APPLETONS' HOME READING BOOKS

THE STORY OF THE BIRDS

BASKETT

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To

Dr Leonard Stejneger

with

Compliments of the

author

Appletons' Home Reading Books

EDITED BY

WILLIAM T. HARRIS, A. M., LL. D.

UNITED STATES COMMISSIONER OF EDUCATION

DIVISION I

NATURAL HISTORY

Driving away the birds.

APPLETONS' HOME READING BOOKS

THE STORY OF THE BIRDS

BY

JAMES NEWTON BASKETT, M. A.
ASSOCIATE MEMBER OF THE AMERICAN ORNITHOLOGISTS' UNION

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TO HIS TWO BOYS ESPECIALLY,

WHO HAVE HELPED HIM IN OBSERVING AND HAVE

STIMULATED HIM IN STUDY,

AND TO THE

YOUNGER STUDENTS OF THE NATION GENERALLY,

THIS LITTLE BOOK IS DEDICATED BY THE AUTHOR,

BECAUSE,

AS HERE AND THERE HE HAS SPOKEN TO THEM OF BIRDS,

HE HAS FOUND IN THEIR BRIGHT FACES AND PATIENT INTEREST

HIS GREATEST INSPIRATION.

PUBLISHERS' NOTE.

Through the courtesy of Mr. Frank M. Chapman, Assistant Curator of the Department of Mammalogy and Ornithology in the American Museum of Natural History, New York city, the publishers have used in this volume several of the admirable cuts prepared for his standard work, Handbook of Birds of Eastern North America. The full-page pictures, which are credited in the list of illustrations, reproduce groups in the American Museum of Natural History. These pictures, like some of the line drawings in the text, were made under Mr. Chapman's personal supervision, and the publishers desire to make special acknowledgment to Mr. Chapman for their use in this volume.

INTRODUCTION TO THE HOME READING BOOK SERIES BY THE EDITOR.

THE new education takes two important directions—one of these is toward original observation, requiring the pupil to test and verify what is taught him at school by his own experiments. The information that he learns from books or hears from his teacher's lips must be assimilated by incorporating it with his own experience.

The other direction pointed out by the new education is systematic home reading. It forms a part of school extension of all kinds. The so-called "University Extension" that originated at Cambridge and Oxford has as its chief feature the aid of home reading by lectures and round-table discussions, led or conducted by experts who also lay out the course of reading. The Chautauquan movement in this country prescribes a series of excellent books and furnishes for a goodly number of its readers annual courses of lectures. The teachers' reading circles that exist in many States prescribe the books to be read, and publish some analysis, commentary, or catechism to aid the members.

Home reading, it seems, furnishes the essential basis of this great movement to extend education beyond the school and to make self-culture a habit of life.

Looking more carefully at the difference between the two directions of the new education we can see what each accomplishes. There is first an effort to train the original powers of the individual and make him self-active, quick at observation, and free in his thinking. Next, the new education endeavors, by the reading of books and the study of the wisdom of the race, to make the child or youth a participator in the results of experience of all mankind.

These two movements may be made antagonistic by poor teaching. The book knowledge, containing as it does the precious lesson of human experience, may be so taught as to bring with it only dead rules of conduct, only dead scraps of information, and no stimulant to original thinking. Its contents may be memorized without being understood. On the other hand, the self-activity of the child may be stimulated at the expense of his social well-being—his originality may be cultivated at the expense of his rationality. If he is taught persistently to have his own way, to trust only his own senses, to cling to his own opinions heedless of the experience of his fellows, he is preparing for an unsuccessful, misanthropic career, and is likely enough to end his life in a madhouse.

It is admitted that a too exclusive study of the knowledge found in books, the knowledge which is aggregated from the experience and thought of other people, may result in loading the mind of the pupil with material which he can not use to advantage.

Some minds are so full of lumber that there is no space left to set up a workshop. The necessity of uniting both of these directions of intellectual activity in the schools is therefore obvious, but we must not, in this place, fall into the error of supposing that it is the oral instruction in school and the personal influence of the teacher alone that excites the pupil to activity. Book instruction is not always dry and theoretical. The very persons who declaim against the book, and praise in such strong terms the self-activity of the pupil and original research, are mostly persons who have received their practical impulse from reading the writings of educational reformers. Very few persons have received an impulse from personal contact with inspiring teachers compared with the number that have received an impulse from such books as Herbert Spencer's Treatise on Education, Rousseau's Émile, Pestalozzi's Leonard and Gertrude, Francis W. Parker's Talks about Teaching, G. Stanley Hall's Pedagogical Seminary. Think in this connection, too, of the impulse to observation in natural science produced by such books as those of Hugh Miller, Faraday, Tyndall, Huxley, Agassiz, and Darwin.

The new scientific book is different from the old. The old style book of science gave dead results where the new one gives not only the results, but a minute account of the method employed in reaching those results. An insight into the method employed in discovery trains the reader into a naturalist, an historian, a sociologist. The books of the writers above named have done more to stimulate original research on the part of their readers than all other influences combined.

It is therefore much more a matter of importance to get the right kind of book than to get a living teacher. The book which teaches results, and at the same time gives in an intelligible manner the steps of discovery and the methods employed, is a book which will stimulate the student to repeat the experiments described and get beyond these into fields of original research himself. Every one remembers the published lectures of Faraday on chemistry, which exercised a wide influence in changing the style of books on natural science, causing them to deal with method more than results, and thus to train the reader's power of conducting original research. Robinson Crusoe for nearly two hundred years has stimulated adventure and prompted young men to resort to the border lands of civilization. A library of home reading should contain books that stimulate to self-activity and arouse the spirit of inquiry. The books should treat of methods of discovery and evolution. All nature is unified by the discovery of the law of evolution. Each and every being in the world is now explained by the process of development to which it belongs. Every fact now throws light on all the others by illustrating the process of growth in which each has its end and aim.

The Home Reading Books are to be classed as follows:

First Division. Natural history, including popular scientific treatises on plants and animals, and also descriptions of geographical localities. The branch of study in the district school course which corresponds to this is geography. Travels and sojourns in distant lands; special writings which treat of this or that animal or plant, or family of animals or plants; anything that relates to organic nature or to meteorology, or descriptive astronomy may be placed in this class.

Second Division. Whatever relates to physics or natural philosophy, to the statics or dynamics of air or water or light or electricity, or to the properties of matter; whatever relates to chemistry, either organic or inorganic—books on these subjects belong to the class that relates to what is inorganic. Even the so-called organic chemistry relates to the analysis of organic bodies into their inorganic compounds.

Third Division. History and biography and ethnology. Books relating to the lives of individuals, and especially to the social life of the nation, and to the collisions of nations in war, as well as to the aid that one gives to another through commerce in times of peace; books on ethnology relating to the manners and customs of savage or civilized peoples; books on the primitive manners and customs which belong to the earliest human beings—books on these subjects belong to the third class, relating particularly to the human will, not merely the individual will but the social will, the will of the tribe or nation; and to this third class belong also books on ethics and morals, and on forms of government and laws, and what is included under the term civics or the duties of citizenship.

Fourth Division. The fourth class of books includes more especially literature and works that make known the beautiful in such departments as sculpture, painting, architecture and music. Literature and art show human nature in the form of feelings, emotions, and aspirations, and they show how these feelings lead over to deeds and to clear thoughts. This department of books is perhaps more important than any other in our home reading, inasmuch as it teaches a knowledge of human nature and enables us to understand the motives that lead our fellow-men to action.

To each book is added an analysis in order to aid the reader in separating the essential points from the unessential, and give each its proper share of attention.

W. T. Harris.

Washington, D. C., *November 16, 1896.*

PREFACE.

Want of space precludes, either in the text or preface of this little work, the proper acknowledgment of the specific sources from which many of the facts and conclusions have been drawn. The obligations are confessed, however, and the result is just the author's presentation of bits of his own experience and deduction, along with much that is well known to all modern ornithologists.

The little book, therefore, has its limitations, and does not pretend to tell the whole story of the birds, even if could be told. Its aim is simply to present in a rather unusual yet popular way the more striking scientific features of their probable development.

From this standpoint the predominance of the anthropomorphic element in the discussions may be criticised, but the author is assured from his experience as a lecturer before the students of all grades from grammar schools to universities, and even before popular audiences, that this is the best form for provoking interest.

If it be thought that too much effort has been expended in trying to account for so many facts, it may be replied that a phenomenon to-day is of little use, or at least has little significance, till it is classified or placed under some theory or hypothesis. If the hypotheses advanced here should not always meet the critic's approval, or seem not always to be wholly justified from every point of view, they are still better than no setting whatever. There is more stimulation to thought, more assistance to memory, more rousing of attention in an imperfect or even an incorrect hypothesis than in none at all.

In interesting rather than instructing, in guiding the observation of the inexperienced into proper channels, in suggesting slightly to the student what to look for among the birds, and what to do with a fact when found, the author hopes that this little volume may find a mission.

J. N. B.

MEXICO, MO., *September, 1896.*

ANALYSIS OF THE STORY OF THE BIRDS.

WITH STUDY HINTS.

THE following brief analysis of the chapters is made with the hope of better enabling the reader to recall or review the essential facts and principles mentioned.

The suggestions for study are intended only as stimuli in the observation of such simple examples as may fall in the average reader's way without special excursions, slaughter, and dissections.

CHAPTER I.—The early ancestry of the birds lies in the primitive vertebrates, but within the reptiles and lizards, shown chiefly through skeleton and methods of multiplication; the large egg not found elsewhere. A bird is characterized by wearing feathers.

Suggestions for Study.—Read in encyclopædias about Dinosaurs, Pterodactyls, and the *Archæopteryx.* Consult any work on zoölogy for characteristics of the five groups of vertebrates.

CHAPTER II.—How birds first flew. First use of feathers and tail.

For Study.—Examine a bat's wing, and compare with Pterodactyl; note how insects fly; parachutes of the flying rodents, lemurs, etc. Observe action of a bird's tail in alighting or suddenly rising.

CHAPTER III.—Use of wings in climbing. Claws on modern birds noted. Skeleton and muscles of fore leg much modified in wing. Wings did not grow out as wings. Birds may have walked before flying, perhaps crawled. Had birds more than one origin among the reptiles?

For Study.—Examine the skeleton of the wing of table fowl in connection with figure on page 13. Notice the separation and superposition of the breast muscles of a cooked bird. Dissect an English sparrow for further study.

Chapter IV.—Plumage was acquired by birds for warmth, not lightness; quickly modified for flight. Skin pores suppressed to preserve heat also. Hollow bones and various air spaces used as reservoirs of air on account of scant lungs.

For Study.—Note heavy downs on a duck's body, and the hook vanes on its flight quills. Observe the hollow, marrowless bones of table fowls. Cut windpipe of dead bird, insert tube and blow, noting inflation of body.

Chapter V.—Plumage grows in symmetrical tracts with bare spaces between. Diagnostic value of this arrangement. Did plumage originate in patches? The pattern much subject to environment and habit and much modified since the beginning.

For Study.—Examine picked poultry in market and note the clustering of the *papillæ.* Look at any nestling of song bird (canary or sparrow) and, if possible, a woodpecker or chimney swift.

Chapter VI.—Downs are of two kinds—nestling and adult. The first grow in the pockets (*papillæ*) of the latter and of the large feathers, and are pushed out. Downs may be degenerate feathers; often ornamental; sometimes powdery in tracts. Downs not usually present in bare tracts except in aquatic birds. Aftershafts formerly prevailed more generally. *Moas* had strictly double-stemmed feathers. Downs developed as needed. All nestlings of early birds hatched downy. Naked nestling a later development (see Chapter XX).

For Study.—Note difference in downs and their arrangement in ducks and chickens, and the nakedness of any little bird's nestling. See the aftershaft on some of the body feathers of common hen. Examine some down under a magnifier.

Chapter VII.—The plumage is a product of the skin purely originating beneath the epidermis. Scales were changed to feathers. Barrel of feathers evidently once flat. The necessities of flight doubtless made them tubular and caused the vanes to become hooked together and air-resisting. Solid vanes also protecting to body. Plumage modified much in Nature in keeping with the bird's comfort, safety, and beauty.

For Study.—Examine any ordinary wing or tail feather. Note the infolding of edges of shaft; run a fine wire or bristle along the groove into the barrel. Observe that the end is closed by a membrane. See the tendency to flossiness near the body. Note ornamental degeneration of other feathers, as cocks' tail feathers, peacock and lyre-bird plumes, and ostrich tips.

Chapter VIII.—Molt occurs with all birds in the fall. Some have various molts, according to needs. Molt necessary for repair and change of ornament and color; affected strongly by environment; now probably a much hurried-up process. Old feather usually *falls* out now, but perhaps was formerly pushed out. New colors are also produced by wearing away or shedding the feather's tips.

For Study.—Note molt of young chicken. See dead center or "pith" of cast-off feather. Note in English sparrow the difference in color of the plumage beneath and on the surface. Observe the young males' acquisition of black throat patch, etc. Observe nestling down on tips of large feathers of a fully fledged young bird yet in nest.

Chapter IX.—Ornament may be incidental, but usually has purpose; may prevail anywhere on the body or extremities; is often displayed and appreciated; may be a matter of shape, but usually of color, or both combined. Brilliancy a special feature of the birds; rarely lost or subdued, but intensified by progress. Both form and color ornamentation may at times harmonize well with surroundings and become protection.

Origin of choice discussed. Ornament may be only a sign of vigor or conjugal capacity. Instances of appreciation. Males usually have more ornament. Some females pretty and males plain. Relations between ornament and style of nest and nesting. Color of female more nearly the primitive color of species.

For Study.—Note wattles, hackles, and tail plumes of roosters, "speculum" on wing of drakes, etc. See the duskiness of female cardinal, indigo bird, bluebird, rose-breasted grosbeak, etc.

Chapter X.—Signal or recognition colors prevail largely among birds. Nature's care about the race makes altruism automatic. Color calls usually white and mostly visible from the rear; often concealed except in flight, depending on motion for display; often ornamental. Doubtless brilliant colors and ornaments may answer the same purpose. Whirring flight, wing strokes, and vocal cries as substitutes. Brotherly affection among birds.

For Study.—Note white wing bars of English sparrows, jays, etc., and the whirring flight of many flocking birds. Observe the little by-talks of small chickens as they run and feed.

Chapter XI.—The weapons of the primitive birds were pre-eminently their teeth, which were lost, perhaps, because of changed habits induced by flight. Early weapons useful more especially in prey taking. Special weapons were developed in fighting rivals. Wing spur the earliest of these, perhaps; leg spur later, and confined mostly to one group. Birds' weapons not ornamented, but probably have given way to other forms of emulation, as song, antics, etc. Battle is often mere bluff, chasing, inflation, etc. Birds have no shields. Weapons a means of advancing the race.

For Study.—Note armament of chickens, turkeys, and various birds of prey. Compare pictures of the sheep and antelopes, and see the curved and lyrated forms full of the curves of beauty.

Note.—There is no such thing as a poison beak or gland among the birds, newspaper paragraphs to the contrary notwithstanding.

Chapter XII.—The play of birds sometimes seems humorous purely, but it usually has the purpose of charming or displaying pretty parts. Instances noted. Females often play back, not always. Some antics take the form of ecstasies.

Odor has no special glands among birds as among mammals and reptiles, with one exception; but odors are evidently quite distinctive, and doubtless have purpose in them in some cases. Some birds smell keenly, but vultures hunt largely by sight. Mud probers use smell in searching, but some other forms have no nostrils.

For Study.—Note little chickens' mock fights, crows tumbling in flight, turkeys strutting, pigeons pouting, house sparrows whirling, etc. Note incidental odors of fish eaters. Put the hand in a laying Guinea-hen's nest and see if she abandons it.

CHAPTER XIII.—Song primarily a call or cry, but now a charming factor. It is the latest acquisition, the song bird having a special throat for it. Song still has rivalry in it. Various tones for various emotions in many birds. Song as a calling or advertising, as a serenading, a cheering, a rejoicing, a warning, a threatening, an exasperating, and a subduing factor.

For Study.—Note the spring songs and incubating songs of birds; also their revival at the second nesting period and their absence usually in late summer. Note answering crow of cocks, gobble of turkeys, coo of doves, whistle of quails, etc.

CHAPTER XIV.—The mating time of our middle-latitude birds extends from January to July. Pairing of resident birds often a matter of association. Perhaps many migrants stay from year to year paired, and, though separated in migration, return to same spot. There is always a charming procedure, however, each year, which may be short or long.

Polygamy largely prevails among the low birds. Males of higher birds very devoted to mate in brooding season. Some similar instances among low birds, but many males of these desert their families. Birds of prey long noted as pairing for life.

For Study.—Note early "hooting" of owls. Note thistle bird or goldfinch in flocks late in June. Watch birds of orchard and yard for love antics, especially jays, blackbirds, and flickers.

CHAPTER XV.—Lost mate is soon replaced by either sex. Doubtless many unmated birds extant. Experiments noted. The widowed call. Darwin's note of incompatibility of temper. Polygamous tendencies in high birds. Results of environment and opportunity on all this.

For Study.—Among English sparrows if either parent be killed the other soon finds a helper. Even if both are destroyed others will feed the crying young, or birds of a different species will sometimes care for each other's orphan nestlings. Is the acquisition of a new partner as much parental as conjugal?

CHAPTER XVI.—Incubation found among a few reptiles only. It is probably an acquired habit in birds, the lowest showing least of it. Perhaps began in the time necessary to the act of depositing eggs subsequent to the first. Earliest birds may have covered eggs with sand or hotbed stuff as reptiles and megapodes do yet. Change of place and climate may have necessitated incubation. Style of nest likely also a factor of the amount needed.

For Study.—Note the duration of incubation of various domestic and wild birds near. Observe the relations between size of parent, of egg, of nestling, and of time incubated; also relation of style of nest to number of young and the time they stay in nest. Observe also duration of laying period and time used in depositing each egg. Report to some ornithological journal.

Chapter XVII.—The style of a nest affected both by inherited tendencies and present surroundings. Centers of origin thus hinted. Different building seasons (early or late) affect the structure. No fossil nest, no embryology of nesting, but present elements hint past development. Platform, cup, and lining likely represent three different stages of progress. The "natural-selection" element of structure and location mentioned. The lining the most recent and constant feature. Intricate nests made for comfort of nestling or sitting parent. Tree building a great nest-developing element. Nests often ornamented or at least concealed by mimicry of surroundings in form and color; shaped also by color of sitter.

For Study.—Note that nests of hens, geese, turkeys, etc., are mere hollows, showing little structure. Note just above them pigeons *moving* the material, but making poor nest. Separate platform, cup, and lining of old robin's nest. Note chipping sparrow's tendency to emphasize the lining and omit the platform. Note frequent simple cups (not purses) of Baltimore oriole. Make notes of variations in all nests examined.

Chapter XVIII.—A few birds seem quite fastidious about nesting material and location. The sham nests of wrens and gallinules mentioned and purpose discussed. The trades of birds. Old nests not usually used a second time except in holes, etc. Frequent theft of each other's material and nesting sites. Nest repairing by owls, eagles, and ospreys.

For Study.—Watch blackbirds and any old nests that are in the yard. Nail up gourds, cans, and boxes anywhere that they can be observed, with holes too small for sparrows, and thus attract house wrens, tits, and chickadees for study.

Chapter XIX.—All colors and markings of birds' eggs once likely had purpose in them. Earliest birds' eggs probably pure white, as are reptiles. Harmony with the place of deposit (after nests became open) the origin of color and spottings. Primitive hole builders all had white eggs likely. Some colored eggs now tend to blanching. Eggs hint relationships slightly by color, markings, and shapes. Various modifying factors noted (page 119).

For Study.—Note ellipsoidal shape of pigeon's egg, and how globular and smooth are those of woodpeckers. In any broken marked egg view spots if possible from inside. Wash any colored egg with weak acid (even a brownish hen's egg) and note how superficial is the color. Note that some hen eggs are spotted and see the great variations, even in same clutch, of the eggs of the English sparrow.

CHAPTER XX.—All primitive birds likely had precocial nestlings, the altricial being a recent degeneration brought about likely by tree building. Other causes conjectured. Some remarks on relations of size of egg to parent and nestling and on size of yolk to "white." The hint from dormant eggs in oviduct that birds once laid more eggs at once than they do now. Nakedness of nestling may be the result of hole building and parental brooding. Herons, hawks, pigeons, etc., now in the transition state, perhaps.

For Study.—Note the ease with which the "egg tooth" slips on newly hatched duck or chicken, and how it is scarcely separable on a nestling sparrow or pigeon even. Note that the pigeon, while naked and helpless, is much less so than the sparrow. Observe how very naked is a young chimney swift or woodpecker.

CHAPTER XXI.—Precocial birds do not carry food to or put it in the mouths of their young generally. Nature's provision for the precocial's sustenance till it can eat well. Altricials thrust food upon their young. Regurgitation practiced by many parents, especially low birds. Peculiarities of hornbills, pigeons, and flickers. Parental devotion instanced.

For Study.—Observe the canary regurgitating to her young for the first few days. If a flicker's nest is near, after the young come to the orifice (in a few days after hatching), note the parents' pumping process. Watch the swifts and swallows after the young are on the wing and they are circling around.

CHAPTER XXII.—Birds' food primitively was evidently largely animal, as shown by their teeth. Subsequent loss of teeth necessitated gizzard in grain eaters. Flesh eaters now do not need it. Various feeding habits noted. Peculiarities of *Apteryx,* snipe, and woodcock's beak, rail form's feet, penguin's wings, geese form's bill fringes, pelican's sac, heron's spear, and birds of prey's talons, terribly hooked upper mandible, etc.

For Study.—Note elevated rear toe out of the way in the scratching fowls and (in the market) the soft sensitive beaks of snipes and plovers. Note that birds with strongly decurved beaks are usually ground or water feeders.

Chapter XXIII.—A bird's implements are related to its habits; instance the bill of the *Apteryx.* Examples of habit preceding structure and of structure inducing habit. Parrots, cuckoos, and woodpeckers as illustrations. Habits noted as compensating for defective structure. Interesting and striking variation between swifts and humming birds. Various feeding habits. Habit away ahead of structure in the water ousels.

For Study.—Note with a glass the outspread outer rear toe of woodpecker on a tree trunk. Observe that a nuthatch head downward stretches a leg far back up the tree as a squirrel. Observe nutcrackerlike bill of parrot, and crushing and cutting form of cardinal's bill—an extreme example of the seed-eating finch forms.

Chapter XXIV.—Roosting with the breast on the perch or support is usual with most birds. Waders stand and hawk forms never squat. Some midocean haunters may sleep on the wing. Some aquatic birds sleep floating. Picarian birds sleep in holes often. Woodpeckers and swifts roost in an upright position, usually in cavities. All birds using a perch strain the toe tendons in squatting till automatic clasping is effected. There are different methods of accomplishing this in different birds.

Some parrots hang (head down) by one foot, some by both, and others hang by the beak.

For Study.—Place the finger in the grasp of any freshly slain bird and bend the leg up to the body. Note the automatic clasp as the bird appears to squat. In such birds as sleep with head under the wing note if the right wing is used, since this is the position in the shell before hatching.

Chapter XXV.—Toe arrangement and peculiarities very helpful in diagnosing, but do not always indicate kinship. Various styles defined. Swimming membranes are, perhaps, rather recent developments. They are transient (or seasonal) now in some amphibians. They speak confidently of habits. The bird's foot is based on the lizard's. Prestige of the middle front (third) toe discussed. Peculiarity of leg bones—the fusion and stiffening of parts for better running. Loss of rear toe and the various tendon arrangements mentioned.

For Study.—Notice feet of ducks and chickens. Dissect out tendons and note their uses. Observe that the very tendons are bony in the turkey. What does this mean? Note in the ostrich (at the menagerie) that for speed afoot purely almost no toes are needed, and that bird's toes now are preserved for clasping and swimming.

CHAPTER XXVI.—The wing, after fluttering-up flight came, was variously modified. Each new need made a new shape. Ground haunters have usually broad, short, round, concave wings. Penguins' wings not long used as such, perhaps. Long wings mean long flight. Chest muscles (quality and quantity) are compensating factors, however. Instances in ducks and plovers. The soaring wing noted. Soaring largely a matter of skill. Flight by flapping largely a matter of propelling rather than lifting after the bird once starts. The number, shape, length, set of the wing quills.

For Study.—Make a collection of, and label such wings as fall in your way without special slaughter, and note shape in connection with the bird's flight habits. Observe difference between those of duck and hen, hawk and plovers, sparrow and quails. Place no confidence in the collection on the hats of any feminine assembly. They are usually trimmed to suit the æsthetics of the milliner.

CHAPTER XXVII.—Birds have a definite home region and love it, and, in the extreme north, are driven from it by stress of weather and scarcity of food. They return to it in the spring. View of glacial theory of migration and the probability that the tendency to conceal nests and get apart send southern birds north. Some migrate afoot partly, but flight is the great factor of the seasonal movements. Some migrations very direct, others straggling, many day birds moving at night high up. Migration may change social habits. Coast lines, rivers, mountains, act as guiding factors.

Islands thronged and special routes often adhered to. Instinct of direction discussed. Leadership of old ones not always present to guide young. Birds often get lost. Curious instances of hunters "crossings" and "fly lines."

For Study.—Keep a record of coming and going of migrants, as noted from window or walk. Get a correspondent north and south of you to warn you to "look out." Learn the migrating haunts of various birds in your region, such as certain bushy swales, wood borders, etc. Keep your ears open at night (when out) for a migrant's call.

CHAPTER XXVIII.—A bird's ideas of geography, climatology, direction, etc., oft inherited from its ancestors, but much comes by experience. The distribution of the birds hints much of geology. Instance our great plains and the meeting of Hudson's Bay and the Gulf of Mexico formerly.

Birds seem to know their proper nest, number of eggs, or clutch. Instances of vireos appearing to count. Peculiarity that the sight of the proper nest number should suppress the formation of other eggs in oviduct. Laying not always controllable. Effects of weather, fright, etc., on this. Migrant sea bird's exact estimate of time.

For Study.—Watch for cowbird's egg and nests about you. Destroy them. Take an egg away each day from some laying bird and note if she will lay more than her usual number to replace the loss. After one or two eggs are laid fill out her clutch with sparrow eggs, and note if she ceases to lay.

CHAPTER XXIX.—Losses have often been large gains to birds. Instances noted in feet, leg, wing, teeth, intestines, carotids, primaries, palate, etc. Habits also lost down to a vestige, which hints former relationship. Instances of ousels, grebes, hoactzins, gallinules, rails, geese, etc. Also in nests and in hoarding of bright things by crow forms.

For Study.—Note in a book any peculiar habits of a bird. Think if this occurs in any other akin to it. Are the crow of cock and croak of pigeon similar—they are kindred groups. Note that the brooding domestic pigeon strikes at your hand with her wing, and recall that many pigeons have wing spurs, Is the rooster's strut with one wing a vestige or a rudiment of the turkey's and peafowl's and other pheasants' perfection of the art?

Does the fact that he snaps his wing over his back before crowing imply that the ruffed grouse may do the same in drumming?

CHAPTER XXX.—This chapter is itself an analysis.

For Study.—If interested in the kinship of the birds, read up, if possible, from cyclopædia or other source a bit about the connecting links (see "connecting links" in index).

Some of those of especial interest on the diagram are the *Apteryx* (or kiwi), between groups 4 and 8, the tinamous (4–5), the button quails (5–9), the hoactzin (7, between 5 and 8 and 5 and 26), jacanas (8–9), the sand grouse and *geophaps* (between 5–6 and 6–9), the bustards and thick-knees (8–9), the *mesites* (10–15?), trumpeters (10–5?), the *seriemas* (10–16), the secretary bird (15–16), the flamingo (14, between 13 and 15), the screamers (13–5?), the *dromas* (9–19–22), the sea runners (22–21), the sun-grebes and finfoots (8–12), the tropic bird (19–20), the oil bird and frogmouth (17–27), the owl-parrot (17–24?) the broadbill and lyre bird (31 and 32), as bordering on to the *Passeres*.

Within these latter such links as cowbird, bobolink, wagtails, honey creepers, wrentits, dippers, etc., may be interesting.

CHAPTER XXXI.—An analysis itself.

For Study.—If further interested, compare the orders mentioned here with descriptions of orders in any zoölogical text-book. Compare the keys to the orders in Chapman's Handbook, Ridgway's Manual, or Coues's Key.

Examine the claws, toes, shank, wing shape, primaries, beak, nostrils, and tail shape of every bird falling in your way.

CHAPTER XXXII.—The essentials of home study of birds are principally interest and attention. Small facilities followed up may do much. Window views of creepers, nuthatches, titmice, chickadees, kinglets, woodpeckers, sapsuckers, warblers generally, vireos, hummingbirds, snowbirds, blackbirds, flickers, jays, screech owls, mocking birds, robins, bluebirds, orioles, cowbirds, and house wrens are noted as being obtained without effort.

Finally.—If you have read this book thoughtfully, you will feel a new and affectionate interest in our feathered friends, and when you are out of doors you will *look for the birds*, and learn many useful lessons from them.

CONTENTS.

LIST OF FULL-PAGE ILLUSTRATIONS.

THE STORY OF THE BIRDS.

CHAPTER I.

A BIRD'S FOREFATHERS.

THE birds form one of the five great groups of the vertebrates, and of course their ancestry began when the backbone was a gristly cord on the lower border of the fishes. Perhaps we might begin later, when the backbone of the higher fish-forms had become bony and jointed and a brain case had expanded upon its forward end; for birds are certainly brainy creatures. Later still, we might set our beginning when the numerous rays of the fins of fishes gave way to the few fingers and toes of the four-footed, land-tending amphibians, and where the fringed gill of the water breather yielded to the simple lung sac of the air breather; for our bird has certainly four limbs only, with few fingers and toes on each, and it is the best adapted to air breathing of all earth's creatures. Or possibly our story might begin at that point where the young ceased to have a tadpole or larval state, but began at once to resemble its parents as soon as it was hatched or born; for we shall see later that a baby bird at once begins to look like his mother (Chapter IX).

Perhaps we might set out at that parting of the ways between the reptiles and the mammals and between the reptiles and the amphibians, where the large egg comes in and the young are capable of being nourished for a long time independent of the parent or of position in the water; for the yolk of the bird's egg feeds the young bird till hatched, and in some cases a short while after, and the hatching is independent of water.

Then there is the region of better or more cellular lungs that we might begin at, or that of a better or more extensively chambered heart with warm blood pulsing through it; but that would be getting up within the realm of the bird itself almost—at least upon the border land. Yet the duckbill (with its kin) has all these traits and lays an egg and incubates it, but it is not a bird or in the line of the bird's ancestry.

Surely we may say that birdward tendencies were set up when Nature began by skin appendages to carry the lizards through the air; but the development of this might have missed the bird completely, for these lizards are certainly not the ancestors of the bird any more than bats are its fellows or descendants. They were only evolved out of the same conditions.

Here, indeed, however, is the true region, for the dawning of bird life closely follows the dawning of vertebrate flight. Had there been no tendency to fly, the true bird could never have been developed. The ancestral outlook of the birds, therefore, lies in the aspirations of the lizards.

But real bird life begins higher up the line still, where flight became very special—not by skin, but by scales with some changes wrought in them. So far as our knowledge goes, no creature except a bird ever *flew by feathers*. It may be possible that there were some soft modifications of the scales among the active terrestrial reptiles, but, so far as we now know, nothing but a bird has ever worn feathers—except a woman and a savage. Better to say that nothing but a bird *grows* feathers.

Birds show that their forefathers were among the reptiles by the following characters common to both, and by many others too technical for our discussion:

The large egg noted, found nowhere else except in that three-way connecting link between birds, reptiles, and mammals—the duckbill group; by the lack of complete diaphragm below the heart and lungs; by having only a *single* ball-and-socket joint where the head turns on the neck, whereas the mammals and amphibians have two; by many peculiarities of structure about the head, especially by having the lower jaw connected to the skull by an intervening (quadrate) bone not found in the mammals. So also there are peculiar arrangements of the circulatory system and of the bones of the feet, etc., that are found only in these two groups. Finally, as distinctive of the groups, they neither pass through a tadpole or incomplete state after birth, as the amphibians, or have

Archæopteryx macroura, Berlin specimen (after Seeley).

special glands (*mammæ*) to nourish their young as the mammals.

While they differ from each other in the bird having hot blood and feathers (instead of cold blood and scales), great naturalists are inclined to make one class of the two groups. The oldest bird which we know of yet is the fossil *Archæopteryx*, and had not the print of the feathers on its wings, tail, and legs been left in the rocks along with its bones, it is probable that it would have been classed simply as a flying lizard.

Thinking back over what has been noted, we may say of the bird that it is—

A back-boned, four-limbed, lung-breathing, egg-laying, hot-blooded, feather-covered, upright-walking creature, having its fore legs adapted to flight; for, however flightless a bird may be now, there is sufficient evidence that it has come out of an ancestry whose wings were once really complete and useful.

Whether all birds have had the same forefather is a much discussed question out of place in this connection, but it is further slightly referred to in Chapter III.

CHAPTER II.

HOW DID THE BIRDS FIRST FLY, PERHAPS?

Nature seems rarely surprised in the demands made of her. She is usually well up to the emergency, and often seems to be looking ahead.

The great instrument of dry land invasion was the backbone, and this was developed in the water; and the great instrument of vertebrate invasion of the "upper deep" was the wing, largely developed, perhaps, before its owners made any attempts at fluttering up.

The wing as we see it now is much modified by the growth of feathers and its adaptation to flight by them, but there were reptiles that walked in an upright position and exhibited many birdlike characteristics before the dawn of the flight quill.

From the structure of the skeleton it is the opinion of some eminent naturalists that birds not only walked uprightly and hopped bipedally in trees before they flew, but that they flew before they had wing feathers; and of many others think that they at least crawled about trees before they flew, as the frequent presence of wing claws yet indicates, and as a few instances of modern young birds crawling and climbing by these claws hint.

Across the front re-entering angle of a bird's wing *now* the skin is expanded into a double membrane, which, when the wing is opened, is kept tight and spread out by a special ligament and muscle stretched from shoulder to wrist, to use the figure of our own arm. This muscle appears as if it had been stripped up from the region of our biceps to support the wing automatically when folded, but it is a distinct development and not stripped up. It is not at all improb-

Pterodactyl.

able that the very, very early birds may have used this skinny expansion on the fore leg to break the shock of a downward leap (whether made bipedally or quadrupedally), or it may have been so extensive then as to enable them to sail downward, as the flying squirrels and others do now by a special development of the skin behind the armpit and in front of the flank.

Skin-flying, as we have seen, was very fashionable in those days. The Pterodactyl group had true, continuous flight by the skin of their little fingers, and some arboreal frogs may have been easing the jar of a downward leap then as now by the expansion of the skin between their toes. It is not likely, however, that birds attained true continuous flight by means of this membrane, which is called the *patagium*, but that it was simply the first instrument upon which the forefathers of the bird first launched themselves into the air. Some thinkers are inclined to believe that, even after the coming of feathers, this membrane was a factor in flying.

But doubtless in time feathers or plumous scales growing projectingly from the rear of the arm and from other regions, became similarly useful in resisting the air, and were finally, in connection with the wing, the exclusive instruments of flight. That feathers were used at first as means of sailing down only is strongly hinted in so complete a bird as the *Archæopteryx*. It had doubtless continuous flight, but the bony part of its tail was longer than its body, and each vertebra (or joint) had a flat feather projecting from each side like the hairs on a squirrel's tail. Likewise the "drumstick" of the leg was feathered so that, outspread as the squirrel in his leap, the ancestors of this bird had likely sailed down from high places.

Indeed, it is just probable that the *Archæopteryx* itself could not rise directly from a flat surface, but had to climb some eminence from which to launch itself. If it could rise from the earth, it was doubtless only against a hard wind, wherein its feathered tail and legs (*tibiæ*) would act as a kite while it fluttered forward with its wings. In view of this great length of tail still persisting in so well developed a bird, it seems quite probable that it (and all the flying lizards below it) could go *forward* only against the wind or in a perfect calm. To go with the wind they had to flutter backward likely as many insects do yet. While these long tails were quite helpful at first, they were shortened later, that the bird might better turn around and fly forward under any condition. Their loss was doubtless gradual, with the development of better wings.

Perhaps there is no better place than this to combat the popularly prevailing idea that a bird's tail acts as the rudder of a boat. To a slight extent in some birds it may, but where the wing is perfected, as in the swifts, the albatross and others, turning is effected at once with a very scant tail; and its use in flight always has more reference to the up-and-down movements than to the lateral. It comes into play in alighting (as a brake) or in rising (as a kitelike surface), and is used dexterously by the soaring birds in balancing themselves against varying currents of wind. Hence we see that the earlier and later uses of the tail of birds are very much the same, and that a large lot of unreadable history lies in the jammed-up caudal vertebræ of the modern flier.

CHAPTER III.

A BIRD'S FORE LEG.

Of course, it is apparent that the wing of a bird corresponds to the front leg of a quadruped, but it is not so evident at a glance that it *is* a leg or the result of a leg's modification. Yet, to the student of the skeletons of birds as an entire group, taken in connection with the skeletons of reptiles, especially lizards, no other opinion can well prevail.

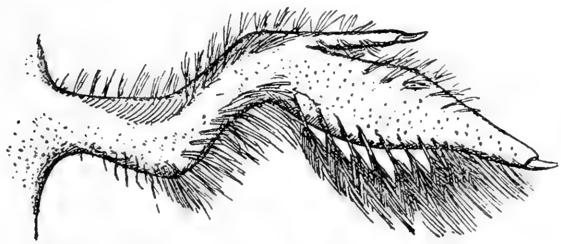
The modifications of limbs by loss of digits from the twenty rays of the fish's fin to the single toe of the horse is interesting. This degeneration soon reached five digits normally in the reptiles, especially in the rear; but in those that were most birdlike, of which the fossils are known, it ran lower both on hand and foot.

The earliest bird we know had four toes and three fingers, and this is the normal yet.

In this half-reptilian *Archæopteryx* already noted all the bones of the fingers were free from each other, and if a thumb were present it was alongside the others and of about equal length with them. In all later birds the thumb, so called, is much shorter than the other fingers and has fewer number of joints, and, except in penguins, is entirely free. The other two fingers are not only inclosed in the same skin and other tissues, but their bones at the base are fused together in such a way as to form a strong wing tip. In very young birds they are free. Birds, bats, and the fossil-flying lizards all fly (or flew) largely by their fingers, and the last almost solely by the little finger.

The claws on the fingers of the *Archæopteryx* were perhaps useful, as we have seen, in climbing.

Many more birds than we usually suspect show vestiges yet of claws on the fingers. Our turkey vulture, some ostrich forms, some swans and others, even up as high as the thrush forms, have claws variously located on the wing tips of the adult. Some young gallinules have these claws so functional that they can pull themselves about over reeds and grass with them, and in an allied bird in South America,



Wing of young hoactzin, showing claws.

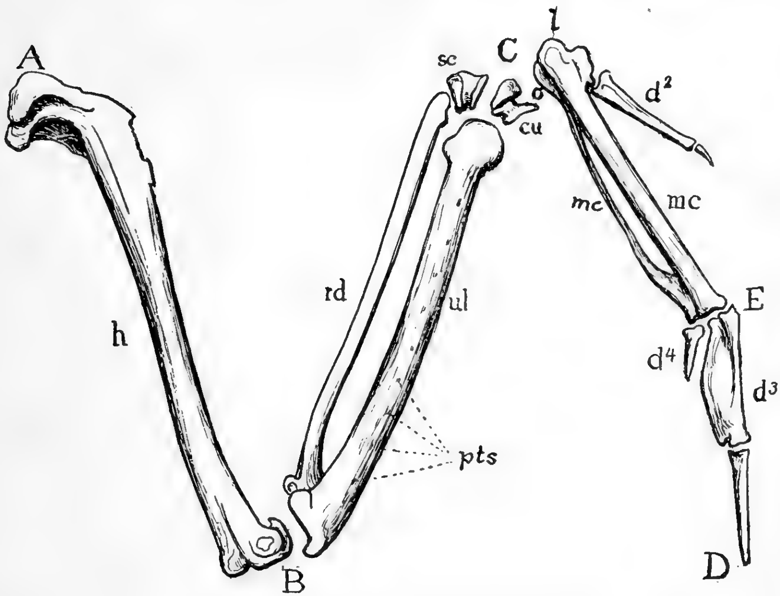
the hoactzin, the young, while yet unfledged, can climb in a crawling attitude over bushes and among the branches of trees. In this latter case the claws are shed when the nestling is fully feathered.

Besides having the front paw thus fused and mittened, the modern bird's fore leg is otherwise much modified. There being small use in flexing the fingers, there are very slight muscles on the forearm. The hand is not flexed to any great extent by tendons, but by a peculiar mechanical union of the two bones of the forearm. We have already noticed the use of the muscle and tendon which spreads the *patagium*, or skin fold, but the modern use of this tendon is more apparent, since, by its elasticity, it holds the wing when at rest automatically folded. This it can more easily do, since it stretches directly across the front angle and furnishes one of the few instances in Nature where a muscle pulls at the long end of a lever.

This ligament and its membrane has another use—that of forming and maintaining a comparatively straight edge to the wing in all its positions in flight, and it is just probable that this has always been its sole use. If we conceive ligaments at C binding rd, sc, and the end of mc at l together, and that ul, cu are similarly bound to mc near o, it will be seen that when C is drawn toward A, the point D will automatically approach B without any muscular effort exercised on CD.

There are many instances in Nature, however, where an old instrument, after ceasing to be useful in the old capacity, is put at new work under new conditions. The bird's fore leg is itself, as a whole, one of the most striking.

Many of these changes have come about at the demand for lightness at the wing's extremity, but other changes have been wrought for the sake of proper balance during flight. In quadrupeds and man the muscles that open the arms or fore legs away from the body lie mostly between the shoulders. But suspended by the wings, the bird might be too top-heavy if the region between them were piled high



Skeleton of duck's wing (after Coues).

h, humerus; *rd*, radius; *ul*, ulna, showing pits, *pts*, where the secondary flight quills enter slightly; *sc* and *cu*, carpals, forming the wrist; d^2, so-called thumb; *mc*, *mc*, the hand bone, composed of three bones fused into one girder-shaped piece, one for each digit; the "thumb" abutting against a short one at the base; d^3, the middle and longest digit; d^4, outer digit, inclosed in tissue with d^3.

with muscles. So these muscles are placed below upon the chest, and by their weight help to keep the bird in proper position during flight; and they effect their lifting power upon the wing by means of tendons that run up over a pulley. Perhaps in all the modifications of the bird's fore leg this is the greatest.

There are some other changes, such as the change of the direction in the hinging of the bird wrist and the pitting of the bones (to better suit the attachment of wing quills), but we can not discuss these here.

There is no biological evidence that wings ever sprouted out of birds (or any other vertebrate) as wings. Short, vestigial wings of some ostrich forms and fossil birds all show traces of having degenerated from a wing once good and complete, but which has lost its parts by disuse as a fanner. Neither can we say that bird wings, as we know them now, were the cause of flight, but rather, as we saw in the last chapter, they are the result of it.

So likewise it is probable that the use of feathers in their present form was simply an incident to conditions begun long before they were useful in flight. But while there is no doubt that feathers are not necessary to flight, there is every reason to believe that much of their present structure, when complete, is the result of their special adaptation to its demands, and that they have been a large factor in modifying a bird's fore leg.

The placing of this muscle on the chest and the development of the greater one that overlies it, by which the down stroke of the wing is made, were evidently brought about by the demands for fluttering up, while the fore leg began at first to be modified as an instrument for getting down. This great change in wing muscles must then have been comparatively later.

Perhaps there is no better place than this to speak sparingly of bipedal motion in birds. While the *Archæopteryx* could evidently stand upright, and had almost a perfect perching foot with a limb-clasping, opposable toe, there is much about the bones of its feet and legs that implies that *it* did not come from an upright ancestry very far back. But some of the ostrich forms, living and fossil, which have their skeletons adapted to running, show such close resemblance to some fossil reptiles which are known to have walked bipedally long before flight that they tend to give us the impression that they are lineal descendants of these terrestrial reptiles. The absence of any muscle-holding ridge on their breast bones and the smallness of these breast muscles may imply that they had never attained to fluttering up flight, and that their wings had degenerated from an *imperfect* condition as their bipedal motion had further developed. This is not likely the case, however. In such other birds, akin to the strain of the *Archæopteryx*, perfect bipedal motion seems to have been the result rather of the fore leg's *complete* development into a model pinion, while it was useful at first to walk or crawl with.

It may be, therefore, as held by many thinkers, that by more than one route the birds have come out of the region of the reptiles; but others feel that every wing to-day, from penguin to thrush, is the descendant of a single type in the beginning, modified by various developments and degenerations.

Certain it is that if we knew the history of a bird's fore leg, we should know a great deal more about its forefathers.

CHAPTER IV.

WHY DID THE BIRDS PUT ON SOFT RAIMENT?

NATURE is a great preserver of her energies. Only in the growing and sowing of many seeds does she appear wasteful, but this is the truest economy.

She expects adversity and accident, and prepares to meet both, as if she had learned her lesson gradually by experience.

The bird was likely her first hot-blooded animal. Certainly it was among the first. For the invasion of earth and air, as we have seen, she needed a better furnace and fanner, and a better fuel carrier than any reptile or fish had. So she added more chambers to the heart (or to her liquid fuel pump) and more cells to the lungs (or flues to her boiler), till the blood pulsed hot and throbbing with power in the new creature.

Except perhaps the smaller winged insects, no animal works at a higher pressure than the flying birds. Their normal temperature (104° F.) is high fever heat in man. They burn fuel fast. No other vertebrate expends so much per hour or for so long a time at a stretch. It is like "an ocean greyhound" in miniature.

Song sparrow and swamp sparrow, both of the same genus, Melospiza.

Heat is power; we know that. It is at present the source of all energy, we know that, and we list our doors, double our windows that we may preserve it when we need it. We clothe ourselves in flannels and heavy outer coats that we may live by it, and jacket the steam pipes and boilers of our locomotives that we may more economically move by it.

Nature having a good boiler now proposes to jacket it to prevent loss by radiation, and hence the mission of fur and feathers, as seen in the toes of arctic birds, being feathered to the claws. This is also the meaning of the dense downs of the water birds.

Foot of snowy owl.

It is not likely, however, that the bird was clothed previous to its show of extra energy. Nature's charity is the best, and she gives only in the line of our needs, and usually at their promptings. Feathers were not necessary to flight, as we have seen, but they greatly advanced it. "Unto him that hath it shall be given" is a law of Nature as well as Revelation, and in preserving the bird's energy she gave it a better means through its covering of hooking on to the air. Because of its struggle upward she gave the bird in its soft apparel a new fin for a new element.

Nature shows her heat-preserving tendencies in the bird by another change which was radical. The fishes and reptiles had various external pores, as also have some mammals. Through them they moistened the skin with various secretions for various purposes, perhaps for lubrication in the fishes. To a quiet, lazy land creature, as a tree frog, Nature could even give oxygen by dampening its surface; and others could thus breathe through the skin solely while beneath the water. But in a bird which moved so rapidly, any surface moisture would tend to cool it too much and to weaken it. Besides, it would dampen the plumage—another thing not desirable. So the pores of the skins of birds were largely suppressed, and the dire possibility of cleaving the air at a hundred miles an hour in a high state of perspiration was prevented. It is possible that this, too, was the result of flight by a long line of fitting survivals; for chilling the surface closes the pores, as we well know when we "take cold."

Scales in no way tended toward heat preservation. In fact, they were rather fitted to dissipate and radiate it. Perhaps this may have been one of their purposes. The primary mission of cold blood was adaptation, without shock, of the creature to a constantly cold or watery environment. But a bird invaded a realm of various degrees of temperature. The one best clothed for extremes could migrate over the greatest range of climate, and a better development of feathers meant a better development of flight and the finding of newer and better food regions—in fact, progress generally. They traveled on their good clothes literally as some persons do figuratively. It was a wonderful step, therefore, when the ancestors of our modern birds first donned soft raiment.

It may be well before closing this chapter to say that, contrary to the usual popular impression, feathers were not given birds to make them light. Feathers have weight of their own, and from this standpoint birds would be better off without them. It is true that some seeds are *floated* in the air by vegetable downs, and that some spiders migrate on gossamers; but there is a very small limit to these uses of fluffy substances—not reaching up to the weight of the bird, even if it were designed to float (only) in the air.

It is well known that weight is necessary to actual flight, and, as a rule, the heaviest birds are among the best fliers—especially the best soarers. Even a butterfly could not go against the wind if it had not some weight.

There is no doubt, however, that the flight quills are made as light as possible consistent with stiffness and strength, and that the tubular form of the barrel (toothpick part) and pithy nature of the shaft are partly brought about by these demands; and doubtless all the plumage is affected by these conditions, first set up in wing and tail. But mere lightness is no more the cause of feathers being plumous, than it is of hair being furry.

In this connection also, though not exactly in order, it may be said that there is much doubt if any of the spaces about the body or in the bones of birds are filled with air for the purpose of buoyancy.

It is not known that a bird inflates itself during flight, and the plumage is certainly very compact at this time.

All bones that are tubular are surely so for the sake of putting the material into the best shape for strength combined with lightness; and in the birds they are devoid of marrow, often doubtless to admit air, since they have openings connected with ducts leading to the lungs and other air spaces. But if mere lightness were the only object their interiors should be vacuums, since air is heavier than nothing at all.

Air cavities in bones and tissues, especially of birds, are probable aids or supplements to scant lung surface, demanded by a very active life; for they are found in the non-flying ostrich forms, and even in many heavy but active fossil reptiles. Some air spaces and sacs in birds, reptiles, and amphibians, and even mammals, have other uses not discussable here. To return to our topic, it is likely that, if we knew how a bird first put on feathers, we should know more of the biography of its fore leg.

CHAPTER V.

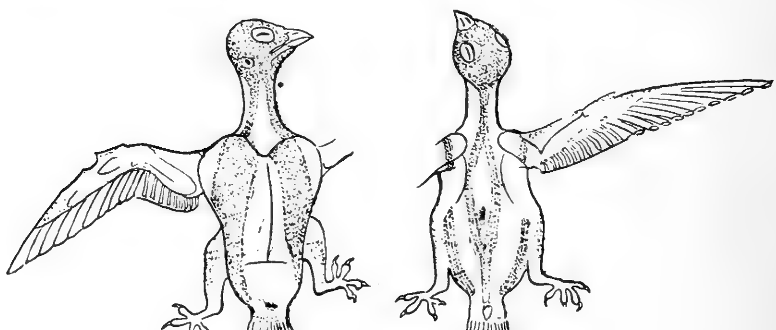
THE CUT OF A BIRD'S FROCK.

THE color of a bird's coat has been much emphasized since Mr. Darwin found it a matter of so much significance, but it is not known so generally that the cut of the garment, its gores, seams, plackets, puffs, etc., tell more of a bird's position in feathered society than its colors. But fissures and rents here do not mean poverty or a low condition—in fact, rather the contrary, since only the lowest birds now have clothing over the entire body.

It would be very tedious, even if it could be done, to notice all the various arrangements of plumage in the different groups of birds. The feathers grow in rather symmetrical tracts, with intervening bare spaces and, at times, with interrupting bare patches, causing forks and various changes in these tracts.

The most characteristic of these are the tracts on the top and bottom of the bird, which are normally median. That beneath in most birds has rather constantly in the center of it a bare space, which may be held there by the habit and effect of incubation, but the bare spot in the back tract is more variable in its position, and is often entirely wanting.

In the very young birds these often give the frock the appearance of having a V-shape front and back—a thing pardonable enough in a baby, but which is decently covered up by the overlapping of the feathered tracts as the bird grows older. Bare skin is used as ornament in adult birds, as well as in the ballet and the best society, but always modestly on the extremities of feet or head. In fact, as we come up higher among birds, where monogamy, gallantry, devotion, and decency prevail, we do not find it at all—the oscines, or *prima donnas* in feathers, in no sense needing the *décolleté* to make them attractive. Even the bare space in the back is wanting here.



Feather tracts (after Coues).

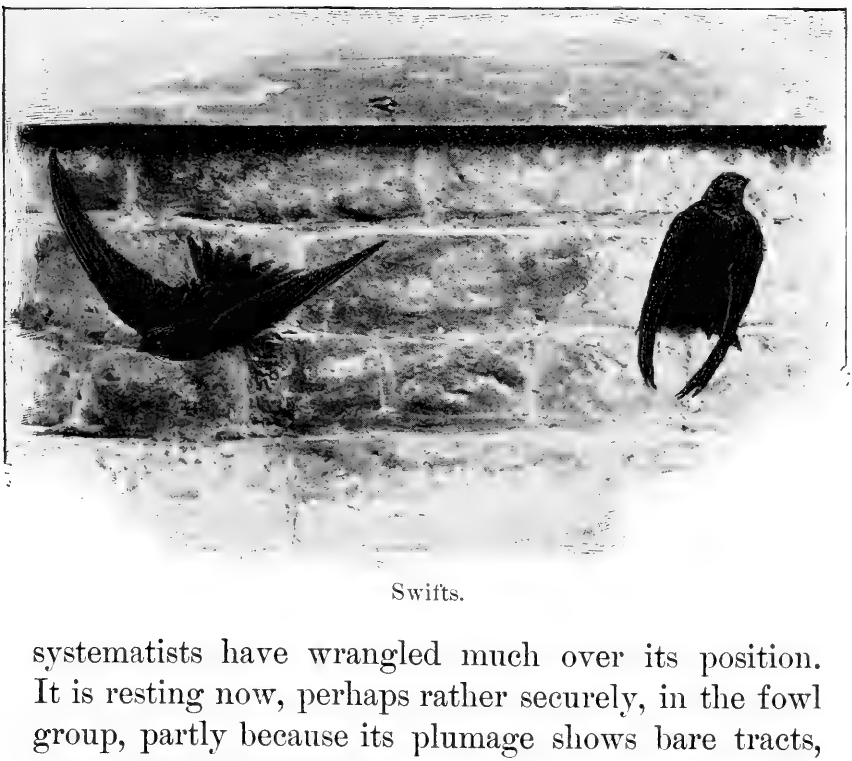
Lower surface of a swift, showing tracts and bare spaces on abdomen, neck, etc.

Upper surface of a swift, showing the forking of feather tracts on back, etc.

Besides these two bare tracts there are many others. Some of those extending upon the neck are very helpful also in showing the kinship of birds.

Among the birds of the group known as the *Picariæ*, where the yoke-toes and other abnormalities of feet so largely prevail, the bare tract on the back is placed variously. A glance at a nestling swift or woodpecker, in comparison with a nestling sparrow or robin, will show a striking difference in the arrangement of the plumage.

There stands directly between the ostrich forms and the fowl forms a singular group known as Tinamous, which have so many characteristics of each that



Swifts.

systematists have wrangled much over its position. It is resting now, perhaps rather securely, in the fowl group, partly because its plumage shows bare tracts, as no ostrich form does.

The origin and purpose of the various tracts is yet rather obscure, and will doubtless remain so. Only the ostrich forms, the penguins, the screamers (and the toucans, perhaps), have their bodies solidly covered. But the embryos (which may tell us so much of the history of the race) in the ostrich forms have the feather tracts well defined, and so have some fossil penguins. We are justified, then, in thinking that the primitive birds had their plumage in patches.

The wise men tell us that feathers are modified scales, and it may be that these modifications had different centers or places of beginning; but since the patterns now show so much variety, it is evident that the original arrangements have been very strikingly changed somewhere in the less remote past. But why these patterns should tend now to prevail so distinctly, and to be rather more than less definite in the higher groups, is not so apparent. It may be that after the plumage grew longer and spread well over the entire surface from different centers, as it does now, these bare tracts were all protected from any external influence tending to change them, and they persist now unmodified. Since solidly feathered birds are largely degenerate and flightless, we can not resist feeling that bare tracts are in some undefinable way connected with flight. At any rate, if we knew why a bird cut its frock so, we should certainly know a great deal more about why it put on soft raiment and about its history in general—just as the fashions of a people help us to judge of its customs and character.

CHAPTER VI.

ABOUT A BIRD'S UNDERWEAR.

It is just possible that underwear is a late acquisition with the birds as it has been with man, although there are some indications pointing otherwise. If feathers are modified scales, it seems scarcely probable that they were at first so soft and plumous as the present downs are, and yet the strong barbed and hooked flight quills and external body feathers which we see now are evidently of later development.

Underwear now with the bird is the first consideration, and the swaddling clothes of all little birds form the beginnings or the germs of all subsequent plumage. In the same sockets in which the nestling downs grow, the larger feathers grow and push out their tiny predecessors upon their tips, making the little bird really wear, for a little while, his slight under garment as an overcoat. So likewise those downs which are found among the plumage of adult birds, and which, differing strongly from the swaddling down, form a bird's true underwear, also push the nestling downs out.

These adult downs may be degenerate feathers, or they may be very primitive ones, we can not say; but certain it is that there are many degenerate feathers—especially noticeable in such flightless birds as the *apteryx* and others, where the plumage has lost its hooks and become slightly hairlike. Some of these degenerations are a source of great beauty, as seen in the plumage of peacocks, lyre birds and others, where the loss of some part of the feather produces the flossy effect. Similarly in the so-called bristles about the beak the feather has lost everything but barrel and shaft. There are many of these among the dense plumage also.

So in its degenerate condition, if such it be, a bird's underwear may be made extremely ornamental at places where it can show, as ours does in cuffs, collars and frills, sometimes. This is especially noticeable in the condor's ruche of down about the neck and on the cottony tufts about the flanks of some smaller birds, which seem to have antedated the modern charmer in exhibiting just the daintiest bits of tantalizing white in a very effective manner.

Nay, it may be that the birds have outdone us in another respect here. In the herons and their kin, in the goatsucker group and others (usually nocturnal) are found, rather symmetrically placed, certain tracts of downs that are constantly undergoing slow oxidation or breaking down into powders which usually show externally. Some of these are front only, some are rear and some birds have them at both places. Their purpose has not been determined yet, but it has been asserted that in herons at least these spots are phosphorescent at night, and that fish are thereby lured within easy reach. If this should be true, it may be that some others charm or signal to their mates in this way, as the fireflies do, by this sort of fireworks formed by the cremation of the ragged edges of the underwear. These things are not very probable, and even the phosphorescence needs confirmation, but certainly here is hinted a very interesting method of changing winter flannels.

Most birds show the presence of downs in the bare tracts only, and not within the feather tracts already noted. If then these downs be regarded as degenerate feathers, the bare spaces would appear to be more recent than the feather tracts; but if these downs be primitive forms of feathers, Nature may now be attempting to fill these "clearings" with an undergrowth.

Water birds only and those close akin to them have these downs over the entire body. Since the water-haunting kinds of kingfishers (and not other insect-eating kinds), and the water ousel or dipper only among the wren-thrush forms, have these downs similarly arranged all over the body, it seems quite evident that the growth of underwear is influenced by environment or habit, inasmuch as these last birds are comparatively recent.

The tinamous alone have the downs confined to the feather tracts only.

Birds have another feature of their underwear worth noting. Many of the contour or body feathers of some show a second feather growing out of the top of the barrel (or toothpick part), directly beneath the first. This is the case (even more marked) with their downs also. In the adult cassowaries and emeus this *aftershaft* (as it is called) is as large as the other or true feathers, but in their nestling downs it is smaller, showing quite probably that its size in their case is a later development.

If it were once a general form of underwear it was a fashion easily changed; for many lower, and most of the higher, birds seemed to have abandoned it. It is scarcely found at all upon the tail and wing quills, and in some birds it persists among the downs only.

Besides thickening the plumage its purpose is not apparent. The only hint—perhaps a faint one—of its origin is that some ostrich forms (the lowest living birds) have double-stemmed feathers. In some *moas* (now extinct) the feather-producing sockets tend to pair and merge into each other on the neck (likewise producing double-stemmed feathers), but they are far apart on the rest of the body. It may be possible that the clustering of *papillæ* or feather-growing pockets has left certain places featherless; and here may lie one step back in the formation of bare tracts. We feel sure that all birds once had after-shafted plumage. But what made the *papillæ* cluster? After all, if we knew more of the style of a bird's underwear we might understand why it has cut its frock so. All of this shows how very, very young the oldest of our modern birds are—that is, how comparatively recent many of their modifications have been.

Downs now seem developed on birds according to their needs, though some doubtless remain as a heritance from a past condition, as those on the helpless nestlings of hawks, owls and others.

Arctic and water birds have the downs dense and fine, while many birds of southern origin have them comparatively scant. In those young birds which run at once from the nest when hatched (precocial) the down is found in great abundance. It is incased before hatching in a membranous tube to keep it dry, but this soon bursts when exposed and the little plumes expand, making the chick fluffy and comfortable.

In such birds as remain long in the nest after hatching (altricial) there are various grades of the amount of nestling down, as noted. It has been observed that among those that evidently have nested long in holes (and lay white eggs usually) the young are noticeably naked. They have no need of swaddling clothes when so well protected. On the contrary, some of such birds as are hatched without a mother (megapodes) leave the eggs fully feathered and ready for flight, having doffed their down while in the shell.

There is no nestling, however, without some down at hatching, and the style and extent of a little bird's underwear tend at once to indicate whether its position be high or low in feathered society, just as an American Senator is said once to have exhibited his night robe to indicate his social standing.

CHAPTER VII.

A BIRD'S OUTER WRAP.

THE skin is the primary outer garment of every animal. It is more than this. It is a very important excretory organ, "the largest gland in the body." Besides this, it assists the lungs in reptiles and others in oxidizing the blood. To the lowest creatures it is lungs, stomachs, legs and tentacles, with perhaps other functions.

But it has been more than this. It has been the source to all organisms of their greatest progress. Every class of creatures has moved by it, every form of motion has employed it—swimming, crawling, walking, climbing, flying—from protozoön to mammal. Perhaps, as we have seen, the bird itself first flew directly by means of it.

But it has been more than this even. It has been the great builder of other parts of the body. From the waste of lime it shaped the shell of the mollusc, and formed of chitin the outside skeletons of the crustaceans and insects. While it is not demonstrated that the backbone had a dermal origin, as it may, we know the appendicular skeleton of toes and limbs had its origin in skin folds and sank inward to meet the *vertebræ.* The nervous system began superficially, Spencer thinks, and the spinal marrow begins on the surface in embryos now as a flat strap. The eye and the ear (and doubtless other organs) began superficially in some creatures, and yet show traces often of the path by which they have gone inward.

All this great work is possible to the skin because of its exterior position exposing it so much to the effects of environment. It was "in touch" with everything and plastic to every demand of the organism.

After the inside skeleton was formed, it demanded so much of the lime and magnesia of the body that the skin seems to have had at first little material out of which to build an outside skeleton or covering, though, so to speak, it seems to have turned its attention that way. The first efforts seem to have been by folds or thickenings of the skin itself. These folds formed pockets into which a hornlike substance—a new material which appeared to dawn with the backbone—formed, and it finally grew out and pierced the outer layer, or epidermis, as in the fish scales. The reptiles have in most cases kept the primitive skin fold, rendered horny in places, as best suited to their haunts and habits, but many amphibians and some fishes have lost them nearly altogether, or had them sink again beneath the surface.

Perhaps some of the reptiles, especially the birdlike, upright walkers, may have burst their epidermis by the great growth of their scales, as the feathers of the birds do now. But it is astonishing, even yet, to note in birds how resisting the outer skin is, as though its integrity were dying hard; for the *papillæ*, or points out of which the feathers grow, rise up high, and long membranous sheaths follow the feathers out as much as an inch or more in some nestlings.

By this rupture of the epidermis the skin ceased to build or secrete the outside skeleton or covering from the mere surface, but grew it from these *papillæ*, or pockets (representing the original folds), in the form of scales, feathers and fur. Only in the armadillos and a few rodents, where excess of material must have prevailed, did Nature in any high animal tend to return to a shell-like covering.

How the soft condition of feathers and fur came about we can only conjecture, with hardly grounds for that; only we feel assured that it was at the demands of warmth. Hair may have been a fibrous breaking down of horny scales, since we know now that there is a very intimate relation between horns and hair. Some kinds of horns are made of hairs glued together, and nearly all horns are skin products.

Hairs, or similar plumous particles, may have arisen on the new scale as helpful in throwing off the old skin above it—a loosening agent. They are found now, it is said, performing this office in some snakes and crayfish. Here they dry down hard later. Possibly, after the skin was punctured by the scale, they may have grown out with it, and losing their use as skin looseners (since now the epidermis was broken up), they persist as part of the outer covering.

It is necessary still to shed the epidermis, but birds and mammals get rid of it in particles almost imperceptibly. Some penguins, however, are said to exhibit the old reptilian habit by shedding theirs in great flakes with feathers attached.

It is quite probable that originally the barrel or toothpick part of the feather was flat, and that the gradual incurving of the edges finally resulted in welding it into a tube. This tube thus inclosed a glandular core, which nourishes the feather till it cut itself off from further food by the closing of the lower end of the barrel. We sometimes call the dried-up cells of this gland "the pith."

The tubular form was not necessary till flight began, as no strain could previously be put upon the quills. But strain demands strength, and the tubular form is the strongest arrangement of a definite amount of material consistent also with lightness. Likewise, until flight came, the development of the shaft (the rest of the stem) was not demanded. The shaft, however, may have been simply the result of the natural growth or general progress of the feather beyond the surface. The downs, which appear primitive now, have practically no shafts, but this may be the result of degeneration.

As flight has influenced so much the structure of feathers, the vanes were doubtless at first flossy, and perhaps without barbules, or little side vanes upon the vanes. These were subsequently added with hooks to hold the barbs together into one solid, air-resisting surface. The *Archæopteryx*, the most primitive bird known, which had imperfect and yet developing means of flight, had even its wing quills flossy near the base and air-resisting near the tips only. The modern flyers have theirs solid-vaned nearly throughout.

Since air-tight vanes are useful to keep out rain and keep in warmth, and are yet found on the tips of nearly all body or contour feathers, it might appear that the barbules developed hooks for this purpose. But in degenerate birds, as the *apteryx* and others, as we have seen, where flight has ceased the plumage has become loose and flossy. Also, where Nature has provided against wind and water she has usually done it with plumous feathers and dense downs, as noticed in the aquatic and arctic birds. Still, there can be no doubt that this hooked condition of the external part of feathers adds to the comfort, and yet more to the prevention of friction of the air in flight. These hooks and barbules (and even the barbs) are further modified or entirely lost at other demands, such as touch, hearing, noiseless flight, water resisting, etc., but more especially in keeping with ornaments by shape and structure of plumage.

Upon the bird's outer wrap, as we have seen, Nature has wrought some of the most skillful of her handiwork, hinting in the garment's frayings the story of the wearer, writing in hieroglyphs of color upon the surface something of its hopes and fears, and in the plainer blotchings spelling out its haunts and habits.

So, likewise, in various stages of the suit's acquisition she may shadow certain epochs in the bird's great past, but writing upon top of writing may make the old manuscript hard to read.

Here, in the downy young of some species that are now water or shore haunters purely, the little coat is striped longitudinally as if the race had once been grass hunters, as the grouses and partridges are yet; and there among some that are more terrestrial now and slightly striped as adults is the solid-colored downy youngster that tells of a watery past. (See cut of land rails.)

Mottled feathers on the young where the old birds are now solid-colored shadow a time when they flattened themselves upon the pebbly beach, perhaps to escape discovery; and the drabbish grays hint of dead-grass hiding. The brown chestnuts in the adult, as in the quail and ruffed grouse, tell of a long ancestry among the dead leaves under deciduous trees. Peculiar corklike and black mottlings, especially on the back, are signs of a habit of tree-trunk climbing, as upon the brown creeper, or at least of rough bark, as a back-ground for the setting, as in the owls.

All these are tinged with the very emotions of the creature: the fear of the enemy that flew above, or the caution of the prey that crouched beneath.

More than this. Doubtless for the sake of expressing more, Nature has stained, with pigments of brighter hues, the bird's outer wrap, tinting it here and leaving it untouched there, as if with a painter's art, and burnishing, carving, and grating it here, and leaving it untouched there, as if with a graver's skill;

so that exquisite patterns and delicate blendings may prevail and dazzling splendors may flash out for purpose. But that is another topic.

If we could read all that is written upon the outer wrap we should have much of the story of the birds, for they have made "broad their phylacteries," like the Pharisees, and enlarged the fringes of their garments, in keeping with much of their past.

CHAPTER VIII.

A BIRD'S NEW SUIT.

All birds get new suits at least once a year, changing in the fall. Some change in the spring also, either partially or wholly, while others have as many as three changes—perhaps, to a slight extent, a few more.

The first class often have only one style of color the year through, though we shall see that this is not always the case; the second don a sort of wedding garment in the spring, or put bright patches of color or special trimmings or ornaments upon the old suit; while the third dress rather to suit the surroundings, as the ptarmigans. This latter class also put on frills and stains by means of these changes, and all sorts of gradations are found between the classes.

It seems now that the manner and frequency of changing the dress is something that has been easily modified in the past, since we find, as Mr. Darwin notes, that the number and manner of molts vary strikingly in birds that are near akin and apparently much alike in habits. Like colors, molt seems to have been readily influenced by external conditions. The spring molt is often only partial—a patch or a plume here and there. Precocial birds, which leave the nest at once, shoot out their wing quills before grown, in keeping with the demands of safety in their exposed conditions, and they get a new and better set later. Altricial birds wait till they are nearly grown to acquire their wing quills (fit for flight), and do not usually renew them that season. In some species some ornamental plumes also are shed in a few weeks after they are acquired, long before the normal fall molt, while other plumes are worn the year around.

The fall molt seems necessary on account of the wear and fading of the plumage, brought about by the business of the year, and, as Darwin suggests, in keeping with the demands of warmth for the coming winter. Incidentally with it often go the heavy plumes acquired in the nesting season, but, as noted, not always. Since we are sure that many of these ornaments are of comparatively recent origin, the getting rid of these could not be the purpose of the autumnal change.

While we may feel that the purpose of the spring molt is ornament, and that the object of intermediate molts is protective coloring, yet we are hopelessly in the dark about how these changes of suit were originally brought about or why a change should so frequently result so suddenly in a new color.

The molts may have originated, of course, in the necessity for repair, as noted; for it is well known that there can be as many renewals of the feather as there are losses, so that (within the limits of the bird's

Louisiana water thrush.

strength) there *can* be any number of molts, depending upon demands.

But why there should be such an intimate connection between change of dress and change of color is a matter not so evident, as it is that certain of these molts *now* are for the purpose of changing either the shape or color of the feathers for certain ends, as ornament, safety, etc.

In some birds (for instance, our red-headed woodpecker) there are certain spots, or series of spots, forming bars that tend to cross the wing, say, in the first plumage, but extend more completely across it in the next. The spot in the first case may be upon one vane only of a wing quill in the young of the year, and extend over the other vane during the next season ; and until the molt occurs there may be no change in the size and outline of these spots. There are innumerable instances of this sort of thing with all degrees of gradation between the incomplete and the complete state, where rows of spots merge into lines, and where, working the other way, lines break up into spots. These are dependent, as seen in the last chapter, upon the past habits of the bird. These young water thrushes and song sparrows are less spotted below than the adults, but young snowbirds (junco) and robins are more marked than their parents.

It is claimed by some that *now* all new colors are acquired by molt, and by others that in some instances (young hawks) an infusion or loss, as the case may be, of pigment takes place as the feather forms, and continues so long as it grows. The battle is now on about the matter. Whatever may be the case now, the impression can not but arise that the gradual infusion of color must have prevailed at one time, and that both methods may obtain together yet; for we shall see that some new colors are acquired by the joint effect of molt and the fraying off of the feather tips.

Nature now is often a great shortener of processes that were once doubtless tedious, and changes were likely hurried up here as elsewhere. In some tree-toads that never go near the water to hatch their eggs, the young pass through the tadpole state while in the egg, and some omit it altogether—a remarkable hurrying-up process; and in connection with our present topic we have seen that some birds (brush turkeys) pass one molt before they are hatched, because of the emergency of quick flight at the demands of the parentless condition.

Likewise this process of coloration by molt can now be hurried up in such young birds as have a change of color. By plucking out the present feather, the new one grows out at once in keeping with the hue and pattern of the next molt, which would have occurred normally some months hence. Thus we may see a possible suggestion of the purpose of extra molts, and how, after this law was once established, some of the color changes may have come about.

It takes some birds yet as many as five years to acquire complete adult plumage; and the various changes which they pass through are found to depend upon food, climate, and environment generally. It may be shown also that color depends upon the same thing, since some birds that have color in the wild state, show no tint of it when confined. Color and molt, therefore, may in part have come out of the same conditions.

Their development, however, has been so gradual that the maturity of the birds frequently outruns the maturity of the apparel, and they marry and rear families while yet in their baby clothes.

Since there is such an intimate relation, as can be noticed in any animal, between vigor and color, it can be seen how unknown physiological agencies (such as congestions brought about by pressure, use, etc.) may have been set up which have produced changes in the whole texture and life of the feather through conditions of the feather-growing follicle or pocket. Out of this crests, plumes, and other abnormal structures, along with the presence or absence of pigment, may have come; and they may have been subsequently intensified by selection and heredity. Thus it is well known that if the skin follicles of a colored bird or mammal be injured at a certain place the feathers or hairs come in there again white; that if an ostrich plume be twisted in pulling, thus twisting the pocket, a twisted plume will ever after grow from it; that if certain parts of the skin of some birds be anointed with certain substances the feathers at the next molt come in having a different and abnormal color; and that the Javanese and other Eastern peoples have learned the art of preventing the molt of certain feathers (on certain birds), whereby they grow to immense length.

As hinted, Nature has rather recently given some birds a paradoxical method of acquiring a new suit by wearing out its old one. What a convenient thing that would be for some of the rest of us!

Much of the colors of a bird's feathers—or the brilliancy rather—is on the tips only. Beneath, frequently a contrasting color may prevail. Some of these tips fray easily or are actually shed—often in certain places only. This wear allows the color beneath to show. The male English sparrow gets his black throat patch largely in this way, and the male bobolink puts on his wedding garment by taking off his traveling suit, though he has a spring molt also. Likewise some birds with faint external tints lose them in this manner, and some young birds get a new shape to the extremities of the flight quills thus.

There are some other evidences that Nature has changed her first method of giving the bird a new suit. Now, usually the old feather closes at the lower end of the barrel, and, shutting itself off from nutriment, it really ceases to grow and *falls* out; but, as we have seen, the nestling downs, which probably type a very primitive state, are not so closed, but are pushed out on the tips of the forming adult feathers or adult downs. This is the case in all the subsequent molts of the cassowaries, which go about for a while with their old suit raggedly hanging to their new one.

Molt therefore may, primarily, have begun as a renewal process rather than a destructive one, dependent not upon the falling of the old feather, but upon vigor of growth infused into the new.

The still more ancient and reptilian method of shedding the skin and feathers in flakes, as is said to be the case with some penguins, has been referred to, and doubtless indicates a still more remote manner that the birds had of changing costumes.

If we knew why they have been so freakish in their fashions we should know more of their history. Over it all there now seems to run a law of *pattern* affecting the nutrition and structure of the follicle, the falling of the feather, the fraying of the tip, the pigmentation of the vane, the microscopic grating and filmy glossing of the very barbules, to aid the bird in putting on a new suit that shall become the occasion.

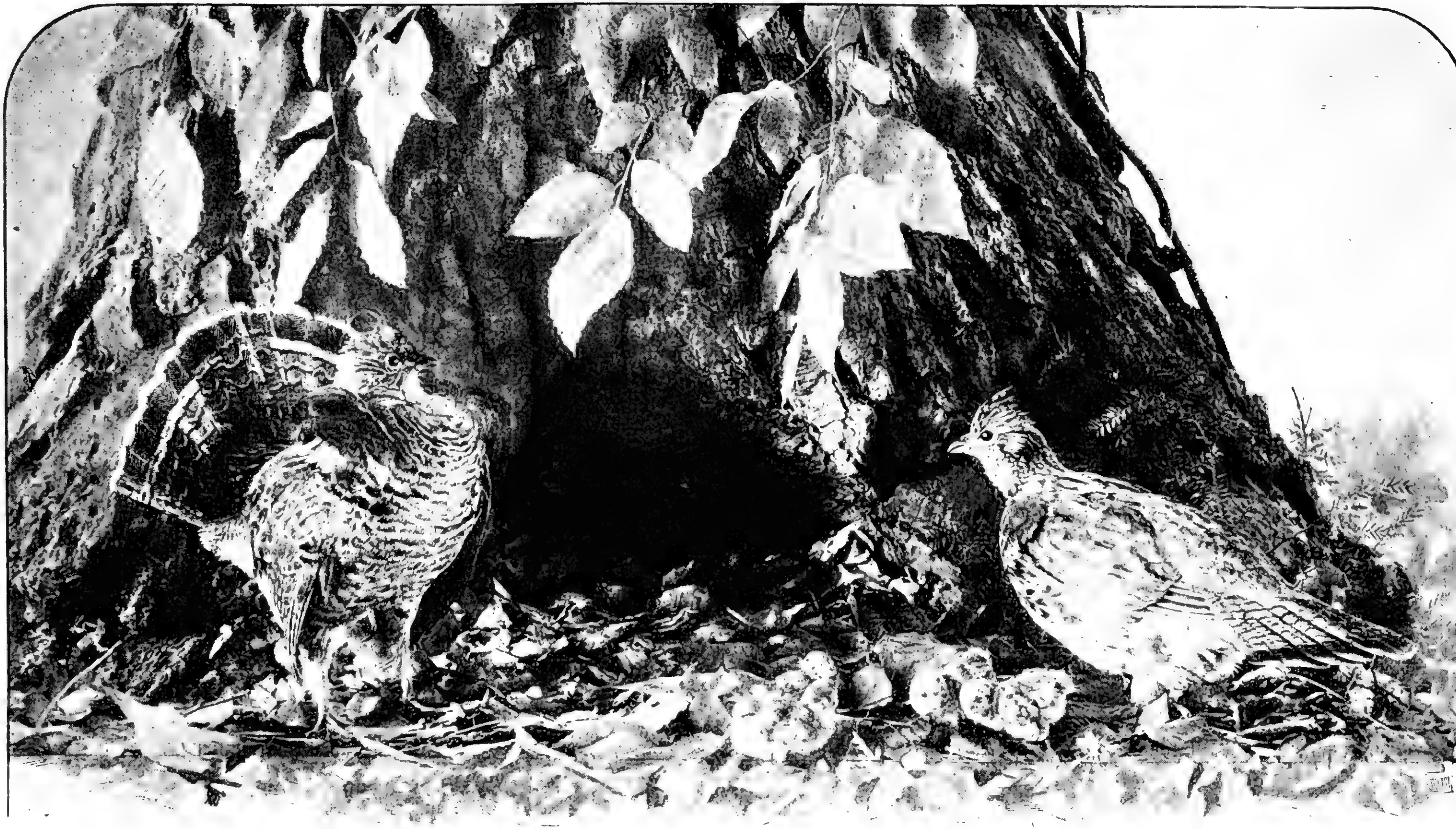
CHAPTER IX.

"PUTTING ON PAINT AND FRILLS" AMONG THE BIRDS.

In the previous chapter something has been said of how these are put on, but in this the reason for it is talked about. Ornament prevails throughout Nature. Much of it may be incidental to the mere form and structure of the material, but its existence for purpose can not well be denied. Its voluntary display is very evident in the birds. Display argues appreciation, at least as expected if not given; and appreciation implies choice and desire to possess. Thus love and beauty have come down the ages hand in hand.

Ornament is not confined to any part of the body. Choice has no law. Nothing is more freakish. It is a law unto itself. Some persons marry for face; others for form. While one indites a "ballad to his mistress's eyebrow," another raves over the arch of her instep. It is so with the birds. Ornamentation may run from beak to toe, according to the fancy, doubtless, of the chooser or admirer.

In the charming season some feathered Juliet may be ravished by the lengthened beak of her Romeo, as in some finches; or by the extra pieces he has piled



Ruffed grouse displaying pretty parts.

upon it, or by the novel frills he has given the loose skin at the corner of his mouth, as in some auks; or by the congested warts, wattles, and snout-like appendages about his head and the bright hues of the skin around them, as in the turkeys and pheasants.

Nudity is used by birds æsthetically, but much more limitedly than in the average art gallery.

Others are delighted by plumous crests, trains, etc., and the much spreading of the tails and wings, often when they are not remarkably colored. Others still among "the sex" seem humorously influenced into a tenderer state by antics, sometimes connected with the display of ornament and sometimes not, as if he who made the biggest clown of himself was the favored suitor. Her appreciation of this sort of "being agreeable" is often more demonstrative than that of any other, for she joins in the fun and plays back at the charmer with a sort of Barkislike willingness. In other cases she may be so apathetic as to simply stand by while she is being fought for, and is led off by the victor, whose ornaments seem only to have served the purpose of exasperating his rival. This is strikingly noticeable in the male turkey's hatred of brilliant colors, especially red.

Nevertheless, color is certainly the most general and the most refined form of ornamentation. It also, like change of shape, may occur anywhere on the bird. The tip of the beak may be tinted or its entire length may be crossed with colored bars in the charming season only. Above the eye a colored scale may shoot out, as in the ptarmigan (which his rival attempts to pluck away), or even the iris may turn red, green, or golden. The inflated air sacs may be beautifully orange, and the usually dull-hued feet may grow pink or yellow, blue or greenish—even banded in some cases, like striped hose.

But the greatest display of color is well known to be upon the plumage. Here the mere act of staining runs nearly the entire spectrum, but, not content with this, ornamentation again dominates structure and provokes polish and general prismatic effects till pigment is merely subservient to splendor, and the love for distinct hues yields to the beauty of their blending.

Many of the brilliant gorgets of the humming birds and others, viewed with the proper angle, give any or all the colors of the spectrum.

Brilliancy seems always to have been progressive. Birds grow yearly more æsthetic. There is little, if any, evidence that any bird has ever receded one step from ornamentation or dressed in duller hues after having once been brilliant. With only a few known exceptions, no young bird is more brilliant than its most brilliant parent, thus not indicating degeneration of color. There are some cases of one color having been substituted for another. Some have changed the style of ornamentation for a better one; some, as the thrushes and others, have lost spots which were incidentally ornamental, perhaps, but not selected or appreciated by its mate as such.

It seems the more remarkable since, as we shall see later (Chapter XXIX), in many other respects most birds have degenerated, to some extent. Their feathers also, as we have seen, have degenerated, but rarely, if ever, at the expense of ornament, and perhaps nearly always to enhance it. Beautiful downs, plumes, and remarkable structural effects, as in peacocks, lyre birds and others, are the results of degeneration.

Birds do not appear to give up their ornaments for safety even. They are there by beauty as the Mohammedan is by his beard or the Chinaman by his pigtail: better die than lose caste. Doubtless many species have been swamped, "like other people," by "putting on too many frills." It is easy to see how such a bird as our peacock, cumbered as he is, would easily fall a victim to a newly introduced adept enemy, as a fox, for instance.

Arrangement for protection (by natural selection or otherwise), such as mimicry of haunt, may slightly rearrange the plume, or cut the patch of color into an imitating pattern, or push it a little around out of sight, but the law is that it must not eliminate it. The two interests may be combined, however. A certain night hawk has two beautiful wing plumes which it sheds after the nesting season. It roosts on the ground, and they project up and resemble the grass plumes among which it squats, and they are thus protective. The patterns of the beautiful chestnut parts of the woodcock and some partridges mimic well the dead leaves; and the black breast spot on the wrybill (which, with a beak bent to the right, feeds around stones in the water always with the same side inward) is pushed considerably from the left to make it less conspicuous.

It is "beauty ever onward" with the birds. In this they are ahead of us, for we have had our lapses into dark periods in art.

As to the origin of choice, which seems so mysterious and freakish, it does not appear unreasonable that some of it may not have arisen as a matter of association, as suggested by Grant Allen, though the idea is usually ridiculed. If a bird delights in a certain brilliant fruit, leaf, or bud, the chance presence of a similar color, markings, or shape in her mate, especially if displayed in a love antic, may cause her to like him better than a suitor without the resemblance; and inheritance would easily intensify all this. The splendor of the hummers and of other tropical birds may possibly be thus accounted for. Perhaps the original turkey's snout-like appendage above his beak may have suggested to his mate a luscious worm.

There is only one instance where ornament in birds takes on a pictorial or perspective effect—the well-known ball-and-socket arrangement of the Argus pheasant. Here is an instance where color has perhaps been lost, to a slight extent, for this higher artistic effect of shade and perspective. Mr. Darwin has ingeniously shown that these balls in black and white have been formed by the merging of slightly chestnut-colored spots. Now, this may have arisen by a fancied resemblance, at least in the estimation of the female, of these balls to some form of nut of which she was fond. When the male displays them, he quivers the wing till the balls seem to dance in their sockets, perhaps resembling some seed shaking in its hull or some berry quivering in its husk, thus arousing pleasant associations, till the bird, like some others, loved her lover because he "looked nice enough to eat."

It is difficult, of course, to see how female choice should be so delicate as to be influenced by the finest shades of color and shape, as indicated in the formation of these "eyes" in the pheasant's tail or those in the tail of the peacock. Often, especially in such low birds as these, where splendor and weapons both prevail, the female seems quite indifferent while the battle or display prevails, and she is won by the law of battle or persistence of pursuit alone.

It may be that variations of color were set up originally (by laws that we do not understand) independent of any choice, and have been intensified rather by food, climate, health, and vigor generally, as we saw in the last chapter, until selection by the female of the brightest, healthiest, and most vigorous or successful in battle would tend to bring color onward in the males up to the point where it stood not as an expression of beauty, but simply as the sign of all that was desirable in a wooer otherwise.

It is well known, of course, that Mr. Darwin held that all these ornaments were brought about by the æsthetic appreciation and choice of the female. This view is now rather generally accepted, but there are a few thinkers to whom it does not seem probable. This is no place for this discussion, for or against, but to the student of birds there is shown much that implies that ornaments and their display are large factors in courtship.

Whether or not choice always is influenced by ornamentation when the female selects a partner for the season, it is certain that it is often present and flaunted in a very conspicuous way.

There are some striking evidences of appreciation of ornament among birds. The female "widow" bird is said to desert her mate if he loses his ornaments. Whiddah bird is the proper name, but "widow" bird is colloquial, doubtless on account of the resemblance in sound. It is not likely that her disposition to make a "grass widow" of herself in this way has anything to do with it. Other instances might be noted, but perhaps those circumstances connected with the courting tactics of the bower and garden birds, where neat runways, green, moss-covered, gardenlike little lawns, ornamented with various bright objects, enable a very plain bird to show his sweetheart pretty things, and to soften her feelings by the æsthetic influence of these and by pretty mazy motions over, through, and near them.

Sometimes it is the female that is attractively colored, whereupon she does the wooing—making a display of her pretty parts, performing antics, wearing the spurs, and doing the fighting and screaming in a very modern fashion, while her literally henpecked husband does the incubating and rears the family with a meekness that should inherit all the dry land of the planet. The new woman was here in

Bobolink, showing brilliant black and buff male and sparrowlike, inconspicuous female.

feathers a long time before she arrived in baggy pantaloons.

This state is found in low birds, however, instead of high ones—an experiment tried and rejected before any great æsthetic progress was made by our feathered neighbors.

It is much more frequent, however, that the mates of brilliant males are plain, or even somber in their dress. Color has progressed in one sex only. It is usually considered that females are kept back from brilliancy for the sake of safety while incubating, thus not being conspicuous; and a series of interesting considerations come in here concerning the relation between color of bird, style of nest, and markings of eggs, which the limits of this little book prevents us from discussing. An instance showing plumage variation in the sexes is given in the illustration of the bobolink.

Many bright-hued and conspicuous males, however, now assist their mates in sitting; but this may be a recent habit, permitted by greater safety on account of the changed conditions, brought about by the disappearance of some former enemy, and induced by a tendency to progress in helping his mate.

That in many cases where the two sexes differ in splendor it is the color of the female which is primitive is shown by the fact that the young male is apt to look like his mamma at first, hinting a time when the sexes were alike. In other cases, where there was no danger, the female has also become brilliant, perhaps because of change of nesting and other habits, which have permitted her also to acquire or inherit color with safety.

Birds not only change their habits, as we shall see (Chapters XXIII and XXIX), but they actually have exhibited some æsthetic or moral progress, a question the special discussion of which we shall again have to pass over.

A great deal of the story of the birds is involved in why they put on "paint and frills."

CHAPTER X.

COLOR CALLS AMONG THE BIRDS.

THIS is an age of badges and uniforms. Every society has its ribbon, every college its "colors." Nations have long had their flags, and armies their banners. Still we are much behind the times in all this compared with the birds and mammals.

Nature has always been concerned about the race, and seems to have cared for the individual only as a means of preserving the species.

The first form of natural increase was doubtless the sacrifice of *individuality* only, as when a simple cell fissured into two. Here was the possibility of immortality. But later she demanded the sacrifice of *life* also to build a higher organism, as when the young budded out and broke away and left the mother a shapeless, helpless trunk; or burst forth and left her a lifeless sac. Later still, as the organism grows higher, both life and individuality are spared awhile to cherish the offspring—to subject the parent to the great laws of love and labor.

But altruism had a higher mission still than the relation of parent and children. Parental interest, after all, is a selfish one, for it is exercised toward a part of self. But society interests were also developed, in which every individual was made in some sense his brother's keeper. Wonderful social instincts were organized among insects, fishes, birds, and mammals. With these came voluntary social calls, so frequently noted in the chirps of birds. These naturally grew out of mother calls and nestling cries for food, and out of their little by-talks.

But Nature was not content yet! An individual might forget his social duties, as many individuals have. Where these are necessary for the good of the race she has made them involuntary. She has fastened them upon external features so indelibly that a mother unconsciously calls her young and a frightened member of a flock mechanically warns and guides his following fellows. She has made altruism automatic by habits crystallized in structure and by calls and cheers that are dyed in color. In some cases she has made the bird almost literally "wear his heart upon his sleeve."

Usually these are on fleeing, flocking, defenseless creatures. Antelopes are social, crepuscular, depending on flight for safety, and usually have a leader. They are conspicuously white in the rear, that those following the weaker brothers may be guided into safety. The mother hides her young, and, returning to it, presents a broad white breast mark as a maternal signal. Similarly the deer hoists a white tail, and the cottony patch of the rabbit answers the same purpose.

But the hare's is a sadder story. Now he is solitary and selfish. Once he was (like the European rabbit), perhaps, an exemplary parent and brother, and led his little family around and guided it in safety to the burrow. But now his altruism is only a vestige. He has become traveled and selfish, and learned to make a tramplike bed for each night's rest in a new region. Farther away from home (out West and South) the cottony signal is growing dull, and Nature stamps on his very fur the tendency of his feelings.

Lapwing.

Birds strikingly exhibit these social or signal colors on various parts of the body. They may be conspicuous head markings, as in some plovers; throat patches, as in our Bob-white and wild (Canada) goose; rump spots, as in the flicker or lapwing; various tail spots, tips, or blotches, or the entire whiteness of one or more tail feathers; wholly or partially white feathers among the wing quills, or white blotches or bars upon the smaller feathers of the wing—more conspicuous usually when spread in flight. There are many other forms—the entire wing or back or some other part being conspicuous.

When it is to the interest of the bird to be inconspicuous while perching, these marks may be entirely concealed, as in the white rump patch of the flicker, which is usually hidden by the closed wings; or in the white outer tail feathers of the snowbirds and others, which, except when spread in flight, are hidden under the others.

Other birds are white beneath and protectively colored above. The "teetering" of the little "tip-up" sandpipers is doubtless the vestige of a signal wrought in the display of white underwear with the "peek-a-boo" up-and-down motion. From above their colors harmonize with their haunt.

These "recognition colors" may be also modified or used for ornament, since many of them are more conspicuous in males than females, as in Bobwhite, the English sparrow, and others. In fact, Mr. Wallace, who first emphasized these markings as thus useful, thought that the purpose of all brilliancy and peculiar patterns in the males might be simply recognition markings, whereby the feathered maiden might know her beau when she saw him; but it is more probable that primarily brilliant colors were usually intended for ornament only or the expression of vigor. White, however, is often used as ornament also.

While not literally within the scope of our topic, there are among the birds other social signs and expressed solicitations for each other's welfare, which might as well be mentioned here because they are of a similar nature and origin.

The well-known assemblage of crows, jays, and others at the presence of an enemy is one of the lowest social feelings based on the most sinister community of interest.

Certain birds have a whirring flight when first flushed, and others have purposely designed wing whistles, as in doves and woodcocks. Others incidentally strike their wings together over their backs as they begin to fly. Yet more voluntary is the little "chit" or back talks of many birds as they feed—accompanied sometimes, as in the snowbirds, by the little flit of the white tail feathers—a sort of "I-am-with-you" kind of signal in the toil for daily bread.

Outer tail feather white, shown only in flight.

Then there are those most conscious, deliberate, altruistic vocal calls of the flocking birds, where so long as a single member is astray the whole remaining flock will risk its safety in calling the wandering brother in—a beautiful instance of the love for the lost one that runs all through Nature—a hint of the concern of the ninety and nine about the hundredth one, away down here in feathers.

Many a man walking homeward from his bloody work among the birds plumes himself upon his benevolence as he thinks of giving a quail or grouse to an invalid or an appreciative friend, and prides himself upon his culture and civilization, when, if he would turn and listen to the call of brother unto brother in the gloaming, while the smoke of his gun is still floating in the damp air, he would feel—if he has cultivated the art of feeling—that he has left much of the altruism of his age behind him in the bushes.

CHAPTER XI.

WAR AND WEAPONS AMONG THE BIRDS.

CONTRASTED with our last reflections comes the sad commentary upon the birds' moral progress—that bluff and battle are such conspicuous features of their history. Like our most civilized nations, while professing the best of feelings for their fellow, the birds, if they do not make large appropriations for defenses, at least secure peace with honor by a large display of warlike talk and tactics. Still, as we shall see, the folks in feathers, like their neighbors, show in their higher development a tendency to use weapons as a last resort and to depend upon milder and more refined means of settling disputes.

While some of the Dinosaurs had spurs on their thumbs, as a certain ploverlike bird has now, it is probable, primarily, that birds inherited no weapons from their ancestors except teeth; and, like all early weapons, these were developed at the demands of prey taking rather than of war among themselves. With the change of the character of the food these were lost, especially as the extra advantages of flight, running, and pouncing from above came about. This is all that we can say about why a bird lost its teeth.

Its discussion would involve the exposition of anatomical details and changes in habit and in the digestive tract not practical in this little book.

With changed habits or changed food supply came about certain special means of prey taking, developing some utensils that were weapons indeed against everything, and some which were adapted only to the special needs. For instance, the beaks of cranes, shaped for piercing a fish or frog, makes a dog howl, but that of a swift or goatsucker, shaped for taking flying insects, is harmless against an enemy. Of course, again, the hooked beak and terrible talons of the birds of prey are all-around weapons. So far as we can see, every modification of beak and claw of birds is made purely at the demands of food taking. In the true sense, therefore, these can not be taken as true weapons, except in their incidental use in defense.

Our topic turns, therefore, upon *special* weapons, and the evidence is that these came in not as a necessity of procuring food, nor even for fighting an enemy of the species, but as a peculiar means of overcoming a rival—some fellow-sufferer in the toils of a charmer. Within the species war and love have come down the ages together.

Mr. Darwin has shown that within the mammals, at least, many weapons are nearly useless against anything but a rival within the species, or at least have a poor use outside of this. One antelope has to get down on his knees and put his nose far back under himself to bring his horns into play. While this is very effective against his bellicose fellow who accepts this style of battle, it places him much at the mercy of other outside enemies, as a leopard or wolf. Expert use of these special means of fighting in others are very effective, however, as instanced in the wild hog, rhinoceros, and horned cattle. Still, the evidence is that the weapons and styles were developed while fighting rivals—the result of some apparently peculiar agreed-upon style of battle. For instance, victory in some lizards consists in throwing the rival upon his back, whereupon he at once yields the palm; and it would not be at all strange if a kind of hook for effecting this topsy-turvy movement should develop upon their snouts.

The lowest bird now living that is specially armed is the cassowary among the ostrich forms, which, besides having the inner toe elongated and armed with a long straight claw, has the shortened and otherwise useless wing quills converted into spines. These it uses effectively against all enemies. But it is more likely that this latter form is a very special and comparatively modern weapon, since it is not found elsewhere.

Besides the special arming of beak and toe, the lowest special weapon is doubtless the wing spur, brought about by a very natural use of striking with the wing in battles among the males. Even the very low fossil divers show its probable existence upon their wings while they yet had teeth. That it is a special development within the species is shown by its many different locations on the wing in different birds.

That the spur is a weapon of rivalry is shown by its larger development upon the wings of the males (though some females have it) and by the fact that where it exhibits itself only as a knob it tends to subside (in some plovers) after the fighting season is over. Its development thus by use may also be implied from the fact that while in some species of a family it is a well-developed spur, in others it is only a mere callosity on the wing's bend, as seen in the swans and others. In the spur-winged goose it is strongly marked, but in our ordinary geese there is only the habit of striking a very effective blow with the "butt of the wing," as any one may observe in a goose fight. The writer has a very vivid remembrance of a time when, having the experience of about five summers only, he undertook to be too familiar with some fluffy goslings, and received upon his forehead a very practical demonstration that an old gander had knuckles on his wings.

Nearly all the low birds appear to have had ancestors with this style of weapons. Among the fowl forms some of the brush-turkey tribe have rudimentary spurs upon the wings; there is a spur-winged pigeon; many plover forms show them variously, and at the junction of these and the rail forms is the jacana, similarly armed. At the bottom of the goose-duck group is the screamer, with double wing spurs, tying this group backward, while triangularly between the birds of prey, the herons, and cranes, and doubtless older than all, is the spur-winged secretary bird. Dr. F. A. Lucas notes that when wing spurs are present the bird is apt to have wattles about the head.

The only other special weapon in birds is the leg spur, confined almost exclusively to the fowl forms. The ostriches strike downward and forward with their feet, a habit which perhaps came about by the degeneration of the wing and the great use of the leg in running. This striking habit is shown in the fowl group, and the leg spur is probably developed in keeping with it. These spurs also show all degrees of development from mere knobs to the terrible stiletto of the game chicken. Some pheasants have more than one.

Wing spurs seem to be a growth of or from the bone, but all leg spurs are likely of surface or skin origin, and only after considerable growth do they attach themselves to the bones and acquire a bony core.

Sharp edges of wing bones may be noted as a modification looking weaponward, and in turkeys and others there is doubtless a hardening of the lower end of the breastbone.

It is not denied that in Nature there are not special precautions and weapons against such enemies as might prey upon the owner. The skin secretions of toads and others, the spines of some lizards, the so-called quills of hedgehogs and porcupines, the shells of many creatures, are evidences of a protective armor. The birds have very little, if any, of this. Whenever they do possess special capacities for being disagreeable, such as those, for instance, incidental to their feeding habits, they are apt to be conscious of their use, as is seen in petrels and vultures ejecting the offensive contents of their stomachs as a means of offense and defense.

In some mammals it is quite evident that their weapons have been changed in shape at the demands of ornamentation, but there is nothing of this among the birds. Thus horns of deer have been unnecessarily branched even till there is danger to both contestants in fighting. This has no reference to victory. Those of sheep, antelopes, and goats have been beautifully corrugated, curled into spirals, or curved into lyre shapes till they are almost useless in their original purpose, and are now only butting implements at their bases. But, unless we except the occasional lengthening of beak during the charming season, there is nothing of this kind in the birds. Ornament seems to have seized on other parts.

There is evidence among the mammals that one style of weapon has given place to another, as where ruminants, acquiring horns, have lost their weapon-like canine ("eye" and "stomach") teeth. Some deer that have no horns still shoot out tusks like a wild boar.

So it is not improbable that weapons, once acquired, have been gradually lost in birds, as other methods of winning wives have been developed. The spur comes no further up in the scale than the pigeons and hawk forms. Color and display are perhaps younger than special weapons, and it is certain that song is a more recent form of overcoming a rival than fighting; for no true song bird is specially armed, if we except the adaptations of the beak in shrikes.

Audubon notes that the yellow-shafted woodpecker (flicker) never fights his rival, but depends upon antics, chuckles, etc., to win his mate; but he is a vigorous defender of his nesting hole when he is at home.

We can not go into various forms of battle among the birds. In many it has degenerated into mere bluff; others fight ridiculously. Audubon notes that snipes and woodcocks push each other around harmlessly with their long beaks. While many song birds fight vigorously, others simply vie with each other in a sort of musical rivalry, as we shall see later, substituting music for war and showing a tendency toward a cultured form of arbitration.

In others battle is mere chase, the bird on his home tree having the best conscience and the intruder the poorest. Repeated evidences of this exhibition of how "conscience makes cowards of us all" may be observed daily when different species of birds nest near each other—an instance again of morals well braced by retribution low down among the brutes. In others the battle consists in the mere sham of pretension, as they inflate themselves, and take on terrifying attitudes. In other creatures there is found a form of protection, wherein by color, shape, pose or gesture a harmless animal will mimic one that is dangerous or disgusting, thereby gaining safety. But, so far as known, there is nothing like a terrifying mimicry among the birds, unless the resemblance which the European cuckoo has to the European sparrow hawk be such. It has been thought that, because of this, the former can more easily frighten smaller birds

Sparrow hawks.

away from their nests while it deposits its egg within them. By reference to the illustrations, this resemblance can be noted.

Among mammals there are some forms of shields, but, so far as known, while some birds carry swords, none carry bucklers. The hackles of cocks, some plovers', ruffs, etc., while having the appearance of shields, seem merely terrifying or ornamental instruments, for there is no doubt that one highly ornamented male can tantalize or humiliate his rival by the exhibition of his own beauty. Birds know each other's weak places and beauty spots, and direct their attacks at them; and it frequently happens here as elsewhere that a bird is weakest where he is prettiest.

The European cuckoo.

From our standpoint, the weapon seems a cruel instrument, but in the purposes of Nature it has been a means of progress and betterment of the species. The outlook for a higher development, when moral growth found poor soil for its lodgment, lay in some sort of suppression of the weak and sickly and in the survival or predominance of the strong and healthy.

Death, any way, is the great doom that comes out of the wear and tear of time and activity, and "Nature red in tooth and claw," as the great poet puts it, is no worse than Nature rank with decay and ruin, as it would still be if rapine had never prevailed. As it is, a wise Power has arranged it so that out of death and sacrifice to others shall come the highest of possibilities—the best there is in life. The mission of the weapon, in Nature as in Eden, is to keep the way of the tree of life, that nothing shall become immortal in its frailties before it has had all the opportunities of progress.

CHAPTER XII.

ANTICS AND ODOR AMONG THE BIRDS.

BIRDS are much given to antics, and seem at times to display a sense of humor. There is such a thing as play among birds, but nothing to compare with its extent among the mammals. Not *all* are confined to charming seasons and tactics. Female birds sometimes seem to display the most reckless sort of capers with each other when there is no Adonis to admire. But among the males it must be admitted that many of them pay their partners the poor compliment of acting as if he who made the biggest clown of himself was the most favored—a state of affairs found too often among other bipeds.

Antics doubtless have their origin in an excess of energy usually accompanying youth or occasions of special vigor. In very young animals exercise is necessary to proper development of their muscles, and to the acquisition of skill in using them. Thus all young things may tend to play—especially if active in after life; and the antics of adult birds is a sort of grown-up sport.

Terns, crows, waxwings, and others have sorts of games with their food sometimes, and the gambols of little chickens in the barnyard are a matter of everyday observation in summer.

This latter is almost invariably a mock fight; and in this many antics of all creatures—man not excepted—have their origin. Mock chases and retreats are the basis of many sports, and an especial charming factor found running all through Nature is that tantalizing "you-can't-catch-me" kind of daring that little girls exhibit and big girls recover from with effort.

But among cranes, plover forms and their relations, and among owls and many others, there seems to be a distinct exhibition of the merely grotesque or clownishness of motion—a struggle at the purely awkward for its own sake, as if the bird were trying to provoke a laugh. This often occurs after the pair are mated, and the females join in heartily.

Other antics evidently have distinct reference to the tender state only, especially those among the grouses, bustards, etc. These often have regular meeting places, or some old male will trumpet forth that the occasion has arrived when these affairs must be settled, and all come at his call. Then they assemble, and pairing is preceded by the most formal waltzes, minuets, and general "walk arounds," in which both sexes take part. There comes in much strutting, swelling, booming, and cackling on the part of the males, throwing defiance at each other till, like other "cake walks" and "hoe downs," the whole ends in a many-cornered fight among the gallants. In the attempt to present a large appearance, we can readily see one mission of the air spaces beneath the skins of birds.

Again, a single snipe or woodcock may get his "intended" off entirely to herself, and exhibit in peculiar dances and jigs that he is hers and hers only, or he may arise high on the wing and cut the most peculiar capers and gyrations in the air, either protesting to her in the grass beneath the most earnest devotion, or advertising to her his whereabouts and his Barkis-like condition. It is quite likely that in this latter case he is trying to induce her to come to the trysting place, and does not know just where she is yet. In some sandpipers the male's crop is inflated as he flies—a state which he doubtless thinks adds to his appearance.

This brings us to that more usual form of antic involving the display of pretty parts. So certain is a bird to make such display that in many cases the style of the antic can be predicted from the position of the color or ornament. The strutting of peacock and turkey cock scarcely needs mention.

A most striking and familiar instance among our small birds is seen in the flicker, already noted, as not fighting his rival. His back is protectively colored, except there is a white rump spot which acts as a signal or banner color during flight, but is usually hidden by the wings when the bird is against a tree trunk. There is also a red stripe across his nape. But his lower parts in front are beautifully polka-dotted, a black crescent or locket lies across his chest, and his wings and tail are lined with a beautiful yellow, with the shafts of the quills golden. From the corner of the mouth on each side runs backward two black lines like a mustache. Out West this line may be red, and other slight changes prevail.

When he wishes to charm his sweetheart he mounts a very small twig near her, so that his fore parts shall not be hidden as he sits upright in regular woodpecker attitude, and he lifts his wings, spreads his tail, and begins to nod right and left as he exhibits his mustache to his charmer, and sets his jet locket first on one side of the twig and then the other. He may even go so far as to turn his head half around to show her the pretty spot on his "back hair." In doing all this he performs the most ludicrous antics, and has the silliest of expressions of face and voice as if in losing his heart, as some one phrases it, he had lost his head also. For days after she has evidently said yes, he keeps it up to assure her of his devotion, and, while sitting crosswise on a limb, a sudden movement of hers, or even a noise made by one passing, will set him to nodding from side to side. To all this she usually responds in kind.

This movement of hers has also some significance. Excepting the mustache, she also is ornamented as he, and she plays back at him in a similar peek-a-boo fashion.

The author once found two female flickers assiduously courting the same male, and they were out-Heroding Herod in their importunities. Numerous other examples of this sort could be given.

The song flight of such birds as the European lark is rather too dignified to be called an antic—it is rather an ecstasy; but it partakes of the same nature, and in our meadow lark, lark bunting, yellow-breasted chat, and others, it is often rather undignified. Our mocker has it also along with a peculiar falling or fluttering down flight in song, which seems the utmost abandon purely to the emotions of his own music.

Skylarks.

Among the reptiles and many mammals odor is a large factor as a weapon, as a charm, and as an advertisement of position—a sort of down-wind call, in many cases quite searching.

Odor is a very low form of being either offensive or agreeable among animals, and the birds are ahead of us in getting away from it; for, with the exception of the musk duck, no bird secretes a specially odorous substance for any purpose. Man, the parasite of the parasites, yet robs every creature of its perfume when he likes it, and hints his kinship backward in musk and unguents and such things. It seems not improbable that he may have once passed through a state when he was free from the necessity of its use before the dawn of soap, since clean little babes have an agreeable odor; but his betterment, like that of the birds, lies in a less use of perfumes and a larger use of water.

Of course, in every organism there is some odor as the result of food, necessary excretions of the skin, etc., but in some there are specially significant odors connected with glands for their secretion. We can not stop to discuss these latter, interesting as they are, since they lie outside of the class of birds. From the suppression of the pores of the skin at the base of the feathers, corresponding to those which open at the base of the hairs in mammals (to oil them), birds have less of these incidental odors than most creatures. This suppression is compensated for in them by openings in the oil gland, whereby a special oiling and waterproof substance is emitted which the bird applies, as needed, to its plumage.

It is remarkable, however, that this should be free from noticeable odor, since in some mammals where similar special openings occur, the secretion, to phrase it mildly, is rather redolent.

Birds certainly have odors, however, which, while not so evident to us, are easily detected by dogs, foxes, weasels, etc. These odors are in many cases distinctive, since an experienced setter often shows that he knows what kind of birds are under his point. These, arising solely from food, insensible perspiration, breath, oil gland, etc., are not, however, so characteristic as in the mammals, since they distinguish each other and their individual young by scent. No chance for a Prince and Pauper romance there. But birds do not seem to recognize their young this way, else the cowbird could not so frequently foist her squab upon the others.

There is much in the stronger existence of odor in flocking birds and in their behavior in reassembling after being scattered, to imply that their odor has been intensified or developed for some such social purpose. Those that are ground haunters are strongly odorous to dogs when adult, but their very downy young before they fly seem scarcely so at all, so that experienced noses fail to "locate" them even when they are near by. This would imply also that the acquisition of these special gamy odors (as they are styled) is rather recent, as in all probability are the social habits.

The sense of smell in some birds is quite keen. This is well shown in some carrion eaters, notwithstanding their large dependence on sight, and in the snipe forms, which to some extent probe the ground for food at the proper place by it. The *Apteryx* is said to snuffle like a dog while it hunts in the dark, Some of the fowl forms and others perhaps can detect, hours afterward, that the human hand has been in their nests. Others who hunt solely by sight have this sense less developed, and the nostrils are almost entirely suppressed in some pelican forms.

There are some unexplained appearances of the voluntary suppression of odor in the game birds which are rather well attested. These may be due to its dissipation during flight, or the suppression of skin secretions during fright, as often happens in any animal.

CHAPTER XIII.

THE MEANING OF MUSIC AMONG BIRDS.

MUSIC now among birds has primarily in it the purpose of charming, and represents, perhaps, the highest feature of their progress.

If it were not for its connection with other courting tactics it ought to end the story of the birds instead of coming near its middle. With them it is the capstone of the great pyramid of the art of pleasing, and man only at the tip of the other twig of development has vied with his friend in feathers in expressing the refinements of the emotions in vocal melody. It is doubtless as recent in the progress of his culture as it is in theirs, for in birds battle, and perhaps even color and "frills," may have been inherited from the reptiles. They are there now at any rate, and odor we have seen was doubtless rampant long before the bird. Special weapons came in early after all these, and perhaps antics as now seen are as old as, at least, or older than, the wing. But song must have waited long upon the feather. The reptiles doubtless groaned and roared, and the frogs trilled monotonously, but there were no modulations that were in any way melodious till the dawn of the avian syrinx.

No other creature has a throat like a bird. It has placed its singing apparatus at the forks of its bronchial tubes, and left all the rest of its vocal cavity to modulation. The greatest *prima donna* has no such instrument to play upon.

Nightingale.

True bird music has developed solely within the birds, for the lower birds have not the modulating apparatus that the higher or oscine kinds have, there being a great difference in kind and number of muscles, which we can not discuss here. The lower birds with down on their nestlings can (usually) scream or squeak only, or at best issue a pleasant, slightly modulated whistle.

Song, therefore, is largely an invention of bipeds, and there is an evident connection between the tree top and the high place (in every respect) and music. No original water haunter or ground builder ever sang. Every melody is a march—a command to move onward—to every ear that can truly comprehend it.

Yet music with the birds has been perverted or has yet the trail of the lower passions over it. Perhaps if a brief general definition of bird song were attempted none would be better than "a vocal effort intended to please." Yet this would fall far short of all that song may sometimes mean. While the pleasing feature may be very basic, song may have a more primitive element of being a mere call for assemblage or the other feature of advertising the singer's position.

This calling feature is doubtless low down in all vocal effort. It may be only an offshoot from the social expressions and by-talks of young birds in the nest, or it may be that all calls have come out of distress cries provoked by pain, hunger, fear, or anger. The language of these is very primitive and universally understood. If a dog howls in pain, the mother birds near by will shriek and scold in sympathy, not at the dog, but at the common enemy.

Out of the consoling tones of parents the tender calls may have had their origin, and a desire to please and attract, by selective action and actual practice, may have developed these into the highest song.

Other birds which have a single tone for all purposes—fear, distress, rejoicing, scolding, cheering, calling, fighting, and pleasing—indicate the probable development of all music from one source.

Spring songs of migrant birds are made by males frequently that come on ahead of the tide of females, and are doubtless an advertisement of position and condition of heart, as well as a serenade and a solicitation. In these cases birds that have usually lowly haunts may mount the tip sprays of tall trees, as they sing, and abandon all else to melody till this engrossing business is over. Such are our robins, thrushes, wrens, indigo birds, chewinks, etc. For four years the writer observed a single red-winged blackbird to sit upon the only brush near a meadow pond, and, for a while in the spring, gurgle out his "con-ker-ee-e" and lift his gaudy epaulets, combining acting with melody. It is probable that it was the same bird each year.

Song doubtless may appear to have a mere cheering effect or that of a serenade purely. The nightingale and many others sing mostly after the mate begins to sit. Others appear to sing as they go about their work, but usually when the young are hatched and the father is busy worm hunting he is silent. The sudden acquisition to the family of from four to eight hungry mouths might dampen the melody of many of us.

Song sometimes seems to have in it the element of rejoicing in anticipation. We can not resist the impression that this is the cause of the bluebird's early song.

In the fall many blackbirds get together and sing

Thrushes.

in concert at the evident freedom from care that they have reached and the prospect of the juicy pulp of the farmer's roasting ear. But this is quite different from the wheezy, asthmatic effort by which the male in the spring won his wife.

Likewise the meadow lark has a giggling sort of rejoicing which is very different from his true song.

After molt, many birds sing out of the usual season, as if they were conscious of and glad at the appearance of a new suit of clothes and at the departure of the great physical strain which growing new feathers entails.

These are evidences of rejoicing, and no bird sings when not well. As to whether a bird sings when sad or not, we can surely say that many sing when a mate is lost, the song then being a call doubtless purely; but we shall see under Step-parents among Birds (Chapter XV) that there is considerable doubt as to whether this is intended for the ear of the quick or the dead. There is no doubt that songs of some birds are simple expressions or overflow of energy, since the most nervous and restless, as wrens, finches, vireos, etc., sing most tirelessly. A bird may sometimes sing just as a boy shouts or a girl giggles.

We have noticed in the last chapter that some songs are evident calls to assemblies and combats, as the booms of the grouse, and many are challenges and defyings that do not lead always to battle. Bobwhite, for instance, sings after mating rather than before it. He has a slight tendency to take more than one wife sometimes, and with his cry he warns his rival with similar tendencies to keep off his domain and away from his beloved. Several males will reply to each other's boastings and threats, much as our common chicken.

In fact, this is a larger use of song than is usually estimated, and its highest use—that of musical rivalry or emulation—has come out of it. Near the writer's home a circle of as many as five rose-breasted grosbeaks have been heard singing, each taking turns at his rollicking warbling, while all the others keep respectful silence.

But not always does such consideration prevail, for some use song as a means of encounter almost. The gentle dove will break in upon his rival's "coo" sometimes, and whip-poor-wills will often get near each other and try to drown each other's voices out by jumbling up ridiculously and rapidly their usually deliberate calls. Likewise the turkey's gobble is intended to drown the challenge of his rival.

But this reminds us that many birds have different tones for various phases of their emotions. The turkey's gobble is purely his challenge or defiance, but he has a tender, low call besides. Yet his vocabulary is so incomplete that he uses this last as his war cry while fighting. Burroughs has noted that the battle cry of the bluebird is his melody which he uses for all purposes, except when he sets up that pessimistic wail of his at the prospect of his autumnal departure.

Likewise, when the rose-breasted grosbeak fights he sings melodiously.

Other birds, especially thrushes, robins, catbirds, etc., are well provided with distinct scolding notes and distress cries, and many, like some boys, fight crying all the time.

Some have a distinct tone for all the cries, but the "attempt to please"—the true song or serenade—can usually be distinguished by the manner of its delivery.

There is much else about the accompaniments of song, the mechanics of song, where rattles, quill snaps, air swoops, ventriloquial effects, and various other features of charming, challenging, and calling come in, but our limits prevent their discussion. Likewise the topics of how songs are acquired, or the instincts of song, and what songs tell of a bird's associations, of its mimicry of and influence by others, etc., are interesting, as well as the relations of song to size, color, structure, climate and weather.

CHAPTER XIV.

FREAKS OF BACHELORS AND BENEDICTS IN FEATHERS.

WE have seen much of the agencies and tactics that birds use in charming, but the features of *when*, *where*, and to what *extent* and *degree* the feathered gallant is enthralled has not been mentioned. If St. Valentine's Day is a time of love letters and tokens because, as it has been asserted, the birds pair on that day, the custom must be based in an age and climate very different from ours. Farther south, of course, from the average of our latitude, some resident birds may be mated by the 14th of February, but within the climate of our middle latitude (35° to 40°) the pairing is much later.

Again, at any point it is very variable in different birds, ranging in extremes in the limits noted from January to July. Some of the birds of prey are either paired in early winter or else have married for life, and many of our large owls, which hoot and "boo-hoo-hoo" and dance so ludicrously to captivate, began perhaps last fall, since their eggs are sometimes found in early February.

This might make this eerie bird of night, instead of the dove, the appropriate symbol of the valentine, especially since it slightly "forces the season," and he might become generally the emblem of love as well as of wisdom. It might be unkind to imply that his great folly at this period has any bearing on the suggested change, except that the clownlike antics of both himself and mate while under the tender influence tend to impair their reputation for dignity and wise demeanor.

It is likely that with those winter birds that stay with us, pairing is often the result of mere association; but there is never just simply "an understanding." So far as the author's observations go, there is always a distinct event, when he asks for her heart by some special expression, and he speaks, in some way, of the wealth of beauty and devotion he has to offer.

This period may last for only a moment, as exhibited by jays and others, or it may be a matter of philandering for days, as the flickers, already noted, often exhibit. It is certain also that there are some long engagements among the birds, or long sieges of charming at any rate. Nearly all put on their wedding suits, and many exhibit the tactics of love long before the housekeeping begins. Our little American goldfinch or thistle bird (sometimes called "wild canary") dons his beautiful lemon-yellow suit early in spring, and sings charmingly of all that he hopes, but that more somber sweetheart of his does not name the day till somewhere near July. She is waiting till the thistle down is right to line her home to the proper tint, and she has her ideas about the color proprieties of the wedding as well as its other sentiments.

Among the birds that come to us in the spring the case may be different, and weddings and housekeeping follow fast after arrival. Very few, if any, migrant birds come to us paired, because, as noted, the males, especially of good singers, come first. They, taking up a definite location, determine often the region where the nest will eventually be, but the female usually has a word to say about its exact situation. In the case of the blackbird that chose the pond bush, there was never any redwing's nest near it.

There is some evidence that among ducks and some low birds an agreement is reached before the northward migration begins, or at least while they are on the way later; but the small birds mostly pass us unpaired, and their "wedding journey" is usually before marriage. Bobolinks go by us in the spring in unpaired groups, the males very much dressed up, and singing in concert as if each now was practicing for a special occasion further on; and it is probable that all the songsters, wherever they stop in their journey, sing, although no feminine ear be near to heed. It may be that when the male reaches the end of his travels and begins the announcement of his loverlike condition, he has "a girl that he has left behind him" whom he expects to meet him in the region of last year's romance, and the peculiar little variations in the songs of various individuals may be for her recognition. It is just as likely, however, that his wife for this season will be a "summer girl" only, and that his old flame has "gone with a handsomer man." It may happen, therefore, that both he and she may have as many partners as there are years in their little lives.

To such birds as rear more than one brood there may be a second or third spring of the season, when the tactics of charming are again resumed. The revival of song about the end of June, when the first fledglings are able to care for themselves, is very noticeable. While most birds retain the same mates for all the year, there is just a hint sometimes that some get a new partner for each nesting occasion. We shall see in the next chapter that birds have no scruples about second marriages the same season when there is the slightest occasion for them.

Neither have some any compunctions about taking more than one wife at one time. Especially is this the case among the lower families. While in all the groups there are some that exhibit both tendencies (i. e., one wife and many wives), yet, as the birds have developed music and the more refined methods of charming, they have become monogamous (one wife only), and exhibit during the nesting season all the tender little gallantries that make up so much of love and life. The hornbill walls his wife into a hole with mud, and feeds her while she incubates (see Chapter XXI). Many others bring choice delicacies to their incubating mates. Others still take their turns at sitting, in constructing nest, feeding of young, etc. Some males construct the nest alone, and many among the lower forms (ostriches, etc.) take exclusive charge of the young when hatched. As noted in some plover forms, the males do all the incubating, while the females usurp all the masculine privileges, having it leap year all the time in their circle.

Other little birds, while unusually devoted in song and frivolous attentions, are content to sing only, while the wife does the work. As a rule, the female builds the nest among our higher birds, though both may work. Frequently the male brings material which the female shapes into the structure.

Down among the polygamous birds, as ostriches, fowl forms, etc., there is an occasional fatherly devotion that is striking. Thus the male ostrich not only scoops the sand cup for the eggs, but does half the incubating, though he may have in the wild state plenty of wives to divide the duty up among, and he takes the more dangerous night time as his portion. Besides this, as noted, he rears the young exclusively, and shows his love of babes to such an extent that he will steal them forcibly from his neighbor.

Our Bobwhite takes the first brood under his care, hovering them from storm, and talking baby talk to them like a mother, while his mate incubates the second brood.

But others of the birds of this level are far from being "model husbands and fathers." Our common rooster is usually indifferent to the chicks, and our turkey cock will frequently kill them if he can.

Usually the males of the true grouses—nearly always polygamous—desert their wives as soon as they go to sitting, and leave them till the family is entirely brought up, when they again selfishly join the flock.

Among some ducks a similar habit prevails, but some geese and swans are devoted to mate and young.

While some birds, as noted, like eagles, etc., pair for life, the tender relation is usually ended as soon as the nesting season is over, even among our most gallant birds. The flocking birds, after the coming in of the males, may all stay together, but the others usually separate. Burroughs notes that the male of our least woodpecker ungallantly drives his mate away, and takes the home-nesting hole exclusively as his winter roosting place; and the writer once saw a female downy woodpecker excavating in November a hole in a fallen tree top, and was able to read as he ran the reason for this winter work.

While fishes and some lower creatures paired, perhaps, in the long ago, or do now, at least, monogamy and gallantry first found their great development in the birds; and while some of them have made small progress, they seem, upon the whole, to have done about as well as some others who have had better opportunities.

CHAPTER XV.

STEP-PARENTS AMONG BIRDS.

Are there any *old* maids or bachelors among the birds? any remated ones after the usual pairing season has passed?

It would seem so, or else there are divorces or the worst kind of desertion of mates. In the writer's yard a kingbird was once industriously and noisily thrashing all the other birds, especially a favorite mocker. A stone was cast the tyrant's way merely to frighten him, which unfortunately slew him. He was given decent burial, and certain glances of condolence were thrown up to his widow with her lonely home upon the limb, filled perhaps with gaping orphans.

But by the afternoon of the next day she had married again, and the new husband was just as assiduously thrashing his neighbors as his predecessor. The dead bird was actually dug up to avoid the conviction that he had come to life and scratched out. Later, personal observations and the reading of the record of others were thoroughly convincing that within the same season there may be many second marriages in feathers, and that the question of the

Sadducees (In heaven whose wife will she be ?) does not worry the birds much. White, of Selborne, notes many similar instances, and others have experimented till they determined that as many as seven successive

Magpie and nest.

spouses would be found very quickly by suddenly bereft pies, daws, rooks, owls, hawks, eagles, and others of either sex.

The new wife or husband has the very commendable virtue of taking up the work where the "dear departed" left it off—anywhere from the earliest stages of nest building to the feeding of the young. It would seem that the new bird would like to begin anew, but in this and other respects it seems a model step-parent.

If the male is left he at once begins to sing or call. This may appear as a wail for his first love, but it looks later wonderfully like a serenade to his second. Some persons have been cruel enough to shoot female nightingales on the nest, that the male may break again into song.

The purpose of this song is more certainly indicated in those cases where females sing in widowhood which are usually nonmusical at other times. Others who can not sing have peculiar widowhood cries that are well understood by the gallants. But since others of them have neither of these means of announcement, and can not don the draperies and colors of mourning as a visual advertisement, and dress better in their bereavement than they did in their first partner's lifetime, it is difficult to see how they so quickly marry again. There may, therefore, be a large number of unmated birds, among which the widow "has her eye out," and whose whereabouts she well knows.

Sometimes they may be persistently near. In the author's yard there has nested for years a pair of house wrens, presumably the same birds. One season they were annoyed (or rather the husband was) by the presence of another male which pried around the nest persistently, notwithstanding the occasional thrashing he got. There can be little doubt that had the rightful husband died the other would have been installed at once in his stead.

But why these unmated birds do not find each other and let other folk's spouses alone is more of a mystery.

It may be that they are young and inexperienced in partner catching, and fail in the struggle with widows and widowers in the fascinating arts, just as others do.

It is not at all improbable, as Mr. Darwin notes, that there are certain incompatibilities of temper and taste that occur among birds which prevent them from finding just the right partners among each other till it is too late; or they may also have been unfortunate in losing a partner. They may have mutually agreed to separate because they could not agree, for there are some very creditable records of mated birds disagreeing about many things.

It is to be feared that there is a less excusable feature in all this, and while constancy is the rule above polygamy, some individuals of any species may sigh for change, even in a summer marriage, and desert their mates for others. Nuttall notes that a Baltimore oriole had quite a tendency to linger in the society of his neighbor's spouse, and that his wife won him back again; and there are various instances of connubial vagaries in both sexes. Even that beautiful constancy so long emphasized in song and sentimental literature—the constancy of the dove group will not bear too close inspection, since even Aristotle denied it so long ago, and his views have been confirmed by others.

Daw.

Mr. Darwin thought also that perhaps in more instances than is usually suspected birds were associated in triplets—two of one sex with one of the other—and he instances some, and that this was a loose union easily broken when a better situation was open. Such things are noticeable among domestic geese, etc. The writer recently received a letter from a Nebraska observer, asking why he so frequently saw three crows together in nesting season; and he went on to say that there was a song about "three black crows," probably founded on a similar basis. But he omitted his address (and a stamp of course), so that he could never be answered from this source, unless this little book falls into his hands and gives him the above inkling.

Birds may change their habits with regard to devotion to mates with change of environment. The mallard duck is monogamous in the wild state, and a Mormon of the Mormons when domesticated.

Very closely allied genera or families—even species—differ strikingly in permanent habits, as we saw in the last chapter. Again, they may hint their kinship in their frailties. Our crow blackbirds are monogamous, but show some quite Lotharian tendencies; the red-winged or swamp blackbird is polygamous usually, and the cowbirds on the border of the family are indifferent to any connubial ties whatever. The weakness of Nuttall's oriole may have been an inherited tendency, since he is in the same family with all these.

Of course, among the purely polygamous birds such vagaries count little, and step-parents may occur without death, as with the ostriches, for instance, where many females lay in the same nest. Mr. Darwin notes a correlation which may tend to prevail between brilliancy of color and polygamy, so that any bird that is pretty may be liable to suspicion as a flirt—a very natural conclusion, tending to hold beyond the feather. But the writer has observed in the male cardinal the most unselfish paternal interest, where, unmated himself, he helped a pair of blackbirds feed their young.

Of course, there is yet that other form of step-parents, blameless except for its stupidity, where one bird hatches and rears the young of another, to the injury and loss of its own, as seen in the parasitic habits of the American cowbird and European cuckoo.

The adoption by a common hen of any bird that she has hatched, as a duck, is a form of step-parental affection common in almost any barnyard.

CHAPTER XVI.

WHY DID BIRDS BEGIN TO INCUBATE?

We have followed the bird's story thus far by the development of changes in its structure slightly and in its outer covering more extensively. This latter led us on into its emotions (and their reflex effect upon structure and color of plumage) and into the development of a love for beauty and music and some other general æsthetic feelings till we have reached some of its tendencies toward the unselfish. From this standpoint we shall now go again to near the bird's origin, and note its progress away from the reptiles through incubation, nest building, egg coloring, young rearing, and kindred topics.

This may be styled another account of the genesis of the birds, parallel with and corroborative of the first.

After this a few miscellaneous side lights will follow, and our task is done.

Since all reptiles have eggs, many of which are hatched outside of the body, as are those of the birds, and since only one quite unbirdlike family of reptiles —the large constricting snakes—show any tendency toward incubation, an interesting question may arise as to the origin of this habit among the birds.

Since the lowest birds, or those showing nearer relationship to the reptiles in structure, practice incubation less closely than do the higher groups (some even ignoring it altogether), we feel justified in inferring that the early birds left their eggs to be hatched by natural heat, and that incubation, as we now know it, came in after feathers.

While the coiling of the python and other similar snakes around their eggs may seem like incubation, it may be really more a matter of maternal watchfulness. The temperature of the eggs are said to be elevated by the act, however, but this may be due in part to their own heat incidental to the mere act of hatching, for the development of life means the development of some heat. Since all reptiles are cold-blooded, they have little heat to impart to their eggs, and incubation can have little significance with them. In fact, it has been suggested that the parent has coiled about the eggs to warm itself from them, and in this way, at least among reptiles, the habit of incubating may have had its origin.

But, strange to say, the opposite idea has been advanced in the case of birds—that is, that, being intensely hot-blooded, they began first to sit upon their eggs in order to cool their breasts. In keeping with this view it may be noted that one thing is fairly established now—that at the incubating period the breast and abdomen of the sitting bird are in a state of congestion, and, of course, the circulation and heat in these parts are much increased. It is said that the cruel experiment has been tried of baring and burning the breast of a common rooster, whereupon he at once began sitting on eggs to cool himself.

All this, if true, leaves the increased circulation at this particular season yet to be accounted for, but incubation itself may have come about in such a manner as to develop both the habit and congestion together, for the mere act of sitting long in one place tends to make the breast warm, while the increasing heat of the hatching eggs tends also to heighten the temperature. Now the rhythm, or regular recurrence, of a physiological condition is well known to be easily established, just as we train ourselves to hunger or to desire sleep at certain intervals. Birds exhibit these physiological rhythms in other ways than this.

Since so many birds even after laying one egg begin at once to sit before others are deposited, it may be that incubation began in the act of laying. It is well known that an egg begins to hatch even before it is laid, and in many reptiles its embryo is thus perfected within the body. It is not impossible that such birds as lingered long over the prior eggs before or in the act of laying the succeeding ones, or rested on them a while from the exhaustion of the act, or possibly took to roosting on them to protect them, had their young more surely and quickly hatched out, and hence, by inheritance of the tendency, natural selection could easily intensify the habit.

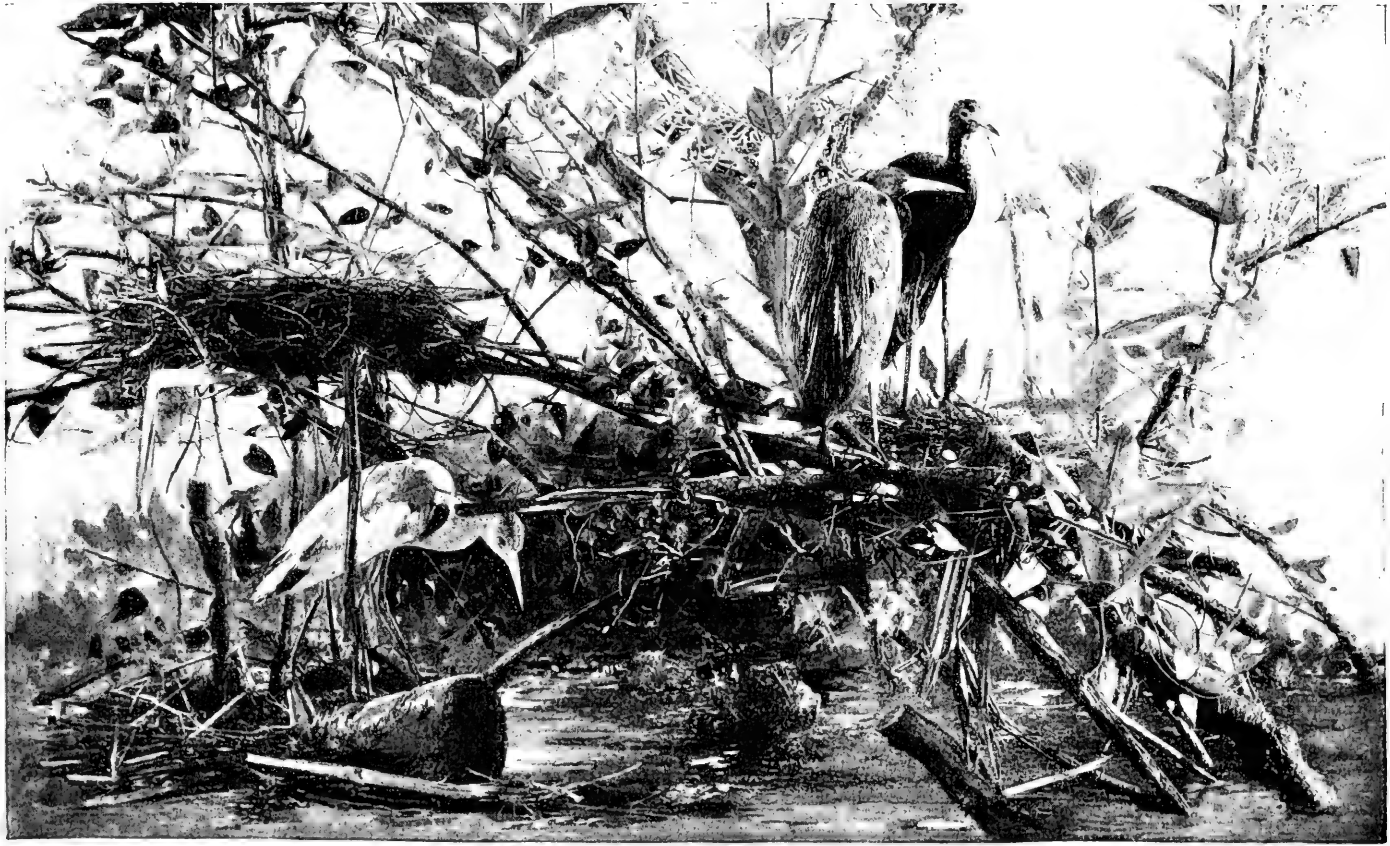
Besides the sun-hatching tendencies exhibited by most reptiles, and to some extent by the ostrichlike birds (in the wild state), there is another interesting example of the similarity of nesting habits between some early birds and some reptiles. The crocodiles generally are known to bury their eggs in the hot sand, but some indicate progress by excavating deep holes and placing in them, with their eggs, much vegetable material, so that a sort of hotbed is formed, and the eggs are hatched by the heat generated by decay. Among the *megapodes*, or brush turkeys, of the Austro-Malaysian regions, a similar habit prevails. Sometimes this is varied into a surface compost heap which many birds, acting together, raise and use in common. Like the reptiles, the eggs are deposited in the night. But the bird out-Herods Herod in the lack of further paternal interest, for some of the crocodiles feed their young after they escape to the water, and in some measure they guard the place of deposit; but the little brush turkey and his kin are always orphans.

A sense, therefore, of the need of more heat or heat differently, or more constantly, applied may therefore lie at the base of incubation. Conditions might easily have arisen that demanded a change, for birds, as we have frequently seen, are easily influenced by changes in environment. Thus the ostrich doubtless leaves its eggs to be hatched in the sand by the sun in some hot regions, but in others, and especially under domestication, it practices incubation, and it has in all probability changed its habits to some extent since the time of Job (xxxix, 14).

With the early birds conditions quite likely arose as the result of permanently leaving the shores for regions where sand for burial was not convenient or the sun's heat was not sufficient, and the egg being laid upon the bare ground or rock, incubation was necessary. This would naturally result also from migration into a cooler region or from a permanent change of climate.

In the varying amount of incubating heat required to hatch eggs of the same size but from different species there is a hint that the habit of sitting has been progressive. In tropical regions it is sometimes quite difficult to hatch a bird's egg under a common hen, because too much heat is applied, and an explosion usually results ; and, as we shall see in the next chapter, birds of southern origin build cooler nests than those from the north. Some birds sit longer than others on eggs of nearly the same size. As a rule, the time of incubation is roughly in proportion to the size of the eggs, and it may vary from seven days in the smaller birds to forty in the largest. It is well known also that some birds sit much closer than others. Likewise the second clutches, where more than one brood is laid, hatch a little the quicker often, doubtless because of the greater warmth of the more advanced season.

This varying amount of heat *now* also has some relation to the condition of the nestling when hatched, whether downy or naked, but that bears on another topic (see Chapter XX). Our space precludes the discussion of the incubating habits of the various species, but some of them have been referred to in other chapters. Others will come up later.



Little blue heron, adult and immature. An early tree builder with a platform only.

CHAPTER XVII.

WHY DO THE BIRDS BUILD SO?

If we walk out and study the architecture and building habits of our feathered neighbors we find that they seem to drop into much the same natural divisions as our human associates. Some are still clinging to the traditions of their fathers and some are wide-awake and abreast of the times, and all are more or less influenced by circumstances either past or present.

Here, now, we shall find those "feather-bed folks"—the nuthatches, titmice, chickadees, and others—sweltering in hot weather at the bottom of deep holes on mattresses of fur and down, all because, no doubt, their ancestors, as they came down to us on the edge of the ice waves, needed these winter linings. Now the bird going on has carried them to the Gulf. So the blue jay here in June must have a bit of wool to stop the chinks in his log-cabin home, and the shrike or butcher bird is still barbarous enough to line his wigwam with the coverings of his quarry.

Then there are the tanagers, the grosbeaks, the cardinals, the cuckoos and others, which, by their greater development under the tropics and their distribution, habits, colors, etc., show themselves to be of Southern origin, building up North here light, airy, basketlike, saucer-shaped nests, like those their ancestors were cradled in under the equator. Some swallows, however, evidently from the South, use feathers.

European house swallow.

Some southern birds' eggs, as noted in the last chapter, require less heat to hatch them than those of their hothouse friends. And here is the crested flycatcher, always trying to have a cast-off snake's skin for upholstering, because it may have frightened away, perhaps, some enemy of his forefathers.

That type of all that is proper, our mourning dove, may be in the same category, though she shows some tendency to improve with the years; for that old broken-wing bit of hypocrisy which she still exhibits very dramatically shows that her ancestry were ground builders, and hints her very close kinship to the fowl forms (*Gallinæ*). Now, however, she frequently pens her eggs in by a few straws and twigs laid on a rail, a flat stump top, a limb, or even upon the platform of thick evergreen needles. But in structure it is a poor affair at best and shows the shortness of her pedigree. She is only the second removal from an ostrich. She has caught the spirit of the age, however, and locates her nest according to the emergencies—never, it is said, failing to use the tall cacti out on the Southern plains to lift her eggs and young above the preying reptiles. Even here at home we may note that she never tries the pious fraud upon man or dog when her nest is high up and safe, as if she knew an emergency when she saw it. In fact, it seems that she is often adverse to needless industry or effort; for while she may place her first few straws up in a tree, she is quite inclined (in the Middle West at least) to place her second clutch in some already prepared bare depression among the grain stubble without the slightest sign of structure. She has lost her tendency upward these dog days and has gone back through sheer laziness to the old style of her ancestors. Ninety-five degrees in the shade takes a deal of energy and progress out of us all, and we show a very degenerative tendency toward primitive habits, as the loose robe and the summer tent often indicate.

Doubtless many other birds are influenced by this element of laziness, for the second nests of most birds are rarely so well built as the first. Even so neat a bird as the chipping sparrow has been seen relining an abandoned catbird's home for its second brooding. But there is no doubt also that there are sloven individuals among the respective species of our neighbors, for some are much neater than others.

Again some, as we have seen in the dove, are much inclined to be influenced by circumstances. These may be brought about by conditions of safety or convenience of material. Nests of the same birds differ in the latter according as they may be in, say, a hemp-, a cotton- or a wool-growing region. An extreme case is that of the little bird, which, straying into the crater of the volcanoes on the Sandwich Islands, builds its home of the spun glass about it —and of course should not throw stones at anybody. Another bird is reported to have built its nest in Switzerland of fragments of the mainsprings and hairsprings of watches thrown outside a factory, and is entirely up to date with a steel structure or at least a woven-wire mattress.

Ornithological records are full of instances of change both in progress and degeneration of nest building. But further instances are precluded by our limits. The subject is in itself a study, and a literature already.

Before we close, however, let us glance a moment at the probable origin and development of nest building.

While we have fossil birds, and fossil eggs even, it is unfortunate for us that we have no fossil nests. Neither have we an embryology of nests in the true sense from which we may infer something of their beginnings. Young birds build cruder nests than their parents do, but this is a matter purely doubtless of experience or the lack of it. Still it is a law that if the individual can progress then so may the race. We have seen that birds may grow more expert under changed conditions. We have also some hints of the route up which modern nest building has come through the study of the nests of the lowest birds now living.

While some fishes now build nests, there is nothing of the kind among the reptiles, except perhaps one of the snakes of India, and the hotbed habits of some crocodiles already noted. The nest, therefore, as we know it has been developed wholly within the birds, and, like incubation, is not an inheritance.

As a simple cup-shaped depression in the bare sand or earth, it may have indeed been the same as the reptiles' sand scrape with the lid left off for incubating. Many birds yet use such a pretense, and a few, especially among those laying only one or two eggs, hatch their young out on bare flat surfaces, as rocks, etc.

Doubtless, however, the first step toward a nest was a hollowed-out place in soil that was not necessarily sandy, especially if the early birds, as is quite likely, laid many eggs. Under this condition a depression was necessary to hold the eggs well together while being incubated.

Conditions of migrations or change of temperature may also have arisen wherein such eggs as had something under them were more likely to be hatched out, and this sort of natural selection might have intensified the tendency to seek grassy places and set up structure, or at the least shaping of the material at hand. We shall see something of a hint of this progress in the color of the bird's egg.

But it was not until birds began to build in trees that much progress was likely made in intricate nest structure. Such birds as we now find building neat nests on the ground belong to families that are largely tree builders, and their ground-nesting habit is evidently comparatively recent.

It is probable that even the first nests in trees were merely rude platforms as we find yet among *low* birds that build there. If we except one bird among the stork forms (*Scopus*), few if any elaborate nests belong below the perchers and their near relatives. Even these complete nests often have the primitive platform first, then the cup on that, and lastly the lining.

That the lining is comparatively recent is shown by this sequence and by the fact that it is usually the last thing that a bird changes; but the platform may often be omitted. Some birds are so concerned about the lining as to always have roots of the same color or hairs of the same fineness and character, or other special material. In a few cases the nest consists of the lining only.

Intricate and comfortable nests have come about more likely for the comfort and safety of the young than for that of the eggs. In all the low birds, which are chiefly ground builders, the young flee at once from the nest or stay in it only a little while, and it has small relation to their comfort. Others, who build no nests but have helpless young, lay their eggs on or under rocks, upon high cliffs or inaccessible islands, and the safety of their nestlings is thus assured. But when birds began building in trees (for the further safety of young perhaps) better structure became necessary. It is said that now the birds that build the best nests have their young remain longest in them. It has been asserted that this long babyhood permits the youngster to better study the parental type of architecture, and thus better nests still are the result; but it seems quite evident that the nest is built better because there is so much longer need of it.

There can be no doubt that a bird may take delight in the skill of its work and the beauty of its home as well as in its plumage, etc. Their æsthetic natures (in some birds) are doubtless factors in the betterment of their homes.

Hummingbirds, gnatcatchers and others garnish the outside of their nests with lichens, silks, etc., and many others show by the *arrangement* of the lining a mechanical form of ornament. One bird in India studs the outside of its nest with fireflies that glow at night. It has been claimed, however, that this ornamentation is purely to make the nest conform to the color of its surroundings, or that the purpose of the fireflies is to frighten away some enemy. But it can not be denied that a love of beauty and skill enters into nest building in the higher birds. Nevertheless the modern nest is often shaped by the builder's attempts at concealing it. Nest concealing, we shall see later, is a large factor in bird life, perhaps affecting migration. We can not enter into details. Every boy knows how snugly a bird's home can be tucked away.

There is no doubt but that in the past, at least, there has been an intimate relation between the style or shape (and location) of the nest and the color of the sitting bird in order to conceal her. The style of nest that she has used may have affected her color, or she, having the color first, may have built her nest to suit her complexion—more likely the latter, when we know all the facts. It is an interesting question which has developed a real philosophy of bird's nests. The naturalists were for a while "cheek by jowl" over it, but we can not discuss it further.

CHAPTER XVIII.

FASTIDIOUS NESTING HABITS OF A FEW BIRDS.

Before leaving the subject of nests, it might be well to notice a few instances of a certain fastidiousness in building and some other peculiarities. No attempt at even mentioning all could be hoped for. The topic of nests alone is a specialty in ornithology.

Mr. Darwin had considerable trouble in convincing the world that birds exercised choice in selecting their mates, but the most casual observer may note how very fastidious they are in choosing the proper location and material for their homes—especially the latter. Even such a sloven builder as our dove has been seen to pick up and reject as many as half a dozen straws before finding one to suit.

After a certain substance is once chosen, however, bird's continue to use that from a certain definite region. Thus a Dick-cissel (black-throated bunting) selected one year all her straws from the midst of a meadow which seemed to the observer to have the same material on its nearer edge. It may be just possible that a convenient dead weed on which her mate sat and sang while she worked had something to do with it, for he went with her to the neighborhood of the nest and sang there and then preceded her to the dead weed again. But it is more probable that he merely *persuaded* himself that he was "bossing the job."

Robin's are quite given to selecting more than one site, building a little there and abandoning it for an-

Singing while his mate builds.

other. This often appears as the result of seeing that they have made a mistake. But other birds seem to be merely unable to settle upon a location.

The palm for this sort of fickleness the world over belongs to the wren tribe, as exhibited in the great number of their well-known "sham" nests.

It may be readily noted in the familiar house wren, which fills every cavity about the place with sticks before it selects one for the real nest. Various theories have been advanced to account for this tendency in our nearest feathered neighbor, all of which are partly plausible, but none of which account for all the facts. It appears to be a matter of pure selfishness, as held by Burroughs and others, as if he did not want any other bird to enjoy these cavities—a sort of dog-in-the manger spirit; but his cousins the marsh wrens and the tule wrens of California, and others which do not use holes, build a number of these sham nests in the grass, sometimes quite near each other, only one of which is said ever to be used. The writer was sure one year that the extra holes were held for the second (or even third) broods, since the birds used one of them thus that season, but the next year they occupied for the second nest a cavity that they had not filled at the beginning of the season. This may, however, still seem the reason generally, and the minds of these individual birds may have been changed; but the fact of the tule and marsh wrens *never* so using their extra nests, if true, is against this view.

In England these extra nests are called "cock nests," because it is asserted that the male roosts in them while his mate is sitting, and the first brood of young occupy them at night while the second are being hatched. But the writer has found both the male and subsequent broods "roosting out" in the crotch of a maple while the mother incubated.

Another plausible theory is that the male wren builds and pretends to defend these sham nests to divert the attention of an enemy from the real nest and his sitting mate. There is no reason why the bird should not be capable of such deception. But the nearness to each other of the nests of the tule wren is somewhat against this view.

It may be, however, that these extra nests once had some such purpose, and they are still built by force of inherited habit. One other bird at least has a nest with a vestibule for the male to sleep in, and various birds resort to deception about their nests. Or it may be that this extra building is the result of the great surplus energy of these birds, just as great abundance of their song may be.

Ofttimes the male alone fills the cavity with twigs and the female comes, burrows into the center of the mass, and lines it with straws and feathers. A male house wren was once observed to pile such a mass under a back porch while his mate was on the first nest. So far as known she came to inspect it only once, and then evidently rejected it. Some of these sham nests may be attempts of the male to please his wife, and their rejection may be just the usual feminine fastidiousness about housekeeping affairs.

Something similar has been noted in the nesting of the purple gallinule, an aquatic bird.

Birds have been rather naturally but unscientifically classified in their nest building according to the manner of making the nest, as carpenters (hole diggers in wood), plasterers (much mud in nest), weavers, felters, basket makers, etc. These things are very apparent when the nest is at hand, and the styles may be combined as in the robin's nest.

The swifts might be styled cementers, since their nests largely consists of twigs glued together by a sticky saliva, secreted especially during the nesting season. Of course it is well known that one Chinese swift omits the twigs altogether.

It is probable that many birds which build such neat, compact nests, also use saliva in felting, especially the hummingbirds, which are next of kin to the swifts. It is well known that the woodpecker uses no nest material at all except the fine chips of the digging, feeling perhaps that if he finishes his home in hardwood his young can do without the upholstering. Here is a striking illustration that the habits of the young and the style of the nest are related, since little woodpeckers after a few days do not sit upon the bottom, but cling constantly to the sides of the cavity. There is little need of a mattress.

It would be interesting, of course, to note the many striking or unusual locations of nests and their peculiarities of material, use and structure; but it would take a volume, and reference must be had to special works on the subject.

Something of the relations of nest and egg colors will be noted in the next chapter.

It is likely that no birds use the same nest to rear a subsequent brood in the same season, but they nearly always build the second nest in the same region. But many birds that build in holes use the same hole, and perhaps part of the same material over again. Such are bluebirds, chickadees, wrens, crested flycatchers, and some swallows. Of course with the woodpeckers, house cleaning in the spring is simply the

Sand martins.

result of the year's disinfection. Sand martins or bank swallows and some woodpeckers make new holes each year. But where a bluebird takes another bird's nest, she is often quite particular about scratching out all the other's material. This is true of some others. Other birds, however, steal or appropriate each other's material, and are even so sloven as to take the old material out of a last year's nest. Others again appropriate the abandoned nests which have already been used that season, and refit them to rear their own second brood in.

Eagles, owls, and others of that sort repair slightly from year to year the same nest. Owls also are great users of abandoned hawks' nests. Of course it is well known that the ospreys, if not disturbed, will continue indefinitely to heap rubbish upon their nests until their bulk is very great.

The saying, therefore, "Useless as a last year's birds' nest" is meaningless from the standpoint of some birds.

CHAPTER XIX.

WHAT MEAN THE MARKINGS AND SHAPES OF BIRDS' EGGS?

HOWEVER varied and beautiful the markings of birds' eggs are now, we can not help feeling that either at present or in the past these spots, streaks, etc., and their colors, have some reference to use or purpose. The most plausible view is that these were for protection. Such eggs as best mimicked the place where they were deposited would most likely escape detection by egg-eating enemies, and the chicks hatched from these would most likely lay similarly marked eggs again.

The earliest birds with highly marked eggs are the plover forms, whose eggs were chiefly deposited perhaps on the pebbly shore, and well harmonized with the various colors of small stones. Such are still strikingly protected in this way. But among the higher birds there are now many instances of marked contrast between the color of the nest lining and that of the egg. At least one bird insists upon black roots to line her home with, while her eggs are conspicuously light-colored.

Mr. Wallace, the great naturalist, revived an old theory that these contrasting markings (such as nearly black heavy blotches on a white ground) were intended to make the egg hard to detect when viewed through the branches of trees from above, claiming that the light and dark markings imitated light and shadow spots caused by the spaces between the leaves. It seems more probable, however, that these markings are now an inheritance from a past condition, when they were imitative, and that the bird has changed its building habit, and of course can not so soon change its physiological habit by laying eggs to suit the surroundings. It is well known that the standard theory is that the ancestors of our birds here in the temperate zone were once resident in regions far north or far south of us; that ours is a region that has been colonized and not a creative or developing center. Now, the bird that once built its nest near the pole when that region was tropical may have had its eggs marked well in keeping with the lining material there used; but when the ice-cap drove it south it could no longer match its nest to its eggs because the old material was not at hand.

Birds, as we have seen, are usually very constant in the use of the same lining material when it can be obtained, but they are also easily influenced by convenience. A bird which formerly, as it advanced from the arctics, lined its nest with grayish fern, wool or lichens, may now use flax fiber in Dakota, black roots or horsehair in Missouri, and sheep's wool or cotton in Texas. Some such instances are actually known to occur.

Usually such birds as have long built in holes have their eggs white. But there are many hole builders that lay beautifully marked eggs, as the sparrow hawks and others. The case here is perhaps similar. The eggs were originally marked in keeping with an exposed nest, and they retain in their hieroglyphics the history of the family, if we could only read it. Doubtless every marked bird's egg is a palimpsest story of the bird, with pedigree after pedigree written over it. Some of the white eggs of hole builders have perhaps never been colored or marked, but others doubtless may be blank by losing their family record. Among the colored eggs of many birds to-day there are tendencies toward an occasional white egg, and in the bluebirds these are rather frequently found. It is possible that, since their eggs are no longer more useful when colored than when plain, the bluebird of the very far future may lay a white egg, if it persist in hole building.

If we had space some evidences could be cited that the coloring and marking of eggs are comparatively recent. It is shown by the deposit of color in the oviduct, occurring usually when the egg is low down only, and then upon the outer layers of the shell chiefly. In some grouses and ptarmigans the color can be readily rubbed off when the egg is first laid.

On the other hand, in a few birds there is evidence which seems to show that there is a tendency toward losing color. In the cormorants and similar forms, in cuckoos and others, the outer layer of the

Sparrow hawk, young, and nesting hole.

shell is usually incomplete and uncolored, while that below is a bluish green. Many of the hawk forms appear (as they have grown more arboreal in their building) to have a tendency to lose those strong markings, and to dilute the deep stains which characterize the eggs of their ancestral relatives, the vultures. So also the flycatchers usually lay strongly marked eggs, but the Phœbe's are only specked occasionally, and the least flycatcher's are always wholly white.

Eggs frequently hint, though not always very reliably, the kinship of the bird; and, strange to say, their very great variations may sometimes seem inclined to point one way and sometimes the other. In fact, many of these variations must be the result of the double strain of kinship that comes into every family. Our crow blackbird lays two forms of eggs—one rather crowlike and one zigzagged, like those of the orioles. In its true kinship the bird stands where its eggs indicate, between the oriole forms and the crow-jay forms.

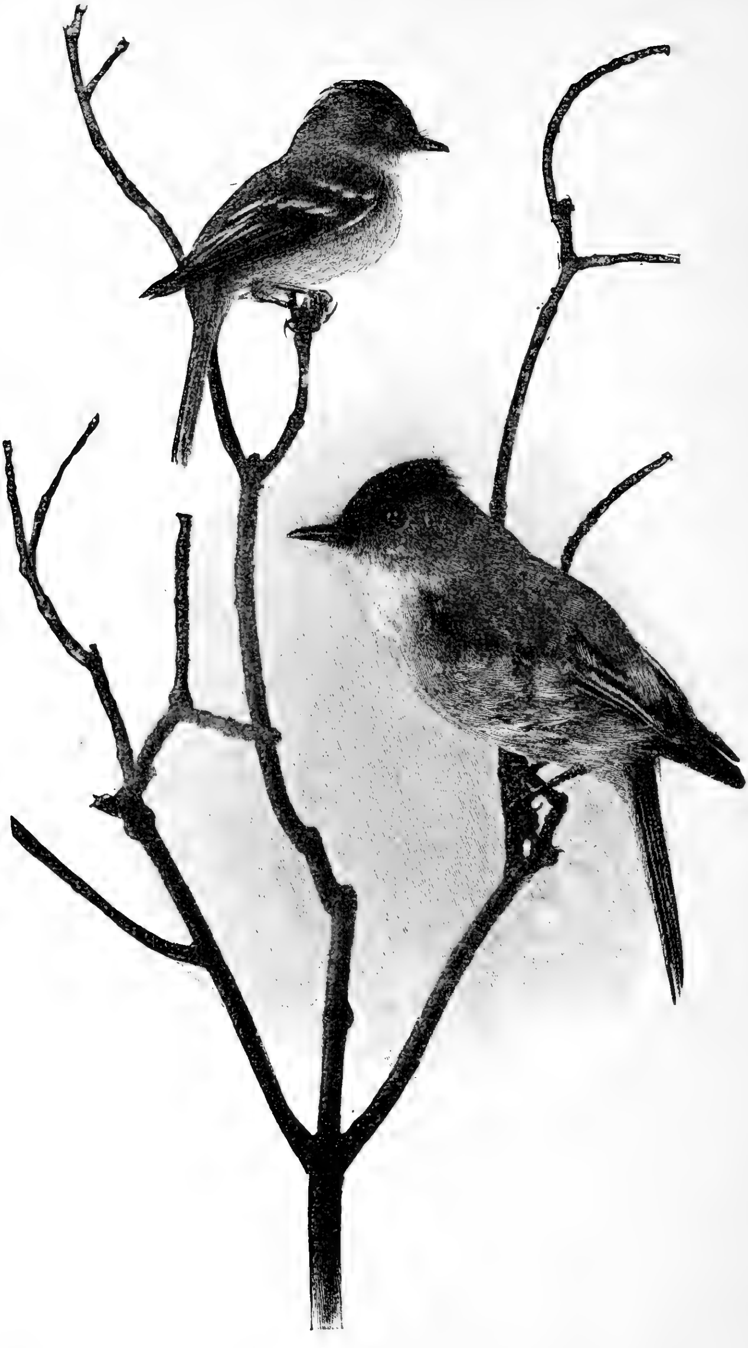
It would be interesting had we space to note the character of these markings and the relations they seem to sustain, to the ground colors; to the number in the clutch; to the earliness or lateness of the clutch; to the size of the egg, and even to the size of the bird; to the result of hybridism; to the character of food; to the effect of fertilization; to the change of climate; and to the general bearing of the environment. Few things are more fascinating than the study of birds' eggs in this light.

The color of the egg is something that has been wholly developed within the birds, since no known reptile's egg is even stained. Neither are these colors incident to the material of the shell, since carbonate and phosphate of lime, of which it is largely composed, are naturally white. They are evidently very specially stained. The first stains may have been blood stains, and certain relations have been asserted between these and the bile stains; so that the condition of the bird's liver, as with the rest of us, may have had much to do with what it has done.

It is altogether probable that there was a time when eggs, if colored at all, were all unspotted. So far as the present "ground" colors are noted they seem to consist largely of drabs and buffs, and various mixtures (often with these) of blue and green. It can be readily seen how these tints once set up could be intensified till they harmonized with sand, soil or growing (blue-greenish) vegetation. Later reddish browns show themselves in spots. Some low birds in and near the Ostrich group show similar solid hues.

This last may probably indicate some progress in nest building, since these colors better harmonize with dead grass, the use of which in the early nesting season may hint of loose material and therefore of structure.

These reddish-brown spots and all others, as lilacs, lavenders, grays, etc., may have come in as a tendency to the degeneration and breaking up of ground color, in keeping with changes of nesting sites and all other



Least flycatcher. Phœbe.

things noted as affecting egg coloration; especially since, as already mentioned, spottings of the older type, that are deep seated in the shell, are not developed until we get up to the pebble haunters (or shore birds)—a second removal from the ostriches. The faint spots and darker stains on the eggs of the Fowl groups show evidence of being recent, as noted concerning ptarmigans.

Oölogy, however, is not regarded as an exact science, and while its indications are sometimes striking and interesting, confirming other hints of kinship, they must usually be taken, on account of the many influences mentioned, with considerable caution.

Birds' eggs usually differ in shape also, in a general way, from those of the reptiles, which last are nearly always globular or ellipsoidal—i. e., elongated with both ends alike. But birds' eggs, with some exception in woodpeckers, owls and their near kin, always show a true ovoidal shape—i. e., elongated with one end smaller or more pointed than the other. The word oval comes from the Latin *ovum*, an egg, and does not mean an equal ended compressed hoop or ellipse, as is often popularly thought. It has been suggested that this shape is the natural result of the upright position of the bird while the egg is forming, thus making the lower end the larger, but the owls and woodpeckers are the most upright birds in position, and yet they lay the most globular eggs. Another theory of shape is that eggs were so shaped among low birds (from which they now retain their peculiarities by inheritance) by their being laid on flat surfaces without any nest. In order that they might roll around in a circle and not roll away or off of a bluff, etc., one end is made larger than the other. Of course the most pointed egg would be the safest, and hence the tendency would be increased. It is a fact that this style of egg tends to prevail among the flat rock builders of to-day.

Again, it has been found that certain plover forms, which lay very pointed eggs, always keep the three or four in their nest with the points to the center—replacing them when disturbed—so that the narrow breast may better cover them; or possibly, as among some fowl forms (quails) where many eggs are laid, they may be made pointed so as to lie closer packed in two layers. It may be noticed by the reader in the kinship diagram (Chapter XXX) that these pointed eggs, running from fowls through plovers, gulls and auks, tend along a line of strong consecutive kinships.

The pigeons lay eggs alike at both ends, but roundish and much elongated, while the grebes lay likewise equally ended eggs, but both very pointed.

The structure and grain of the shell also bear on the relationship of birds, but this and other interesting things about the development of the egg and its hatching, etc., are beyond our scope.

CHAPTER XX.

WHY TWO KINDS OF NESTLINGS?

Few things about birds are more interesting than the condition of the young when hatched and the various features connected with the duration of their babyhood.

Doubtless all young of the primitive birds were precocial, or hatched with eyes open, with down or possibly coarser feathers, and able to run and forage at once (or very soon) for themselves. Such is the case with the lower birds now, and such exclusively is the case with the reptiles.

Of course it is well known also that the higher birds (usually the smaller) are hatched naked, blind and helpless, and are fed in their nests by the parents for a longer or shorter season. Between the extremes of these and the precocials are all degrees of gradations both in strength and covering—the two last features varying independently of each other.

But the altricial condition has generally the appearance of being the result of premature hatching, and there are a few things that tend to confirm this view of it.

At least there can be little doubt that the altricial condition has come out of the precocial—a sort of degenerate process consequent perhaps upon changed conditions. True, in certain reptiles there is a premature hatching of the eggs within the body, but the young comes forth as perfect as by the slower process of external heat.

In the mammals generally a premature condition of the young at birth is strikingly within the lower forms—as in the marsupials—and its perfection before birth is evidently a later or higher development. Still, since some (such as kittens and puppies) in the higher mammals are much more helpless and blind than others (as pigs and calves), it is evident that the condition of babyhood is even here quite variable, depending upon some unexplained influence. It is probable therefore that some change of habit or environment, by selective agency or otherwise, has effected this change in birds. While we can never know what it was, we can glance tentatively at the problem and note some interesting possible factors of the change.

First, the condition of the nestling seems to depend largely upon the relative size of the egg, both to that of the parent and to that of the young at hatching. Precocial birds generally lay much larger eggs in proportion to the parent's size than do the altricials. But there are striking variations among the precocials for reasons noted later in connection with the number of eggs. Second, in relation of egg size to that of nestling, altricial eggs appear as if they were too small for the further development or perfection of the embryo. This development may depend upon absolute room within the shell or upon the presence of the necessary food for further growth, or upon both. Possibly the latter may be merely a lessening of the proportion of the white of the egg to the yolk, since it is well known that precocial birds have a surplus

English land rails—a typical precocial family—young solid colored, adults striped.

of yolk at hatching, which is drawn directly within the body to sustain the bird till it can provide for itself; but all that of the altricial bird is used up while yet within the shell. Since the white is used up first, it may be a matter of decrease in the white, especially since it is known that the size of the yolk is complete before the white begins to form. All this would imply a more rapid transit of the egg through the oviduct, and hence a greater rate of egg deposition might occur. The result, from whatever standpoint considered, is a smaller egg, which produces a premature hatching and much subsequent provision of food by the parent while the young is yet helpless. Another little fact bears on our hypothesis. In precocial birds the egg tooth (or limelike "pip" on the tip of the beak by which, in hatching, the shell is broken) is shed in a few days after they are out; but in the altricials it persists much longer, showing that the period during which its use was normal was once perhaps much longer or later after incubation first began than now. So likewise the naked and helpless condition hints the same, since the hotbed-hatched megapode (brush turkey), as we have seen, is hatched not only with the ability to run, but passes the downy state within the egg and is able at once to fly feebly also.

What then could have brought about this decrease in the relative size of the egg or change in proportion of white to yolk if such exists? It is a difficult question, since progress of the bird seems to imply a lessening of the relative size of the egg and a degeneration of the nestling. It is noticed in a general way (of course with exceptions) that the relative size of a bird's egg varies with the number in the clutch or with the capacity of the bird to cover many. Often perhaps it varies with both, or one condition may limit the other. The largest egg (for the size of the parent) is that of the *Apteryx* perhaps, and it is single.

The number of eggs in a clutch appears to depend—other things being equal—upon the danger to which a bird is exposed, especially noticeable in many ground haunters. But other correlations may compensate where the eggs are few, such as frequency of broods, safety of perch or haunts, or other peculiar habits, such as in the nocturnal, swamp-dwelling habit of the *Apteryx*. A bird may also, by size or peculiar weapons, be able to defend itself or its nest or it may have special means of escape.

A bird might acquire the habit of laying many eggs while it was yet a ground haunter, which would not be kept up when its progeny became tree haunters; for it can be shown that the laying bird has some physiological control over the number of eggs she deposits for one brood, as we shall see (in Chapter XXVIII). At present most altricial birds are either tree builders or occupy holes or burrows in the earth or under rocks, or else nest on high cliffs or islands inaccessible to their enemies below man. But this start for preserving the race by a large *number* of eggs was doubtless set up before birds acquired such safe nesting habits. While the number of nestlings is now decreased because safe position does not require so many, the nestling itself is still held helpless; for it can be readily seen that where the nest is safely located, a helpless nestling remaining in it till it can fly perfectly is the better condition.

The fact that all birds now after laying the usual nest number have in them yet other little dormant eggs which can be developed to order when needed for replacing broken ones or for second or third broods, is a strong hint that they (or their ancestors rather) may have laid all these eggs at a single sitting. At least there is the possibility of such a thing; and this faculty is largely developed in tree-haunting birds. Many ground builders, however, as our Bob-white, lay great numbers of eggs at one sitting as often as three times a year.

But the mere habit of tree building or other safe nesting habits may of itself be sufficient to account for the altricial condition, except perhaps the nakedness. Those nestlings that stayed longest in the nest would be most likely to be reared; hence heredity and selection would tend to maintain the altricial condition when once started. Few things now are so destructive of little birds as their premature escape from the nest.

Likewise the nakedness may have come about gradually without the influence of the small egg or premature hatching. It is well known that many nestlings that are long helpless in the nest are well covered with down, as young hawks, owls, herons, etc., and that this downy state, as noted in Chapter VI, disappears almost exclusively as soon as (coming up the line of the bird's development) the hole-building, Picarian group is reached (see diagram, Chapter XXX). It does not seem improbable, therefore, that the down has been lost by disuse, because in holes there is no need for it. It is especially noticeable that the young of hole builders in this group are the nudest known. Since the higher birds (perchers) come out of the region of these white-egged, hole-homing ancestors, the naked nestlings in them are inherited and kept from dying or acquiring more down by the extra care of the mother in sitting over them.

Recently some new terms, as substitutes for precocial and altricial have been proposed, which in their translations are more expressive of the real facts than the old terms. The first are called *Nidifugæ*, or nest fleers, and the second *Nidicolæ*, or nest stayers or nest inhabitants. But in further discussion we shall use the old adjectives.

CHAPTER XXI.

HOW SOME BABY BIRDS ARE FED.

It is well known that among the precocial birds strictly there is no carrying of food by the parent directly to the young, but the latter are led and sometimes carried to places of plenty and allowed to help themselves. Often the mother will capture food for them, or partially chew it or break it up and scratch it out, but only in a few cases does she put it directly into their mouths.

When the precocial nestling is hatched it has not used up, as we have noted, all the yolk of the egg which is its food before coming forth, but a portion of it is drawn directly within its body, and furnishes it nourishment till it is strong enough "to pick up a living"; but the naked, helpless altricial nestling uses all its yolk up, and must be fed at once or perish.

It is a peculiarity of many of the low birds that feed the helpless young in the nest that they regurgitate (or throw up) the contents of their own crops or stomachs directly into the mouths of their young. This is especially true of the fish eaters, the cormorant, it is said, being able to digest off the skin of the fish between the place of capture and the nest.

In this respect the petrels go further and convert the fish into an oily substance which is ejected for the young. The baby petrel revels in the delights of a cod-liver-oil diet from the start.

The Pigeon group is very peculiar even among this kind of birds, in that the young inserts its beak into that of the parent and finds there at first not half-digested food but a curdlike secretion, or, rather more accurately, the thickened and "peeled up" lining of the parent's crop. Until the young are about nine days' old this occurs in both parents, as an unexplained physiological result of incubation. Toward the last of this period this curd is mixed largely with the food of the parent, and gradually ceases to form till the youngster finds for his dinner only bread without cheese.

Only among the hornbills perhaps is there found anything similar. Here the male at the nesting season walls his mate into a hollow tree, plastering up all the opening except a small hole. Through this he brings her—and in due time her single nestling—food, which is usually fruit. This is ejected from his stomach—not the crop. In casting it up the entire mass is inclosed in a gelatinous envelope or pellicle, which is a temporary lining of his stomach. The wrapper goes along with the goods, and the little bird and his mother have long antedated us in taking things in capsules. This is a very convenient arrangement. Even in the higher birds this regurgitating habit prevails quite extensively. Some of the most refined, as the purple finch and others, are noted as using it. Doubtless many others will yet be found with this habit, especially while the nestlings are very young. It is only rather recently that our Eastern flicker or golden-shafted woodpecker was discovered practicing this method exclusively. Here the parent drives his long sharp beak very forcibly down the nestling's throat, and, while the youngster holds on for dear life and a dinner, a long-continued wriggling process either pumps the baby full or the parent empty. Both parents feed the young, and both in this instance incubate. But where only the female sits she is usually fed by the male in the same manner that he feeds the children.

While this regurgitation method is quite popular among the Picarian birds, this flicker is the only woodpecker, with us at least, that is known to practice it. Others are seen to enter their holes with food in their beaks, and the redhead frequently sits outside and pounds and pulps the morsel before taking it in.

In case of the flickers, one nestling usually occupies the opening of the hole till it is satisfied, when it drops back and another takes its place. In other cases it seems hard to determine how the parent knows which one she fed last, since all seem usually equally hungry. It is surprising how early the altricial nestling makes this demand for food. In a few minutes after the shell is off it lifts its little head and gapes from ear to ear—the most expressive sign in all Nature.

Even among birds which feed their young in the usual way there are doubtless many interesting habits that would repay study. Thus, swifts and swallows bundle insects under their tongues (literally as a sweet morsel), and after the young leave the nest they are fed upon the wing. By some sign the parent indicates her readiness, whereupon both fly directly upward till they meet, when the morsel is delivered. Robins bunch great masses of earthworms in their beaks, while others, as our bluebirds, carry them singly. In the case of this bird it has been noticed that if the male find the mother within delivering her morsel, he often awaits till she comes out and delivers his to her, much as if he thought she understood this baby-feeding business much the better, and she takes it into the nest.

Closely connected with this topic is the care generally that bird parents exercise for their young. During the time of their weakness there is usually no more devoted mother than she in feathers. With the exception of the female ostrich, noted by Job, this prevails even among the lowest birds; and except among cowbirds and cuckoos in the higher groups, there is no farming out the baby and carrying a lap-dog. Man by selective action has suppressed the motherly instincts in some chickens. But the birds with respect to this have no reason to blush in the presence of "our best society."

The care for her chicks by the common hen is a type of the motherly care of all the fowl forms; and there are no more devoted mothers than the ducks, though they do less for their young because the young can do more for themselves. On one hand (see diagram, Chapter XXX), toward the divers, the grebe forces the young to dive beneath her wings, and a kindred form (the finfoot) flies with the nestling clinging to the plumage. Mother ducks and others carry their young in their beaks or upon their backs to the water; and on this side of the fowls, the woodcock takes her young from place to place in her toe-grasps, at the demands of food or safety.

Hawks, ospreys, owls and others fairly heap food upon the nest around their young. It is well known, of course, how rapidly a nestling grows, and how it often uses each day a quantity of food equaling its own weight. This involves an immense amount of labor on the part of the parent; and it frequently happens that the bird must change its habit of feeding itself and search out a different kind of food for its young—as is the case with the seed eaters, which feed the nestling on worms.

This devotion of the parent first found its highest development in birds. Some fishes, it is true, cared for the young, and some crocodiles, among the reptiles, eject food from their stomachs on the water for their young. But the marsupial sac in the lowest mammals was perhaps a close second, while it is often stated that snakes swallow their young to protect them from danger.

It is interesting to note that the three-cornered duckbill, or *platypus*, is said to voluntarily eject its milk upon the water, whence it is drawn in by the

Pied-billed grebe and young.

young—a case of dilution rather antedating that of the newspaper milkman, and a case of casting bread (and milk as well) upon the waters antedating the precept of the Preacher.

CHAPTER XXII.

HOW SOME GROWN-UP BIRDS GET A LIVING.

While, as noted, some birds give their young food differing from that which they eat when grown, yet the rule is that parent and children fare alike. This is peculiarly the case with fish eaters and necessarily so with the regurgitators.

Our last topic, therefore, leads us into this.

At the time when the ancestors of many of our modern birds all had teeth the diet was evidently not vegetable, but was more likely of fish and other aquatic life. It is probable that either the bird ceased to fare upon flesh or else took to gulping its food whole without chewing. The lowest of birds now—the ostrich forms—are noted for their "most uncommon bolts"; but their wholesale swallowing of hard substances is a necessary consequence of the loss of teeth and not the cause of it. The birds are the first users of artificial teeth, but they shifted them from the mouth to the stomach, and the dawn of the gizzard doubtless came in with the loss of the fang in the jaw.

Flesh eaters, it is well known, have small use for the tough, muscular, grinding pouch, with its pebbles and other triturating things; and in them it is often

Woodcock and precocial young—a mud prober.

a loose sac. We can, therefore, often look into a bird's digestive apparatus and read much of his story. Some delicate traces of ancestry and ancestral habits are written there which are found nowhere else. But they are too technical for the scope of this little book. Some slight reference to them will occur elsewhere incidentally.

Now, in glancing at the feeding habits of some of the birds, the reader is referred to Chapter XXXI, where will be found the groups in an accepted order, and to the diagram in Chapter XXX, where the kinship is indicated.

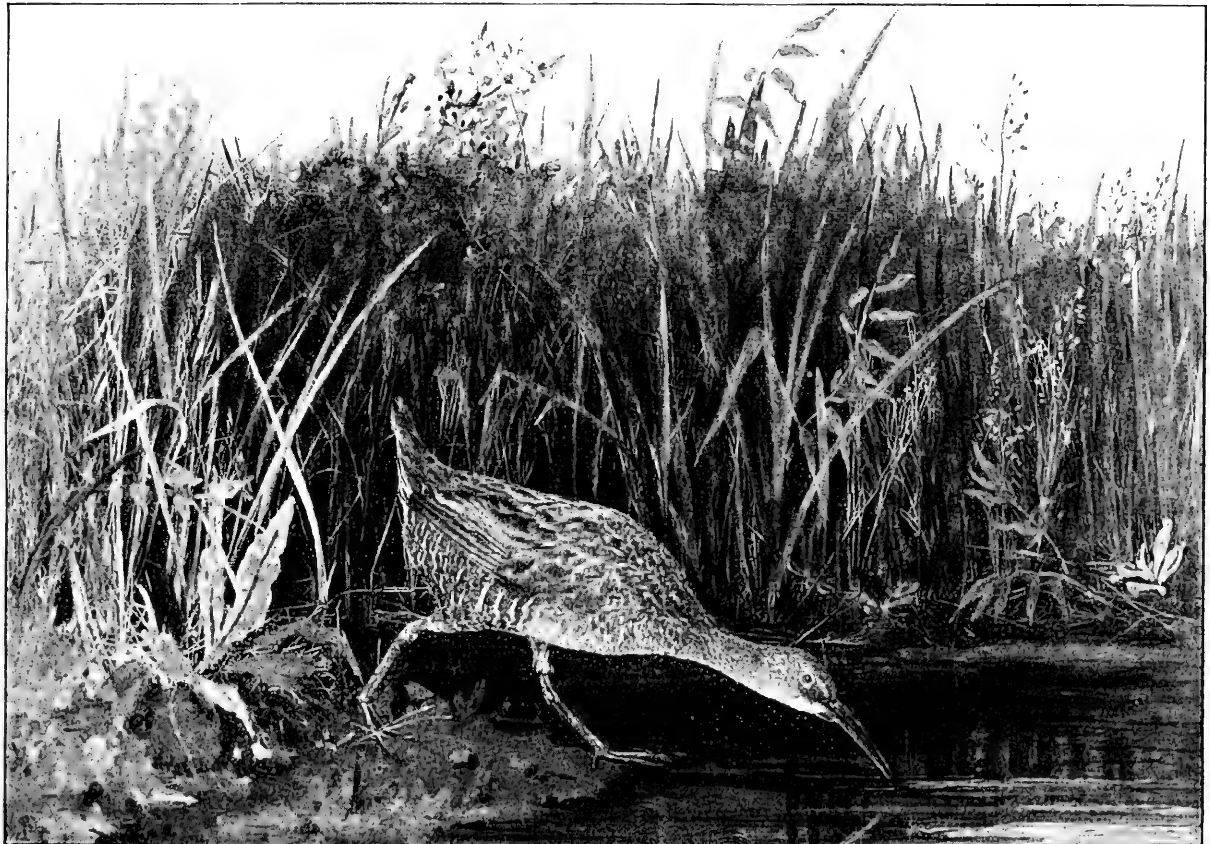
The ostrich forms usually just "pick up a living," and are followed in this respect by the fowls and pigeons. The fowls scratch the earth and its covering, and eat both animal and vegetable findings. But the pigeons do not scratch usually, though placed in the old group *Rasores*, or Scrapers, and are almost if not entirely confined to seeds (with us) and to fruits (in the tropics). Some little seed- and worm-eating birds among the perchers also scratch, but with both feet instead of one, unlike the fowl forms.

One bird, however, among the ostrich forms feeds by probing the soft mud for living things. It has a long, softly tipped beak, with the nostrils directly in the end of it, and surely uses the sense of smell in feeding. It is the *Apteryx* of New Zealand—a small, almost wingless, totally flightless and flossy-feathered bird.

In its long decurved, flexible beak there is a hint of the ancestry (as we shall see later) of all the mud-probing snipe forms. Some of these have the upper prong of the beak so flexible that it can be bent into a hook with which to pull the earthworm out. Many others of them have beaks that are soft at or near the tip to feel with, and all have the nostrils low down and grooves along the beak to allow them to smell. All feed in water, swamps, or rather damp earth, and largely neglect vegetable diet, especially seeds. All except woodcocks have their legs naked above the joint for wading. In this Plover-snipe group there are many peculiar shapes, curves, etc., given the bill in keeping with feeding habits. Some are bent down, others up, and one sidewise to feed around under stones. One is spoon-shaped at the end, and another is flat and thin, like a knife, vertically to probe narrow crevices. Likewise their feet are modified for simple running by the loss or elevation of the rear toe, and by the growth of two kinds of swimming membranes.

Near by their cousins the rails show a stronger likeness to the *Apteryx* in structure, shape, and habit, but not in beak. Their feet are simply spread by the lengthening of toes (but not webbed) that they may walk over scums and slush, but their hind toe is low and clasping that they may climb up reeds also. So important is this arrangement that a form (the jacanas) that stands between these and the plovers, in order to preserve the typical raillike foot and yet get much spread, has its claws very greatly elongated, that it may walk on floating leaves, lily pads, etc. These do not dive as a rule for food.

But on the other side of the rails are the galli-



Clapper rail.

nules, which are more aquatic, have swimming membranes on their feet, and while vegetable feeders to some extent they dive for food; and beyond are the grebes—divers almost strictly with legs set far back for it, but rather shallow water haunters. Beyond still are the loons—often called divers—which haunt deeper waters and live on fish only, being able to fly under water, and actually pursue and capture the fish. Further waterward still are the auks, with very short wings and habits that keep them always at sea and rarely in the air except when migrating. Further on this aquatic trend finds at the south pole its extreme in the penguins, whose wings have lost their feathery form and appear as fins, and flight under water is all that is left to them since flight in the air was abandoned. They are almost helpless afoot on land.

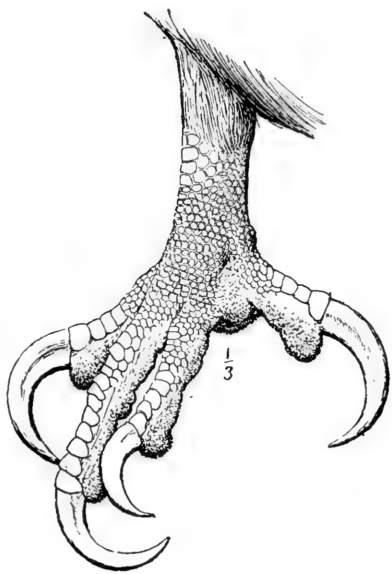
More landward from the grebe-loon region starts the geese, ducks and swans. Some (sea) ducks dive exclusively for fish, and have teethlike notches in the edges of their beaks; other ducks and the geese haunt the edges of the water where it is shallow, and have strainers on the margins of their flat scooping bills to let the water through and yet retain the small animal creatures. Many eat vegetable green parts and seeds also, and some geese graze almost exclusively and have long legs—a sort of storkward or waderward hint. The swan develops the long neck for reaching from the surface, and the flamingo has both long legs and neck and retains a strainer beak, but, unlike the goose forms, the beak is bent down, and he uses it upside down, as if standing on his head. He has the fringes, therefore, on the upper prong of his bill. He is a connecting link in feeding habits between the geese with long legs, the swans with long necks, and the waders which have both, but omit the bill fringes.

Now, lying near all these short-winged divers, and also stretching out on one edge toward the plovers and on another toward the storklike waders, is a group of divers that fly well. The gull forms, which are most ploverlike, feed much awing by picking up from the water's surface floating things. They swim on the surface, rarely diving deep. Some of them pursue other birds that have prey, rob the fish out of the pouch of the pelican and are freebooters generally. In many respects they have the spirit of the birds of prey. They dart also upon fish from above, and one plows the water in flight with a knifelike beak in hopes of running through a shoal of fishes.

In them flight has found a high development. Occasionally terns feed over the land, darting gracefully down, seizing a worm, etc., tossing it into the air and catching it again—all without alighting. The petrel forms feed similarly, diving slightly, and are the most exclusively midocean haunters of all birds.

Some of the Pelican-cormorant group feed by diving from the air on to fish beneath the surface, as gannets, and others by pursuing the fish beneath the surface, as the cormorants. They are wonderfully cushioned with air spaces beneath the skin to resist shock in striking the water, and most of them have a sack below the bill to store fish in or to act as a scoop or net in surface fishing.

Now, running toward the plovers in one direction, toward the rails in the other, toward the geese forms in a third, and the pelican forms in the fourth, with some bird-of-prey tendencies in the fifth, is a group of birds known as waders, composed of two orders—the crane forms and the heron or stork forms. These two do not show such strong relationship except in feeding habits. Both are usually characterized by long wading legs "with the pants rolled up high," and long, narrow and sharp-pointed beaks for spearing and reaching deep into the water. They often thrust the beak unopened into the prey. Some heron forms, however (spoonbill, ibis), have a spoon-shaped bill, bent bills, boat-shaped bills, etc., in keeping with their habits, and the beak is also varied in the crane forms. One of these, the *seriema*, has a hawk-shaped beak. We can not dwell upon the peculiarities of the feeding of these groups. Some of the forms, as storks, are almost exclusively upland.



A typical seizing foot of the bald eagle. (Chapman.)

The seizing claws and tearing hooked beaks of all the birds of prey render their method of feeding well known. Here is the first use of the foot as a prey-grasping member, and here comes in the first tendency among the birds to prey on each other. This, however, had prevailed long ago among the lower creatures, and in the land-haunting reptiles that show nearest kinship to birds there were evident modifications for preying upon each other. In these cases the rule is that the prey is captured with the foot and usually killed with it. The most terrible armament of talons prevail and a remarkable development of strength of grasp. The hook on the beak alone, with the jaws closed, is frequently used to lay out a victim, as the lion uses his unsheathed paw.

Some of the low forms of this group, as the carrion vultures, are not so well armed. Indeed, they scarcely have a foot fit for grasping. They are wonderfully endowed for soaring flight, keen sight and scent, depending mostly upon the former two. From these run all gradations to the true falcons which eat nothing that they slay not themselves, and rarely attack a sitting object. In them is found not necessarily the highest form of flight, but its best form for darting upon a victim. Perhaps in all Nature there is nothing so fine as an exhibition of skill and daring as the swoop of a bird of prey, though there is no comparison in bravery with the attacks of some mammals.

The owls are usually night prowlers. They are endowed with large eyes and soft flight by means of specially shaped, recurved feather tips, so that they may noiselessly steal upon their prey. The ear is also so shaped as to gather sounds from below. They are not, as a rule, so cannibalistic as the hawks. While the larger catch fowls, the smaller owls subsist mostly upon small mammals.

Of course, it is well known that the osprey takes fish exclusively, grabbing them with its feet. Both

Peregrine falcon, the most skilled bird of prey.

it and the owls have the outer toe well spread backward to increase the certainty of grasp—a sort of shotgunlike arrangement that a skilled marksman as an eagle or falcon would disdain. Kites are large consumers of snakes, eating them as they fly, and the secretary bird makes war upon them also, striking them down with its spurred wings.

CHAPTER XXIII.

TOOLS AND TASKS AMONG THE BIRDS.

We may look at this question of a bird providing for its comfort in a more philosophic and helpful way than that of simply narrating the kind of food and the feeding habits. We see in many groups a general type of beaks all adapted to similar uses, as when all birds had teeth; but when birds grew older they branched into some forms with tools very peculiarly shaped (specialized) for specific purposes. Thus the beak of the *Apteryx*, already noted, is very different from that of its fellow ostrich forms.

Now, we can never know whether the ancestors of this bird, by some sudden and extensive variation, were endowed with a longer beak than the usual clap-trap shape of the others and *then* took to prodding with it, or whether it took to prodding first with an ordinary beak and by the slightest favorable variations developed the present shape. This latter case would be an instance where the usual natural-selection argument would prevail, as follows: The bird having the longest beak would prod the deepest; the one with the slimmest, sharpest beak would thrust the quickest; the one with the most sensitive beak would feel the surest; and the one having the nostrils nearest the tip would smell the best. Hence in the struggle for existence in the ancient swamps the birds that had all these fortuitous combinations would most likely survive and be the ancestors of other fortunately endowed birds. But this view does not at all account for the reason why one of these good qualities does not develop beyond the other; why the long bill might not be better than the sensitive bill, and why feeling highly developed might not suppress smell. There is what is called a "nice correlation" of all these factors here that mere selection does not account for. Neither can the effects of use only account for the change, since there is surely nothing in the act of prodding that would tend to make a beak slimmer and softer—in fact, just the contrary. There is then in the making of this tool other forces that we know not of which nicely balance all these shaping factors to a certain end, as if a Great Power of Purpose throbbed beneath them all.

Nevertheless it can in most instances be shown that all forms of organisms have been brought about gradually, and we can frequently see many of the developing forces; and in our present discussion we may perceive how the tool has usually been adapted to the task. Some species of *Apteryx* have shorter beaks than others. Thus the change in the style of feeding or the nature of the food at hand may have set up the fringes on the bills and tongues of ducks; the pelican's rear toe was webbed forward with the others (from an evident condition when it was once free and opposable) at the demands of better swimming, and the flamingo's bill is bent down and fringed on its upper prong only, not that he *should* feed as if standing on his head, but because he did do it.

All these cases partake of the same nature generally as the development of the bird's wing: not so much that it *might* fly as that it *attempted* it. Nature does her best for any creature in its chosen environment. If the snake insists on wriggling instead of running on legs, she takes away the useless organs, and adapts the creature by alterations and neat adjustments of other parts for his new mode of motion. If creatures haunt caves, then useless eyes go; if they ride on others, they lose legs and wings; and if they haunt the stomachs of others, they may even lose their stomachs.

But there are other instances where the task seems to come about because the tool is ready at hand. Certain habits are set up because the ability, capacity or means for practicing them are present. Thus the practice of the vultures, petrels and other organisms in ejecting disgusting food for defense is the result of the capacity for doing it, which is purely incidental to their manner of feeding.

So likewise a creature in a new environment may carry with it an old tool of some ancestor, which was quite useful in the former state for a certain purpose, but may remain for a while or forever a useless vestige in the present. Again, it may be used here for another purpose and retained in this new capacity; and its presence may set up new habits. Let us glance now at the feeding habits of a few higher birds in this light.

Next after the owls (in our arrangement at Chapter XXX) come the parrots. Some systematists think them akin to owls, as shown by the white egg, reversed outer toe, hooked beak, etc., common to both. Now, if the parrot inherited these from the owls, he uses the toe arrangement not as a grabber so much as a hand to hold food in while he eats, and the hooked tip of the beak is not a tearing instrument, but a means of preventing substances from slipping out while being ground against the filelike surface in the roof of the mouth. Evidently this bony file is a development depending upon the hook, a case where an old tool in a new use provokes others. Still, this old tool may cause its own use, if the old conditions should prevail. When sheep became abundant in New Zealand a certain parrot left off fruit eating, and with its hooked beak dug holes in the animal as effectively as did ever any eagle.

But another new use of hooked beak and paired toes may have kept these tools present and useful in the parrots, and set up the new habits of climbing and roosting by them.

The case of the paired toes in the cuckoos is much more difficult. They are not close akin to owls, and it is likely that other conditions have brought this arrangement about. Their near relatives (and probable ancestors) are the plantain eaters—fruit eaters by name and habit—but our cuckoos are mostly caterpillar consumers and spider eaters. That, since acquiring paired toes, their habits have largely changed is shown by some of them, as road runners, taking to ground haunting—a condition where two toes in the rear is really in the way, since the best-formed birds for running either lose the rear toe or have it small and much elevated. The cuckoos' remote ancestry runs by the way of the trees doubtless where paired toes were useful in clinging.

We will dwell a little upon the interesting group of the woodpeckers and pass on more hurriedly, for we can not discuss all the peculiarities of these very remarkable birds.

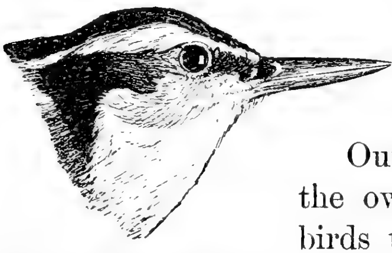
In the woodpeckers there is a wonderful series of specializations or modifications of the usual tools in keeping with an upright position on a tree trunk and the habit of digging into it. The outer toe is reversed alongside of the rear when at rest, but in use it is often set out horizontally, ready to pull the bird suddenly around the trunk. It seems as if its reversion might have come about through its use in this way. Evidently it is not now needful in limb clasping, since few woodpeckers sit across small limbs; neither is it necessary in climbing as the woodpecker climbs—a well-known method, very unlike that of the parrots. The ordinary type of foot is as good if not better for simply ascending a trunk, as seen in nuthatches, brown creepers, etc., which are more agile on an upright surface. Besides, the typical foot for simply clinging to rough upright surfaces has all the toes front, as seen in some swifts. Some woodpeckers even have the true rear (or inner back) toe

Hairy woodpecker. Yellow-bellied sapsucker.
Note the side reach of reversed outer toe.

gone and the outer reversed in its place. It is not improbable that this true rear toe disappeared in these birds by disuse because of this constant upright posture, and that the outer is there because of the dodging around habit. Later habits of occasional sitting across limbs have prevented the rear toes of others from going, and have given the outer toe also a limb-grasping use. In keeping also with this upright posture the tail feathers are stiffened and spinous at the tip, to aid in supporting the body.

The great specializations in favor of these birds, bearing directly on feeding habits, are the strong chisel-pointed straight beak and the long protruding, horn-tipped and barbed tongue, especially covered with slime. The beak is also much stiffened, and the tongue, besides being slimy to hold the grub, is so set that it may be darted *far* out with great force to pierce it. Our flickers feed on the ground partly, digging for ants and using the tongue for capture, and the near kin of the woodpeckers, the wrynecks, pick up all their living this way. If the woodpecker change his habit his beak may change with him, since the earth-digging flicker's beak is not especially chisellike, but sharp pointed and curved down.

Nature may compensate by special habits for many deficiencies of special tools. The imperfection of a tool may set up a new task or lighten one. To illustrate: Both woodpeckers and nuthatches nest in holes. The former opens his by splintering all the wood into a solid tree away, but a nuthatch with his poor beak makes punctures in a circle, and cuts a bung-shaped piece out of the side of some cavity; the woodpecker rarely uses a knothole for a beginning; but the nuthatch (European) may plaster up with mud a (too large) natural opening or (American) enlarge one to suit.

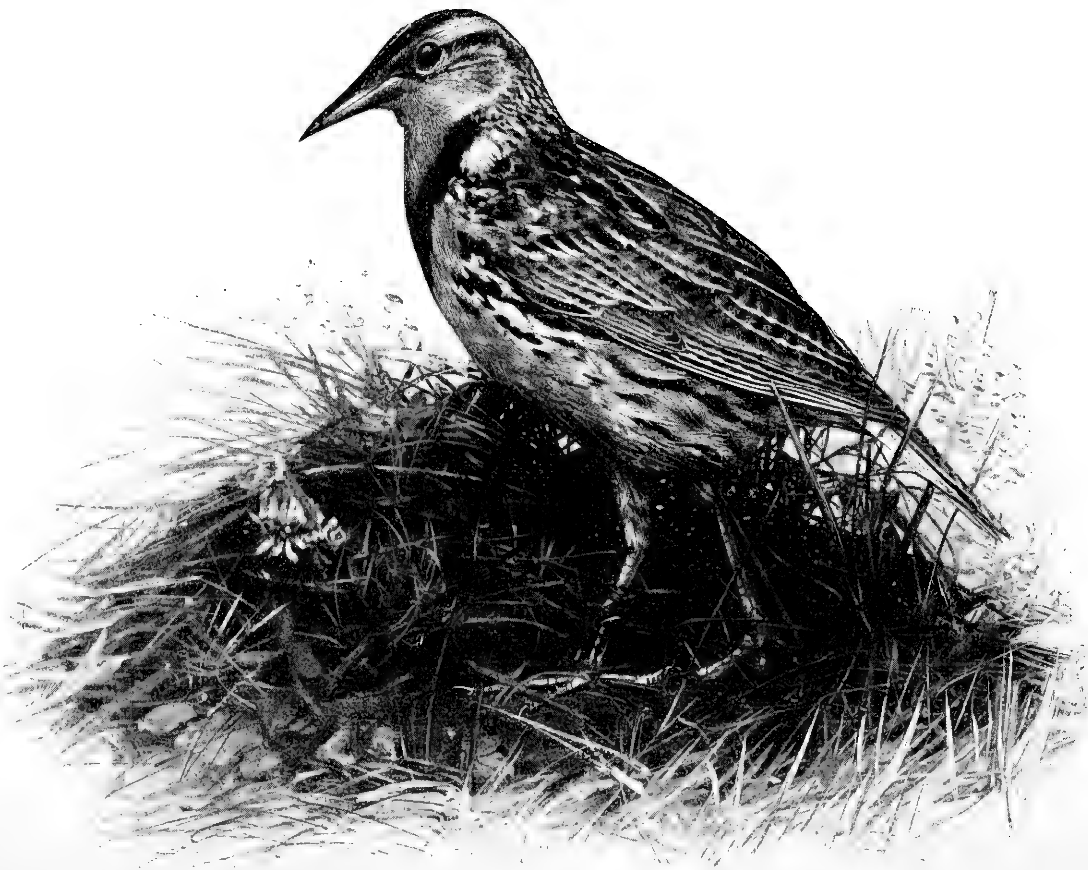


The head of nuthatch.

Out the other way, beyond the owls, runs another group of birds that are mostly insect eaters, flying by night usually, as the whip-poor-will, night hawks, etc. Some of the lower forms, like the owls, eat mice, but normally they are all provided with broad deep gapes, and some have hairlike feathers on each side to broaden their aim in catching flying things in the gloom.

Close akin to these are the swifts, with similar habits by day, and out from these, with similar wings, comes the hummingbirds. These get a mixed diet of insects and honey, and doubtless got their humming habits because flowers were too weak for them to perch upon. In them the beak, like that of the *Apteryx*, has gone from the widest in their ancestors near the swifts to the slimmest known in Nature, so as to pick out the gnat; and the tongue has grown long and fringe-tipped to lap up the nectar, and is thin and membranous on the edge that it may be rolled into tubes to absorb it.

Other members of this Picarian group feed upon fruits and small animals, and have various interesting habits. The kingfishers, as we know them, dart



Meadow lark.

down upon fish, but many of them in the tropics feed on insects. There is in this last division of these birds a peculiar tendency to have an abnormal bunching of the toes or to be deficient in the number of joints; and they nearly all have weak legs. This all comes about doubtless by the little use of their feet while feeding, drinking, etc., so much upon the wing. The trogons have the *inner* toe reversed.

But we must pass on. We can touch only upon the more interesting phases of feeding among the true perchers or *Passeres*.

Of our American birds the lowest of these in our arrangement is the flycatcher family, of which our kingbird, phœbe, crested flycatcher and wood pewee are types. They take their food mostly flying, and have broad flat bills with outlying bristles. Some birds, as woodpeckers, nuthatches, etc., with slim beaks take flies also awing.

The crow forms, including jays, blackbirds, etc., are well known to be omnivorous, with a taste for eggs and nestlings, sprouting corn, etc. At its finchward margin is the meadow lark, a digger, and the orioles that hang at the twig tips in search of gnats. All are really useful to the farmer and horticulturist when taken the year through. More finchward are the cowbird and bobolink, with stout short seed-crushing beaks, and are evidently connecting links.

The finch forms (including sparrows, buntings, grosbeaks, tanagers, towhees, etc.) have usually a strong crushing beak, often with cutting edges (as the cardinals), and are typical seed eaters, but their diet is by no means strictly vegetable. Towhees scratch in the leaves for grubs, wagtails haunt the edge of swamps for little living things, and the honey creeper feeds on juices and nectars.

The warbler forms, into which the finch forms grade, feed variously also, but they use little vegetable matter. Some have ground-haunting and even swamp-haunting habits, others have fringed tongues hinting of juices and nectars, while tree-trunk exploring, as in the creepers, nuthatches, titmice, etc., also prevails.

The vireos or greenlets are strictly arboreal and, having a hook on the beak, they have been thought by some to lead toward the butcher bird or shrike, which has many of the habits of a bird of prey. Its only endowment that way is a strong hooked beak and muscular build. It usually kills little birds by piercing the brain or snatching off the head or unjointing the neck at the head, and it is so expert at it that the motions can not be always perceived—the act being even sometimes accomplished while both birds are flying. Its food also is mice, grasshoppers, etc. It has the habit of impaling its victims on thorns, apparently as a feature of storing or hoarding.

The wrens appear akin to the warbler forms *via* the wren-tits, and are almost exclusively insect or grub eaters, sometimes tackling spiders also so large as to make quite a battle.

Thrashers also eat fruit in season. Bluebirds in the thrush forms eat fruit in winter only, but the robin eats anything. The other thrushes confine themselves more to an insect diet.

Here comes in again a striking example of how habit may precede structure—the task outrun the tool—as exemplified by the dippers or water ousels. They stand on the border where the wrens merge into the thrushes and have no external endowments that are not possessed by either, and yet they are as aquatic almost as a duck. They not only feed on the margin, but they dive into rapid streams, walk on their bottoms, and swim against their currents by a fluttering of the wings. It shows what a strong will may do in spite of special tools. The only effect thus far that these habits and new environments have had is to thicken the down beneath the feathers. When the bird wishes to fly it simply shakes the water out of its plumage and is gone much as a wren goes.

Above the thrushes we have no American birds. There are some Old World caterpillar eaters, and a peculiar group of flycatchers, with the usual shaped beak and gape. These are thought to stand near the thrushes, and near to these last perhaps stand the swallows with their swiftlike shape and habits.

We have seen enough to feel that while a bird in his way of getting a living may differ widely from his near associates, yet he may show as he eats his feathered social status and hint the story of his development in the use of his knife and his fork.

CHAPTER XXIV.

HOW A BIRD GOES TO BED.

Sleeping follows eating as a necessary consequence in many animals, and our present topic is not so far removed from the last as it might appear. Of course, young altricial birds are always abed till they can fly, for the nest is not only a *typical* cradle, but many that are built on bough tips or hang suspended are literally such. The purpose of their location and style of structure was not to rock the nestlings to sleep, however, but to provide for them safety by putting them where an enemy could not easily get to them. Thus must the facts in the case dispose of the sentiment.

But precocial nestlings must go to bed, and "as a hen gathereth her chickens under her wing," so is the usual procedure where the parents literally put the children to sleep. Later, when too large for this, the young crouch on the ground around the parent or fly up to roost near her.

Only a few birds are so social as to sit in the compact clusters seen in our Bob-whites, where with tails inward they all actually touch each other, with a head out every way for watching and for easy escape without interference. Floods in the wooded bottoms may compel them to roost in trees, however. Our Western partridges nearly all roost in trees.

We should at first have mentioned that all the ostrich forms roost squatting on the earth. Only the *Apteryx* (*kiwi*) among them has a rear toe, whence there is little hope of perching. But this bird rolls itself into a fluffy ball with scarcely a sign of neck and head or beak apparent. But the ostrich proper squats peculiarly, and leaves his form and long neck projecting high. The cassowary, however, sits humped in a very awkward way upon the tarsi (lower part of legs) and end of his tail, as if he would like to get farther down if his stiff joints would allow him.

All the pigeons and fowl forms roost with their breasts flat down upon the perch or surface beneath them. All the former roosts in trees or holes, perhaps, having a good perching foot. Grouses usually sit a little apart from each other on the ground. When the snow is deep each may make him a kind of burrow in the drifts in winter.

One branch of the Fowl group has a very good, long, low down rear toe like a pigeon, and are quite arboreal—some of them, as the curassows, even nesting in trees.

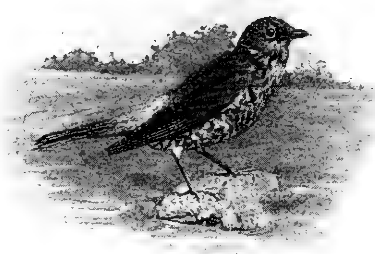
Many of the oceanic water birds roost on rocks at regular places, others on the water doubtless, and some, as the petrels, albatrosses, etc., must be able to sleep a little while flying or else do without sleep for considerable periods, since they have been known to follow slow-going vessels for great lengths of time.

The Goose-duck groups sleep sometimes floating on water, often squatting at its edge. Sometimes they may squat simply on the feeding ground in fields, but usually they have favorite couches, at least during the winter season, to which they will travel—often after dark—as much as a hundred miles, coming back next day to a favorite larder. There are some exceptions to these methods.

The plovers sleep variously, but all out of trees of course. The waders generally sleep standing—usually on one leg, since one is found often much stronger than the other. Some are said to have a locking mechanism to prevent the joint bending while asleep. Storks, however, rest in a squatting position at times. Many ducks and geese also rest standing on one foot with the head under the wing. There can be little doubt that many of these birds have sentinels that watch while others sleep. All birds, however, are light sleepers and are apt to cry out or fly at the least sign of danger.

The birds of prey have the peculiarity of roosting standing on both feet, never allowing the body to touch the perch. In the great capacity of their tendon arrangement for grasping, a crouch brings, perhaps, a painful tension on their toes, or they may inherit their standing tendencies from heronlike ancestors. Most birds above them in the Picarian group (that perch) have the breast down, and all the *Passeres* roost thus. Near the fowl forms (practicing this) is that singular bird so frequently mentioned, the hoactzin (pronounced *wah-zeen*) of South America, which is specially adapted to this habit by having a callous bare notch in its breast (and breastbone) which fits snugly over a small branch. Many mammals, as camels, etc., have similar callosities (bare, hard places) to lie upon, but this is the only bird that "takes up its bed and walks." This squatting position is especially helpful to birds in automatically clasping the limb when asleep, since these tendons in running around the outside of the (then) Z-shaped legs are incidentally tightened by it.

It has been usual to note that birds have a special muscle (the ambiens) whose sole purpose is to so automatically render the toes clasping. But since it flexes the inner and middle toes only and has no effect upon the hind toe, its use in connection with roosting is not striking. Since it is not found at all in the true perchers (*Passeres*) and is found largely in low birds, many of which do not perch, it likely has (or has had) more to do with swimming than perching.



A fieldfare.

Picarian birds, which nest so largely in holes, are apt to roost there; but it does not always follow, as has been broadly asserted (Burroughs), that a bird always roosts in the same kind of place in which it nests. This is contradicted in turkeys, Western quails, house wrens, and White, of Selborne, notes that while the fieldfare nests in trees it sleeps upon the ground. It is of course well known that some parrots suspend themselves head downward from boughs during sleep and that others sleep hanging by the hooks of their beaks on the insides of cavities. Swifts and woodpeckers sleep in cavities usually in the upright position, braced by toes and spinous tail feathers.

Lodgings for the little birds.

As noted, the *Passeres* all sleep sitting, though some squat on the ground. It is not possible to attempt here the roosting habits of all such as are known even, and some general statements must suffice.

A rookery.

Under the edges of hay and fodder stacks, in dense cedars or other evergreen trees, in the midst of dense dead leaves still clinging to their branches, at tangling intersections of bare vines and in any place where there is the combination of concealment and the scantiest protection from wind or rain, you may expect to find a little feathered sleeper. Sometimes these places are used only once, and again they may be resorted to for a few successive nights or for all winter. It may be noticed that if you simply scare the bird away from his couch in passing, he will resume it when you are gone.

Of course, some birds, as rooks, crows, many sea birds and others, have definite rookeries, used for long periods. Even our blackbirds show their kinship crowwards by their selection in late summer of a constant location for sleeping. But many others lodge—tramplike—wherever night overtakes them. This is necessarily the case while migrating, when birds stop at night.

Birds go to bed in various ways, and even in the same tree select different locations on different nights. Thus, turkeys seem to deliberate a long time about flying up, and blackbirds sit around and seem to quarrel a long time about favorite berths, but a house wren jumps into a tree crotch like a boy into a cold couch, has his head under his wing, and is asleep in ten seconds.

Quails and grouses sometimes walk to their couch and sometimes fly to the region of it with a low, soft, noiseless flight, that their enemies may not hear them or be able to trail them.

Besides the placing of the head under the wing practiced by many birds, many small sleepers make special dispositions of their plumage as a sort of night robe. They usually fluff it up till their shape is much changed. It has been asserted that this is done to prevent their heat's radiation, but it is more likely a simple protective measure whereby the appearance of the body is made quite unbirdlike at least, and often very like a knot on the limb. A few birds feel safer on a bare perch where they can see around well, as turkey vultures and others.

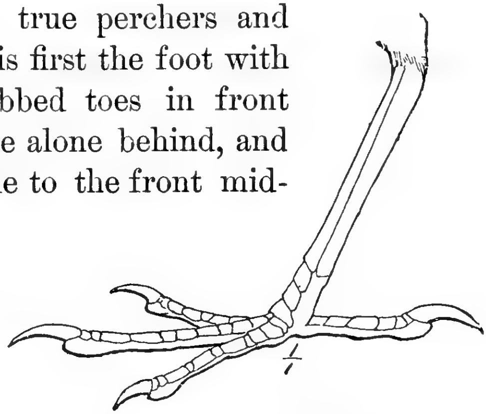
CHAPTER XXV.

A LITTLE TALK ON BIRDS' TOES.

We have seen already that a bird's toes are largely connected with its feeding habits, and we have discussed rather specially those of the birds of prey, the parrots, cuckoos, kingfishers, swifts, etc. Others that are equally interesting we have not noticed.

Let us outline the usual arrangements of the toes, using the old terms that were once made so much of in classification.

To begin at the true perchers and go backward, there is first the foot with three perfect unwebbed toes in front and with the rear toe alone behind, and completely opposable to the front middle one. It is quite likely that the earliest birds had a foot something like this, though not so complete in all its parts. It may have come on down to the present unmodified, but there are some hints from the study of its tendons



Foot of robin, a typical percher.

that it is a modern development. This we shall see is suggested by some other things also.

The next style of toe arrangement is the SYNDACTYLE foot of the Kingfisher group, with inner and middle front toes sheathed together in a common sac up to near the tips. (See illustrations to Chapter XXXI.)

The ZYGODACTYLE toes of parrots, woodpeckers, cuckoos, etc., are paired or yoked, two behind, two before. The outer is usually reversed, but in the trogons it is the inner—a more natural arrangement. There are variations and gradations in each of these two divisions. The owls and osprey have the outer toe capable of either a forward or backward position, and this toe is said to be "versatile." Some abnormal deficiency in the number of joints lies on the border of the syndactyle arrangement found in some swifts and kingfishers.

The next peculiarities come in through the various arrangement and extent of the swimming membranes. Even in the high birds there are some hints of the presence of these, and in the birds of prey as we go down they are quite evident as small webs at the base of the front toes; so also in pigeons and the fowl forms. But it is as we approach the aquatic birds that we find their development useful, although some of these have toes as destitute of them as a finch.

Perhaps all birds swim a little when they drop into the water, but often many of the perchers persist in wing-flapping and merely float. But a baretoed wader will swim gracefully at once, and a fowl form is near enough akin to them to strike out very boldly for a few minutes.

There are various gradations of the extent of the web along the toes or the fullness of its front margin between them. When it comes only half way up or thereabout on the front toes only, the foot is styled Semipalmate; when it extends to the claws (though it may be cut back much between the toes) it is simply Palmate, and when there is a membrane between all the toes, binding even the rear toe forward with the rest, the foot is said to be Totipalmate, as seen only in the pelican forms. Some ducks, however, have a thin membrane hanging to the opposable and elevated rear toe, seemingly much as if it had been torn loose from the totipalmate form.

Then there is the swimming foot that is slightly palmate at its base, but has flaps upon the margins of the toes, as in gallinules, grebes, phalaropes, etc. In some of these the membranes are distinct, for each joint of the toe is lobed, while in others, as the grebes, the membranes are nearly straight-edged. In grebes the rear toe has also a membrane. This style of foot has the appearance of a palmate foot that has been split down part way between the toes, but it is much more likely that these membranous margins have been developed up.

In fact, all swimming membranes are likely but simple and often recent developments of the skin on the margin of the toes necessarily flattened beneath by the bird's weight. As they appear to be easily acquired and lost, it is not improbable that they have been at times more extensive or less so in the bird's past history. Even some dogs acquire them while others have not, and they are so easily influenced that some dry-land amphibians put them on at the social season when they go into the water and shed them when they leave. Many birds, as our Northern grouses, expand the same margin into a fringed snowshoe to use in winter to broaden their tread, and they shed it again in summer. A close study of webs is therefore interesting as bearing upon the history of the bird's recent habits, but we can not follow it further here, except to say that since webs may come and go so easily, it is not at all probable that any bird inherited a webbed foot from any reptilian ancestor. So far as we can now see, it is more likely that most of the modifications of the feet for special uses were made within the birds by their own peculiar habits.

It is true that the reptiles' feet were also modified for similar purposes, showing how sensitive to use and environment the foot has always been. We have seen that such reptiles as walked upright (bipedally) had birdlike feet, rather like those of the ostrich forms of to-day; and it may be possible that tree-haunting habits had given some of them, that were immediate ancestors of the birds, opposable hind toes for limb grasping, just as the toes of the chameleons are bunched for this purpose, and as the first toe of some low mammals, as opossums and others, is opposable.

The bird's foot, however, shows every indication of being based upon the type of that of the lizards.

In these last there are normally five toes, all placed forward. The first and fifth are shorter than the others, and doubtless in the three-toed foot it was these marginal toes that were gone, just as ~~the ostrich and~~ many mammals of to-day have lost those on each edge of the foot.

Now, in the lizard's hind foot the first toe has two joints; the second toe, three joints; the third toe, four joints; the fourth toe, five joints; and the fifth toe only four joints, as in the third. The bird omits the fifth toe, but its remaining four run exactly in the same order as to number of joints as the first four of the lizards do.

If we did not consider these things we could not see why a bird now should seem (by the greatest number of joints) to have its outer toe the most prominent, when it is usually its third or middle front toe, which is really the longest, strongest and most useful. The extra number of joints in the outer toe is simply a vestige of past prestige when this digit also was more centrally located.

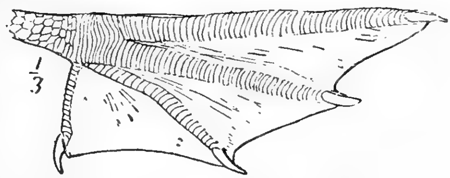
If we glance at a bird's wing or a fish's fin (even in pictures), we see that their long tips are always on or near the edge farthest away from the body. Flying and swimming strokes are made more effective by this arrangement, because the outer edge moves most and fastest. Hence, at a time when lizards were aquatic and a toe, like the ray of a fin, was simply an instrument to hang a swimming membrane upon, the outer was necessarily the longest, and this was manifested in the increased number of joints.

But we shall see in the next chapter that when sudden spurts of speed are required by fluttering in a fluid as air or water, a shorter, rounded fanning member is demanded. Hence, in keeping with safety, the fin, foot or wing has had its outer rays, toes or quills shortened. Now we can, therefore, see how the *next* to the outer toe in lizards became the longest, and how when the shorter fifth was lost in the birds they were left with their outer toe having the greatest number of joints.

It is evident, however, that neither limb clasping or walking on a flat surface would have any tendency to preserve this prestige, but would tend to develop the middle front (or third) toe into the stronger by its greater use in its central position. Hence, we find its joints (though only four) usually lengthened and enlarged in perching and walking birds, until it is decidedly the most prominent. This same tendency to strengthen the middle toe (horse) or pair of toes (cows, hogs) and to lessen the size of the outer, or abolish them altogether (horse, antelope), is strikingly seen in many mammals and is an interesting study.

Among the diving birds of long ago and in some low aquatic birds now the use or need of this outer toe to make a backward and outward paddling stroke more effective has brought out again the prestige of this outer five-jointed toe, and it is here not only the longest, but very much the largest in some cases—a possible instance of redevelopment when an old tool is used at an old task in an old environment.

In the leg, above the bird's toe, are many interesting things that bear on their story, but we can only glance at them. Beyond what in them seems to be the ankle (though really at the knuckles in our hand) the bones that were separate in the reptiles are fused together to form a stiff, slim, light, swiftly moving shank (tarsus), a condition brought about in most other creatures at the demands of speed afoot. So also in most birds, except penguins (and in an occasional specimen anywhere), the smaller bone (*fibula*) of the next joint (drumstick) is partly gone or much fused to the other (*tibia*). Since the reptiles and *Archæopteryx* have this bone complete and separate, it seems hard to resist the impression that this arrangement also was brought about for speed while running, and that all birds except penguins have come from ancestors that once became terrestrial after having acquired flight. There are some other things that bear in the same direction, but we shall have to forego them.



Foot of cormorant—a typical diver—showing prestige of outer toe.

Returning to the bird's *toes* in this connection, it is evident that the rear or first one, when lost, is always lost in connection with terrestrial or at least nonperching habits; and so far as we can note its gradations, it always tends to be opposable and elevated before going.

Perhaps in nothing about a bird's toes lies more of its history than in the tendons that flex each one of them, and in the various interlacings, fusions, splittings and crossings that they exhibit in various groups. In the feet of the five-toed lizards one great flat strap, with a little splitting up in the most regular order, bent their toes all by a common pull, but in the birds there began with the separate use of the opposable first toe a series of changes and separations, reunitings and resplitting of strands, till in the true perchers the hind toe appropriates to itself the sole use of a distinct tendon. When some swifts put all their toes front, Nature gave them again something similar to the flat strap of the reptiles, even upon the very border of the *Passeres.*

Thus we can see how there lies yet largely unread in the arrangement, the webbing, the jointing, and especially in the arrangements for bending, a large chapter of the story of the birds.

CHAPTER XXVI.

THE WAY OF A BIRD IN THE AIR.

We have seen that perhaps the first flight of the bird was sailing down, and that it likely first developed a wing adapted solely to this sort of flight. But when flight came in perfection, and birds began to depend upon it as a means of motion and escape, the wing must be shaped for getting *up* also, and getting up quickly, to avoid an enemy.

There can be no doubt, therefore, that the wing has undergone many modifications, being shortened or lengthened, widened or narrowed, concaved or flattened (beneath) and variously outlined to suit the habits. Here, again, the task has shaped the tool.

We have seen in the last chapter that all birds except penguins show evidences of having once been terrestrial, using the leg so much that the wing set up a tendency to degenerate or shorten. This resulted among some fossil forms in complete loss of wing and in various grades of degeneration. Some doubtless retained the use of the wing to a small extent in true flight. Out of these latter have likely come the low short-winged birds which we now find so near the ostrich forms, as the fowls on the dry land side and the rails on the aquatic. Some of these latter have such poor wings that it has been believed by some unthinking folks that they turn to frogs in the fall instead of migrating—a theory on a par with that which formerly held that swallows hibernate in the mud of shallow ponds.

A redevelopment of the wing as some of the birds took more to flight again has probably given us, out of the region between these two short-winged groups, such long-winged birds as some of the plovers, all the gulls, petrels, pelicans, and some others. The fast hawks, the swifts, etc., have also shorter winged kinsfolk, out from which they may have come.

Others, as the divers, have remained short-winged because of the small amount of flight resorted to, since they depend upon swimming and diving so largely as a means of escape and foraging.

It is not improbable that the penguins, with finlike wings and reptilelike drumstick (with both bones present), and their many other very primitive peculiarities, may have been aquatic ever since their early development, and that their ancestors went directly from flight to water, never having, as noted, passed through a ground-haunting ancestry. Some of them are said to make no use at all of their feet in swimming except as rudders, and they strike first with one wing and then with the other in diving—a very unflightlike motion, as if they began swimming before they ceased crawling. Still, a biological study of the structure of their wings hints of a time of flight in their past, but that their wings were never brought to a state of perfection—in fact, but little beyond that of the *Archæopteryx*. The peculiar pocket found among some of them, for hatching the egg in, hints that they may have diverged from the bird stem at an early period.

These suggestions are given to add interest to our study of the shape of wings in this chapter, and the deductions might not be sustained if all the facts were presented, nor is it likely that they will be indorsed by all the students of bird flight.

Whatever the origin may be, we find ground-haunting birds now usually with wings that are short and round, so that they may be fluttered rapidly, and that are broad and concave beneath, so as to resist the air greatly. The hollow side of a curved disk resists the air more than if it were flat, and very much more than the convex side.

Such birds as persist in ground-haunting, skulking and hiding habits need such wings for suddenly hurling themselves up when discovered or chased; and short flight only is desired that they may again hide, run, etc. Hence, there is nothing in their habits to develop a better wing. In fact, there is no better wing for their purposes. But such birds as wish to sustain themselves in long continuous flight need a wing that is a little longer and which does not require so much effort, at least such rapid strokes, to keep the flyer up and going. The longer the flight the longer the wing usually. We may find all grades of length also according to habits.

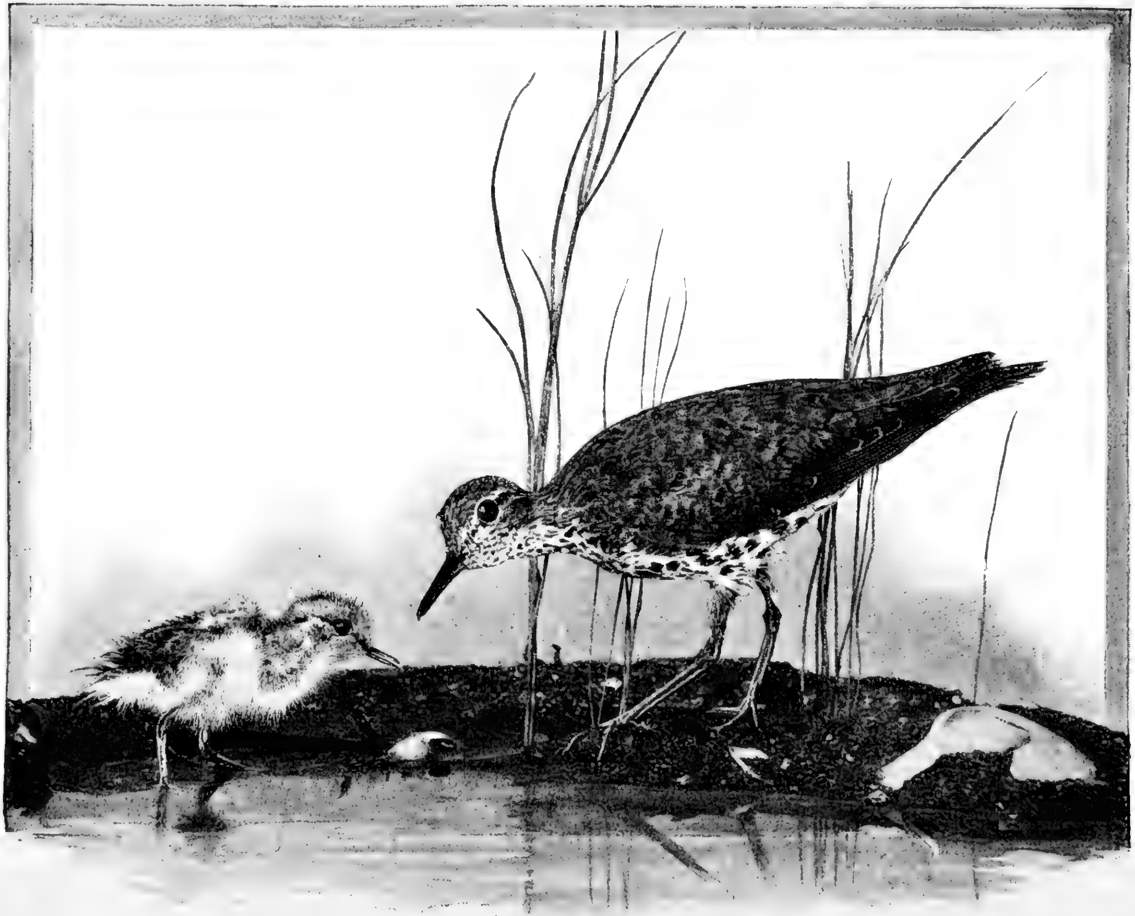
In birds that are given to long continuous flights the tip of the wing is usually formed by the outer feather, or else the next one or two are very little longer than the outer; and the wing is not so broad or concave, nor is it fluttered so rapidly as in the short flyers.

Usually such birds do not suffer themselves to be approached, or they are tree haunters or haunt other safe places. Sometimes birds combine ground habits with very long flight, especially in migration, and a few long-winged birds, as the snipes, may skulk and hide and allow themselves to be approached; but when they fly up they do not rise so quickly upward. They usually go swiftly away near the ground.

In fact, only a very few light birds among those that are long-winged can fly quickly directly upward. They must skim *away* in order to get *up*. Some of these, as the albatrosses, boobies, etc., can not rise from a flat surface, but must paddle along awhile with their feet till they get agoing. This is also the case with some rather short yet pointed winged water birds, as loons, some ducks, etc., which can be watchful and have no need to rise directly upward.

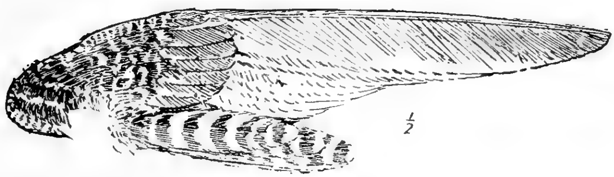
But many of the grouse forms can hurl themselves directly from the earth into the air with tremendous velocity, especially when their muscles are fresh; for they are not only endowed with a special wing, but with rather unusually large chest muscles, which are capable of great exertion for a short while only.

A great compensation for deficiencies in various wings is found in both the quantity (bulk) and quality of these chest muscles. In some plovers, with such



Spotted sandpiper and young—a long-winged ground haunter.

long perfect wings, these muscles are scant, in keeping with the light body and long slow stroke; but in ducks, where the wing is shorter yet shaped for long journeys, these muscles are ample and the stroke is very rapid; and in both these and plovers the tissues are tough and almost tireless in their action. This quality of the tissue often shows in the color of the flesh. Short-range flyers are often "white-meated"—a poor characteristic for long continuous use, but specially adapted to the gridiron and platter. The best flight muscles are usually black. Ducks have both quantity and quality, and with an elegantly shaped but short wing they make rapid and long flights by working their passage very industriously.



Wing of solitary sandpiper, a typical wing for continuous flight, with the elongated *tertiaries* of a ground haunter.

Again, there is a kind of wing that is adapted to the highest and latest style of flight, the capacity of sailing when once well up either with or against the wind, or of even getting up higher, without any flapping whatever. There doubtless comes in here also something else besides the shape of the wing; for while the albatross and others are most expert at sailing and gyrating with an almost perfect wing, which is light and hollow-boned, carrying a proportionately light body, certain rather heavy vultures float for great periods in the air with a much shorter, broader, and more rounded wing. Just how the thing is done is by no means settled, but to some extent it must be a matter of skill on the part of the flyer. It is not probable, however, that *any* sort of wing could do it.

While albatrosses and others appear so to float continuously in calms, it is fairly certain that this sort of flight is connected with strong horizontal currents by nice adjustment of wing, tail, neck, etc. It has been asserted that upward currents are always prevailing also, but this is not proved yet.

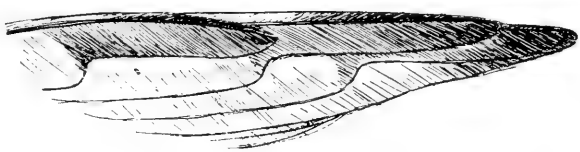
Various theories have been (and are being) advanced, but none of them yet account for all the facts, and many are based upon assumptions not yet established. In this outlook lies our human hopes of flying, and upon it some most abstruse physics are brought to bear, too technical for our discussion.

But we may glance a few minutes at how a bird progresses by flapping. As the quills all lap under each other with their longer vanes backward, the wing is nearly air-tight as the down stroke is made, and it becomes loose, like the slats of a window blind, on the upstroke. We can see, therefore, how flapping lifts. Likewise, the downstroke is more rapid or at least more forcible than the upstroke, and the air is much more resisting to a rapid stroke than to a slow one. Again, the difference in the shape of the lower and upper side of the wing is helpful, as noted.

Now, since the feathers have either their tips or their wider vanes backward, as the wing is extended, these both tend on the downstroke to bend upward, and as the air resists them on the downstroke it glides out behind the wing and tends, like the blades of a propeller, to push the bird forward. This alone would be enough for slow motion, but after a bird is well up the wings reach forward and strike backward as they go down.

It is well established that a flying bird needs nothing but propulsion after getting a start, since the under surface of both wings, the body and the tail, by being slightly tilted up front, tend to lift the bird as it goes forward, just as a kite rises when drawn rapidly by a string. In this case, as in many others, rising or keeping up means going. But a bird may so adjust itself as not to go when it flutters, as seen in hawks, shrikes, bluebirds, etc.

There are many other features of a bird's wing, such as are shown by the length, number, arrangement and special shape of the individual flight quills, and the



Wing of broad-winged hawk, with notched primaries—another way of narrowing the tip of a wide wing to fit it for soaring.

probable causes that have brought about their shortening or suppression, their narrowing, tapering off, etc., but our discussion can not include them.

There are also some correlations, not well understood, between the number of primaries (quills in the hand or tip joint of the wing) and the scaly condition of the shank and the number and arrangement of the song muscles. Higher birds have also fewer secondaries (quills growing out of the middle joint of the wing) than the lower birds, and many birds with sharp-pointed long wings, which feed on the ground much, have the feathers which grow out of the upper joint of the wing (tertiaries) next the body very long, as if they were in some way intended as an arrangement for rapid rising, which Nature was trying to put in without shortening, broadening or concaving the wing.

One can look at a bird's wing and know much of its way through the air, and draw some strong inferences about its story.

CHAPTER XXVII.

HOW AND WHY DO BIRDS TRAVEL?

WHILE birds appear so free and roving, they usually have rather definite homes or home regions, remaining in these their entire lives if not forced away; and many use the same tree or other location from year to year to nest in. It is certain that where a bird rears its young is its home, and this is surely the home and native place of the nestling.

But stress of cold and scarcity of food may, and often does cause the birds to travel, and they take their well-known journeys southward at the approach of the winter. Such as live on flying insects are compelled to go.

But all the birds do not travel. Some stay in the same region the year around, enduring the cold and picking up a living in spite of the departure of the insect and the berry. Why, then, do others leave us? It would seem that they, too, might learn the art of living in and enduring the severities of the winter, and save themselves the great labor and danger of a long journey which is so often fatal to many.

It is one of the theories of the migration of birds north of the equator that many of them originated around the north pole, on all the continents near it, at a time when this region was tropical in climate, as it evidently once was, judging from its fossils; and that as the great ice-cap formed over it and covered the earth, gradually extending away southward, perhaps to the Ohio Valley on our continent, it drove before it many of the birds, fleeing for their safety. There was no opportunity to temper themselves to the climate, no chance whatever to live upon the bare ice only. But when summer came each year the great ice wave would recede a little, and the birds would follow it back and build their nests as near as possible to the old home location, placing them often, no doubt, under the very brow of the glacier. In time the ice receded to its present limit, and the habit once set up has caused many birds to follow it yet. Others have set the limit farther south, with all degrees of gradation, for the old tropical climate never came again to the arctics.

If this view be correct it will be readily seen that the habit of migration thus set up and continued would prevent the traveling birds from becoming hardened to winter or adapting themselves to a winter diet, because the first cool blast, or even the dimming and lowering toward the south of the autumn sun, would send them south, doubtless, with the inherited impression that the great ice billow was creeping down yet only a short distance north of them; just as the little kitten while yet blind hisses at the odor of the friendly dog, because his tribe has so long been the enemy of its ancestry.

A byway of the birds.

But experience has, nevertheless, crept into some of the birds, and many that doubtless formerly went south with their tribe now remain and endure our winters. Others that could well stay still go yet, while with some others still the old tendency seems stronger at some seasons than others, and they may go or they may stay, according to some fancy that is not often apparent. Thus all the flickers or redheads may leave a certain region one winter, though it be milder than the one previous, when they stayed; and it is certain (in some regions at least) that robins, bluebirds, and others remain all the year around (or tend to remain) much more frequently than formerly when they find a friendly haunt.

There is another element in migration that is in direct opposition apparently to that just noticed. Birds of evident southern origin, having most of their species resident south, as humming birds, tanagers, etc., and showing by their nest, as noted (Chapter XVII), their hot-weather habits, also come north to rear their young, whence they have never been driven by an ice-cap. We can readily see why all birds should flee at the hint of cold weather, but why should these (as it grows warmer) make the northern trip? If they were ever of northern origin when the arctics were tropical, it seems probable that for a long time their ancestors have resided permanently in the south, and their northward tendencies seem quite recent. Only a few of them have acquired the habit.

Here, however, may come in a factor in nest building which also influences the northern bird as well as the southern. All birds except the most social seem to like to get apart from others in nesting, and even in the social kinds one colony usually pre-empts all of a certain region. The tendency to conceal the nest is very strong in many birds, and such as turkeys, guineas, etc., of our domestic birds even steal away at this season. Here, then, from a crowded condition might be set up a movement from any center in any direction, and the northward spring migration of southern birds may be only an incidental portion of this motion. Doubtless much of the distribution of birds—a topic our little book will have to omit—depends upon this tendency and the seeking of new food fields. This latter may also be one element of this form of migration.

Having once come up north and made their homes (nests) here, the tendency of the young bird is to remain in his native region, and to be driven south only by stress of weather and famine. But if food be present we find many of these southern birds learning to endure northern winters, such as doves, mockers, cardinals, flickers, etc.

But the question that most concerns us is *how* the bird travels. Flight of course is the usual means, though a few, such as quails, turkeys, etc., move southward afoot often. But flight makes extensive migration possible. It is said that some plovers that nest in Labrador winter in Patagonia, their long wings easily carrying them this great distance. But even short-winged birds make long flights at this season. There are doubtless some long migrations made in a single continuous flight, while others consist of a sort of straggling from place to place with stops for food, water, or rest. The migration of the same birds may differ in this respect at different seasons or different stages of the journey. Or different flocks or individuals may differ much from others in their migrating habits for the time.

Where the flights are long and continuous it frequently happens that birds go in great flocks or streams, some that are solitary at other times being very social now.

Such flights are apt to be at great altitudes, so far as to be usually out of sight. Star gazers have seen them pass their telescopes in the night (for these long flights extend over nights, especially if the moon shines), and they are able to estimate by the sharpness of the focus how high these bird nebulæ are. Two, three, and even more miles have been asserted. An observer on a certain island where birds rest speaks also of single birds coming down from the unseen heights and alighting.

Often after approaching land and nearing the end of the journey, our little birds stop short of home and drift up, singing and feeding. Thus we may note the loitering of the Peabody sparrow, purple finch, and various thrushes, etc. The Baltimore oriole rides up on the great spring wave of the opening leaf and expanding catkin, and the warblers, vireos, etc., wait till the full flush of summer is here, and beat northward part of the way through tree top and tangle to the music of the insect's gauzy wings.

While over water or great stretches of land where they do not care to alight the route of birds may be rather direct between points far apart, unless, as is often the case, they are deflected by winds; but where there are coast lines tending in the right direction they are apt to be roughly followed, and inland great streams and wooded borders are followed. This last is likely because of the opportunities of rest, food, and shelter or proper haunt that they may offer. Even at sea birds are apt to lay their journeys by islands, and these islands will lie for ages in their routes. Ordinary land birds are recorded as resting sometimes by simply floating for a while upon the water in mid-ocean.

The island of Heligoland, in the North Sea (or German Ocean), has for generations been the resting place for migrants to and from northern Europe. It is said that the bird routes now over the Mediterranean Sea are over shallow places that were once isthmuses. Bird routes even through the air are apt to be very permanent when once established, and these over the Mediterranean were probably set up by following the land beneath when it was visible, and are followed now by the heritance of habit. Columbus was influenced in his voyage by following one of these bird "aërial lanes," and was led on to the West Indies instead of Florida. These bird flights are said to be there to-day at the same season of the year.

But by far the most interesting question about the migration of birds is, What guides them? There is quite a tendency among modern students to assert

A landmark in the birds' highway.

that the bird is guided by the topography of the land, the stars, the waves, etc., attributing the direction taken solely to the reasoning powers of the bird, just as it knows how to flee when you approach it. But there are some statements concerning certain practices in migration that are much in the way of this view. It has been maintained that the old birds guide the young, but observers upon this island of Heligoland and other places often find the young birds preceding the old ones. Again the old ones in other instances precede the young so far as to be in no sense a guide. Thus the European cuckoo is said to be out of England and into Africa, while its fledgeling is yet being fed by some duped finch or warbler at the north.

There can be no doubt, however, that birds reason about their course, as we have seen, turning aside to feeding grounds and laying their courses by or alongside of great landmarks. It is claimed also that homing pigeons are guided wholly by the "lay of the land," etc., in taking up their direction, since they often circle for a while.

But with all this the knack of returning quickly, often in a direct line, to the old home so frequently displayed by lower animals when carried away in sacks by circuitous paths is in all probability instinctive or intuitive.

So the capacity of the young bird for *starting* in the proper direction is no more remarkable than the fact that without instruction it should *desire* to go. Both may be an inherited habit, or, if you choose, an instinct. Birds, however, often lose their routes and grow confused in fogs, darkness, storms, etc. Their instinct of direction is not unerring. They are certainly within limits reasoning creatures, and a yielding to the influences of reason may sometimes confuse instinct as well as aid it. We can not here enter into any discussion of instinct. It is not impossible, however, for its pure manifestations to be more nearly unerring than we think. But it is an inheritance from the past out of which all present experience and intelligence tend to lead, and the Great Beyond of all creatures lies above it. If we could separate it, we might find it perfect for its purposes and unerring when its promptings only were obeyed. Especially would this be true if the same conditions and environment could prevail now which were present when the instinct was evolved. In so many cases, however, as we shall see in Chapter XXIX, the conditions have outgrown the instinct or fixed habit; and the bird stands tied to the past with the emergencies of the present pressing upon it.

There are some other peculiarities concerning daily bird routes—hunter's "crossings," so called—whereby upon a certain day all wild geese will enter a field at or near a certain point, though one flock can not see the other ahead of it, and certain deflections in the "fly lines" of plovers, etc., which show that birds are peculiarly endowed with some sense of direction not yet understood. But no dissection hints of any special organ originating it.

After fifty years of study of the migration of birds upon the island of Heligoland, Herr Gätke declares that we are no nearer than ever to the solution of the problem, as to what guides the bird. The study, however, of how and why a bird travels may show us many features of the story.

CHAPTER XXVIII.

WHAT A BIRD KNOWS ABOUT GEOGRAPHY AND ARITHMETIC.

THAT a bird has received its ideas of geography from its ancestors there can be but little doubt. If some progenitor had not once gone south, or set up the habit of going south, no nestling now would yearn for the sunny land as the winter approaches. But just how it holds through the ages, this experience of its forefathers, we only can say in our ignorance that the capacity for this is a special endowment of low creatures that man does not possess. If instinct be not an inspiration, the faculties out of which it is evolved are as remarkable as the thing itself.

But we can sometimes see where a knowledge of geography in the feathered learners is a matter purely of experience, the proper direction or "short cut" being not instinctively perceived. Thus it is stated that such bobolinks as have gone West and are building beyond the Rocky Mountains have not yet learned how to take a short cut south to their winter homes by passing west of the Gulf of Mexico, but must return (as they worked their way out) to the Atlantic slope, and go south as their tribe has done for ages.

Geologists hint that in the long ago the Gulf waters extended north till they met those of Hudson Bay, and that our plains were once the bottom of a shallow ocean whose beaches were the highlands of the Appalachian and Rocky Mountain regions respectively.

There is much in the distribution and migration of our birds to confirm this. At any rate, there are on our continent two great divisions of migrant birds, those from the east going south, usually on the east side of the Gulf, and passing on mostly by the West Indies, and those from the west going southwest of the Gulf and passing on by the Isthmus.

Except in a few instances, which, like those of the bobolink, are comparatively recent, our great plains west of Missouri have been almost as complete a barrier to the mixture of the birds of the two regions as the original waste of waters was.

Now these two masses of bird life show considerable resemblance to each other, but frequently differ in genera and species. Often, however, only the slightest variations in coloration are evident between Eastern and Western species. In some instances (as the flickers, meadow larks, etc.) it is evident that they have intergraded across the plains, but in others the line of kinship more likely runs around by South America or by the arctic landed regions, where the intergradations were made. In a few cases, some Western birds show their kinship from Asia, by the way of the Aleutian Isles say, and some Eastern birds have a cousinly line running across to Europe via Iceland.

While a bird knows geography only in the line of its needs or its forefathers' uses, it may tell us a great deal of a condition of the earth that no human eye has ever seen. Taking the world over, we can look back through the bird's inherited knowledge and get glimpses of ancient geography away beyond our oldest records. The entire subject of the distribution of birds and other animals is full of such suggestions.

In connection with what a bird knows we may mention its knowledge of numbers. All creatures appear to distinguish between many and few, and all know the value or force of great numbers. Wolves become fierce when the pack is large, and jays, crows, and others are valiant in their attack on owl and eagle after they have called up a crowd. But it seems that within a small limit birds have a correct, or nearly correct, estimate of the number of objects present. This is especially noticeable in the behavior of some birds with regard to the proper number of eggs that should be in the nest before they begin to incubate, or rather before they stop laying. Many birds do not have a definite number in their clutch, but all have

A crow.

a limit which they rarely exceed or fall very far short of.

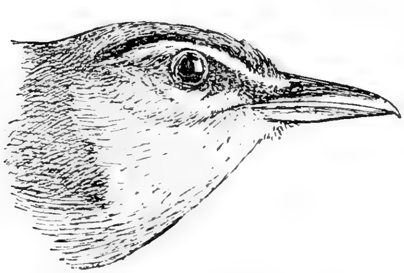
Others are much more definite. Thus, as noted among some plovers, three or four eggs are very regularly the rule. With a few it is definitely three. We have seen already that a bird can lay more eggs than she usually deposits, having a reserve, it seems, for emergencies, such as robbery, etc. She soon fills another nest if one is broken up.

If also, in many birds, as they are laying, an egg be taken daily, the mother will continue to replace it, to the limit of her egg-laying capacity, so long as she perceives the number too small; and one may, in this way, just at this time get an egg or eggs for study without destroying the bird's prospects. Now this argues that the bird can count up to her needs in this respect.

It is not likely, however, that she has a "one-two-three," etc., sort of appreciation of the numbers as she goes along. It may be just an estimate in the lump of when the nest is properly filled.

As noted, the cowbirds are well known to be parasitic upon other birds in laying their eggs. Meadowlarks' nests have been found with their proper number of eggs deposited, but with one or more thrown out and a cowbird's egg or eggs in their place. It appears as if the parasitic mother felt that there were too many in the nest for hers to have the proper chance in incubation.

It would be straining our theory too far to suppose that she instinctively knew what was the proper number for various species to cover and hatch surely, and that she deposited her own or threw out the other's eggs accordingly. But that she has some ideas of her own may be inferred from the foregoing case, and from the fact that where there are already many eggs in the nest the cowbird deposits only one or few. But if she gets to a nest early she may lay many in it, as seen in the following cases of record :


Red-eyed vireo. (Natural size.)

A vireo, while building, had deposited in her nest a sufficient number of cowbird eggs to come within one of her usual complement. She deposited only the one egg needed, and immediately began to incubate. Another vireo was found where her clutch was completely filled by the time her nest was finished, and she went to sitting without laying any eggs at all.

Here the vireo certainly knew her nest number, and it may be just possible that the cowbird did also, though this is not very probable.

It is not easy to see how the sight of a proper number of eggs in her nest should so affect the bird's physiology as to render her able at once to cease laying. Dissection often shows many small eggs yet unformed. Laying does not always, however, appear to be a matter wholly voluntary, for it is well known that at the beginning of the nesting season a bird may have to deposit an egg anywhere before she can build ; or even some may lay while yet on their way north long before they reach the nesting region.

It can not be the mere act of incubating that suspends egg laying, for many birds begin to sit so soon as a single egg is laid, where from four to eight are laid afterward. We have seen, however, that incubation does affect the circulation, even of the males, making the crop of the male pigeon secrete and scale up a peculiar curdlike substance.

Outside influences, such as fright, sudden cold, or bad weather generally, may affect a bird so as to cause it to cease laying, as may be observed in any barnyard.

It seems a little remarkable that a bird having so much mathematical perception should not be better able to know its own egg as well as its number. But many seem to be unable to see that they are duped or else are wholly indifferent to the fraud. There is the well-known instance, however, of the summer yellow-bird's building another floor above the false egg, thus showing her knowledge, but she has been more frequently observed feeding the squabby cowbird's nestling than rejecting its egg. There are times, however, when the cowbird's egg is found pierced or thrown out of the nest by various birds. But this is off of our topic.

There are some facts recorded that show that, besides the very prompt return, almost to the day, of some migrants, birds have an accurate estimate of how many days lapse between certain events that recur regularly. Do they count, or just "feel it in their bones"?

CHAPTER XXIX.

PROFIT AND LOSS IN THE BIRDS.

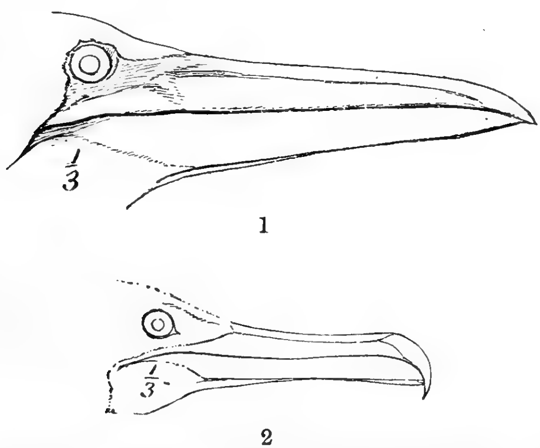
We have seen that birds in growing to be birds have lost much; in growing to be better birds they have lost more. With them, as elsewhere, loss often has its compensations, and has been the means of gain.

They have mounted higher, in some instances, on *part* of "their dead selves" at least. Let us look back a little:

They flew first by the loss of a pair of legs, or the use of their fore limbs as such, and they flew better by losing some fingers, perhaps, and at least the separate use of all; better still, by the loss of tail, or its great length at least.

After they became runners and used their wings less, such of them as depended on escape afoot lost most of the *fibula*, or the smaller of the leg bones, that they might run better. Likewise, later they lost some muscles that were necessary in running, swimming, or moving the tail even; and they had various adhesions of the tendons in keeping with their wants.

They took on certain organs as they had need, and lost these new ones as readily when they became useless by change of habit. But some of them persist yet as vestiges of past conditions. When birds took to water they developed webs between the toes, and their toe tendons split up and spread out to each digit, in keeping with very complicated needs. Vestiges of these persist (in the fowls, birds of prey, and others) with peculiar arrangements of tendons to pull the outer toes in under the middle, as if to offer little resistance to the water on the forward swimming stroke. Many of the lower birds that are not swimmers retain a muscle whose sole use was to close the front toes automatically when the leg is bent.



Head of gannet (1) and cormorant (2) showing abortive nostrils.

Some of the diving birds have lost their nostrils, and others which gulp their food, judging of its fitness by sight only, have lost their tongues. An unused organ always tends to go, at least till it gets out of the way. Internally also have come about great changes and losses.

Cœca, a part of the digestive tract, seems once to have been necessary in all birds to the digestion of such food as they then used. Now they are very variable, and some birds are entirely destitute of them, or such vestiges of them as remain are useless. Likewise gizzards have been developed and lost, or become loose, thin sacs rather; and other internal organs have been changed. The very loops and arrangements of viscera hint much of the route of development.

A very peculiar loss among some birds is that of *one* carotid artery. Usually it is the right that is gone, or the two may be merged into one. This change may have come about in keeping with the demand or needs of the brain's blood supply. Perhaps when the bird became hot-blooded with a very active heart, the brain received too much blood in the intense exercise of flying. In mammals this blood supply is sometimes regulated by crooking the artery. This suppression of the carotids is very variable in different groups or different members of the same group. It seems to be something easily and recently influenced.

In losing the skin pores, birds, as we have seen, found some compensation in the development of the oil gland, but some of them have even lost that.

We have already seen how parts of feathers have been lost for beauty.

In some way not well understood, except that it *may* imply progress away from the reptiles, the higher and more songful birds have lost many scales upon their legs, or rather the scales have all merged into one sheath. The shanks of the melodious thrushes are, for part of the way, entirely scaleless (see cut, page 161). We can not see how this can in any way be a compensation; so that the best we can do is to cloak our ignorance by calling it a correlation. Since the bird left the reptilian state by losing scales partly, this may be regarded by some as merely the result of a scale-losing momentum; but why it should be co-ordinated with, or accompanied by more than three pairs of song muscles we can not say, unless the acquisition of song muscles is also the highest development away from the lizards. The loss of one or two primary wing quills seems to run quite unexplainably almost parallel with these last two changes also.

Melodious thrushes.

Lastly, besides the loss of teeth, there have been great changes in the skull, in keeping with progress or degeneration, especially in the bones of the palate or skull floor. These seem to be related to the bird's brain, or its intelligence, and to its habits. They are too technical even to mention here. The relations between them remain more nearly constant than any other one feature of structure in single groups. They perhaps come nearer indicating the progress of the bird than any *one* set of characters. This is likely, because they are so near the brain; for whenever the body loses an old tool or acquires a new one, some change must be made in the brain to correspond to its use, and this change affects the skull and the bones adjoining it.

But profit and loss among the birds have not been confined to structure only, but habits also, as we have seen, are lost and gained. It may be interesting, on this next-to-the-last glance at the Story of the Birds, to see what such habits may hint of history.

We have already had some of the habits that are shaped by structure under Tools and Tasks, Chapter XXIII. It is the habits which, independent of structure, seem so freakish frequently, or rather it is the vestiges of such habits that we shall now notice. The formation of new habits is going on among the birds constantly, but only observation and study from day to day can interpret these.

We saw early that structure of the embryo or young may indicate phases through which the race has passed, as the frog's young are fishlike, etc. So likewise there may be a sort of embryology of habit. If we find a young bird exhibiting a peculiar habit not practiced when old, we are led to believe that some adult ancestors once practiced this regularly, or that some living (and usually lower) relation does so yet. While indications of this sort are not by any means always reliable, they are often probable, and are valuable in confirming other indications. Frequently they can be verified in some lower group or in some near relations.

Thus little water ousels, when chased before they can fly, run and dodge about, but make no attempt to dive, although an old one, slightly wing-wounded, will dive at once to escape. Now, when we recall that this little bird's ancestry among the wrens and thrushes is not at all aquatic, his dry-land tactics will be better understood. Only recently has his tribe taken to water.

Something similar appears among the grebes, which have kinsfolk landward. Sometimes, as already mentioned, the little ones crawl upon the mother's back, and she swims away from danger with them, and, if pressed, puts her wings above them and *forces* them to dive. Now they can dive as well, or better, than she, but it seems strange that they have not yet the instinct to do it at once at the danger signal, but prefer to scatter and hide in the reeds and grass, like their landward cousins, the fowl forms. See diagram of kinships in the next chapter.

In this diagram it will be noted that the hoactzin stands as a connecting link between some fowl forms on one side and the gallinules, leading to some very aquatic kinsfolks, on the other. There is a little habit that hints that their ancestors were once more aquatic, for, while the adult birds avoid the water, they build their nests over it; and should the young, in trying to escape, drop into it, they both swim and dive readily. Another hint here: As noted, these young hoactzins crawl on bushes by wing claws; some gallinules do the same when young, and very young grebes, Prof. Newton notes, move as if crawling on "all fours." Recalling the swimming of some penguins by alternate strokes of the wings, already mentioned, you may see that this little strain of habit runs well down the line of divers on the diagram.

But interesting vestiges or faint exhibitions of habits, which also hint of history or relationship, may crop out even in *adult* birds. The impression is prevailing now that geese, ducks, swans, etc., may find their ancestry among the grebes and loons, or near them. Now, here runs the habit of covering the eggs in the nest. Some rails—quite landward—all grebes, and the ducks especially do this. Some of the latter use their own down. Further on, the domestic goose simply picks up a few straws and throws them at her eggs as she leaves them. Again, grebes build floating nests often, and some rails on one side and some other birds on the other side do the same.

These instances of hinted kinship through nests are too numerous for our space. Often they are quite apparent and constant within the group. Thus, as noted, most Picarian birds use holes; all vireos or greenlets build basket-shaped nests suspended at the brim; the thrushes like a little plastering; the finches want upholstering, usually of hair or very fine fibers; the tits and their cousins, the wrens, wish fur and feathers; and the jays, a lining of rootlets, etc.

In the variations from these standard shapes, as in the variations of eggs, a bird may show its kinship either onward or back. Thus the jays sometimes (or some of them, rather) have a twiggy nest, like a crow's on one side, or a mud-cemented affair, like the blackbird's, on the other.

Often it is only one or two individual species of a group that will vary toward a kindred group, and this may crop out on different continents. Our orioles have been thought to resemble structurally the weaver birds; and our Baltimore beauty builds a nest somewhat similar to theirs. Brown creepers and warblers are faintly akin. One warbler builds as the creeper—a striking breaking away from the customs of the family. Wrens and tits, of which last the nuthatch is a member, are akin, and the warblers are near by. One warbler runs on a tree as a nuthatch, and wrens may be seen sometimes running similarly—head downward —on a tree trunk. Some wrens build much like the tits—in holes. We have just noted the kinship of wrens and water ousels. The strain runs by the way of the so-called water thrushes, which are really warblers. Now, the ousel builds a domed nest near water, one water thrush, called the ovenbird, often does the same, and nearly every wren's nest is domed.

Lastly, it is now well known to bird students that crows, ravens, jays, and magpies have a great propensity to steal and hoard bright objects; that the birds of paradise are just crows in fine feathers, and the umbrella bird is a crow dressed as a drum major. In the whole family is an appreciation of pretty things. But close akin to these latter are the garden and bower birds, already mentioned as ornamenting their bowers and love promenades with bright objects. These use bright objects sensibly, but the magpies, etc., show their kinship in the little vestige of knowing how to steal and hide them only, but not how to use them.

We have already seen how a bird's building habits may show something of where it originated, whether north or south.

Enough has been said to show that every glance out of the window may be interesting, and that every vestige of either habit or structure is like an island now—a mere point above the surface, which indicates the isthmus, long since sunken out of sight, that once lay perhaps between the two great continents of Then and Now.

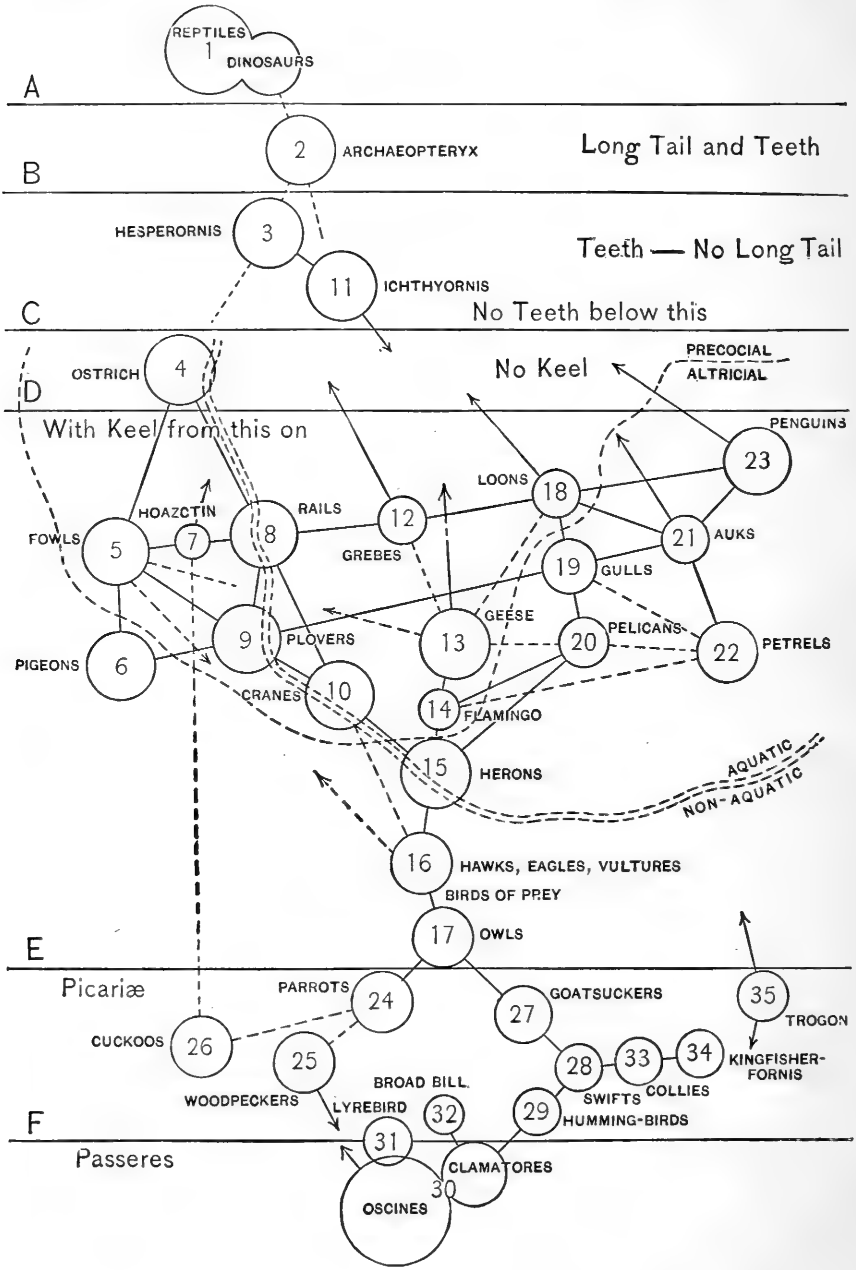
CHAPTER XXX.

A BIRD'S MODERN KINSFOLK.

WE have already said much of a bird's kinsfolk. In fact, the whole story of the birds, as we have seen, lies in their relationships, and how they have branched away from each other. This last topic will be a sort of summary statement of all that is past.

Here, then, is a little diagram that may help us to see this kinship as it now presents itself, taking all the indications into consideration. It does not follow that this is a scheme of classification. Little attempt at order is intended, though something of the usual arrangement crops out. Neither is it intended to imply always that the upper group is older than the lower, but that most of its ties of kinship lie above rather than below. In order that the diagram may be read easily, the low forms are placed at the top and the high forms at the bottom. But, of course, development is usually spoken of as being upward. If we think of the newer forms as "coming down from the past," our diagram will be appropriate.

The small circles represent groups that are strikingly distinguished from each other in popular discussion, and the question of orders, families, etc., with


REPTILES
1
DINOSAURS
A
2
ARCHAEOPTERYX
Long Tail and Teeth
B
HESPERORNIS
3
Teeth — No Long Tail
11
ICHTHYORNIS
C
No Teeth below this
OSTRICH
4
No Keel
PRECOCIAL
ALTRICIAL
D
With Keel from this on
PENGUINS
23
LOONS
18
HOAZCTIN
RAILS
12
21
AUKS
FOWLS
5
7
8
GREBES
19
GULLS
GEESE
PELICANS
9
PLOVERS
13
20
22
PETRELS
PIGEONS
6
CRANES
10
14
FLAMINGO
15
HERONS
AQUATIC
NON-AQUATIC
16
HAWKS, EAGLES, VULTURES
BIRDS OF PREY
17
OWLS
E
Picariæ
PARROTS
24
27
GOATSUCKERS
35
TROGON
CUCKOOS
26
25
28
33
34
KINGFISHER-FORNIS
BROAD BILL
SWIFTS
COLLIES
WOODPECKERS
LYREBIRD
32
29
HUMMING-BIRDS
F
31
Passeres
CLAMATORES
30
OSCINES

their interminable prefixes of "subs" and "supers," and with their refinements of subdivisions, is omitted. The lines between the circles represent ties of kinship. When dotted, the kinship is faint or apparent only.

The first great circle represents the reptiles with the birdlike *Dinosaurs* on the birdward margin. Next is the *Archæopteryx* as the earliest known branch from the bird stem. Doubtless other fossils nearer the reptiles exist and may be found yet.

Hesperornis and *Ichthyornis* are simply thrown in as birds of a later period, still having teeth but with short tails. These Prof. Marsh found in Kansas. *Ichthyornis* was perhaps like a tern or gull, and flew well with a keel or ridge on its breastbone. *Hesperornis* was a diver, with imperfect wings and no keel. While it was not at all ostrichlike, the degenerate wings and keel show that the same general conditions affected it that affected them. There are numerous other fossils in this region and further on that we can not note.

The members of the Ostrich group are regarded as the lowest living birds, not because they are flightless, but because their structure generally is quite reptilian. They early took to running, developed large legs, lost the use of their wings, and quite likely their keels. Some persons think, however, that they never had keels. They form the keelless division of modern birds.

Out of these run at least two quite distinct strains of kinship. That to the fowl forms (line 4–5) is by the way of the dry-land tendency, passing through by the peculiar birds called tinamous; and the second—that is, the rails (4–8)—runs through the nocturnal swamp-haunting habits of the *Apteryx*, already noted under Chapters XXII and XXIII.

Onward the fowl forms, including chickens, turkeys, guineas, peafowls, pheasants, grouses, partridges, quails, curassows, brush turkeys, etc., have three strains of kinship going out of them. The first and closest is that toward the pigeon forms, there being two birds which are nearly as much one as the other. In fact, the sand grouse lies as a three-way connecting link between these two groups and the plover forms (6–9 and 5–9). Beyond this the pigeons have no well-marked kinship. They are the tip of their twig.

There is also a more direct tie line (5–9) between fowl forms and plovers. The button quails of the former group form an immediate connecting link.

The third strain from the fowls runs to the rail forms *via* that remarkable bird the hoactzin (5–7–8), since it is thought to stand between the curassows and the gallinules. From the hoactzin runs a faint line down to the cuckoos.

Besides the lines 8–4 and 8–7 the rail forms have three other very marked ties. The jacanas are a connecting link between these and the plovers (8–9), and the courlan or "crying bird" between them and the cranes (8–10). Toward the grebes there is also a strong tie out through the aquatic gallinules (still in the Rail group) and *via* some very peculiar forms known as finfoots and sun-grebes (8–12).

More landward the plover forms show a strong strain (9–10) onward to the crane forms *via* the bustards and others; but more waterward (and it may be backward) is shown their remarkable kinship to the Gull group (9–19). The gulls should not be so far away as shown on the diagram, but their other affinities place them there. This last kinship was overlooked for a long time, and, as noted under eggs, is said to have been first observed on account of the resemblance between the markings and shape of the eggs of the two groups. To the student it is now apparent from structure.

Returning to the cranes, they show a faint kinship to herons (10–15), but nothing like so close as their great resemblance in form would imply. In fact, we shall see that the heron forms get their closest ties from the aquatic side. It appears as if herons came from the water to the land, and cranes from the land to the water, and both becoming waders acquired similar structure from similar habits, a case where the task influenced the tool again.

Among the crane forms is found one genus of remarkable birds, the seriemas, that have beaks and habits quite hawklike, and suggest the necessity of the dotted line (10–16). This group shows great variation from its most railward extremes to its most heronward or hawkward limit.

Having run these landward lines let us now go up to the grebes, the only remaining route from the rails which we have not followed. Since these and all the divers are very low birds, and are always placed lowest in all modern classifications (after the ostriches), it seems likely that we should have begun with them. But starting at the ostriches, the kinship has led us along in this way.

Four arrow lines (12, 18, 21, and 23) are drawn backward out of each member of the great Diver group, to show a rather probable kinship behind them —among the fossil divers—quite independent of the tie ostrichward.

Grebes are akin to loons perhaps more closely than their appearance shows, but their closest tie is more likely toward the rail forms. Below them, on our diagram, is also a faint strain (12–13) running to the goose forms.

The Goose group shows by its digestive system that it may have its origin in the Great Beyond between the grebes and loons, as indicated by the upward arrow. An arrow also runs toward the Fowl group, since, *via* the screamers, they point that way slightly also. To the right (13–20) there are some indications of resemblance to the pelican forms, but their closest relationship leads off *via* the flamingo toward the Heron group (13–14 and 15). See the notes about feeding methods (Chapter XXII), where some dry-land members of this great group are mentioned. Some petrels also have faint laminated (strainerlike) beaks.

In structure the flamingo is a connecting link between goose forms and stork forms, but it is closer to the latter. In its rough egg and some of its structure it is like the pelican forms (14–20), and in its nesting habits resembles some of the petrel forms (14–22) slightly.

Having come to the heron forms by a second route, let us go up to the loons (18) and come again.

Perhaps the loons are akin to the penguins (18–23) rather more strongly *via* the auks (18–21–23) than directly. The gull line (18–19) is fairly strong.

Besides the ploverward and loonward ties, gulls are strongly akin to auks (19–21), and faintly to the pelican forms *via* the tropic bird in this latter group, which is quite gull-like. A faint line, perhaps (19–22), should run to the petrels *via* the sea runners. Both petrels and gulls are very long winged, and stay in the air more than on the water.

The affinities of the pelican forms have long puzzled the students. They do not appear at a glance to be nearly related anywhere; but their structure sets much more strongly along the heron-stork direction (20–15) than any other. That to the flamingoes is in a similar direction. This brings us again to the Heron group.

Going up again, we begin at the penguins. While they are in shape and habit something like the other divers, especially the auks, it has been seriously doubted if they have any near modern kinsfolk. They stand far apart in structure and distribution, since they only, of the divers, center around the south pole. It seems not improbable that if they had no keels they would be placed below the ostrich forms—all things considered, though, the skeleton of the ostrich is probably more reptilian. Some auks, also, have become flightless by the degeneration of the wings in size, but not in structure.

The auks' strongest tie is that to the gulls (21–19), already noted; but *via* the sea runners in the petrel forms a strain runs petrelward also (21–22).

The petrels, like the penguins, are not closely connected, but tend to tie up slightly in many directions. A faint hint runs even to the plovers. In structure of head some petrel forms are like some pelican forms. They also, as noted, have an intimation of relationship to the heron forms, *via* the albatross and flamingo, as noted, but this is not to be stressed at all.

We have now come to the heron forms by several different sources. Their kinship backward is evidently strongest toward the goose forms, and next, perhaps, toward the Pelican group. But downward to the birds of prey, *via* the secretary bird, is a strong tie —so much so that for years this last bird was thought to be a stork rather than a vulture.

The Bird-of-Prey group, besides this last noted strain, is thought by some to be akin to the fowls (see arrow line) by the way of the carrion-eating vultures and the curassows. Some of the former have weak elevated rear toes like fowls, and some of the latter have hooked beaks with their nostrils opening through or at the edge of a skinny membrane at the base of the beak, like hawks, etc. A similarity of toe-tendon arrangement also exists between fowls and some birds of prey.

The owls are placed with the birds of prey on account of the structure of bill and claws, but their relationship in structure otherwise is not so close. The osprey and owls each can reverse the rear toe, and some hawks have faces rather owllike; but many students tend to think that owls are really closer akin down toward the Picarian birds (17–24 and 17–27), than along line 17–16 toward the hawks.

Out of the owls *may* run two lines, as noted in Chapters XXII and XXIII. The one to the parrots appears faint structurally, but the white egg, hooked beak, with skinny membrane (the cere) at the base, and the reversed toes may justify line 17–24. One parrot resembles the owls so closely as to be called the "owl parrot."

Parrots are not otherwise related strongly, but their paired toes place them near the cuckoos and woodpeckers in the usual classification.

Cuckoos are also quite apart from others except the plantain eaters, but they send back line 26–24, and take slight hold on the fowl forms *via* the hoactzin.

Woodpeckers have grouped around them a lot of other forms which we shall not name. The association is based largely on toe peculiarities, but the group has an evident hint of kinship toward the true perchers (arrow lines 25–30).

The other strain out of the owls is based upon resemblance and nocturnal and other habits, but is not so strong structurally. It is likely that it is closer than that to the parrots. It runs into the great Goatsucker group via some very peculiar birds. Beyond the goatsuckers (i. e., whip-poor-wills, nighthawks, etc.) are the swifts, akin beyond further still to the humming birds. These latter stand on the border of the true perchers.

Starting from the swifts, in another direction are the collies, leading toward the Kingfisher group. This kinship is not very definite.

The birds hereabout the kingfishers are too tedious and irregular in kinship for our discussion. The motmots on our southern border have toes like the kingfisher. Farther apart are the trogons, which are unlike any other birds, in reversing the *inner* toe.

From somewhere in this chaos come the broadbill and the lyre bird with striking, yet not perfect Passerine qualities. The latter has song muscles, and yet a down-covered nestling—a wonderful connecting link.

The *Passeres*, or true perchers, are unique in having a single and distinct tendon to bend the rear toe, and it only. The humming birds are the nearest approach to it. Roughly, there are the clamatorial *Passeres*, who have not a good singing syrinx, and the *Oscines*, whose song muscles are many and admirably arranged to change pitch and volume in their tones. Between these are some gradations, and in the true singers there are some, like the crow, that are not so musical as some low plovers, grouses, and quails. They either do not care for music or have not learned to sing.

No further attempt will be made at noting kinship in the families of *Passeres* than is done in Chapter XXIII, which can be referred to. Some have thought that the crow-jay forms are the highest birds, because their brains and digestive systems show greatest perfection. Others think the thrushes the highest, because of the perfection of song muscles and the scaleless condition of the shank, already noted.

Indeed, in looking over our diagram we must not be misled by its order of arrangement. While the fowls, rails, plovers, herons, gulls, etc., may each by their varying diverging lines of kinship seem to be centers of development for other groups around them, we can not always assert that they are so. Nearly all groups have yet in them some very old forms. The secretary bird in the hawks shows evidence of being as old as the screamer in the geese, and as the brush turkeys or curassows in the fowls; and away up later cuckoos are tied to a bird (the hoactzin) so reptilian as to crawl by claws, and yet have a naked nestling, while the lyre bird with song muscles has young that are downy like a precocial bird's.

Instead of looking at the lines running between these little circles as branches of a tree, we should have a better presentation if we imagined ourselves directly above the tree, and that the circles represented the branches sawed off at different levels which we saw "end on." The kinship, then, would be indicated not only by nearness of the circles to each other, and by the tie lines between, but also by the regions on the trunk out of which the branches grew. These, of course, we can not see. Thus the hawks (say), while apparently high, may have their limb run into the trunk below the limb bearing the fowls. The hoactzin may be a living twig from the old stem that started the fowl-pigeon-plover-rail clusters; and another twig, sprouting near it, may have grown away on up to the cuckoos.

To such as will put a bit of study on matters of this sort, the story of the birds has various interesting readings.

The broken, irregular, single line upon the diagram divides the precocial from the altricial birds. No. 7 and some forms between 8 and 12 have naked and rather helpless nestlings. Except these and the pigeons, all birds above the line E have downy nestlings, all below it (except the lyre bird) have comparatively naked young.

The double broken line touching the edge of the ostrich forms, and passing through the rail-plover-crane-heron forms—leaving a few of them dry-landward—cuts off to themselves the aquatic birds. It may be noted how nearly it corresponds to the other line, as if dense down had been developed at the promptings of the aquatic habit.

CHAPTER XXXI.

AN INTRODUCTION TO THE BIRD.

Knowing the bird by the usual keys is often a great bugbear to the untrained bird lover.

Let us see, if you should have in hand a bird belonging anywhere within the United States, whether you can read this supplementary chapter through without knowing to which of the groups on our diagram your specimen belongs.

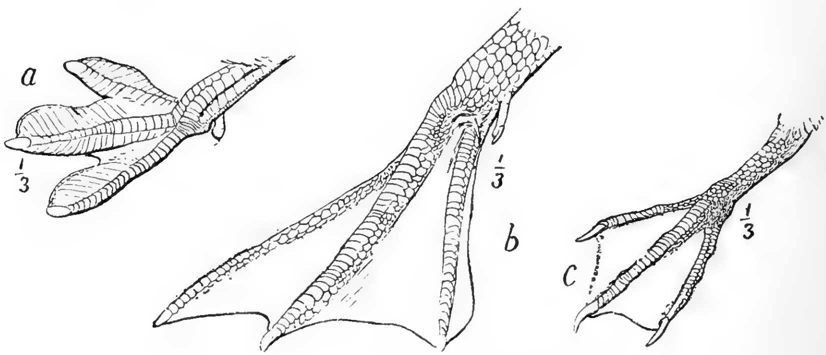
The linear arrangement of the orders here is that of the American Ornithologists' Union.

(1) Ostrich forms (*Struthiones*) are known by their great size, or by the small, flightless wings combined with a nonswimming foot, or by hairlike plumage, with the nostrils in the end of the beak. All ostrich forms now in the United States have been imported or are reared from imported parents, and are kept in confinement.

Now, if your bird is evidently aquatic, with short legs and swimming toes, begin at the next paragraph (2); if it has long legs, bare above the joints (a wader, evidently), skip to paragraph (14) of this chapter; if the feet and legs are not at all aquatic, but the feathers extend down to the joint, go to paragraph (21); if toes are only two in front, or if the outer and middle are grown together without a web, go on to (30) and (31); if shank is sharp in rear, toes unwebbed, go at once to (47).

(2) But if your bird belongs to any group of the order of DIVERS, its legs will be set far back, its toes membraned for swimming, its bill not fringed or toothed, and it will sit upon its tail, which is very short, and in the grebes absent. They are called *Pygapodes* because of this sitting posture when they stand.

(3) If the wing is finlike, its feathers scaly, it is a PENGUIN. If wing ordinarily feathered and useful, but sometimes rather short, the bird may be—



a. Foot of a grebe. *b.* Foot of a loon. *c.* Foot of an auk.

(4) First, with three toes only, an AUK form; with four toes it is,

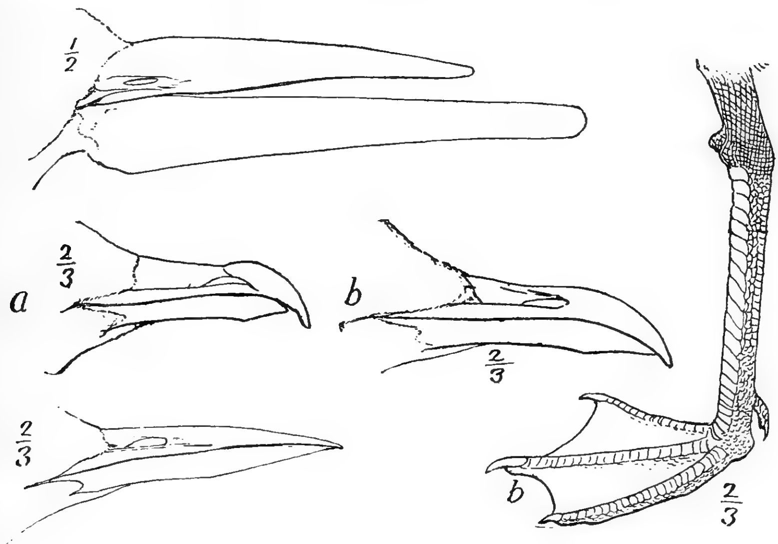
(5) Second, a GREBE, if toes are simply lobed (and no tail); and

(6) Third, a LOON, if the toes are webbed.

(7) Now, possibly the bird is not as at paragraph (2). Its legs may be a little far back, but its beak is fringed, or there are other peculiarities. So we pass on.

(8) It may have the nostrils ordinary and the beak with a distinct angle on its lower edge (where the taper starts toward the point of the lower prong), and webs between the three front toes only. Or possibly the lower prong of the beak is much longer than the upper. Then your bird is one of the GULL forms.

Some other birds have this style of beak, but then the nostrils are tubular, or the rear toe is webbed to

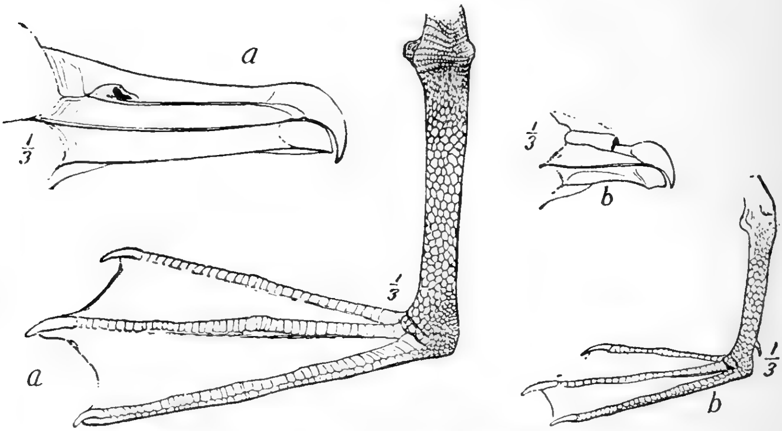


A foot and some bills of the gull forms.

the inner, or there are no useful webs at all on the foot.

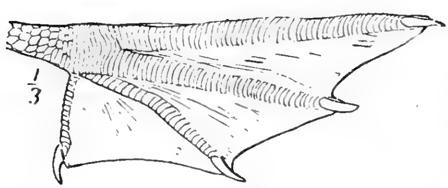
(9) If the bird has tubular nostrils and webbed front toes it is surely a PETREL form. In the last two groups the wings are very long.

For ducks, geese, swans, and flamingoes alone have fringed or toothed beaks, combined with webbed feet and ordinary nostrils. If you find a bird with anything like a tooth or notches on the beak and *unwebbed feet*, go on at once to paragraph (21).



Bills and feet of some petrel forms.

(10) If your specimen has the rear toe connected to the second by a complete web from claw to claw, it is one of the PELICAN forms. Some of the ducks have lobes on the rear toe, but they are not completely if at all connected forward.

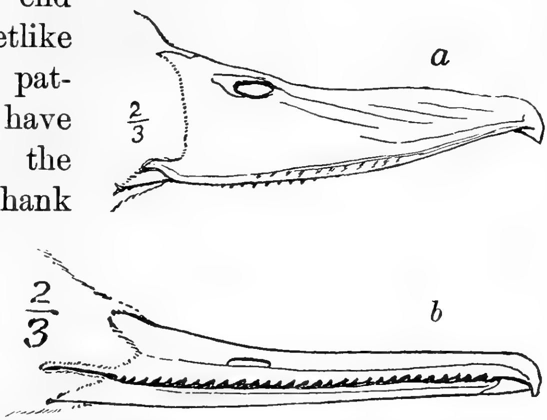


Typical foot of a pelican form.

If the bird has a fringed or serrate bill it is one of the goose-duck forms.

(11) If your gooselike bird has a straight bill (i. e., not bent down) and, first, its neck longer than the body, or a naked (loral) space between the bill and eye, it is a SWAN; if the neck is shorter than the body or the loral space feathered, it is then a GOOSE,

provided the bare shank is longer than the middle toe, not counting the claw; and it is a DUCK if the shank is the shorter. Usually geese have the scales on the front lower end of the shank, netlike (*reticulate*) in pattern, and ducks have the scales on the front of the shank usually elongated crosswise and in not more than two rows (*scutellate*). But the tree ducks (*Dendrocygna*, not wood ducks) are an exception to this, their shanks being reticulate.



Fringed (*a*) and serrate (*b*) bills of the goose forms.

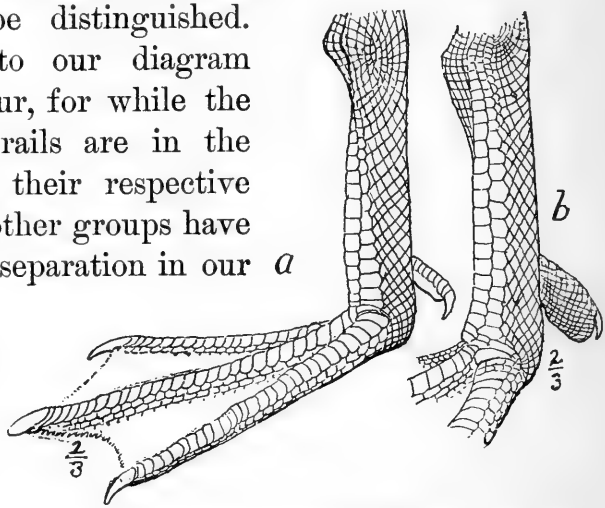
(12) But if the bill is fringed and bent down, the bird is a FLAMINGO. Its legs and neck are unusually long, and with us it is found usually in Florida only.

If the tubular nostril appears *without* the webbed foot, go on to paragraph (41), where some goatsuckers show a similar nose, like a double-barreled shotgun. Sometimes a petrel shows a little fringe on its beak, but its style of nostrils prevents any confusion with the goose-duck group.

(13) Our bird may not have any of the foregoing peculiarities. Then we must see if the legs are feathered down to the joint at the upper end of the shank (or tarsus). If so, we pass on to paragraph number 21, unless the bill is soft, long, and slim, for prob-

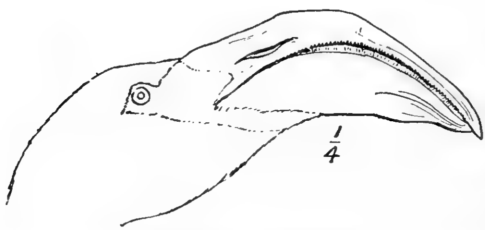
ing in the mud—the woodcock forming a single exception.

(14) If the legs are bare above the joint or the bill long, soft, and suited to probe with (woodcock), there come in here three great groups to be distinguished. According to our diagram there are four, for while the cranes and rails are in the same order, their respective kinships to other groups have caused their separation in our scheme.



Feet of ducks showing scutellate fronts of shanks.

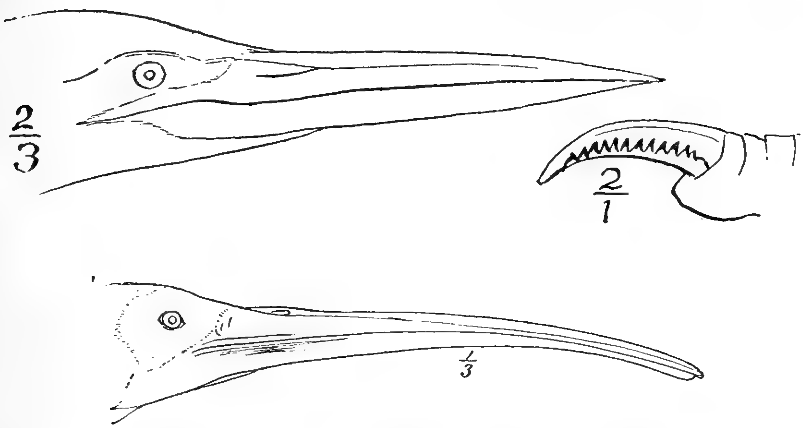
By the way, if the leg is just noticeably bare above the joint and the outer and middle toes grown together halfway, pass on to the kingfishers at paragraph (38).



Bent bill of flamingo.

(15) Now, if there is a distinct naked space (not even growing any hairlike feathers) running around the eye or between the eye and bill (*lores*), or if the legs are long and the claws like human nails (*Ibises*), or if the length of the bird is more

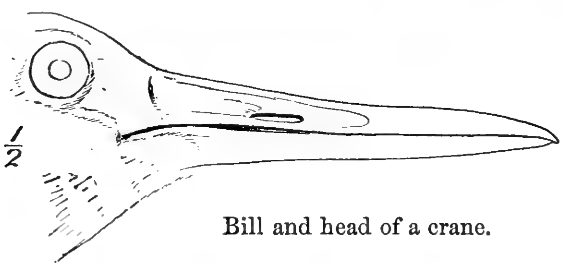
than twenty-six inches and the bill is spoon-shaped at the tip (or the bill broad and boat-shaped), your bird belongs to the HERON forms.



Bills of heron forms showing naked loral spaces.

This naked space around the eye characterizes the flamingo, swans, and the pelican forms also—all rather near relatives of the Heron group.

(16) But if none of these last conditions prevail, and the space between the bill and eye is feathered, at least with apparent hairs, why, then—

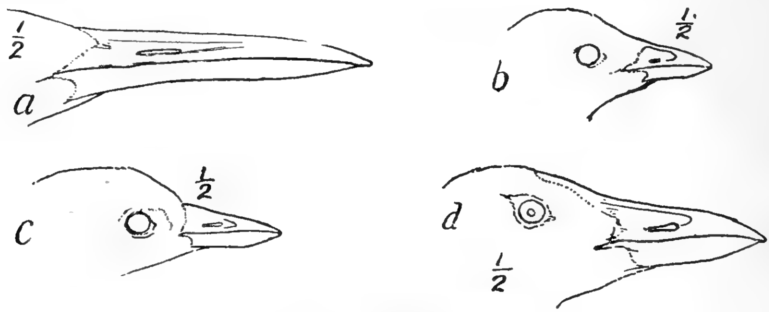


Bill and head of a crane.

(17) If the bird is over thirty-six inches long, it is a CRANE. These usually have the rear toe ele-

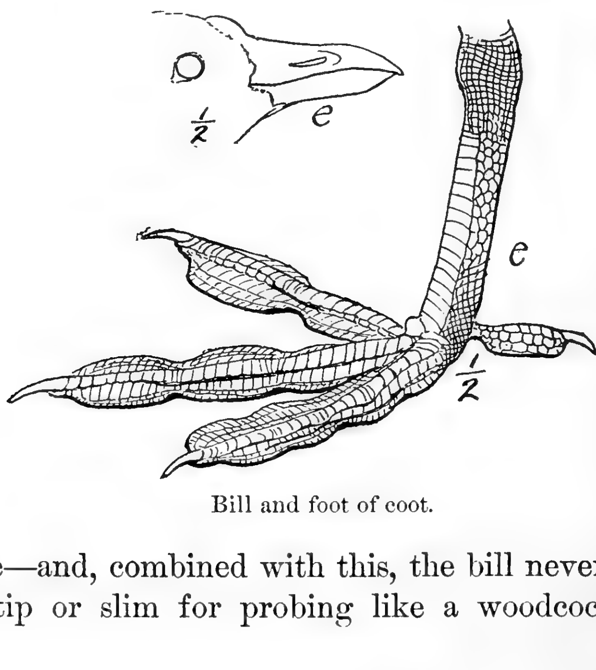
vated, and short, while herons, storks, bitterns, etc., with similar beaks, have rather long rear toes low down.

If, however, the bird is less than thirty-six inches long, then—



Bills of some rails.

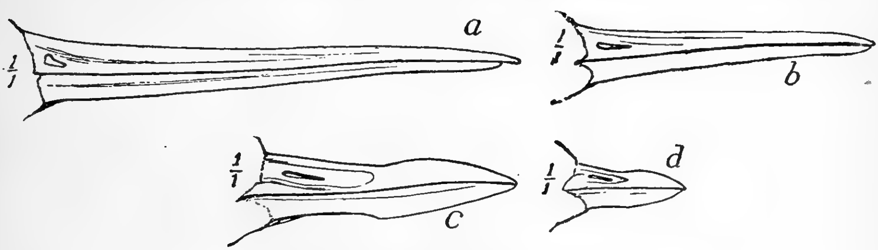
(18) If it has its wings short and rounded at the tip—the outer quill never so long as the next two or



Bill and foot of coot.

three—and, combined with this, the bill never soft at the tip or slim for probing like a woodcock's, and the front toes long and slim without any membranes, your bird is surely a RAIL proper. Or if there are marginal membranes to the long toes and a horny shield upon the head at the base of the bill (see *d* and *e*), the bird is still in the RAIL group, and is a coot (toe membranes lobed) or a gallinule (toes with straight margins). All are skulking swamp haunters, but the last swim and dive readily, especially the coots.

(19) But if the wing is long, narrow, and pointed, with the first quill as long as the next ones, or else the bill long, slim, and soft-tipped, or if the foot is membrane without any shield upon the forehead, or if the bill is spoon-shaped at the tip, or is long, keen, and bent down or up (or one side in one Old-



Some typical ploverine bills.

World specimen), and the length is less than twenty-six inches, you can set your bird down as one of the PLOVER forms.

In many of these the rear toe is wanting, and in all, when present, it is much elevated. In only one real plover (not snipes, sandpipers, etc.) is there any rear toe.

(20) Now, if the legs are feathered to the joints and the bill never like a woodcock's, you have left

all waders and swimmers behind, and had better look closely at your specimen. You may find vestiges of webs between the toes in the fowls and birds of prey especially, but other things will show you that the bird is not aquatic, such as the feathered legs, just mentioned. From this on webs are vestigial and not considered.

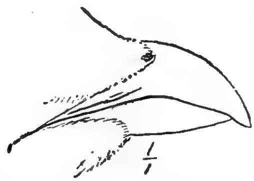
(21) Now, if the shank is evidently sharp-edged in the rear, or if the hind claw be straight and much longer than the front ones, or if the foot is ordinary and there are bristles at the gape combined with a length of rear toe and its claw that is *not* less than that of the inner toe and its claw, then pass on to paragraph (44).

But if the feet have two toes only before, or the outer and middle toes bound together for halfway; if the toes are armed with terrible talons and have warty pads under each joint; if the beak is strongly hooked in connection with any toe peculiarities; if the nostrils open into each other so they may be seen through (i. e., perforate), or if they open under soft swollen fleshy flaps, or through or at the edge of a flat (feathered or naked) membrane, called a cere, stretched across the beak at the forehead; if the gape is deep and wide, with the bill short on top, combined with either a shank that is round in the rear or with a hind toe and claw whose combined length is less than that of the inner toe and claw; or if the bird is small and brilliant, with insectlike flight or with a beak like a large needle, then you may stop here.

(22) If the hind toe is strikingly elevated and

your bird found well within our borders, especially North, it is apt to be one of the FOWL forms, but not necessarily so in Texas. Some fowls or *Gallinæ* have the hind toe down, and you can not be sure till you see that your bird has—

No fleshy swollen flap over the nostrils (though sometimes a soft membranous scale); no perforation of nostrils; no sharp-curved toe talons; no abnormal arrangement of toes except elevation of the rear; no deep *broad* gape; no size under five inches combined with needlelike bill. If all these negatives prevail, the bird is a FOWL form, whether the rear toe be up or down.



Bill of a fowl form.

The only fowl in the United States with rear toe entirely down is the Texas guan.

(23) If the bird has not all the foregoing negative characteristics it may be more easily distinguished.

(24) With soft fleshy flaps over the nostrils (claws ordinary), it is a PIGEON form.

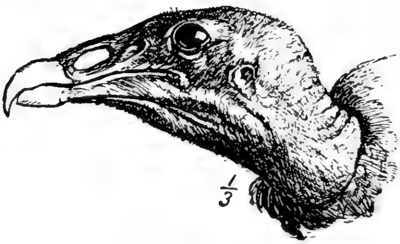
For fear you may mistake these flaps for a cere, see that the claws are blunt and the nostrils never perforate. Some of our ground doves are quite partridgelike in appearance, but their beaks are long, narrow, and rather straight on top, while those of partridges are stout, short, broad, and much curved on top. But, as noted in the last chapter, the pigeons and fowls grade so imperceptibly

Typical bill of the pigeons.

into each other in some birds that even dissection is puzzled to separate them.

(25) If the bill is strongly hooked and a flat, skin-like membrane (cere) is across it on top near the head, your bird is either a bird of prey or a parrot.

(26) If a Bird of Prey, there are never two toes permanently in the rear, and the claws tend to be very



Head of vulture.

Head of a hawk.

sharp and curved, or else the nostrils are perforate and head naked.

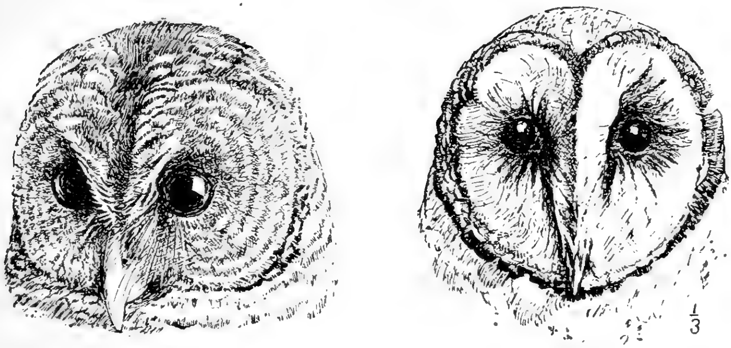
(27) If the head is wholly naked, nostrils perforate, it is a Vulture.

(28) If the head is not wholly naked, and the eyes are on the side of the head, or else the nostrils open *through* the cere *and* the outer toe does not bend back *easily* by the rear one, it is a *Hawk* or Eagle.

(29) If the eyes are far forward, with a feathered disk around each; or the nostrils open at the *edge* of the cere, and the outer toe easily turns back by the rear one, the bird is an Owl.

One owl has a hawklike face, but its nostrils are within the cere, and has its feet feathered to the claws, a tendency not strong in the hawks.

The owls all have the outer toe capable of turning either front or rear on the perch; so also has the osprey only in the hawks, but it has no disk

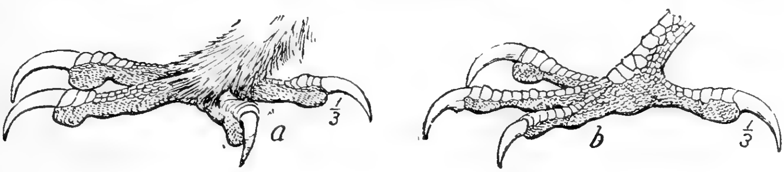


Heads of owls.

about the eye, which is well on the side of the head.

(30) But, referring again to (25)—

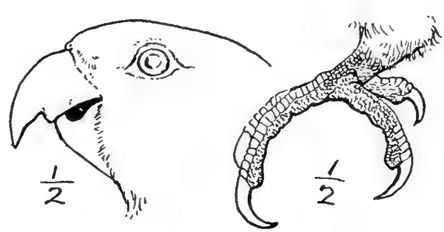
If with this hooked beak (the cere is often feath-



(*a*) Foot of owl; (*b*) foot of hawk.

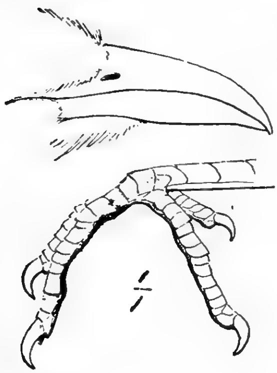
ered) we find the outer toe *permanently* reversed, the bird is a Parrot.

(31) Now, if the beak is *not* strongly hooked, as at (25), you have two classes. If the toes are normally arranged, pass on to (40).



Head and foot of parrot.

(32) But if toes are either only two in front, or the outer and middle are bound together, then—



Bill and foot of cuckoo.

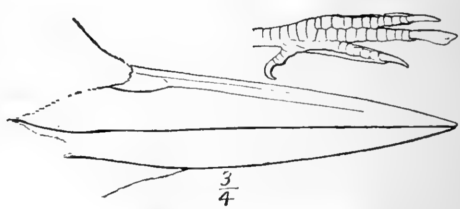
First, if the bill is long, straight, and chisel-shaped vertically and the tail feathers are pointed and stiff, supporting the bird on the tree trunk in an upright position, go to (39). If not, you have one of that wonderful group of birds called by American ornithologists the *Coccyges* or CUCKOO forms; though how a kingfisher can be a cuckoo form you may never see.

Under this head—

(33) If toes are only two in front:—

(34) First, *outer* toe reversed, bill smooth-edged and curved down, it is a CUCKOO.

(35) Second, if *inner* toe reversed, bill notched like a saw (serrate) on the edge, it is a TROGON.



Bill and foot of kingfisher.

(36) But if three toes are front, but the outer is bound to the middle for half of its length, then—

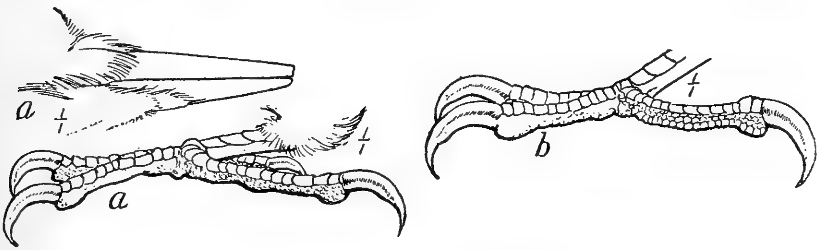
(37) First, if bill is saw-toothed, MOTMOT.

(38) Second, bill smooth, KINGFISHER.

(39) Again, if (see 32) the bill is long, straight, and has the tip thin and chisel-shaped vertically (*a*),

or the tail feathers are pointed and stiff and the bird sits upright on trunks usually or with the direction of the limb, it is a WOODPECKER. Some of these have only one toe rear and two front (*b*).

(40) Referring to the last part of (31), if the toes are not abnormally arranged (i. e., two only in front



Bill and feet of woodpeckers.

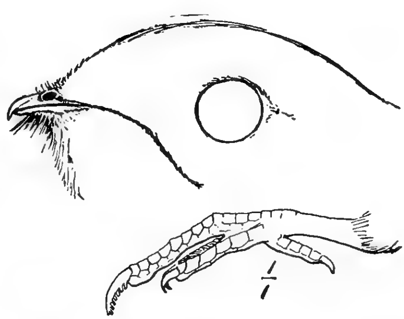
or two grown together), then all that is left is an order known as the *Machrochires*, or long- (literally large-) handed birds.

(41) If the bill is wide and short, and the gape deep (associated with a rear toe much shorter than the inner), it is—

(42) First, if tail feathers soft and round at tip, GOATSUCKER form.

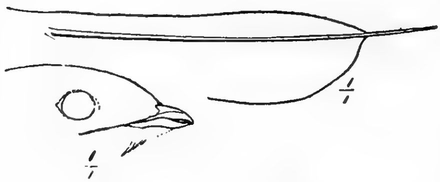
(43) Second, if tail feathers stiff and spinous at tip, a SWIFT.

(44) But if bill is long and slim like a needle, the gape ordinary, and the bird very small, with insectlike flight, it is a HUMMING BIRD.



Typical head and foot of goatsucker.

Goatsuckers have the middle toe unusually long and the others short. Swifts tend to have the rear toe elevated and grasping sidewise. Humming birds have typical perching feet, and except in appearance they are not easily distinguished from Passeres by any external trait, except that they have only six secondaries, while all true perchers have more.

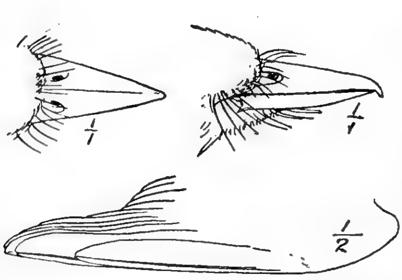


Head and tail feathers of a swift.

Head of humming bird.

Head and foot of a true lark.

(45) But if none of these fit your bird, you will find that it has, with a normal, unwebbed foot, either a shank sharp in the rear, the edge being formed by the meeting of the two smooth plates on the sides; or else the shank is round in the rear and the hind toe has a long straight claw (true lark); or the shank is round and the bill is rather short and flattened, with very noticeable bristles at the corners of the mouth, and combined with this the

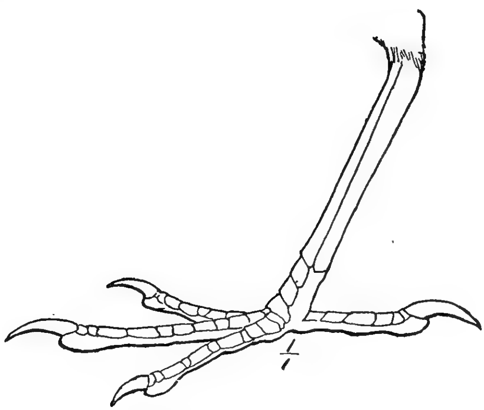


Broad beak and bristles of flycatcher —a round shanked percher.

rear toe and claw are as long as the inner toe and its claw. Then it is one of the PASSERES.

(46) If leg round in rear and hind claw never exceedingly long and *straight*, it is one of the CLAMATORES.

(47) If the shank is sharp in the rear, or if round with the rear claw long and straight, it is one of the OSCINES.



The highest type of passerine foot, showing unbroken rear side plate, forming the sharp edge of oscine shank.

CHAPTER XXXII.

ACQUAINTANCE WITH THE BIRD.

THE brief Story of the Birds is done. You know a little of their structure, their history, their pedigrees, costumes, customs, and their general development as science sees it now. But to know the aims and purposes of the individual bird when you meet it —the acquaintance with the bird itself—this, unlike the kingdom of heaven, cometh only with much observation.

It is not meant that you need know the name, though that is better for the purpose of comparing notes and reading bird literature. Some of the best of observers, so far as their own pleasure was concerned, have had names of their own for the species; but so closely had they noted every feature of color, song, haunt, and habit, that no field ornithologist would have much difficulty in knowing the bird from their name or description.

Not every one has opportunities for *observing* the bird, but many that have only *see* them. A bird is just a feathered biped to them, nothing more. Others feel that only in the deep woods or long walks should they put on their habits of Nature study, and yet, as Dr. Coues has well said of the robin, the study of many birds may be simply a turn of the head, a keen, appreciative ear, or a quick eye at the proper moment, all combined, of course, with an abiding interest.

Attention may do much under difficulties, where the field is small. Neither need "physical disabilities" or the lack of opportunities of travel stand in the way if the heart is right. One of our most observant field ornithologists is paralyzed on one side; another, young and rising, has only one arm; and a third, with an international reputation, is a woman, hampered with skirts and a great surplus of flesh.

My study has an octagonal end with three windows looking southeast, south, and southwest respectively. They are high, and the blinds are kept well up that the tree tops and the sky may be seen. Within the view directly from my desk there are (or have been) a half dozen elms, a walnut tree, two Siberian crabs, a wild crab, several rose bushes, an old stump, two trellises, and a flat-topped fence—all within fifty feet.

By leaning a little away from my desk I can see eastward many rather low evergreens (pines), and, towering high above them, a honey locust, whose long, slim, bare limbs in early spring form a favorite perch for many observant migrants.

On my table stands on its large end an opera glass or small field glass, with a focus constantly set for this view, and with simply a paper cap (to exclude the dust) over the eyepiece end of it. If it were shut snugly in its case, the bird might be in another township before the glass could be got out and focused. An opera glass is rather better than a field glass, because the focus is deeper and the field larger—very convenient qualities when the bird is skipping around. Its defining powers should be excellent.

In the drawer of the desk lies a notebook. Pardon the egotism now while we attempt to see from it what a single point of view, occupied for a few years only, may reveal of the Story of the Birds by glances at the proper time

Through the Window Pane.

For two winters some of the most interesting visitors that I had were a pair of brown creepers—rather rare birds in the region. In many rambles I have seen but one other elsewhere. Their behavior led us to think that they were members of the same family. They kept near each other, and came and went together. Their visits were usually about a fortnight apart; they always made almost exactly the same round among the elms. They began at the bottom of each, and ascended in rather crude spirals, rarely passing far into the limbs. When they wished to re-explore the bark they fluttered down again, never backing as a woodpecker may, or running head downward as a nuthatch. I could see with the glass the keen bill thrust into the deep corrugations of the bark and note the long, stiffened tail feathers and long rear claw. There was no pecking or driving at the tree—just the gentlest sort of thrusting and the closest inspection. What a wonderful range of focus that eye has which can see insect eggs a half inch away and distinguish the bark of an elm several rods off!

The third winter only one came. It had a little "chit" of a call, and the children wondered if it were talking of its absent mate. It took the same trees in the same regular order that the others had, and we felt that it was one of the old friends. It was remarkable to note how much like the trėe bark the backs of these birds were. Since they are so strikingly color-protected and build their nests in secluded places in the deep woods and lay many eggs, it seems strange that they should be so rare.

Over the rough bark of these same trees the nuthatches frequently crawl also. They are little bluish-gray birds, with white undervests—sometimes a little soiled. Their tails are ridiculously short, and never touch the tree; neither does the body, unless they are suddenly affrighted, when they crouch and look, with their beaks extended, much like a knot with a broken twig in it. I have sometimes put the bird into this attitude by clapping my hands loudly near the window. It is an impulse that seems to come to the bird before flight, especially if the head should be downward.

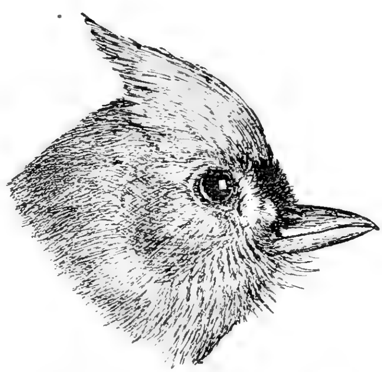
This bird's arrival is sudden, and seems often to be distinguished by turning a somersault before alighting, head downward, on the tree trunk, as if he had changed his mind so suddenly about alighting that it unbalanced him.

In the woods this busybody is "quanking" much of the time, but here he is silent, as though he feared that he might interrupt some one. It is more probable that he fears some one might interrupt him. He is very much absorbed in his work when he once gets down to it, and boys sometimes slip up on the other side of the tree and throw a hat over him. He comes much oftener than the creepers.

I once glanced out and found two nuthatches at what I then supposed was a new habit, but I afterward saw that others had noted it as an old trick of his. One spring day some little gnats were engaged in their little crazy love waltzes in the air, forming little whirling clouds, and the birds left off bark-probing and began capturing insects on the wing. They were awkward about it with their short wings, and had to alight frequently to rest. I went out to them, and so absorbed were they that they allowed me to approach within a yard of a limb that they came to rest upon, where they would sit and pant till they "caught their breath," when they went at it again. They seemed fairly to revel in a new diet and a new exercise.

These are frequently accompanied by the tufted titmouse and the black-capped chickadee. This is an association frequently noted by bird students. There seems to be no reason for it, except that the birds are all akin. The nuthatch, however, seems very exclusive, staying down on the trunk while the others explore the small limbs, and frequently hang back downward at the twig tips. Others have noticed the kinglets as frequently being in this procession, but I have never seen it thus in my yard. But the titmouse and chickadee come so often together, without the others, that I found the boys had the impression that the titmouse with the crest was the male and the black cap was his wife. I had to resort to the books to convince them otherwise, my ornithological prestige not being sufficient.

One late winter and early spring I was awakened every morning by what Thoreau calls the "fee-bee" call of the black-capped chickadee. It came about the same time of the clock from a limb not ten feet from my bed. The tones are noted for their purity—a clear, sweet *sol mi* of the vocal scale—the first note highest. To my ear it seems to be "see bee!" I studied this special bird, and learned to know his song from others. On my way down the street, if I went early, I found him later in other back yards, singing like a troubadour for his breakfast, announcing that he had come for the contents of last evening's crumb pan.



Tufted titmouse. (Natural size.)

The tufted titmouse also has a spring song—that sugary sap-rising call to "Peter-peter-peter" to get about his spiles and sugar troughs. He also is fond of the dog scrap in the back yard, and steals it off and hides it like a jay sometimes. His resemblance to a small blue jay is quite remarkable. I would bind little bits of meat skin to the limbs for these birds, but the blue jays would devour them.

These last two little birds are very greedy about meat. In the old days, when the "smokehouses" of the rural regions were of logs unchinked, these little fellows dug into the hams and middlings, and the crested tit is especially known as "meat-eater" among some old Southern folk yet.

To induce them to build with me, I put up gourds with holes too small for the sparrows, but nothing but the house wrens ever used them. In my region the tits are rather deep-woods builders.

Sometimes the downy woodpecker comes in this crowd—but oftener alone. He is especially fond of a bone. The dog likes to gnaw his under the window, so that he can watch that his master does not go out without him. Here he may leave it, and the little bird will steal up to it, rarely flying directly, but jumping awkwardly along the ground from a near tree. It is pitiable to note his anxiety and fear along with his enjoyment. No matter how good it tastes he must leave it occasionally, fly to the tree, and sneeze up his courage awhile. This on-the-ground business seems queer to him, and he is not comfortable unless his claws grasp the bark occasionally. Then he creeps to the bone again, sneezing at me to see if I am dangerous.

His larger cousin, the hairy woodpecker, comes not so often now as formerly, when the Siberian crabs had so many grubs in them.

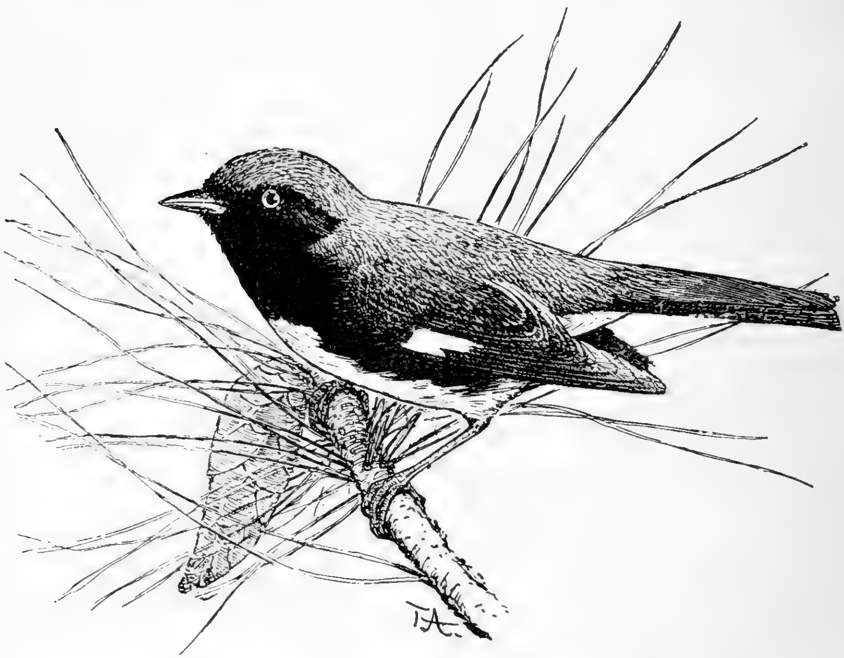
One of the trees died in spite of his diligence, but he has cleaned the grubs out of the others. He would work hard on the far side from me (which happened to be the grub side), and would throw one eye around every second or so to watch the great ogre with tubular eyes that sat in the glass cage there. How I wished I could say to him that it was all right, and that I was grateful for his services; but my silence was my best greeting. If I could not save him from the labor of eating his bread in the sweat of his face, I wanted to relieve him from that of getting his grub in the fear of his heart; but I could not.

These two little woodpeckers are frequently miscalled "sapsuckers." But they do not eat sap. They do, in plumage, and in a general way, resemble the sapsuckers, but the latter lacks the horny barbed tongue to spear the grub with, and sips the sap of trees and does not dig for grubs. (See plate facing page 149.)

For a long time I could not see this last bird, though it left its girdlings on the pines in the yard and evidently passed me every spring. Many birds stun themselves against my window panes—as if they tried to fly through the half octagon; or perhaps they see the reflection of trees in the glass. The first time I ever saw this sapsucker was just after one had stunned herself in this way. I picked her up, kept her all day, when she seemed to revive. I threw her up late that afternoon and she alighted in an elm, but next morning she was dead, but still clinging upright as if alive.

Later I have noted many other individuals in my yard, and have learned to know their plumage markings and their flight even.

The window pane has shown me other birds this way—a rare warbler now and then—and others still that my look outside would not detect. The only male humming bird I ever saw on my place was try-



Black-throated blue warbler. (Reduced.)

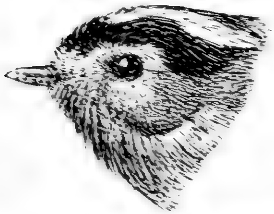
ing to come in at my window pane, but when I arose to let him in he left. I wish that I could take to myself the compliment that he desired to visit me, but I fear he thought the reflection of his pretty self was a rival, and he wished to fight it. Female hummers come often, but males are strikingly absent.

The vireos come out on the twig tip not three yards from the glass.

Above, the vireos come out on a twig tip not three yards from the glass, and "keep everlastingly at it" with their warbling. Once I saw the cuckoo on an outer elm swing head down to get a caterpillar, and then fall with dangling feet and swing to the *larva* with his beak to jerk it loose. Then he fell further, caught himself in the air with his wings, alighted and slung his prey till he eviscerated it dexterously and then swallowed it. Again, I have had the purple finch stop with me and sing his charming song to his mate, and heard her warble back in response—a rather rare thing in birds.

Referring again to the kinglets, they come at a certain early spring date before the leaves are fully expanded, and flutter upward, while they take something from beneath the budding leaf or twig. It is a peculiar motion, which with their restless ways, olive-green color, and small size, readily distinguishes them. It is rare that one is still. But the ruby-crowned sometimes favors me with a song, and as it is a little long, he usually is quiet till done. It is one of the sweetest little lullabylike strains that comes to me. One day I saw him in the rosebush just near voluntarily expand the plumage of his crown and show the brilliant golden-ruby feathers beneath. Usually they are mostly concealed. It was a rare treat, and visible to me only because of my rather exalted view. He usually reserves this display for his mate, but he was here among some snowbirds and tree sparrows, and seemed to be trying to make these plain folks envious of the pretty feathers in his hat.

Of course the snowbirds come. They like the seeds of the "wet weather" grass near the window. As they feed they constantly flit out the white tail feather as a signal, but one rushes fiercely at his fellow if he feeds too near. The tree sparrow also feeds with them. This association is perhaps a fellow feeling because both are so far from home now. I fall out a little with the tree sparrow, because he does not sing in the yard. In the woods he is musical at intervals all winter. Sometimes in spring my glass shows the Oregon snowbird stopping among the others, as he goes up North. Later the snowbird fairly giggles under the pines at the prospect of his journey; and, taking his song all around, it is better than none a great deal, and is cheering because it is always a dirge to winter.



Golden-crowned kinglet.
(Natural size.)

The number of birds that come in view depends upon the weather. I often wonder where they are when not with me. Even a walk on some days will scarcely reveal a feather. I suspect that this is as largely a matter of sitting still and keeping silent as it is the result of retiring to deeper cover.

After the blackbirds come to the yard, however, they *stay*, rain or shine. Six or eight couples nest with us regularly, and, till ready for business, they perch on the honey locust, especially about "retiring time," and have a sort of wheezy concert. Then they go below and have a little quarreling about upper and lower berths in the pines. If there is any wind at all they always perch on the bleak twigs of the locust with their heads toward it—true as weather vanes. Later in the season they walk the sward with a lordly stride and a dignified "chuck," very different from the undignified fluffing up and asthmatic serenade that prevailed before pairing. Later still they choose, after their young are out, some one else's yard for a roost, and my gratitude goes with them.

In late summer the sward is a favorite resort for the young flickers. They dig into the little ant hills. In the spring one of them is sure to find that the top of the box where the newsboy leaves the paper is an excellent drum on which to sound his "alarm to wake the spring up," as Thoreau has it.

He gets so engrossed at this that the boys have crept up by stages and thrown a hat over him. Of course with all this racket he can not hear footsteps, or see anything but stars, probably. Sometimes, too, several assemble in the elm near the fence, and go through their silly love antics. After all, this is better than fighting, but it has always lessened my respect for a bird that otherwise showed such dignity and common sense. "Love makes fools of us all," some one says, but no one beneath my window is so silly as the flicker. Over the fence is the usual hole in a decaying apple tree where a pair nest.

One April day, just at dusk, I saw a flicker settle into a crotch of an elm near the fence. I went out and she was evidently intending to sleep there, but some one passed and she left. Next night she came again, and was there when I left her. Next April I chanced at the same time of day to see the flash of a wing at the same spot. It was the flicker again, and by stealing around I saw with the glass that it was a female. Was it the same? I can only think so. Perhaps it was on its migratory journey farther North, and not acquainted with the best (hotels) sleeping places of the region, else she would more likely have been in some hole. But I found her sleeping there later through the summer. Many flickers doubtless roost in exposed places.

The jay is nearly always in view, and I saw him one spring make the flicker almost ashamed of himself, while he danced on the ground before his mate. His pirouettes were as graceful as those of the average dancer, and he always kept his back with its brilliant markings toward his partner. Like some others, he may have felt that his strong points lay neither in his head nor his heart; so he went in strongly on his feet and his figure.

I often wonder if they are the same that are hatched in the yard. From a certain suspiciousness I suspect not. But this is a poor criterion. Many birds, as robins, are wild in winter and confiding in summer. The little boy had a pet jay one summer which, when grown, escaped to his parents. I often met him out, when he would whine back an answer to my call, and flutter his wings begging me to come and feed him, but never suffering a near approach. Inasmuch as he left us late in the fall I suspected that he migrated; and the winter jays in my yard may be from farther North.

I like the jay in the winter. He gets upon the elm limbs and vigorously hammers an acorn, or takes a wild crab to the fence top and splits it for its seeds. Away from the callow nestling and the newly laid egg of other birds he picks up an honest living, and is fairly respectable—so much does decency depend upon environment. He is rarely "loud" in winter, unless he finds a luckless screech owl, and he wears his good clothes all the year round. I saw him engaged in the walnut tree one day in late summer in a manner that made me fear that his bath had not been sufficiently effectual. He would pluck off a leaf, lift his wing and rub it into his plumage. I saw him do it repeatedly; and since walnut leaves have a pungent odor and are disagreeable to insects, I feared that he had some guests that he was trying to get rid of. If this theory should be correct, here was a case of a bird using perfumes, with at least good intentions.

Scops, the screech owl—much to the discomfort of the jays—spent a summer with us once, and in his shuddering way, gave us several evening serenades from the trellis. I suspect that he was a bachelor. When winter came he hunted a home in the shaft ventilating the unused cellar under the woodhouse. It was smooth inside and he fell to the basement below, where he was found, evidently some weeks later, in such a state of fasting that his sins must have come up heavily before him. He became the household pet for a while, but always remained meditative, refusing to eat except at night, and refusing to sit in our laps unless his back was stroked. He never grew gentle and was set free. Next winter, either he or another like him, made the mistake about the cellar shaft again. Both were of the red phase, and we wondered if the second one were the old Scops, with a bad memory.

Once a mocker wintered in the yard. It was, perhaps, a female turned out of a cage too late to migrate.

Of course robins and bluebirds came about in abundance, and a volume could be written about their vagaries. Since beginning this chapter, I have seen two robins fighting out on or near the fence. After a struggle they each sat awhile on the top plank and rested. I admired the methodical manner of their madness. There was no bantering or strutting or feinting or swearing at each other, or calling names between the rounds. When they had got their breath they went at it again, and rolled and tumbled on the ground till one fled. The robin times himself well and impresses one as being a success. Sometimes I play a joke on him by pegging down one end of a twine string, at which he pulls as he flutters up with it toward his nest. It takes several attempts to convince him that some one is experimenting with his perseverance.

I glanced out the other direction once and saw two female bluebirds fighting. One was our home bird with a nest in the yard, the other was a stranger trying to get the hole for herself and husband. The males fluttered above the battle with an appearance as if they were both shocked at the performance—always musical—for they have no scolding note, and fight singing. Shortly the home bird bore the other down in the watering trough. She got a little damp herself, but was able to fly. Her mate followed her up to the home box caroling of her prowess. But she looked indeed as "mad as a wet hen," and seemed to say by her manner that if he were half a man she would not have to do everything. I went out and took the other female out of the water where she was rapidly chilling to death, being too exhausted to rise. She simply floated, flapped her wings and cried piteously, like her tribe's autumn call. I wrapped her in flannels, put her near the kitchen stove, and she recovered. I have often seen similar fights with all four birds engaged. It is as musical as an opera—and has more sense in it.

So the rose-breasted grosbeaks have come under my window to fight. They, too, are always musical in battle, but their crimson breast spots give the affair quite a gory aspect. Sometimes I am aware of a battle outside merely by the sound of snapping beaks that come through the open window. Usually the jays, robins, and blackbirds, which are much of a size, settle these matters between them early, and live peaceably afterward.

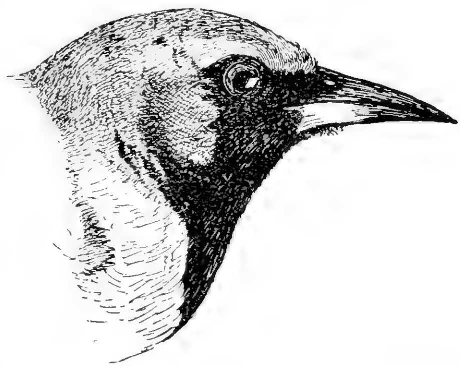
Of course, my standpoint shows me many transient birds. For many springs the olive-backed thrushes have stopped over with us for weeks, getting more abundant and confiding each year, and breaking recently into song. At first I could not well identify this bird through a glass. The "distinct orbital ring" of the books was not so distinct. And the spots on the breast at one time did not appear as at another. I did not want to shoot one, so I wrote the Smithsonian folks about their specimens. There was a throat stripe that bothered me, and not till I read from Mrs. O. T. Miller that the spots on the breast of the wood thrush form a line when the bird bunches itself for sleep, did it flash upon me about my olive backs. A mark was a stripe or a series of spots according to the position of the bird. I subsequently found a flicker with his mustache in spots—like a stripling's.

Through the window pane I have had under my glass various warblers, and identified them without slaughter. In the rosebush just beneath me I saw the yellow-crowned notching the leaves—I know not why, for he did not swallow the bits—saw both the eastern and western Maryland yellowthroat come on the same day; and beneath this bush the ovenbird has made his mincing steps once. The white-crowned sparrows and the Peabody birds, or white-throated sparrows, scratch beneath the one that is farther out, and the latter linger around for weeks, trying to get through with their wailing song and rarely doing it.

The goldfinches, the orioles, and others are around in season, but the Baltimore will not honor me any more with a long nest, but builds a shallow cup above me; rather, he does honor me with the shallow nest, for it shows that he puts great confidence in my pro-

White-throated sparrow.
White-crowned sparrow.

tection. The orchard oriole prefers my neighbor's orchard just beyond, but feeds in my yard; and last summer, a little fellow that had married without his wedding garment, brought the sole output of the season—a squabby cowbird—into the wild crab to feed him. I went out, and as I stood under the squab, and he was constantly "chitting" for more food, there flew down to him a female cowbird and sat near him and seemed interested in him. I waited patiently to see if she would break the record by feeding him; but in a few minutes she flew off with her "glassy" call (as Burroughs has so well called it) after her mates. I could but wonder if the youngster was hatched from her egg, and if any maternal feeling had been stirred in her breast by the call of this babe of her own blood. It may have been a remembrance only of her own babyhood, for cowbirds do not have this "chit" when they are grown. Well, I was studying the development of young birds' wings and wanted a specimen, and as the life of every cowbird means the death of several other little bird's equally useful, and these young people were being seriously imposed upon, I took this orphan off their hands. Some birds I have



Immature plumage of male orchard oriole—all the body yet yellow, but the throat black.

to discourage occasionally—the sparrows always; and when a jay just lies around and watches for the young wren, he receives some very warm suggestions about space being better than company.

Over the fence—but we can't go over the fence—in this little book.

Of all the little birds, he that gets nearest to me through the window pane or elsewhere is the house wren. He is a little loud, and does not get along well with his neighbors, but I love him for his stimulating presence and his confidence. We have spoken elsewhere of his greedy building habits. He soon took possession of all the gourds set for the chickadees, filled them full of rubbish, working long sticks in miraculously, and singing all the time. He fights anything—light weight or heavy—jeers at every bird, and trusts none of them. I saw the pair utterly rout a pet squirrel that had run up their home tree. They struck him repeatedly on the side of the head. The mother wren can find more grubs, worms, etc., to the minute than any hunter under my window. One day I saw her dig up a very large beetle, and she seemed to get something from him, as she rolled him over, though she was wonderfully afraid of him. When I went out I saw under a magnifier that he was infected with spiderlike parasites, but while rather large for parasites my unaided eye did not detect them.

Working in the garden one day I found the male wren almost at my feet, and taking out my opera glass I saw that he was spider hunting. He soon found a large woolly one and was quite afraid of it, for it threatened to run at the bird. I never saw him quite so timid before. But he tiptoed around it and put in a stroke now and then, till finally he was rising high on his legs and driving his beak home fearfully. Before "the finish" I interfered, and he walked only a few feet away as I inspected his prey. Then I stuck a straw by it and walked around him that he might again renew the battle. But although he searched diligently he could not find it. I was disappointed in his powers of location, but I felt more charitably toward him after I myself had again searched and could not even find the straw I had stuck up. I thought that his trill from the apple tree had a strain of irony in it.

A few evenings later, just at dusk, as I was pushing the lawn mower under a maple, he came and nestled down into a little basketlike crotch just over my hat, and, after watching me a few seconds, put his head under his wing and went to sleep. I got a box and mounted up with my face not a foot away. I could easily have taken him in my hand. Fearing that he might be ill I spoke to him. He raised his head, looked into my eyes a moment, and again put his head under his wing. I crept away from him. Next night I stole out and again found him in another little crotch near by, sleeping so soundly that he never seemed to know that I had looked in upon him, nor that toward his little feathered form my heart had gone out so warmly.

Why should not a man love a bird? If the palm of one should clasp the pinion of the other there would come together two of the greatest implements God and Nature have ever given any creatures to explore the world with; and when the two bipeds gaze at each other eye to eye, the intelligence in the one might well take off its hat to the subtle instincts in the other.

INDEX.

THE END.

CAMP-FIRES OF A NATURALIST. From the Field Notes of LEWIS LINDSAY DYCHE, A. M., M. S., Professor of Zoölogy and Curator of Birds and Mammals in the Kansas State University. The Story of Fourteen Expeditions after North American Mammals. By CLARENCE E. EDWORDS. With numerous Illustrations. 12mo. Cloth, $1.50.

"It is not always that a professor of zoölogy is so enthusiastic a sportsman as Prof. Dyche. His hunting exploits are as varied as those of Gordon Cumming, for example, in South Africa. His grizzly bear is as dangerous as the lion, and his mountain sheep and goats more difficult to stalk and shoot than any creatures of the torrid zone. Evidently he came by his tastes as a hunter from lifelong experience."—*New York Tribune.*

"The book has no dull pages, and is often excitingly interesting, and fully instructive as to the habits, haunts, and nature of wild beasts."—*Chicago Inter-Ocean.*

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"The adventures are simply told, but some of them are thrilling of necessity, however modestly the narrator does his work. Prof. Dyche has had about as many experiences in the way of hunting for science as fall to the lot of the most fortunate, and this recountal of them is most interesting. The camps from which he worked ranged from the Lake of the Woods to Arizona, and northwest to British Columbia, and in every region he was successful in securing rare specimens for his museum."—*Chicago Times.*

"The literary construction is refreshing The reader is carried into the midst of the very scenes of which the author tells, not by elaborateness of description but by the directness and vividness of every sentence. He is given no opportunity to abandon the companions with which the book has provided him, for incident is made to follow incident with no intervening literary padding. In fact, the book is all action."—*Kansas City Journal.*

"As an outdoor book of camping and hunting this book possesses a timely interest, but it also has the merit of scientific exactness in the descriptions of the habits, peculiarities, and haunts of wild animals."—*Philadelphia Press.*

"But what is most important of all in a narrative of this kind—for it seems to us that 'Camp-Fires of a Naturalist' was written first of all for entertainment—these notes neither have been 'dressed up' and their accuracy thereby impaired, nor yet retailed in a dry and statistical manner. The book, in a word, is a plain narrative of adventures among the larger American animals."—*Philadelphia Bulletin.*

"We recommend it most heartily to old and young alike, and suggest it as a beautiful souvenir volume for those who have seen the wonderful display of mounted animals at the World's Fair."—*Topeka Capital.*

Dear Sir:—

As a token of your kindness in answering questions & otherwise making helpful suggestions I trust you will accept this little book as a token of my appreciation of what you have done

for me. Some of its hy-
potheses you will doubtless
not indorse, and if you
choose to express any dis-
senting views, it would
give me great pleasure to
learn of you.

Very Sincerely Yours
James Newton Baskett.

Dr. Leonard Stejneger
Washington D. C.