equalizing the pressure of the wind against the after part of the wing.

In examining the covering of feathers we see that they are of different lengths, differently attached. There are the short ones which cover the skinny portions of the wing in overlapping layers, and the long ones which are attached to the back edge from tip to body in a single line of strong, wide, long quills whose use is to increase the area of the wing by adding the least possible weight. These quills are arranged in series according to the place where they grow. Those that spring from the tip of the wing, or hand, are called *primaries;* those that are attached to the forearm are the *secondaries,* and

those that lie along the upper arm-bone are the *tertiaries*, or *scapulars*, as they are sometimes called, that is, shoulder feathers. The primaries are always either nine or ten in number, and never vary in birds of the same family; they are also unevenly webbed and often have the broader web sheared

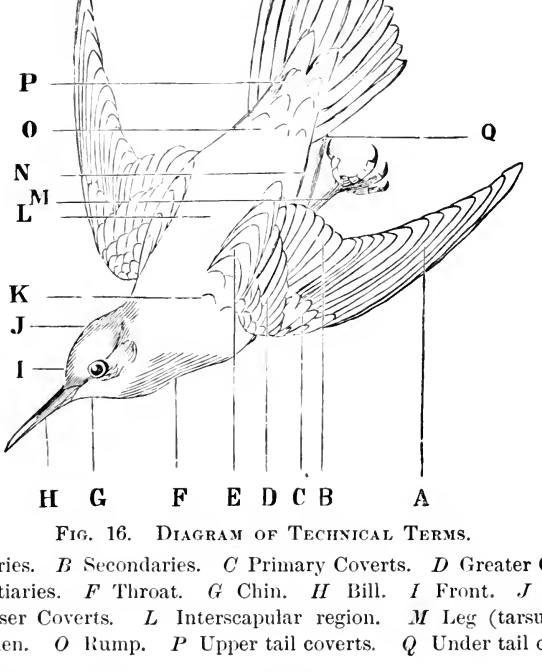

FIG. 16. DIAGRAM OF TECHNICAL TERMS.

A Primaries. *B* Secondaries. *C* Primary Coverts. *D* Greater Coverts. *E* Tertiaries. *F* Throat. *G* Chin. *H* Bill. *I* Front. *J* Crown. *K* Lesser Coverts. *L* Interscapular region. *M* Leg (tarsus). *N* Abdomen. *O* Rump. *P* Upper tail coverts. *Q* Under tail coverts.

away toward the tip, making *emarginate primaries*. The secondaries vary much in number, are evenly webbed or nearly so, are never emarginate, and differ from the primaries in one other important respect, — they are *movable*.

With the bird's wing in our hand we should notice one other

point, — its extreme lightness. Here are strong bones, powerful muscles, stiff, long quills, a wing of large extent made to bear up a heavy bird and to propel him faster than a railroad train can travel; yet the whole machine weighs but a few ounces even in a bird of the largest size. We have noticed how a membrane stretched out in front and a band of feathers thrown out behind, without any heavy frame to support them, save weight; but the same economy is even more apparent when we observe that the wing-bones themselves are hollow.

The general shape of the wing is such as to beat down the air with a firm, clean stroke, for which it is concave below to hold the air on the downward, convex above to shed it on the upward beat. We must not conceive of the air as having no weight and no resistance; on the contrary, every time the wing rises it has to lift all the air above it, and special provisions are made, not only in the shape but also in the structure of the wing, to relieve it of as much weight as possible. The secondaries are movable, and lie between little ridges across the larger fore-arm bone, in which they turn, like oars in rowlocks, edge up on the upward stroke, face down on the descending beat.

It is generally believed that the hollow bones of a bird help it to rise in the air, and that all a bird's bones are hollow. This is a gross error, as you will see if you examine the leg-bones of a chicken or a duck. Indeed, I do not now remember any bird of this country which has not marrow in its leg-bones. On the other hand, the leg-bones of the ostrich, which cannot fly at all, contain more air-cells than those of our strongest flyers. While nearly all a bird's bones are full of air-cells, none but the wing-bones are hollow, and even these in some of our strongest fliers are solid. The swifts, for example, have long, slender, solid wing-bones. The swallows have only the upper arm-bone hollow. Hollow bones, therefore,

are not necessary. The first thing absolutely required is strength to stand all strains put upon the wing; the second is surface enough to fasten the muscles, tendons, and strong flight feathers firmly. We can imagine the wing-bones as being made of the right size and shape, and then bored out inside until the weight is reduced as much as is safe. We can see thus that a long and very slender wing-bone like the swift's or swallow's might not perhaps be bored out at all without making it liable to break.

Lightness is only an advantage, not a necessity in the wing. Safety is the prime essential. To secure this the weight is never reduced to the danger point, and a number of neat devices are arranged to guard against accidents. If you examine the wing of a chicken you will see that while there is considerable freedom of movement in the joints as they lie by the side in the closed wing, as soon as the wing is extended the joints lock and become rigid, so that the wing cannot be twisted back by any sudden flaw. Only at the shoulder is there any flexibility, and this is guarded by the strong muscles that draw the wing up and down.

Thus we see how perfectly the bird's wing is planned to secure speed and safety with the least exertion. It is not so simple as at first appeared, and there is still more which we shall have no time to study.

A FEATHER.

In order to understand how the bird's wing can resist the pressure of the air, we must examine the wing-quill of some large bird. Our Christmas or Thanksgiving turkey may furnish us with a stout wing-feather, or we may pick some up in the parks in summer when the ducks and geese are moulting, or we may, if nothing better can be obtained, pull a feather from the turkey-tail duster, remembering always that we have a tail-feather, not a wing-feather. But having procured a broad-webbed feather, study it carefully. Rub your finger along the webs to test its elasticity. Notice the effect of pressing it in different directions and observe how it stretches under pressure like a piece of jersey cloth, breaking apart only under rough usage or great strain, and readily being coaxed back into place again.

What makes the web of the feather so elastic? The question is not easy to answer clearly, for a feather is complicated and its parts are minute. With the unaided eye we see too little and with the microscope we see too much. We shall understand best by taking for the first a feather whose parts can be readily made out without a microscope. An ostrich plume, for example, is made up of a multitude of little plumes, called *barbs*, attached to a quill, or *shaft;* and each of these barbs is itself a miniature plume with its own shaft and barbs, to which is given the name of *barbules*. Few feathers show the barbules as plainly as these plumes of the ostrich, but the ostrich's barbules are not connected, so the

plumes would be wholly useless for flight even if the wings were large enough to lift the bird.

In the long feathers of the peacock's tail-coverts we see a feather that is fringed with scattered disconnected barbs near the base, but is tipped with interlocking barbs. We notice too that the barbs are set upon the shaft at an angle, so that where they come close together they overlap like clapboards on a house; and the barbules, being hooked at the end, catch hold of the barb next in front of them, and hold to it. Thus at the tip of the peacock's feather there is the beginning of a true web. The barbules, we notice, are all upon the upper side of the barb, or upon the upper *edge* of the barb-shaft, if we observe more closely; for the barb-shafts have been greatly flattened, and they lie side by side like the thin leaves we see beneath a toadstool on turning it over. This is an arrangement to give stiffness without increasing the weight, and it greatly strengthens the feather to bear the upward pressure of the air.

In the hawk and eagle this arrangement is even more remarkable, though we cannot see it so easily. And in these strong-flying birds the barbules interlock much more firmly, so that the feather is impervious to air, and is stiff enough to resist the pressure of the wind.

Without a microscope we cannot see the little barbicels, split up like shavings partly cut from a stick, and like them hooked at the ends, which reach out from barbule to barbule binding the feather together still more closely. Some of the other arrangements are too minute to be seen by the naked eye and not easily understood from description, but in every part we find the feather wonderfully planned to resist the pressure of the air without the slightest unnecessary weight.

These little barbules have to hold tight to each other; for if they lost their grip the wind would blow up through the

gap, and much of the effectiveness of the feather would be lost. If a bird is to fly well it must have firmly webbed feathers, and all flying birds have them. If the ostrich had wings as large as thunderclouds, he could not fly unless his airy plumes were replaced by good quills fit to beat down the air under them.

We observe that all the long quills overlap each other like the shingles of a roof, and that the unevenly webbed primaries lie with their narrow edge uppermost, and their wide web caught under the quill next nearer to the body. This greatly aids in making the wing air-tight; for, on the downward stroke, the wide web is pressed so firmly against the strong quill and stiff outer web of the next feather that the air cannot pass through.

But on the up stroke there is nothing to hold the weak web, which is borne down by the air, and thus the pressure on the wing is relieved. While this would happen anyway, it is such a help to the bird in flying that a special apparatus is provided along the back of the forearm for turning the secondaries on edge to let the air pass through on the upward stroke. By these arrangements the bird is able to press down a large quantity of air with every wing-beat, but is not required to lift an almost equally large amount when the wing rises. The inability to do this is what makes the bat so much less swift and capable upon the wing, although in comparison with the weight of his body his wing area is very much greater than the bird's.

THE BIRD IN THE AIR.

As long ago as King Solomon, who was the first naturalist, "the way of the bird in the air" was one of the stock mysteries for men to wonder over. How *does* a bird fly? It is only recently that the secret has been discovered.

In order to fly a bird must have wings large enough to support his weight, and muscles strong enough to move his wings; there seems to be nothing else required beyond a proper adjustment of power and supporting surface. We do not at first observe any such wonderful adaptations in wings as we saw in the loon's foot to fit it for a life in the water — merely more or less wing, longer or shorter, pointed or rounded. But the wonderful thing is that the bird can fly at all.

Here we have the problem in its simplest form: how is an eagle, weighing ten pounds, to raise himself in the air by flapping two broad fans that spread from tip to tip some seven feet? Some say that his hollow bones and the air-sacs in his body help to lift him, — as if a bird were a balloon. But a balloon, if filled with *air*, would rise no more than a grocery bag blown full and tied; a balloon is always filled with a gas *lighter* than air. An eagle can never, by any kind of puffing himself up with air, diminish that ten pounds in weight, even by a single ounce. The balloon theory finds two other obstacles — a balloon must sail before the wind, and it can travel no faster than the breeze that bears it, while the bird's speed is voluntary, and he usually prefers to fly against the wind. The bird's power to fill himself with air does not account for his flying.

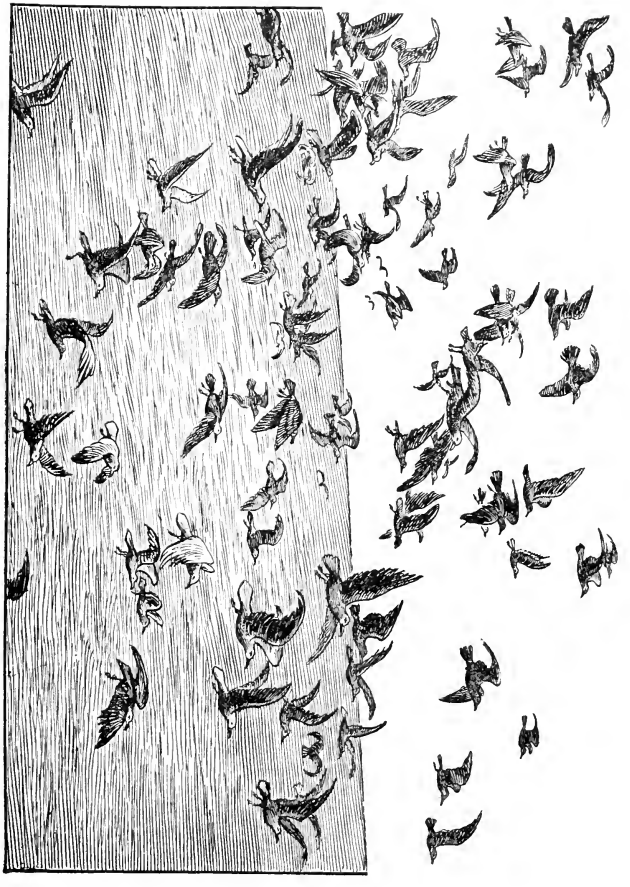

FIG. 17. GULLS FLYING.

Others say that the bird flies like a kite, and this is partly right. The bird's body does act very much like the string of the kite, serving as a weight to hold it steady. But the kite cannot lift the boy at the end of the string; if it could, the kite would fall just as we see it do when the string breaks.

That laughable story for boys, "Phaeton Rogers," tells us how Phaeton made his great kite draw his wagon down the road, and how the kite ran away with him while the whole town raced after to find out what the matter was. Now we know that the kite would not fly at all unless it could keep a taut string; and the faster the wagon moved the nearer it would be to outrunning the kite, so that it is hardly probable that Phaeton's wagon would travel as fast as the story says. Did you never underrun your kite and bring it down even

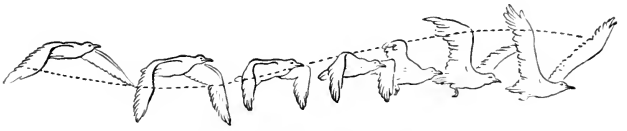

FIG. 18. GULLS FLYING — FROM INSTANTANEOUS PHOTOGRAPH. (AFTER MAREY.)

(The dotted line shows successive positions of wrist joint in flight.)

when there was a good breeze? Now in most instances a bird outruns the breeze, and he has no stationary weight; for his body, the weight, travels as fast as the wings. So we see that a bird does not resemble the kite.

More nearly does the bird resemble the swimmer, who supports himself in the water by striking out with his arms, pushing himself up and forward by the resistance of the water to his stroke. The bird rises and moves ahead by the forward and downward sweep of his wings, falls a little in air as he again raises them, and once more moves ahead and up with the new stroke.

Like the swimmer he advances by a series of undulations, a long incline upward (Fig. 19) when his wings press the air, a little drop downward as he raises them to get them in position once more. But the bird's stroke is different from the swimmer's. As soon as his wings are at their highest point, they begin to turn *forward* and downward with a strong, even sweep that lifts the body and carries it ahead.

The air is driven backward less by the direction in which the wing is moved than by the curvature of the under surface, by its general shape, and by the rotary motion at the shoulder joint. When it is necessary to recover for the next stroke, see by the picture how neatly it is done. The wing bends at the joint, leaving only half as great a resisting surface, the

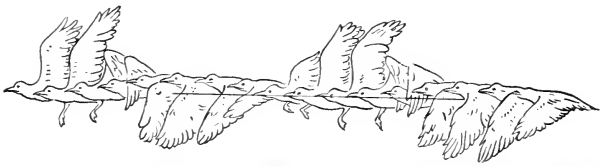

FIG. 19. GULLS FLYING — 50 IMAGES PER SECOND. (AFTER MAREY.)
(The line shows the centre of gravity in successive positions.)

secondaries roll on edge, removing still more pressure; the body drops a little by its own weight, and up flies the wing into place so quickly that the camera can get but two pictures, though it takes four of the descending stroke. Please notice carefully that the wing-beat is a *forward* motion; the tip of the wing never drags far back; even when it is ready to be raised it is still on a line with the eye. The bird is always reaching ahead to cut into air not yet disturbed by his own movement.

We know that the bird rises by the resistance of the air, using his wings as levers and the air as a fulcrum. But how

does he get his start? How does he guide his course? How does he stop?

Watch different birds taking flight. The old crow on the fence-rail, if there is no breeze, throws himself forward and drops a little, which gives him his first wing stroke with all the momentum of his falling body. When there is a wind he turns to face it, even if he intends to fly in the other direction, stretches up on his legs to his full height, and lifts his wings. The wind fills them. He leans down upon it, and his first stroke gives him headway and bears him up.

Many birds give a little leap in air as a help in rising from the ground. From a tree it is easy for any bird to get upon the wing, but starting from a level surface the difficulties are greater and they increase with the weight of the bird, whether he be a good flyer or not. The turkey-buzzard, a majestic bird on the wing, makes a slow, ungraceful start. The eagle, even when in danger of his life, has been reported to stop to run in awkward leaps several rods because he could not at once gain momentum enough for his wings to get their leverage. The loon is habitually in a worse plight, for he can get no chance to spring from the water, and must get his momentum by running along the surface, flapping his wings. Even then his wings are too small to lift his heavy body unless there is a breeze blowing.

What is momentum? — *an impulse to go ahead.* A body at rest has only a tendency to stay still, its *inertia*, until something sets it moving. The bird starting to fly must overcome its inertia. If it can once get the going-ahead motion, all it needs to do is to hold its body in the right position and lift itself with its wings.

Holding the body in this or that position alters the direction of the bird's flight. If he wishes to rise he throws the body

into a more or less vertical position, according to the angle at which he wants to ascend; if he wishes to glide down, he just lets himself fall forward. The straighter the body is held the straighter up the bird goes. The straighter it is held the more directly he descends.

If you should ever see a game bird "tower" you will notice how erect the body is. I know no flight among our American birds so nearly vertical as the towering of the ruffed grouse, but it is an exhibition not often seen unless one is with a gunner, as the birds seldom or never tower unless wounded in the head.

We have already described the forward movement of the bird in studying the stroke. Let us notice again the peculiar folding of the upraised wing and the rolling secondaries which spill the air and make the work of lifting the wing both quick and easy.

Speed in flight is attained in two ways — by the shape of the wings, and by the quickness with which they are moved. A small-winged bird may fly very fast by moving its wings with great rapidity, and a large-winged bird may be a slow flyer if it move its wings very slowly. But if two birds move their wings the same number of times a minute, that one will fly the faster which has the longer wings, because it has the greater leverage on the air. We shall notice too that all swift-flying birds have very strong primaries, and the stronger flyers have also very long primaries. Long wings, long primaries, strong primaries, make the work easier for the bird.

Very swift birds one may expect to find with narrow wings. The reason is that the wings are levers and their length and strength give them their efficiency without regard to their width. So the swifts and swallows and terns have very long, narrow wings. Birds with wings both wide and long must

either be rather slow flyers or else in the habit of soaring, for which they need a large area of wing. But a very long-winged bird, even though its wings are narrow, may be able to soar if, like the albatross and man-of-war bird, its wings are long enough to furnish the required area in spite of their narrowness.

In steering the tail does most of the work, though a part of the work is, and the whole may be, done by the wings. Birds making quick evolutions are commonly long-tailed. The terns, goshawk, Cooper's and sharp-shinned hawks are good examples of this. On the other hand, the chimney-swift is rather short-tailed. Birds with short tails and long legs usually trail the legs behind in flight, so that a boy of my acquaintance described a heron as "a big bird with only one tail feather, which was a yard long." The loon also, though his legs are not long, stretches them out behind him with the webs of the feet held close together to steer him. Finally, a bird that loses his tail has to learn how to steer himself. A cat-bird that I once knew, having lost his tail by accident, was hard put to tell where he was going until he learned to steer a more certain course with his wings.

In hovering, also, the tail plays an important part. Watch the humming-bird before the flower, the king-bird over the grass, the sparrow-hawk above the hole of the meadow-mouse. You will see that the tail is held full spread and nearly at right angles to the body, unless the body itself is dropped, as it often is in the humming-birds. Thus the tail holds a large part of the air fanned back by the wings, and acts as a drag on the bird to hold him stationary or nearly so.

One of the prettiest sights I ever saw was a common tern that, attracted by my fishing, came and hovered within ten feet of me, keenly curious, his scarlet bill and feet, black cap, silvery mantle, and white body gay as a picture against the

blue water of the bay. For nearly a minute he held himself as stationary as if suspended on a wire, hovering with head bent down, wings partly flexed, and his long forked tail dipped almost at right angles to the body and spread so wide that it looked nearly square across the end — a position in which the forces that naturally would have borne him ahead were balanced by others that held him back.

Stopping is accomplished by both wings and tail. A bird in swift flight, wishing to check his course immediately, spreads his tail to the fullest extent, throws up his wings, and drops as nearly vertically as his momentum will permit him. Watch pigeons and you will observe that they are experts in this method of alighting. But commonly a bird merely draws in his wings, spreads his tail more or less to check his motion, and comes gliding down on an easy slant.

Aside from these necessary motions the bird has a number of tricks no more a part of flying than riding on one wheel is a part of bicycling, but very pretty sport. We sometimes see a bird glide until his momentum is gone, when, with a stroke or two, he sends himself forward and rests on his wings till the new impulse is exhausted.

Sometimes birds play with the wind, mounting by merely turning to face it, and then sliding down the breeze a short distance, when they turn once more to the wind and let it raise them. Again one bird, the tumbler pigeon, is noted for its habit of falling backward in mid-air, a habit thought by some to have its root in the method by which wild pigeons sometimes escape the onslaught of a hawk.

But the most beautiful flight trick of all is the common one of soaring. No one knows all about it, and yet it is easy to see that under most conditions the bird is playing with a breeze, letting himself be borne up as he faces it, gliding downward a

little as he wheels about the circle, which will once more bring him breast to the wind. Hawks are among our best soaring land-birds; but some sea-birds excel all others in the sport, wheeling about hour after hour on motionless pinions, keeping their course and their elevation entirely by some slight adjustment of the body or by an inclination of the tail. Sailors declare that an albatross will follow a ship for days together, circling above her without rest. It is certain that on moonlight nights the man-of-war bird may be seen for hours together floating far above the sea. Nor is a soaring bird easily disturbed. I have seen a soaring goshawk, when a bullet clipped a secondary from one of its wings, answer with its wild scream of defiance, and without haste or change of motion fill out an unbroken curve of its ascending spiral.

COMPARING FEET.

Not until we see many birds together do we realize how very unlike they are. No bird looks out of place in its own home unless we catch it doing something quite out of the ordinary. When a wounded heron tries to swim, or a breeding sandpiper alights in a tree, it looks strange and uncouth. But what could be more in keeping than a sandpiper trotting along a pond-side, or a still heron standing in a pool? Structure and habits are so interwoven that from either one something may be inferred of the other.

Does a bird spend his life on the wing chasing fish or insects? Then look to find him furnished with very long wings and very short legs. Short legs, as in the hummingbirds, the night-hawks, the swifts, the terns, and others may be taken as almost certainly indicating that the bird has long wings; for if he does not get his food afoot he must get it on the wing, or else spend all his time in the water. Almost the only exception to this is the woodpecker family, where short legs indicate nothing as to the shape of the wings, their convenience in climbing being enough to explain why they are short.

On the other hand, long legs are a sign that they have some peculiar use, probably to help the birds to get their food. Though long-legged birds often have very good wings, we find that they use their wings chiefly for safety, and depend upon their legs in picking up a living. It is always safe to infer that a long-legged bird finds most of its food in shallow water,

and that a web-footed bird seeks its living in water too deep for wading.

When we compare all the different birds, we see that there are no great jumps from one extreme to another, — from very short legs to those ridiculously long, from tiny bills to those enormously long or thick or wide. Somewhere in nature we may expect to find a bird which just fills in the gap and makes a graded series.

From the man-of-war bird with his abbreviated legs, for which, short as they are, he seems to have almost no use at all, to the stilt perched up on his absurd, artificial-looking shanks, extends all the long procession of birds — the terns and gulls and the whole race of sandpipers and others that take their food less and less by pursuing it on the wing, and more and more by running or wading after it. The changes, after all, are gradual.

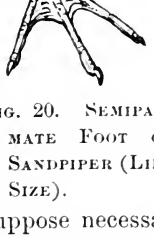

FIG. 20. SEMIPALMATE FOOT OF SANDPIPER (LIFE SIZE).

Watch the growth of the idea of a swimming foot and see how the need of more or less surface to oppose the water is met in different ways. The first hint we get of a web-foot is in the slight *semipalmation* of some of the sandpipers. We need not suppose necessarily that this is a sign that the sandpiper swims much, for we find semipalmation in some land-birds, even in the hen, and we know that this is to bear them up in walking over snow. Perhaps in the sandpipers the principal use of this slight webbing is to help them in walking over soft mud. But soon it becomes evident that it aids in swimming, and the little phalaropes,

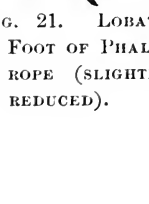

FIG. 21. LOBATE FOOT OF PHALAROPE (SLIGHTLY REDUCED).

close cousins of the sandpipers, have the webbing extended along both sides of their toes, in a scalloped edge.

Again we find another variation for increasing the surface in the *excised web*, in which the space between the toes is still

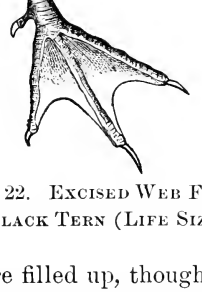

FIG. 22. EXCISED WEB FOOT OF BLACK TERN (LIFE SIZE).

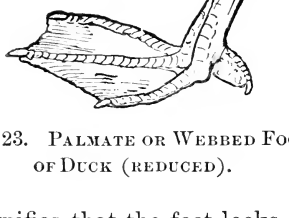

FIG. 23. PALMATE OR WEBBED FOOT OF DUCK (REDUCED).

more filled up, though the word signifies that the foot looks as if it had once been full-webbed and then cut out, or excised. In the ducks and geese we see the webbing carried out to the toe-nails, and the surface increased by spreading the toes wide apart. In the loons it is still further increased by lengthening the toes, which make the webs long as well as wide. But one other device seems possible, and that we find in the *totipalmate* birds, where all four toes are joined by the web. Observe, please, that in these the outer toe is longest while in all other web-footed birds the third, or middle, toe exceeds the others.

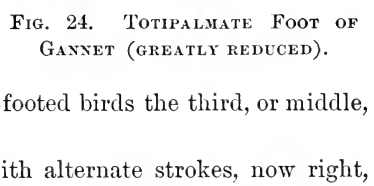

FIG. 24. TOTIPALMATE FOOT OF GANNET (GREATLY REDUCED).

Most palmate birds swim with alternate strokes, now right, now left, or with one foot a little behind the other, seldom with both exactly together. The swans often swim with only

one foot, sticking the other up behind. To keep a straight course a swan swimming with one foot must "bear off" with every stroke, just as a canoeman does when using a single-bladed paddle; otherwise he would swim in a circle.

Some of the totipalmate birds are said to swim with both feet together. We can see that such a stroke would be a very strong, effective one. The feet would be held together like an inverted triangle; and the longest, strongest toes, the outer ones, would form the lower edge of a V where the greatest resistance would be met. With feet so placed a powerful backward and downward stroke would bring every part of the webbing into full use, and give a great impulse to the bird.

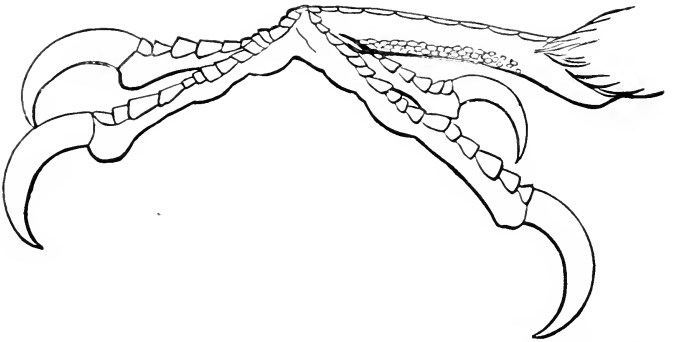

FIG. 25. ZYGODACTYL (OR YOKE-TOED) FOOT OF WOODPECKER (LIFE SIZE).

After we get into the higher orders the feet differ less noticeably; yet many oddities occur. Notice the yoke-toed foot of the woodpeckers, the cuckoos, and the parrots, or the still odder foot of the kingfisher, in which two of the toes are grown together for a part of their length.

What is the origin or use of such a foot never seems to have

been guessed. We can see, however, that the kingfishers use their feet only in clasping small perches, and that parts so little exercised would naturally be small and weak as we find these. Instead of learning the hard names for these forms of feet, it may be better to tell you that dactyl comes from an old Greek word for a finger or toe, and that any word of which it forms a part always tells you something of fingers or toes. Syndactylous means "with toes joined together"; zygodactylous means "yoke-toed"; now what does pterodactyl mean? Look it up, and you will have mastered another word from the Greek, which is often used in science, as in apteryx and in other compounds.

FIG. 26. SYNDACTYLOUS FOOT OF KINGFISHER (LIFE SIZE).

We must not forget to notice the differences in birds' claws. Here, too, are all sorts of variations, hinting something of the bird's ways of living. Do not a hen's short, stubby nails look like those of a hand that has scratched in the ground? The crooked claws of the hawk and owl, sharp and shining, indicate a very different mode of living. Birds of prey keep their claws in scrupulously neat condition, never pressing them against any hard perch but lifting them as a cat lifts her claws, or turning them to one side that they may not be blunted. Whenever we see a bird with extremely long nails on the hind toes, like the long-spurs, the skylarks, the horned larks, and the meadow lark, we may be sure that the bird frequents the ground. Probably he will be found to be strictly terrestrial.

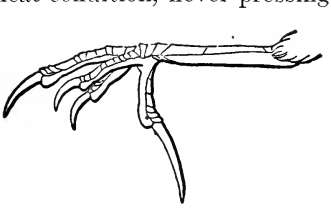

FIG. 27. FOOT OF LONGSPUR (LIFE SIZE).

While most birds have claws that are flattened or hollowed beneath, the claws of birds of prey are generally rounded. Yet hawks' claws have a slight groove beneath, owls' claws have a flange on one side, and the foot of the fish-hawk, or osprey, has a rounded or *terete* claw without either groove or flange. Why these differences? Perhaps no one can explain them any more than why the long-legged heron and the short-legged night-hawk — birds of utterly dissimilar habit and form — should each have a comb-like ridge along the inner edge of the middle toe-nail. The fact that differences exist in birds of similar habits and that likenesses are found in birds of dissimilar habits shows how hard it is to make a theory that will cover all cases.

COMPARING BILLS.

To walk through a museum, looking at the different kinds of bills that the birds have, and wondering how they are used, is almost as much fun as choosing the pretty things in a store window. Until one tries it, it is hard to believe that there can be so many shapes, — noses that tip up and tip down, Roman-nosed and straight-nosed birds, and a hundred noses that we have no name for. For bills are noses — and mouths too. The bird's nostrils always open somewhere along the upper portion of the bill, so that the whole upper mandible forms an exaggerated nose. Indeed, one of our commonest names for describing a certain kind of nose, the word *aquiline*, indicates the resemblance of a bold, humped nose to the hooked beak of *aquila*, the eagle.

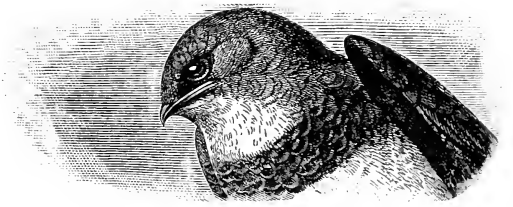

Fig. 28. Head of Swift.

Among our North American birds the smallest bills of all are those of insect-hunters like the swifts, swallows, and night-hawks, which have merely a tiny triangle of bill pierced by the two nostrils. But what a mouth they have! Open it

and the whole head seems to have disappeared down its own throat. Though the bill itself is so small, the fissure, or *gape*, of the mouth extends nearly the whole length of the jaws, so that the mouth begins to open as far back as the eye.

The night-hawks and whip-poor-wills, which fly with their mouths open, have the sides of the gape fenced in with rows of bristles which prevent insects trapped in the wide mouth from escaping at the sides.

The swallows and swifts, which fly with closed mouths and catch each insect separately with a snap, have few bristles, or, in most cases, none. These birds that hawk after insects have very small tongues. The swifts have a pouch just beneath the tongue, in which they keep the flies that they carry home to their little ones.

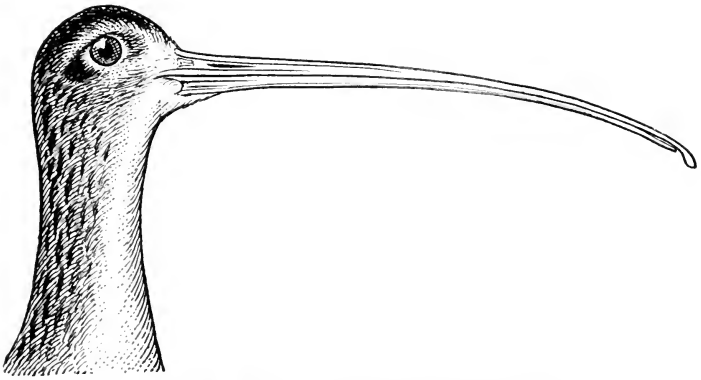

FIG. 29. HEAD OF LONG-BILLED CURLEW.

Of the long-billed birds in this country none compares with the long-billed curlew, which uses his sensitive slender probe in searching out food that lies deeply buried in the mud. Near relatives of his, as the snipe and the woodcock, have

bills, equally sensitive and nearly as long in proportion to their own size, and capable of being opened at the tip without opening the whole length of the gape. I have noticed the same peculiarity in woodpeckers' bills, and these, like the snipe, seek their food by digging it out of deep holes. Sometimes when walking through alder ground, or in muddy places, we may see the "borings" made by woodcock and snipe where they have fed at night. At first we might mistake them for wormholes, but there are no "casts" about, and they are too numerous and too near together to be made by worms, and if you look intently perhaps you may see the prints of a bird's foot.

The white pelican's is the longest bill without reference to the bird's size. Watch him some day in the park and see the flat upper mandible pointing straight down his breast as he sits thinking, or lifted with its pendulous pouch beneath as he looks up in anger or expectation. Surely this bird with a bag is grotesque enough.

A bill hooked at the tip is almost a sure sign that the bird lives on animal food, and the sharpness of the tip and decision of the curve are guides to the strength and liveliness or to the toughness of the flesh of the prey it contends with. So we find a slight hook at the tip of the bill of the insect-eating flycatchers, a stronger point to the fish-eating frigate pelican's, and an abrupt hook in the bills of the hawks, owls, and eagles.

Some fish-eating and insect-eating birds, as the terns, herons, and humming-birds, have straight bills; but a hooked beak, which is the characteristic mark of the *raptores* or birds of prey, often indicates a more or less raptorial character.

Sometimes a hooked beak may have another use, as in parrots and cross-bills. But you will notice that the hawk's bill is

made for tearing food, the parrot's for crushing it, and the cross-bill's for reaching into out-of-the-way crevices, and that the hawk's beak is really far less like a parrot's, for example, than it is like a shrike's, whose habits are more like the hawk's.

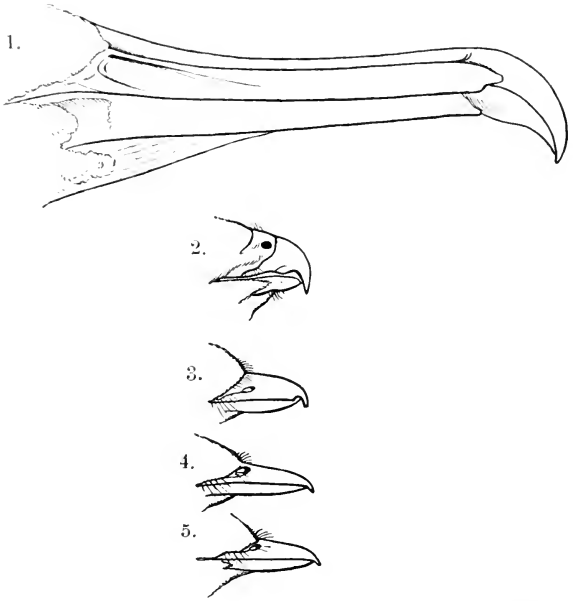

FIG. 30. BILLS OF (1) FRIGATE BIRD, (2) HAWK, (3) SHRIKE, (4) VIREO, AND (5) BLUEBIRD.

Of the *compressed* bills, — that is, those that are very deep but thin, — the puffin's is a prominent example; but even odder is the bill of the ani, or tick-eater, a bird sometimes seen in Florida, which is thinner for its height than the puffin's, and more rounded at the tip. The bird is a relative of the cuckoos, and, as its name shows, gets part of its food by eating the

ticks and other vermin that cling to the legs and hides of cattle in hot countries.

The opposite of this form, the *depressed* or flattened bill, is well shown in the duck tribe, some of which have very broad, flat bills. The broadest of these are ridged along the inside with little laminæ, or plates, that act like a strainer, holding the selected morsels tight, while the mud and water are drained away. This is a convenience to birds that pick up most of their food under water and must take it without cleansing. The flamingo's bill is furnished with a similar strainer. In spite of its size, the flamingo's bill is extremely light, being made up of a spongy, bony tissue, full of air-cells. Few large bills are as heavy as they look to be, since, unless great strength is needed, the interior of the bill is made up of this cellular or *aerated* bone, as it is called.

If you were to draw all the kinds of bills you could imagine, I could agree to match most of them from birds now living in some part of the world. Do you make one that turns down at the tip? You have already seen the long-billed curlew's; and the bills of some of the foreign humming-birds and sun-birds are curved in a quarter-circle at the tip. But if you make one that curves up, we can match that, too, in the avocet, a bird of our shores and prairies, with his tilted bill, and as great an oddity as any. With such a bill one would suppose that any bird must be handicapped in getting a living, yet the avocet seems to fare well.

"It is a beautiful sight," writes one who knows them, "to see a flock of these birds feeding. Wading along in the shallows, the bills are moved regularly from side to side, through the water or mud, with the motion a man makes when mowing, each bird keeping to the side and a little behind the leader, and if the water is deep the head and neck are frequently immersed.

They advance into the water up to their bellies, and if it should suddenly deepen they keep right on by swimming, not at all incommoded by the loss of their foothold."

Here is a shape you would hardly have dared invent, a bird with the under mandible much longer than the upper and as thin as a knife-edge. There are but three such bills in the world, and all belong to different species of skimmers.

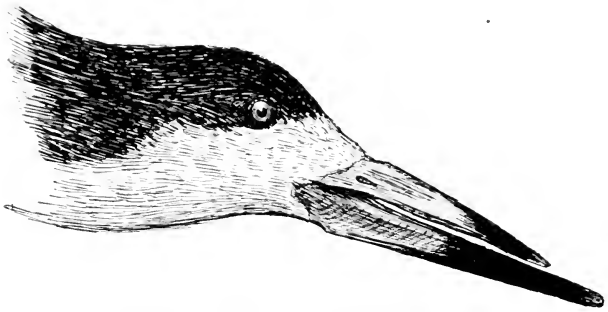

FIG. 31. HEAD OF BLACK SKIMMER.

"This bird," says Wilson, "is formed for skimming, while on the wing, the surface of the sea for its food, which consists of small fish, shrimps, young fry, etc., whose usual haunts are near the shore and towards the surface. That the lower mandible, when dipped into and cleaving the water, might not retard the bird's way, it is thinned and sharpened like the blade of a knife; the upper mandible, being at such times elevated above the water, is curtailed in its length, as being less necessary, but tapering gradually to a point, that, on shutting, it may offer less opposition. To prevent inconvenience from the rushing of the water, the mouth is confined to the mere opening of the gullet, which indeed prevents mastication taking place there; but the stomach, or gizzard, to which this business is solely allotted, is of uncommon hardness, strength, and

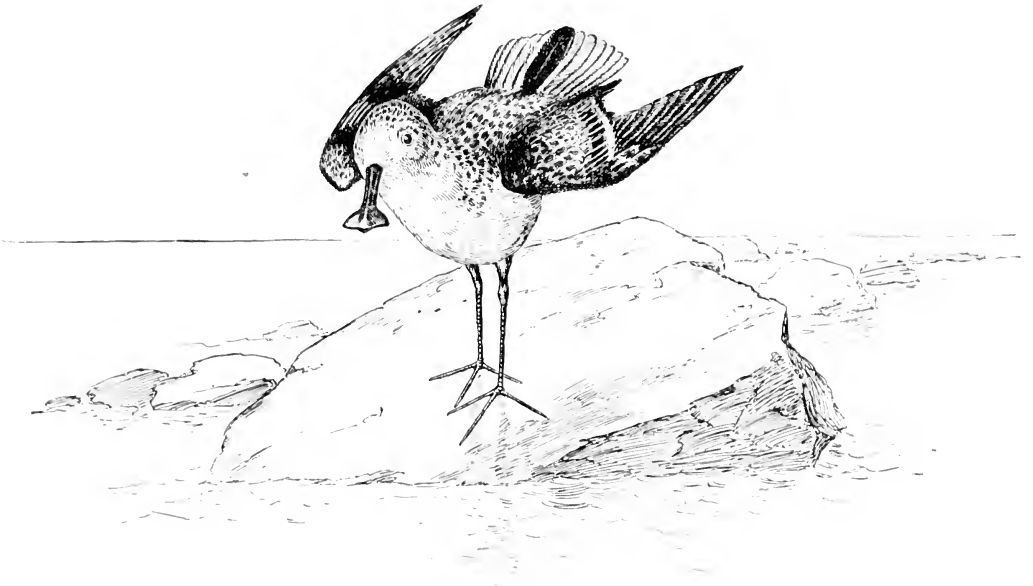

FIG. 32. — SPOON-BILLED SANDPIPER.

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muscularity; far surpassing, in these respects, any other water-bird with which I am acquainted. To all these is added a vast expansion of wing to enable the bird to sail with sufficient celerity while dipping in the water."

It is interesting to know that the young skimmers have the mandibles very nearly equal in length.

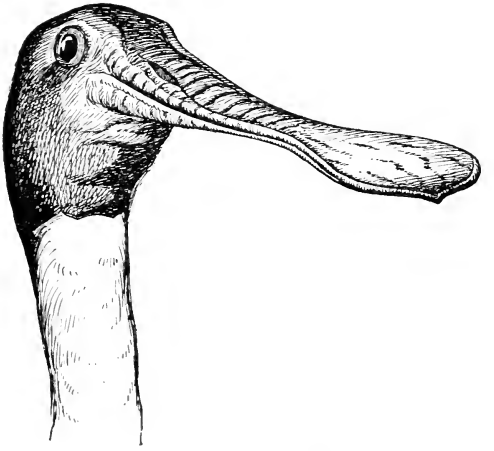

Fig. 33. Head of Roseate Spoonbill.

Of spoonbilled birds we have in this country the well-known roseate spoonbill, or pink curlew, of the South, with his bald head, and this rare little sandpiper (Fig. 32), that a few times has straggled over to our coasts from its Asiatic home. See what a dainty poise it has upon the slippery ledge, confident and alert, not at all awkward, — a true shore-bird, although its blunt-ended bill is so unlike the delicate little probe of its sandpiper cousins. It looks like an accident to find a bill otherwise unknown except among the family of spoonbills, in a group of birds that are noted for the length and true taper of their bills; yet undoubtedly the reason for this form would be

fully explained if we knew what food the bird preferred when at home.

We have had bills that turned up and down, but no one would admit that a bill that turned sideways could be possible except by accident. Yet here is that "accident." Every egg laid by this little plover produces a bird with the bill crooked to the right. It is a New Zealand bird, but unlike the spoon-billed sandpiper, it has never strayed to our shores.

Fig. 34. Bill of Crook-billed Plover.

What is a bird with such a bill to do? How can any bird be better fitted for his work by having a bill bent to one side so that he cannot feed unless his food is on the right side of him? But this bird gets his food by trotting along rocky river-beds and picking up small forms of animal life that creep in under the loose stones of the dry channels for greater security and moisture. Therefore, since his course lies never in a straight line and usually in a circular direction, it is no disadvantage to him to travel always in one direction, or perhaps it is a decided advantage not to have to turn in his tracks so as to face the stone at every stop he makes.

A very curious point about this bird's coloration is worthy of notice. His constant habit of turning to the right leaves the left side open to danger; all his foes must approach him on that side. He has across his breast for ornament a black band; and it has been noticed that while this is three-fourths of an inch wide on the right side, it is not more than half an inch wide and is much lighter in shade on the exposed left side, thus varying both in width and color. Think of it, — all the other birds in the world are bisymmetrical; that is, alike

on both sides, so that a picture of one side of them is precisely like a picture of the other; but this, the only bird in the world that is colored unsymmetrically, is also the only bird that moves always in the same direction while feeding, thus keeping the same side exposed to its enemies. This is a wonderful instance of what is called protective coloration, about which we shall soon study.

EYES AND CAMERAS.

When you have longed to own a camera, did it ever occur to you that you already had two, and that you could not avoid taking pictures all day long unless you closed your eyes?

The eye, like the camera, is a box, blackened on the inside and divided into two unequal chambers by a partition with a lens in it that, like a little round window, is directly in line with a hole in the front. These are the essentials of a good camera, though the little "pin-hole" cameras that boys sometimes use are even simpler.

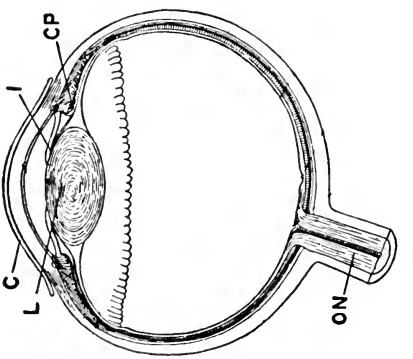

Fig. 35. Diagram of Human Eye.

C Cornea. *L* Lens. *I* Iris. *ON* Optic nerve. *CP* Ciliary processes.

But some one who has owned a camera and who knows all about them says that though our eyes may be black inside, and

may have lenses and even holes in them (though he has yet to see the hole), they cannot be good cameras unless they have a shutter to keep out light when not in use, a diaphragm before the lens to exclude the light when it is too strong, a movable lens so that they may be focussed, and a sensitive plate or film for the picture to fall upon. "And eyes," says the man who owns the camera, "have no shutters, nor diaphragms, nor focus-screws, nor sensitive films."

But our eyelids are shutters; whenever we open our eyes we "make an exposure," and we take pictures till we close the lids over them. The eye is the first and best of cameras, more wonderful than any other. That colored ring, the iris, which sometimes is narrow and sometimes wide, is the device which lets in more or less light as it is required. It adjusts itself without thought on our part. The black spot in the centre, the pupil, is the hole we spoke of. It is covered by a transparent plate, the cornea, which keeps out the dust, but through which we can look just as we do through a window. The blackness of the pupil is merely a portion of the black lining of the inner surface of the eyeball which we see through the opening in the iris. Watch the eye of your cat, your dog, or any other creature, and observe the way in which the iris expands and contracts, and notice the varying shape of the pupil. How does the pupil of a horse's or a cow's eye differ from a cat's, and how do both differ from a dog's?

But if an eye is a camera, how is it focussed? Not by turning a screw to regulate the distance of the lens from the object pictured, but by changing the shape of the lens itself. We need not think about this change at all, for it acts of itself, or automatically, as we say. It will be long before any camera is advertised with an automatic focus. As to sensitive films, our eyes are furnished with the best to be had, one that does

not need to be renewed, and on which any number of pictures may be taken, one after the other, and carried to the brain to be developed. And the retina, as it is called, takes not only form and light and shade, but color.

We have not tried to explain how we see, because that would need much study. It is enough for us to know that our eyes have all the parts of a perfect camera, and that they take pictures in just the same way. And not only our eyes, but those of all beasts, birds, fishes, and reptiles are formed on the same plan. *The eye of the vertebrate animal is a little camera.*

We must not conclude that all eyes are alike, only that they all are made on the same plan. They vary in shape and size and in some points of construction, just as cameras do, but the essential parts are the same. These diagrams of the

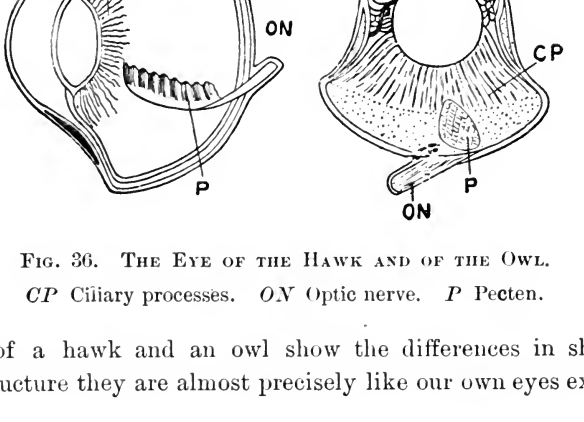

FIG. 36. THE EYE OF THE HAWK AND OF THE OWL.
CP Ciliary processes. *ON* Optic nerve. *P* Pecten.

eyes of a hawk and an owl show the differences in shape. In structure they are almost precisely like our own eyes except

that they have inside them a little folded membrane called the *pecten*, which our eyes lack. Its use is not known, but it has been suggested that it helps to focus the eye instantaneously, so that the hawk, swooping from a height, or the gannet, diving from the air like an arrow, may always keep a clear and unblurred vision of its prey. Our own eyes could not be adjusted for such rapid motion. It is interesting to compare the elongated eyeball and round lens of the nocturnal owl with the flattened eyeball and lens of the diurnal hawk. Contrary to popular opinion, the owl can see very well by day also, because his eye is capable of great adjustment to the amount of light, and can either collect the scattered, feeble rays of dusk and darkness, or exclude the strong glare of day.

Eyes are not only the most perfect cameras, but they are also the smallest. Small as our own eyes are, there are others far tinier. Think of the birds about us, the swallow chasing the fly, the vireo tripping along a bough, the chickadee clinging to a twig, searching for food too small for us to discover. Probably the smallest cameras known are the eyes of the humming-birds. The tiny Princess Helena humming-bird of Cuba is only two and a quarter inches from bill-tip to tail-end, and its eye is about the size of the head of a round-headed black pin. Can there be a smaller camera than this? But the little humming-birds, when they first open their eyes, are not nearly as large as their mother, and yet their eyes are as perfect as hers. Surely these are the smallest cameras in all the world.

THE IRIS OF BIRDS.

If we look at the birds about us, we shall soon notice that not all of them have the same colored eyes. Can you tell the color of a dove's iris? of a crow-blackbird's? of a gray parrot's? You will find more difference among them than among boys and girls with their brown, blue, and gray eyes. When we begin to observe these differences, we ask certain questions as: How many colors do birds' eyes have? Is the color always the same in the same kind of bird? Is it the same all through the bird's life?

There are birds with white, blue, green, red, purple, orange, yellow, and brown eyes. Black eyes are among the rarest, for most of our black-eyed birds, like our black-eyed boys and girls, have a dark brown iris. If you ever held an English sparrow in your hand, you may have noticed what a clear brown the iris is. The old pelican waddling about the park has a white iris; the puffins are blue-eyed; cormorants are green-eyed; most wild pigeons have eyes of some shade of pink or purple; while owls and herons are usually yellow-eyed, and hawks are either yellow, red, or brown eyed. Nearly all our small birds have dark brown eyes. We must remember that it is only the iris which is colored; the pupil of every healthy eye is black. Notice the eyes of different animals. Did you ever see a white-eyed horse? or a blue-eyed cat? or a yellow-eyed dog? What are the commonest colors seen in the eyes of horses, dogs, and cats?

Naturalists think that wild birds and animals of the same

kind and the same age always have the same colored eyes. Often this makes an easy way to tell one species from another. The red-eyed vireo and the white-eyed vireo could easily be distinguished by the color of the eye alone. So, too, the common towhee of the North with his red eye is readily distinguished from the white-eyed towhee of the South, which otherwise is almost precisely similar. But here we find a curious fact. The white-eyed towhee is not a distinct species, but is a race of the red-eyed, and we find that part way between the northern and the southern limits of the two forms, — in Georgia, for example, — the towhees are neither white-eyed nor red-eyed, but have brownish eyes.

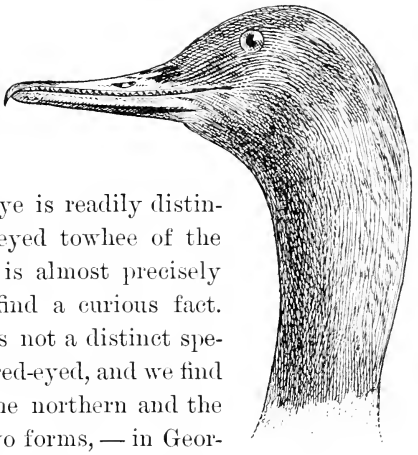

FIG. 37. — HEAD OF GOOSANDER (MALE).

A curious instance of seasonal change has been observed in the Louisiana egret. In the spring, during nesting time, both the male and female have a red eye, surrounded by bare blue skin. In the female the iris gradually changes to yellow after the breeding season is over, while the blue skin becomes yellow also. The male keeps his red eye.

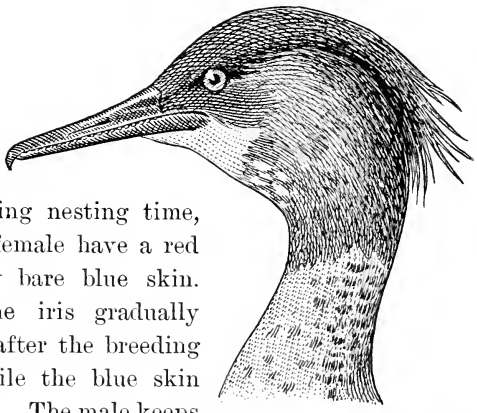

FIG. 38. — HEAD OF GOOSANDER (FEMALE).

A notable difference in colors in the two sexes is that of the sheldrake, or goosander, which we have already studied. The male's eye is red, the female's yellow. The red-breasted merganser, however, has a red eye in both sexes, and the hooded merganser has a yellow eye in both sexes. What is odd is that though the males of the first two species are remarkably different, the females are so nearly alike that they can hardly be told apart except by the color of their eyes and by their nesting habits.

There is sometimes a change of color with age in birds as in cats. A young crow, or raven, is as blue-eyed as a kitten, but as he grows older his eye becomes as black as his reputation. I have seen a young goshawk, taken from the nest, which was blue-eyed, though at a later period the goshawk's eyes are yellow, and at maturity they are red. From blue to yellow, yellow to red, what a change for one bird!

We have seen that the color may vary with age, sex, and season, or may even form a racial mark, as in the towhee, yet that it is usually constant in the same individual and species through life.

There is another interesting thing about birds' eyes. Any one who has watched an owl will remember the third eyelid, or "winking membrane," which the owl draws sleepily over his eyes. You may observe something similar, though not nearly so complete, in your cat when she is lying on the rug half asleep. Even in your own eye there is a trace of this winking membrane in the little folds of membrane in the inner corner of the eye; but you have no power to draw it over the eye as the cat and the owl do.

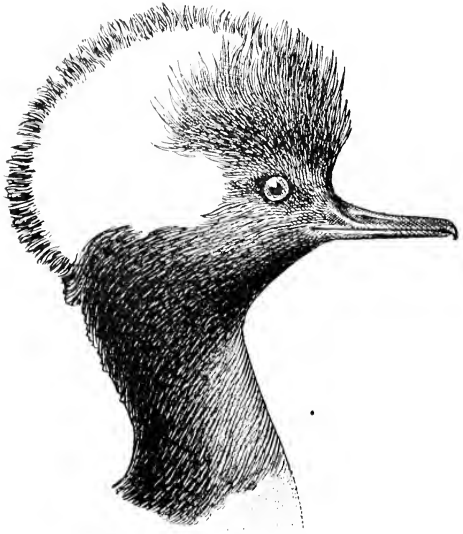

FIG. 39. — HEAD OF HOODED MERGANSER (MALE).

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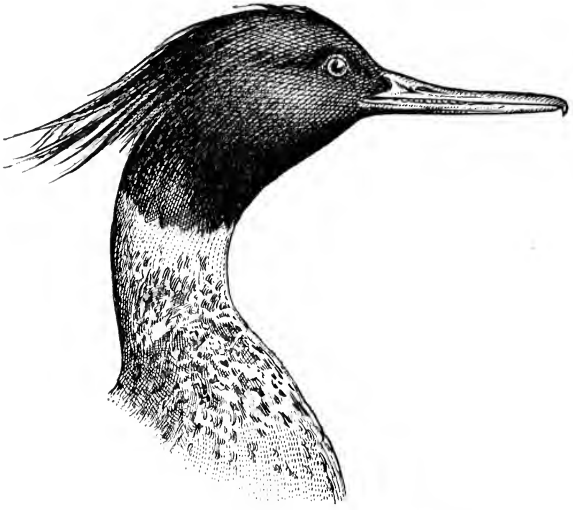


FIG. 40. — HEAD OF RED-BREASTED MERGANSER (MALE).

WHITE BLACKBIRDS AND OTHER FREAKS.

It is the hope of seeing something new and strange that keeps the naturalist always enthusiastic: there is always a chance of seeing white blackbirds, and he lives in expectation of the rare chance falling to him.

White blackbirds are not of uncommon occurrence. I have seen the cowbird, the rusty grackle, the Brewer's blackbird, and the red-winged blackbird — besides crows and meadow-larks, which are relatives of the blackbird's — either partially or entirely white. Of course these were mounted birds, for so much good luck would not fall to any one person in the field. It is an accident of nature, but by no means a rare one, that every now and then a bird will be hatched without the usual amount of coloring matter in its feathers, in which case it will be either wholly or partly white. These accidents are called *albinos,* or *partial albinos,* as the case may be. When the bird is an entire albino, it usually has pink eyes. Similar accidents occur among animals with the same accompaniment of pink eyes if the albinism is entire. The white of such birds is seldom pure white, oftener a yellowish, or grayish, or dirty white, and oftener only partial, being confined to a few wing or tail feathers, or a patch of grayish white about the head and neck. Among English sparrows it is not unusual to see a bird thus marked Take note of such birds to see whether you ever meet them again; they are curious, but have no other interest.

It is very odd that albinism appears to run in some genera of birds more than it does in others. White crows are not un-

common, nor are white blackbirds, as has been said. I have seen a white meadow-lark also almost pure white with only a faint yellow tinge on the breast, yet I have never heard of an albino among the jays and orioles, though they are nearly related. Ducks are frequently albinistic, and so are quail and grouse; but hawks are rarely, if ever, affected in this way. Sparrows are another family among which albinos are common. I have had a snow-white eaves swallow brought to me, and have seen a cherry bird all white except the yellow tip of the tail. Thrushes also not infrequently show signs of albinism, but I have never seen an albino warbler nor a white flycatcher. This is not saying that these freaks will not be discovered by sharp eyes; rather it shows that in certain groups the accident is rarer than in others.

Even rarer than albinism and certainly far prettier is an occasional paleness of plumage that gives the whole bird a delicate *café-au-lait* color — just the shade of coffee with cream. I have seen this in ducks, and a remarkable case of it in a robin, where the whole head and upper parts were delicate creamy brown, while the breast was as red as in an ordinary robin.

Another accident sometimes noticed is just the reverse of albinism. Instead of being white, the bird is black or much darker colored than usual, sometimes a dark chocolate or deep blackish brown. This is called *melanism*, from the Greek word for black, just as *albinism* comes from the Latin for white. Melanism is most frequent among the hawks, which so seldom show traces of unusual whiteness. In certain hawks, as the red-tailed, Swainson's, and the rough-legged, this occurs so often that it is probably not an accident, but a "color phase." Robins are particularly subject to melanotic changes. Sometimes they have been reported "as black as grackles."

While albinism seems to be permanent, melanism is not

always so. Caged birds sometimes turn dark in moulting, and then moult back again. A robin that was black in infancy afterward acquired white wings and a white tail; while another that was caged for six years was normally colored for the first two years, on the third showed some white and some black feathers, on the fourth, white wings and tail and a black breast, with red under the wings and a white belly. The fifth year it was normally colored, and the last year it was red below and black above, with white wings and tail.

The "color phases" already mentioned form another class of oddities. No one knows the reason, but among certain groups of birds it is common or usual for individuals to be some of one color, some of another, all their lives. They look like entirely different species of birds, and yet scientists agree that they are not. This is a very common freak among some of the sea-birds, especially the jægers and the shearwaters, in which the light and dark phases are well recognized. In one genus of owls, and in one or two of the heron kind, something like it occurs. Of two little screech owls from the same nest, one will sometimes be gray and the other reddish brown, and so far as is known they will keep their color all their lives. This phenomenon is sometimes called *dichromatism* or double coloring. In one of the little bitterns a supposed black dichromatism has been discovered, while in the reddish egret a white dichromatism has been known for many years. The young of certain herons are white, while the old birds are very dark colored; but this is not called dichromatism, because the color depends upon the age of the bird. However, among the reddish egrets specimens are frequently seen which are white all their life. It is not albinism, because the white is always pure white, and the iris is not pink, but white. The dark

phase of the bird has a white iris also, and a dark and a light bird will frequently mate together.

These are some of the oddities of the coloring of birds which scientific men are now investigating in the hope of discovering a reason for them.

PART III.

PROBLEMS OF BIRD LIFE.

LITTLE STUDIES IN ZOÖLOGICAL THEORY.

"Science is nothing but trained and organized common sense." — HUXLEY.

THE BASIS OF CLASSIFICATION.

We come now to another kind of science work. We are no longer asking: What is this? or, How does this happen? but *Why* is this so? Our eyes will not help us as much now, but if we have used them to train our imaginations and have laid up a good store of facts, we are ready to begin these more difficult but far more interesting studies.

As you study, you will see more and more that science is not purposely dry and hard and uninteresting, but that it is an attempt to make study easier by grouping together related facts so that you will have fewer of them to remember. A scientific arrangement is always the *easiest* arrangement. A great deal of scientific work is only an attempt to sort things of a kind in an orderly manner, so that they may be referred to with the least time and trouble.

If a scientist had ten thousand living creatures of all sorts, from bees and spiders up to birds and beasts, to arrange and name, how would he do it?

What would you do if you were given twenty kinds of peas and beans mixed together in a basket, and were told to separate each kind without mistakes? You would not begin by sorting them into twenty baskets; that would give too many chances for errors. And you would not put the dwarf peas with the dwarf beans, and the tall peas with the pole beans, merely because their habits were similar; nor the white peas and beans together, because they were of the same color, for you would say that any bean is more like every other bean than it is like any pea.

First, you would throw all the beans into one dish and all the peas into another; then you would take one of these dishes and separate the plain white beans from the spotted ones, and finally you would sort out the white bush beans from the white limas, and the spotted yellow-eyes from the streaked cranberry beans, putting each by itself. You would have *classified* the beans. Then you would classify the peas in the same way. *To classify means to sort out into kinds.*

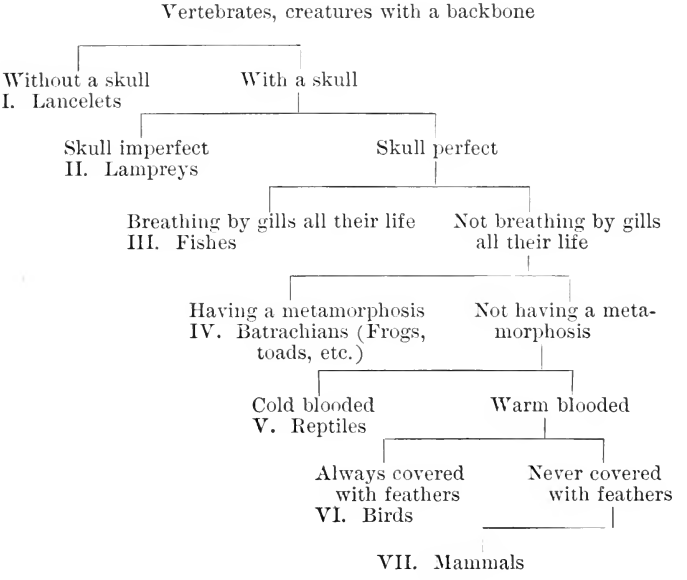
Now this is what the scientist would do with his ten thousand specimens. He would classify them. For convenience and exactness he would first divide them into but two classes, each of which he would divide again and again into two more classes, until at last he had separated each kind out by itself. It is never safe to divide into more than two classes at a step for fear of making some mistake.

In his classification the scientist would try to find out the plans on which these creatures were made. With the peas and beans you very rightly judged that there was something within the seed more important than the shape or color of it, and you soon saw that the kidney shape of the bean and the globular shape of the pea stood for that difference within them — was the *index*, as we say, of the plan on which each was made, while the size and color only served to tell bean from bean, and pea from pea.

In the same way the scientist studies his animals to find out the plan on which each is made and the index of that plan. He finds two great divisions which are well marked by a number of differences, among others by having, or not having, bones. It seems to him that bones are the index to two distinct kinds of life, so he culls out all the shellfish, worms, spiders, insects, and other boneless creatures into a group by themselves. Those with bones he puts into

another group. The last he calls vertebrate, or backboned animals.

But the vertebrates are not all planned alike. Let us sort these into classes as we did the peas and beans: —



Thus we get seven classes of vertebrates. In some such manner as this the scientist would sort out his living creatures, and then he would test his work to see whether he had made any error. He would ask questions about each group, and then would make out a little table of answers. Are mammals warm or cold blooded? Do birds have lungs? How do fishes breathe? How are reptiles clothed? How are mammals protected? His table will look like this: —

Vertebrate Animals.

	Fishes	Batrachians	Reptiles	Birds	Mammals
Are they warm or cold blooded?					
Have they a metamorphosis (or change of shape)?					
How do they breathe?					
Do they lay eggs?					
How are they covered?					
What sort of limbs have they?					

By writing an answer to each question and reading the columns downward, he will make a definition of each class of creatures. Try this yourself and see how well you succeed. At least you will find yourself giving definitions very different from those you would have given a few minutes before. I suspect that had you been asked what a fish is, you would have said, "A fish is a swimming creature," and you would have defined a bird as "a creature that flies." Then what a tangle we should have been in! There are birds that swim nearly all the time, and mammals that cannot live out of water, reptiles that swim as well as fishes, and fishes that come out on dry land. And there are lizards that fly, and reptiles that fly, and mammals that fly, not perhaps as well as most birds, but much better than some birds, which do not fly at all.

You see now the difference between a scientific definition and an unscientific one. The scientific definition refers to one thing or class of things and to nothing else. It is accurate. You have seen how scientific definitions are made; indeed,

you have been told how to make them yourself. You will not be troubled in this book with either making or learning definitions that are not necessary, but you have seen that the scientist does his work of classifying just as you would do yours, that is, in the most accurate way, which in the end is the easiest way.

THE DEGREES IN CLASSIFICATION.

We have discovered that the *basis of classification is difference in structure.* We have arrived at a definition of a bird which enables us to separate all winged, feathered, egg-laying, warm-blooded vertebrates into a class by themselves. We call them a *class* because the line is so well marked between them and all other living creatures. They form a group by themselves as distinct as a class in a school — a collection of individuals that do the same work in the same way.

But each of these classes may be sorted out still farther. Let us take the class Birds. What do we notice first? The differences between them. We see that some are simple in structure and some are complex, that they are of all degrees of simplicity and complexity. So we divide them by their rank into *orders,* just as classes in school are often divided into sections according to their scholarship. *An order is a division by grade.* Really an order means a row or line composed of different objects of the same kind, especially a file of soldiers. But we so often compare the lower orders and the higher orders that it is perfectly correct to think of them as divisions into grades. This grade is decided by men who have studied every bone and muscle in the bird and who know what each one means. They take no notice of the size and color of the bird, but study its structure and decide whether it is built on a simple or on a complex plan.

The orders are divided into *families.* While it takes a very wise man to decide what birds make up an order, it is not

usually very difficult to decide which belong to the same family. *A family is a division by relationship.* The members need not be of the same size or color, but they usually have the same look or similar habits. Who would not say that all the horned owls belonged to one family? They may be very unlike in size, but they have the family nose and eyes.

The next division below a family is a *genus*. *A genus comprises those kinds so closely related that we judge they may have had a common ancestor.* Birds of the same genus are usually nearly alike in size and often have some peculiar color pattern which makes them look alike, but the surest marks are resemblances in feet, bill, wings, and tail.

A *species* is the next and final division. We cannot go any farther in our classification. *A species includes all the birds so near alike that they cannot be told apart by any permanent peculiarity.* Each species has its own marks, colors, and shapes, and mates with its own kind, never (except by a rare accident) with any other species.

When we have separated our specimens into species, we have found the *unit of classification.*

HOW BIRDS ARE NAMED.

If we were asked to find names for all the many hundreds of different species of birds that live in this country, we should understand better than we can now how hard it is to invent appropriate names. Some we would naturally name from their actions, as woodpeckers, creepers, divers, and humming-birds. To some we would give good old names that have no meaning to us now, but that have come over the ocean with our ancestors, as ducks, thrushes, snipe, grebes, and gulls. Some good names are suggested by the calls and songs of birds, as whippoorwill, bobolink, towhee, phœbe, pewee, and cuckoo. Others are gay-colored, and we readily select their color as their most striking peculiarity and call them bluebirds, redbirds, yellowbirds, or blackbirds. But still there are more birds than names for us to give them.

We see that it is not a simple task to name all the birds of a country, much less all those of the world. But the scientist, who must first of all be exact in all he does, must have a different name for each bird. So he selects the best of the popular names, and by adding descriptive words, as red-headed woodpecker, black-backed gull, ring-necked duck, he makes a compound name that will describe the bird; or he names it from the place it lives in, as Californian cuckoo, Carolina chickadee, Arizona sparrow.

There is still a great difficulty. Many times the same name is applied to very different birds in various parts of the country. What is a partridge? The New Englander says it is the ruffed grouse; the Virginian says that the ruffed grouse

is a pheasant and the little quail is a partridge; the man from the Pacific coast when speaking of pheasants means the beautiful ring-necked pheasant imported from China. When they talk together, they are sure to disagree, because they have in mind entirely different birds. With other birds it is even worse. A gannet is usually supposed to be a short-legged sea-bird that dives from the wing, but in Florida a long-legged wading bird, elsewhere known as the wood-ibis, is called a gannet. In Louisiana a white egret, a kind of heron, is called a grosbeak, but in other places a grosbeak is a small perching bird. The water-turkey of Florida is the snake-bird, or anhinga, a great web-footed creature, a cousin of the cormorant; but with Nevada miners the little water-ousel, a relation of the cat-bird, is a "water-turkey." In Colorado the same bird is known as a "water-wren," a much better name than either of the others. There is no limit to the number of interchanges of name like these. And the situation is not improved by some birds having ten, twenty, or even thirty names in different parts of the country.

What is the scientist to do? He gives the bird a Latin name that is to apply to that one bird and to nothing else; and he either translates the Latin name into English, or selects the best-known English name as the standard English name. So every bird has at least two names that in the usage of science apply to itself and to no other bird.

Who names the birds? It used to be that the man who discovered them gave them both an English and a Latin name; but now the discoverer less often names them himself. Instead, he sends the bird to some man whose whole time is spent in studying birds, to determine whether it is really new or not; and if this man decides that the bird is something never seen before, he gives it a name.

CONCERNING THE BIRD'S LATIN NAME.

Do not think that Latin names are useless or meaningless. Do not think that anything in science is done without a reason. We shall neither use Latin names nor talk about them after this chapter, because you ought not to get the impression that learning hard names is studying science; but in this short chapter I wish to tell you why these long names are useful.

In the first place, the hard names in science enable you to say exactly what you mean to say. Of course, it is of no advantage for you to know the words themselves if you use them inaccurately; but if you know precisely what they mean, these scientific terms will make it possible for you to speak with so much exactness that you cannot be mistaken. The Latin names of birds, like all other scientific terms, have this precision, and are ordinarily preferred to the English names, which may be indefinite.

A bird's Latin name is made up in a particular way and has a particular significance. The same is true of the Latin name of every fish, insect, reptile, or living creature, and also of all the botanical names, so that what we are about to say of the names of birds holds true of the Latin names of all other creatures or plants.

If you understand Latin and Greek, the name will tell you something about the bird. Is not *Oceanites*, "the sons of the ocean," a pretty name for a group of petrels? Another genus of the same birds has a name meaning "wave dancers," which beautifully describes their habits. Take *Pinicola enu-*

cleator, the name of the pine grosbeak. It means "the bird that dwells in the pine woods and shells out nuts," a name which tells us something of the habits of the bird. Some names tell us of the color, or the shape, or the home of the bird; but all have some appropriate meaning.[1]

The Latin name of every plant and animal is made up of either two or three words, usually of two. The first always is the name of the genus, and the second is the descriptive word added to point out the species. So that birds' names are like boys' names — a Christian name, like James, and a surname, like Brown, together making up the whole name of the bird. Only in the case of a bird the surname is placed first, and the Christian name after it, as Brown, James, and Brown, John, are sometimes written in directories and lists of voters. This places all the Browns together, and is more convenient for ready reference. For the same reason the bird's generic name is always written first; it makes it easier to refer to all the birds that are nearly related, and it is also better Latin.

Let us take the name *Dryobates pubescens*, the name of the downy woodpecker. The first name, which means "one that walks on trees," tells us that it belongs to the genus Dryobates, so that we know at once what other birds it most resembles; the second name tells us that it is a soft and downy bird. But what are we to think when we meet with *Dryobates pubescens medianus*, the name of the little downy woodpecker of New England, our smallest and one of our commonest woodpeckers? Why do some birds have two and some have three names? The third name shows that the bird is a subspecies of *Dryobates pubescens*. But this opens a very puzzling question, which we must discuss in another chapter.

[1] Barring, of course, the few "nonsense names" of some of the earlier naturalists.

A SUBSPECIES.

You will recollect that we said classification does not go below species; that the species is the *unit of classification*. This is very true. But may we not divide a unit? *A subspecies is a fraction of a species.*[1]

We can see by a little illustration what is meant. A red-cheeked apple may sometimes be divided so that one half will appear to be entirely red and the other entirely green; yet when the halves are put together, it is impossible to tell where the green fades and the red begins. Taken separately, we might suppose they were halves of two different apples, but when put together they fit perfectly. It takes both the red and the green parts to make a whole apple.

As we travel from east to west or from north to south, we shall often find the birds that we know well singing different songs, showing a different shade of color, or we shall see that they are larger or smaller than the same bird was in our own home. If we were to compare one from the extreme East with one from the far South, we should not believe them to be the same bird, and yet as we travelled we could nowhere say, "These birds to-day are different from those I saw yesterday." There were all possible gradations of color and habit, like that play of color between the red cheek of the apple and its greener side. The change came little by little, as the rosy flush grew on the sunny side of the apple. So we cannot say

[1] These are not given as *definitions* of species and subspecies, but as convenient *descriptions*. As definitions they would "beg the question."

that all these birds are not the same species, because there is no fixed difference between them.

But it becomes convenient to have some way of showing that there are differences. So we cut the species up into pieces, as it were, just as we did the apple. We take the whole range of the species and divide the country up into as many portions as there are peculiar varieties of the species, and give to all the birds of the species that live in each section a name that tells the scientist just what part of the country the bird comes from. Most birds do not have any subspecies; that is, they are alike wherever we find them. Of the rest, most do not have more than one subspecies besides the original form, one of them being found in the East and the other in the West. But some, and they are usually among our best-known birds, have three or four or a half-dozen subspecies. The ruffed grouse has four, the downy woodpecker five, the hairy woodpecker six, the horned owl five, the screech owl nine, the horned lark eleven, and our common song sparrow twelve recognized forms. Sometimes a subspecies will be found only on a small island far off from land, sometimes on a desert, or sometimes confined within other narrow limits, but most of them are spread over a large extent of country. Because these subspecies are found in different parts of the country, they are frequently called "geographical races."

It is often supposed that the birds with two Latin names are the only ones of any importance, and that those with three names are a mere after-thought of science or nature. This is an error. When a species is split up into different forms, all the forms composing it are subspecies, and one is no more important than another unless it is more abundant. When you cut an apple, all the parts are fractions; when you

divide a species, all the divisions are subspecies. But out of respect for the man who first discovered the bird, it is customary to reserve for the subspecies which he described the name that he gave it, so that the form first described always holds first place on the list and has but two words in its Latin name, while the other races follow usually in the order of discovery, with three-word names. It usually happens, as the East was settled first, that the Eastern birds were described first and stand at the head of the list of divisions of species. Sometimes the reverse is the case. The bronzed grackle, the crow blackbird of New England, is a subspecies of the more Western crow blackbird, the purple grackle. Everybody knew the bird, but until recently no one had noticed that the gloss of its feathers was unlike that of the more abundant and earlier described purple grackle. When this was observed, the northeastern bird was marked off as a new subspecies, because the birds first described, the "type specimens," were of the other sort.

Perhaps we see now why the Latin name is a help to the naturalist, and how it is that the same bird will look and act differently in various parts of the country.

Indeed, it is much easier to see why there should be subspecies than to decide to which subspecies a bird belongs. But that is the work of the scientist; all that is important for us to know is why he separates a species into smaller groups, and what a three-word Latin name indicates.

THE THREE GREAT PROBLEMS OF BIRD LIFE.

I WOULD like to have you think of a bird that is not some particular kind of a bird, not a sparrow, nor a dove, nor a robin, but *just a bird.* Do not imagine it as either large or small, as having any peculiar shape, or any particular color, as a bird that lives in some special place or feeds upon a certain kind of food; but such a bird as you might hear calling in the dark and know it was a bird, yet know nothing more. I want you *to think just plain bird.*

This is easiest done by imagining that you are a bird yourself.

What is the first thing you would really long for? What is your greatest need?

If you were a boy you would say, "Something to eat." Because you are a bird would your wants be so very different? Men and birds are alike in that both have to spend most of their lives hunting for something to satisfy their appetites. *Food* is the first problem.

What will be your next want? Warmth, do you say? It is very necessary to keep warm, but with a good coat of feathers and two wings, you would fly to a warmer region just as naturally as a boy goes into the house when the air nips too keenly. You will not be anxious on that score, unless some accident befalls you.

A more important question with the bird is how to keep away from his enemies. These hunt him constantly while he is seeking his necessary food. To get his food without

being caught himself is the bird's most important study. Shall we not put down *Safety* as the second problem?

The third problem is not so easily hit upon as these last; but we know that though the life of each particular bird is short, it is necessary that the same kinds of birds should exist as long as possible. Unless a bird has little ones, that kind of bird will die out; it will become an extinct species. Now it is not intended that any bird or plant or living creature should become extinct until it has been fairly crowded out of existence by some better or stronger kind of plant or animal. To prevent this happening by the creature's own fault there was implanted in it an instinct almost as strong as its desire for food, and stronger than its love of safety, which urges it to choose a mate and to spend its time and risk its life in rearing a family of little ones. This is the family instinct, and this whole problem of the bird's life is called by the name of *Reproduction*.

Food, Safety, Reproduction, — these are the three great interests of a bird's life. We may of course carry the analysis one step farther and say that food and safety are the means of preserving the bird's own life, and are selfish instincts, while reproduction is an unselfish instinct, which gives us two problems, self-preservation and self-perpetuation. But for our study it is best to stop with the three, food and safety and reproduction. Of these three the bird must be constantly thinking, and to secure them he must be continually working.

Now it is a law, both of your life and of every creature's, that what he thinks of constantly and works for continually has an effect both upon his body and upon his mind. Often we can tell a man's trade and opinions by his look, his walk, or his figure. For the same reason what a bird eats, how he secures it, how he provides for his safety, and how he brings

up his little ones will have a large effect upon his shape, his color, and his habits. If you knew nothing of a bird but what he fed on, how he got it, and how he nested, you could tell a great deal about his appearance. It was that you might better understand what is to follow concerning the changes of a bird's structure, color, and habits that are brought about by the way he solves these problems of bird life, that I asked you to suppose that you were plain birds.

THE FIRST PROBLEM OF BIRD LIFE.

FOOD AND ITS RELATION TO STRUCTURE.

HERE we are, we plain birds, and we are hungry. What shall we eat?

If we were boys, we should say, "Whatever we can get easiest, if we like it." Our choice would depend on whether we preferred to gratify our appetites or our laziness; also, though all boys appear to have the same powers, on the presence or absence of some peculiar accomplishment or intrepidity. The skilful fisherman would catch fish, the daring climber might climb trees for nuts, and perhaps those without such special gifts would pick berries. Though all might prefer the same food, some would be so much more active that they would secure the whole of it before the others could get any. Rather than go hungry the others would take second choice or third choice or whatever was left, according to their strength and skill. The art of getting your own dinner is to make up your bill of fare of what you can get easily and in abundance — provided it suits your taste.

Now if we plain birds must hunt our dinners, we ought, as the boys say, "to have an eye out for the main chance." We have our preferences, no doubt. We also have our fitness or unfitness for getting what we prefer. Our "main chance" lies, first of all, in our swiftness of locomotion, of one sort or another. The one that flies better than he walks, covers most ground by flying. He will, therefore, be most likely to secure a dinner quickly by flying around in search of it. The one that swims well, but flies poorly, travels farthest with least

exertion by swimming, and will find it to his advantage to seek his prey in or near the water. The bird with strong legs and short wings will cover ground more easily by running than by flying, so he will naturally look for his food on the ground. Each one would employ his natural advantage or accomplishment as the easiest way of getting his food.

Now hunting for something to eat takes up nearly all the time of these plain birds, so that the one that is fond of swimming spends most of his time in the water; the one that likes to run trots about so steadily that he flies very little unless frightened or in danger; while the one that is light and swift of wing spends his day in the air. You can guess the result. Each one grows more and more adept in his own favorite mode of hunting and less and less adapted to following any other method. As the swimmer neither flies nor walks much, he may at last become incapable of doing either with any ease: the penguins that cannot fly and the grebes that cannot walk are such birds. The runner may, like the ostrich, become as swift of foot as a horse, yet lose his power of flight. The strong-winged flying bird may, like the swallow, be tireless on the wing and yet scarcely able to walk. Not only do they grow unlike in the parts they exercise constantly, but also in the parts they neglect to use. The limbs and muscles in constant use grow large and strong; those that are disused become feeble and pine away, or else stay undeveloped.

But some one asks if I mean to say that a penguin, an ostrich, and a swallow were ever one bird. No, I do not mean to say that. But I wished you to notice that if there ever was a time — as many believe — when all the birds were just plain birds (undifferentiated, a scientist would say), they could not have remained so. They were bound to change, and they were bound to grow unlike.

For see how it is with men. The blacksmith is not like the soldier, nor the bicycler like the tailor. They use different sets of muscles, and the men are unlike in size, shape, and accomplishments. The blacksmith can bend an iron bar, but he could not catch a runner in a race; and neither he nor the runner could make his fingers fly like the slender white fingers of the musician. If blacksmiths' sons were always blacksmiths and musicians' children musical, we might expect much more remarkable differences.

In like manner, a bird's work changes its shape and structure; eating one kind of food, using one form of exercise, the bird, like the man, grows better and better fitted to follow his own trade and more unfitted to take up any other. We say he becomes *adapted* to his kind of life, and that his structure is *modified* (that is, changed) by his search for food.

This is the first problem of bird life — to find food. This is the principle, — *The search for food results in modifications of structure.* Take this principle and see how it will explain the shape of many kinds of birds that you see. Why is the swallow so swift and light of wing? He hunts little dancing, flitting flies. Why is the humming-bird so slender-billed and quick-winged? He seeks his insects out of the long tubes of flowers as he poises buzzing before the blossoms. Why is the yellow warbler so trim and dainty? He, too, eats insects, but such as he finds in his pathway as he trips along the branches, and so he needs neither strong wings nor long probing bill. All three feed on insects, but they find them in different places and hunt for them in different ways. The way they find their food — not the kind of food itself — decides what the structure of the bird will be.

You may be able to discover for yourselves why the heron, the loon, and the sea gull, which all live on fish, are yet so

very different from each other. Find out the places each prefers to live in and how he hunts his food, then see if these facts will not explain why the heron's neck and beak and legs are so long, why the gull's wings are so strong, and why the loon, though it cannot walk much nor fly easily, is a better fisherman than either of the others.

THE SECOND PROBLEM OF BIRD LIFE.

SAFETY AND ITS RELATION TO COLOR.

From plain birds structurally alike we have become transformed into birds of very different shapes, — long-billed and short-billed, long-legged and short-legged, large and small. Let us learn how the second problem of bird life, that of providing for our own safety, affects us.

We have enemies. Other creatures, which like ourselves have their first problem to solve, are trying to kill us for food. Some fishes will swallow us greedily when we are swimming; other birds have learned to prey on their own kind and hover in air ready to swoop down upon us; snakes creep up to our nests and devour us; even large spiders will occasionally terrify and capture the tiniest of us; but most numerous and most destructive are the quadrupeds of prey that hunt us incessantly and with great success. How are we to get our necessary food while exposed to these persecutions?

Our greatest security would come not from weapons but from some means of escaping observation. In the days when men fought the Indians, how did they avoid being seen? Partly by silent, secret habits, and partly by their suits of homespun and dull colors which blended with their surroundings. The British soldier with his scarlet coat was a mark that could be seen far off, and the straps crossing on his breast gave the Revolutionary marksman a sure guide to his heart. Many a British soldier fell because his uniform prevented any concealment. The modern khaki, which has been adopted

instead, offers protection to the soldiers because it is not easily distinguished from its surroundings.

But how are we birds that cannot change our coats to take advantage of such means of concealment? Let us take a broad view of the subject. If we were to fly far above the earth, it would appear to us, I fancy, very much like those colored plates of hemispheres and continents in our geographies. So, indeed, it appears looking down from a mountain top. All the country round is spread out before us like a painted card. The sandy stretches shine white in the sunlight; the less barren, but still infertile, spots show buff or brown; ploughed lands appear in squares of all colors, from yellow to black, according to the soil; and meadows, grain fields, gardens, and forests are each green after its own kind. If our view could be extended to include a whole hemisphere, we should still find it marked off in fields not less vivid in color than these laid out by men, but less regular in outline. We should see the deserts sparkle with sand, the plains lying bare and buff with clay beds, the river courses and watered countries spread out in green champaigns, the mountain chains standing like rows of crystals and striped like tourmalines from their green bases to their white and icy summits. And the whole glowing picture would shade away from the luxuriant and almost sombre vegetation of the green tropics to the wind-cropped mosses of the brown and barren north.

What colors would best befit a bird of the tropics? or a bird of the deserts? or a bird of the arctic north? Greens for one, dusty browns or tawny for the next, and brown or white for the last. As a matter of fact we find this actually true. The birds of the tropics wear the gayest of coats, and have among them a large proportion of birds wholly or partly

green. Birds of temperate regions are rarely gay in color, most of them being of soft browns or grays or blues or dull olive shades. Many of the most northern land-birds and mammals undergo a remarkable seasonal change, so that they are brown in summer to match the heaths about them and white in winter like the driven snow. Indeed, among the few birds that you know yourself, do you not find sparrows most commonly on the open fields and dusty roadsides, while the greenish vireos and flycatchers, and the bright orioles and tanagers, stay among the tree-tops and the blossoms? It is a hint of what Nature is doing on a large scale the world over. Unless there is some good reason for another color, we shall find the bird harmonizing with the prevailing surface color of the region he inhabits, or with the light and shade of his favorite haunts.

But the very first birds that ever were, plain birds, such as we imagined ourselves to be, must have been either of one tint, or of we do not know what shades and mixtures. How can we explain the change from this unknown primitive color to the kaleidoscopic colors of birds to-day? Could we plain birds change our colors as we changed our shapes?

Yes, we could change our colors, not as a man does his coat (except in the seasonal moult, which is another problem), but just as we changed our shape. Let us go back to our analogy of boys and birds. If we were boys, could we not change our color? Does your mother never say after a summer at the seashore: "How your hair has faded! How tanned and sunburned you are!" And, after a long illness, your visitors notice how pale you have grown. These are instances of boys changing their color. Wind, sun, and rain — in other words, climate — will alter a man's complexion very much. In time it will change a whole nation's so that a certain complexion

becomes national, as the olive skin and dark hair of the Italian, and the fair hair and white skin of the Scandinavian.

If climate can alter a man's color, why should it not affect the birds'? It does. The suns of the desert bleach them; the humidity of wet and dripping forests removes the brighter hues and leaves dull blues and grays and browns predominant; and tropical warmth and brightness seem to tone up the colors by some secret chemistry of the sun. It is not so much that birds choose regions that correspond to them in tone, as that they are changed to harmonize with the surroundings they prefer to live in. The object of safety is not so vividly before the bird that he would leave his favorite food because his coat did not match the scenery; but natural causes work upon him against his will to secure for him what he would not seek for himself.

The result here is safety. The principle is, — *Animals involuntarily tend to acquire a color that accords with their usual habitat;* or, in simpler words, they become like the color of the places they live in.

We have touched the secret spring of a great truth in this principle, and now that the door is open before us we have no time to go farther. We cannot fully appreciate how well this principle explains many difficulties until we know more; until we have seen how the gayest bird even may be protected by his brilliancy and the plainest favored by his shadings; how certain patterns of coloration resemble inanimate things, and how, unless a bird is favored by its color or by its sense, it is likely to have a short life. But we have learned that even if in the beginning all birds had been of one color, they could not always have remained alike, and that there is safety in a color that blends with the surroundings.

THE THIRD PROBLEM OF BIRD LIFE.

REPRODUCTION AND ITS EFFECT UPON HABITS.

The search for food and for safety has resulted in making our plain birds over inside and outside. They are transformed in structure and in color. What is there left to be done by this third problem?

The care of a bird's young is in a great measure a repetition of its care for itself. They must be fed and protected. Of course it makes no difference whether the food sought is to be eaten by the bird itself or to be given to its young ones; whether the color-change merely protects the old bird's life or her own and her nestlings'. To a very great degree the cares and labors of reproduction must produce the same effects as the other two great demands of the bird's life. But does it do nothing else? Is an instinct as resistless as that of hunger, requiring the bird's closest attention several months in the year, to have no effect of its own? No other of the bird's labors is so absorbing, so exacting, so unceasing, as the care of its young. It demands the bird's greatest energy, it taxes to the utmost her courage, discretion, and forethought; all her mind is occupied with building the nest, and afterward with feeding and defending the helpless young. Shall this leave no mark that can be seen?

Here we find the principal effect of reproduction — what we call its *specific effect,* because it seems to belong to this problem more than to any of the others. The specific effect of the first problem was a change of structure; the specific effect

of the second problem was a change of color; *the specific effect of reproduction is an improvement in the bird's intelligence.* It is not that the other problems do not also have a similar effect. Many a shrewd trick has the bird for hiding himself, and many an inventive turn helps him in getting his food; but food and safety can usually be secured without any great tax upon his brain. It is working for a half-dozen helpless, ignorant, fearless, stupid little nestlings that makes the bird shrewd and ready.

We seldom see birds do anything remarkable except at their nesting season, or on their breeding grounds. We cannot be said to know a bird's character unless we have met him in his summer home, with his family. There he usually has a peculiar song, and often a different dress and habits than are seen elsewhere; sometimes he appears to be an entirely different bird. Who would suspect that our Northern dandy, the bobolink, with his harmless rollicking ways, gay suit, and glorious song, was the same bird as the dull-colored, songless, mischievous rice-bird of the South? You will notice, too, that the stupid birds are as a rule the least affectionate. There is a very close relation between love and intelligence. Nothing makes a man or a bird so quick to learn and to invent as having to do for some one he loves. We must admit that affection is one of the greatest possible spurs to improvement. It seems to have done more than anything else to develop the mind and character of the bird.

We cannot study changes of this sort as we can color and structure. Those can be touched, seen, judged by the senses; but mental changes can be judged only by their effect upon the actions of the bird. We see them in the habits of the bird. *Habits are ways of doing things.* There are habits of

perching, habits of swimming, habits of hunting, and habits of eating, but the most remarkable habits of the bird are those in some way connected with reproduction.

What would have been the effects of reproduction on us plain birds is a question no man can answer. We cannot reason from the resemblances between birds and men in answering that, for we do not know that the minds of both are as near alike as their bodies are. But if we study birds, we shall find among them two very remarkable habits which no other creatures have so universally or in such perfection. And they are habits which students tell us are due to this instinct of reproduction. Nearly all birds make nests, and nearly all that live in temperate and polar regions migrate, or move to warmer winter homes, returning in the spring to their breeding grounds. *Migration and nest-building are important habits, arising from the instinct of reproduction.*

Structure and color are the two points about a bird that we notice first, but his habits are just as interesting, and have a meaning. They tell us about the bird's intellect and character, and by studying them, we may know how well educated the bird is. Are you disappointed that the other problems produced such great results, while this seems to give us so little change? When we study migration and the other changes of habits, we shall find them not less remarkable than the thousand shapes and myriad colorings of the bird.

PROTECTION BY COLOR.

The problem of safety, as we learned some time ago, put a premium upon a bird whose color helped him to pass unobserved. It was a very pretty theory, but we are to see how it works in practice. When we think of the red and blue and yellow birds we know, it seems hard to realize that they are included in any such design; when we think of the odd-colored ornaments that birds wear, bands, crescents, stripes, and patches, often of the most brilliant hues, we fail to understand why such markings are not a sure clew to discovery; when we recollect how unlike the different sexes of the same bird often are, and how frequently young birds are very dissimilar to their parents both in colors and markings, we must think that it is a poor law that does not apply to all the birds of one species, but explains the plumage of one age or sex, and leaves the others still unaccounted for.

We cannot go into all the details of this subject, — even men of science are agreed to dispute about them, — but we can at least notice among the birds of our acquaintance instances where their color helps to conceal them from our eyes. If all our sparrows, for example, had blue or red backs, how much more readily we should discover them; for sparrows have a way of staying near the ground, either directly upon it, or in low bushes, or about fences, where a bright-colored back and breast would serve to distinguish them instantly. Now most of our common sparrows, we find, are dull-colored little birds varied with stripes about the back, breast, and head that seem

to blend with the colors of the earth and with the grass stems they live among.

But the sparrows have cousins, like the grosbeaks, cardinals, and buntings, that are among our gayest birds, brilliant in red, blue, yellow, and striking combinations. Are these ground-birds? Not at all, they swing and sing among the tree-tops where there are green leaves about them and blue sky for a background, and the keen edge of their own color is, as it were, taken off. I have often thought, seeing an indigo bird swinging on the top of a balsam fir, that he was just the proper weather-vane for such a tree, his rich blue coat with peacocky hints of green seeming to stand exactly between the clear blue of the sky and blue green of the fir tree. And in the case of so brilliant a bird as the male scarlet tanager, the brightest color possible, unrelieved by any shading, there seems to be an advantage taken of the law of complemental colors which makes you see scarlet after gazing too steadily at green, or green by looking too intently upon scarlet. He cannot be hidden, and yet you do not see him among the leaves much more quickly than you would a duller-colored bird.

Another thing that has struck me is that the brightest-colored birds are found most often near civilization. You do not find the orioles and grosbeaks and tanagers so abundant away from farms and gardens. Why this is so I cannot tell you now; all we wish to infer from it is that their colors evidently do not expose them to so much danger that they avoid men; in some way they either blend with their surroundings or are able to take care of themselves in spite of their brilliant plumage. They are the birds that most of all plunge into the midst of blossoms and frolic in the snowy drifts of apple and cherry blooms.

Another family of our gayest birds, the warblers, are quite

commonly tricked out with yellow and green. In watching them, I have sometimes noticed how much yellow there is in the green of foliage, how they accord with leaves just opening or with leaves just fading. This is scarcely color protection, but it is color harmony, which is much the same thing.

The dull-mottled coloring of the owls, we may suppose, has less to do with their hunting by night than with their lying still by day, when in shape and color they often much resemble dead and broken branches such as abound in a forest. An owl alighting on the top of a dead stub will seem to be a part of it, he sits so stiff and shapeless, and looks so square-headed. Nearly all the sandpipers, snipe, and other shore-birds are streaked or dotted upon the back with brown and buffy like the light grass stems and the dark background behind them, a coloring which often protects the sandpiper, especially the mother bird upon the nest, from observation. But the plovers, which are nearly related to the sandpipers, have plain-colored backs, so that they come under a different protective device. They are less spotted than the sandpipers, and often have dark bands, bars, or marks about the breast and head that may help to efface the outline.

When you have opportunity, notice how much the backs of nighthawks and whippoorwills look like some of the dark-spotted, night-flying moths that lie still by day under brown leaves and upon tree trunks. In the same way, these birds that hunt during the hours of dark and twilight, and crouch upon the ground or upon the branch of a tree during the day, closely resemble the surface they alight on. The back of the woodcock is quite similarly mottled. The back and sides of grouse and quail are also protectively colored.

The outline of a bird is often more readily recognized than a spot of color would be; we see the familiar line, and infer

that it belongs to a bird, therefore many of the bird's ornaments are a protection against discovery. "This makes, for instance, the mallard's dark green head tend to detach itself from his body and to join the dark green of the shady ledge, or the ruby of the humming-bird to desert him and to appear to belong to the glistening flower he is searching." In this way, bright or strongly contrasting crown patches, throat patches, necklaces, and collars may be seen to have a use other than mere ornament, and crests often help to conceal birds by disguising familiar outlines. The cedar bird and the ruffed grouse are experts in evading notice by throwing themselves into strange attitudes and erecting their crests. Curves are what betray the bird; broken outlines or stiff lines conceal him. Therefore the ruffed grouse, when in a tree, lays all his feathers flat, stands stiffly at his greatest height, with his neck stretched as far as he can reach or crooked sharply at an angle. I have stood within two rods of a ruffed grouse, in fair sight, and that not many years since, and have decided that he was a very strange branch on a willow bush, before it flashed upon me what I was looking at.

The most beautiful arrangement for protective color is also the commonest, and though nearly every bird and animal profits by it, no man ever discovered it until a few years ago. It is called the "*law of gradation.*" Nearly every bird, you know, is lighter on the breast than on the back, and it is almost a rule that birds not uniformly colored, like the crow and the blackbirds, shall be white or gray or buffy along the belly and beneath the tail, even if they have dark breasts and throats. Why this is so, is as simple as it is interesting.

Every bird, standing in his usual positions, cuts off a portion of the light that falls from above and so casts a shadow on his own breast and under surface. We do not see the shadow,

we do not know of its existence, but it is there. If the bird's breast were the same color as his back, the shadow, making it appear darker than it is (that is, darker than the back), would bring out the line of the breast sharply against the background. The shadow on a light breast cancels the effect of light upon a dark back and causes the outline to blend with the background.

Nothing could be simpler than the experiment by which Mr. Abbott H. Thayer, the artist who painted the "Madonna Enthroned" and other well-known pictures, proved his discovery of this "law of gradation" to a large number of scientists. Any child can perform the experiment with very little trouble. We quote from the original report of the experiment: "Mr. Thayer placed three sweet potatoes, or objects of corresponding shape and size, horizontally on a wire a few inches above the ground. They were covered with some sticky material, and dry earth from the road on which they stood was sprinkled over them so that they would be of the same color as the background. The two end ones were then painted white on the under side, and the white color was shaded up and gradually mixed with the brown of the sides. When viewed from a little distance these two end ones, which were white below, disappeared from sight, while the middle one stood out in strong relief and appeared much darker than it really was. Mr. Thayer explained that terrestrial birds and mammals which are protectingly colored have the under parts white or very light in color, and that the color of the under parts usually shades gradually into that of the upper parts. This is essential in order to counteract the effect of the shadow, which otherwise, as shown by the middle potato, makes the object abnormally conspicuous and causes it to appear much darker than it really is. Some of the witnesses could hardly believe that the striking difference in the

visibility of the three potatoes was entirely due to the coloring of the under side, and Mr. Thayer was asked to color the middle one like the two others in order that the effect might be observed. Mr. Thayer complied with the request, painting the under side of the middle potato white, and shading the white up into the sides as in the case of the others. The effect was almost magical. The middle potato at once disappeared from view. A similar experiment was tried on the lawn. Two potatoes were painted green to resemble the green of the grass above which they were suspended. One was painted white on the under side and at once became invisible when viewed from a little distance, while the other showed plainly and seemed very dark, the shadow, superadded to the green of the under side, making it remarkably conspicuous. The experiments were an overwhelming success."

Try this experiment yourself and then notice how almost invariable is this law of gradation by which Nature helps the birds and beasts to escape detection, however gayly they are colored.

ZOÖGEOGRAPHY.

When you look in your geographies and see the continents all marked out into countries and states, you forget that anything except men inhabits those lands. How would you like to see a bird geography of those regions? Or what would you say to an animal or a plant geography, showing where each kind of animal and plant was to be found? There are such maps, and if you were to see a book full of them, with all sorts of plants and insects and birds and mammals claiming the country you are living in, you would feel as if you had been crowded out yourself. Yet as a matter of fact we all live on the same territory very comfortably. Did you ever have a dish full of apples and then fill the spaces between the apples with hazel nuts, and shake rice kernels down the crevices between the nuts and the apples, and grains of sugar through the whole? There were as many apples in the dish as if there had been no nuts, rice, or sugar, were there not? These smaller articles merely filled in the waste room. So it is with the animals on the globe. Innumerable creatures may live on the same ground if they do not get in each other's way, and each one can and does have a geography all its own without interfering with the states and territories laid out by men. The geography of any kind of plant or animal is called its *distribution*, and it tells us where that species lives.

If we had the maps of the distribution of all kinds of plants and animals, each with its own home marked in a bright color, and all the rest of the map blank, we should be surprised to see that the maps could be sorted out into a few patterns so

near alike as to be very remarkable. For instance, one kind of bird would be found in northern Maine and New Hampshire, in the Adirondack Mountains, in the Catskills and down along the Alleghany chain even as far south as the Carolinas, but nowhere else in the United States except perhaps in northern Michigan and Minnesota. Then another bird, entirely unlike the first, would be found in the same places and in no others. Then a third and a fourth and many more, until it dawned upon you that you had discovered a bird state. Then you would find other birds visiting southern Florida, but never getting north of a line drawn from Tampa Bay to Cape Malabar; and others still that were found only in a little point of land at the very southern part of Texas; some that lived on the Great Plains only, and some that were found in the Great Basin, and others that followed mountain ranges, and though they travelled south the whole width of the United States, never strayed more than a few miles east or west. These limits would mark the bounds of other bird states, which we could increase until the whole continent was divided among them.

The curious point would be the fantastic shape of these bird states. Why should Arctic birds be found along a narrow strip leading far down into Mexico? Why should birds of the warm Mississippi Valley push up into the cold North as far as the Saskatchewan and Athabaska rivers? Why should the different kinds all agree to make the same skips and jumps?

The men who study the geography of animals and draw maps of their states undertake to explain these puzzles. They say that there is a reason for the shape of these bird and animal states, and they call the whole study *zoögeography*, or the geography of animals; or, when speaking of a single species or of a few species, they talk of their *distribution*.

DISTRIBUTION.

THERE are two questions to be answered in studying the distribution of plants and animals: What in the past caused them to be so scattered, and what in the present holds them where they are?

The first could not be determined without the help of the geologist, but the second flows naturally out of what we have been studying.

Birds are like people. Some need and enjoy much greater heat than most others, and some few cannot live in regions even moderately warm, but all of them desire and seek a place just warm enough for their own constitutions. Furthermore, no bird, however hardy he may be, can exist where his food will be destroyed by cold or will be buried under snow and ice for many months in the year. So choice and necessity, acting together, drive the birds back and forth as the cold and the food supply increase and diminish. For many months in the year the bird is homeless, but as it comes summer he always seeks some spot that promises just the right degree of warmth and food enough for himself and family. The *breeding grounds* are always reckoned as the *home* of the bird, and maps showing distribution are supposed to show us where the birds are found in the height of summer.

Why is it then that birds whose natural home is in the North leave behind them such lagging rear columns in lands of sunshine and almost tropical heat? Why are the three-toed woodpeckers, which are found elsewhere only in the most northern of the Northern states, found also in a narrow,

southward streamer that straggles south almost to Mexico? Why is the red-breasted nuthatch never seen in summer south of the northern tier of states except along a narrow line in the East and another in the West reaching hundred of miles south of his natural home? In answering these questions we shall show that distribution is principally a matter of temperature, or of temperature and moisture, which is climate.

Did you ever notice in your geographies (but not all geographies have them) little, fine, brown lines that wave about over the map like a filmy cobweb, now looping downward, now hooping up, but in general travelling east and west? They are called *isothermal lines*, — that is, lines of equal heat, — because all the places through which they pass have the same average temperature. There are also isotherms for every month in the year passing through all the places that have the same heat in summer and the same degree of cold in winter, but these are not put down on our maps.

In a general way, we were aware that it is warm in the South, and that it grows colder as we go north, but perhaps it is new to us that the change is not uniform; in other words, that the isotherms do not run straight across the map parallel with the degrees of latitude. It is much more interesting as it is. The isothermal lines now tell us considerable about the country they cross, so that if all the lakes, rivers, and mountains were removed from the map and only these lines of average temperature left, we still might know something of the surface of the country, while a map of the summer isotherms would tell us a great deal.

When an isotherm takes a northward bend, we know that the heat is greater inside the loop than it is outside it. Usually we find within the loop either a flat plain that reflects the heat, or a lower level of land along some river

valley. Isotherms travel around the upper edge of such places. But they travel around the lower edge of a mountain chain. A decided bend to the southward, therefore, means that a chain of mountains bars the line of equal heat, which is deflected, or turned out of its course, by the obstruction. Near the seacoast the isotherm may turn either up or down. A warm ocean current with warm, moist winds will turn the isotherm upward, as on the Pacific coast; the outswinging of the Gulf Stream from the Gulf of Maine turns the isotherm downward and gives the cool summers of the New England coast. The temperature line may be thought of as like a tiny cobweb attached at both ends and driven up and down by warm winds or cold, or turned out of its course by obstructions that would cause a change of temperature. Thus it may be that a place far to the north and one far to the south may have the same climate, one isotherm passing through both.

But it is not only winds, currents, and distance north that make temperature. There must be some reason why a mountain chain will deflect the isotherm. Why is it? We know very well that the top of a mountain is cooler than the valleys about it, not only because it feels every breeze, but because it is higher. We can *see* that it is cooler than the country round about, for the snow lies upon its top long after it has disappeared from the valleys, and the higher the mountain the longer the snow lingers. Thus we infer that *temperature decreases with elevation.* Places of the same latitude and having the same level above the sea, if there were no disturbing influences, would have the same climate. There would be one climate at sea-level, another at two thousand feet above, another at five thousand, and so on, every few hundred feet showing more or less difference in climate. In a single lone and lofty mountain we should find

zones or belts around it all the way up to the top, each inhabited by slightly different trees, insects, birds, and mammals, until we reached the summit of perpetual ice, barren of life and vegetation.

We may regard the earth itself as such a mountain, its ice-capped pole the summit, surrounded by zone below zone of vegetation each more luxuriant than the one above it until we reach the equator, or base of our world mountain. There is a curious similarity between the belts on a mountain and the zones of the earth. Very often on the hills and mountains of New England I have picked the spicy mountain cranberry, the goosefoot potentilla with its starry flowers, or the scrubby little *Corema*, and have recognized the land I was on as like the coast of Labrador; it was as if I had travelled north five hundred miles instead of climbing up half a mile. Still more remarkable is the case of higher mountains farther to the south. On San Francisco Mountain in Arizona, which rises 12,800 feet above the sea, have been found Arctic plants identical with those of the extreme North.[1] Nine species found on this mountain have proved to be precisely similar to those brought by General Greely from Lady Franklin Bay, latitude eighty-two degrees north. By climbing a mountain two miles and a half in height, we would be able to see plants growing for which we must go more than three thousand miles if we journeyed due north. Thus the tops of high mountains give us an arctic climate.

Now we see why it is that northern birds are sometimes found far to the south. They follow down the mountain peaks and find at different elevations the zone which gives them the climate they would naturally seek in the north. Or if they have wintered south and would return in summer

[1] Davis, *Elementary Meteorology*, p. 343.

to a cooler climate, instead of travelling hundreds of miles north, they go up into the mountains a mile or two and find just the degree of coolness they desire. So the three-toed woodpecker and the arctic ptarmigan, the leucosticte and the snow buntings, drift southward along the lines of lofty peaks in the Western ranges, and in the East the red-breasted nuthatch, the chickadee, and the junco follow down the Appalachian system, finding a climate that is in most respects the same as their Canadian home.

In the northward extension of southern birds, we find that they follow plains and river valleys. The flat, barren plains reflect the heat, and the winds across them are often burning hot, withering all vegetation like a fire. Such winds and such heat bear the lines of summer temperature far to the north, even to the plains of the Saskatchewan and the interior of British America. Here the birds find a summer as hot as that upon the seacoast fifteen or twenty degrees farther south. It does not matter that in winter these same plains are many times colder than the seacoast, for the bird's distribution is influenced by the summer climate.

The map of faunal provinces and subprovinces shows us very nearly the course of the summer isotherms marking each ten or fifteen degrees difference in average heat. The north and south division through the centre of the map is, however, not a temperature division, but it cuts off the dry western half from the moist eastern half of the country — the green and luxuriant prairies and woodlands from the parched and scanty herbage of the plains. And, of course, with the change in amount of rainfall and the consequent change in vegetation, follow changes in the insect life and in the birds that live upon insects and berries. There is often a very close connection between birds and certain plants or

trees. Who would expect to find a sage cock away from sage brush? or a spruce partridge (Canada grouse) outside of the spruce forests? It may not be chance alone that makes the pine warbler haunt the pitch-pine country, and the blue yellow-backed warbler always seek the neighborhood of the hanging usnea, or swamp-moss. All these are facts of distribution, and it is part of the good naturalist's work to observe whether certain birds and plants always are found together.

The study of distribution needs long training and wide observation to be of any great worth, but a beginner may do several things that will have a scientific value. One of the simplest is to make a list of all the birds found within certain limits; another is to notice carefully the kind of locations preferred by each bird, whether open hard-wood, soft-wood, thickets, brook-sides, meadows, and the like; while a third is to explore carefully some hill or mountain near home, with the aid of a map, marking every hundred feet in elevation, and to note carefully the elevations at which every kind of bird and flower is seen, together with the slope of the hill, north, east, south, or west, on which they are seen. By such explorations, year after year, over any mountain, noting its zones and the trees, plants, birds, and insects, the exposure to sun, the amount of rain received, the character of the rock beneath, and always the elevation, a patient observer could accomplish much. But studies of this kind require more time and painstaking observation than most amateur naturalists are able to spend.

MIGRATION.

Besides this regular distribution in summer over certain well-marked areas, most birds have another winter home farther south, and in going from one to the other they make long flights called *migrations*, or movings. The causes of this remarkable custom are so remote that, without the aid of the geologist, we can hardly understand how the habit was acquired, nor why, when once the birds are driven south by cold, they do not stay there. But simpler questions than these, questions which might not seem too hard for ourselves to answer, as, in what manner they travel these great distances; how they find their way back to the same place, to the same porch or bush, after a thousand miles of wanderings; why we so seldom see them going, but only wake up to find them come or gone — these apparently easy questions have, until recently, been a standing puzzle to the world. Many foolish guesses have been made, wide of the mark, but at last, by patient study, the facts have been discovered; and now all seems so simple, so much like what we would do ourselves, that we wonder at our not knowing it years ago.

In the first place, it was settled that most of the smaller birds flew by night, which sufficiently explained why we neither saw them come, nor saw them leave. One moonlight night in September, a number of years ago, I was awakened from a very bad dream of burglars by hearing in my room a noise that could not be explained as cat, rat, bat, or mouse. The windows were open, and there was out of doors the dying glimmer of a setting moon, but the room was dark; nothing

could be seen, yet the noise continued. Lighting the gas, I found a poor little bird bumping his head against the ceiling, in frantic efforts to escape. He was easily caught, and proved to be a young yellow-rumped warbler, much frightened, but unhurt except from a temporary baldness where he had rubbed his head against the ceiling. Evidently he had been flying by moonlight, and the chances were that he was not going alone on this unknown journey, but that all his tribe were on their fall migration. But I could not see the passing armies, and when I looked out in the morning the little warblers flitting about in the shrubbery were apparently the same that had been there for days.

It is not often that one really has an opportunity to see the flood sweep past; and, because it is, perhaps, the most vivid story ever written of the way a great army of birds makes its marches, I am going to quote to you the account written by Mr. William Brewster of his studies of the migration of birds at Point Lepreaux lighthouse, near the Bay of Fundy. Of the experience of one stormy night he gives the following description: —

"A clear, cool day; the evening perfectly clear up to ten o'clock, when a heavy curtain of clouds rolled overhead from the northwest, and it became very dark. An hour later dense fog set in, and at midnight it began to rain, heavy showers succeeding one another at frequent intervals. Wind south; puffy, at times strong.

"As soon as the sky became overcast small birds began to come about the light. Their numbers increased steadily from ten to eleven o'clock, but during this time the majority kept at a safe distance, and only two or three struck. With the advent of the fog they multiplied tenfold in the course of a few minutes. For the next hour from fifty to one hundred

were constantly in sight, and from one to eight or ten dashing at the lantern. . . . I remained on the lighthouse from ten o'clock until two the next morning. During this time fully two hundred birds came against the lantern. Of these at least fifty were killed or disabled, and I caught and examined probably fifty more which were too wet or exhausted to fly after dropping on the platform.

"At the height of the *mêlée* the scene was interesting and impressive beyond almost anything that I ever witnessed. Above, the inky black sky; on all sides, dense wreaths of fog scudding swiftly past and completely enveloping the sea which moaned dismally at the base of the cliffs below; about the top of the tower, a belt of light projected some thirty yards into the mist by the powerful reflectors; and in this belt swarms of birds, circling, floating, soaring, now advancing, next retreating, but never quite able, as it seemed, to throw off the spell of the fatal lantern. Their rapidly vibrating wings made a haze about their forms which in the strong light looked semitransparent. At a distance all appeared of a pale, silvery-gray color, nearer, of a rich yellow. They reminded me by turns of meteors, gigantic moths, swallows with sunlight streaming through their wings. I could not watch them for any length of time without becoming dizzy and bewildered.

"When the wind blew strongly, they circled around to leeward, breasting it in a dense throng, which drifted backward and forward, up and down, like a swarm of gnats dancing in the sunshine. Dozens were continually leaving this throng and skimming toward the lantern. As they approached they invariably soared upward, and those which started on a level with the platform usually passed above the roof. Others sheered off at the last moment, and shot by with arrowlike swiftness, while more rarely one would stop abruptly and,

poising a few feet from the glass, inspect the lighted space within. Often for a minute or more not a bird would strike. Then, as if seized by a panic, they would come against the glass so rapidly, and in such numbers, that the sound of their blows resembled the pattering of hail. Many struck the tin roof above the light, others the iron railing which enclosed the platform, while still others pelted me on the back, arms, and legs, and one actually became hopelessly entangled in my beard. At times it fairly rained birds, and the platform, wet and shining, was strewn with the dead and dying."

Few of us will ever see the like of this, and yet, watching the play of insects about an electric light, do we not see something very similar, so nearly the same that the question at once rises, Why are not birds killed by electric lights as well as by lighthouses? To a small extent they undoubtedly are killed by striking electric lights, especially the tall clustered lights used in some cities; but there are two good reasons why more of them are not so destroyed: first, the lighthouses are placed along the migration routes while the electric lights are more often away from these paths of travel; and, second, foggy weather is needed to bewilder them, especially a sudden fog arising after a clear day, an occurrence common at the seashore, but rare inland. If there is no fog, the birds do not strike the light, and unless the fog comes in after they have begun their night's journey, they will not travel that night. Mr. Brewster infers that they migrate only on clear, cool nights, and that they are unable to forecast the weather for a single night even, else such fatal trips as the one he describes would not occur.

But why, once involved in a fog, having lost their bearings and the sight of land, they seek the lighthouse as the only object visible is plain, and why once within the circle

of its rays they hasten to their own destruction we can also see by looking at an electric light on a foggy evening, seeing the halo it builds out upon the mist and the solid pencils of light that stream out from it. A bird striking one of these beams of light and seeing nothing beyond but a blank wall of darkness, dazzled and bewildered, follows up the ray in which he is confined, a cage of light that he cannot break out from, until he dashes against the lantern.

What birds migrate by day and what by night and why they differ in their habits, is another interesting problem of migration, and those who wish to study further will find in the appendix Mr. Brewster's list and his conclusions, reached after twenty years of study, which show that not even in selecting a time to travel do the birds act without good reasons.

But another point much more likely to attract our attention is the way this army is guided, why the birds all go at one time, and how those born in a northern home can find their way thousands of miles to places they have never seen. We shall find that they do not all start at one time, as we commonly think, but begin to slip away weeks before we take notice of their departure, the places of those we have been acquainted with in our gardens being filled with strangers from the north. About the earliest to leave in a body are the swallows, the dates of whose departure are easily determined, but the others are passing and passing for many weeks in a leisurely procession. We cannot give a better idea of the way the migration is accomplished than by quoting again from Mr. Brewster: —

"The conditions which cause one flock, or family, or individual to start southward are ordinarily so widespread and generally operative, that countless flocks, families, and individuals

are set in motion at nearly the same time, and the members of each flock or family, instead of flying in close order, scatter about sufficiently to approach or mingle with the stragglers of other flocks or families. Thus in effect they form a continuous but straggling army, often hundreds of miles in length, and varying in breadth according to the character of the country over which it is passing.

"Over a wide, level, and generally uniform region the host spreads out in thin order; following a river valley, it contracts and thickens; and at narrow passes, such as the Straits of Mackinac, it focusses its myriads into a solid stream.

"As is well known, there are certain definite routes or paths of migration along which birds pass in especially great numbers. These are usually coast lines, river valleys, or continuous mountain ranges. Toward them converge innumerable less frequented paths, each of which in turn has still smaller tributaries of its own. Thus bird streams, like brooks, flow into common channels, and each particular region may be said to have its bird, as well as water, shed. An important consideration is that the tributary bird streams follow courses in no wise strictly dependent on points of the compass.

"Bearing these facts in mind, the manner in which birds find their way seems very simple. From the height at which they fly the country presents the appearance of a map on which, in the light of the moon or stars, the mountain ranges, plains, lakes, rivers, and seacoasts are more or less distinctly outlined for a hundred miles or more in any direction. (Any one who has spent a clear night on the summit of a mountain, will not question this statement.) Guided by such landmarks, the older birds can have no difficulty in following paths which they have repeatedly traversed before, and they unquestionably direct and perhaps lead all the larger flights, although it

is by no means certain that they do this in a systematic manner, or that their leadership is distinctly recognized or realized by the younger birds who accompany or follow them. On the contrary, the latter are probably directed as well as perhaps urged onward, simply by the contagion of general example and a desire to keep within sight or hearing of their companions, — both strong influences with birds, especially very young ones which have only lately passed from a state of complete dependence and are still not wholly independent. That a very few experienced old birds could thus direct and guide the movements of thousands of inexperienced young is to my mind obvious. . . .

"It is not necessary to assume, nor in my opinion is it likely, that these flocks keep intact throughout the whole of their long journey. . . . But whether among friends or strangers, the contagion of example would not fail to act on every favorable occasion, at least as long as old birds were present. . . .

"It may be asked in this connection how the various species which start together or join one another during the early stages of their journey separate again, as must be the case, when they reach a point beyond which their routes diverge. An answer to this was suggested at Point Lepreaux by the fact that, while many species of birds arrived together on the same night, and mingled indiscriminately in the neighboring woods during the following day, they did not invariably depart together or in exactly the same direction. This leads me to believe that similar places along every route constitute what may be called stations or points of departure. At such places — ordinarily promontories extending into the sea, points of timber bordering extensive plains, or the extremities of mountain ranges — the migratory tide hesitates and halts before venturing on the dangerous stage ahead, and (as we know to be the

case) birds of various species quickly collect, often in extraordinary numbers. This pause allows the stragglers to come up, and when the host again starts, the different leaders are naturally followed by all the members of their own particular species. I believe further that the southern extremity of the Alleghanies is the chief point of departure in the eastern United States.

"It may be further objected that the adults of many or, as I believe of all, species migrate southward first, and often several weeks in advance of the young. It is perfectly true, nevertheless, that a few old birds are always to be found in the larger flights, although the latest of these are certainly composed mainly of young. The two facts taken in connection, however, seem to me to strengthen rather than to weaken the conclusions just advanced, for it is evident on the one hand that many of the smaller parties must be entirely without experienced leaders, and equally clear on the other, that a few such guides must always mingle in the armies which these parties collectively form.

"Another possible objection which has occurred to me is that the flood-tide of migration is preceded, as well as closed, by more or less local or limited movements, during which the birds at any one time on the wing must be too few and too scattered to constitute an uninterrupted stream. How, then, do they find their way? It may be answered that the earlier flights can have no difficulty, for, as already stated, they are made up chiefly, if not wholly, of old birds, who, being familiar with the route, are independent. With the closing flights there is more trouble, for these, as we have also seen, are composed chiefly, and in some cases entirely, of young. But is it necessary to assume that such tardy travellers often reach their southern destination, unless fortuitously and after long

wanderings? Are they not much more likely to perish of cold or hunger, or to furnish some of the many recorded cases of exceptional wintering or other unusual occurrence? As far as I have seen, accidental visitors to Massachusetts, almost without exception, are young birds, and the majority also are taken very late in autumn — facts of obvious significance in this connection."

There is one thing connected with migration that as Americans we cannot pass by without mention. Mr. Frank M. Chapman has shown us very plainly that without the help of the birds, Columbus would not have discovered America. All the historians tell us how he was cheered by the sight of land-birds "that came singing in the morning and flew away again in the evening." For more than three weeks before they sighted land they were thus visited by land-birds; "some of them, such as sing in the fields, came flying about the ships, and these continued toward the southwest, and others were heard, also, flying by night." A week before they came to land, Columbus, persuaded that the birds knew whither they were going, turned his course also to the southwest, taking them as his pilots. And just as he predicted, they did lead him to land two hundred and fifteen miles, according to the historian Fiske, nearer than the coast of Florida for which he had been steering. That he could ever have held his mutinous sailors in check long enough to cross so great a distance is hardly possible. He was well guided and was happy in trusting his heaven-sent pilots.

But we do not yet understand how almost by miracle it was that he fell in with these flights of birds. Mr. Chapman was the first to point out to us the real significance of the event. The Bermuda Islands are one of the "stations" on the way of the migrating armies, and the Bahamas, where Columbus

landed, are another. All the land-birds that touch at the Bermudas take a southwest course to the Bahamas, so that Columbus was running across the line of their annual flight before he changed his course and followed them. But this migration, though it carries myriads of birds, lasts but a short season. Had Columbus come too early, he would have seen no birds, and a few days later the hosts would have been already in their Southern homes. As Mr. Chapman says: "After nearly twenty years of disappointment, a delay of ten days at Palos would not have seemed of much importance. But if Columbus had sailed from Palos September 16th, or, using the 'new style,' September 26th, he would have seen few migratory land-birds, or none. Whether, in their absence, he would have had sufficient influence over his men to force them to continue a westward course, is an open question; but we can clearly see that, without the presence of birds, his efforts at allaying their fears would have been seconded by no really conclusive signs of land."

And so all good Americans must be thankful to the birds. Had it not been for their guidance, the whole course of American history would have been changed, and, indeed, the history of the whole world would have been different. For all we owe to the birds, both in protecting our fields and orchards, and in guiding Columbus to land, are we not bound to be bird protectors, and good friends of theirs?

PART IV.

SOME COMMON LAND-BIRDS.

LITTLE STUDIES IN THE ART OF OBSERVATION.

"As for fowling, during the last that I carried a gun, my excuse was that I was studying ornithology, and sought only new or rare birds. But I confess, I am now inclined to think that there is a finer way of studying ornithology than this. It requires so much closer attention to the habits of the birds, that, if for that reason only, I have been willing to omit the gun." — THOREAU, *Walden.*

ABOUT BIRDS' DRINKING.

If you wish to make an experiment that will cost little trouble and will give much pleasure, try for a summer the plan of keeping a drinking dish for the birds, in some spot loved by them. A bit of shrubbery, the neighborhood of the grape vine, the side of a hedge, are usually spots that they frequent, and the best of all is near a tree or bush which bears fruit worthless to any one but the birds. An old tin baking-pan, not so deep as to be dangerous, or else a little tilted so that the water may shoal off gradually, is a bath tub that will attract birds all summer long.

Birds love fresh water, and unless the dish is kept neat and clean, they will not use it much. If it is kept in good order and freshly filled, you will find that all the birds know about it. Keep a list of the different kinds that come, and, if you can, of the different birds. Some birds, by their voices, their manners, or some peculiar marking, will be readily recognized, and you will know Billy, or Peep, or Spot, or whatever you choose to name him. Notice the time of day when each kind prefers to come to bathe, and you will see that they have preferences. There are early birds, just as the proverb tells us, and there are birds that are late abroad, birds that are particular about the temperature of their bath, and others that find nothing too cold for them. I have seen the little juncos, early in March, splashing in an ice-edged pool, and singing as cheerily as if March were May.

Birds differ in their dispositions as much as people, and it is not a little amusing to watch the selfish bird, or the timid

bird, or the bird who knows it all. Some demand the whole bath for themselves; others are content to share it; some dip and spatter in one way, while others dress and preen themselves after quite a different fashion. It was always amusing to me to see a certain motherly old robin, who was in the greatest temper if any other bird attempted to use the bath while she was in it. She always intended to have the whole pan — and got it, though not at other times noticeably overbearing to the other little birds. There, too, those feathered ruffians, the English sparrows, met their match in the purple finches, whose company the sparrows seemed to desire so much that they acted the toady quite humanly, and meekly followed their bright-coated cousins about, pretending to peck at the fallen mountain ash berries, though they despised such food.

While you are watching birds drink, please observe the way a pigeon drinks. All pigeons drink in the same way, and no other birds drink like them. The difference is well worth observing if you do not remember what it is. But there are other points of interest about birds' drinking; not only how, but what they drink. What do you suppose the albatrosses drink, and the fulmars, the shearwaters, the petrels, and all those birds that wander continually on the high seas and never come to land except to nest? Salt water undoubtedly. There is no record that they do this, and some persons have supposed that because a man would die of thirst if he drank sea-water, it would affect these birds in the same way, and that therefore they never drink at all. This certainly is bad reasoning. All the probabilities are against it, as we shall see.

There is a class of birds that live part of the year on the seacoast and part of the year inland, like the grebes, the loons, and those gulls and terns that nest upon the prairies and by the shores of inland lakes. Half the year they can get noth-

ing but salt water to drink, and the other half they are unable to get anything but fresh water. Either they must drink both or they live without drinking half the year.

There is a pretty little story that shows their need of water. Some years ago a gentleman had two little downy kittiwake gulls which he intended to keep as pets. He gave them food and water, but they would not drink, and in two days one was dead and the other was not likely to live long. Everything possible was done for him, and at last to please him a bucket of salt water was dipped up to give him a bath and a swim. To the surprise of every one he drank the salt water eagerly. He was dying of thirst, but of thirst for salt water, never having learned to drink anything else. He grew up to be a beautiful bird and a great pet, but he never changed his habit of drinking salt water.

Yet this is not an invariable habit with sea-birds, for terns, when nesting on low, sandy islands like Muskeget, have been observed to drink from the pools of rain-water standing in the hollows of the island. Therefore these birds can drink both fresh and salt water, and often are unable to get anything but salt water. Which is more reasonable to suppose, that the petrels and albatrosses do not drink at all, or that, like the terns, they drink salt water?

The hunters along the Maine coast have told me an interesting fact. They especially prize the black mallard, or dusky duck, often called the "black duck," though it is not black; yet they find him so wary that he is hard to approach. Now the dusky duck is naturally an inland bird, and goes to salt water only when his food supply is cut off by the freezing of the ponds. But he has a craving for fresh water to drink, which the hunters know and take advantage of. In winter after a thaw with heavy rains, the brooks rise sud-

denly and pour out a great volume of fresh water, which, being lighter than the salt water of the ocean, runs out upon it as it would upon ice before the two commingle. So after a rain the dusky ducks gather about the mouths of streams running into the ocean to drink the fresh water, and here the hunters come to find them. It is worth noticing that the scoters or "coots," which are true sea ducks, never come inshore to drink.

Here are some little points for bright eyes to settle. Who can make a list of the birds that quench their thirst by eating snow? Does a hawk ever drink, when wild? And who has ever seen a woodpecker drinking or bathing? And what birds take dust baths instead of water baths?

HOW A HAWK EATS HIS FOOD.

We must not forget that there are very many kinds of hawks which feed on everything from grasshoppers and snakes to squirrels and partridges, so that their ways of eating must vary somewhat; but we will study only one, the one that even city children may sometime chance to see, our little sharp-shinned hawk, the boldest fellow for his inches that wears feathers, excepting only the humming-bird. Since the sparrows became so abundant, he has learned to come into the cities after them, and in winter he may sometimes be seen in our parks or along our avenues, chasing the sparrows, without fear of the multitudes of passers-by or of the thundering traffic of the streets. He is equally at home in the silent recesses of the forest and about the wind-swept tops of our bald mountains, where I have often found a little heap of quill-feathers that told me who had been eating my friends the junco and the chickadee in that lonely place.

It is odd, too, that my only two opportunities to learn anything of the feeding habits of this bold killer of little birds should have been once in the heart of the crowded city and once in the solemn quiet of the great woods.

My first chance came to me in the city of Charlestown, Massachusetts, along its busiest street. I looked out at just the right moment, and there in an elm tree, on a level with the second-story window and not thirty feet away, his long tail blowing in the winter wind, was a sharp-shinned hawk with a sparrow pinned under one foot. What a fierce, alert bird he was, with his keen yellow eye ranging on all sides for

danger, as he crouched there, plucking his victim and letting the feathers drift away on the wind. What his next work would have been after the bird was plucked I could not tell, I only saw the long wing- and tail-quills drop slowly downward, and the lighter feathers float away like thistle-down; for some noise or sight alarmed him and he sailed away, bearing his victim in his claws.

A year later, in the Maine woods, where the river leaps tumultuously over the Indian Falls on Webster Stream, I took from the claws of a hawk just killed the yet warm body of a little warbler that he was eating. It could not be identified further, for the head was gone and every feather had been stripped from it so neatly that not one was left to name it by. The intestines also had been taken out by a rip down the back and all the blood had been drunk up. It was the second stage of the sharp-shinned hawk's preparations for dinner — or the first course, we may say; for most carnivorous creatures are fond of the brain of their quarry, and all the hawks that I have seen will eat the head for their first mouthful. The sharp-shin is also bloodthirsty in its most literal sense, and will drink the blood with evident relish while it is warm. More than once I have seen him taken fresh from the killing, and his bill was bloody to the cere.

Unless his large cousin, the Cooper's hawk, is equally dainty, the sharp-shinned is the nicest of our raptores. The broad-winged hawk will not trouble to skin a squirrel or even the portions of a rabbit that he eats, and the goshawk, after stripping off the quills and a few of the larger feathers, will bolt a large hen, joint by joint, in less time than it would take to describe the process. With his strong claws he tears out the wings at the shoulder and the legs at the hip and swallows them at a gulp. None of our hawks is so bold, so power-

FIG. 41.—SHARP-SHINNED HAWK.

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ful, and so cruel as this great robber of the north which comes in winter to the Northern states and is at once conspicuous by his boldness, by his long tail and round wings, and by his steel-blue upper parts when in full plumage, or his striped breast when immature.

These three — the goshawk which is rare, the little sharp-shinned hawk, and his large cousin, the Cooper's hawk, which you would probably mistake for a very large sharp-shinned hawk unless you noticed critically the shape of the end of the tail and the color of the top of the head — are the three most destructive hawks. For all the others some good word can be said.

The sharp-shinned hawk has a double, the pigeon hawk, so near like himself in size and color that even if you had both in your hand you probably could not distinguish them until advised how to do so. But besides differences in the bill, the pigeon hawk's wings are sharp and pointed, while the sharp-shinned hawk's are round. The two birds also fly very differently, so that it is not hard to distinguish them in life.

Are their feeding habits alike? I never saw the pigeon hawk eat, but I have watched him clean himself up after a meal. He was very leisurely about it, and must have spent at least thirty minutes on his toilet, opening his tail and laying the feathers in perfect order, spreading each wing and dressing the quills with his bill, and putting up his claws to clean his bill of feathers. I had not supposed that making its toilet was such serious business with a hawk.

Before we leave the subject let us look for a moment at the hawk's foot. The sharp-shinned hawk, as you have guessed, gets its name from its long slender legs. The tarsi and toes are so thin that the bird looks spindle-shanked, and we note a peculiar modification of the foot on this account. There are

heavy pads under each joint, it is true, to enable the bird to grasp as firmly as possible whatever it lays hold of; but that is not what I mean. Do you see that the middle toe is so long that it will wrap almost around a small bird, and its claw will be struck in near the claw of the hind toe? This is a weakness. For a strong grip the claws should oppose each other fairly and strike the body of the victim, not on the same side, but on opposite sides. In the other hawks we find this arrangement, and we notice that the middle toe bears the largest, strongest claw. In this bird we see that it is the inner toe, the second toe, that has the largest nail. This toe, then, does the same work as the middle toe of the other hawks in the capture of small prey, and the long middle toe is of particular service with larger game, giving a wider grip and enabling the hawk, whether he strikes small game or large, to hold with equal security. It is well known that this bold little hawk frequently attacks birds larger than himself, which he cannot paralyze and cannot carry off at once. By this device he is enabled to hold on until he tires them out. The very possession of such a foot is an evidence of his ferocity and bloodthirstiness.

THE SMALL FLYCATCHERS.

THE old proverb of "a bird in the hand" gets a stiff rebuff among the small flycatchers. To the amateur naturalist, for the purpose of identification, a live flycatcher in the bush, if decently tame and sociable, is worth half a dozen dead ones in the hand.

Those who know about birds may consider it ill-advised to introduce young beginners to this puzzling group of the little flycatchers; but the best lesson a novice can learn is to single out the largest lion that lies in his pathway, and, "having killed him, to go on singing." The small flycatchers are hard to study, especially when they are dead and unable to speak for themselves, but as we learn about them we find out a remarkable fact. It is that two birds may have scarcely a feather's difference between them, may be so near alike that only experts can determine the differences, and yet may be entirely distinct, so unlike that no one would think of calling them the same species. Much as we sometimes envy the man who shoots little birds his opportunities for looking at every feather, in the case of the little flycatchers the advantage lies all on the side of the man who hunts them without a gun. Their habits are unlike, their haunts are different, their notes are individual, and the nests and eggs vary with each species so that they are identified even more readily than the birds themselves.

Up to a certain point no bird is easier to determine than a flycatcher. As far off as you can see or hear him you know his ways and his voice. At one hundred and ten measured feet I have been able, without a glass, to recognize a phœbe merely by the way he sat on a limb, and after a little experience any one can readily pick out a flycatcher when no one

color or mark is visible. They are fond of particular places, usually a dry twig, which gives a clear view and a small perch for their tiny feet. Day after day they return to the same twig and keep up a patient watch for flies. The wood pewee, which has this habit in the most marked degree, in the South is called the "dead-limb bird." Often, when he is not at home, one can pick out his favorite perch by the signs of long occupation.

For all that the flycatchers sit so still, they are nervous birds. The snapping of their bills, the quick twitching of their tails, and their short, abrupt motions are a strong contrast to the composed industry of the vireos and warblers. As they sit on their perches, the flycatchers are big-headed, square-shouldered, erect little birds, and their tails hang straight down over the limb. Close at hand one notices the large, round, buff-ringed eyes, full of intelligence and decision, and the breadth of bill, which gives them a wide-mouthed look. In color, all the small flycatchers — except a bright scarlet one that lives in Mexico and along the southwestern boundary — are much alike, — a dull brownish olive, with lighter, sometimes quite yellowish, underparts and with two light wing-bands. The shade varies, especially with the season, but the pattern of coloration never does.

The flycatching habit from which they get their name is not peculiar to this family. Some woodpeckers are expert flycatchers; a number of the warblers find much of their food in this way; I have seen chipping sparrows catching insects at odd intervals and other birds, the kingfisher for example, will do it now and then; but the manner of sitting still and erect, the habit of twitching the tail, and the tuneless voice, are characteristic of the flycatchers. From three to five of these little birds are found in most localities, the species varying with the place.

FIG. 42. — PHŒBE.

Facing page 185.

No bird is more sociable than the least flycatcher, or chebec. He likes to live with people, in orchard and shade trees, and prefers to nest in an apple tree. He is fond of society, and will, by preference, take a perch that commands your windows or your piazza, where he will sit and snap his bill and *chebéc* at you with intelligent sprightliness. How much the little fellow wants to talk! What sensible remarks he appears capable of making! His big head seems full of ideas; he wants to tell you something, and men are so stupid! There is good reason for his sharp, snappy remarks, interrupted now and then by little turns of flycatching.

The wood pewee is quite a different bird. He does not court society, but sits high up in a tree, an elm or maple when in village streets, and from his retirement drawls out his slow *peé-e-wee* or *peé-er-ree*. It is hot weather music, languid and listless, as fitted to the warmth of June and July as is the cicada's *z-ing* to the heat of August. We see little of the wood pewee, though he is common enough. Every year he nests in my garden; but, as he builds some thirty or forty feet above the ground, in the limbs of the bushiest maples, I never find his nest till autumn strips off the leaves. I am accustomed to his retired, listless, melancholy ways, credit him with being here when I hear his *peé-er-ree*, and do not much court his companionship when he seems not to care for mine.

Phœbe is larger and browner than the others, seeks more open locations, and builds about outhouses, and farms, and beneath bridges, especially in deserted houses and the horse-sheds attached to country churches. Phœbe is a brisk, alert bird, always calling out *phœbé! phœbé! pewit phœbé*, and clicking her bill as she snaps her tail back and forth. Sometimes, on one of her sallies, she will catch several insects before returning to her perch. Few birds are so domestic as phœbe.

She builds near man, and spends her time among his groves and orchards. As she is an early comer, her spring greeting is always welcome; and as she has no bad habits, she never wears her welcome out.

These are the commonest small flycatchers of the East, and with the kingbird make up the bulk of those we meet. Sometimes a great-crested flycatcher will build her nest, wreathed with snakeskins, in a hole in a tree, or an olive-sided flycatcher will mount guard over some remote meadow and warn off all intruders with his harsh cries; but more often the new bird, if we find a new one, will be a small bird, of the size and color of the chebec. He will be a source of perplexity wherever he occurs because he will do things that the chebec does not do. I first noticed him because he acted so much like a chebec gone crazy. There were half a dozen of them in a fringe of willows between a sloping field and the marsh where the red-winged blackbirds lived. Instead of sitting out in plain view, they kept inside the willows out of sight; instead of darting out after flies, they flew upward, with a loud, peculiar note, turned a somersault above the tree, and dived again into the middle of it. It was quite impossible to believe that they were sedate, inquisitive little chebecs like those that nested in our garden and perched on the bean-poles to inspect the hoeing and to talk to us. As indeed they were not, but the alder flycatcher, the Eastern subspecies of the Traill's flycatcher. This bird is fond of the neighborhood of water, and is seldom seen far away from low land; just as the least flycatcher, or chebec, is not common away from cultivated grounds, as the Acadian, or green-crested flycatcher is the inhabitant of upland groves of beeches, and as the yellow-bellied flycatcher is a denizen of evergreen growth.

The nests are almost a sure means of identifying all these

little flycatchers. The phœbe is the only bird that habitually builds under bridges or inside of deserted houses, and any flycatcher's nest discovered in such a place may be safely called hers. A nest in an evergreen tree near the water, saddled high up on an outstretched limb, is the olive-sided flycatcher's; but this is a rare, northern species. A flycatcher's nest found upon the ground is the yellow-bellied flycatcher's, and this will be sure to be a bulky nest of moss and leaves sunk in a mossy bank or between tree roots, in evergreen growth and usually near running water. A flycatcher's nest found low down in a bush near water is the Traill's, or the alder flycatcher's, which builds a bulky nest about four feet from the ground, in the upright forks of a willow, alder, or aspen, or even, in the Northwest, among ferns. The chebec builds a smaller nest, puts it higher up, usually selects an apple tree or some bush or tree near cultivated land. She lays a buffy white egg, not speckled like the Traill's flycatcher and the wood pewee's, and very much smaller than the big spotted egg of the kingbird, which chooses similar places. The Acadian, or green-crested flycatcher, lives among beech woods principally; and there in the end fork of a drooping branch, such a place as a red-eyed vireo would choose, constructs a shallow, flimsy nest, not to be mistaken for the vireo's deep cup wrought of birch-bark and hornet's nest. The wood pewee builds a shallow nest and saddles it upon a limb high up in a maple or other shade tree — a nest noticeably unlike the deeper, cup-shaped nests of most of the other small flycatchers. Thus each one has her own way of building, though all dress and look nearly alike, and by the house they leave behind them, we may identify the bird that made it, though if we had the bird in our own hands we might not be able to tell its name.

SPRING IN WESTERN OREGON.

THE BOOMING OF THE SOOTY GROUSE.

Spring in western Oregon is perhaps as welcome and as beautiful as spring in any part of the country; for if it does not follow a cold and snowy winter, it brings sunshine after a season of cloud and constant rain. What a joy it is to see Mount Hood blinking in the steam drawn up by the warm sun from the water-soaked ground, while a Western meadow-lark on a fence, with the sunshine in his beautiful breast, sings us into summer! Mount Hood and the Western meadow-larks always seem to belong together as two of the surpassing creations of the Lord. As the mountains of the East are less grand than these snow-capped monarchs of the Coast Range, so the Eastern meadow-lark, with his sweet, melancholy *te-lee-é-ri-ó*, is no way to be compared with this glorious songster of the West, who is thrush and skylark and nightingale in one. If he is not our best singer, — and on that point there has been some discussion, — he at least comes upon the stage when his presence is most effective; "For, lo, the winter is past, the rain is over and gone; the flowers appear on the earth; the time of the singing birds is come."

Late March and early April in western Oregon are a time of gladness to the woods wanderer. The mud is drying enough to render roads and woods passable, and the birds and blossoms are making everything gay. From the brilliant yellow skunk-cabbage, that looks like a calla-lily, and the golden clumps of the *Mahonia*, or "Oregon grape," to the

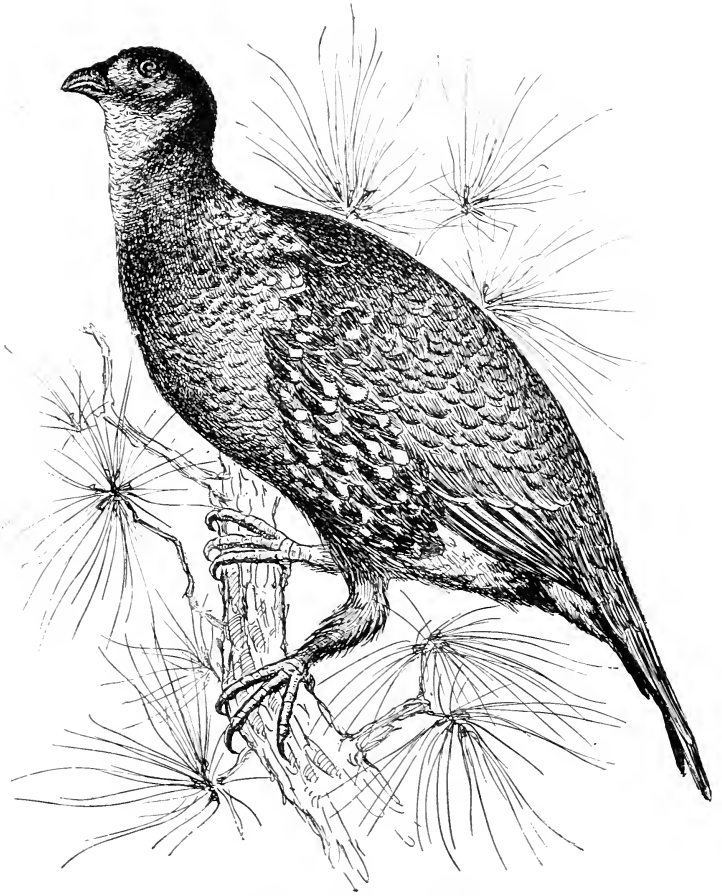

FIG. 43.—SOOTY GROUSE.

Facing page 188.

soft-pink salmon berry and fire-pink wild currants, the native spring flowers by the roadside strike a high note of color. There is a marked contrast to our own delicate, pale-colored, spring blossoms.

What most impresses an Easterner going to the Northwest coast is that all is so familiar and yet so different. It becomes confusing, like well-known voices speaking from unknown presences. When we stop to think, it seems as if something had happened to us instead of to the flowers. Here are white trilliums, dog-tooth violets, yellow violets, and lady's-sorrel, among other old favorites, but all twice as large as those at home and many of them curiously different in color. There are more yellow flowers than at home; blue flowers are replaced by white; white ones take a flush of pink. It seems quite homelike to see a familiar flower until it turns up a strange face when you stoop to pet it.

And yet there is much that is the same. The coast of Puget Sound might be the Maine seacoast, but that it is less rocky and irregular. The woods of Washington and Oregon have much in common with the primeval forest, now almost gone, that once overspread all New England. In many sections there are no round-topped, hardwood trees to fill up the distant prospect, and the tall, spire-pointed pines march up the foothills in loose ranks, — but they are pines; and the fir tree does not badly simulate the old-growth hemlock of our Eastern forests. And when, in some upland gully, among brakes and alders, I have scared the ruffed grouse from his drumming-log, it all seemed home once more. But the alders overhead were a forest; the brakes in the open rose above my shoulders; the drumming-log was five feet through. In this enchanted forest only the partridge and myself were of the right dimensions, and he, too, was different. The familiar

aspect wore away and left me once more bewildered by a newness that was not new.

Among the birds many are old friends, some just the same and some a little changed. Eave and barn and tree swallows twitter and sport in the air, and with them is a new acquaintance, the violet-green swallow. The social chimney swift is lacking, but his place in the air, if not in our affections, is filled by the rarer and more retiring Vaux's swift, which still nests in hollow trees as a bird of the wilderness. A towhee in black and white and chestnut, apparently our own, shows his unlikeness by *mewing* at you from the lower boughs of an evergreen. It is the Oregon towhee, an unfamiliar species, though from his color you would never guess it. A junco spreads his white-edged tail as he flits to one side; but it is the Oregon junco, a little browner on the back and sides than ours, though similar in habits. When I found its nest in a horse's hoof-print in a deserted woods-road, it seemed to me in all respects like our little Eastern junco's home in bank sides and under tree roots. In the woods, the ruffed grouse that you hear drumming is the Oregon ruffed grouse — our bird in all save the brighter red-brown tinge of the back. On a high branch a flicker — but the red-shafted flicker of the Northwest coast — whickers familiarly, and where the timber is heavy our old Maine friend, the pileated woodpecker, the king of all the Northern woodpeckers, raps unseen at his work, or cackles on his undulating flight from tree to tree.

Mingled with those we recognize are other birds new and strange, — the dark-colored Steller's jay that replaces our blue jay; the red-breasted sapsucker, a gayer substitute for our yellow-bellied sapsucker, at a distance nearly resembling our red-headed woodpecker; the Oregon jay, as hoary-headed a villain as our Canada jay, and no improvement in either

manners or morals on that soft-spoken reprobate. The pygmy nuthatch runs up and down the tree trunks, the Audubon's and the hermit warblers sport in the branches on the edge of the woods, and to a lone tree in a clearing a Lewis's woodpecker flaps her heavy flight, betraying the secret of her nest to all observers. These are the familiar sights near the borders of an Oregon forest.

Sometimes in following up one of the clear mountain streams of Oregon, cold, green, and sparkling, that sweep down through the deep, narrow cañons from their sources among the mountain snows, one may hear among the scattered firs or pines above the undergrowth, the love-call of the sooty grouse. It is a sound equally hard to locate and to describe. The residents sometimes call it "hooting" and sometimes "booming." You may look high for it, you may look low for it, but you will not be able to tell whether it is near at hand or far away. The best way, perhaps, is not to seek the voice but to look out from some convenient resting-place halfway up the cañon side, where you are on a level with the branches of the trees below you. From such an outlook you may sometimes see the male grouse in the very act of booming.

He is a bird as large as a hen, dull-colored and uninteresting in appearance, a mingled black and slatey black, with a few whitish markings that only help to blend his color with the dark shadows of the Oregon forest. Above each eye is a featherless tract, and on the neck of the male are two pouches of bare skin, which ordinarily are hidden from view by the feathers. In the spring, however, when the male bird booms, these pouches undergo a change and become a pinkish orange. During the act of booming they stand out like small oranges on each side of the bird's head. Whether the noise is caused in taking the air

into the pouches, or in letting it escape no one can say; but it seems not unlikely that it is the escaping air, rushing through the vocal cords, that creates the sound, just as in penny-whistles it is the escape of the air from the inflated rubber bag that does the whistling. At least, if you watch the sooty grouse, you will see that his bill is *open* when the noise is made. On the other hand, when a horned owl hoots his bill is closed.

When he booms, the male grouse takes up his position on a horizontal limb fifty feet or more from the ground, and, sitting crosswise of his perch, crouches low, with wings drooping and tail spread. The air sacks swell till they almost hide the head, the red skin above the eye rises like a comb, the bill is opened, the sacks contract and dilate and "*poom-poom-poom-um-poom*" sounds the mellow love-call over the cañon. Five or six times in succession is the "*poom-poom-poom-um-poom*" repeated before the bird stops to rest.

The female is not visible. Perhaps, as in the case of the ruffed grouse, her presence makes no difference in the performance, which is for the male's own delight rather than to attract a mate. While the male is booming, she may be dusting her feathers on some dry knoll, or she may be hopping from branch to branch as she leisurely climbs to the top of a tall fir tree, or she may be sitting crosswise of a limb looking out over the cañon. She listens to the mellow love-call of her mate, she basks in the warm spring sun, and, while the spring lasts, before the summer cares of the family have come, or the autumn fear of gunners in the "open season," or the dripping winter rains have made the woods a sodden swamp, she enjoys the greatest peace and leisure of her life.

If it were possible to linger in the oozy, mossy forests of

the Northwest, we should meet many new birds and should become more and more impressed with the effect of climate upon a bird's color. A bright winter day is rare. Everything is wet, mossy, oozy. Houses, rocks, and trees are covered with moss. The hardwood trees are draped with moss, the evergreens with ferns that grow up the trunks and along the branches, and hang down like the fringes on buckskin leggings. A thousand rivulets and streams gush from the edges of the forest and pour into the larger streams and rivers. A rising vapor or a falling mist marks the difference between fair weather and foul. The effect of all this gloom and moisture becomes very apparent when we notice the birds that do not migrate. The summer visitors, who stay only during the bright and beautiful season, would hardly be much affected by the climate. The residents, on the other hand, are apt to be larger than their Eastern relatives, darker, and with a dull slate-gray cast which matches well the gloomy woods about them, as if the clear colors had been soaked out of their plumage. The song-sparrow becomes a streaked brown, the flicker grows dull-colored, the jays are dark, the bright rufous fox sparrow turns to a slatey brown. The sooty grouse which we have just been observing is notably dull-colored. There is one exception. The ruffed grouse of the Northwest coast loses his cool clear grays and browns and becomes distinctly rufous. Why is it that the climate should affect one bird in one way and another in a different way? This is one of the naturalist's problems; even a child might ask the question, but the wise men have not yet answered it.

A WINTER RESIDENT.

THE RUFFED GROUSE.

"The north wind doth blow,
And we shall have snow,
And what will poor robin do then?
Poor thing!

"He'll sit in the barn,
And keep himself warm,
And hide his head under his wing,
Poor thing!"

But Robin Hood's barn, where the ruffed grouse spends his days and nights, is sometimes a very cold house, especially up in Maine, where the mercury shrinks down into the bulb, and the snow often lies level with the fences. No matter how cold it is, the grouse never goes south; no matter how deep the snow is, he must get a living of vegetable food, for never, except in summer, when he catches a few grasshoppers, does the grouse eat anything else. But what is there in the woods in winter for the grouse to eat? How does he get a living when not a leaf, or berry, or green thing is above the snow?

If you are driving along country roads in early morning or at nightfall, you may expect to see him gathering one of his two daily meals. Up in a poplar, or a birch tree, he will be standing, snapping off the brittle ends of the twigs. Sticks, nothing but sticks, are his supper. And for many months in the year he feeds on sticks. Sometimes, in the city, warm even

FIG. 44. — RUFFED GROUSE.

Facing page 194.

in winter nights under the blanket of smoke which overhangs, and abounding in dainties of all kinds, my thoughts turn to the ruffed grouse in a bare tree-top, picking his supper of frozen twigs before he goes to his bed in the cold snow; houseless, unsheltered, knowing no change of diet the long winter through, yet always plump and contented. Brave bird! he loves the cold and his plain, bitter food.

To us, poplar is unpalatable, but it is the ruffed grouse's staff of life. Not only does he eat poplar buds and twigs all winter, varying them only by the addition of yellow- and white-birch buds, and occasionally by the buds of apple, hornbeam, or willow; but he resorts to poplar long before the snows have driven him into the tree-tops. He not only "buds" as the hunters say, during the fall, but sometimes, even in August, when his bill of fare is almost unlimited, he eats heartily of the hard, sapless leaves of the poplar. And late in spring, too, he continues to live by the poplar, eating the catkins even when they are three inches long, and look like great woolly caterpillars. But in spring he also eats the willow buds and the pretty "pussies," or willow catkins. As the willow contains a purple dye, a grouse that has been feeding long on them will have its stomach and intestines dyed bright purple.

As the snow melts, the grouse goes down upon the ground and picks the young leaves just coming up and the older ones that have remained green under the snow — checkerberry leaves and berries, goldthread leaves, clover and strawberry leaves, and, later, the strawberries, together with raspberries and blackberries in summer, rose-hips when they ripen, sweet elderberries, thorn plums in the fall, black alder berries to some extent, and rarely a little rock fern or tree-growing fungus. Beechnuts are a favorite food, as they are for deer, bear, porcupines, and other wood's creatures. The ruffed grouse will eat as

many as eighty of the sharp-angled little nuts and appear not to mind their points and corners.

It takes a great quantity of food to satisfy the grouse. Of poplar twigs he will eat a cupful for a meal if left to satisfy his appetite undisturbed. After a full meal his crop is swelled enormously, for he keeps them in his crop until he has collected his full supply. Thus, like the cow and other ruminant animals, he can gather a supply quickly and digest at his leisure, in some more retired and safer spot, if necessary.

Supper gathered, the ruffed grouse seeks his bed. Sometimes he settles down in a sheltered nook; sometimes, and especially in snowy weather, he dives quite beneath the light snow and lets it fall upon him like a coverlet of down. These are his warmest nights. If he likes his quarters, he may stay beneath the snow for several days, picking up goldthread leaves, or beechnuts, or checkerberry leaves, or whatever food lies beneath the snow. Is it dark there? Not mirk dark, I fancy, but like being down cellar when the windows are blocked with snow, for the snow is translucent — a soft light comes through it as through a porcelain lamp-shade. Soft, dry snow also contains a large amount of air, so that the grouse can breathe easily under the snow.

If the storm change to rain, forming a stiff crust above him, he has, as it were, a glass roof to his house. But that he is ever imprisoned beneath the crust and dies there, as we so often read, there is little likelihood. I have never known a case that, when followed up, proved to be more than hearsay. Wherever the snow is deep, the grouse lives easily beneath the crust, wandering at will beneath it in search of food, and coming out either by bursting up through it or by picking an exit in some place where the crust is weak. The only accident I ever knew to happen to a grouse in winter was when one had his

tail feathers frozen into the damp snow so that a man caught him alive. After the greatest ice storm on record in eastern Maine, when the crust would bear up a two-horse team and the trees were bowed to the ground with the weight of the ice frozen upon every bough and twig, the grouse were budding as usual the next day. But they had changed their habits to meet the emergency. They were feeding at noon instead of at night; and, instead of sitting quietly to eat, they flew from perch to perch, striking the limbs with such force as to rattle off showers of crystal fragments that fell tinkling on the hard crust below. Had they waited till their usual hour, the evening frosts would have set the ice immovably upon the twigs, while now it was loosened by the warm noon sun.

It may seem to you not difficult to discover a bird nearly as large as a hen, sitting in the top of a leafless tree; but I think, indeed I know, that you will find it hard to see the budding grouse even when it is pointed out to you, and that you will not, without aid or experience, be able to discover half of those that are in plain sight. Unexperienced observers see the grouse only by accident. John, James, and Jack go clattering home from town at sunset with rattling whiffletrees and creaking bob-sleds, shouting from team to team about the March meeting or market prices, and the noise does not startle the old cock ruffed grouse, budding almost over their heads as they pass. Ask John if they are common, and he will tell you: "There ain't scursely no patridge this year. I ain't seen one. They was all killed off by last winter's snow." The birds are there but he does not know how to see them.

When sitting still the grouse blends with the background against which he is seen, or else he resembles some inanimate object so nearly that it is more a matter of instinct than of eyesight to pick him out from his surroundings.

At a distance, against the red sunset, you call him a bunch of dead leaves; close at hand, if back to you, he blends with the tree trunk behind him; side to, the dark back clings to the poplar bark, the light breast melts into the pale blue sky; front to, his breast appears a bit of white birch stem, while the dark sides take the color of the thick birch twigs. Every new position seems to hide him and to confuse you. But once find him and, like the hidden animals in puzzle pictures, he becomes so plainly seen that you wonder at your own blindness. The grouse knows very well when he is detected, and however unsuspicious he may have been before he felt human eyes fairly fixed upon him, he is apt to become restless or alarmed soon after. Noise he does not mind. Often from the windows of a railroad train we may see them, undisturbed by the shriek of the locomotive, still quietly budding while the train rattles by. Yet, on the other hand, crack a stick, or break the crust, or make any noise in approaching them and they are alert at once.

The winter night must be long and tedious to the grouse, whether he spends it upon the ground or in some sheltered corner among evergreens. As he drowses in the muffle of his feathers, he hears the harping of the north wind through the thin birch twigs, or the snap and squeal of frozen trees, cracking to the heart under the knife of the bitter frost; he hears on the crust the heavy thump of the white hare's feet or the ring and tinkle of the wind-packed drift, telegraphing the wild-cat's long, soft-footed stride. The wings of his arch enemy, the horned owl, brush the fir bough over him, or he wakes from dreams of summer to smell the warm breath of a fox so near that his terror causes a delay that is almost fatal.

A light snowfall would have left all the night's adventures written in bold head-lines on nature's daily news-

paper — the fresh fallen snow. A shrewd observer can read there the whole story. Where the trefoil tracks are thickest was the scene of the hare's dinner party, — poplar on the stick was the *pièce-de-resistance*, — and a very merry party it was to judge by the number of tracks, until the old horned owl swooped down and seized poor Long-ears. How scared the others were can be read in these tremendously long leaps toward the alder thicket. These light, triple-pointed tracks are the grouse's where he alighted and walked a few feet toward that little fir tree with down-hanging limbs, which stands sheeted in snow like a pointed soldier's tent. His bedroom was the slanting lower bough, walled and roofed by the drift. This beaded chain straight to his hiding place was the fox's track; that long-paced, round-pitted track the wildcat made. And mark the broken level where he tossed the snow from the bough above him as he burst up in terror, and the wing-strokes in the snow where he struck it three or four times before he could gather headway and rise clear.

So it is written in the snow. Every little while Nature prepares a new edition of the great blanket sheet newspaper, powders all the fields afresh, and lets the creatures of the woods write again the story of their woes and pleasures among the personals and in the society columns. There it is reported, plain as if in print, that the flying squirrels had a frolic about the hollow apple tree; that the mink caught a trout in the open water below the mill-dam; that the red squirrels had a sapping party in the maples, and ate the burrs of the junipers for dessert; of the snow-bunting's feast of weed-seed eaten from a snow table-cover; how the old porcupine has broken out his lumber road between his den in the rocks and the tall hemlock; and the shrew-mouse's wanderings beneath the snow were not so crooked and out of the

light that he could keep them out of the papers, for this winding ridge marks the line of his devious tunnelling. It is not hard to tell who is out of doors in winter. Whenever a creature puts his foot down in the new snow, he signs himself with an unmistakable mark. Only the birds do not write themselves in full, but they leave other signs. There are the quill feathers dropped by the hawk as he stripped them from his prey; the bark hammered off by the woodpecker; bud scales scattered by the grosbeaks; fine weed-seed set adrift by linnets, red-polls, snow-buntings, and the hardy tree sparrow; the grouse's track, like a line of feather-stitching across the snow. It was a cock grouse, too — see the line where he dragged his wings, as he spread his tail and strutted like a turkey cock. Long life to you, my fine fellow! But look out for the fox and for the man with a gun!

THE EAVES-SWALLOW: HOW SHE CAME AND BUILT HER NEST.

Your great-grandfather probably never saw an eaves-swallow until he was a man grown. As you pass the barn and the mother swallow puts out her head and twitters at you, as friendly as a kitten, showing the forks of the light crescent above her beady eyes, you cannot believe that this social little creature was not here to make friends with the Pilgrims when they landed. Yet men now living probably saw the eaves-swallow arrive from the West.

We have noticed that the eaves-swallow loves open, sunny places, overhanging cliffs, and good, sticky mud. Now a hundred years ago the whole of this country west to Ohio was a thickly wooded country but little broken by clearings, and with no extensive natural meadows. The clay banks were covered by forests; the cliffs, of which there were indeed enough, were under the shadow of great trees, and the whole aspect of it to a bird looking down from a height must have been dark, green, and gloomy, quite unlike the warm sunshine over the Western prairies. There great rivers flowed through channels cut in lofty cliffs, and receding with the summer heat, left beds of mud for the swallows to work on. Here there was nothing to attract a lover of wide space and sunny plains. So the eaves-swallows from times unrecorded fluttered and digged in the mud banks of the West and plastered their nests against the cliffs above. There they were first seen by naturalists; by Forster, who gave the first description of them in 1772; by Audubon, who notes them in 1815 at Henderson,

Ohio, and in 1819 at Newport, Kentucky; by Major Long and Sir John Franklin, who observed them the next year, one in the Rocky Mountains, the other in British America. All these early mentions are from the West and very far west for those days.

But, after the Revolutionary War, the country began to grow. Farms spread out and met each other, while the forests vanished. The swallow, soaring overhead, could see new open spaces to the East, new nesting-places in a region full of better cliffs than he had known, and, what was more, full of strange, square artificial cliffs that were hollow inside, and filled with men and children and cattle, and surrounded by house-flies. The abundance of food was an attraction. Houses and barns were a new experience to our wild Western swallows; but they came trustingly, and plastered their cradles up under the eaves of the new barns in the clearings, as much at home as if they had always been civilized. Every year the farms grew and the swallows spread along the line of them to the East, where houses and barns were still more numerous, where hawks seldom dared molest them, and where flies were abundant. By the middle of the present century they were established in all the New England states as common residents.

Though so numerous where they are found at all, the swallows are very irregular in their distribution. We may find several species in one town, and but one or two in a neighboring village, or we may find large tracts almost unvisited by swallows. The causes for this are various. A great storm has been known to kill nearly all the swallows resident in certain places — as a few years since a storm annihilated the purple martins of Cambridge, Massachusetts. It may be years before a region thus depopulated will be stocked again, since the

young birds naturally return to the place where they were born. Or the English sparrows may have driven out the swallows from the houses erected for them, as has happened in most of our larger New England towns. Or suitable nesting-places may be scarce and the materials for building wanting; for each species of swallow has some peculiar requirement.

The bank swallow not only desires, but must have, a bank to dig in, and the soil must be not too stiff for him to excavate with his feeble feet and not so sandy as to cave in upon him while he is digging. The rough-winged swallow, which less often makes his own hole, likes the deserted burrows of the kingfisher. The barn swallow wants a barn whose doors stand open or whose owner has kindly made little openings large enough for his going in and out. The blue-backed swallow demands snug crannies, natural or artificial, and often builds in old woodpecker's holes or in the gutters of old-fashioned houses. The eaves-swallow wants mud. No less necessary is a suitable place on which to plaster it, either a cliff or an overhanging clay bank, or the sides of a barn or house with sheltering eaves. As human dwellings are now far more abundant and convenient than suitable cliffs, the eaves-swallow, except in the remotest regions, has entirely lost the original cliff-building habit, and is now seldom called by her old name of cliff-swallow, but by the new one of eaves-swallow.

The eaves-swallow cannot use all kinds of mud. To make a nest strong enough to support four or five full-grown young and one or both parent birds, requires mud that is adhesive and tenacious, that is, sticky mud, which will not be brittle or crumbling when dry. Clay has these properties; so the eaves-swallow and the brickmaker, who also helps to build houses out of mud, work together on the clay beds. Nearly always about brickyards you will see eaves-swallows if

there are any in the country. The brickmaker bakes his clay by fire; but the swallow hardens hers in the sun, and makes it more tenacious by mingling with it rootlets and bits of vegetable fibre to hold it closer together. So in the days of ancient Egypt, when men built of sun-dried brick, they mingled straw with the clay to keep it from crumbling.

After a shower, when the puddles are still standing in the roads or have dried away just enough to leave a creamy stretch of mud about their edges, you may have seen a cluster of swallows gathered as thick as butterflies around a puddle and not unlike them in appearance; for every swallow balances itself on its tiny feet with its wings raked high in air and fluttering above its head. The whole cluster flickers its wings unceasingly, and when one rises all the others fly too, and they travel home together. Why do they keep their wings up so? And how do they carry their mud? The first question you may answer for yourself, the last one we can easily settle by looking at the spot they have just left. There are the little pinholes left by their toe-nails, and in front of these are creases an inch long, where the mud was taken. Evidently they take the mud with their bills, not with their feet, else we should not see the toe marks so distinctly. It is equally evident that they must carry the mud in their mouths, for their bills are too small to hold any considerable amount. Indeed, if you watch them through an opera glass, you will see that when they fly home their throats stick out like a chipmunk's when his pouches are full of nuts.

They come and go in companies from the barn to the mud-hole. If one gets his mud sooner than the others, he flies about once or twice waiting for them to get their loads. Perhaps he does not get his full load at one place and rises in a circle to drop again and finish filling his throat elsewhere.

Usually mates do not go together. One stops by the nest and rests or works upon it while the other flies after mud. They stop and chat a moment together and then change places, the loaded newcomer remaining to plaster and build up the home while the other joins the outgoing mud-seekers. When the nest is small, one bird starts out just as the other arrives; they say, "How do you do?" in passing and waste no time; but when it is nearly finished, and time is not so important to them, they sit in the nest and converse a little while. The colony I am speaking of went about five hundred yards for its mud, — that is, rather more than quarter of a mile, — but no doubt they sometimes go much farther.

The bird with the load of mud, on arriving at the nest, rests a moment, then begins retching violently and ejects a large ball of mud, which it adds to the edge of the nest. This is immediately followed by one or two smaller mouthfuls. These are placed more carefully than the first and often seem to be mixed in the bird's mouth before they are deposited. Perhaps some sticky saliva is worked into them to make them adhere more closely to the mass. There is need that the nest should be made as firm as possible, for when the young are well grown it must support a considerable weight. With us the swallows use both the white clay and the blue sea clay. The blue marine clay, containing seashells and sea plants and still smelling of the briny ocean, underlies the white fresh-water clay, which was deposited later. In making bricks men have used up the white clay and have worked down to the blue sea-deposit. This is valueless for brick-making, but, oddly enough, the swallows seem to find it just as good as the other, of which they can get any amount and quite as near.

One might watch some time and yet not see the swallow lay the foundations of her house; and, without seeing it done,

it would be hard to tell how she strikes so true a curve in setting her first course of mud pellets. She may not always use the same method, but I have seen her proceed as scientifically as a mason. Coming with her load of mud, she clings to the side of the barn with both feet and braces herself by her tail at such an angle as to begin at one of the upper "corners" of the nest. Then she deposits her mud in little dabs, not in large lumps as she lays it on later in the work, turning on her feet as a pivot and still keeping her tail fast applied to the wall, although it is spread quite out of shape by the turning of her body. She has struck out a circle, her feet the centre, her bill making the circumference; and by working in this way, from the mud carried at that first load, she lays a line of pellets nearly half around the circumference of the intended nest. I do not know whether one bird is architect and master mason, and the other merely a hod-carrier, but it is interesting to see that they know the use of the compasses and that, rather than lose their line, they prefer to hang in a cramped position, sometimes almost head down.

Rude as the work looks to us, these little masons are skilful builders. They must also be trained architects or their work would not stand the strain put upon it. What do they allow for the weight of their families? How do they calculate the effect of the drought and sun on the dry mud? What are their tests for the adhesiveness of their clay? These are their masonic secrets, which they never divulge.

Wherever you find a large colony of eaves-swallows, you will find conditions most favorable for mud-gathering. As such choice places are not abundant, and as the birds are social, large communities build together. Nearly always their nests are on the south side of a barn, grouped under the

overhanging eaves. In one case I know of their building on the east, and in another on the north side of a barn, but this was because these were more sheltered. However, the north side is often occupied by a few pairs that have arrived too late to take up a house lot under the warmer eaves. Rather than be separated from their friends, they will build on an undesirable homestead.

Near my home is a barn that has, for many years, been the resort of a large colony of eaves-swallows. The owner had wisely protected them, and they visited him every year in great numbers. I imagine that several other colonies near there are made up of swallows of this original community forced to emigrate and seek a home elsewhere for lack of room here. In 1898 there were seventy nests in the colony, two years before there were one hundred and eleven, and the year before there were one hundred and sixty-five. The last two years the numbers decreased, and this year the whole colony has removed.

In the winter of 1896, the English sparrows roosted all winter in these old swallows' nests and in the spring built in them, intending to raise their broods in nests they had not made. But when the swallows came, there was war. The swallows pulled down the nests, — eggs, young ones, and all, — and fought the sparrows till they were glad to escape with their lives. However, the north side of the building was not needed by the swallows that year, only a few pairs building there; and a pair of sparrows that resisted the onslaughts of these few came off victorious. They occupied an old swallow's nest, and a pair of swallows lived next-door neighbor to them. The next year the sparrows again wintered in the barn and tried to occupy the ground for their nesting, but bag and baggage they were packed off, and the swallows gloried in their complete possession.

THE EAVES-SWALLOW: HOW SHE CHANGED HER STYLE OF BUILDING.

When the eaves-swallow first came about the homes of men, she built a different nest from that she builds to-day. Her home had been the sides of cliffs, not so smooth and straight as the sides of a barn, and not protected by any overhanging

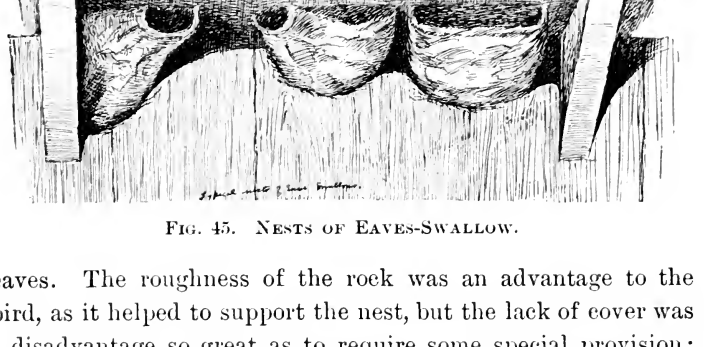

Fig. 45. Nests of Eaves-Swallow.

eaves. The roughness of the rock was an advantage to the bird, as it helped to support the nest, but the lack of cover was a disadvantage so great as to require some special provision; for if the rain beat into the swallow's nest, it would drown the little ones, or soak the nest until it fell from the cliff. The mud nest of the swallow is water-tight, and rain cannot drip through, as it might through a nest of sticks. So, in her wild state, the eaves-swallow built a covered nest of a form commonly known as the "bottle-nosed nest." It was like a rudely modelled, round-bodied, short-necked flask of mud, stuck against the cliff by the bottom end, so that the bird could enter by the mouth of the flask. The neck of the bottle was a little passage-

way that led to a round and comfortable chamber. Though not pretty, this nest was very ingenious, and it answered perfectly the swallow's requirements.

To-day the swallow makes a very different nest. It is a little pocket hung against the wall of the barn close under the eaves, partly supported by the side of the barn, partly by the roofing eaves, with no tunnel to enter it and no mud roof. Instead of being like a mud bottle, complete but for the bottom, which the rock supplied, the commonest form to-day resembles a quarter section of an orange peel stuck up beneath the rafters and entered by a hole scooped out at the top.

Why has the swallow changed her architecture within fifty years? All the older swallows built mud bottles even for years after they frequented barns. Your grandfather will tell you that when he was a boy he saw nothing else. Yet you perhaps never saw one in your life.

The swallow is a bird that learns much by experience. When she first began nesting against barns she had a great deal of trouble. A modern barn presents quite a different problem from a cliff of rock or a bank of hard clay. In the first place, it is much smoother, and it is much more nearly perpendicular, so it offers no natural support to the nest. We speak of perpendicular cliffs, but we rarely see one. The partial support that the slope of the cliff afforded was wanting in the barn. Then, the rock was always moist while the barn grew very dry in summer. The moisture that condensed upon the rock was just sufficient to keep the mud from growing too dry at the point of contact, so the nest held securely. But the dry boards robbed the nest of its natural moisture, and the racking of summer tempests, or the jar of heavy carts across the barn floor, or the weight of the birds in the nest, would often send the whole household tumbling to the ground.

These calamities were so frequent that the swallows began to consider. They liked their new quarters too well to return to nesting against cliffs. On the whole, men were good to them, flies were abundant, and it was warmer here than in the wilderness. So they remained; and they took the sensible way of remedying their distresses. They began to remodel their nests. The first thing to do was to diminish the weight. They cut away the long, bottle-nosed entrance, and they altered the shape of the body of the nest. Its greatest length had been perpendicular to the side of the barn, so that gravity tended to drag it off; now they made the greatest length parallel with the barn, thus exposing the structure less to the pull of gravity, and giving a greater surface of attachment. No roof was needed now, for the eaves formed that. No entrance passage was needed, and that was sacrificed. The eaves-swallow's nest had been perfectly adapted to its new conditions.

And yet there arose circumstances wherein the new house was not an entire success. Once, on a trip in the Maine woods, we came to a farm ten miles from the nearest house and about thirty from the nearest town. It was kept up to raise hay for the lumbermen's horses in winter, and had a fine new barn, with the eaves finished out at right angles to the sides. Here a colony of swallows had built their nests, and to my surprise they were the old-fashioned, bottle-nosed structures that civilized swallows had abandoned forty years before. There are two possible explanations of this. Perhaps these backwoods swallows had never learned to alter their nests; perhaps, as they were outside the limits of civilization, they held old-fogy notions of letting well enough alone, or perhaps they had some method in their work.

This barn was painted, very smoothly finished, and much

more difficult to build against than the ordinary rough structure. The eaves, too, were at right angles. If we make some diagrams we can see what shape would be best fitted for these conditions and for the old style of barn. Under sloping, unfinished eaves the bottle nest does not fit well; a pocket is better. But under square-finished eaves the flask-shaped nest, with slight modification, fits perfectly. When we recollect that mud does not stick to smooth paint very well, we shall see that under eaves of this sort the bottle nest gives a greater supporting surface than the pocket. The nest is stronger for being of that shape. It is more work to make it, but the work pays in the end. Whether these swallows built their nests so because they were wise, or because they did not know any better, we cannot tell; but we shall see that they are still capable of making improvements and of adapting themselves to varying circumstances.

The bottle-nosed nest is not entirely gone yet. There has been a revival of it in a colony near my home within a few years. When this colony grew so large that it found its favorite barn too small, there was a great demand for nesting-places among the swallows, and much ingenuity was shown in building on badly shaped house-lots. This is an old-fashioned barn with sloping rafters, unfinished beneath. The nests not only follow the side of the barn close beneath the eaves, but they extend down both sides of the rafters, and are placed in tiers one below the other, clinging partly to the wall and partly to the nests above. The lowest nests, that is, those nearest the edge of the eaves, are most exposed to the weather, and these are often built with bottle necks. The nests built first are not of this type because the birds take the most desirable places and build the nest requiring least work. But, later in the season, the bottle necks appear.

Once I saw a new shape of nest in a peculiar situation. In two or three colonies I have seen the same, but the location for it is so unusual that I can only regard it as a new departure in swallow architecture. The site chosen in these cases was just above the window frame of clapboarded buildings. The only support was a finish about an inch wide around the window and what little additional support came from the outward slant of the clapboards. Two objects evidently must be held in view, — sufficiently large attachment surface to make the nest secure, and protection from the weather. The first was gained by making the nest nearly round and perhaps five inches in diameter, which gave it a wide circle for its point of support. The last was provided for by making it entirely covered, the entrance being by a small round hole near the centre. The nests looked like big mud pies, with holes in them, stuck against the sides of the houses. These colonies were small, but all nested in the same way. Sometimes these hemispherical nests were not attached to the side of the building, but were placed upon one another till they formed a great, shapeless mass of mud, full of holes; for even in this swallow apartment-house, every nest still had its own private entrance.

In the colony near my home I see scarcely two nests alike. Each one is fitted to its own place, or to its maker's whim, but there is a reason in it. Allowing for individual preferences, we find that they fall into certain well-marked types. There are the pocket nests, lying entirely under the eaves, the bottle-nosed nests placed near the edge of the eaves where the exposure is greater, and the hemispherical nests fully exposed on the face of a vertical surface.

It has taken not more than fifty years for the birds to learn all this, and they still are learning. Men never began to learn so much about building houses in so short a time.

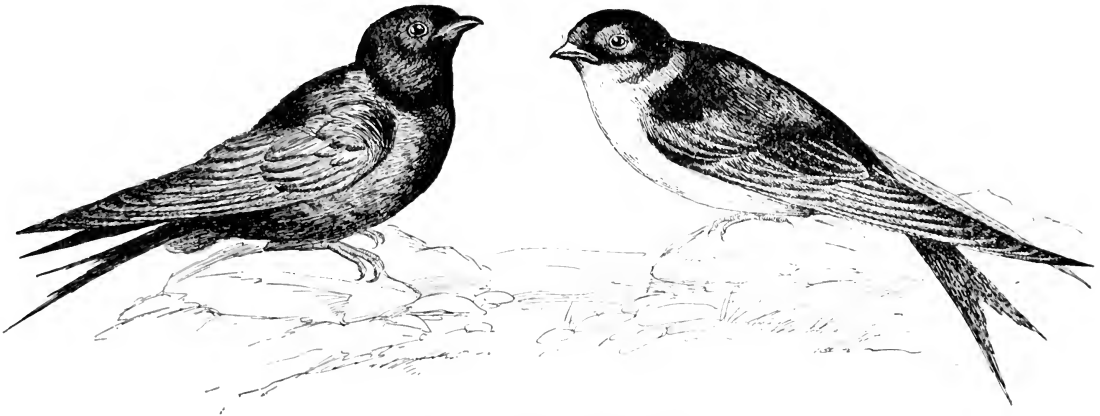

FIG. 46. — PURPLE MARTINS.

Facing page 213.

KNIGHTS AND CASTLES.

THE PURPLE MARTIN.

As a fighter of unimpeachable courage, address, and boldness that never takes up the gauge of battle without reason, nor lays it down without honor, the purple martin stands peerless. He is a knightly character, amiable, gentle, courteous, and wholly devoted to his lady wife whom he adores and caresses with sweet words; but very valiant toward any enemy, and, though unarmed in either bill or claws, both of which are small and weak, willing to engage in battle with any that affronts him. Like the knights of old he wears a steel-blue suit that shines like polished metal (but his lady's gown is white beneath); and, like the ancient knight, he prefers to live in a castle.

I do not see them so often now, but in my childhood no carpenter in New England considered that he had finished a barn until he had built and placed upon its gable a martin box. These were sometimes elaborate affairs, and occasionally were so large that, instead of being perched above the peak of the barn on a short pole, they were erected in the middle of the farmyard upon a staff of their own as large as a small mast. In this case they spun a weather-vane upon their roofs, a horse, or a fish, or a gaudy cockerel that tried to run before the breeze, and could do nothing but turn round and round as it whiffled east or west. In this case, too, they were usually not snug little cottages, but pyramidal palaces of many stories, each with a wide balcony in front, and with many little round-topped doors opening into as many snug chambers, in

each of which a pair of martins or blue-backed swallows nested. Indeed, were it not for its inaccessibility, we should call this a swallow hotel instead of a swallow castle.

How these martin houses came to be so generally built, especially in scattered farming sections, it is hard to say. Perhaps the early settlers had some real fondness for the pretty, social bird; perhaps they were reminded in him of the old country over the sea; but quite as likely, in their sensible, unsentimental way, they encouraged him as a protector to their chickens. There was a time, with the woods creeping up to the edge of every farm, when crows and hawks were far bolder and more troublesome than to-day, and when a colony of martins not only gave the chickens a cry of danger which they understood, and brought out the farmer with his gun, but joined battle themselves, and held the thief and assassin from his plundering by their furious assaults. The farmer of the old times was not particularly intelligent or sentimental or merciful; he neither knew nor cared what a bird ate so long as it did not eat anything he could sell; he was not the least grateful to the martin for destroying insects, and he tolerated no bird or beast that "wasn't some good." If he encouraged the martin, the chances are that he was merely retaining him as a sky watchman on his chickens. The lazy dog got no bone of charity in the old-time farm-house, and the martin paid his rent, no doubt, in hard work. But for some reason he had a house provided for him.

It was always a glad sound in the spring to hear the martins coming back with loud chirps of joy as they saw at a distance and recognized their old home. "There it is! Don't you see it? Oh, hurry, hurry up!" they called to each other, and swift and straight as a flight of cross-bow bolts they sped to it. All the rest of the day they would sit about their door-

ways, talking in loud, sweet voices, much above their usual key. Their excitement and joy were delightful to witness.

In time they began to think of nest building. The old castles underwent a spring cleaning, and the furniture was thoroughly renovated. They are cleanly birds, and love sweet fresh beds and pleasant situations. Do you recollect how Shakespeare's Scottish general in the play of "Macbeth" mentions this daintiness of the English martin — a bird which in habits more nearly resembles our eaves-swallows than our martin?

> "This guest of summer,
> The temple-haunting martlet, does approve,
> By his lov'd mansionry, that the heaven's breath
> Smells wooingly here; no jutty, frieze,
> Nor coign of vantage, but this bird
> Hath made his pendant bed, and procreant cradle.
> *Where they much breed and haunt, I have observed*
> *The air is delicate.*"

A wonderfully accurate observation, as you see, for that early day, and an excellent naturalist this Banquo, or Shakespeare.

The martin is equally particular about her bed. Other swallows, except those building mud nests, gather their material on the wing, but the martin is deliberate and critical in her choice. Near our neighbor's martin house there once was a field of oats bounded by a high board fence that, by reason of a convenient knot-hole, was a fine place for spies and eaves-droppers to birds' private business. From behind it one could observe the martins. In the spring much of the oat-straw, still clean and bright, was left among the stubble, and to it the martins came for nesting-stuff. The knight and his lady always came together and dropped among the stubble. They would chat a little together softly, and

the female would look about for suitable straws, picking one or two long, heavy ones. She always made her own selection and carried her own load, though the male made every journey with her. Whether she discouraged male interference and wished to choose the furniture herself, or whether he escorted her to defend her, was never plain; but the males of that community, while kind, loving, and full of deference to their wives, never carried any burden. The nest was finished with a few fresh feathers; but how it was constructed was one of the secrets of the martin house that no boy ever was reckless enough to try to discover.

There was a time when the martins nested in holes in trees, and in Southern California they still do that. In the South, gourds or calabashes were often hung where they could build in the hollow shell. And it seems probable that at some time they may have built a mud nest like the English martin and our eaves-swallow; for there is a record that a pair that were troubled by water dripping from the eaves of their house and running under the nest, built a wall of mud two inches wide and six long, weighing half a pound, as a water-guard, showing that they had not forgotten the mason's trade.

When men are friendly, the martin lives without fear. Cats cannot climb to his castle, hawks cannot overtake him on the wing, none have an enmity against him, and he bears ill will to none, with a single exception. One year, when he came back from the South, the martin found the muddy tracks of a strange bird on his verandas, his castle filled with rubbish, and a harsh-voiced ragamuffin in possession. The English sparrow had moved in. And the English sparrow was invited to move out again with more speed than ceremony. How the angry martins flew at him, how they tossed every stick of his dirty furniture after him, and raged in their wrath against the

foreign interloper! The sparrow was a bully and a tyrant over all the other birds, but he learned that the martins were his masters.

However, when winter came and the air was frosty, the empty martin houses were too inviting to be resisted. Back the sparrows went, and who would leave earlier in the spring than he had to? They always forgot to leave until the day the martins came and they were whipped into ignominious retreat, their nests, eggs, and half-fledged young being pitched out after them.

Nor were these bloodless encounters. They were battles royal to be sung by Homers of the swallow tribe, each hero called by name; for here was foughten field, beleaguered castle, the storming of a citadel, the rout of the entrenched where those unarmed and unprotected fought against stout and well-armed ruffians sheltered behind walls that could not be breached nor broken. The best and most knightly tales we can remember are scarcely too grand to be compared with this story of some little birds fighting for a toy house stuck up on a pole. I am wholly serious in admiring them. These battles lasted two or three days, as much, in proportion to the length of their lives, as two or three weeks would be to a man. We think that perhaps the pulls and pecks and pinches did not hurt, they being birds; but these were battles to the utterance; these birds killed each other. At one of the two martin houses nearest my home, one year two dead sparrows and two dead martins were found on the ground — perhaps a fifth of all those engaged in the fight; and at the other house I am told that more were killed, though not more in proportion to the contestants. The martins always were victorious. The only time when they were not completely so, was once when the colony was so small that they could occupy only the upper stories of the house, when they permitted the sparrows to build below them.

If you wish to know how dauntless is the spirit of the martin let me tell you a little story. For many years a colony of martins have nested in a house on the gable of one of the tannery sheds in Brewer, Maine. The tannery itself, a large wooden structure, stood not more than thirty feet from the shed, but disconnected. In the year 1897, the martins returned on the twenty-second of April, fought their annual battle with the English sparrows, and settled down for a few days before they began to keep house. There were six or eight in the flock, which was never a large one. On the first day of May, just at dusk, the tannery caught fire. The martins were asleep for the night and must have been awakened by the shouts of men and by the glare and crackling of the fire. From the first the building was doomed, though the firemen made an effort to save it, and took their stand on the windward side near by the martin house. But the heat there was terrible, and they were forced to fall back to a much greater distance. Not so with the martins, however; it was their home, and they would fight fire as they had fought sparrows. They never retreated from it, but wheeled round it with the fierce battle-love of war-eagles, drenched by the heavy streams of water so that they could hardly fly, scorched by the heat, but heeding neither fire nor water, the roar of the flames, the rending of timbers, the puffing of engines, nor the noise of the crowd. They had no nest nor eggs to protect, but they never thought of deserting the house they had fought for even if it cost them their lives. It is pleasant to know that their house was saved and that they bred and brought up their families there, and sang to them little home-made ballads of the great events of the year, the fire and the fight with sparrows, a sort of swallow-saga of exultation.

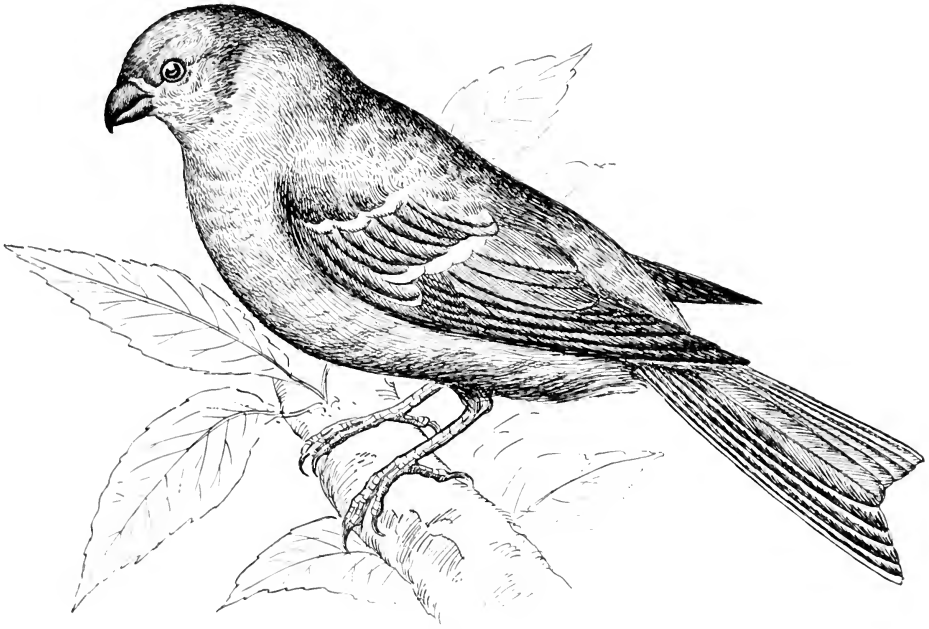

FIG. 47. — PINE GROSBEAK.

Facing page 219.

SOME CAGED PINE GROSBEAKS.

THE pine grosbeak comes down from the North only in winter, and seldom goes far south of New England; but a little account of a pair that I held captive for a time, may give some hints of what can be learned from watching a caged bird.

On those winters when food is scarce in the north the pine grosbeaks come south in large flocks to eat the berries of the mountain ash and black alder and the buds of maple, ash, and pine trees. Our first notice of their coming is hearing their wild, sweet whistle overhead, or seeing the ground strewn with the scales of leaf-buds, which they drop in feeding. They are the largest of our tamer winter birds, and look like a magnified sparrow, being about the size of a robin and more heavily built. Though they vary in color, from gray with a yellow rump and crown in the female and young, to a rosy red all over in the adult male, all ages and sexes have two broad white wing-bars which give an easy mark of identification.

During the great flights of grosbeaks in 1897, four were brought me alive, and for a few hours all were put into one cage. In this interval one of them lost all the long quills from both wings, either by self-injury or by malice on the part of the others. The poor fellow could not fly, and his wings needed attention, so it was decided to keep him and one companion, and to release the others. The birds were so near alike in color that the sexes could not be distinguished, but the gentlest tempered bird was selected to remain with this one, which, by his determined resistance, his fierce biting, and his loud snapping of the bill, was supposed to be a male.

The pair were put in a large parrot cage with a swinging ring and lived there for six weeks, apparently happy and certainly well fed. They were very much pleased with the swinging ring, and became quite expert in leaping into it without losing their balance, although I often altered the position of the perches below, so they must strike the ring at a new and inconvenient angle. They swung in it singly and together, and at night always slept in it side by side — a forest habit, no doubt, of sleeping in a high place for safety. At first they slept soundly, with their heads tucked under their wings; but frequent interruptions and night alarms caused them either to give up the habit entirely or to sleep much more lightly, for after a few days we never caught them napping.

They ate apples, both fresh and the "frozen-thawed" from the trees, preferring the seeds, but eating a portion of the pulp also. The berries of the mountain ash they ate eagerly, rejecting most of the pulp. They loved the terminal buds of fir and maple twigs, and one day, when loose in the room, cropped their mistress's carnations and azaleas of every leaf-bud. Bird-seed formed their principal diet after the first two weeks, and they showed a decided preference for canary seed. When fed the mixed hemp, rape, millet, and canary seed they appeared to reject all but the latter. At first they carefully shelled all their bird-seed, as they do their apple-seeds, and the cage was littered with the chaff; but toward the end of their stay they seemed to learn that there was no necessity for this extra work, and few husks were found on the floor. When the fresh seed was first put in, the male usually stood in the middle of the seed-dish and made his little wife watch him while he enjoyed himself. When their hunger was satisfied, and they were eating for the fun of it, they would take several seeds in their mouths and hop up on the perch, where

they would chew each separately under the corner of their beaks. Gravel they ate eagerly and seemed to need frequently, but cuttle-bone they either did not desire or its use they could not understand.

They were exceedingly particular about their water, drank much if it was good, but went thirsty rather than touch any that had stood in the cage over night. A bath was their greatest pleasure, and they threw the spray in such quantities as to wet the floor for three feet around the cage. But the bath must be fresh or they would go without it. They seemed to need it to keep their feathers trim. For the first week it was not offered them because we knew that in winter they could get no water to bathe in but dusted themselves in snow; yet when given them regularly the bath produced an immediate improvement in their personal appearance. It was noteworthy what a difference life indoors made in their figures. They always look to be stout, puffy birds when wild, because they fluff out their feathers so as to make a loose, thick garment that holds the heat of the body; but in captivity, needing no extra warmth, they laid their feathers flat, and became trim and elegant in figure, rather slenderer, it seemed to me, than most birds.

The little grosbeaks became very tame. Though they would not willingly allow us to handle them, they were never afraid of any grown person. Of a child they were suspicious; in the presence of the baby they showed positive alarm. The dog terrified them; but the sight of a cat made them frantic, and often their cries of terror would draw one of us from another room in time to see a strange cat slink away from the low veranda windows. This excessive fright at a cat was at least partly explained by a narrow escape they had one day from a neighbor's pussy, which, having the liberty of the house, got

into the room where they were and with her claws tore the neck of the little female. But why should they have been afraid of the baby unless they classed four-footed beasts and creeping things together?

When first captured they had two notes, — their low, pleasant, conversational talk with each other, and their shrill alarm note, which they uttered when they saw flocks of their mates outside, a peculiar, piercing call, fit for the company of pine trees and a home in the North. The last of February the male began to sing, a little whispering warble, sweet and ventriloquial, performed with the bill shut, and so hard to be located that when the birds were not more than a foot away it was difficult to tell which was the singer. Yet through a closed door the song could be heard, apparently just as loud. It is probable that the male would have improved in his singing in a few weeks, for his nearest relatives are good songsters, and he himself is not without a reputation.

We were now able to be sure that the singer was a male, for, during the few weeks that the birds had been with us, one of them had been slowly, but unmistakably, turning red. Had this one been alone we should hardly have believed the change had occurred; but, knowing that in the beginning both were alike, it was easy to see that the male's color had spread and deepened, had suffused his breast and crept down his back and brightened on his head and rump till these parts were no longer yellow, but a coppery red. And yet the change had come about without the loss of a single feather, except the primaries torn out in battle and two tail feathers broken by the cage. If new feathers grew, we did not see them, though the birds were often in our hands. Here was a case of "color-change without moult," a subject of great interest to scientists and not yet fully explained.

Another point worth notice was that both of them were right-handed. Whenever they clung to the bars of their cage, the right foot was put lowest down to bear the strain; and not only was this seen by constant observation to be their preference, but it was proved by the tails, which became very much worn upon the *left* side, where they rubbed against the bars. A lady who once kept a wild swamp sparrow captive, noticed that it always wet its food with its right foot and became lame in its left hip in consequence of the strain. Still, it is a matter of dispute whether animals are naturally right-handed. The parrot, it is said, is left-handed. Can you guess why? Do you know whether it is so?

After a few days the little grosbeaks became very tame. They would allow no one to fondle them, and seemed to have no favorites among their attendants; but they were not at all timid, and could be given the liberty of the room in which they were kept for an hour or two every day. There were some hard knocks against the window-panes before they learned that glass is solid, although so clear, but they learned the lesson. Nor did they seem anxious for their liberty. After an hour or two of freedom they would go into their cage, or allow themselves to be caught in the hand. There was something so brave and trustful in the way they would look up with their clear hazel eyes, as if to say, "You don't mean to hurt us; we are sure you don't." All this time the wing-quills of the male had been growing, and he was now able to fly as well as ever. They were great pets, and we tried to make them happy. Our last attempt succeeded so well that it ends this story; for there came a day in March when to do them a pleasure they were taken out on the veranda for an airing. The bottom of the cage dropped out, and the male, wild for the freedom of the fresh air, leaped from his cage,

and with joyful cries flew to the top of the highest maple. His little mate did not attempt to follow him, but a gentle hand drew her out and made her feel the breeze beneath her wings, when she joined her mate, and neither ever came back to thank us for six weeks' entertainment.

This simple story contains nothing that any child might not observe; but it shows that something may be learned even from caged birds, and it happens to illustrate three disputed points in science: whether wild birds sleep with their heads beneath their wings, whether they are naturally right-handed, and the color change without a moult. However, unless some accident, like that to our pine grosbeak, disables a bird, no wild bird should ever be kept in captivity unless it has perfect freedom, like a tame crow or blackbird.

FIG. 48. — CUCKOO.

Facing page 225.

THE BIRD INVISIBLE.

THE CUCKOO.

WHO knows Cuckoo? Listen! *Kow-kow-kow-kow*, you hear it in the apple tree, and *kow-kow-kow-kow* off by the brookside, and up along the fringe of willows *kow-kow-kow* just as loud as before.

The farmer's boy snaps together his jack-knife and sets off in the direction of the sound, grumbling that the old turkey is straying again, and the fox in the swamp will get him as he richly deserves. He never suspects that it is not the turkey at all but a cuckoo leading him off into the wet and oozy thickets. Perhaps he thought she shouted out her name as clearly as the little birds on the Swiss clocks that sing *cuck-oo, cuck-oo,* with the hours; perhaps he thought that any bird which the poets had praised so highly ought to be able to sing at least a little. This hoarse *kow-kow-kow* is nothing but a noise, and a very harsh one at that; so that it was an apt retort, as well as a witty one, when Shakespeare's heroine declared, —

> "He knows me as the blind man knows the cuckoo,
> *By the bad voice.*"

That is as good a way as any to recognize Cuckoo. Not only is her voice bad, except when crooning her soft *coo-coo-coo, coo-coo,* but it is unmistakable, and usually it is the only warning of her presence. She flits and calls and wanders from bush to tree, restless as a ghost and nearly as invisible, but proclaiming her whereabouts by her loud and frequent

calling. But long shall you watch before you catch her crying out her *kow-kow-kow*. Let her come upon you lying in the grass and there is not a more silent bird anywhere than our shy, soft-mannered cuckoo. She will regard you shrinkingly a moment, and then fade away before your eyes. Not a rustle of a leaf, not a stir of a twig, not a flip of wings, but a ghostly vanishing. The slender, soft-colored, long-tailed bird that looked at you out of a clear hazel eye evaded you just at the moment when you winked or glanced aside. Perhaps she merely hopped a little way and drew herself into some uncouth position, as long and slender as a dead apple-branch; or perhaps her hazy colors hid her; or perhaps she removed quite away from you, and you hear her *kow-kow-kow* from another leafy cover.

You must not expect a closer acquaintance. Cuckoo is so shy, so quiet, so unwilling to be looked at, that unless you have a good glass or unlimited patience you must be satisfied with a glimpse of the soft brown back and the long, graduated tail. In time you will learn her peculiar flight, her size, and her notes so well that even a half glimpse will be all you need to be certain of her neighborhood.

The two kinds of cuckoos which we have in this country look much alike, but they differ enough in their haunts, their habits, and their call notes to be quite readily distinguished, even without a sight of the black on the tail which marks the yellow-billed, and the red stripe around the eye which distinguishes the black-billed cuckoo. In many parts of the country both species are found; in some but one is common, and the other rare or wanting altogether. Do you know whether both sorts live near you? Which do you have? How do you tell them apart? If you have ever heard them called rain crows, as they are in many places, perhaps you can tell

us why they get the name. Do not look for the black-billed cuckoo west of the Rocky Mountains, nor for the yellow-billed at the farthest northern limits of the country, for it is rare north of Massachusetts. In the farthest South there is sometimes seen a third kind called the Mangrove cuckoo. When both kinds are found in the same region, the black-billed will be most commonly detected along wet lowlands, where a little growth of willows or alders borders a meadowy rivulet, while the yellow-billed cuckoo haunts the dry upland pastures, with scattered tufts of shrubby trees and near access to taller, thicker growth.

Some day you may find Cuckoo's nest. Cuckoo is a poor nest builder, so you may easily guess whose house it is even if the owner is not home. "As a nest builder," says one observer, "the cuckoo is no genius, or if a genius he belongs to the impressionist school. The nest is but a raft of sticks flung into the fork of a bough." If you find such a nest, — so shallow that the pale, blue-green eggs may easily be rolled out if the wind blows hard, — thrust into the side of a quickset hedge, or on the low bough of an evergreen, there is little doubt it is Cuckoo's. She usually further advertises herself by twisting a piece of rag into her structure, just as the red-eyed vireo always uses a piece of hornet's nest, and the Baltimore oriole twists strings into her woven pocket, and the great-crested flycatcher wreathes a snakeskin about her nest rim.

It is not wise to go too near Cuckoo's nest, nor to visit it often. She is the most suspicious of mothers, and often deserts her nest when she finds that it has been discovered. Instead, keep away from the pretty green eggs and the ugly black babies until some day you see Madam Cuckoo bringing caterpillars to what you think are little Plymouth Rock chickens. Then you may watch her if you will. Naturally you will be rather aston-

ished till you reflect that, in bird-land, to feed a young bird and to worry over it always means either an own child or an adopted one. These little short-tailed, mottled slate-and-white nestlings are certainly the own children of our elegant, graceful, long-tailed cuckoo. In time they will outgrow the difference and will look like her.

There have been all kinds of stories about Cuckoo. Some say that she lays her eggs in other birds' nests, and some that she sucks eggs to make her voice clear. But we all know that she is as hoarse as a crow, and the best naturalists to-day, though they admit that they suspect her of egg-stealing, do not say that they ever caught her at it. All that I am sure of is that the other birds call her very bad names and try to drive her away. This looks suspicious, but proves nothing. Of the other charge there is rather more evidence, but even that is not wholly against Cuckoo. She makes her own nest and takes care of her own brood, as a rule. Occasionally she lays an egg in some other bird's nest, but so rarely that you are never likely to see it, or at most only in a certain particular case. The black-billed cuckoo is rather prone to lay her eggs in her yellow-billed cousin's nest, and yellow-bill just as frequently returns the compliment. You can tell the eggs apart by their color. But who cares? Aren't they all cuckoos? And who cares if the cuckoo drops an egg now and then into the nest of some other bird? A young cuckoo is as useful as any other young bird, and is no more trouble to his foster parents than their own birdlings.

The most important fact about Cuckoo is that she is our greatest caterpillar hunter, and one of the best friends the fruit grower has. When the ugly tent caterpillars have twisted their webs about the ends of the apple-tree boughs, and are beginning to crawl down the trunk in an endless

procession, she is there to make war upon them. When the canker-worms are cutting up the leaves till the trees are stark naked, then Cuckoo comes to fight them. She cannot eat them all, but she abates the nuisance even at its worst; and more often than we know for she nips the devastation before it has grown great. The cuckoos are almost the only birds that will touch a hairy caterpillar, but they eat the hairy, spiny sorts by the hundreds at a meal. Being such a quiet, shy bird she is present oftener than we think for; and, working without pay and without vacations, she is not a bad bird to keep around the farm and garden.

A DEAD BEAT.[1]

THE COW-BIRD.

THE habit of laying its eggs in other birds' nests, which we remarked had been a few times observed in our American cuckoos, and which is the regular habit of the European cuckoo, has a name of its own. It is called parasitism.

Parasite is an old Greek name for one who eats at another man's expense. Nowadays we call such a person a dead beat. Any animal that does not work for its own living, or that expects some other animal to bring up its young, is called a parasitic animal. Our cuckoos are only occasionally parasitic, and then without doing any harm; but we have another group of birds that are dead beats of the lowest class.

Little can be said in favor of our common cow-bird.[2] Not only does he shirk the labor of building a nest, and of caring for his young, but the youngsters themselves are worthless fellows, and they always cause the death of all the young in the nest of their foster parents. So every cow-bird that you see is responsible for the death of four or five useful and pretty insectivorous birds, while he himself is good for nothing except eating a few bugs and a little weed-seed. The cow-bird is not only useless and morally disreputable, but he is actually criminal.

[1] The facts concerning cow-birds are principally drawn from Major C. E. Bendire's "Life Histories of North American Birds"; the theory, except the comparison with cuckoos, from Sclater and Hudson's work on the "Birds of the Argentine Republic."

[2] The cuckoo is often called cow-bird, too, from its note; but the true cow-bird is the cow-blackbird, shiny-eye, clodhopper, lazy bird, or buffalo bird of different localities.

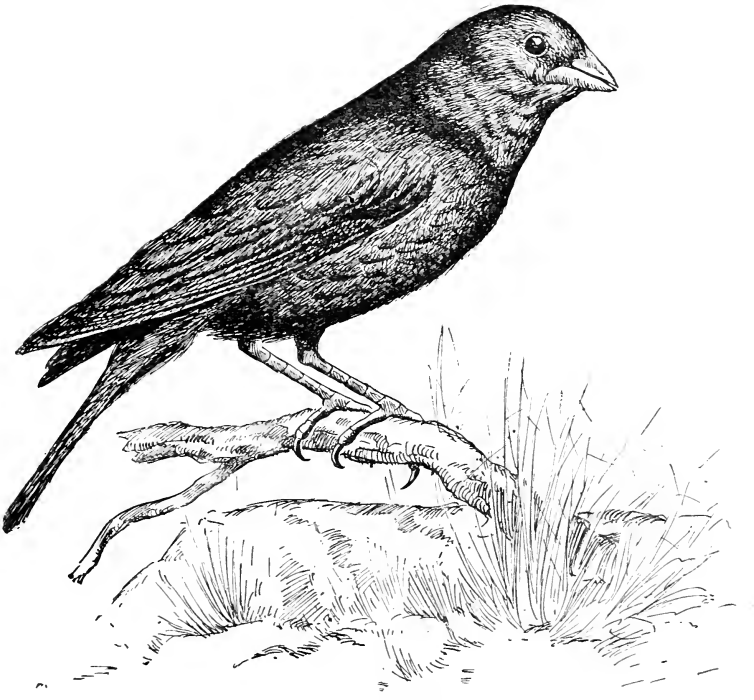

FIG. 49. — COW-BIRD.

Facing page 230.

But even if we do not approve him, we may study him with profit. Naturalists agree that there is a great deal about his crooked ways that is not yet known or explained, and that the study of the cow-bird is one of the best fields open to observers.

We need have no trouble in identifying him. He gets his name from his fondness for cattle, in whose company he is often seen, sometimes even riding on their backs to pick up the vermin on them. (But other birds, like the ani and Brewer's blackbird, also do the same.) His color is a good mark. The male, in spring, is a glossy black, with brown head and shoulders; the female, dull brown. But his note is his most unmistakable characteristic. It has something of the reedy vibrancy of the other blackbirds, but more harshness; and it is uttered with strange contortions of his body, with wings and tail quivering, head depressed, and throat swelled out — an effect wholly disproportioned to the harsh and brassy "*chuck-seé-e*" which he finally jerks out. A flock of these birds in a tree-top sounds like a congregation of rusty door-hinges.

A curious fact about the cow-birds is that the males so outnumber the females that there are usually three or four to a single female. And instead of a large crop of old bachelors, she goes with all of them. Polyandry — having many husbands — this rare habit is called. Polygamy — that is, being married to many wives, like our barnyard cock — is the reverse of this. It is rather a curious observation that in a polygamous society the females have to work very hard; but in a polyandrous society they do not work at all. Perhaps this may account for the lazy ways into which these birds have fallen.

There are twelve species of these birds in the New World and none (except rarely one of them) is known to build a nest, though one South American species raises its own brood in

the nests built by other birds. The three species occurring in the limits of the United States neither build nor care for their young. This carelessness is the more notable because the blackbirds, as a rule, build very respectable nests, and their relatives, the orioles, are among the most famous weavers in the world. Why is it that a single genus has entirely given up the habit of nest building?

The female cow-bird lays an unending succession of eggs all summer long in any nest that comes handiest, or sometimes on the ground, as if not caring what became of them. Cow-birds' eggs have been found in the nests of ninety different species of North American birds, some in such strange places as the eaves-swallow's high-hung cradle, the hole of the red-headed woodpecker, and the long tunnel of the rock wren. Usually she selects the nests of some smaller bird, and those most commonly imposed upon are the phœbe, the song-sparrow, the towhee, the indigo bunting, the oven-bird, and the yellow-breasted chat. Often these contain several eggs of the cow-bird and none of their rightful owner's. As many as seven cow-bird's eggs have been found in one nest, though it is not usual to find more than one. When this hatches, it crowds out, smothers out, or starves out the young of the rightful owner, and becomes sole occupant. It is estimated that each female cow-bird[1] lays from eight to twelve eggs. These are usually laid singly in nests that should contain from four to five eggs of another bird. If all the cow-birds' eggs hatched, each female cow-bird would be responsible for starving from thirty to sixty little birds of our most beneficial sorts. Perhaps it is fortunate that the males are in excess of the females, or the destruction might be greater.

[1] Hudson estimates that the female Argentine cow-bird lays from sixty to a hundred eggs in a season, and gives good reasons.

Luckily, accidents happen to the cow-bird's eggs. She lays many on the ground; she lays some in deserted nests of the year before; others she puts in new nests that are scarcely completed, and these are frequently deserted by the owners or another story is built over the intruding egg. But too many of them are received and tended. Once the foster mother adopts the big egg, her own brood is doomed. The new egg gets more than its share of warmth; it has wonderful vitality; it hatches very quickly, and its thick shell protects it from accident, for the cow-bird has a habit of breaking the eggs in the nests she visits, even her own if she finds there one laid previously. It is not known whether she pricks them with her beak or with her claws, but each one is punctured so that it will not hatch. How she does it, young naturalists may attempt to discover.

The instance of that South American cow-bird, which takes care of its young in a nest built by other birds, indicates that at some remote period the others probably did the same. It has been suggested that several females might have been in the habit of laying in the same nest to avoid the work of building; and that thus they got into the habit of turning over their eggs to each other's care, each expecting some other bird to do her work for her, until at last in order to hatch any young they were obliged to lay in the nests of unrelated species that were better mothers. Whether laziness or inability to build good nests be the cause of the parasitic habit we cannot determine, but it is noteworthy that the cuckoos, the only other North American birds that are much inclined to similar habits, are poor builders.

But there is another theory, more ingenious and perhaps equally true. In South America many birds build large, domed nests, and these prove so attractive that other species

seek them to nest in just as our martins and sparrows and wrens hunt for martin houses. In time, some of them have lost the art of building nests for themselves, or else rarely practise it. Among these birds is the honest cow-bird. She can build her own nest and sometimes does do it, but she prefers to fight for one of these fine, domed dwellings. She usually gets it, and no sooner has she taken possession than she makes a window in the side to let the light in. Here is a bird that can make an open nest, but that prefers to live in a covered nest.

Now, it is observed that the other species of cow-birds of South America, which are never known to build for themselves, are greatly attracted to these domed nests. They examine them, linger about them, seem inclined to enter, but are afraid to do so, and after a half day's debating between their desire to go in and their fear of the dark, they back away reluctantly. If the inside is light, they will lay in it, but they will not make a hole to let in the light as the honest cow-birds do. A lost instinct seems to prompt them to enter holes, indicating that they once bred in such places, or else built a partially covered nest.

Among these South American cow-birds we observe three stages in acquiring parasitic habits. The bay-winged cow-bird often makes its own nest and brings up its own young, though it more commonly uses the empty nests of other birds; the screaming cow-bird is parasitic on the bay-winged, and more rarely on other birds; the Argentine cow-bird is parasitic on many other birds but not on other cow-birds. One takes an empty nest to avoid the work of building; one lays her eggs in her cousin's nest to escape the care of her young; one goes entirely out of the family and imposes upon birds that are not related.

Among the cuckoos, the first stage of borrowing a nest seems not to have been observed; but the second, of laying in the nests of other birds of the same family, is not infrequent among the American cuckoos; and the third, of complete parasitism, though rare among the American, is habitual in the European cuckoo, which neither builds its nest nor cares for its eggs. It would seem that parasitism must be a habit which has been increasing among these birds, and that our American cuckoos are yet in the earlier stages, while our cow-bird and the European cuckoo have passed on to the extreme form of the habit. But habits are not acquired by a perfectly regular and imperceptible advance. There are always some birds that are ahead of the rest and some that are behind in learning the new ways; even after the habit has become a settled one, there are survivals of the older habit or reversions to it, just as in forming a new habit there are anticipations of it by the most progressive birds. Who knows then but some day sharp eyes may yet discover an old-fashioned cow-bird, not yet educated up to this end-of-the-century new-birdism, feeding her young in a nest of her own building; or perhaps may be able to prove that our cuckoos have as yet just begun their career of parasitism, and, like the cow-bird, are degenerating into bird-hoboes, and gradually but surely becoming bad bird-citizens.

THE NEST IN THE PASTURE SPRUCE.

THE LOGGERHEAD SHRIKE.

Out in the half-cleared New England pasture, where checkerberry leaves glisten on the hillocks, and, in spring, rhodora grows among the pools in the hollows, stands the old pasture spruce, — not tall and stately like its forest brothers, but a sturdy, knotty tree that reaches its long arms out to shelter the sheep and cattle on hot August noons. In a thousand New England pastures stand just such spruce trees, among the clumps of bayberry and huckleberry bushes. In many of them a gray-and-white bird must have her nest, as she does in this. Not many birds care for such an exposed place, which must seem like living on a lighthouse far out from land; but this bird seems to prefer that isolation. In eight nests of which I have records near my old Maine home, six were found in pasture spruces, one in a birch tree, and one in an apple tree, all isolated trees.

The nest was always placed upon the south side of the tree, saddled upon the broad, flat palm of an extended spruce bough at about ten feet from the ground, and built with so much superfluous material that one wonders at the bird's patience in collecting it. An old one which I have just weighed, weighs a quarter of a pound. If you wish to see how much work it was to make it, try to pick up that weight of hairs, dry grasses, and tiny sticks.

But you can by no means judge the work she puts out upon her nest until you work as she does, carrying them

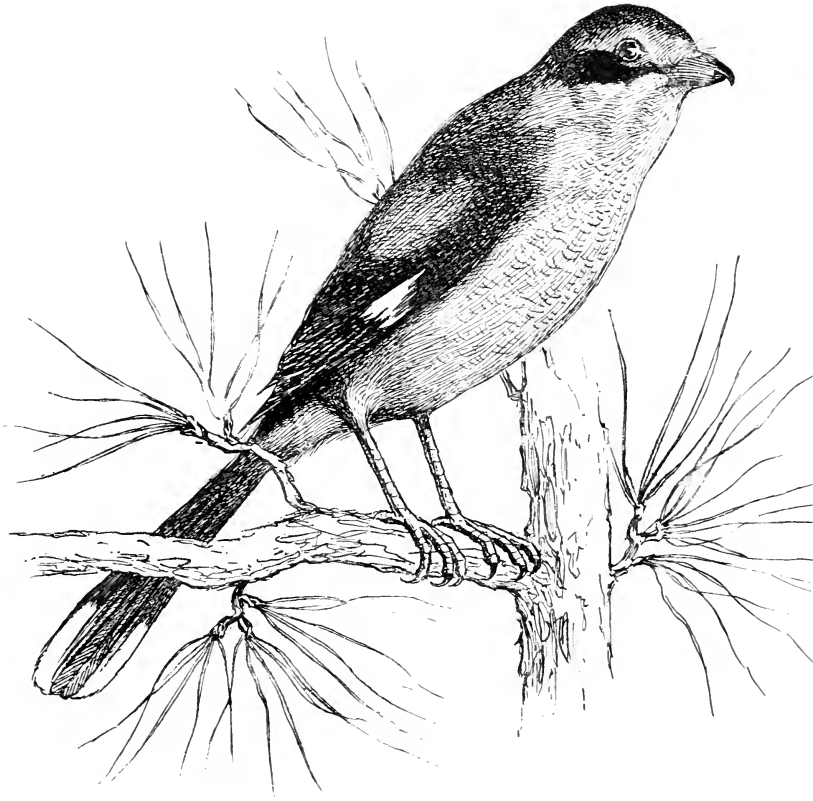

FIG. 50. — SHRIKE.

Facing page 236.

singly from one rod, or five, to a quarter of a mile from the spot where she finds them. Birds often carry their nesting-stuff very long distances. I know some crows that used to line their nests with cow's hair which they must have collected fully a mile from the nest. This was evident because we could see that the hair was such as is scraped from hides at the vats of tanneries; it was in mats that had been soaked; and the only tannery was a full mile away.

Let us examine the nest in the spruce tree. First there is a coarse platform of twigs of birch and juniper, intermingled with tough spruce roots. These must have been pulled by great effort out of the hard, stony ground. It would be as easy for you to jerk up a five-year-old apple tree, and the bird must have gone to work very much as you would have done with the apple tree, first separating each of the side roots, so that only the largest one was left to be pulled off by main strength. There are a number of large roots, more dead twigs, much cedar bark, moss, fine roots, string, and rope yarn in the outer and coarser part of the nest, each with a history when we think where the nest came from.

The cedar bark was stripped from the rail fence surrounding the pasture. I suspect that the rhodora lent these fine rootlets, and these dried, smooth suckers look to me like dried witch-grass stems. (Do not call them *roots;* the witch-grass spreads by an underground *stem.*) Here is the gray moss that grows on ledges. The nearest boulder, where this could be obtained, is twenty rods away from the spruce tree. Here is string — hard-twisted cord, in pieces eight inches and a foot long, as if bitten into convenient lengths by the graybird; loose-twisted wicking, which could be used in bulk; fine thread; materials that I cannot identify; rope-yarn — untwisted; cotton-waste from the railroad track; sheep's wool,

or woollen waste; and store twine, — so much of the last that it would seem she must have begged it of the butcher's boy before he got to the door. Probably she did pick it up early mornings in the yards of houses near by, long before men were stirring.

Did you ever think that some bird's sharp eye was on the lookout for every bit of twine which you throw away? We begin to appreciate how much our habit of using strings freely means to the birds when we notice the use they make of threads, cords, and twines. Time and labor are saved to the birds when men are generous with their strings; and we can make a variety of interesting and simple observations by noting what happens when a good supply of string is at their disposal. A veranda roof is a good place to put them if you spend much time upstairs. Shut the blinds and peep through the cracks to see what kinds of birds come for string. Vary the experiment by putting out weak strings, like worsted, and strong ones, like twine, to see whether the strength of the string is of any importance to them. Place colored strings with the white ones, and notice whether they prefer or avoid the colored ones. Perhaps you may be able to tell whether it is lack of an eye for color or fear of betraying their nests that makes them avoid the colors; and perhaps you will find some species preferring the colors when a choice is given them. Try them with long strings and short, to see whether they judge their material before they carry it off. Fasten some of the strings in various ways to see whether they notice the difference between those that are free and those that are tied, and how much ingenuity they have in clearing them of obstructions. The more systematic and careful you are in making such experiments the more you will see that is worth notice. Random experiments amount to very little. When

you wish to establish one fact, make your arrangements so that your experiment or series of experiments will clearly show what you wish to be proved. This string experiment is the simplest possible, but it is worth trying.

But we are far enough away from our nest in the spruce tree. The outer structure we have already analyzed. Inside this is a layer of hair. There is sheep's wool among it, though I do not know of a sheep in the neighborhood. These white horse hairs certainly came from the tail of old Dobbin, though Dobbin and the Deacon, his master, live half a mile away. If there is any other white horse in that vicinity, the graybird knows her neighbors better than I do. This soft white hair, still lying in little parcels just as the industrious bird collected it in her beak, I recognize as the winter coat of the Squire's cow which must have been gathered hair by hair in such places as the cow was wont to rub her sides while she waited for spring to come. Thus three kinds of animals have furnished the second layer of the graybird's nest.

But there is still a third, softer than any of the others. The widow's hens furnished that, yet her stock is not fairly represented. Here are feathers and feathers, but all of two sorts, — either the white hackles from the neck of some white Cochin cock, or the soft, mottled feathers of Plymouth Rock fowls. There are no gaudy bronze and red plumes from the ruffs of strutting barnyard lords; none of the brown feathers of the Polish, nor black ones from the Spanish fowl. If I did not know better I should think the widow and her neighbors raised little else but Plymouth Rocks. On the contrary, they were not abundant in this neighborhood when this nest was made. If I had not seen other nests, I should think the graybird had "happened" to take these dull, spotted feathers so near her own color. But every nest

I ever saw contains more of Plymouth Rock or of plain white feathers than of every other kind taken together, and observers from other localities near by note the same. Evidently, in this section, the bird chooses these dull feathers, hunts till she finds them, and then arranges them in a curious manner that well bears out the assertion that her choice is reasonable.

At first sight you would call this a rough nest. Any bird, you would think, would know better than to leave feathers sticking up all around her nest in this unfinished way. But more careful observation will show you that the feathers are sticking up only around the rim of the nest; that they are put in carefully so that the tips curve inward over the hollow of the nest. Fifteen Plymouth Rock hen's feathers arch over this deep warm nest, and shade the mother as she sits upon it.

Do you recollect that the bird built in a lone tree in an open pasture, where she was much exposed to enemies? There is a good reason why she should wish to hide herself while on her nest, and why she chose dull, mottled feathers that harmonize with the color of her back and of the nest, for a screen.

It is true that I have not told you the name of the graybird. There is a prejudice against the name of shrike, and when a bird has such an unattractive title as "loggerhead shrike," it is hard for her to get justice done. But really, she is not at all a bad bird, and she does know how to make the softest, warmest nest you ever saw. In the South and West she does not build in a spruce tree nor use so many feathers; there you would best look for her in some thorny thicket.

We have two kinds of shrikes, — the great northern, or winter shrike, and the loggerhead, or summer shrike. The former is seen only in the more northern states, and there

only in winter; the latter, with its subspecies, is found in summer all over the United States, and in the more southern portions is the only shrike ever seen. The two look so much alike when alive that the surest way of identifying them is by the season when they are seen. In Maine the great northern shrike arrives about the first of October and leaves about the first of March, while the loggerhead arrives from the South just in time to relieve him, and stays till the great northern returns in the fall. Farther south, the northern bird spends a shorter time and the southern bird a longer time on the field. The only one known to nest in the United States is the loggerhead, with its subspecies, the Californian and the white-rumped shrikes. Both species are medium-sized birds, gray above and white below, with black wings and tail, marked with white, and a black stripe across the forehead, extending down the side of the head. Young birds lack the black markings and are of a brownish color. Shrikes may be easily identified by their color and by their habits, especially by their choice of the topmost branches of a lone tree or of a fence-post, and by their flying as if intending to alight below their perch and suddenly rising to it with a bound.

HOW THE SHRIKE HUNTS.

Every boy considers the shrikes fair game. He may pop pistols and snap slingshots at them in virtuous indignation, because they are so cruel to the little birds. It is generally believed that they love to torture little birds, and have a habit of hanging them all alive on thorns, and that they are barbarously cruel.

Is it not true that the reason why we think the shrike a bad fellow is not so much because we pity the little birds, as because we feel that if he were only big enough he would like to hang us up on hooks too? We make a bug-a-boo out of the shrike when really he is not a particle more cruel than the crow or the blackbird, not to mention the hawks and owls.

Let us do him justice. He does not torture his victims, but kills them speedily by pecks on the head, or by throttling them; he does not hang them up alive; and though he kills more than he needs, he does not seem to do it wantonly, but tidily hangs up the carcass where he can find it some day when he needs food.

Here is a picture of an English sparrow killed and hung up by a great northern shrike in the fork of an alder twig, drawn from nature so that you may be sure it is correct. It is an honest witness to the fact that the sparrow was dead when dropped into the fork of the branch. Had a spark of life remained, he must have fluttered out of such a wide-angled crotch of a tree which has no thorns or side limbs to hold the

bird. And though very often the shrike hangs up its prey by driving a sharp thorn through its neck, the bird must be dead before this is done, because the shrike has neither the strength nor the sharp claws needed to carry a struggling and frantic bird from a quarter to half as heavy as himself. It is his custom either to peck his victim on the head, or to throttle it by pinching its throat, but not to torture it. Hanging it up is a mere matter of convenience, and shows that the shrike has forethought for the rainy day that is coming, when dinner will not be so easily obtained. If any young observer finds where the shrike has left his meat, he should leave it and watch it occasionally, to see whether the bird ever comes back for it.

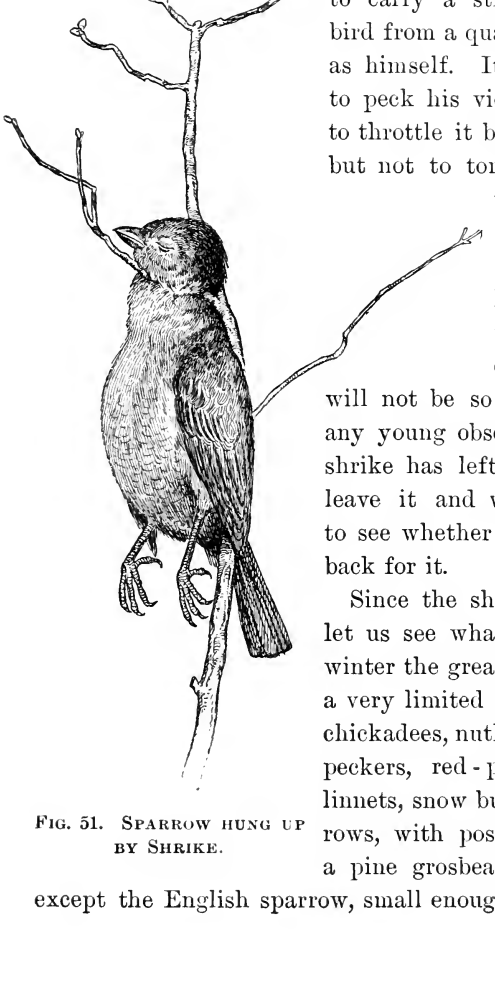

FIG. 51. SPARROW HUNG UP BY SHRIKE.

Since the shrike has a bad name, let us see what harm it does. In winter the great northern shrike has a very limited bill of fare. A few chickadees, nuthatches, downy woodpeckers, red-polls, crossbills, pine linnets, snow buntings, and tree-sparrows, with possibly, now and then, a pine grosbeak are all the birds, except the English sparrow, small enough for him to master,

and, except the first three, none of these are beneficial. Like the shrike, the others are winter emigrants from the North and do no helpful work while they are here.

Indeed, the shrike is one of our most useful birds, for he is a champion sparrow killer. We have no bird so utterly depraved, destructive, and altogether odious as the English sparrow. Aside from all the other harm he does, he is estimated to eat or destroy not less than five million dollars' worth of grain and fruits yearly. Any one who makes one English sparrow live where there were two before does more good than the man in the proverb who set himself to raising grass. We ought to thank any bird that devotes his time to thinning the ranks of this pest.

It has long been well known that the great northern shrike, though a shy bird, naturally averse to the society of man and even of his own kind, is a regular visitor to the parks of great cities and to town and city gardens where sparrows resort. Though not visible every day and all the time, like some birds, he is much more commonly seen there than in the unsettled country.

In my own neighborhood he first became conspicuous a few years after the English sparrow arrived, and his entrance into city life in this vicinity seems to have dated from about that time. Though never an abundant bird, he has become a regular instead of a rare winter visitor, and is still rare, so far as my experience goes, a few miles from town. One city church surrounded with hedges and trees, the favorite resort of sparrows, is his headquarters also; and it is not uncommon while passing the place, to see him make a dash among them and drive them screaming in all directions. However, it was only recently that I realized that he had reduced sparrow-hunting to a science.

At nightfall of a very cold day, as I went out for a walk, I noticed that the sparrows had gone to bed. It was not dark, for a mellow golden light filled the west; but, on account of the cold,the birds had gone to roost early and sat quietly muffled in their feathers. Half a mile farther on, as I paused on the top of a hill to look at the after-glow in the west, I saw a bird flying directly toward me with the greatest speed and a perfectly true course. He must have come from the city across the river, a half mile away, and the manner of his flight showed that he knew whither he was bound.

As he whizzed past, I saw his black, gray, and white livery, and marked his peculiar wing-beat, like the stroke of a strong rower, who rests on his oars a moment between each pull. It was a great northern shrike. He was heading straight for a clump of thick cedars a hundred feet beyond. As he approached he scaled downward, and, when near the ground, gave the peculiar upward bound that marks the shrike's manner of alighting. For a moment all was still. Perhaps ten seconds or more passed without a stir in the cedars. Then there rose a clamor of sparrows and out buzzed a flock of them while the shrike in pursuit singled out one of them, and the chase began.

The sparrow did his best, but he made a mistake, heading for the open and flying a straight course. The shrike was far the better bird on the wing, and it was only a question of time what the end would be. A house prevented my witnessing the actual capture, and I was rather glad that I did not see it, even if it was one sparrow less. But I had learned something new to me about the shrike: that he has hunting-grounds at some distance from his headquarters; that he visits them probably with some regularity; that he knew there would be sparrows in this place at

this time of night; and that he hunted after other birds were abed to take advantage of their habits. When he arrived he did not dash in and give the alarm at once, but entered quietly and low down where he could not be so easily seen, waiting there till he had located his victims, when he charged at them in such a way as to drive them out into the open rather than through another clump of

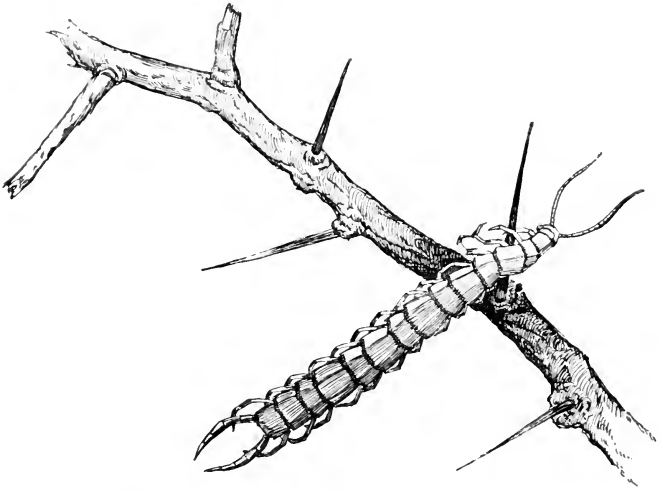

FIG. 52. CENTIPEDE IMPALED BY SHRIKE.

cedars close at hand. Evidently he knew all about sparrow-hunting, and I suspect that this was his regular night beat.

There is a record of a shrike that killed two sparrows, and, holding one in each foot, tried to pursue a third. It has been somewhat disputed whether the shrike carries his prey in his feet or in his bill, but young naturalists can easily settle that for themselves by watching the bird. Besides, how do birds always carry heavy weights? and what reasons are there that

they must carry heavy objects differently than they might carry light ones?

The character of the loggerhead shrike, our summer visitor, seems to me scarcely to need much defence. If any questions are asked, here is the picture of a mesquite branch which a friend of mine brought me from Arizona as a sample of the work of the white-rumped shrike. He said he had several others, all with centipedes on them. A bird that spends its time sticking centipedes on thorns, and killing Jerusalem crickets, is worthy of encouragement. The Southern planter will tell you that in his fields the shrikes kill mice like cats; and you yourself may find the beetles and grasshoppers which she has caught, but not eaten, stuck upon the sharp spurs of wire fences and behind slivers in the fence-rails. In Florida, it is reported that they come day after day bringing their grasshoppers and beetles to eat them on some favorite spot, as a tree stump, and that one of their dining tables may be known by the quantity of hard wing shards and legs of insects dropped about it. So far as I know, the loggerhead shrike is largely an insect eater. It may be that she eats little birds now and then, and I would not invite her to build too near my favorite chipping sparrows; but her bird neighbors give her a good name, and sit fearlessly in her spruce tree, while they cry out in wrath if a crow, or a blackbird, or a cuckoo, or a bluejay, comes too near their nests.

HOW THE ROBIN GETS HIS WORM.

The robin is the one bird among those which most frequent our lawns and gardens that makes a practice of eating earthworms. One of our most familiar sights is to see him go trotting over the lawn, apparently stamping harder than he needs to as he comes down heavily on his hind toes — "heels," I had almost said, forgetting for a moment where a bird's heel is — as if to wake up the worms, then cocking his black head to listen as they try to crawl back into their burrows. How shrewd he *looks*! How capable he is! How quick in his actions! He has that worm by the head in an instant. When the worm feels Robin's sharp bill, he tries to crawl back into his hole, and if he is large there is a pretty little tug-of-war to be witnessed on the lawn; but bold Robin sags back and pulls so well that it is seldom a worm escapes him when once fairly nipped.

You may have noticed that Robin is oftenest seen on the lawn in wet weather. When it has been fair for some days he is not there to pull worms. The reason of this is not hard to seek.

You may remember some morning having seen the neat walks of your garden pierced with little round holes, surrounded by piles of dirt, and of being told that these were "worm casts," and that seeing them was always a sign of rain. The earthworm is fond of moisture; he must have it. In dry weather he gets it by burrowing deep, where the ground is still cool and damp; but in wet weather he comes to the surface and perhaps crawls about on the top of the ground. We say sometimes, when we see the angleworms on the concrete walks

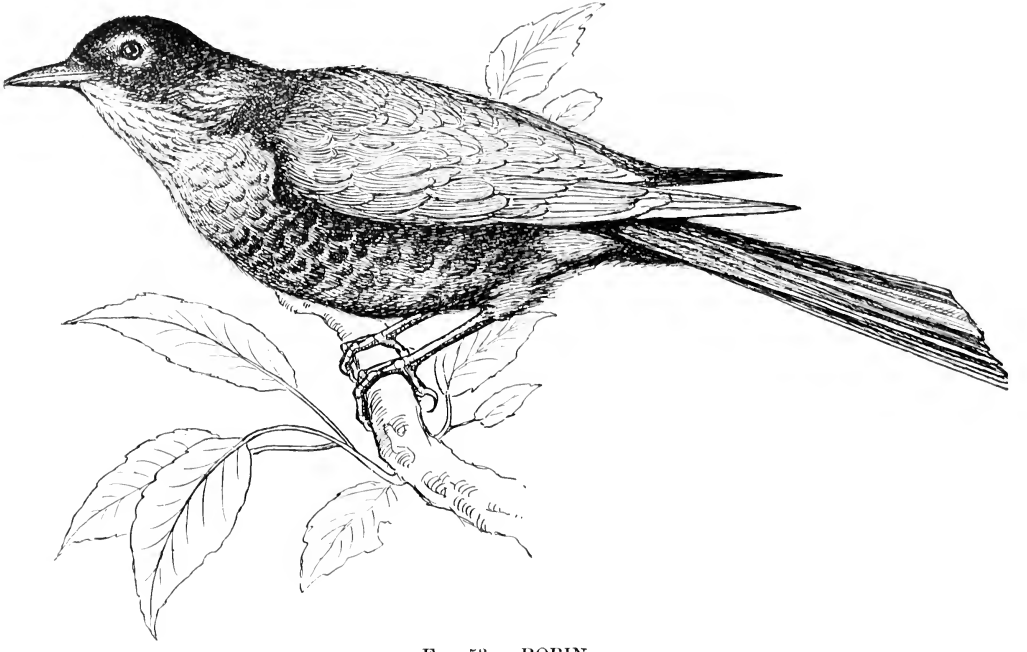

FIG. 53. — ROBIN.

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of a town after a rain, that they "rained down." The truth is that they were wandering about the surface, enjoying the moisture, and were drowned or crushed before they could get back.

The robin knows very well this point in the natural history of earthworms, and that rainy weather is the time to look for them. His spirits rise with the dampness, and he becomes more active, carolling his loud rain-song, gathering mud for his nest, digging worms, and feeling unusually chirk and happy just when other birds look depressed. If you wish to see what a robin knows about angleworms, set the lawn-sprinkler out some bright day. If Robin is as hungry for worms as usual, he will be there, hopping and digging right under the shower of drops. Of course he is getting his back wet when he might easily keep dry, but he knows that where the ground is wettest the earthworms will come nearest the surface.

I must confess that I never watched a robin carefully to see how he ate his worm, but the narrative is so interesting that I will quote from Mr. Daniel E. Owen's account of a pet hermit thrush, a description of the way the thrush ate its worms. As the robin is a thrush, perhaps the description may serve for both. "The bird began by worrying the worm, much as a cat does a mouse, nipping, pecking, and slatting its victim violently. The attack seemed to be directed mainly at the extremities of the worm. Thus, in one case, the head of the worm was pecked ten times, the tail seventeen times, and the middle twice. The worm, of course, struggled vigorously at first; but after a time lost, in a measure, the power of motion. Now and then the bird's beak would miss the worm, or would slip off. At such times the mandibles came together with an audible snap, conveying a suggestion of the torturing pinches

to which the unfortunate worm was being subjected. The pommelling and nipping having gone on for from one and a half to three and a half minutes, the thrush would next essay to swallow the worm, beginning, almost invariably, at the tail. In the case of a big worm, the process of swallowing was distressingly prolonged by the efforts of the worm to escape, in which it often succeeded so far as to crawl out of the bird's mouth almost as fast as it was drawn in. The fact that the thrush swallowed its worms tail first, gains something in interest when the structure of the earthworm is taken into account. As is well known, the earthworm's body consists of from one hundred to two hundred rings or segments. Every segment, except the anterior two or three and the tail, affords insertion to four groups of short bristles, to which muscles are attached and by means of which the worm progresses. Now a person would suppose that the presence of several hundred little bristles, all pointing the wrong way, would interfere with easy and pleasurable deglutition; and, inasmuch as a worm normally crawls ahead and not back, I expected to see my thrush swallow worms head first, when it is to be presumed the bristles in question would not retard the process. As a matter of fact, the contrary method was followed."

This hermit thrush always ate at least half its own weight of raw beef a day, or a much greater amount of worms, which were not so hearty. Careful experiments indicated that it would have eaten its own weight of worms in three or four hours. How hard it would be to feed children if they ate in proportion! The thrush had a keen sense of taste and would refuse worms that came from a dirty place, "making a great splutter" or "rejecting them with every symptom of nausea and abhorrence, wiping its bill on the nearest object which was, generally, my hand." Though taken captive when very

young, the bird showed an instinct for hunting worms, and would alight on its master's table and pull over all the sheets of paper, just as it would have searched beneath the dead leaves in its home in the woods.

What has most interested me in Robin's worm-hunting is the way he gets his worms in early spring. When he first comes in the spring to his far Northern home in Maine he arrives long before the snow is gone. In ordinary years he reaches here by the middle of March, when it is spring by the almanac. At that season, even in the best of years, every fence carries a great snow-drift along its northern side, which often does not melt till the middle of April. Looking from my window to-day, the thirteenth of April, 1898, I can see snow-drifts in gardens where peas are already planted. When the robins first come, one would expect to see them avoid this snow and seek the open fields and gardens; but I most frequently find them, often in small flocks, hopping along the edges of the drifts, eating food that they find there. In any field I would expect to find most robins on the south side, which is of course the one where the snow lies, as it is shaded by the fence, or stone wall, or row of trees that bounds the field and shuts off the southern sun. Whatever you may think, the northern side of a field will dry sooner than the southern side, the northern sidewalk will dry sooner than the southern one, if the field have a fence and the sidewalk have houses on the southern edge.

To settle why the robins followed the drifts was a matter that required some thinking. What was the advantage to them?

I have just been out and examined the drifts I spoke of, to be sure that no one can think me mistaken in assigning a reason. These drifts are made up of granulated icy

snow, resting upon a bed of solid ice formed by their settling and packing. On the southern side, next the high fence, the slope of the drift is steep and but little ice shows at the foot — an inch or two perhaps; on the northern side of the drift, where the sun strikes soonest as it looks down over the fence, the slope is more gradual and a rim of ice four or five inches wide borders the drift. Everybody knows that in March there is always a muddy line about a snow-drift that he must leap across. This bank has soaked a line from one to three feet wide, according to the slope of the soil, so that the mud is from three inches deep to one inch deep around the snow-bank, according to the amount of water that has been absorbed. The narrower the width of the muddy line, the deeper the mud at that point.

Here we come to the point that appeals to the robin. Food is hard to get in March. Every night the fields freeze up to the edge of the drift, and the next day they are dry. But as the snow melts, the waste water thaws the ground and leaves a muddy line in the track by which it retreats, a soft space which can be worked over easily by the birds, who gather to pick out seeds and torpid insects or such bits of food as they can find a little beneath the surface. In this way the robin takes advantage of the forces of nature just as a man would, and turns even ice and snow to good account.

Wise robin ! coming early, with a song, with a brave disregard for winter only partly vanquished, and a good heart to fare hard if need be, spring in the North would lack its best delight if it missed your annual return.

"THE STRANGE THINGS BIRDS DO AND THE STRANGE THINGS THEY SAY."

THERE is a delightful uncertainty of expectation in studying birds. You never can be sure but the bird you know so well will next moment do something so unexpected that you will feel that no one else in all the world has seen such a strange, true thing.

Most birds can swim a little under compulsion. The pectoral sandpiper voluntarily alights on the ocean. The wounded stilt swims, the wounded least sandpiper dives, and even a heron will swim if it falls into the water; yet none of these are swimming birds by habit.

And often, too, a bird will suddenly change its habits, as when swallows alight in trees, and when domestic pigeons alight in bushes to eat berries, or when one builds its nest in a tree, as I have known one to do; or, when such exclusively ground birds as the willet, the yellow-legs plover, the whistling plover, the Wilson's snipe and other waders, during their breeding season, perch by preference on the branches of trees. But what shall we say when a hawk eats choke cherries; when owls hunt by day, and bitterns hunt by night; when kingfishers eat insects, and chickadees eat meat, and sea-gulls are said to live on corn?

It is not unusual to hear of a bird adopting a family of an entirely different species, as cats sometimes adopt rabbits or puppies, and as dogs have been known to become responsible for broods of chickens. There is a record of a male cardinal grosbeak becoming foster-father to two young Baltimore orioles;

of a scarlet tanager feeding young chipping sparrows; of a chestnut-sided warbler caring for some young redstarts that were not orphans, and a wren-tit feeding a young lazuli bunting. We may any day expect to happen upon an incident of this kind, or to find where some bird has laid in another's nest, as the quails often do and as the roseate and Wilson's terns have been reported to do.

Who would expect a woodpecker to turn cannibal and eat little birds? Or to rob birds' nests of their eggs and young? We have no more staid and respected birds than these woodpeckers, who are not commonly regarded as "eaters of little children" even by jealous bird mammas; but now and then some lunatic or hopelessly degenerate woodpecker will commit a ghastly crime. The crow-blackbirds are not generally supposed to be above temptations of green corn, but they were not till recently accused of playing the thug to little birds and of poaching live fish from private ponds. But both these serious charges have been fully proved against them in several instances and the different observers agree that in such cases the blackbirds pick out and eat the brains of their prey. The honest eaves-swallow has been seen to steal her neighbor's mud and to build it into her own nest; and I have seen the blue-backed swallow which is supposed invariably to eat nothing but little flies, taken by coursing after them, flying round by the dozen and alighting on a cherry tree to pick off the caterpillars that had nearly stripped it of its leaves. It was a strange thing, too, for a Baltimore oriole to eat green poplar leaves, as it was observed to do year after year.

There is always a chance of seeing something new and incredible, though the chance comes to him who knows best what is usual and even more than credible — tiresomely familiar. And over and above the pleasure that comes from watching

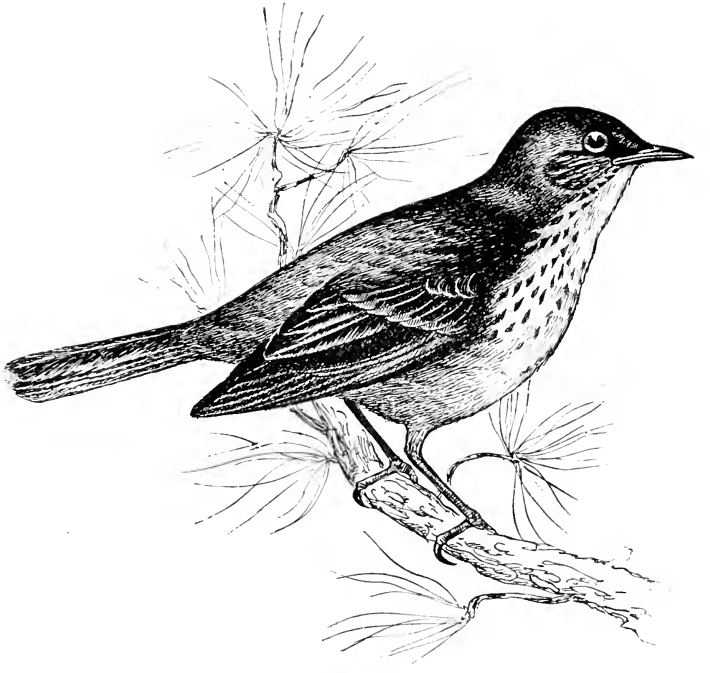

FIG. 54. — HERMIT THRUSH.

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the ways of birds, is the enjoyment to be taken in their songs and calls, which often tell us as much as our eyes could discover.

If your musical ear is not good, and you cannot whistle a bird's song or write it in musical notes, you may put it into words that will say as nearly as possible what the bird seems to be singing.

> "For what are the voices of birds,
> Ay, and of beasts, but words — our words,
> Only so much more sweet?"

This exercise will fix your mind upon the bird's song and will help you to carry this in your memory from year to year, though it has no other value unless it is very well done. There is, however, always the chance of doing it well, so well that it becomes a classic, and everybody after you will quote your version because now they can hear nothing else than what you heard. Do we not always remember Thoreau's version of the brown thrasher's talk to the farmer: "Cover it up! cover it up! cover it up! Pick it up! pick it up! pick it up! Pull it up! pull it up! pull it up!" — a song that shows properly enough that their relationship is with those nervous little scolds, the wrens, rather than with the divinely placid spotted thrushes. How Mr. John Burroughs's "O spheral, spheral! O holy, holy!" the ringing vesper hymn of the hermit thrush, doth "serenely exalt the spirit!" It brings up before us the birch wood veiled with a misty gauze of half-unfolded leaves and sweet with the earthy fragrance of early May, where, in religious solitude, these saintly singers, like nuns in chapel, chant an evening service. "O spheral, spheral! O holy, holy!"

We are indebted to Mr. Burroughs for many of these clear transcriptions of songs we have known always. "Teacher!

teacher!! TEACHER!!!" calls the oven-bird to Mr. Burroughs, and it is clear how he got it; he must have been thinking of the school days of his youth, when the boy who knew the question, but wasn't asked, took advantage of the mortified silence of the boy who had been asked, but didn't know, to call attention to himself by sliding far forward on the seat, snapping the fingers of his uplifted hand, and calling, "Teacher! *teacher!!* TEACHER!!!" When you hear the oven-bird high in a tree-top calling that sharp crescendo, you will think of the boy in the old-time country school and wonder how any one could have been so unobservant as to tell of his *we-cher* or *beecher* notes.

I find in my notebooks a rendering of the goldfinch's spring song, which I am very sure must have come from Mr. Burroughs. The goldfinch, our little "yellow bird," with the black cap and the black wings and tail, called by the scientists "*tristis*, the sad one," hits the heart of melancholy with his plaintive late summer and fall song. But in the springtime he is a joyous lover, and his mating song is a pretty compliment to his beloved: "Sweet, sweet, sweet, Marjo*rie*, Marjo*rie*."

To me the yellow-throated vireo seems to say, "Here I am! Mary! Mary! Here I am!" No doubt Mary is very fond of him; they always seem entirely devoted to each other, and they build one of the prettiest nests a proud mother ever introduced us to, trusting us to admire and not to injure it.

The scarlet tanager is generally set down as saying *chip-churr*, a remark equally without originality and meaning, but to me he always seems convulsed with laughter at his little green wife's doings, and like to burst his waistcoat buttons as he chuckles, "Oh, dear, *kick* her! *kick* her!"

"Who, who, who are you?" Thoreau says is the question of the great horned owl. Those big eyes and tall ears cer-

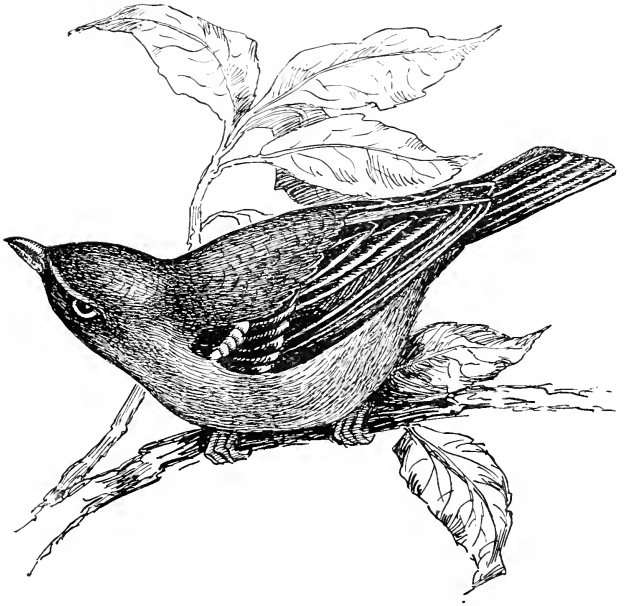

FIG. 55. — VIREO.

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tainly indicate curiosity. Isn't the remark appropriate? for before you hear him talk you must go into the forest, his own castle, and he has a right to inquire, "Who, who, who are you?"

There are the low-spirited goatsuckers, with their "*whip-poor-will*" and "*chuck-will's-widow.*" They remind us of people who take pleasure in going to funerals; all their news is doleful, but they tell it at length and over and over again. In some parts of the South the chuck-will's-widow is called the "chip-the-red-oak-white-oak" bird, which is certainly a more cheerful if not a more sensible remark. All of you can think of other birds that go about telling their own names. *Chick-a-dee-dee! Phœbe! Pee-e-wee! Chebec!* you cannot help imitating the sagacious, businesslike tone of the first; the rather impatient call of the second, as of a mother calling out of a window to a truant child; the discouraged, hot weather drawl of the wood pewee; and the sharp snappy click of the least flycatcher as he jerks out "chebec! chebec!" like a tart but bright-eyed girl who intends to bang the door together if you ask her another question. There is so much individuality about all these birds that have given themselves their own names.

There is, too, our white-throated sparrow, who, in the North, gets all sorts of names from his song. He is called the Peabody bird, the Asa Peabody bird, or the Old Sam Peabody bird, and on Prince Edward Island the Kennedy bird, from the syllables he speaks so plainly. High up or low down the scale he sings his "*a*" syllable, then drops or rises to the "*see*," and sings off in a succession of ringing triplets his "*Peabody, Peabody, Peabody, Peabody.*" He sings in the evening or early morning; but if he is heard later than nine o'clock, rain is coming in a few hours. Unfortunately he is silent until he gets

as far north as Massachusetts, so that few of us may hear his clear, thrilling notes. Some say that he sings, "Hear me, holy Theresa," as if supplicating a saint; but on Prince Edward Island they declare that he sings, "Good Lord, pity me, pity me, pity me!" which is a true litany put to most fitting music.

Few birds are easier to tell by their music and harder to tell without it than the vireos. By all means put their song into words. Remember the yellow-throated vireo's song already given and Mr. Chapman's rendering of the white-eyed vireo's abrupt little, "Who are you, eh?" and that one by which Wilson Flagg described once and forever the red-eyed vireo's incessant homily, "You see it — you know it — do you hear me? — do you believe it?" as he trips about the tree trunks, picking up insects between the phrases.

And here is one of the bobolink's worth remembering. If run through rather quickly and with increasing rapidity and a rising inflection, it mimics admirably the spring song of this jolly, careless, light-hearted, and boisterously happy fellow, who doesn't try to sing, but just opens his mouth and lets the music bubble out. "Tom Noodle, Tom Noodle, you owe me, you owe me ten shillings and sixpence!" — "I paid you, I paid you!" — "You didn't, you didn't!" — "You lie, you lie; you cheat!" And then the black-and-white dandy who has been singing both parts of the duo, just tumbles down into the grass to rest himself.

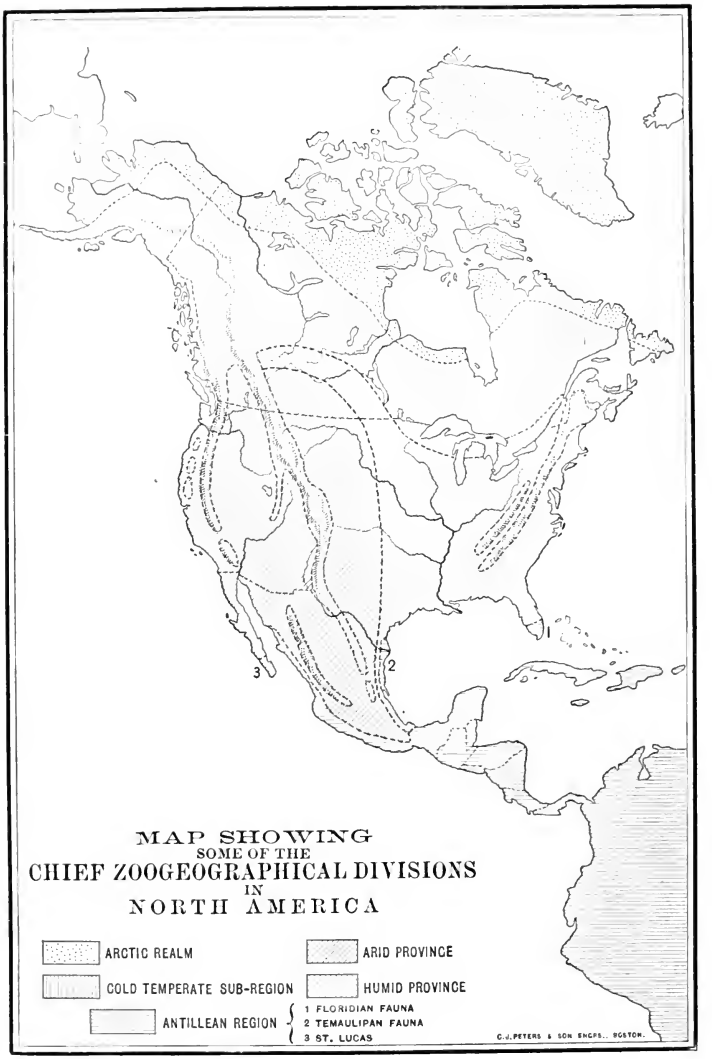
> "June's bridesman, poet of the year,
> Gladness on wings, the bobolink, is here;
> Half hid in tip-top apple-blooms he swings,
> Or climbs against the breeze with quivering wings,
> Or, giving way to 't in a mock despair,
> Runs down, a brook of laughter, through the air."

FIG. 56. — WHITE-THROATED SPARROW.

Facing page 258.

These are among the pleasures of the study of birds — the unexpectedness of so much that we see, and the novelty that we can create for ourselves by trying to find interpretations of their songs and habits. Yes, and the uncertainties. It is these that make birding a true sport, not inferior to angling to those who find their hearts set upon it. It is the gentlest of the sporting pleasures, and yet it has the attractions of the keenest. Here is an object for a well-earned outing, a chance of failure, the thrill of the quest, the premium on knowing how, the acquisition of skill and patience, the recollection of delight that will help in dull and dreary hours. And there are advantages over the other sports of the chase, which not only end in bloodshed that is not pleasant to remember, but which are forbidden at times and seasons. For there is no law against birding with an opera glass, and it yields more varied delight than either rod or gun. How few are the kinds of game or fish which the sportsman counts as fit for his pursuit! how many are the kinds that are accounted game for the opera glass! There is no anticipating the results of a day's sport with an opera glass. Science may not be attractive to us; we may not desire knowledge; but who is able to deny the attractions of days with the birds when we reckon them with our sports?

APPENDIX.


MAP SHOWING
SOME OF THE
CHIEF ZOOGEOGRAPHICAL DIVISIONS
IN
NORTH AMERICA
ARCTIC REALM
ARID PROVINCE
COLD TEMPERATE SUB-REGION
HUMID PROVINCE
ANTILLEAN REGION
1 FLORIDIAN FAUNA
2 TEMAULIPAN FAUNA
3 ST. LUCAS
C.J. PETERS & SON ENGRS., BOSTON.
1
2
3

ZOÖGEOGRAPHICAL DIVISIONS OF THE WORLD

After Dr. J. A. Allen.

REALMS, REGIONS, SUBREGIONS, PROVINCES, SUBPROVINCES, DISTRICTS, FAUNÆ.

1. Arctic . . . . . — Barren Ground; Arctic Alaskan

2. North Temperate
- North American
  - Cold Temperate — Aleutian; Sitkan; Hudsonian; Canadian
  - Warm Temperate
    - Humid
      - Appalachian — Alleghanian; Carolinian
      - Austroriparian — Louisianian
    - Arid
      - Campestrian — Great Plains; Great Basin; Pacific Coast (not yet divided into faunæ)
      - Sonoran (not yet divided into faunæ)
- Eurasian (Europe and Asia, except India)

3. American Tropical
- Central American
- Antillean . . . . . — Floridian; Temaulipan; St. Lucas

4. Indo-African (including India and adjacent islands and Africa except northern part).
5. South-American Temperate (including all outside Realm 3).
6. Australian (Australia and surrounding islands).
7. Lemurian (Madagascar).

8. Antarctic (Antarctic circumpolar region).

All the realms may be subdivided like Realm 2, which alone is shown in this table.

MIGRATION.

I. Mr. William Brewster's list of birds which migrate freely, chiefly, or exclusively by day: —

The Robin.
The Bluebird.
The Horned Lark.
The Titlark.
The Kingbird.
The Chimney Swift.
The Oriole family (except the Meadow Lark and the Orioles proper).
The Waxwing family.
The Swallow family.
The Shrike family.
The Hummingbird family.
The Crow family.
The Hawk family.
The Dove family.

Also from the other list, Pine Grosbeak, Purple Finch, etc., etc.

The manner of the migration of the Kingfisher is not known.

The Nighthawk, Whippoorwill, Owls, and birds that are habitually nocturnal or crepuscular naturally migrate by night.

II. Mr. Brewster's list of birds that migrate exclusively by night: —

The Thrush family (except Robin and Bluebird).
The Kinglet family.
The Titmouse and Chickadee family.
The Nuthatch family.
The Creeper family.
The Wren family.
The Warbler family.
The Vireo family.
The Tanager family.
The Finch family (except Pine Grosbeak, Purple Finch (?), Crossbills, Redpolls, Goldfinch, Pine Linnet, and Snow Bunting).
The Meadow Lark.
The Orioles.
The Flycatcher family (except Kingbird).
The Cuckoo family.
The Woodpecker family.

Several of these take short flights by day, but never make any extended migration until night, merely seeking their food in the direction they intend to fly by night so as to lose no ground.

III. Mr. Brewster's Theory of Migration.

"1. Species which migrate exclusively by night habitually feed in or near the shelter of trees, bushes, rank herbage or grass, and when not migrating are birds of limited powers of flight and sedentary habits, restricting their daily excursions to the immediate vicinity of their chosen haunts. As a rule they are of timid, or at least retiring disposition, and when alarmed or pursued seek safety in concealment rather than by extended flights.

"2. Species which migrate chiefly, or very freely by day, habitually feed in open, exposed situations, and in their daily excursions for food often cover considerable distances. As a rule they are of a bold, restless disposition, and when alarmed or pursued seek safety in long flights rather than by concealment.

"3. Species which migrate exclusively by day, habitually feed either on the wing or over very extensive areas. In disposition they are either trustful and unsuspecting, or wary and self-reliant. Without exception they are birds of strong, easy flight, and rely solely on their wings for escape from danger.

"These premises lead easily, if not irresistibly, to the conclusion that: —

"Timid, sedentary, or feeble-winged birds migrate by night because they are either afraid to venture on long, exposed journeys by daylight, or unable to continue their journeys day after day without losing much time in stopping to search after food. By taking the nights for travelling they can devote the days entirely to feeding and resting in their favorite haunts. Good examples are the Thrushes (except the Robin), Wrens, Warblers, and Vireos.

"Bold, restless, strong-winged birds migrate chiefly, or very freely, by day, because, being accustomed to seek their food in open situations, they are indifferent to concealment, and being further able to accomplish long distances rapidly and with slight fatigue, they can ordinarily spare sufficient time

by the way for brief stops in places where food is abundant and easily obtained. Under certain conditions, however, as when crossing large bodies of water or regions scantily supplied with food, they are sometimes obliged to travel partly, or perhaps even exclusively, by night. Excellent examples are the Robin, Horned Lark, and most of the Oriole family.

"Birds of easy, tireless wing, which habitually feed in the air or over very extensive areas, migrate exclusively by day, because, being able to obtain their usual supply of food as they fly, or to accomplish the longest journeys so rapidly that they do not require to feed on the way, they are under no necessity of changing their usual habits. The best examples are the Swallows, Swifts, and Hawks.

"Nocturnal and crepuscular birds, at least migratory species, are all strong-winged and accustomed to seek their food over wide areas. Hence, like the Swallows, Swifts, and Hawks, they migrate during the hours of their habitual activity.

"The conclusions just reviewed will apply also to the wading and swimming birds; for their migrations, making due allowance for the peculiar habits of certain species and groups, are easily explainable by considerations either identical with, or similar to, those above mentioned.

"The Bittern, Woodcock, Wilson's Snipe, Spotted Sandpiper, and the Rails without exception, migrate exclusively by night. They are all sedentary birds addicted to feeding in particular and usually limited areas, and all but the Spotted Sandpiper seek safety in concealment. Accordingly, it is in line with the previous reasoning that they should migrate by night and rest and feed by day. The case is not, however, exactly parallel with that of any of the land birds, for these waders (except, perhaps, the Spotted Sandpiper) feed habitually more by night than by day. But all — even the Woodcock — also feed freely by day during the migrations.

"The remainder of the wading and all the swimming birds migrate indifferently by both night and day. This was to be

expected when we consider that they feed more or less indifferently and freely at all hours, and are not accustomed to seek safety in concealment.

"Certain species of Ducks, as well as all the Loons, Grebes, and Auks do, however, frequently or habitually elude their various enemies by diving. Thus water is in one respect to them what grass, rushes, etc., are to Snipe and Quail, — a refuge from danger. This doubtless explains a fact which I have often observed; viz., that while most diving birds migrate freely by day *along our coast* they invariably perform long *overland* journeys by night. The reason is obvious. In one case flying directly over a continuous expanse of water they are able to avail themselves of its shelter at a moment's notice; in the other they would be quite without this resource, if suddenly threatened or attacked.

"The manner of migration of our birds is determined by one, two, or all of the following considerations: habitual manner of procuring food, disposition, wing-power. It evidently has little or nothing to do with relationship or affinities except within very narrow limits."

HINTS ON OBSERVING BIRDS.

Briefly stated, these hints fall under a few heads, — tools, time, what to look for, how to see it, where to go, what to notice. The last is treated under hints on identification.

Of tools. — Besides books, a teacher needs a note-book and, if possible, a good glass. A beginner's note-book should be kept after his own whim, and with little elaboration beyond a fixed set of abbreviations. This is nobody's but his own, and it makes no difference if the birds all fly away before they have been described. An elaborate note-book is possible only when one is well acquainted with the commoner birds.

Children should not be urged to keep note-books; they see more and see it better when there is no effort at composition.

If you own an opera glass, use it. Any glass is a help, but in buying one *always buy a better one!* In buying be generous with yourself, recollecting that cheap glasses are not good and good glasses are not cheap. And yet the price is no surety of excellence. A friend, who had bought six, told me that the best of them was much the cheapest. A field glass is better than an opera glass. Select a good maker, whose name is a guarantee. A glass must be achromatic, stiff-framed, of large field and fair power. Sacrifice power to field rather than field to power. A high power necessitates a longer frame, which tires the neck and the arm, and a small field, which makes it difficult to locate the bird. An aluminum frame is best on account of its light weight. The new Bausch and Lomb Triëder glasses, being made on a different principle, give a high power, a large field, light weight, and a compact, short frame, but the price puts them beyond the reach of the ordinary amateur. With these, one of the night glasses may be found to be less trying to the eyes for sustained observation than the regular day glass.

Time. — The morning is worth many times any other part of the day, because it is generally cool, bright, free from wind; it is also the period of the bird's greatest activity. Enthusiasts rout you out with the sun, but unless it is proposed to visit crow, robin, or swallow roosts it seems to me that the uncertain light, malarial fogs, heavy dews, and morning chill must damp the enthusiasm of even the "four-o'clockers." Six o'clock is early enough, and from seven to nine is the best time for the most people. Afternoon work is seldom satisfactory, as the wind rises, the light is weak and bad, and the birds are tired and silent.

Look for birds you know. Don't hunt rarities. They will come to you if they are in the neighborhood, but if you hunt them you will be losing good notes on the familiar but not less interesting species.

Go to gardens, groves, shrubbery, and thickets near town,

especially wooded ravines near water. There are no birds to speak of in the wilderness and few in deep woods. One's best resort will usually be near houses, though the beginner never believes this. Go to the same places repeatedly rather than to many at intervals; you will see as much and will learn more, after having learned to recognize thirty or forty birds, than by wandering.

How to see birds is an art not to be communicated. The first step to it is patience; learn to wait for them. But never lie or sit upon the ground or on rocks until full summer time unless you have a coat or wrap or are proof against rheumatism. This is more important to observe than the birds. Learn to take the same advantage of the sun that you would in photographing.

HINTS ON IDENTIFYING STRANGE LIVE BIRDS.

Notice as many as you can of the following points: —

Size (in inches from the tip of the bill to the tip of the tail, remembering that the live bird is always longer than he appears to be).

Color (if you can be sure of it, but at all events the *color areas*) :
- wing bars, number and color, if present;
- stripes on head and how placed;
- white outer tail feathers, if present;
- rump, if differently colored from back and tail;
- under tail-coverts, if different from belly;
- flanks and sides, if brightly colored;
- odd ornaments or patches of color, as collars, necklaces, breast-spots, etc.

Shape:
- of body, slender, bulky;
- of tail, long, short, square, forked, rounded;
- of wings, round, pointed (in flight);
  - long or short, judged by the distance they measure off on the tail (while sitting);
- of bills, length, shape, color;
- of crest, if present, pointed, erectile, etc.

Habits: walking, hopping; soaring, hovering; terrestrial, arboreal, climbing; perch preferred. — trunk, limb, tree-top, dead twig, etc.; manner of sitting. — erect, crouched, lengthwise of limb (as the night hawks); manner of flying. — direct, undulating, heavy, flapping, etc.; disposition. — restless, quiet, stupid, shy, tame, unsuspicious.

Food and how procured (if this can be observed with certainty; often it cannot be determined).

Song: chirp, trill, twitter, melody, scream, hoot, etc., describe as nearly as possible.

Nest: place. — ground, bush, tree, hole, limb, twig;
placed how, — saddled, pensile, in fork, etc.;
materials, — grass, moss, feathers, hair, twigs, etc.;
eggs. — number and color.

The more of these points that are determined the surer will be the identification, but often one or two of them will suffice to identify a bird. The secret is to seize on the really distinctive mark, whether of habit, voice, or color. A note "walks head downward down tree-trunks" surely means a nuthatch; "tail with yellow band across tip" means the cherry bird, even if there is nothing more said or seen about the bird.

Always write the notes while the bird is before you. Use your own code of abbreviations. Whatever is doubtful write, but mark it by a sign of interrogation in parentheses following, thus: "crested (?)." Whatever is absolutely certain, if either strange or apparently important, mark with an exclamation point not enclosed in marks, thus: "crested (?), a band of yellow across the tip of tail! small vermilion spots apparently on rump!" There is no doubt here that the cedar waxwing has been seen, and that the bird must have had a crest.

CERTAIN QUESTIONS ANSWERED.

There are a few questions so sure to come up that they may as well be answered now.

Do I think a school might own a few mounted birds? I do not see why it might not. A few well-chosen, well-mounted

birds, kept away from dust and moths are an invaluable aid. It is the fate of the vast majority of birds to die violent deaths, and it seems to me that it is no worse for the bird to live in effigy for the interests of science than to die uncounted by the talons of the hawk and owl and by the teeth of fox, skunk, and weasel. Full well I know the thirst for knowledge that prompts the boy to make a closer acquaintance of what he only half sees at a distance; full well I know, if parents and policemen do not, the mysteries of the deadly air-gun and pop-gun and sling-shot. "Better the eyes should see than that desire should wander," said the Preacher, who perhaps remembered that he had once been a boy.

A representative and fairly satisfactory collection would be: One of any species of Grebe, Gull, Duck, Grouse, Heron (the least Bittern would be the smallest, the Bittern more fairly representative), Sandpiper (or Plover, or both), Hawk, Owl, Cuckoo or Kingfisher, Woodpecker, Blackbird, Sparrow, Fly-catcher, Bluejay, Swift, Swallow, Warbler, Robin. This would give types of eighteen of the best-known families.

Specimens of the commoner species are not expensive,— from 75 cents to $1.50. Small birds, if not of rare species, cost less than large ones. All specimens should be mounted on stands and fully labelled. All must be kept in air-tight glass cases with *locked* doors, and with camphor or naphthaline in the case to drive away moths and dermestes. If this is not done, the collection is sure to be ruined shortly.

While a local taxidermist may be able to supply good specimens, I take pleasure in naming (without their permission) two firms well known for their fair dealing: H. A. Ward, 2 College Ave., Rochester, N.Y., and Charles K. Worthen, Warsaw, Hancock, Ill. By merely stating that the collection is for school use and the amount of money to be expended on it, these firms will furnish a better selection of well-prepared specimens than the novice would be able to choose for himself.

Do I approve of boys making collections of birds? By no means. It was to prevent just this that I advocated a school collection prepared by a competent naturalist.

Do I approve of dissections in class? Not in the lower grades certainly. In high school and college work nothing takes the place of actual dissection; but is it best to exploit the whole world of wonders for children too young to appreciate them? I have purposely left out of this book all physiology and anatomy that could not be illustrated by chicken bones, in order to avoid any necessity or excuse for dissections, for which most children have a distaste and to which many parents have objections. In this book the *mechanism* of the bird is taken up instead of its anatomy. Even the study of the eye is conducted by means of a comparison with a mechanical instrument.

Is there any substitute for collections? No two-dimension representation can take the place of a three-dimension object in teaching children. They need the "real thing." Still, where economy is necessary, there is a substitute which is not without merit. The little monthly magazine, *Birds and Nature*, published by the Nature Publishing Co. of Chicago at $1.00 a year, gives many colored photographic reproductions of mounted birds, accompanied by a simple and usually correct text. Back numbers may be obtained at moderate rates. The same pictures may be bought separately of the Perry Pictures Company.

What books do I recommend for teachers? Among so many excellent texts, I decline to make invidious distinctions. It is scarcely possible that there is a mind so abnormally developed that there has not been a bird book written to fit its needs! Still, it must be conceded by all, that for the earnest student, especially for one who already knows thirty or forty species, nothing competes in price and quality with Mr. Frank M. Chapman's "Handbook of Birds of North America" ($3.00). A young beginner should have a more elementary book

Another book, in a class by itself and of high value to the field student, is Mr. C. J. Maynard's "Handbook of the Sparrows, Finches, etc., of New England" ($1.50). This gives a simple but trustworthy guide to every one of this large and difficult family visiting New England. Any bird book not to be locally obtained may be purchased at any time of L. S. Foster, 30 Pine St., New York, who makes a specialty of bird books.

LISTS OF BOOKS.

I. Books that will be helpful to a beginner in identifying birds: —

MERRIAM, Birds through an Opera Glass. $.75.
Fifty common land birds of New England and Northern New York; illustrated. An admirable "first book" for children.

GRANT, Our Common Birds. $1.50.
Ninety species found near New York City; with photogravures from mounted specimens.

HOWE, Every Bird. $1.00.
One hundred and twenty-four genera of New England birds, illustrated in outline, and too briefly treated for field work.

MAYNARD, Handbook of the Sparrows, Finches, etc., of New England. $1.50.
Forty-six species, with colored plates. The colors do not print well, but the book is a very satisfactory handbook for this difficult group, and is especially adapted for field work.

WRIGHT AND COUES, Citizen Bird. $1.50.
A story of bird-life, exquisitely illustrated, and especially good for children.

MERRIAM, Birds of Village and Field. $2.00.
One hundred and fifty species of our better-known birds, finely illustrated.

CHAPMAN, Bird-life: a guide to the study of our common birds. $1.75.
Seventy-five full-page drawings and ample text; a *vade mecum* for beginners.

CHAPMAN, A Handbook of Birds of Eastern North America. $3.00.
This book includes every species and subspecies known east of the Mississippi River, and is the best brief, scientific ornithology ever

written; not adapted, however, to students too young to use a standard botany, though it is as little technical as possible.

WRIGHT, Bird-craft. $3.00.

Two hundred birds pictured and ably described.

MINOT, Land and Game Birds of New England. $3.50.

Accurate and untechnical, an excellent book to get one into the spirit of the study, but scantily illustrated.

MCILWRAITH, Birds of Ontario. $2.00.

Good not only for the birds of Canada, but for the more northern states as well; illustrated.

BLANCHAN, Bird Neighbors. $2.00.

Fifty colored plates.

BLANCHAN, Birds that Hunt and are Hunted. $2.00.

Forty-eight colored plates. These two books cover most of the better-known land and water birds, and give good colored pictures to guide in identification.

ELIOT, North American Shore Birds. $2.50.

Includes all the snipe, sandpipers, plovers, etc., with fine drawings of each species, and accurate technical descriptions; also short account of habits.

ELIOT, Gallinaceous Game Birds of North America. $2.50.

Treats the turkeys, grouse, quail, etc., after the same method as the above.

COREY, How to Know the Ducks, Geese, and Swans of North America. Paper covers, $1.00.

A fully illustrated and thoroughly prepared manual.

COREY, How to Know the Shore Birds of North America. Paper, $.75.

Similar to the above in scope and plan; fully illustrated.

LANGILLE, Our Birds in their Haunts. $3.00.

A high authority on songs, habits, etc., and long a favorite work with beginners.

FISHER, Hawks and Owls of the United States. (United States Bulletin.)

Has very fine colored plates of each species, with full account of the economic value of each.

NUTTALL, Handbook of Ornithology. Revised by Chamberlain. 2 vols., $9.00.

A modernized reprint of an old and valuable work.

BELDING, Land Birds of the Pacific Coast. $2.50.

GOSS, Birds of Kansas. $7.50.

Five hundred and twenty-nine species treated; thirty-five plates; a recognized authority, not only on the birds of Kansas, but of all the Mississippi Valley.

COUES, Birds of the Colorado Valley. $4.00.

COUES, Birds of the Northwest. $4.00.

Two old books, but still high authorities on the regions covered.

COREY, Key to the Water Birds of Florida. $1.75.

SAMUELS, Birds of New England and Adjacent States.

STEARNS AND COUES, New England Bird Life. 2 vols.

Two books of good value, but displaced by later and better illustrated works.

The following standard works are either very large, rare, costly, or highly technical works such as the ordinary purchaser would not care to buy. They are invaluable in their place, and can be consulted in any large library. It should be remembered that the older works, like Audubon and Wilson, use a different nomenclature, so that sometimes a bird will not bear the same name as to-day; also that many new species have been discovered since these books were published.

AUDUBON'S Birds; colored plates of all species.

WILSON'S Ornithology.

BAIRD, BREWER, AND RIDGWAY, Land Birds (3 vols.) and Water Birds (2 vols.).

BENDIRE'S Life Histories of North American Birds. 2 vols.

This work was left unfinished by the death of the author, but the part completed is an acknowledged authority on the habits and nests of the Hawks, Grouse, Woodpeckers, Flycatchers, etc. Colored plates of eggs only.

RIDGWAY'S Manual of North American Birds.

COUES'S Key to North American Birds.

These two are the standard technical works on North American birds, but are not intended for field work, and contain nothing about the habits of birds.

MAYNARD, Birds of Eastern North America.

A large and valuable work, fully illustrated, and with ample notes on the habits of birds.

II. Books that treat of birds descriptively and informally; good books to draw from the public library for home reading.

Frank Bolles,	Land of the Lingering Snow.
	North of Bearcamp Water.
	From Blomidon to Smoky.
Wilson Flagg,	Birds and Seasons of New England.
	Field and Forest.
	Woods and Byways of New England.
C. C. Abbott,	Birds about us.
	Travels in a Tree-top; and other volumes.
John Burroughs,	Birds and Poets.
	Locusts and Wild Honey.
	Wake-robin; and his other nature books.
Henry D. Thoreau,	Walden.
	The Maine Woods.
	Early Spring in Massachusetts.
	Summer.
	Autumn.
	Winter.
H. E. Parkhurst,	The Bird's Kalendar.
	Song Birds and Water Fowl.
Maurice Thompson,	Byways and Bird Notes; and other books.
Bradford Torrey,	Birds in the Bush.
	A Rambler's Lease.
	The Footpath Way.
	A Florida Sketch Book.
	Spring Notes from Tennessee.
	In the White Mountains.
Florence A. Merriam,	A-birding on a Bronco.
	My Summer in a Mormon Village.
Leander S. Keyser,	In Bird-land.
	Bird-dom.
Olive Thorne Miller,	Little Brothers of the Air.
	In Nesting Time.
	Bird Ways.
	A Bird Lover in the West.

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ADVERTISEMENTS.

Supplementary Reading

A Classified List for all Grades.

GRADE I. Bass's The Beginner's Reader	.25
Badlam's Primer	.25
Fuller's Illustrated Primer	.25
Griel's Glimpses of Nature for Little Folks	.30
Heart of Oak Readers, Book I	.25
Regal's Lessons for Little Readers	.35
GRADE II. Warren's From September to June with Nature	.35
Badlam's First Reader	.30
Bass's Stories of Plant Life	.25
Heart of Oak Readers, Book I	.25
Snedden's Docas, the Indian Boy	.35
Wright's Seaside and Wayside Nature, Readers No. 1	.25
GRADE III. Heart of Oak Readers, Book II	.35
Pratt's America's Story, Beginner's Book	.35
Wright's Seaside and Wayside Nature Readers, No. 2	.35
Miller's My Saturday Bird Class	.25
Firth's Stories of Old Greece	.30
Bass's Stories of Animal life	.35
Spear's Leaves and Flowers	.25
GRADE IV. Bass's Stories of Pioneer Life	.40
Brown's Alice and Tom	.40
Grinnell's Our Feathered Friends	.30
Heart of Oak Readers, Book III	.45
Pratt's America's Story — Discoverers and Explorers	.40
Wright's Seaside and Wayside Nature Readers, No. 3	.45
GRADE V. Bull's Fridtjof Nansen	.30
Grinnell's Our Feathered Friends	.30
Heart of Oak Readers, Book III	.45
Pratt's America's Story — The Earlier Colonies	.00
Kupfer's Stories of Long Ago	.35
GRADE VI. Starr's Strange Peoples	.40
Bull's Fridtjof Nansen	.30
Heart of Oak Readers, Book IV	.50
Pratt's America's Story — The Colonial Period	.00
Dole's The Young Citizen	.45
GRADE VII. Starr's American Indians	.45
Penniman's School Poetry Book	.30
Pratt's America's Story — The Revolution and the Republic	.00
Eckstorm's The Bird Book	.60
Heart of Oak Readers, Book IV	.50
Wright's Seaside and Wayside Nature Readers, No. 4	.50
GRADES VIII *and* IX. Heart of Oak Readers, Book V	.55
Heart of Oak Readers, Book VI	.60
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