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DIVISION OF BIOLOGICAL SURVEY—BULLETIN No. 17
C. HART MERRIAM, Chief

BIRDS OF A MARYLAND FARM

A LOCAL STUDY OF ECONOMIC ORNITHOLOGY

BY

SYLVESTER D. JUDD, Ph. D.
ASSISTANT, BIOLOGICAL SURVEY

PREPARED UNDER THE DIRECTION OF
Dr. C. HART MERRIAM,
CHIEF OF BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1902

FIG. 1.—DWELLING HOUSE ON BRYAN FARM.

FIG. 2.—VIEW OF THE POTOMAC FROM BRYAN HOMESTEAD, SHOWING FEEDING PLACES OF GULLS, DUCKS, AND OTHER WATERFOWL.

Mount Vernon in the distance.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Washington, D. C., July 5, 1902.

Sir: I have the honor to transmit herewith, for publication as Bulletin 17 of the Biological Survey, a report on the Birds of a Maryland Farm, the same being a local study in economic ornithology by one of my assistants, Dr. Sylvester D. Judd. Acknowledgment is made to the Entomologist for assistance in the determination of some of the insects, as well as for the use of certain illustrations.

Respectfully,

C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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BIRDS OF A MARYLAND FARM.

I.—INTRODUCTION.

The principal method used by the Biological Survey in investigating the food habits of birds is examination of the contents of stomachs, the material for which is obtained from all parts of the United States. In the case of each species the separate data accumulated by examining as many stomachs as possible are tabulated and show the food of the bird in question to consist of various proportions of certain elements. This method, combining as it does data from many parts of the country, gives results necessarily somewhat composite, but certainly trustworthy, and shows to what extent a bird eats fruit, grain, or insects, thus furnishing a comprehensive and detailed knowledge of food habits that probably could not be obtained by any other available means.

In a study of local conditions, however, general conclusions regarding the utility of a bird based on data from perhaps a score or more of States may sometimes require modification. For instance, from a study of the smaller herons from material collected from North, South, East, and West the conclusion would be drawn that they live on food of no economic value and are therefore unimportant species. But a study of these birds in the State of Louisiana alone shows them to be highly useful, for here they prey on crayfish, which, by tunneling through the levees, cause great damage to crops by flood. In similar ways the relations of birds to a certain locality or particular farm can not always be exactly tested by conclusions drawn from a large range of territory. The exact damage to crops is not revealed by stomach examination. A bird may have punctured several grapes in each of a hundred clusters and yet betray to the microscope no sign of its vicious habit. On the other hand, a bird may be condemned as injurious because it is found to have eaten berries or grain, although, as a matter of fact, it has taken the berries from wild plants and gleaned the grain after harvest. Then, too, the material examined at the Department is not usually accompanied by notes of the available supply of fruits, seeds, and insects present at the places where the birds were collected. Such information would be a significant supplement to the results of stomach examination. The faults of a fruit-eating bird might be condoned if it were found to rob the garden and orchard only when the thicket and pasture were barren. And the value of birds as insect destroyers in any particular locality

can be understood only when one knows just what crops of the region are infested, and the identity and importance of the pest by which each is chiefly attacked; for only then can one learn which birds select the worst pests and destroy them in the largest proportion.

With a view to ascertaining how far local conditions might modify the details of general conclusions based on data from widely separated regions, a study of the food habits of the birds on a particular farm was undertaken. From July 30, 1895, to July 24, 1902, visits were made at frequent intervals and including every month of the year except January. To obtain an idea of the available food supply, the insects, berries, and seeds found on the place were collected; the condition of the crops and the insects infesting them were noted; detailed observations of the birds' food habits were made in the field, and the stomachs of 698 birds were collected and examined, 53 being those of English sparrows and the remainder (645) those of native species. One of the most serious disadvantages attending the work is that from such a limited area one can not examine stomachs enough to get a thorough knowledge of the food of each species, and is often compelled to rely, for the general idea of the food, on conclusions drawn from material collected elsewhere. Still, such information, supplemented by the knowledge gained from local stomach collections and field notes, has made it possible in most cases to determine whether a given species is, on the whole, helpful or harmful to the farm in question.

TOPOGRAPHY OF BRYAN FARM.

The farm chosen for this investigation is the Bryan farm, at Marshall Hall, Md., on the south bank of the Potomac, 15 miles from Washington, directly opposite Mount Vernon, Va. (see Pl. I, frontispiece, fig. 2). The former owner of the farm, Mr. O. N. Bryan, was an enthusiastic collector of birds, plants, and Indian implements, and was known to many Washington scientists. On his death, in 1892, his collections were given to the National Museum. The farm passed to his nephew, Mr. George R. Bryan, to whom the author is indebted for permission to conduct these investigations on the place, and for cordial cooperation and uniform courtesy throughout their course. The farm contains about 230 acres, of which 150 is cultivated and most of the remaining 80 covered with timber, principally hardwood interspersed with pine. The arable land, forming as it does nearly two-thirds of the farm, is all in one tract (see map, Pl. II). Its western limit is a straight line of fence separating it from the next farm; its northern boundary, almost twice as long, is the nearly straight shore of the Potomac River, which here flows from east to west. A small bay, formed by an indentation of the river shore (Pl. III, fig. 1), a calamus swamp, 200 yards long (Pl. VII, fig. 1), which drains into the bay, and a tract of woodland (Pl. XVI, fig. 2) form

the eastern and southern boundaries. The uncultivated part of the farm consists of timber tracts, level except about the swamp, where the land rises on two sides, the eastern rise forming a little wooded hill more than 100 feet above the river (Pl. VII, fig. 2).

The cultivated area is a level, alluvial bench extending back from the river a half mile to foothills (Pl. III, fig. 2). It is divided into five approximately equal lots, two along the southern or woodland boundary and three along the northern or river boundary. A straight line of fence parallel to the river separates the three river lots from the two inland lots. The river tract is rectangular, about three times as long as broad, and extends east—that is, up river—several hundred yards farther than the inland tract. A bushy draining ditch, which will be designated throughout this paper by the local name Persimmon Branch, stretches lengthwise through the middle of this area from the calamus swamp to the lower or southwest corner of the farm, where it empties into the river by a swampy, timbered outlet. Persimmon Branch is joined not far from its river mouth by a tributary—locally known as Partridge Branch—that drains the western inland lot. The other inland lot has no ditch, and part of it is often wet; the side toward the swamp washes badly during heavy rains. It has been found convenient to designate these lots by numbers, the three along the river being numbered 1, 2, and 3 and the others 4 and 5 (see map, Pl. II).

The farm meets the river in a precipitous, tree-fringed bluff from 20 to 30 feet high, which at low tide has a strip of sandy shore (Pl. IV, fig. 1). All the buildings but one stand at intervals on a road running along the brink of the bluff. In the middle of the river front of lot 1 are the house, surrounded by a yard with a paling fence and shaded by great locusts, and a horse barn with its corn house (see Pl. I, frontispiece, fig. 1). In lot 2, touching the line dividing it from lot 1, is a cow barn, and at the middle of lot 2 is a negro cabin. A storage barn stands several hundred yards south of the cabin, at the northwest corner of lot 4 (see map, Pl. II).

The staple products of the farm are corn, wheat, and tobacco in irregular rotation with timothy, which furnishes the winter supply for some half dozen cows and about as many horses. In recent years market gardening has been attempted on a small scale, in the light, sandy part of lot 3, between Persimmon Branch and the river. It is seldom that even two-thirds of the five lots is under cultivation at once. Of the remaining third or more, 5 to 10 acres is usually devoted to timothy, and the rest is worn-out mowing lands and weedy old cornfields (Pl. V, fig. 1). Broom-sedge, which in spring makes good pasturage but later is refused by stock, comes into these cornfields after the first year, and, in time, into the timothy fields (Pl. XIV, fig. 3). Of the cultivated area, as much as 30 acres is sometimes devoted to corn. A smaller acreage is given to wheat, and still less to tobacco

(Pl. VIII, fig. 1), which, however, is the most steady in price, and during good years the most profitable crop. Vegetables, strawberries, pears, grapes, and quinces are grown in an inclosed kitchen garden adjoining the dooryard on its upper side. Beyond is a hog lot of several acres, with a small wooded gully leading down to the river and affording shade to the dozen or more hogs that range there (Pl. IV, fig. 2).

DISTRIBUTION OF BIRDS.

After this preliminary account of the topography and the products of the farm we may consider the birds and their relation to the crops. The whole farm with its arable land, river shore, steep bluff, and low calamus swamp bordered on one side by the high hill and on another by the extent of level forest, presents conditions so varied as to attract many different kinds of birds. The actual distribution of the various species is of great importance. Other things being equal, those that live on the arable land, and thus have the best opportunity to check the work of injurious plants and insects, may be expected to do the greatest good, while such as frequent only the swamp or the remote woodland have little effect on crops.

BIRDS THAT FEED IN OPEN FIELDS.

Meadowlark.—The meadowlark (fig. 1) is a good example of species

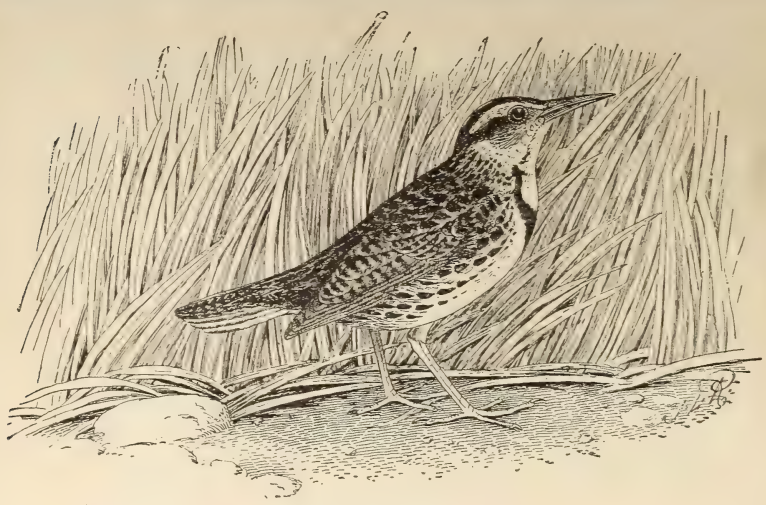
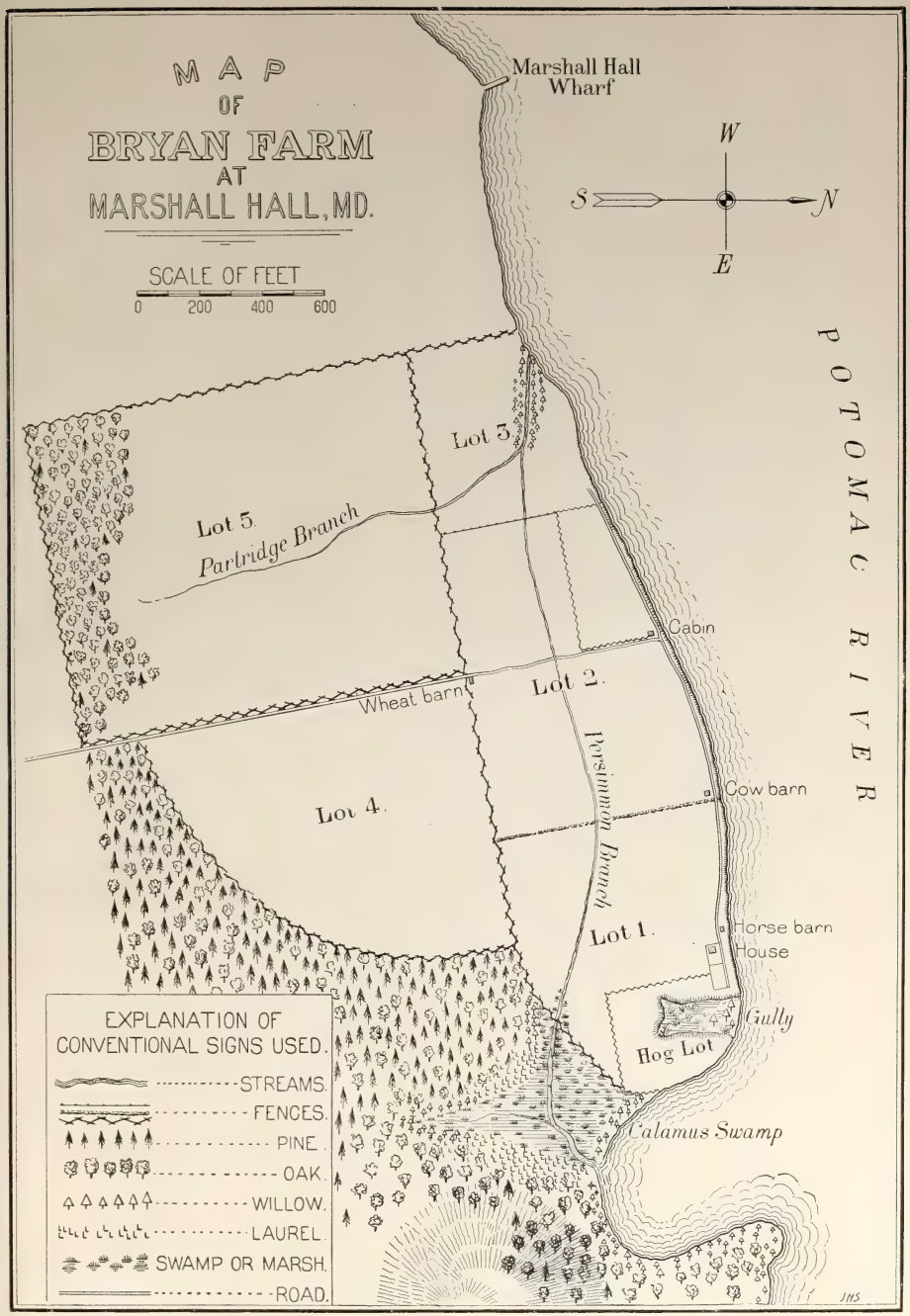


FIG. 1.—Meadowlark.

of the former class. It was found breeding in all the lots, usually in a timothy field or an old weedy cornfield (Pl. V, fig. 1), and was present in numbers sufficient to do much good. In late summer flocks of 20 were often seen, and in November usually more than twice that number. These birds in their feeding completely covered the open parts of the lots, and came fearlessly up to the barns and foraged within a stone's throw of the house.



MAP OF BRYAN FARM, WHERE THE INVESTIGATIONS WERE CARRIED ON.

Grasshopper Sparrow.—The grasshopper sparrow is even more exclusively a bird of the open land than the meadowlark, for it seldom flies up from the fields to perch in trees. During the period of observation it happened to breed for the most part in lots 1, 2, and 3, choosing timothy fields or pastures (Pl. V, fig. 2), or weedy, briery cornfields. It was often seen feeding in lot 5, but was seldom observed in lot 4, probably because the rotation of crops in that lot did not happen to provide favorable grass land.

Bobwhite.—The bobwhite—the quail of the North and the partridge of the South—is also a bird of theopen, though it has the habit of flying to cover when alarmed. Bobwhites were frequently found in coveys of a dozen or more in lots 4 and 5. On being flushed they sought shelter in the neighboring oak woods, where they spent much time, especially in fall and winter. In summer they lived chiefly in the open lots of the farm, where they nested. From the time that corn was 3 feet high until it was cut, they used it for cover. They were not as closely confined to grass land as the grasshopper sparrows, but foraged in every lot, and appeared to come in closer contact with crops than did any other species on the farm.

Mourning Dove.—Among the birds of the first class may also be included mourning doves (fig. 2) and crows, which, though not nesting on the arable land, were always to be seen feeding there. The doves nested in small pines in the more open parts of the adjacent woods. As their food is weed seed and waste grain gleaned on stubble-

FIG. 2.—Mourning dove. (The background of this picture is typical of the Bryan farm.)

fields, they avoided fields of timothy and broom-sedge and areas under actual cultivation and foraged in waste corn land and on wheat stubble, where, for a time after harvest, they obtained wheat and, later, abundant seeds of ragweed. They were often observed in lots 2 and 3 feeding on the seeds of oxalis, spurge, and other weeds that grew among old cornstalks, and in fall worked among the rank weedy growths that overran the truck land between Persimmon Branch and the river; but they were more often seen in lot 4, which was near the woods where they nested, and which furnished them wheat stubble or new corn stubble with their favorite pigeon-grass. At harvest time and later the flock of doves numbered a score or more. Their feeding grounds changed from time to time according to the rotation of crops. They did not approach the buildings with as much confidence as did the meadowlarks and the bobwhites, and thus lost some effectiveness as weed-seed destroyers.

Crows.—Both the fish crow and the common crow occurred on the farm, but the latter species was much the more abundant. Crows nested in the scrub pines (*Pinus virginiana*) which grow among the white oaks and red oaks bounding lot 4, and bred also in the woods across the calamus swamp, where, in addition to the trees just mentioned, there is a sprinkling of cedar, sycamore, and holly. Their favorite feeding grounds in spring were newly plowed fields where May-beetles and cutworms were to be found. Even when such fields were close to buildings the crows, though usually shyer than the doves, watched for opportunities to visit them, and many times were noticed in the early morning stalking along the furrows, sometimes within a few rods of the cabin, cow barn, and storage barn. As they did not often enter the timothy fields, which were tenanted by meadowlarks and grasshopper sparrows, and as these, on the other hand, were seldom seen on plowed land and among the hoed crops where the crows constantly foraged, the work of the latter was, in a measure, complementary to that of the former.

Blackbirds.—The crow blackbird, although it did not nest on the farm, was a frequent visitor. During the breeding season its favorite haunt was the cherry trees along the river bluff, but in spring and fall it foraged in flocks over all the lots of the farm. Sometimes with this bird, but more often in separate flocks, the rusty grackle visited the farm during migration. At this time also, the cowbird, often in large flocks, appeared in the open fields and helped to reduce the weed-seed harvest; but during the breeding season the species was limited to several pairs, which were generally to be seen walking about the pastures at the heels of the stock.

Other birds.—The robin, though not breeding at Marshall Hall, was abundant in spring and fall, and might be found foraging out in the centers of the largest fields. The goldfinch showed the same fondness

for the open and was often observed feeding far afield in flocks of from 100 to 300. Of the birds of the open, that fed far out in all the five lots and did not depend on adjacent cover, there remain but two to be mentioned, the vesper sparrow and the savanna sparrow, which visited the farm only during migration, but helped, nevertheless, in the valuable work of destroying weed seeds.

BIRDS THAT DEPEND ON COVER.

Cover furnished by farm.—Other species, mainly sparrows, though occurring on the arable area, fed less generally out in the centers of the fields, and depended on protecting cover. This was afforded in part by an osage orange hedge which bounds three sides of lot 2, and by blackberry bushes and cedar and sassafras trees along fence rows. Excellent cover was furnished, also, by a narrow belt of locusts, cedars, and cultivated cherry trees along the edge of the river bluff, and by a tangle of blackberry, honeysuckle, smilax, wild grape, bittersweet, and trumpet creeper that grows under the trees and in many places covers the face of the bluff (Pl. VI, fig. 1). Other good cover, nesting sites, and feeding grounds are afforded by the trees and bushes around the house, by the forested gully of the hog lot (Pl. IV, fig. 2), and by the timbered outlets and bushy upper courses of Persimmon Branch and Partridge Branch. (The course of Persimmon Branch near the outlet can be seen in Pl. XII, fig. 2.) To the thickets of the hedgerows and streams is due the presence on the arable land of many species that would not live on unwatered and wholly cleared farms.

Field Sparrow.—The field sparrow, which appears so often in the open that it may almost be grouped with the preceding class, is found, on observation, to be dependent on cover. But it is a bird of the broom-sedge and briers, and its presence is not conditional on the neighborhood of large trees, water, or buildings, as is that of some other sparrows. Its nesting sites included each side of Persimmon Branch, the broom-sedge and dewberry tangle of the high part of the hog lot (Pl. VI, fig. 2), and the crest of the bluff overlooking the swamp. After the young were fledged small flocks of two or more families followed the branches, hedgerows, brush piles, and fence rows all about the arable part of the farm, even finding their way along a rail fence to tobacco seed beds in the woods. The field sparrows avoided timothy, but foraged far out in weedy old cornfields where the stalks remained standing, and when new corn had tasseled they fed under its shelter. They were found with most certainty, however, in waste grounds bearing little but broom-sedge and briers.

Chipping Sparrow.—The chipping sparrow, the field sparrow's congener, in conformity to its semidomestic habits, nested in the door yard, the kitchen garden, the adjacent orchard, and cedar trees near the storage barn. It was characteristic of roadside and rail fence and

foraged in cropped pastures and among hoed crops. Unlike the field sparrow, it sought cover, not in bushes, but in trees isolated as in orchards. On account of these habits its work is more or less complementary to that of the field sparrow. Neither species was noticed feeding to any important extent in standing timothy, the habitat of the grasshopper sparrow, but they both destroyed weed seeds and insects over a large part of the farm, even out in the center of lot 4 far from cover. In August and September they fed together in loose flocks along fence rows. At this time there were nearly a hundred of the two species, the chipping sparrow being the more numerous.

Song Sparrow.—The song sparrow (fig. 3) is a bush bird, which, though feeding on the ground, is generally too cautious to venture far afield. It is essentially a bird of the waterways, and bred in the undergrowth along Persimmon Branch and the river, in the hog-lot gully, and about the calamus swamp; yet, like the chipping sparrow, it came with confidence up to all the buildings. It foraged over the garden and dooryard and along a strip several rods wide extending from the house to the mouth of Persimmon Branch. In feeding here it usually avoided the open parts of newly plowed fields, but ran amid corn, wheat, tobacco, truck, and timothy, and, as will appear later, did considerable good in this way. It spent much time along the river shore, however, and thus wasted opportunities for protecting crops. In summer it was less abundant than the chipping sparrow or the field sparrow, but after the breeding season it came down from the North in great flocks and did good work among weeds.

FIG. 3.—Song sparrow.

Other native sparrows.—Fox sparrows, and many tree sparrows, juncos, and white-throated sparrows also come down from the North in the fall. The fox sparrows are cover loving birds, and frequented the tangle of the river front and Persimmon Branch, seldom venturing more than a rod into the fields. The whitethroats usually associate with song sparrows, and were found all along hedgerows and waterways. The tree sparrows associate with field sparrows, and like them preferred broom-sedge fields, though they, too, often followed the

FIG. 1.—BAY AND HILL ADJACENT TO CALAMUS SWAMP.

FIG. 2.—BRYAN FARM FROM THE RIVER, SHOWING SHORE, BLUFF, ALLUVIAL PLAIN, AND FORESTED HILLS.

FIG. 1.—RIVER BLUFF IN WINTER, WHICH SHELTERS SEVERAL SPECIES OF NATIVE SPARROWS.

FIG. 2.—HOG LOT GULLY, WHICH FURNISHES SHELTER, SHADE, AND FOOD FOR MANY BIRDS.

hedges and water courses. The juncos are an independent species, taking refuge in large trees as well as in bushes, and foraged far afield, even in bare and exposed situations.

English Sparrow.—In addition to the native sparrows, the English sparrow occurred on the farm. Its distribution depended solely on suitable nesting holes and available grain. A dozen pairs bred in the crannies of the house, in an old dovecote on the granary, and in the dooryard locusts. At harvest time the flock numbered 100 or more. No part of the farm was too remote for their forays if it yielded them grain, so their feeding grounds varied with the rotation of crops. They were often to be seen, also, gleaning amid poultry and stock at feeding time, and stealing into the corn crib. The presence of this bird had affected the distribution of other species, particularly such as nest in cavities. The bluebird had been driven from the farm, and many of the house wrens that formerly bred about the buildings had had to seek more secluded places. A few pairs of wrens continued, however, to nest near the house in cavities too small to admit the sparrow. Others lived at both mouths of Persimmon Branch and the lower end of the hog-lot gully (Pl. IV, fig. 2).

BIRDS OF LESS LIMITED DISTRIBUTION.

Kingbird and Oriole.—About a dozen pairs of kingbirds and orchard orioles were also on the place. Neighbors at nesting time and often associates in their feeding range, they lived together in fruit trees by the house, and were also noted at the negro cabin and on the shore by the calamus swamp.

Wherever a kingbird's nest was discovered, a nest of the oriole was sure to be found in the same or an adjoining tree. It seemed odd that such a tyrant as the kingbird should tolerate such close proximity. The kingbirds skimmed over all the five lots after insects, occasionally poising on weedstalks and often perching on the highest trees along the river bluff and the hedgerows. The orioles, though not infrequently seen along fence rows, were generally confined to the trees of the river front, whence, however, they flew out into the adjacent mowing land to pick up insects from the ground.

Cedar Bird.—From a dozen to a score of cedar birds also frequented the trees along the river, though they did not nest on the farm, and they were often noticed at the ends of Persimmon Branch and in the hog-lot gully. Their distribution appeared to depend on the presence of ripe fruit, such as mulberries, cherries, blackberries, or cedar berries.

Catbird.—The most abundant summer bird was without question the catbird (fig. 4). Its usual habitat was practically the same as the song sparrow's—that is to say, the undergrowth of moist places. But while the

song sparrow preferred thickets of blackberry, elder, and alder, somewhat open to the sun, the catbird chose tangles of catbrier deeply shaded by overspreading trees. It was therefore numerous in the swampy, forested dells at the extremities of Persimmon Branch (see map, Pl. II), and still more so in the hog-lot gully (Pl. IV, fig. 2),

FIG. 4.—Catbird.

where it found attractive food, consisting of cherries, mulberries, blackberries, and elderberries, besides May-flies, which were abundant before the fruit ripened. Here, in one morning, fifteen catbirds were seen. Like the song sparrow, this species came up to nest about the house. One pair built in a holly by the gate, another near the horse tub, and two pairs in the garden. All these families fed among the vegetables and moved about under the apple trees and in the dooryard. The catbird is arboreal to the extent of securing probably three-fourths of its food in trees or bushes. Because of this fact, and also because its feeding range does not extend out into fields, it does not appear to have a close relation with crops.

Other birds.—One or two pairs of cardinal grosbeaks bred on the river bluff, but more were noticed in the edge of the swamp bordering the arable land. They built chiefly among catbriers, in stunted young scrub pines, and in the tops of fallen oaks. Cardinals were also seen along the wooded parts of Persimmon Branch, and may have bred there. Two pairs of yellow-breasted chats nested close to crops, one in the thick undergrowth of Persimmon Branch and the other in a similar shaded thicket at the northeast corner of lot 4. Indigo birds and brown thrashers nested near the storage barn, phœbes in the cow barn, and swifts in the chimneys of the house.

BIRDS OF VARIED DISTRIBUTION.

The distribution of the birds remaining to be mentioned can not be so definitely limited. Various gulls and ducks were present in the river during the colder months. The least bittern, great blue heron, little blue heron, little green heron, and sora rail occurred in the calamus swamp (Pl. VII, fig. 1), and the little green heron was also noted feeding all along the river (Pl. III, fig. 2). Woodcock were found on Persimmon Branch near the river, and were observed at dusk flying into adjacent cornfields. Sandpipers, usually the spotted, but now and then the solitary, were to be seen, particularly at the mouth of the hog-lot gully, teetering along the beach in twos and threes.

Various species of hawks, including the broad-winged, red-tailed, red-shouldered, marsh, Cooper, sharpshinned, and sparrow hawks, occurred on the farm. One pair of Cooper hawks bred in the scrub pines on the edge of lot 4. Broad-winged and red-shouldered hawks built on the slope of the wooded hill that rises from the calamus swamp (Pl. VII, fig. 2). Eagles frequently came over from Virginia, and one established a post in a large tree on the bluff just below the negro cabin. Ospreys sometimes passed the farm on fishing trips up and down the river. Several pairs of great horned owls and screech owls built in the woods above the calamus swamp (Pl. VII, fig. 2). Turkey buzzards soared over the fields and often fed along the shore: some nested beyond the farm in the chestnut stumps of a deep, narrow gully.

Kingfishers, which bred in the sandy face of the bluff beyond the farm, fished in the calamus swamp and along the river front. The downy woodpecker foraged in all the fruit trees and nested in the hog-lot gully, at the river mouth of Persimmon Branch (see map, Pl. II), and also in some of the most remote woodland. Flickers, though breeding at Marshall Hall, were most numerous in spring and fall, when they frequently fed in open fields with robins. Sapsuckers were seen in various places during the colder half of the year, very often in the apple orchard by the kitchen garden. The red-headed woodpecker also occurred, but its distribution was very erratic. Night-hawks sometimes appeared in the late afternoon, circling after insects, and whip-poor-wills were frequently heard, though seldom seen. Hummingbirds were seen in various places about the farm dipping into the flowers of the trumpet creeper, persimmon, and tobacco. One nest was discovered on a horizontal bough on a red oak beside Persimmon Branch. Another was found fastened to the limb of a box elder in front of the farmhouse.

Two pairs of wood pewees nested in the kitchen garden and the dooryard, and more than a dozen pairs bred in the recesses of the woods. The great crested flycatcher habitually stayed in solitary

retreats and journeyed over to the hog-lot gully, the river front, and even the dooryard. Several pairs of blue jays and scarlet tanagers frequented the oaks bordering lot 4. Two or three pairs of red-winged blackbirds, that sometimes fed on the cultivated land, nested in the calamus swamp (Pl. VII, fig. 1). Purple finches were found during the colder half of the year along the brink of the bluff. Barn swallows nested in the cow barn one summer, but the individuals usually seen were visitors from other farms, as were also the purple martins, white-bellied swallows, and rough-winged swallows, that mingled with the barn swallows, often in a flock of a hundred, and skimmed over the field in pursuit of insects.

The red-eyed vireo, in summer one of the most abundant species on the farm, built in trees everywhere, but was most numerous in deciduous woodland. Having strictly arboreal habits, it did not feed among field crops, but protected the foliage of orchard, shade trees, and woods. The white-eyed vireo was found in moist places outside of the cultivated land and also in the woodland about the calamus swamp. The last-named locality sheltered large numbers of migrating warblers in spring and fall. Here at these seasons could be noted the black-throated blue warbler, myrtle warbler, magnolia warbler, black-poll warbler, black-throated green warbler, pine warbler, prairie warbler, oven-bird, the two species of water-thrushes, Wilson's blackcap, and the Canadian warbler. The yellow warbler built near the house and also in willow swamp land back from the arable area. The redstart nested on the west side of the swamp. The Maryland yellow-throat, rivaling the song sparrow in numbers, frequented all the moist, bushy regions, but often came out into the five lots to feed along the fence rows, and was sometimes seen scurrying among the leaves of tobacco. Half a dozen or more pairs of long-billed marsh wrens had nests in the swamp (Pl. VII, fig. 1). Carolina chickadees nested near the swamp and in the pin oaks of the woods near lots 4 and 5, and several were seen in the orchard and the hog-lot gully. Tufted titmice were occasionally observed in the neighborhood of the swamp and the same woods. Kinglets of both species occurred in the apple orchards. The hermit thrush, olive-backed thrush, gray-cheeked thrush, and Wilson's thrush occurred during migration in the oaks bordering lot 4. The wood thrush was found breeding in the forest east of the calamus swamp (Pl. VII, fig. 2), but never came out into the garden or house yard, as it often does in more northern States.

TOPOGRAPHY OF HUNGERFORD FARM.

In order to study the effect of birds on a greater variety of crops than were grown on the Bryan farm alone, the next two farms, namely, the Marshall farm and the Hungerford farm, which were conveniently situated for the purpose and were kindly placed at my service by the

owners, were visited from time to time. A brief description of the latter, on which most of these subsidiary observations were made, is necessary for a clearer understanding of the results here set forth. It is primarily devoted to truck and fruit, though it produces also wheat, corn, and tobacco. A hedgerow of large cedars cuts it into two parts, each part with its house and barn. The upper section has a swamp fed by a bushy brook and emptying into the river, while the lower section is drained by two ditches merging into one at their river outlet. There is also a timbered dell, shallow and swampy, which extends from the river back into the cultivated fields, and which harbored a colony of breeding crow blackbirds, more than a dozen catbirds, several woodcock, and at least two pairs of cardinals. Along the Hungerford farm the bluff is seldom half so high as on the Bryan farm, and in many places is entirely wanting.

II.—INSECT FOOD.

In studying data derived from the examination of stomachs collected over areas widely diverse in latitude and longitude the investigator seldom knows exactly what kinds of insects were available for selection at the time the food in the stomachs was obtained, how abundant relatively the various species of insects were, and to what extent, if any, they were injuring crops. He is therefore in some danger of misinterpreting results, especially when he attempts to show how the birds' insectivorous habits relate to agriculture in specific cases. He may, for instance, commend birds for having fed on a certain pest, when, as a matter of fact, they had found no other food available, or he may condemn them for not having eaten injurious insects when the district from which they came happened to be free from such plagues. For this reason, therefore, a careful study was made of the relative and absolute abundance of the different kinds of insects on the farm at each visit. It may be mentioned here that in recording observations of this kind the calendar date should be supplemented by the biological date, which shows the advancement of the season and is best determined by the condition of the vegetation; but this rule has not always been followed in the present report.

CRANE-FLIES.

The most interesting visits were, naturally, those made when insects were most numerous. Crane-flies appeared every year, but during 1900 were unusually abundant. The farm was visited on April 22 of that year when the forests were bare and the fields brown. Peach, plum, and pear were in bloom, but the apple was not yet out. Crane-flies were seen everywhere, but were thickest in the grass land of lot 1, where they fairly swarmed on the ground and flew into one's eyes,

nose, and mouth. No birds were collected, for it was evident that all were feeding on crane-flies, which formed the only abundant supply of insect food. Several species of sparrows, including song sparrows, white-throated sparrows, and chipping sparrows, were observed greedily eating them. A pair of kingbirds left their perch on an apple-tree spray every now and then to snap up the insects, and a Maryland yellow-throat, several meadowlarks, and a pair of bobwhites feasted on the swarming prey. These insects fly feebly and are easily caught; and since there is hardly an insectivorous bird that is not known to take them, it seems safe to conclude that when they are abundant they are eaten in great numbers. Coming as they do in the spring, when other food is scarce, they are a boon to birds. They supply both the newly arrived species and those that are about to journey to their northern nesting grounds. The destruction of crane-flies by birds is a benefit to the farmer, as they are injurious to grain and grass. Their larvæ, repulsive, leathery-looking objects, feed underground, largely on roots. Crane-flies are said to do great damage in Europe, but are much less important in this country.

MAY-FLIES.

Of all the insects on the farm, the May-fly (fig. 5), during the period of its aerial life, is undoubtedly the most abundant and the most conspicuous. The respective numbers of other species fluctuate greatly from year to year, but the myriads of this plague are nearly always constant. Fortunately the life of the adult lasts only from a few hours to two days. As a water nymph, however, the insect lives from one to three years. When the locust trees are dropping their blossoms, usually about the middle of May, the nymphs rise to the surface of the Potomac, transform into adults, and flutter to the shore. The suddenness with which they appear and their vexatious numbers may be understood from a description of the conditions that prevailed at Marshall Hall from the 13th to the 15th of May, 1900. On the morning of the 13th not a May-fly was to be seen. In the late afternoon several were noticed along the shore. On the 14th many came up from the river and flew around the house, and on the morning of the 15th thousands were found clinging to the porch. They soon spread all over the farm, or, more strictly speaking, were blown over it. The air was full of them. After a walk of a hundred yards along the bluff in lot 3, I found 67 clinging to me. They covered the cedar trees beside the river, turning the dark green of the foliage to a distinct gray. They frightened the horses so badly by alighting on them that plowing was suspended for several days. They swarmed into the house and made meal-times almost unendurable. This condition

FIG. 5.—May-fly (from Packard).

seldom lasts more than a week or two. Soon the dead bodies of the short-lived creatures are cast up all along the shore in windrows several inches high, and then there is a marked decrease in their abundance about the farm. They occur, however, though in constantly diminishing numbers, throughout June and even into July.

At their flood tide they furnish most of the food of practically all the birds of the farm, even including barnyard fowls. They are soft, entirely edible, and highly nutritious, owing to the fact that the females are heavy with eggs. Any bird, no matter how clumsy, can capture them as they make their aimless, blundering flights, or fall helplessly from contact with objects in their way. It was interesting to see the methods by which different birds procured them. A green heron, three spotted sandpipers, several song sparrows, and a dozen crow blackbirds frequented the beach, picking up insect after insect. Woodpeckers and at times Carolina chickadees snapped them up from tree trunks in the apple orchard or the hog-lot gully. The parula warbler, the yellow warbler, and one or two other warblers, with the white-eyed vireo and the red-eyed vireo, gathered them from among leafy boughs. The redstart darted out and caught its share of the quarry on the wing. Some species fed in a lazy, sated manner. Thus in the top of a cedar that was gray with the insects, five crows sat for half an hour slowly choking them down. A pair of red-winged blackbirds and several blackpoll warblers later visited the same tree to feed. Such flycatchers as the phœbe, the wood pewee, the kingbird, and the great crested flycatcher stood nervously at their sentry posts, every now and then rising to hover and snap up a victim. The kingbird had another, more interesting method of feeding. Perched in the dead top of a tree, it would make a dash into one of the lateral boughs of an adjacent locust that was so heavily laden with May-flies that the tips of the branchlets drooped under the weight, dislodge hundreds of the insects, snap up several as they fluttered out, and then return to its perch. Over and over it played this game, apparently with keen zest. I watched a similar, though less adroit, performance by a female catbird that spent a long time gathering food for her young from a maple in the dooryard. Every few minutes she would take a short flight and drop on the end of a slender bough; then from the scores of May-flies shaken out she would, by clumsy efforts, generally manage to catch one. A hen with her brood of eleven chicks derived the chief profit from the bird's industry, and remained for two hours gobbling up the manna that rained from the maple tree. English sparrows also shook the insects from the branches and captured them on the wing. A flock of a dozen cedar birds pursued them through the air, appearing to swim rather than fly, and reminding one of a lazy sunfish dawdling after a baited hook. At other times, possibly when they were more hungry, they caught their prey with an alert-

ness that would have been creditable in a flycatcher. Swifts and a variety of swallows, including the tree swallow, the bank swallow, the rough-winged swallow, the barn swallow, and the purple martin, appeared to feed on May-flies exclusively. Whenever a kingbird dashed into a tree these birds would fly by the dozen to the spot and seize the fluttering, helpless insects that had been dislodged. When, however, a gust of wind drove the May-flies before it, the swallows were seen to best advantage as they circled gracefully after them.

Field observations and the examination of stomachs proved that 40 species had eaten May-flies, but this number probably represents only about half the truth. Not many birds were collected at the height of the insects' abundance, because even casual observation showed that practically all the birds of the farm, not only the highly insectivorous species, but also the species chiefly frugivorous or granivorous, turned to them for food. The following is the list obtained:

List of birds known to have fed on May-flies.

Green heron.
Woodcock.
Spotted sandpiper.
Yellow-billed cuckoo.
Black-billed cuckoo.
Downy woodpecker.
Chimney swift.
Kingbird.
Great crested flycatcher.
Phœbe.
Wood pewee.
Blue jay.
Common crow.
Bobolink.
Red-winged blackbird.
Orchard oriole.
Crow blackird.
English sparrow.
Field sparrow.
Cardinal.
Purple martin.
Barn swallow.
White-bellied swallow.
Bank swallow.
Rough-winged swallow.
Cedar bird.
Red-eyed vireo.
Parula warbler.
Yellow warbler.
Black-poll warbler.
Water-thrush.
Maryland yellow-throat.
Yellow-breasted chat.
Wilson warbler.
Redstart.
Catbird.
House wren.
Carolina chickadee.
Blue-gray gnatcatcher.
Gray-cheeked thrush.

Though May-flies furnish valuable food for fish and do no harm to crops, they are of course a plague when they become so numerous. Broadly considered, however, their consumption by birds is a misfortune, for it suspends or prevents the destruction of really injurious insects. At no other time do all birds eat so large a proportion of insect food, for at no other time do they find such a scarcity of other suitable food, and if their attention were not diverted by this easy and palatable prey they might be expected to do the best of their work against insect pests. This unfavorable condition is, however, strictly local, lasts only a few days, and would not occur on areas remote from large bodies of fresh water where the May-fly breeds.

INFESTED CROPS.

At each visit the crops were inspected for pests, and whenever any crop had suffered appreciably it was regularly watched to see whether birds came to its relief. Stomachs were collected also around the infested fields.

FIG. 1.—WEEDY OLD CORNFIELD, LOT 3.

FIG. 2.—PASTURE, LOT 1.

FIG. 1.—TRUMPET CREEPER AND OTHER VINES OF RIVER BLUFF.

FIG. 2.—BROOM-SEDGE AND BRIERS IN HOG LOT.

White potatoes.—The potato beetle (*Doryphora 10-lineata*) caused every year considerable injury to white potatoes. During May, 1899, it had destroyed at least half of the foliage of several acres of potatoes about 6 inches high in lot 3. The field was watched for an hour or two each day for several days, but only three birds were seen in the patch—a pair of bobwhites, which are noted potato-beetle eaters, sometimes consuming from 50 to 100 at a single meal, and a cardinal, which is a near relative of the rose-breasted grosbeak, probably the the most valuable destroyer of the pest. Unfortunately neither species could be either observed feeding in the patch or subsequently collected. Other birds were very abundant along Persimmon Branch and the river front, but appeared to manifest no interest in potato beetles. From May 28 to May 30, 1896, the potatoes in the kitchen garden, though in fair foliage, had from several to a dozen beetles on each plant. Birds were about the garden all the time. Forty of them, principally catbirds, vireos, house wrens, chipping sparrows, summer warblers, orchard orioles, and flycatchers were collected, but none had eaten the beetles. On the 16th of June, 1901, a large patch of potatoes by the negro cabin in lot 2 was infested. Above it circled a score of swifts and swallows, mainly barn and bank swallows, with a few purple martins. They did not touch the beetles, but caught caddis-flies, which were numerous over the patch.

The caddis-fly, very abundant and regarded by birds as a choice morsel, may, like the May-fly, distract their attention from other insects. It usually appears about the last of May or the first of June, and it is greedily eaten by many species, especially by arboreal and aerial feeders. It is a harmless insect, whose larvæ lead an aquatic existence. It, too, like the May-fly, would be excessively abundant only near large rivers or lakes.

String beans.—At a time when potatoes were suffering in the kitchen garden (May 28–30, 1896), a dozen rows of string beans beside them were ravaged by thousands of bean flea-beetles (*Cerotoma trifurcata*), but none of the 40 birds collected had preyed on them, a fact possibly due to the presence of caddis-flies. Another uprising of these beetles was observed May 17–20, 1899, but then May-flies were abundant enough to engross the birds' attention. This beetle is similar, however, to species that are eaten by many kinds of birds, and, under other circumstances, might perhaps have been destroyed in large numbers.

Sweet potatoes.—Two tortoise beetles injure sweet potatoes (Pl. VIII, fig 2) at Marshall Hall. The more common one (*Coptocycla bicolor*) has the power to change its color, and at its brightest looks like a drop of molten gold, from which it is generally known as the 'gold bug.' During June, 1899, it was especially abundant. On the Marshall Hall farm, near a small plot of sweet potatoes that it was injur-

ing, 20 birds, principally kingbirds, wrens, and chipping sparrows were collected. None of them had molested it. On the Bryan farm, in lot 3, it was so abundant that it killed every plant in a patch of several acres. The lot was watched for an hour or two for three days, but no birds were seen coming to the relief of the dying plants. On the Hungerford farm, 24 birds, largely wrens, barn swallows, and catbirds, were collected near infested plots, and one bird, a catbird, was found to have eaten a tortoise beetle. This fact appears to show that the insect is not unpalatable to catbirds, which might therefore have given some help to the potatoes if cherries had not been so plentiful.

Cabbages.—Three pests attacked cabbages—the wavy-striped flea-beetle, the common cabbage worm, and the harlequin cabbage bug. During the middle of June, 1899, the beetle was found in numbers varying from a dozen to a score on each plant of a cabbage patch on the Hungerford place, near the dell where the crow blackbirds breed. No birds were observed among the cabbages. Ten catbirds were collected in the dell, but they had fed mostly on May-flies. If these tempting insects had not been present, and if birds had come into the patch, doubtless they would have eaten the beetle, for it is closely allied to other forms on the farm that are eaten with avidity. The cabbage worm (*Pieris rapæ*) did considerable damage during June and July of 1896 and 1899 in the Bryan kitchen garden. From six to a dozen worms could be found on every cabbage. A few stomachs of catbirds, chipping sparrows, and other species numerous around the garden were collected, but none contained the worms. The patch was carefully watched for five days. Song sparrows, catbirds, and chipping sparrows frequently hopped among the cabbages, but were not seen to eat the worms. This was surprising in the case of the chipping sparrow, for it is known to hop up into cabbage plants and extract the larvæ. In one instance the kingbird fed on the butterfly of the cabbage worm. The harlequin cabbage bug occurred only once in injurious numbers, and then on the Marshall farm. From 20 to 50 bugs could be counted on each plant. Several field sparrows and grasshopper sparrows, the only species near the patch, were collected, but had not taken the bugs. Other observations have shown that birds do not like these insects, and consequently can not be depended on to destroy them.

Lima beans.—During the last week of June, 1899, the 12-spotted cucumber beetle (*Diabrotica 12-punctata*) was very abundant on lima beans, though not injuring them seriously. Twenty birds were collected close by, half of them chipping sparrows and the others kingbirds, house wrens, and goldfinches. None had eaten the beetles. The bobwhite and the white-eyed vireo, which feed on them, were not at hand.

Peas.—Next to the beans was a patch of peas so ravaged by the pea plant-louse that the crop was a total loss. Only one of the 20 birds had eaten it—a chipping sparrow. It was somewhat surprising to find even one, for the various species of plant-lice are seldom utilized by birds for food, but later it was learned that the chipping sparrow had elsewhere been found preying on the pea plant-louse. This insect has only recently become known to science. It suddenly made its appearance along the Atlantic coast and occasioned a loss of $3,000,000 in the first season.[a]

Melons.—Melons at times suffered badly from insects. In lot 4, not far from the woods, a patch of watermelons in the critical stage of growth, when the first leaf had appeared between the thick, nutritious cotyledons, was ravaged by three species of leaf-beetles—*Diabrotica 12-punctata*, *D. vittata*, and *Systena elongata*. There were from six to a dozen beetles on each plant, and they ate so many of the cotyledons that practically the whole piece had to be replanted. When they were most abundant the patch was watched for several hours on June 15, 1899, and again on June 16, but no birds came to its aid. Birds are known to eat these three insects at times, but the remoteness of the melon field from water courses, hedgerows, and other cover attractive to the most abundant species may explain their failure to do so in this case. At the same date (June 15, 1899) *Diabrotica vittata* was found on canteloupes in blossom on the Hungerford farm, but although there were from 12 to 20 insects on each plant, they appeared to be doing little harm. The patch was observed for an hour in the late afternoon, and three field sparrows, the only birds near it, were collected, but none of these insects were found in their stomachs.

Tobacco.—During the last of August and first of September, 1899, tobacco was grown on the Bryan farm in lot 2 near the negro cabin (Pl. VIII, fig. 1), and also on the other two farms. The entire crop was

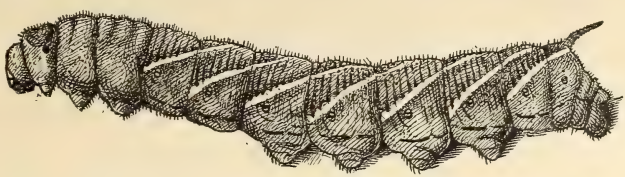


FIG. 6.—Tobacco-worm (after Howard; loaned by Division of Entomology).

damaged by worms (fig. 6) to the extent of 50 percent of its value, in spite of the fact that men, women, and children turned out to pick worms every day for two weeks. When the pests were most abundant (August 28–31) an effort was made to learn whether birds were joining in the war against them. Field sparrows and chipping sparrows spent considerable time hopping among the plants, a song sparrow

[a] Circular 43 (2d. series), Div. Entomology, Dept. Agr., p. 3, 1901.

and several wrens went into the field often, and two Maryland yellow-throats scurried among the leaves. Forty birds were killed in the vicinity of tobacco fields. They comprised, for the most part, the several species of native sparrows that breed on the farm, including also a few wrens, meadowlarks, flycatchers, and others. Not one of the 40 had fed on tobacco worms, although observations on the farm at other times had shown that birds eat them as well as other sphinx caterpillars. Bobwhites and vireos take them, but were not represented in the collection. The chipping sparrow had eaten them at other times, the English sparrow had been seen picking them from the plants, and the crow is known to be an habitual 'wormer.' In June, 1900, an old crow and five young stayed near tobacco in lot 1 for ten days. In the early morning and late afternoon the youngsters would sit clamoring on the fence, while the mother bird brought them worms from the field.

By way of summary it may be stated that while the observations made to determine whether or not the birds of the farm were protecting field crops from insects yielded in the main negative results, they do not lead to the conclusion that birds are of no service. They do indicate, however, that birds are not to be depended on to check uprisings of insect pests, and that insecticides should be used freely and repeatedly. In case of this farm it is probable that the superabundance of May-flies and caddis-flies diverted the birds' attention from pests to the hordes of harmless insects. The pea plant-louse is a new species, unfamiliar to birds, which, however, seldom eat plant-lice. The potato beetle, though unpalatable and avoided by many birds, is eaten with relish by the bobwhite. Had an especial effort been made to collect this bird in infested fields, it would probably have been found to be doing much to reduce the numbers of the pest. Tobacco worms have also been attacked by the bobwhite as well as by the crow, English sparrow, and chipping sparrow; and it is likely that when these worms are small many species of birds feed on them.

INFESTED TREES AND SHRUBS.

Fall webworm.—The next group of observations concerns insects that attack trees and shrubs. The fall webworm occurred regularly at Marshall Hall. It was most often found on willow, black walnut, mulberry, apple, and pear trees. At a time when it was not especially abundant 62 birds, largely catbirds, sparrows, orioles, warblers, and flycatchers, were collected. One of the orioles, a male Baltimore, had eaten webworms. During the middle of June, 1899, webworms defoliated parts of apple and pear trees. A number of stomachs were collected and the trees were closely watched, but nothing gave evidence that the pest was being destroyed. During the last of August, 1896, it was so abundant that it defoliated all the willows of the hog-lot gully and fairly festooned the branches with webs. The trees were

watched for three hours, August 23. Catbirds and vireos, though numerous, did not molest the larvæ, but a pair of yellow-billed cuckoos continually extracted them from the webs. The destruction of this insect is an habitual practice with the cuckoo. In a single stomach of the species examined by Professor Beal there were 325 of the larvæ.

Saw-flies.—In August, 1896, also, the willow saw-fly (*Pteronus*) was defoliating the willows farther up the gully. No birds were observed preying on it, though the cuckoo is known to relish saw-fly larvæ, sixty of which were found in a cuckoo's stomach examined by Professor Beal. The cornel bushes of the same gully were almost every year stripped by the larvæ of another saw-fly (*Harpiphorus varianus*). On July 30, 1895, they covered every large bush, and later they devoured all the foliage. A dozen catbirds and several birds of other species were constantly near the bushes, but evidently did not touch the insects. A repetition of these circumstances was noted August 2, 1896. An interesting outbreak of the pine saw-fly (*Lophyrus*) occurred May 17, 1900, in which hardly a dozen pine trees in the woods adjoining lot 4 escaped attack. In the areas of woodland where the insects had finished their work the trees cast no shade and appeared to be dead. In places where the larvæ were feeding their dropping excreta made a continuous patter like that of falling rain. From the infested district 34 birds were collected, comprising the following species: Great crested flycatcher, wood pewee, blue jay, crow, scarlet tanager, red-eyed vireo, white-eyed vireo, magnolia warbler, black-poll warbler, oven-bird, chat, Canadian warbler, redstart, gray-cheeked thrush, and olive-backed thrush. Seven birds, including the black-poll warbler, the red-eyed vireo, and the gray-cheeked thrush, had eaten the insect. Since it has not yet been found practicable to protect forest trees by means of insecticides, such services as birds render among these pests ought to be appreciated.

Plant-lice.—The fact that plant-lice are not selected by birds has been mentioned in the notes on the pea plant-louse. It was illustrated in the case of a large plant-louse (*Lachnus*) that was noticed on an old willow in the hog-lot gully August 23, 1896. The tree was infested by so many of the insects that its limbs were more or less covered with the honeydew that exuded from their honey tubes, but none of the numerous birds of the neighborhood manifested the slightest interest in the matter.

Locust Leaf-mining Beetle.—In the summer of 1895 a destructive outbreak of the locust leaf-mining beetles (*Odontota dorsalis*) turned all the locusts of the farm as brown as if they had been scorched by fire, ruining the verdure of the river bluff. On July 30, 1895, when adult beetles were swarming on the locusts of the hog-lot gully, catbirds were observed to be spending a good deal of time amid the browned foliage. Thirteen were collected and nine were found to have eaten

the destructive beetles. One bird contained no fewer than 18. From 1896 to 1902, inclusive, the beetles did not again ruin the foliage, though they were present every year, and at times in early summer were so numerous that a scourge was feared. In 1896 the trees farther up the river, however, were turned brown, showing that the escape of those at Marshall Hall was not due to climatic conditions unfavorable to the insects; therefore it is possible that the birds were, at least to some extent, responsible for it. Forty-six birds from the following 21 species, taken during different years, had eaten the locust leaf-mining beetle:

List of birds whose stomachs contained locust leaf-mining beetles.

Catbird.	Red-eyed vireo.	Great crested flycatcher.
Chipping sparrow.	Warbling vireo.	Wood pewee.
Field sparrow.	Yellow warbler.	Phœbe.
Song sparrow.	Orchard oriole.	Yellow-billed cuckoo.
Towhee.	Baltimore oriole.	Cedar bird.
Cardinal.	Scarlet tanager.	Carolina wren.
English sparrow.	Kingbird.	Junco.

Moreover, when most of these birds were collected, the beetles were not numerous. All the common species, especially the arboreal feeders, ate them eagerly whenever they were to be had.

CERTAIN DESTRUCTIVE INSECTS.

Flea-beetles.—Reference has already been made to the injury done to melons by the flea-beetle (*Systena elongata*). Its congener, the pale-striped flea-beetle (*Systena blanda*—fig. 7) is also abundant on the farm and one or the other has been found harmful to corn, melons, and beans. Elsewhere they have attacked fruit trees and tomatoes. Fortunately, however, they appeared to form the natural beetle food of several ground-feeding species of birds and were sought for even when they were very scarce. They were seen in the stomachs of 28 birds, including the savanna, the grasshopper, the chipping, the song, the field, and the white-throated sparrows, the crow, the crow blackbird, the bobolink, the meadowlark, the house wren, and the Maryland yellow-throat. *Systena blanda* was found on ragweed in a field of ripe standing wheat, June 16, 1898. Eleven chipping sparrows that had been flying into the field were shot. None had taken wheat and eight had fed on the beetles, destroying in all 73. The smallest number found in a single stomach was 5, the largest 14.

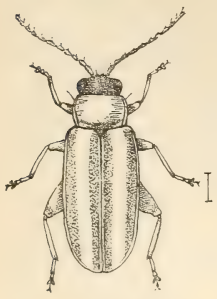


FIG. 7.—Pale-striped flea-beetle (*Systena blanda*) (after Chittenden; loaned by Division of Entomology).

Rose-chafer.—During the last week of May, 1896, the rose-chafer (fig. 8) was present in such numbers that 100 individuals were counted on one rosebush and three times that number on an adjacent blossom-

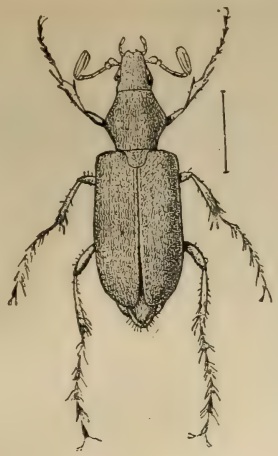


FIG. 8.—Rose-chafer (after Riley; loaned by the Division of Entomology).

ing elder. Of 62 birds collected during this outbreak, only 3—2 kingbirds and a cardinal—had destroyed rose-chafers. This result was not expected, because May-flies and other tempting insects were not com-

FIG. 9.—Kingbird.

mon then, and because rose-chafers have no disagreeable secretions like those of potato-beetles and the two diabroticas, but are relatives of the May-beetle and the dung-beetles, which are highly relished by

many birds. The kingbirds (fig. 9) had, however, shown a great liking for rose-chafers, as these two, the only ones collected, had eaten 15 and 20 of the insects respectively.

May-beetle.—May-beetles attract only the larger species; their hard shells offer too much resistance to small birds. During their season—May and June—292 bird stomachs were examined, but May-beetles were found in only 16. These stomachs were from birds of the following ten species: Brown thrasher, orchard oriole, phœbe, catbird, gray-cheeked thrush, blue jay, crow, crow blackbird, screech owl, and broad-winged hawk. This record is far below a fair average, for at the time it was made the beetles were rare; moreover, the two famous beetle-eaters, the crow and the crow blackbird, were represented only by a single individual of each kind.

Cutworms.—Similarly unfavorable conditions attended the destruction of cutworms (fig. 14), though these insects are obtainable for a longer period and are edible for small as well as large birds. No serious outbreak of this pest occurred. Had there been one, birds would have been found combating it, for all species that are in the slightest degree insectivorous and feed at all on the ground show a marked liking for cutworms.

Grasshoppers.—Grasshoppers (fig. 10) when abundant are to the bird what bread is to man. They were, however, comparatively rare at

FIG. 10.—Grasshopper (after Riley; loaned by Division of Entomology).

Marshall Hall; therefore only 71 of the 645 native birds collected had eaten them, though most of these had made them the major part of their food. The list of species eating them is as follows:

List of birds examined whose stomachs contained grasshoppers.

Bobwhite.	Orchard oriole.	Cardinal.
Kingbird.	Crow blackbird.	Maryland yellow-throat.
Great crested flycatcher.	Savanna sparrow.	Catbird.
Blue jay.	Grasshopper sparrow.	Carolina wren.
Common crow.	Henslow sparrow.	House wren.
Cowbird.	Chipping sparrow.	Brown creeper.
Red-winged blackbird.	Field sparrow.	Robin.
Meadowlark.	Song sparrow.	Bluebird.

Had grasshoppers been abundant the birds would undoubtedly have destroyed them in large numbers. Their scarcity may possibly be due to the abundance of birds at Marshall Hall.

Ants.—Whenever temperature allowed any insects to occur in appreciable numbers, ants were abundant, and at times they were the most

FIG. 1.—CALAMUS SWAMP, THE HAUNT OF SEVERAL MARSH-LOVING BIRDS.

FIG. 2.—CALAMUS SWAMP IN WINTER, SHOWING HILL TENANTED BY BLUE JAYS, GREAT HORNED OWLS, RED-SHOULDERED HAWKS, AND RUFFED GROUSE.

FIG. 1.—TOBACCO FIELD OF LOT 2, WHERE THE EFFECT OF BIRDS UPON AN UPRISING OF TOBACCO WORMS WAS STUDIED.

FIG. 2.—SWEET POTATOES AND PEAR ORCHARD, WHERE VARIOUS INVESTIGATIONS WERE MADE.

conspicuous of all forms of insect life. Of the 645 native birds collected, 147 had fed on them. Woodpeckers, flycatchers, night-hawks, swallows, catbirds, and white-throated sparrows seemed to have the most liking for them.

A large ant very frequently eaten is a black species, *Camponotus pennsylvanicus*, which during the warmer half of the year is very abundant on tree trunks. Its habits expose it to attack by several kinds of birds. The downy woodpecker was constantly making spirals around the trunks of trees at Marshall Hall in vigilant search for these insects. The catbird was seen feeding on them as they journeyed on the ground from tree to tree. These two birds probably destroy more than any other species, though the sapsucker also appears to relish them. The small species of ants are eaten much oftener than the larger ones, especially at their swarming time. For several days during the middle of April, 1899, great swarms of corn-louse ants (*Lasius*) were taking their marriage flight, and of the 55 birds collected then, mostly native sparrows, 23 had joined in the work of destroying them. This was a valuable service, for destruction of the corn-louse ant is the only effective means of combating the corn louse, which this ant protects and disseminates. Swallows, also, often attack the corn-louse ant. On July 8, 1898, six out of seven rough-winged swallows collected on the farm had fed on it and on little else, one bird containing 40 ants and another 50. At the same time kingbirds, house wrens, marsh wrens, yellow warblers, song sparrows, and chipping sparrows were making inroads on it, though it was much less numerous than during April, 1899. In the late afternoon of July 18, 1898, flying ants of the species *Myrmica scabrinodes*, which, as Prof. S. A. Forbes has shown, injure corn both when it is sprouting and when it is in milk and also foster the corn louse, were so abundant over lots 1 and 2 that their gauzy wings in the level sun rays filled the air with shimmering rainbow colors. Bank swallows were circling among them, close to the ground, making a hearty supper. By crouching low one could see them catch the insects, sometimes within a few feet of one's head. While the flock were feeding, four birds were collected. They had consumed practically nothing but ants and contained, all together, just 200. At this rate, 250 swallows—a fair estimate of the number present—would consume in a single afternoon 12,500 ants. Many other birds were feeding on them, including night-hawks, a single one of which has been known to eat 1,000 at a meal. A house wren, a yellow warbler, a chipping sparrow, and a phœbe, which were collected earlier, had all taken them, but three swifts collected after sunset had not.

On August 5, 1898, *Solenopsis molesta*, an ant injurious to corn and also a household pest, was swarming, and a number of birds were preying on it. In a newly mown timothy field near the cow barn:

chipping sparrows hopped about, springing a foot or two into the air every few minutes to obtain a mouthful. Two strayed off by themselves and made good subjects for observation. In twenty minutes they had eaten 21 ants. Song sparrows and English sparrows were feeding in a similar manner. A kingbird now and then left his station on an apple tree to snap up the prey, and bank swallows and barn swallows skimmed over the fields, gathering in large numbers. Undoubtedly other species were also doing good service.

The total number of native species engaged in the destruction of ants was 39 and included the following list:

List of birds examined whose stomachs contained ants.

Spotted sandpiper.	Towhee.	Worm-eating warbler.
Downy woodpecker.	Chat.	Yellow warbler.
Flicker.	Canadian warbler.	Magnolia warbler.
Kingbird.	Mockingbird.	Black-poll warbler.
Great crested flycatcher.	Catbird.	Prairie warbler.
Phœbe.	House wren.	Oven-bird.
Wood pewee.	Long-billed marsh wren.	Water-thrush.
Orchard oriole.	Cardinal.	Maryland yellow-throat.
White-throated sparrow.	Barn swallow.	Brown creeper.
Chipping sparrow.	Bank swallow.	Carolina chickadee.
Field sparrow.	Rough-winged swallow.	Blue-gray gnatcatcher.
Junco.	Red-eyed vireo.	Gray-cheeked thrush.
Song sparrow.	White-eyed vireo.	Olive-backed thrush.

On August 3 there was a large flight of termites (*Termes flavipes*), commonly known as white ants, pests that tunnel into woodwork. At the lower end of lot 3 fully 200 swallows, mainly bank swallows, with a few barn swallows and white-bellied swallows, were very busy among them. Two birds of each of the first two species and three of the third were found to have eaten together 320.

Weevils.—Sparrows, blackbirds, orioles, and meadowlarks appeared to be the worst enemies of weevils. The orchard oriole had a useful habit of feeding in plum orchards of the Hungerford farm on the plum curculio, which usually ruins seven-eighths of the crop at Marshall Hall. A score of bobolinks feeding (May 17 and 18, 1899) in a wheat field that was just coming into milk were suspected of injuring the grain, and six were shot. None of them had eaten wheat, but all had fed chiefly on a very injurious weevil—the imbricated snout-beetle (*Epicærus imbricatus*). A dozen bobolinks were observed (May 15, 1900) in plants of red clover securing the clover-leaf weevil (*Phytonomus punctatus*). These two weevils are also relished by blackbirds, meadowlarks, crows, catbirds, and other species. Bill bugs (*Spheno-*

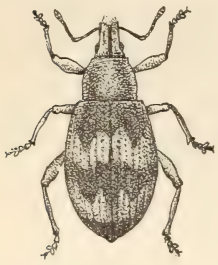


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FIG. 11.—Weevil (after Chittenden; loaned by Division of Entomology).

phorus parvulus) also are often taken, but the small clover weevil (*Sitones hispidulus*) is destroyed most frequently of all. The sparrows and other terrestrial-feeding species and all the aerial feeders consume this little pest in great numbers. The rice weevil (*Calandra oryza*) was found in the stomachs of two marsh wrens collected in the wild rice of the swamp September 7, 1896, and the injurious cabbage curculio (*Ceutorhynchus rapæ*) had been eaten by three rough-winged swallows taken July 9, 1898. Among other weevils destroyed by Marshall Hall birds may be mentioned *Apion*, *Baris*, *Centrinus*, *Macrops*, *Tanymecus*, and *Tyloderma*.

The weevil-eating birds numbered 166 of the 645 collected, and were divided among the subjoined 44 species:

List of birds examined whose stomachs contained weevils.

Downy woodpecker.	Henslow sparrow.	Yellow warbler.
Chimney swift.	White-throated sparrow.	Magnolia warbler.
Great crested flycatcher.	Chipping sparrow.	Black-poll warbler.
Wood pewee.	Field sparrow.	Oven-bird.
Blue jay.	Junco.	Water-thrush.
Common crow.	Song sparrow.	Maryland yellow-throat.
Bobolink.	Towhee.	Chat.
Cowbird.	Cardinal.	Catbird.
Red-winged blackbird.	Barn swallow.	House wren.
Meadowlark.	White-bellied swallow.	Long-billed marsh wren.
Orchard oriole.	Bank swallow.	Brown creeper.
Rusty blackbird.	Rough-winged swallow.	Carolina chickadee.
Crow blackbird.	Red-eyed vireo.	Gray-cheeked thrush.
Savanna sparrow.	Warbling vireo.	Robin.
Grasshopper sparrow.	White-eyed vireo.	

It seems strange that so many birds should have eaten weevils, for the insects were never sufficiently abundant to be conspicuous, seldom, indeed, affording the collector a dozen specimens without diligent use of the sweep net. Moreover, they harmonize so admirably with their surroundings that birds do well to find them at all. Many aerial feeders, it is true, capture them on the wing, but a large number of ground-feeding species take them from the ground despite their protective coloration. The inference is that birds find them dainty morsels, which pay for close seeking. Such a relish is not easily explained, for weevils appear scarcely more edible than little stones; but it is a fortunate circumstance, for they are dangerous pests, not easily controlled by insecticides.

Oak scale.—An unexpected and somewhat suggestive habit discovered at Marshall Hall was the feeding of certain species on scale insects. Of the 22 vireos and arboreal warblers collected during the pine saw-fly invasion previously referred to, 10 had preyed on an oak scale (*Kermes*). This insect does not occur on fruit trees, but its destruction suggested desirable possibilities in cases where scales of

the orchard were present, notably in the case of the San José scale, which in many places has threatened to ruin certain horticultural interests.

Unobtainable insects.—There are several insects that would probably be palatable to birds if their habits did not render them unobtainable. During the summer of 1898 a grain moth caused a loss of 50 percent of the corn in the crib. The only birds that entered the building were English sparrows, which prefer grain to insects, and therefore probably did not destroy the larvæ. In 1900 tobacco was affected by a stalk-borer, the larva of a crambid moth, and in 1898 corn suffered severely from the corn stalk-borer (*Diatræa saccharalis*), but the seclusive habits of these two larvæ prevented the possibility of their destruction by birds. Certain kinds of flies, though palatable, are too alert to be caught. This proved to be the case with house-flies, stable-flies, bluebottle blow-flies, and horse-flies, particularly the banded-winged form (*Chrysops*). The last-mentioned flies were so numerous that they greatly annoyed both man and beast. The kingbird, the barn swallow, and the bank swallow frequently caught them, and in single instances Acadian flycatchers, catbirds, song sparrows, and chipping sparrows had eaten them.

USEFUL INSECTS.

In addition to injurious and neutral insects, certain species that are useful to man contribute to the food of birds. They consist for the most part of various kinds of bees, and numerous species of wasps and beetles that prey on insect pests.

Honey bee.—Birds are often accused of eating honey bees. The kingbird is most frequently mentioned in this complaint, and his nickname of 'bee bird' or 'bee martin' attests the common belief about him. It is true that he is often guilty of the charge, but as he selects the worthless drones and does not molest the workers, his habit is not injurious to bee keepers. During 1895 and 1896 two hives of bees within 30 feet of two kingbirds' nests were not meddled with at all.

A good deal has been written about the destruction by birds of useful predaceous and parasitic insects that serve to keep insect pests in check, and the assertion has been made that even though birds feed on pests, they destroy so many of these useful species that they overbalance by this injury the good which they accomplish. Special attention was given to this subject. Whenever any useful insect was abundant at Marshall Hall the relation of the birds to it was particularly noted.

Soldier-beetles.—With the exception of rose-chafers the useful soldier-beetle (*Chauliognathus pennsylvanicus*) was the most conspicuous

species present May 28–30, 1896, after May-flies had become comparatively scarce. The soldier-beetles were in the grass, on blossoms, on the foliage of bushes and trees, and in the air, yet of the 62 birds collected, representing 19 species, only 3, namely, 2 wood pewees and a phœbe, had eaten them. At other times (June, 1898 and 1899), when the beetles were abundant, more than a hundred birds, including nearly all the common species on the farm, were collected, and only a chat, 2 catbirds, and 2 kingbirds (June, 1898) had eaten them. Experiments with several kinds of caged birds have shown that the species is distasteful, probably on account of its pungent and disagreeable flavor.

Fireflies.—Another useful predaceous beetle of the same family, having a similarly repulsive taste, is a firefly, *Photinus*. In June it sometimes, even during daylight, outnumbered the soldier-beetle, but it was never found in stomachs of Marshall Hall birds.

Tiger-beetles.—The useful tiger-beetle, a ferocious predatory insect, represented at Marshall Hall by several species, was never so numerous as the soldier-beetle or the firefly, but was often seen by the dozen, especially about the middle of April, in the sandy road along the bluff. It has no unpleasant flavor and must rely on its alertness to save it from enemies. When danger threatens, it springs into the air and flies swiftly away. Only the quickest birds have any chance of catching it. A few birds, mainly swallows and flycatchers, secure it occasionally. Of the 645 birds examined only a phœbe, a kingbird, a great crested flycatcher, and a crow blackbird had eaten it.

Ground-beetles.—With ground-beetles (Carabidæ, fig. 12), which as a class are regarded as predatory, the case was different. Most birds eat them, some species largely.

FIG. 12.—Ground-beetle (after Riley; loaned by Division of Entomology).

Ground-beetles are numerous in spring, then become less conspicuous, but appear later in large numbers. Their period of greatest abundance in the five years was April 10–14, 1899, when, with the exception of ants, they were the most noticeable insects on the farm. The smaller kinds (*Anisodactylus agricola*, *A. rusticus*, *Casnonia*, *Amara*, and a small *Harpalus*) predominated. Most of the birds collected then were sparrows, which had eaten very few of the beetles. At the same time the larvæ of a large ground-beetle (*Harpalus caliginosus*) were fairly abundant, and 4 of the 8 robins collected had destroyed them. During midsummer (especially 1898 and 1899) the large Carabidæ (*Harpalus caliginosus* and *H. pennsylvanicus*) fairly swarmed after dark and were attracted to lights in hosts. They were seldom seen during the day, but crows, blackbirds, catbirds, meadowlarks, and others frequently extracted them from their hiding places. Three meadowlarks (August

29, 1898) had made the bulk of their food of them. The genus is not exclusively carnivorous, for it has been known to feed on seeds of grasses and weeds, and recently (1900) has been discovered eating strawberry seeds to a harmful extent. One grower at Leechburg, Pa., lost on a quarter-acre patch $350 in three nights through their depredations.[a] The nature of the injury has so far made remedial methods impracticable; consequently the predatory habit of birds is valuable in this case.

There is an increasing tendency to doubt the utility of ground-beetles as a class. A European species (*Zabrus gibbus*) is a notorious grain pest, and an American species (*Agonoderus pallipes*) has recently been ascertained to feed sometimes on newly planted corn. Professor Forbes has shown that the food habits of ground-beetles vary with the structure of their jaws, species with sharp-curved jaws being carnivorous, while those with blunt jaws are decidedly vegetarian. Only a few—probably less than half a dozen—of the Marshall Hall birds examined had destroyed the more carnivorous species. It is probable, therefore, that birds do no appreciable harm in their relation to ground-beetles, but may even do some good by reducing the numbers of such species as have vegetarian habits and occasionally become pests. The following is a list of the different ground-beetles found in the stomachs collected: *Amara*, *Anisodactylus agricola*, *A. rusticus*, *Bembidium*, *Cratacanthus dubius*, *Chlænius æstivus*, *Harpalus caliginosus*, *H. pennsylvanicus*, and several smaller species of *Harpalus*. These had been eaten by 82 birds of the following 35 different species:

List of birds examined whose stomachs contained ground-beetles.

Woodcock.	Rusty blackbird.	Louisiana water-thrush.
Spotted sandpiper.	Crow blackbird.	Maryland yellow-throat.
Bobwhite.	Savanna sparrow.	Chat.
Downy woodpecker.	Grasshopper sparrow.	Mockingbird.
Flicker.	Henslow sparrow.	Catbird.
Kingbird.	White-throated sparrow.	Brown thrasher.
Great crested flycatcher.	Chipping sparrow.	House wren.
Phœbe.	Junco.	Gray-cheeked thrush.
Blue jay.	Song sparrow.	Olive-backed thrush.
Crow.	Towhee.	Robin.
Red-winged blackbird.	Cardinal.	Bluebird.
Meadowlark.	Water-thrush.	

Ladybirds.—The most useful of all beetles are the members of the family Coccinellidæ, commonly known as ladybirds, which with their larvæ are voracious feeders on insect pests. Only three of the Marshall Hall birds—a long-billed marsh wren, a song sparrow, and an English sparrow—were found to have destroyed these valuable insects.

[a] Bull. Cornell Univ. Agric. Expt. Sta., p. 150, 1901.

The particular species eaten was in each case *Hippodamia maculata*. It was not noticeably abundant at the time it was taken, but during August, 1896, it was the most conspicuous insect on the farm. Then, however, it was not molested. Ladybirds of another species (*Coccinella 9-notata*) were very numerous when the pea plant-louse was making havoc, and appeared on every pea vine greedily devouring the plant-lice. It was, fortunately, quite free from attack by birds. Indeed, ladybirds appear to be distasteful to birds. I have offered them to a dozen different caged birds, and they have always been refused.

Flies.—Beneficial diptera, such as the predatory robber-flies and the parasitic tachinid and syrphid flies, are too alert to be caught by any birds except flycatchers and swallows, and even these secure them rarely. During June and July, when robber-flies were plentiful, birds were not found disturbing them. Syrphid flies were so numerous during the last of August, 1899, that several would alight on my camera whenever it was set down, but a score of birds collected then had not made use of them as food.

Bees[a] **and wasps.**—The most abundant and conspicuous of the useful insects are bees and the flower-fertilizing species of wasps. Of the 645 native birds collected only 31, representing 20 species, had eaten bees. It is interesting to note that the offenders were largely either warblers or aerial feeders. The list is appended:

List of birds examined whose stomachs contained bees and wasps.

Chimney swift.	Song sparrow.	Yellow warbler.
Ruby-throated hummingbird.	Scarlet tanager.	Black-poll warbler.
	Purple martin.	Water-thrush.
Kingbird.	White-bellied swallow.	Maryland yellow-throat.
Rusty blackbird.	Bank swallow.	Canadian warbler.
Henslow sparrow.	Rough-winged swallow.	Catbird.
Chipping sparrow.	Red-eyed vireo.	Carolina chickadee.

Practically all the bees eaten were small species of the family Andrenidæ, mainly *Andrena* and *Halictus;* the larger species are seldom taken. During May, 1900, bumblebees and carpenter bees congregated in such numbers around locust trees white with grape-like clusters that from sunrise to sunset a deep, continued hum arose as from a hive; and when fruit trees were in blossom bees swarmed about them also: but in both cases observation failed to discover any consumption of the insects by birds. Blossoming persimmon trees alive with bees were watched for several hours, but only one bird, a hummingbird, visited them.

No arculate wasps, except certain species of the family Scoliidæ, become food for birds; indeed, less than half a dozen of all the birds

[a] Exclusive of the honey bee, which is considered separately (see p. 36).

collected had taken these species. Others, such as *Vespa*, *Polistes*, *Pompilus*, *Pelopæus*, *Monobia*, and *Ammophila*, were collectively abundant on frequent occasions, but so far as observation went no birds preyed on them.

That birds feed extensively on parasitic wasps is indisputable; but the harm thus done is less than might be supposed, for the usefulness of such wasps is in inverse ratio to their size, and birds seldom select the smallest forms, such as Braconidæ and Chalcididæ. Ninety-seven of the Marshall Hall birds, representing the following 36 species, had eaten parasitic Hymenoptera.

List of birds examined whose stomachs contained parasitic wasps.

Bobwhite	Baltimore oriole.	Warbling vireo.
Downy woodpecker	Grasshopper sparrow.	White-eyed vireo.
Chimney swift.	Chipping sparrow.	Yellow warbler.
Kingbird.	Field sparrow.	Magnolia warbler.
Great crested flycatcher	Song sparrow.	Black-poll warbler.
Phœbe.	Scarlet tanager.	Louisiana water-thrush.
Wood pewee.	Summer tanager.	Maryland yellow-throat.
Blue jay.	Purple martin.	Chat.
Bobolink.	Barn swallow.	Redstart.
Red-winged blackbird.	White-bellied swallow.	Catbird.
Meadowlark.	Bank swallow.	Long-billed marsh wren.
Orchard oriole.	Red-eyed vireo.	Olive-backed thrush.

In this mischief the flycatchers are by all means the greatest offenders, the swallows next, and, less generally but still noticeably, the warblers next. Of all the flycatchers the wood pewee appeared to be the most active and persistent in this destruction. Parasitic wasps are not usually so alert and swift as many other insects; therefore they are easy victims. Most of the class are ichneumon flies (Ichneumonidæ—fig. 13). Somewhat more than a fifth of the birds that had taken parasitic wasps, however, had fed on a certain black wasp, *Tiphia inornata*, which is a vigorous enemy of the larva of the May-beetle. These wasps are so common in May and June that it is not unnatural that a good many should fall prey to birds. The only other noticeably abundant parasitic Hymenoptera were some very large braconids

FIG. 13.—Ichneumon fly (after Howard; loaned by Division of Entomology).

(*Melanobracon*), of which at any time during the first part of September, 1896, a dozen could have been collected within a few minutes. Field sparrows and probably other birds consumed them freely, though as a rule parasitic Hymenoptera are eaten only in small numbers.

Many of these useful species appear too late in the season to be of much effect. An attempt was made to measure the evil effects of their destruction by observing how far they were parasitizing abundant insect pests, but conditions were unfavorable and adequate results were not obtained. The white grub of the May-beetle was not present in numbers sufficient to furnish evidence. The tobacco worm was parasitized by braconids to some extent, but even at the time of greatest activity (August, 1898) only one-tenth of 1 percent of the worms were attacked. The question, then, of the degree to which birds offend by preying on these Hymenoptera remains, so far as Marshall Hall is concerned, a doubtful one, especially since most of the species destroyed are not known to be effective parasites.

SUMMARY.

Considering the insect food of the 645 native birds collectively, we find that the birds were most insectivorous in May, when somewhat more than 90 percent of their food was insects, and that naturally they took the fewest insects in the coldest weather. During the blizzard of February, 1900, however, insects constituted 12 percent of the diet of the 37 birds collected. Throughout the entire time of observation insects and their allies, including a small percentage of spiders and other invertebrates, amounted to 60.41 percent of the total volume of food. They are distributed as follows:

Proportion of insects and their allies in food of birds examined.

	Percent.
White ants	1.07
Bugs	3.63
May-flies	6.51
Ants and other Hymenoptera	9.64
Caterpillars, with a few adult Lepidoptera	7.80
Grasshoppers and a few crickets	4.11
Beetles	18.62
Miscellaneous insects	3.72
Spiders	4.48
Miscellaneous invertebrates, mainly crustacea, snails, and myriapods	.83
Total	60.41

The bugs consisted both of Heteroptera and Homoptera. The Heteroptera included such forms as *Podisus*, *Euschistus*, *Trichopepla semivittata*, *Sinea diadema*, *Thyanta custator*, *Hymenarcys nervosa*, *Metapodius femoratus*, *Nezara hilaris*, *Corizus*, *Coriscus*, *Corimelæna*, *Prionidus*, *Alydus pilosulus*, and *Alydus eurinus*. The Homoptera

included leaf-hoppers, scale insects, and an occasional plant-louse and giant water-bug. Of the Hymenoptera the insignificant proportion of 1.89 percent consisted of parasitic wasps, while the remainder was almost entirely ants. The Lepidoptera were very nearly all caterpillars, though moths were occasionally eaten. The caterpillars comprised the smooth forms, oftenest cutworms (fig. 14) and others of the family Noctuidæ, together with some Geometridæ and occasionally an arctiid or a sphingid.

FIG. 14.—Cutworm and moth (after Howard; loaned by Division of Entomology).

The grasshoppers were long-horned grasshoppers (Locustidæ) and short-horned grasshoppers (Acrididæ), the latter consisting of such forms as *Hippiscus*, *Melanoplus atlanis*, *Melanoplus femur-rubrum*, and *Dissosteira carolina*, the former largely of such meadow grasshoppers as *Xiphidium* and *Scudderia*, with an occasional katydid. Beetles formed twice as large an element of food as any other order of insects. Ground-beetles (Carabidæ), generally considered useful, formed 2.10 percent of the food; injurious species, largely weevils (Rhynchophora) and leaf-beetles (Chrysomelidæ), and, to a smaller extent, lamellicorn and longicorn beetles, leaf-chafers, click-beetles, and metallic wood-borers (Buprestidæ), amounted to 13.25 percent; while miscellaneous beetles, largely dung-beetles of the genera *Aphodius* (fig. 15), *Atænius*, and *Onthophagus*, and beetles of a number of other families, such as the Anthicidæ, Bruchidæ, Byrrhidæ, Histeridæ, Staphylinidæ, and Tenebrionidæ, completed the remaining 3.27 percent of the beetle food. The spiders were largely the ground-spiders of the family Lycosidæ. Spiders are said to do about as much good as harm, and are usually regarded as of no economic importance.

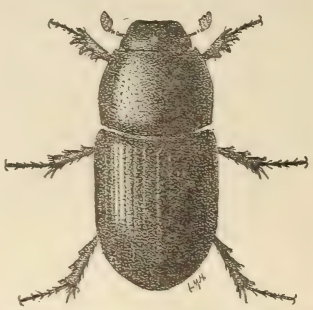


FIG. 15.—Dung-beetle (*Aphodius*) (after Prof. S. A. Forbes).

Beneficial insects (predaceous beetles and parasitic wasps) formed 3.97 percent of the food, while injurious insects, principally caterpillars, grasshoppers, and harmful beetles, amounted to 26.80 percent. It will be remembered, however, that what has already been said about the destruction of useful species shows that but a small fraction of the percentage of these insects should really be counted against the birds.

FOOD OF NESTLINGS.

The largest consumption of insects is to be credited, not to adult birds, but to young ones in the nest. All land birds at Marshall Hall except birds of prey and doves, whatever be their own diet, feed their young chiefly on insects from the time they are hatched until they leave the nest. Many species rear every season two or three broods of from 3 to 5 each, and so voracious are these wide-mouthed youngsters that the parents can supply their wants only by unremitting efforts. Meals often begin before sunrise and continue till after sunset, frequently occurring every two minutes. At first nestlings take considerably more than their own weight of food in a day, and they increase in weight daily from 20 to 50 percent. The number of insects required to supply a season's host of nestlings must be almost incalculable.

Work of other investigators.—One can best study the food of young birds by field observations. Such studies have been pursued by Mrs. Wheelock,[a] Dr. Francis H. Herrick,[b] and Prof. Clarence M. Weed.[c] Professor Weed's bulletin on the feeding habits of nestling chipping sparrows has already been cited at length in Bulletin 15 of the Biological Survey. Dr. Herrick found young cedar birds fed by their parents on grasshoppers, cicadas, chokecherries, raspberries, and blueberries. A brood of red-eyed vireos were given blackberries, red raspberries, bugs, beetles, larvæ, katydids, and grasshoppers. Nestling catbirds were nourished with red cherries, strawberries, larvæ, moth millers, beetles, and dragon-flies (*Æschna heros* and *Libellula pulchella*). Young bluebirds were fed robber-flies (*Asilus*), larvæ, crickets, grasshoppers, and katydids. Mrs. Wheelock states that she observed nestling red-headed woodpeckers eating black beetles; that marsh wrens bring May-beetles to their broods; that young robins are fed moths and dragon-flies, and that crows give frogs and nestling birds (English sparrows, song sparrows, and meadowlarks) to their young.

Methods of investigation.—Mrs. Wheelock's excellent results were obtained in the field by observing the nests *in situ*, and Dr. Herrick's by cutting the nests down and placing them in a favorable situation for observation. Both of these methods have been employed at Marshall Hall. The choice of glasses is important. Mrs. Wheelock used binoculars in studying her subjects. These were used at Marshall Hall with the best success in the case of very active shy birds or those in shadow. A Zeiss monocular 12-power was tried, but was found to be useless unless there was an abundance of strong sunlight, and

[a] Nestlings of Forest and Marsh, 1902.
[b] Home Life of Wild Birds, 1901.
[c] Bull. 55, N. H. Agr. Expt. Sta., 1898.

under any circumstances not so desirable as had been anticipated. A 2-inch telescope with a single draw tube proved much more serviceable. Working with it, however, is very slow and arduous on account of its limited field and the difficulty of changing the focus quickly.

Grasshopper Sparrow.—The difficulties encountered in the use of the telescope in field work may be well shown by a somewhat detailed account of its use in the following instance: On July 9, 1898, a grasshopper sparrow's nest containing four naked young birds was found in a bunch of rabbit-foot clover in a timothy field of lot 1, several rods from the cow barn. The male parent was poised on a weed stalk at no great distance, rattling out his dry ditty, never once stopping to help the mother bird, which was making frequent journeys for food. The latter, on seeing me, perched on a dead mullein stalk 20 to 30 feet away, instead of carrying to her little ones the mouthful she held. The telescope was immediately focused. It enlarged the mother bird so much that she appeared to be peering in at the end of the instrument. The object in her bill was seen to be of a delicate green color, but before further observation could be made she flew to the top of a blackberry bush. Here, by fragmentary glimpses, during which it was necessary to change the focus several times, a narrow wing cover and a long, slim leg were discerned, which showed that the insect belonged to the order Orthoptera (grasshoppers, crickets, etc.). The bird next returned to her perch on the mullein stalk, where she remained long enough to enable the telescope to reveal, projecting from the beak on the side opposite the leg and wing, two filiform antennæ which exceeded the body in length and furnished the necessary clew to the insect's identity as a meadow grasshopper. Further observations were made, with the same interruptions and demands upon the patience. In the next two trips she brought the same insects. She next came with a cutworm, then with a chrysalis, and later with two short-horned grasshoppers (*Melanoplus* and *Dissoteira*). The meagerness of these results, considering the time required for obtaining the information, was due to the restless uneasiness of the grasshopper sparrow and the location of the nest in an open field where no cover for the observer was available to reduce the bird's apprehension. Observation of a house wren (see p. 45) was conducted under more favorable conditions and was much more satisfactory. No nestling grasshopper sparrows were collected at Marshall Hall, but 14 from other localities have been examined, and diagrams that were made of their food and of that of 10 adults taken at the same time show the great importance of insects in the food of nestlings.[a]

Orchard Oriole.—A few observations were made of a brood of well-feathered orchard orioles in a black-walnut tree near the negro cabin,

[a] These diagrams were published in an article entitled The Food of Nestling Birds, which appeared in the Yearbook of the Dept. of Agriculture for 1900.

July 18, 1898. The male parent, a bird in greenish plumage, did not help to provide for the young, but appeared to think that his sole duty consisted in coming to the tree occasionally and singing. The mother worked incessantly. It was difficult to identify what she brought, because she was so shy and remained at the nest so brief a time. I had to stand close to the tree and focus the glass on her when she was nervously hopping from branch to branch. Working under these difficulties I was able to identify but 2 caterpillars, 3 May-flies, 2 short-horned grasshoppers, and 3 meadow grasshoppers.

House Wren.—The most satisfactory and continued observations were made June 17, 1899, of some young house wrens that were about three-fourths grown. In this case it was found desirable to remove the nest, which was in a cavity in a locust tree, transfer it to a baking-powder can, and nail the can to the trunk of the tree about 4 feet from the ground. The following is a detailed account of the feeding:

Feeding of a brood of house wrens.

A. M.	
5.55.	Green caterpillar (*Heliothis dipsaceus*).
5.56.	May-fly.
6.00.	May-fly.
6.02.	Undetermined.
6.05.	*Heliothis dipsaceus.*
(Observations suspended till 7.20 a. m.)	
7.21.	Undetermined.
7.23.	May-fly.
(Observations suspended till 7.45 a. m.)	
7.46.	Harvestman (Phalangidæ).
7.47.	May-fly.
7.48.	Undetermined insect.
7.49.	Undetermined.
7.51.	Undetermined.
7.55.	Undetermined.
7.56.	Undetermined.
7.57.	Undetermined.
7.57½.	Undetermined.
8.00½.	Undetermined.
8.01.	Undetermined.
8.03.	Undetermined.
8.03½.	Undetermined.
8.06.	*Heliothis dipsaceus.*
8.08.	Undetermined insect.
8.11.	Undetermined insect.
8.13½.	Brown caterpillar.
8.16.	Undetermined insect.
8.18.	Undetermined insect.
8.20.	Undetermined insect.
8.22.	Undetermined insect.
8.23.	Two May-flies.
8.24.	May-fly.
8.29.	Brown orthopterous insect.
8.30.	*Heliothis dipsaceus.*
8 35.	Undetermined.
8.38.	Caterpillar.
8.41½.	May-fly.
8.43.	May-fly.
8.45.	Brown caterpillar (cutworm?).
8.46.	*Heliothis dipsaceus.*
8.47.	Undetermined insect.
8.48.	Undetermined insect.
8.49.	Undetermined insect.
8.50.	Undetermined insect.
8.52½.	Cutworm (?).
8.55.	*Heliothis dipsaceus.*
8.56.	Undetermined insect.
8.59.	Pentatomid bug (*Nezara?*).
9.03.	Cutworm (?).
9.05.	Cutworm.
9.10.	Caterpillar (*Acronycta oblinita*).
9.13.	Brown soldier bug.
9.17.	Green caterpillar (noctuid).
9.20.	White grub.
9.25.	Clay-colored grasshopper.
9.25½.	Grasshopper.
9.30.	Undetermined insect.
9.37.	(Two cabbage worms placed on edge of tin can.)
9.38.	*Acronycta oblinita.*
9.39.	*Heliothis dipsaceus.* (Refused cabbage worm.)
9.39½.	May-fly.

Feeding of a brood of house wrens—Continued.

A. M.	
9.45.	Grasshopper.
9.46.	Cutworm.
9.50.	Grasshopper (*Melanoplus*).
9.52.	Saw-fly larva (?).
9.54.	Miller (noctuid).
9.55.	*Heliothis dipsaceus.*
9.57.	*Heliothis dipsaceus.*
10.00.	Spider.
10.01.	*Heliothis dipsaceus.*
10.05.	Black chrysalis.
10.08.	Cutworm.
10.15.	Spider.
10.16.	Caterpillar.
10.20.	May-fly.
10.23.	Spider.
10.26.	Clay-colored grasshopper.
10.29.	Clay-colored grasshopper nymph.
10.30.	*Acronycta oblinita.*
10.35.	Green caterpillar.
10.38.	*Heliothis dipsaceus.*
10.41.	*Heliothis dipsaceus.*
10.46.	Clay-colored grasshopper.
10.48.	Spider.
10.50.	Miller (noctuid).
10.52.	Clay-colored grasshopper nymph.
10.54.	Miller (noctuid).
A. M.	
11.02.	May-fly.
11.02½.	May-fly.
11.15.	Green caterpillar.
11.20.	Miller (noctuid).
11.21.	Black chrysalis.
11.22.	Saw-fly larva (?).
11.25.	Spider.
11.26.	Grasshopper (*Melanoplus*).
11.30.	*Heliothis dipsaceus.*
11.30½.	May-fly.
11.32.	Spider.
11.34.	Grasshopper (*Melanoplus*).
11.34½.	Saw-fly larva (?).
11.36.	*Acronycta oblinita.*
11.39½.	May-fly.
11.47.	Cutworm.
11.48.	May-fly.
11.50.	Cutworm.
11.51.	*Heliothis dipsaceus* (2).
11.59.	*Heliothis dipsaceus.*
P. M.	
12.02.	*Heliothis dipsaceus.*
12.06.	Spider.
12.07.	*Heliothis dipsaceus.*
12.09.	Cutworm.
12.11.	Spider.

The mother wren thus made 110 visits to her little ones in four hours and thirty-seven minutes, and fed them 111 insects and spiders. Among these were identified 1 white grub, 1 soldier bug, 3 millers (Noctuidæ), 9 spiders, 9 grasshoppers, 15 May-flies, and 34 caterpillars. On the following day similar observations were made from 9.35 a. m. till 12.40 p. m., and in the three hours and five minutes the young were fed 67 times. Spiders were identified in 4 instances, grasshoppers in 5, May-flies in 17, and caterpillars in 20.

Previous to the observation of this brood of wrens a collection of adult and nestling wrens was made. Their food is shown in diagrams (Pl. IX, fig. 1).

Barn Swallow.—The food of seven nestling barn swallows (fig. 16) collected June 17, 1899, consisted of beetles (*Onthophagus pennsylvanicus*, *Aphodius inquinatus*, *Agrilus* sp., and Rhynchophora), parasitic wasps (*Chalcis* sp., Ichneumonidæ and *Tiphia inornata*) and flies (Leptidæ, *Chrysops* sp., *Lucilia cæsar* and other Muscidæ), bugs (Capsidæ), May-flies, and snails. The vertebræ of some small fish, which may have been taken to aid the gizzard in digesting the food, were also found in the stomachs.

Bank Swallow.—An examination was made of the stomachs of 83 young bank swallows collected a few miles above Marshall Hall from

a colony in the face of the river bluff. They were probably the progeny of the swallows that frequently circled over the farm. The food of the nestlings and that of adults collected during the nesting season is shown in diagrams (Pl. IX, fig. 2).

Purple martins, which came from a colony of somewhat more than a dozen pairs nesting in boxes on poles at Bryan's Point, a mile above the house, were often seen circling about the farm. On June 28, 1902, I visited the colony and found the parent birds feeding the young soldier bugs, ants, fig-eaters (*Allorhina nitida*), and dragon-flies (*Libellula* and Agrionidæ).

FIG. 16.—Barn swallow.

Three young downy woodpeckers which were collected May 28, 1896, had fed principally on ants, but had also eaten spiders, ground beetles, and caterpillars.

Catbird.—The difference between the food of adults and young belonging to a highly frugivorous species is well illustrated in the case of the catbird, and is shown in diagrams (Pl. IX, fig. 3), which were made principally from results obtained at Marshall Hall.

Crow and Crow Blackbird.—Such granivorous birds as crows and crow blackbirds feed their young mainly insects. Sufficient material

to illustrate this habit was not available at Marshall Hall, but the diagrams here given (figs. 17 and 18), based on results obtained elsewhere,[a] will serve to show it. By the time the young are ready to leave the nest, however, they are fed to a large extent on either grain or fruit, according to locality. In the Middle West they take grain and in the East generally fruit. Both crows and crow black-

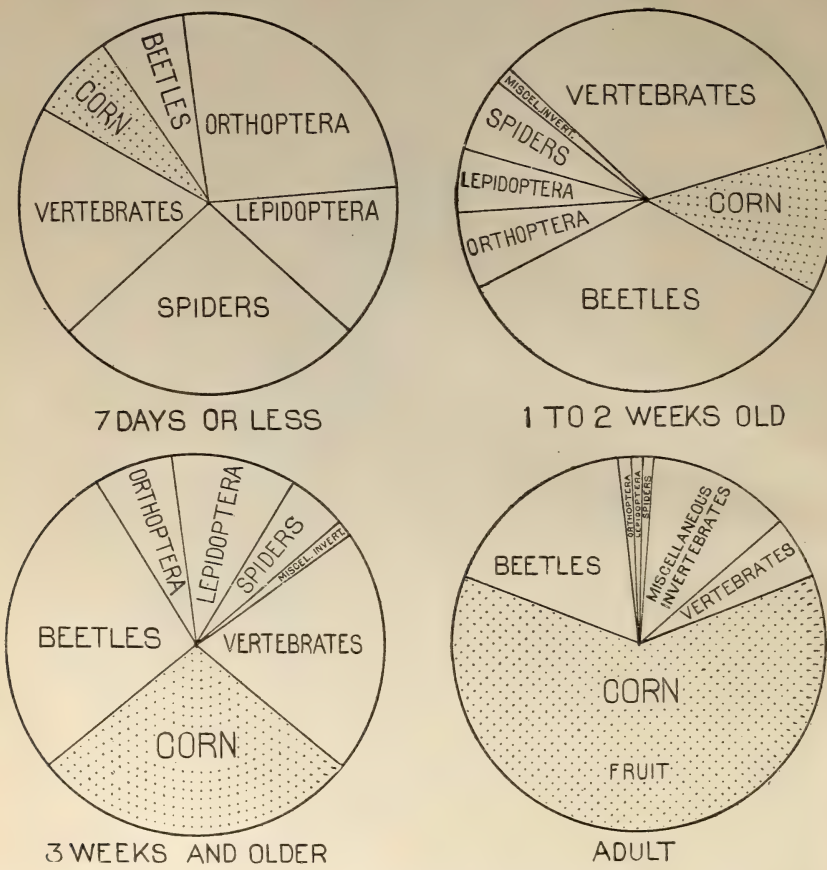


FIG. 17.—Diagram showing proportions of food of American crow (*Corvus americanus*), young and adult.

birds do great service by feeding to their young not only cutworms and grasshoppers, but also large numbers of weevils and May-beetles.

GENERAL REMARKS.

Consumption of caterpillars and grasshoppers is the largest benefit derived from the presence of nestlings on the farm. The parent birds

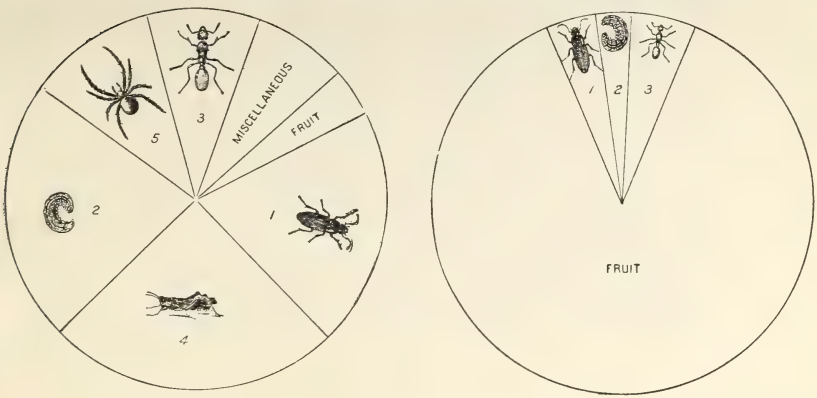
[a] Most of the stomachs of young and adult crows used in the investigation on which the results shown in the diagram are based were obtained at Sandy Spring, Md.; and most of those of young and adult crow blackbirds came from Onaga, Kans.

NESTLING. FIG. 1.—HOUSE WREN. ADULT.

[1, Cutworm; 2, spider; 3, stink-bug; 4, May-fly; 5, weevil; 6, grasshopper.]

NESTLING. FIG. 2.—BANK SWALLOW. ADULT.

[1, Weevil; 2, ichneumon fly; 3, winged ant; 4, fly; 5, dragon-fly; 6, stink-bug.]



NESTLING. FIG. 3.—CATBIRD. ADULT.

[1, Ground-beetle; 2, cutworm; 3, ant; 4, grasshopper; 5, spider.]

FOOD OF NESTLINGS AND ADULTS OF THREE COMMON BIRDS.

[The diagrams show the proportions of the various orders of insects in the food, each order being represented by the insect belonging to it that is most commonly eaten by the bird whose food is shown. (In the case of the Hymenoptera a division is sometimes made between the parasitic members of the order, which are very useful, and those that are neutral or injurious. The figures of insects are reduced from cuts kindly loaned by Dr. L. O. Howard.)]

FIG. 1.—RED-TAILED HAWK.

FIG. 2.—SHORT-EARED OWL.

hunt out these insects when they are not abundant and even when they are rare. At the time of the foregoing observations of orchard orioles, house wrens, and grasshopper sparrows, caterpillars and grasshoppers were comparatively scarce; yet the parent birds, though they chose insects for their own eating from more abundant species, hunted far and wide for these rare ones to feed their young. At Marshall Hall

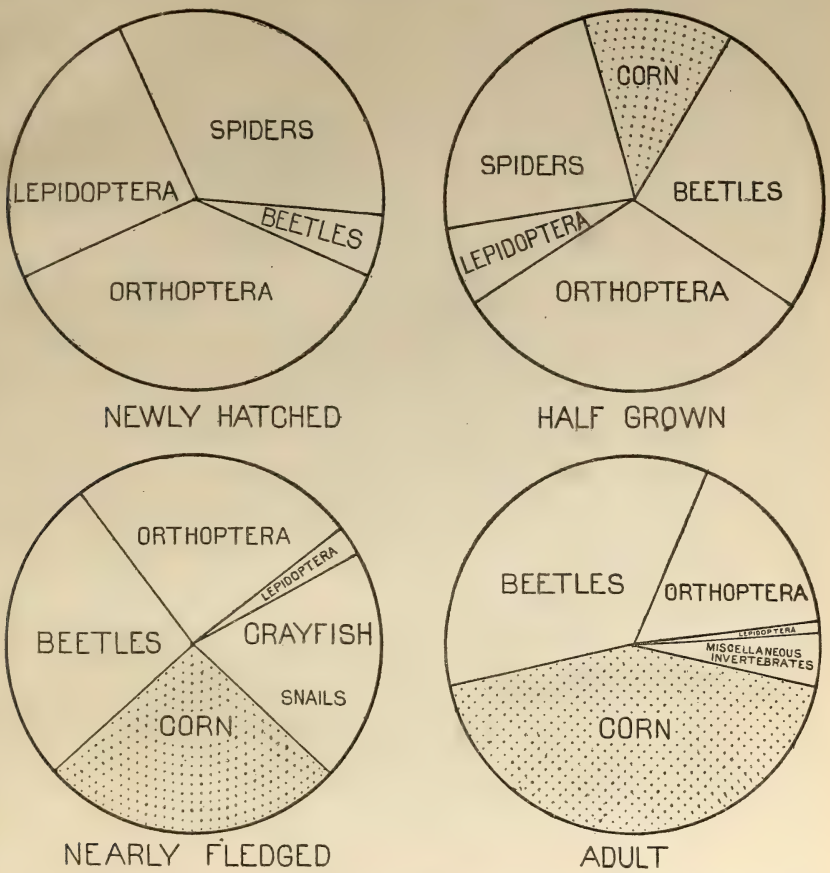


FIG. 18.—Diagram showing proportions of food of crow blackbird (*Quiscalus quiscula æneus*), young and adult.

the protection and encouragement of birds at nesting time is of prime importance. Adults of the most numerous species on the farm are either highly frugivorous or highly granivorous, hence the insectivorous habits of nestlings help considerably to establish the beneficent relation of birds to the farm economy.

III.—VERTEBRATE FOOD.

POULTRY AND GAME.

Crows.—Certain species of the larger birds were found to take vertebrate food. Crows and some of the hawks and owls destroyed useful small birds and also game and poultry. On the Hungerford farm crows were observed killing newly-hatched turkeys, and on the Bryan farm they were not uncommonly seen carrying off little chickens. The most serious offense against the poultry interest, however, was the habitual stealing of eggs. During April, 1900, a crow came every day and robbed a hen's nest in the side of a hayrick at a little distance from buildings. Often he would be seen waiting on a fence near by until the hen announced that the egg had been laid, when he would dash down and make off with his booty. Such depredations could be avoided by furnishing the hens with such facilities that they would no longer lay in exposed situations. As it is, incessant war upon the crow is necessary to prevent heavy loss to poultry on this farm. Game birds also suffer. On May 15, 1900, a crow was caught on the forested slope beyond the swamp (Pl. VII, fig. 2) in the act of pillaging the nest of a ruffed grouse. Crows also despoiled the nest of a bobwhite, a species which probably suffers oftener than the ruffed grouse.

Eagle.—The bald eagles that are frequently seen at Marshall Hall do not disdain to pick up a little game now and then. Early in March, 1897, a crippled scaup duck was seen in the river a hundred yards from the house chased by an eagle and diving every time its pursuer swooped down on it. When the quarry was almost tired out the eagle was shot, and fell into the river with a broken wing, but it had sufficient strength left to lacerate a pointer that attempted to retrieve it. On November 15, 1900, an eagle was seen flying over the house gripping in its talons a live coot, which turned its head rapidly from side to side in its struggles to escape. During the hunting season eagles get a good part of their food by picking up wounded ducks. They also prey on domesticated ducks. In the first week of August, 1896, they carried off several ducklings that went down to the swamp. The royal brigands relish chicken, and in the nest of one pair that came to the farm was the carcass of a recently killed Plymouth Rock hen.

Cooper Hawk.—With the exception of the English sparrow, the Cooper hawk (fig. 19) probably does the least good and the most harm of all the birds of the farm, for it subsists almost entirely on wild birds and poultry. It very frequently steals little chickens, and constantly preys on the bobwhite and useful insectivorous or seed-eating small birds. During November, 1900, the bobwhites were so persecuted that they were seldom found far from cover. In one instance a hawk was seen to swoop to the ground and rise with a victim, the

identity of which was afterwards made sure by the discovery of the feathers of a cock bobwhite on the spot where the hawk had struck.

Sharpshinned Hawk.—The sharpshinned hawk, congener of the Cooper hawk, is also a harmful species. It was frequently observed pursuing native sparrows, and on November 15, 1900, was seen tearing a mockingbird to pieces. The smaller birds suffer most in autumn. On the 15th of November, 1899, I was observing a score of cardinals, juncos, white-throated sparrows, fox sparrows, and song sparrows

FIG. 19.—Cooper hawk.

that were eating ragweed seed in wheat stubble by the negro cabin. Suddenly the whole flock sprang into the air and flew straight toward me and into the bushes behind me, twittering with fright. Their swiftness just saved them from a sharpshinned hawk, which swooped and struck the ground where they had been feeding. It was two hours before they dared to leave their shelter and feed again on weed seeds of the stubble-field. These two species of hawks patrol the farm

so vigilantly in autumn and winter that birds which eat weed seed are kept in constant terror, and are unable to do all the good they might accomplish were it not for their tireless enemies. Owing to the depredations of these two hawks, all hawks without distinction have been relentlessly persecuted by man, although very few are actually detrimental to agriculture.

Great Horned Owl.—Only one of the several species of owls occurring at Marshall Hall is harmful, namely, the great horned owl (fig. 20).

FIG. 20.—Great horned owl.

It occasionally makes inroads on poultry that is not housed. In December, 1897, a great horned owl carried off a full-grown hen from her roost in a tree beside the negro cabin, and on five of the first ten nights of May one came and took hens from the cedar trees behind the house. On the night of the sixth visit a steel trap baited with a hen secured the robber. A year seldom passes without losses from this fierce and powerful bird of prey.

FISH.

Several species of birds on the farm are known to feed on fish, but they are so few in number and take food fishes so seldom that as far as has been learned they cause no material injury to fishing interests, which at this point on the river are of considerable importance. A pair of kingfishers were often seen fishing along the shore in front of the Bryan house (Pl. III, fig. 2), and five nestlings taken from the bluff on the Hungerford place had been fed wholly on fish. Herons, including the night heron, the green heron, and the great blue heron, were frequently seen wading in shallow water, spearing fish with their long, pointed beaks. Two green herons that were collected had eaten silversides (*Menidia notata*) and mummichogs (*Fundulus heteroclitus*). Ducks, particularly the mergansers, feed to some extent on fish. Two hooded mergansers, collected November 15, 1900, had eaten respectively 12 and 20 tiny fish. Gulls are decidedly more piscivorous than ducks. During November the herring gull and the ring-billed gull fished by the dozen out in the river between the farmhouse and Mount Vernon (see Pl. I, frontispiece fig. 2). In the same place the osprey was once in a while seen plunging after his prey. The bald eagle was observed catching fish, but more often it feeds on those that it finds dead.

CARRION.

Some birds, notably eagles, crows, and buzzards, feed at times largely on dead fish. Eagles may be seen along the river scanning the shore for those cast up by the tide. May 19, 1899, an eagle flying over the farm dropped an eel 26 inches long that had evidently been taken as carrion. Gulls, also, undoubtedly pick up a good deal of such food. Crows and buzzards are valuable scavengers of dead fish cast up at low tide during the last of April and the first of May, when the fishing season is at its height. These fish are small, principally sun-fish, white perch, and shad, that were fatally injured by nets. Observations on May 5, 1901, showed the whole river front of the farm strewn with decaying fish, which gave out such a stench that one could not sit comfortably within several hundred yards of the beach. Some 40 buzzards were feeding on the carrion all day. On close inspection they were seen to be selecting that which was most badly decomposed. Crows in almost as large numbers and several crow blackbirds were also feeding, but they commonly took that which was less decayed. Several crows came repeatedly to the shore of lot 1, picked up fish, and carried them to their nests in the woods. By abating this nuisance crows and buzzards do a service that is appreciated by the occupants of the farmhouse.

Buzzards are also useful in removing other carrion. Stock that dies on the farm is never buried, but is left for them. November 16,

1899, some notes were made on the manner in which a carcass was disposed of. On the edge of lot 1, near the mouth of Persimmon Branch, lay a horse that had died two weeks before. Fully 30 buzzards closely attended it, and some were to be found at work on it at any hour of the day, while the others, tired of gorging, sat around on a rail fence, stretching their wings and preening. At night they all roosted together in oak trees within a hundred yards of the horse, as if they wished to keep near the food. A year later another horse was given over to the buzzards. The buzzards did not in either case tear open the skin to expose the large muscles, but if the weather had been hot they might have eaten these as well as viscera. Crows are seldom known to feed on dead stock, but during the March blizzard of 1898 they were almost starved, and resorted with buzzards to a dead cow. Buzzards dispose of the entrails and other refuse of pigs, fish, and chickens, which are thrown to them in a certain place where they have learned to expect it.

MAMMALS.

Mice.—The crow and several other birds of the farm do some good by destroying injurious mammals. In the vicinity of the storage barn a loggerhead shrike was often to be seen. Here it impaled its prey on thorns of the osage orange hedge and on the barbs of a wire fence. In one instance a house mouse was found spitted on the fence. If extended observations could have been made it is probable that mice would often have been found in the larder of this useful little shrike. The crow takes mice at every opportunity. On February 21, 1900, signs of its work appeared near the runways of meadow mice in a wheat-stubble patch of lot 5, in the form of crow tracks in the light snow, holes pecked in the earth, and at one place spatters of blood and tufts of mouse hair. Hawks feed habitually on these mice. In January, 1898, when there were several inches of snow on the ground, a red-tailed hawk (Pl. X, fig. 1) shot in the road by the negro cabin held in its talons the warm body of a meadow mouse. November 15, 1900, a marsh hawk skimming over lot 2 suddenly dived into the brown broomsedge. As it rose it was killed and a meadow mouse dropped from its clutch. In its stomach the head and hind quarters of another were found. This species of hawk is undoubtedly the most useful mouser on the farm and should have due credit, for mice cause much injury there to fruit trees, sweet potatoes, and grain. The short-eared owl (Pl. X, fig. 2) has several times been observed preying upon meadow mice. This bird, the marsh hawk, and the red-shouldered hawk, which are all excellent mousers and rarely attack poultry or birds, are continually made to pay with their lives for the depredations of the real poultry thieves of the hawk and owl tribe—the Cooper and sharp-shinned hawks and the great horned owl. The illustration of a short-

eared owl here given is of a bird that had just made vicarious atonement for depredations on the poultry by the great horned owl.

Rabbits.—The marsh hawk and other large species prey on rabbits. In the last week of December, 1897, a marsh hawk was shot which had just killed one of unusual size. The crow regularly feeds on young rabbits. On March 27, 1901, several crows that were congregated in some grass land at a point 150 yards behind the house were frightened away. An empty rabbit's nest found on the spot and stains of blood on the broom-sedge told what they had been doing. The rabbit is a nuisance on the farm. It often ruins hotbeds of sweet potatoes, cuts tortuous paths through wheat fields, and nibbles cabbages and turnips. Not more than 20 miles from Marshall Hall rabbits girdled and killed 2,000 young pear trees in an orchard of 4,000 within two months.

The food of the 645 birds examined shows only 1.72 percent of vertebrate food. The reason for so small a proportion is the fact that the collection included only 19 birds that could be expected to feed on flesh.

IV.—FRUIT.

CULTIVATED VARIETIES.

Fruit forms with many common birds an important element of food. Of the 645 stomachs of native birds collected at Marshall Hall 139 contained either wild or cultivated fruit. The greatest interest naturally centers in the cultivated varieties.

Strawberries.—The earliest fruit on the farm is the strawberry. It usually ripens about the middle of May and would naturally be expected to tempt the birds. With a view to measuring their depredations on the crop, two visits were made to Marshall Hall between the 13th and the 20th of May of 1899 and 1900. A strawberry patch in the Bryan kitchen garden was watched for several days in the early morning, when birds were feeding most busily, but although catbirds, orchard orioles, and other notably frugivorous species were all around the patch, not one of the birds entered it for berries. On the Hungerford place, adjacent to the wooded dell tenanted by the colony of crow blackbirds already referred to, there was a large strawberry patch, from around which were collected 13 blackbirds, 13 catbirds, and 2 orchard orioles, but only one of them, a catbird, had eaten strawberries. On the previous day the patch was watched for several hours. Only a solitary catbird entered it and he did not take a berry. These and other observations showed that birds at Marshall Hall did not harm the strawberry crop, but, on the other hand, protected it by destroying ground-beetles, which, as has been said, injure the fruit. If catbirds were fond of strawberries, they would have made sad havoc on these farms, for they fairly swarmed amid the

tangled vegetation on the river front (Pl. IV, fig. 1). Their liking for fruit is well known, and it seems strange that they should prefer winter-cured smilax berries to strawberries; yet of 13 individuals collected at this time 5 had eaten smilax berries that had hung on the bushes all winter.

Cherries.—During cherry time 227 birds were collected, 23 of which, comprising crows, crow blackbirds, catbirds, cedar birds, brown thrashers, and kingbirds, had fed on cherries and little else. Cherries ripen from the 30th of May to the 15th of June and remain on the trees for about a month. Some interesting field observations corroborated the results of the examination. On the Bryan farm cherry trees are so numerous that an observer can not keep track of the birds that fly to them, but on the Hungerford farm, where the trees are few, there is no difficulty in taking notes. One large black ox-heart tree in a hedge row several hundred yards from the river was watched June 15, 1899. From sunrise till sunset there was seldom an interval of ten minutes when it was empty. Catbirds flew up to it from the matted vines on the river front; thrashers came from inland thickets; and kingbirds flew over from apple and pear orchards. A flock of half a dozen cedar birds every now and then came to it and fed eagerly, and a crow made it a base of supplies for her greedy brood in a neighboring sycamore. The colony of crow blackbirds that had nested in the adjacent dell were, however, the most regular and frequent visitors. They had taken their recently fledged young to a swamp a quarter of a mile away, and all day long flew back and forth in a 'bee line' between that and the cherry tree, often meeting one another in the journey and sometimes numbering three or four in the tree at one time.

As an experiment looking toward the possible protection of cherries, a screech owl with a clipped wing was placed in a cherry tree near the Bryan farmhouse. Several catbirds that came to pillage made an outcry at first, but soon attacked the cherries, regardless of the owl. An English sparrow, a red-eyed vireo, and two orchard orioles that entered the tree were at first much disturbed, but were all eating cherries within fifteen minutes. Since the screech owl does not feed on birds to a considerable extent, they probably did not recognize in him a dangerous enemy. The presence of a great horned owl or a Cooper hawk would doubtless have had a completely deterrent effect. The cherry crop at Marshall Hall is not marketed, nor is one hundredth of it ever picked; the proportion consumed by birds is, consequently, of no economic importance.

Other orchard fruit.—When the cherry season was over the birds that had shown themselves notably frugivorous were expected to turn their attention to the orchards of plums, peaches, pears, and apples. While these fruits were ripe 161 birds were collected, but not one appeared

to have molested them. Many had taken fruit, but had drawn on nature's supply instead of man's. All the trees in the orchard were watched, but birds apparently did not rob them, a fact in striking contrast with the notorious pillaging by birds in the fruit-growing regions of California. In California birds also do much damage in spring by eating the buds and blossoms of fruit trees, but at Marshall Hall no appreciable loss is caused in this way. White-throated sparrows occasionally feed on buds and blossoms, and on one occasion (April 25, 1901) three of these birds were seen mutilating pear blossoms in the kitchen garden, but beyond this no example of such depredations was observed.

Grapes.—Grapes are not raised for market at Marshall Hall. In the Bryan kitchen garden there is a trellis for family use, but birds did no appreciable injury to the grapes that grew on it.

Tomatoes.—Catbirds were reported to be ruining the tomato crop on the Hungerford farm during the third week of June, 1899. The place was visited and every tomato that had reddened at all was found to have been pecked. The injury was causing heavy loss to the farm, for the fruit at that time brought a high price. The patch was watched for several hours, but not a catbird entered it. Nine chickens, however, stole up from a small house on the shore and went from plant to plant, eating greedily. To make doubly sure that catbirds had no share in the mischief, 15 individuals were collected from the neighboring dell and the bushes about the patch, and examination was made of the stomach contents. No trace of tomatoes was found.

Melons.—The only fruit grown for market that suffered from the depredations of native birds was the melon, and it was attacked by only one species—the crow. In numbers from three or four to a dozen at a time crows began to injure melons about August 1 and continued for three weeks, attacking both watermelons and cantaloupes, but preferring the former. Each crow would peck at a melon a dozen times or so and then pass on to another. If no protective measures had been taken, the crop would often have been a total loss, and in spite of all efforts from 5 to 20 percent of the melons grown at all distant from buildings were punctured (fig. 21). Carcasses of crows, strings with long white streamers attached, an improvised miniature windmill that revolved and struck noisily against a piece of metal, and a bit of bright tin suspended from a string so that it turned with every breath of air and reflected the sun about the field were some of the devices used to frighten the wary and suspicious marauders. In 1873, 1874, and 1875, when the melon crop was so important that 4 or 5 acres, containing from 3,000 to 4,000 hills, were given up to it, the method of protection used in the rice fields of the South was adopted: from sunrise to sunset a negro with an old musket and plenty of pow-

der watched from a brush shelter in the middle of the field and, whenever a crow appeared, frightened it away with a thundering report. If the field was left unguarded for any length of time, the crows were sure to make havoc among the melons. Since they would never come within gunshot if they knew anybody was watching, attempts were made to destroy them by a stratagem; two men would enter the brush house and one of them would soon leave, hoping to delude the crows into thinking that the house was empty, so that they would venture within range of the second man's gun. The plan worked only in the first few trials, however. The farmers at Marshall Hall maintain that crows can count up to three, for they could not be hoodwinked unless three men left the house and a fourth remained to shoot.

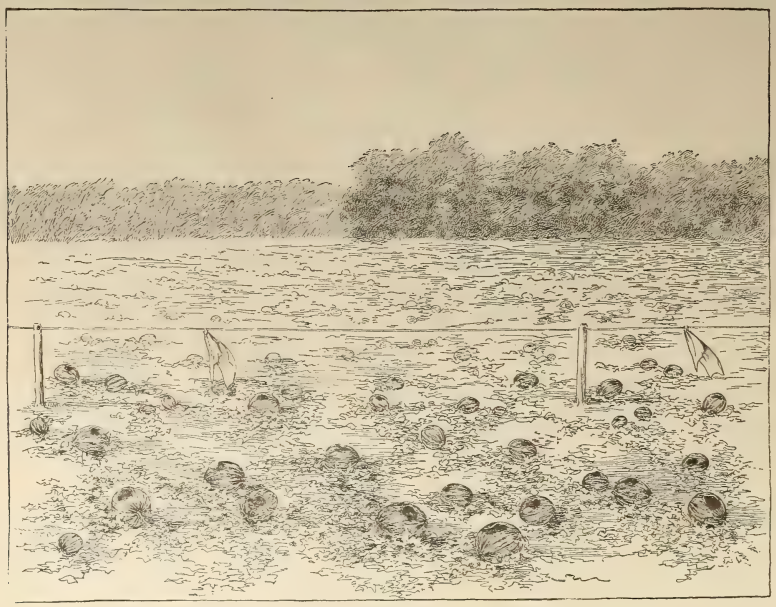


FIG. 21.—Melons damaged by crows.

WILD FRUIT.

Wild fruit formed 10.12 percent of the food of the 645 birds collected, and had been eaten by 120. Both examination of stomachs and notes of field work showed how important an element it is in the food supply of many species.

Smilax.—The catbird, which, with the possible exception of the cedar bird, is the most conspicuous frugivorous species on the farm, ate in May, when it arrived from the South, the winter-cured berries of smilax. Out of 13 individuals collected May 17–20, 1899, 5 had made from 15 to 40 percent of their diet on these husks in preference, as has already been said, to the feast spread in the strawberry patch.

During May cedar birds and crow blackbirds also relished them, and the robin, when hard pressed on its arrival, during the last of February, was seen to eat them eagerly.

Mulberries.—The first wild fruit that offers a freshly ripened supply at Marshall Hall is the mulberry, and it lasts from the end of May until the end of June. On May 29, 1896, observations were made of birds feeding in a large mulberry tree in the wooded gully of the hog lot. A pair of downy woodpeckers that bred in a willow stub near by were twice noted eating the berries. A Baltimore oriole, probably a late migrant, fed on them eagerly. Several pairs of orchard orioles and kingbirds which nested together near the house came to the tree at frequent intervals. The kingbirds would balance themselves on the topmost sprays and pluck the berries as gingerly as if they had been insects. Two pairs of red-eyed vireos and a pair of white-eyed vireos haunted the mulberry and adjacent trees, now and then taking a berry, but most of the time apparently eating insects. A cardinal that nested on the shore of the calamus swamp, 200 yards distant, made one trip to the tree, but was accidentally frightened out of any subsequent visits. Crows came from the woods 25 rods away and three blue jays journeyed at least a quarter of a mile for the fruit. Song sparrows frequently hopped about on the ground beneath the tree and picked up fallen fruit. A flock of eight cedar birds fairly gorged themselves. At intervals they would repair to cedar trees on the brink of the gully and sit as motionless as if they were literally stuffed, until digestion relieved their repletion. Then they would apparently wake up, preen their pretty plumage, and, regaining activity one after another, would presently with one accord fly back to the berries with renewed appetite. They appeared to spend their whole time alternately feasting and napping. The catbirds were about as gluttonous, but not so lazy. They came to the tree from the neighborhood, from the house, and from the river bluff. Hardly a period of five minutes passed in which not one was among the branches, and three or four were often present at once. They were so tame that it was possible to see just how they fed. One would pluck a berry, sometimes an inch long, bolt it whole, and then stand almost choking, with mouth wide open, while the berry, which made a great lump in its gullet, slowly passed into its stomach. Then with evident relief it would hop about and perhaps sing a few bars of song. There was no luxurious idleness among the catbirds. As soon as they had eaten they either sang or flew away to resume nest building, incubation, or the feeding of their young. Mulberries formed at this season the greater part of their food.

A list follows of the birds that were observed feeding on this fruit or that were found by examination to have eaten it.

List of birds feeding on mulberries.

Blue jay.	Cardinal.	Downy woodpecker.
Crow.	Carolina chickadee.	Cedar bird.
Crow blackbird.	Song sparrow.	Catbird.
Orchard oriole.	Red-eyed vireo.	Kingbird.
Baltimore oriole.	White-eyed vireo.	Bobwhite.

Raspberries and blackberries.—The black raspberry, the dewberry, and the blackberry, which are the wild fruits that, in the order given, ripen next, are too plentiful and too widely distributed for much remunerative field observation. The following list of birds that ate them was prepared chiefly from stomach examination:

List of birds feeding on raspberries and blackberries.

Bobwhite.	Brown thrasher.	Kingbird.
Summer redbird.	Catbird.	Red-headed woodpecker.
Cardinal.	Orchard oriole.	Cedar bird.
Song sparrow.	Bluebird.	
Field sparrow.	Crow.	

A few field notes on the destruction of these fruits were made, however. Catbirds were seen, May 30, 1896, in black raspberry bushes near the house, eating half a dozen berries apiece. During June, 1899, lot 2 was overrun with a network of dewberry vines. Here, on the 17th, bobwhites were observed walking from vine to vine, picking the berries in a systematic fashion. During 1896 blackberries fruited heavily, and birds were not slow to take advantage of the generous food supply. July 12 a red-headed woodpecker was observed to come and feed on the berries with catbirds and orchard orioles, and a kingbird was seen to fly down to a bush, hover beside it, and pluck a berry. In early August, 1898, two field sparrows were seen in several instances selecting fruit which had dried on the bushes in preference to that which was fresh and juicy. They may have done this to obtain the seeds of the berry and extract their meat. A number of song sparrows picked up blackberries from the ground as they had mulberries. Since this species is often very abundant in cultivated patches of blackberries and takes 10 percent of its food from this fruit in its season, the habit of feeding on fallen berries may be fortunate for the horticulturist. Rubus fruits are not raised for market at Marshall Hall, hence it is unimportant whether the birds eat them or not; if they were, and if there were no other fruit available, the abundant frugivorous birds would probably decrease the profits considerably.

Elderberries.—Elderberries ripen next, usually during the latter half of July. There are so few of them on the farm that the record is scanty, but field notes made August 5, 1898, show how much they are

relished. A large elder bush was watched from 1.40 to 2.50 p. m. The observations may be thus summarized:

Detailed account of birds feeding on elderberries.

1.45: A song sparrow hopped along under the bush and picked up a fallen berry.
1.51: A downy woodpecker alighted on the main stalk and, ascending within reach of a cluster, ate 2 berries.
1.58: A female orchard oriole came and fed.
2.00: A catbird ate several berries.
2.03: A red-eyed vireo took 1 berry.
2.09: A catbird ate 3 berries.
2.11: A pair of red-eyed vireos flew into the bush; one took a berry and scurried away, but the other remained long enough to eat 4 berries.
2.12: A male redbird dashed in, took a berry, and dashed out.
2.13: A crow dropped clumsily into the bush, but after one peck at the fruit espied me and flew away with loud clamor.
2.15: A catbird took 1 berry.
2.16: A white-eyed vireo took 3 berries.
2.20: A catbird took a berry.
2.23: A female summer redbird came shyly and hurriedly ate several berries.
2.24: A catbird took a berry.
2.25: Another catbird picked at a cluster rapidly for one minute, swallowing in that time 20 berries.
2.27: A red-eyed vireo, poised in the air like a humming bird, ate several berries from the same cluster.
2.28: A female cardinal ate a berry.
2.30: A catbird ate 10 berries in a minute, rested, and
2.33: Took several more.
2.35: A female summer redbird, bending a berry stalk under her weight, leisurely plucked 5 berries from the drooping cluster.
2.37: A catbird ate 4 berries, sat and preened its feathers, and
2.50: Ate 17 more.

Wild cherries.—The wild black cherry (*Prunus serotina*) is plentiful at Marshall Hall, but as a rule birds did not congregate about it as they do in more northern States. The following species were found feeding on it:

List of birds feeding on wild cherries.

Catbird.	Song sparrow.	Orchard oriole.
Kingbird.	English sparrow.	Red-headed woodpecker.
Phœbe.	Crow.	

Blueberries.—Blueberries, though a staple article of birds' diet, are so scarce at Marshall Hall as to be unimportant. Tufted titmice and catbirds have been noted feeding on them at the southern corner of lot 4.

Other wild fruits.—With the waning of summer there comes such an abundance and variety of wild fruit that birds scatter over wide areas of the farm, and observation of their feeding habits yields only desultory results. There are, altogether, more than a score of wild fruiting plants at Marshall Hall, which furnish food to at least 30 kinds of

birds. Some of them, such as sassafras, blackberry, elder, and wild cherry, drop their berries shortly after ripening them, while others, such as hackberry, catbrier, and sumac, keep theirs well into winter and even until spring. The bountiful supply of late fruit is most noticeable just after the falling of the leaves. Then one may see large trees festooned with the burdened vines of bittersweet, woodbine, catbrier, and wild grape. Besides the climbing plants, many shrubs and trees are laden with fruit. The low horse-nettle is bright with yellow berries; the rank pokeweed bends under long grape-like bunches of dark purple fruit; and the persimmon is hung with yellow globes. The sour gum has dropped its deep-blue berries and light-red leaves together, but the holly is set thick with scarlet clusters that will glow all winter amid its shining green.

Some of the tastes exhibited by birds in their selection of fruit are interesting and singular. Catbirds and vireos have been known to pass by ripe blackberries and elderberries and choose green wild cherries and sassafras berries. Many birds eat sumac berries, which are practically all seeds and would seem to be about as satisfactory food as so much gravel. Fully a dozen species select the berries of black alder, which are as bitter as quinine. Cedar berries, a favorite food with birds, have an effect on the human system like cantharides, while the berries of pokeweed, nightshade, and poison ivy contain dangerous poisons. If birds are not immune from the toxic effects of these berries, one may question whether they do not take them for stimulation, as man takes tobacco and alcoholic beverages.

Poison ivy is eaten by practically all the frugivorous birds of the farm. A crow that was shot November 15, 1900, had 144 poison-ivy seeds in its stomach. The pokeberry is also a favorite fruit. Mockingbirds and catbirds that were collected had fed on it so freely that their intestines were discolored by its juice. During February, 1900, the snow was stained in several places by bright red spots with a hole in the center an inch or more deep, at the bottom of which was a mass of fruit pulp and pokeberry seeds. These deposits proved to be excreta of cardinal grosbeaks that had eaten the berries, the heat from the droppings having sufficed to melt the hole in the snow. Nightshade berries (*Solanum nigrum*) were eaten by several birds of the farm, especially by the bobwhite. During February and November, 1900, a few sapsuckers, downy woodpeckers, bluebirds, and myrtle warblers, together with dozens of flickers and robins, and scores of cedar birds and purple finches, fed on the spicy, stimulating berries of the red cedar.

Distribution of seeds by birds.—The large consumption of wild fruit results in a wide distribution of seeds, which are voided by birds and germinate where they are dropped. Some observations on crows will

illustrate this dispersion. On November 17, 1899, a large flock on the wing was noticed in the distance, at a point opposite Fort Washington, several miles above Marshall Hall. They came on down the river in a line that at times stretched almost from one bank to the other. When they neared Marshall Hall they circled several times and finally alighted on the shore of the Bryan farm, at the mouth of Persimmon Branch. The flock numbered at least a thousand, and hoarse caws and croaks gave evidence that it was made up to some extent of fish crows. After the birds had remained on the shore fifteen minutes they were put to flight by a farmer's boy, and flew on down the river, lessening to specks, and finally disappearing on the horizon. Going to the place where they had alighted, I found the sandy beach cut up for more than a hundred yards with their tracks. Many led out to the water, and floating black feathers here and there showed where baths had been taken. The most interesting trace of their sojourn, however, was several hundred pellets of fruit material, which they had ejected through their mouths and dropped on the ground. These pellets (fig. 22) were about an inch in length and half an inch in diameter. They were of a deep purplish color, due to the fruit of woodbine, wild grape, and pokeberry, of which they were mainly composed. In 50 pellets collected there were only 11 seeds of other plants—namely, holly, bittersweet, and poison ivy. Pokeberry seeds were by far the most numerous. Mr. A. J. Pieters, of the Botanical Division of the Department of Agriculture, germinated some of them, thus demonstrating the fact that they were distributed uninjured.

FIG. 22.—Pellet ejected by crow.

Examination of the pellets showed the interesting fact that they were made up not only of seeds (fig. 23) and skin, but largely of fruit pulp in an undigested state; indeed, many pellets appeared to be compacted masses of mashed or squeezed berries. It seems strange that the birds should have rid themselves of a substance that still contained a good deal of nutriment.

Little is known of the distribution of fruit seeds by crows during migration, but it is certain that they do this work effectively while they fly to and from the roosts where they congregate in winter, for their feeding grounds often cover an area stretching out on all sides from the roost for 50 miles or more. It appears highly probable that the crows which are found in winter at Marshall Hall roost at Woodridge, D. C., some 15 miles distant. There, in the midst of several acres of woodland, a crow dormitory is established, in which probably 100,000 crows sleep every winter night. It was visited in February, 1901, and the ground was found to be strewn with disgorged

pellets containing the seeds of poison ivy, poison sumac and other sumacs, smilax, cedar, sour gum, and flowering dogwood. Some pellets, also, were made up of the hulls of corn and oats.

The distribution of fruiting plants illustrated by the crow is effected, though usually in a slighter degree, by all other frugivorous birds. Areas from which such plants and shrubs have been removed are in a short time replanted by birds. At Marshall Hall such plants thus assisted are constantly striving to secure a foothold on the arable land. This scattering of fruit seeds is illustrated by some observations made March 27, 1901. Under a large black walnut tree, remote from other woody vegetation and near the negro cabin, a two hours' search brought to view 172 fruit seeds, including mulberry, cultivated cherry,

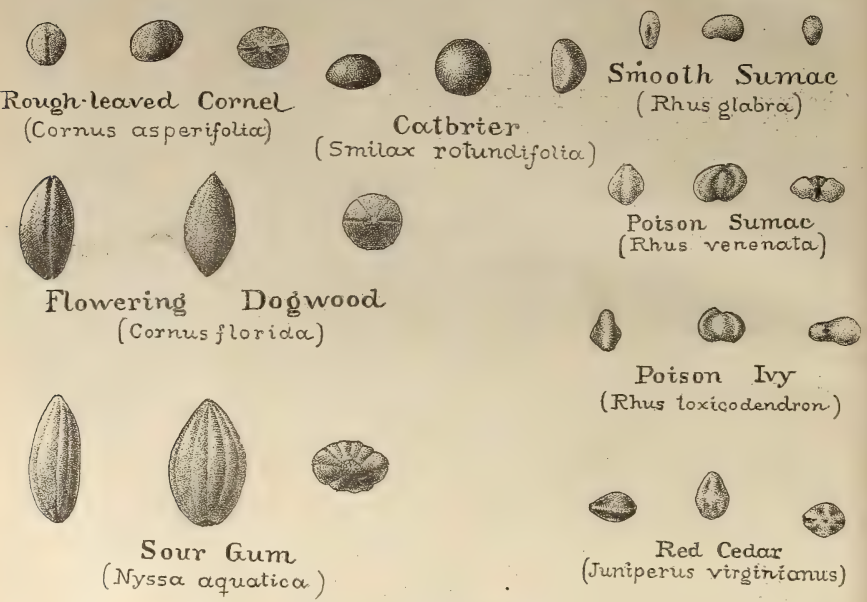


FIG. 23.—Some common seeds found in crow pellets.

wild black cherry, wild grape, woodbine, pokeberry, cedar, sassafras, blackberry, and sumac. Under a large cedar in the middle of lot 2 seeds of the following additional fruiting plants were collected: Elder, hackberry, bittersweet, sour gum, smilax, blueberry, flowering dogwood, and poison ivy.

The most striking examples of trees planted by birds at Marshall Hall are the ox-heart cherry trees that extend along the river front for half a mile. Almost as notable, perhaps, are the tall cedar trees which stand in long rows between adjacent fields (see Pl. XII, fig. 1). Scattered over the old pastures, also, little cedar trees, like fox brushes, attest the work of the winged planters, but in the arable land the rotation of crops kills all except such as may start along fence rows.

FIG. 1.—SASSAFRAS AS A WEED, IN LOT 5.

FIG. 2.—CORN INJURED BY CROWS.

FIG. 1 —CORNFIELD, LOT 5.

FIG. 2.—WHEAT STUBBLE, LOT 3.

The line of trees in the middle-ground marks the course of Persimmon Branch.

Sassafras planted by birds on arable land is not so easily exterminated. On the Hungerford farm it almost choked a peach orchard of several acres. On the Bryan farm it attained such a growth in a cornfield previously used for grass that it had to be cut down with brush hooks (Pl. XI, fig. 1). In another part of the same lot high-bush blackberries sown by birds had to be similarly eradicated.

V.—GRAIN.

Grain had entered into the food of 38 out of the 645 birds examined. Of these 21 had picked up waste kernels and 17 had secured valuable grain, which, however, amounted to but 1.25 per cent of the food of all the birds.

Crow.—The crow (fig. 24) is by all odds the worst pilferer of the cornfield. Every year at Marshall Hall, as elsewhere, a part of the field must be replanted because of his 'pickings and stealings.' In 1899 the replanting was more extensive than usual, requiring on the 39-acre field 1 bushel 2½ pecks, 46 percent of the 3½ bushels originally planted. This unusual ratio was probably caused by the failure of the cherry crop, which left the crow short of food. The protective device of tarring seed corn is employed to some extent on the Hungerford farm. In June, 1899, I planted two rows of corn, one tarred, on the edge of lot 4, near a nest of young crows. When the seed sprouted 3 kernels were pulled from the untarred row, and 7 plants were uprooted from the tarred row, the kernels of which were left intact. On May 30, 1901, a field of sprouting tarred corn on the Hungerford place was visited. In spite of the fact that a field of unprotected corn adjoined it, crows came to this field, perhaps because it was nearer woods. After three of them had walked about among the hills for fifteen minutes the place was inspected. Only three plants had been pulled up, but in each case the grain had been removed. It may be mentioned here that at Wayland, Mass., during June, 1901, crows pulled a large quantity of tarred corn, but did not eat it. The corn there had been coated with wood ashes after the tarring

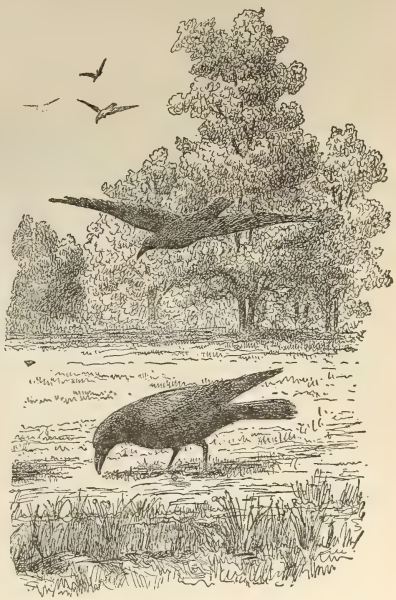


FIG. 24.—Common crow.

and dropped by a corn planter. Some farmers object to tarring for fear of clogging the planter. At Marshall Hall lime is used instead of ashes, but most farmers who tar their corn discard the machine and plant in hills.

The injury to corn by crows at other seasons than sprouting time is, as a general thing, comparatively insignificant, but in some years it has been important when the ears were in the milk. Unfortunately at the worst times no observations were made, though crows were seen each summer feeding on corn in this stage of development, tearing open the ears and picking out the kernels in rapid succession (Pl. XI, fig. 2). In the National Zoological Park at Washington during the summer of 1896, their depredations on an acre of corn in the milk were watched and 50 percent of the crop was found to have been ruined. The only scarecrows that proved effective at Marshall Hall were dead crows and strings stretched on poles around the field and hung with long white streamers. Although in fall the number of marauders is greatly increased by reenforcements from the North, ripe corn sustains less injury than roasting ears. One reason is the fact that the extracting of a few kernels from a ripe ear does not cause the rest to rot, as is the case with roasting ears. Another reason is the abundance of fall fruit. Wheat also suffers comparatively little. When it is ripening, cherries and sprouting corn divert the crows' attention. After it is cut and gathered into the shock, however, they often join the English sparrows in removing the kernels from the cap sheaves. In November, 1899, they attacked newly sown wheat also, cleaning every kernel off a patch of wet ground where the drill had failed to cover the seed. They were also observed in several instances pulling up sprouting wheat. Oats are injured even less than wheat, though crows have been noticed feeding on them at harvest time.

Crow Blackbird.—The crow blackbird (fig. 25) takes grain to the extent of 45 percent of its food, as Professor Beal has shown, and is a bird that needs watching. The farmers at Marshall Hall complained that it injured sprouting corn, but observations did not show the damage to be serious. The only birds concerned in this work were those in the breeding colony in the dell on the Hungerford farm. Except in rare instances, they were not seen visiting the Bryan farm at sprouting time; consequently they could not be held responsible for serious injury there. On May 18, 1899, they were watched in their dell. The parent birds kept going to and from their nests, which held eggs or newly hatched young, and many foraged in an adjacent field of sprouting corn. Nine old birds and four nestlings were collected, but only one, an adult, had taken corn, and that one in trifling proportion. On May 30, 1901, the colony was again visited. The young were then feathered and old enough to eat vegetable food. The most available supply was a field of sprouting corn unprotected by tar, that lay within

a hundred yards of the dell. It was watched from 1 p. m. till 6 p. m., but although the birds often flew over it and in two cases alighted in it, they apparently did it no injury, and a careful search for pulled corn showed not a plant disturbed. Blackbirds probably did some mischief to corn in the milk, however, and were often seen stealing from the shock, but these offenses were trivial in comparison with their attacks on sprouting winter wheat. During November, 1900, a flock of from 2,000 to 3,000 pulled wheat on the Bryan farm, and only continual use of the shotgun saved the crop. At each report they would fly to the oak woods bordering lot 5, where they fed on acorns. Nine birds collected had eaten acorns and wheat in about equal proportions. The flock must have taken daily at least half an ounce of food apiece,

FIG. 25.—Crow blackbird.

and therefore, if the specimens examined were representative, must in a week have made away with 217 pounds of sprouting wheat, a loss that would entail at harvest time a shortage of at least ten times as much. When wheat and oats were harvested no appreciable loss was possible, as only a few blackbirds remained on the farm, and, in fact, these few appeared to be feeding on fruit or insects, or, when they did eat grain, to be taking chiefly waste kernels. During June of 1898, 1899, 1900, and 1901, when wheat was ripening or being harvested, blackbirds came from their nesting dell to the Bryan farm, but only in few instances were they seen in the wheat fields. On June 15 and 16, when oats and wheat were ready to cut on the Hungerford farm, the colony was closely watched. The young were on the wing and the

whole flock was expected to resort to the grain fields, but none were seen to enter them. On June 18, however, when oats were being cut, several birds were noted feeding on them in two instances.

English Sparrow.—The English sparrow (fig. 26) is the most highly granivorous bird on the farm. The stomachs of 53 birds—17 nestlings and 36 adults—were collected. Grain had been eaten by 8 of the young—a large proportion, for nearly all nestlings are almost exclusively insectivorous. It formed 86 percent of the food of the adults, all but two having taken it. Six had selected oats, 14 wheat, and 15 corn. The number of English sparrows on the two farms varied from 200 to 1,000. They fed on grain whenever and wherever it was attainable. They did not appear to hurt sprouting fields, but did considerable harm to standing crops. In 1898 lot 4 was in wheat, and

FIG. 26.—English sparrow.

about the middle of June, when it was nearly ready for cutting, a strip 200 yards long beside the fence near the storage barn was found broken down by sparrows. The loss by this mischief was even greater than that by their continual thefts from the rest of the field. A year later they ruined in the same way a strip of wheat several yards wide, extending from the negro cabin to Persimmon Branch, and also sections of oat fields on the upper part of the Hungerford farm. They attacked both wheat and oats in the shock, and stole much of the grain in the cap sheaves. They were seen feeding on corn in the milk, but probably selected ears that had already been torn open by crows; Dr. A. K. Fisher, however, has observed English sparrows at Chevy Chase, Md., opening and eating the tip ends of ears of corn

without any aid from crows. Whenever stock was fed with grain they were always on hand to get their portion. They ate corn with the pigs in the hog lot, and often outnumbered the little chickens in the back yard around their rations of cracked corn or Indian mush. Not satisfied with regular feeding times, they drew on the source of supply, the corn house, and could be seen any day in the year, but most commonly in winter, flying out of it, sometimes by the score.

Other birds.—So far as is known, no other birds of the farm committed serious depredations on grain, though several occasionally did trifling harm. The red-winged blackbird did not disturb sprouting grain, but was seen in the first week of August, 1898, to visit cornfields in flocks of from 12 to 20 and eat from roasting ears. Goldfinches were troublesome in ripening oats on the Hungerford farm during the last week of June, 1899. A flock of a hundred spent most of the day swaying on bending oat stems. Four were collected, but singularly enough no grain was in their stomachs. On an acre of the field where the birds usually assembled, 5 percent of the crop was lost from the breaking down of stalks.

If the mourning dove and the bobwhite do harm to grain it is so slight as to escape notice. The dove, however, has been taken with a few kernels of sprouting wheat in its crop.[a] Both birds eat a good deal of waste grain in stubble-fields. On August 31, 1898, in lot 4, there was a flock of at least 30 doves in the wheat stubble of the Bryan farm, and at the same time there were two smaller flocks on the Hungerford place. In November, 1899, the flock on the upper part of the farm fed with the bobwhites on wheat stubble, and, like them, did not appear to relish corn dropped from the ear in fields where they were searching for weed seed. There was considerable diversity of feeding habits among different flocks of bobwhites on the two farms. One flock on the Bryan farm during November and December, 1900, was seldom seen on a patch of wheat stubble adjacent to their cover, the oak woods of lot 5. Hawks were numerous there, however, and may have frightened the birds away from what would ordinarily have been a tempting feeding ground. A large covey on the lower part of the Hungerford farm, where no wheat had been raised, fed entirely on weed seed, but one at the upper end spent about all the feeding time in wheat stubble. This covey had a habit of sleeping in a peach orchard, as was attested by little rings of dung showing where the birds had squatted in a circle with heads out and tails in. From six of these rings, representing as many days' feeding, 300 droppings were collected. Remains of wheat, or more strictly speaking, fragments of bran from one-fifth of a millimeter to 5 millimeters in length, formed 85 percent of them. A bird of this covey had in its crop 160 whole

[a] In Essex County, N. J., the dove does much damage in newly sown fields of buckwheat.

grains, and in its stomach other wheat half digested, all amounting to 91 percent of its food. The next year bobwhites were noted feeding in wheat stubble in lot 3 (Pl. XII, fig. 2). In November, 1900, observations were made in a cornfield in which the tops of the stalks had been removed for fodder, leaving the ears attached to low stalks. In many places kernels had dropped to the ground, but the bobwhites that frequented the field to procure weed seed apparently did not touch them. These desultory data would seem to indicate that the bobwhite takes only waste wheat and does not relish corn, but observations made in November, 1901, on lot 5 of the Bryan farm, when the corn was in the stack (Pl. XII, fig. 1), does not confirm this supposition; for in this case the birds fed to a certain extent on the waste kernels of corn scattered on the ground.

The meadowlark is much less granivorous than these two species, but it often picked up wheat in stubble-fields just after harvest and late in the fall. One specimen obtained November 29, 1900, contained 70 percent of wheat. The cardinal was occasionally seen feeding on waste wheat and corn along the edge of stubble-fields. The English sparrow, the crow, the crow blackbird, the red-wing, and the cowbird are also stubble feeders. On the 5th of August, 1898, fully a thousand crow blackbirds with a few redwings were noted picking up waste grain in the wheat and oat stubble of the Hungerford farm. If such a horde of these birds were present at harvest time, complaints would be made against them as serious as those now heard from the Mississippi Valley.

During the blizzard of February, 1900, several birds obtained food from the droppings of farm animals. English sparrows and crows were seen picking corn from dung in the hog pen on the Hungerford farm, and meadowlarks, horned larks, doves, and cardinals were noticed taking it from cow droppings in an open pasture.

The native sparrows, unlike the English sparrows, have little or no liking for grain. In a field of wheat on the Bryan farm 5 English sparrows and 19 native sparrows, including song, field, chipping, and grasshopper sparrows, were collected, just before and just after the crop was cut. All the English sparrows were gorged with wheat, but only 2 native sparrows—a chipping sparrow and a grasshopper sparrow—had eaten it, and they had taken only a single kernel apiece. Moreover, when winter wheat sprouted, the hosts of native sparrows from the North that were running over the fields could not be detected doing it any injury.

VI.—WEED SEED.

Weed seed is a staple article of diet for practically all seed-eating birds. It formed 18 percent of the food of the whole number of birds collected, and had been eaten by 162. Lists of these birds and of the 41 kinds of seeds that they selected are appended.

List of weed-seed eaters and weed seed eaten.

SPECIES OF BIRDS WHOSE STOMACHS CONTAINED WEED SEED.

Bobwhite.	Rusty blackbird.	Chipping sparrow.
Mourning dove.	Crow blackbird.	Field sparrow.
Horned lark.	Goldfinch.	Junco.
Bobolink.	Savanna sparrow.	Song sparrow.
Cowbird.	Grasshopper sparrow.	Cardinal.
Red-winged blackbird.	White-throated sparrow.	Carolina chickadee.
Meadowlark.	Tree sparrow.	

SPECIES OF WEED SEED EATEN.

Bull thistle (*Carduus lanceolatus*).
Beggar-ticks (*Bidens frondosa*).
Sneezeweed (*Helenium autumnale*).
Ragweed (*Ambrosia artemisiæfolia*, fig. 27).
Giant ragweed (*Ambrosia trifida*).
Sow thistle (*Sonchus oleraceus*).
Dandelion (*Taraxacum taraxacum*, fig. 27).
Wild lettuce (*Lactuca spicata*).
Black bindweed (*Polygonum convolvulus*, fig. 27).
Pennsylvania persicaria (*Polygonum pennsylvanicum*).
Knotweed (*Polygonum aviculare*).
Climbing false buckwheat (*Polygonum scandens*).
Bitter dock (*Rumex obtusifolius*).
Curled dock (*Rumex crispus*).
Sheep sorrel (*Rumex acetosella*).
Crab-grass (*Panicum sanguinale*).
Pigeon-grass (*Chætochloa glauca*, fig 27).
Green foxtail grass (*Chætochloa viridis*).
Broom-sedge (*Andropogon virginicus*).
Sheathed rush-grass (*Sporobolus vaginæflorus*).
Poverty grass (*Aristida* sp.).
Yard grass (*Eleusine indica*).
Bermuda grass (*Capriola dactylon*).
Paspalum (*Paspalum* sp.).
Sedge (*Cyperus*).
Sassafras (*Sassafras sassafras*).
Blackberry (*Rubus villosus*).
Pokeberry (*Phytolacca decandra*).
Partridge pea (*Cassia chamæcrista*).
Sweet clover (*Melilotus alba*).
Tick-trefoil (*Meibomia nudiflora*).
Snowdrops (*Kneiffia fruticosa*).
Chickweed (*Alsine media*).
Amaranth (*Amaranthus retroflexus*, fig. 27).
Trumpet creeper (*Tecoma radicans*).
Yellow sorrel (*Oxalis stricta*).
Rib-grass (*Plantago lanceolata*).
Spurge (*Euphorbia maculata*, fig. 27).

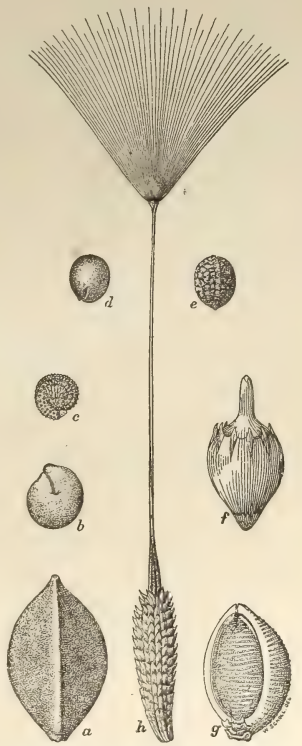


FIG. 27.—Weed seeds commonly eaten by birds: *a*, bindweed; *b*, lamb's-quarters; *c*, purslane; *d*, amaranth; *e*, spotted spurge; *f*, ragweed; *g*, pigeon-grass; *h*, dandelion.

Lamb's-quarters (*Chenopodium album*, fig. 27).
Purslane (*Portulaca oleracea*, fig. 27).
Jewel-weed (*Impatiens*).

WEED DESTRUCTION BY NATIVE SPARROWS.

Spring.—The farmer's strongest allies in his campaign against weeds are the various species of native sparrows (Pl. XIII), which are a potent aid every month in the year, though chiefly in the colder months. The value of their work, obvious in fall and winter, is less easily appraised in spring and early summer, but may be suggested by a few notes.

The sparrows that breed on the farm have to content themselves early in the spring with seeds left from the preceding year, but by the middle of May they find in fields that have lain fallow all winter, or that were in corn the previous season, a plentiful supply of the ripening seeds of chickweed and, a little later, of yellow sorrel. Song sparrows were seen (May 18, 1899) on the edges of such fields helping themselves liberally from opening chickweed pods. Chipping sparrows were noted (May 30, 1896) far out in a patch of corn stubble feeding on yellow sorrel that was going to seed, and a chipping sparrow and a field sparrow collected June 16 and 17, 1898, had eaten seeds of the same weed.

Summer.—During the second week in July, 1898, a song sparrow was often seen following lines of knotweed in the road along the bluff, and a telescope showed that it was plucking off the newly ripened seeds. At the same time another song sparrow, killed on the edge of a timothy field, and two grasshopper sparrows from the center of the same field, had eaten seeds of rib-grass, which at the time was a bad weed in the timothy. During August the seed-eating of sparrows is sufficiently noticeable to attract the attention of even a casual observer, for by this time great stores of weed seed have ripened and the young sparrows, which have been exclusively insectivorous, are ready to take vegetable food. The following notes merely give a few specific cases that might have been multiplied many times every day. A song sparrow was observed (August 28, 1898) picking out soft immature seeds from a spike of green fox-tail grass, a plant that, with its congener pigeon-grass, furnishes seed-eating birds with favorite food. On the same date a score of chipping sparrows were noted amid crab-grass, which was spreading so rapidly through a market garden in a pear orchard on the Bryan place that it was likely to impair the product. They hopped up to the fruiting stalks, which were then in the milk, and beginning at the tip of one of the several spikes that radiated from a common center like the spokes of a wheel and, gradually moving their beaks along to the base, they chewed off the seeds of spike after spike in regular succession. Usually they did not remove their beaks until they reached the base, though some individuals, especially birds of the year, would munch a few seeds in the middle of a spike and then take a fresh one. Fourteen birds were col-

FOUR COMMON SEED-DESTROYING SPARROWS.

1, Junco; 2, white-throated sparrow; 3, fox sparrow; 4, tree sparrow.

FIG. 1.—GIANT RAGWEED IN GARDEN.

FIG. 2.—BROOM-SEDGE APPROPRIATING LAND.

lected from this orchard and 10 from other parts of the farm. Crab-grass seeds were found to have formed 54 percent of their food, one stomach containing 150 seeds. Most of the remaining 46 percent consisted of such weeds as green fox-tail grass, yellow sorrel, spotted spurge, and purslane, with a very small quantity of ragweed. Other sparrows were found feeding on crab-grass and the foregoing weeds during the last week of August and the first part of September, 1898. It is important to remember at this point that each of the sparrows that live on the farm in summer, namely, the song, chipping, field, and grasshopper sparrows, has its own peculiar habitat, and to note that the consequent diversity of feeding ranges makes their work more or less complementary, hence more valuable.

Autumn to late spring.—From autumn to late spring evidence of the seed-eating habits of sparrows is so plain that he who runs may read. The influx of northern migrants has by this time increased the sparrow population several-fold, and as the leaves have fallen and the crops have been cut, the lively flocks diving here and there among the brown weeds to feed are familiar adjuncts of every roadside, fence row, and field. Sparrows were collected only during November, 1899, February, 1900, and April, 1899. In all, 76 were taken, which comprised 25 song sparrows, 23 white-throats, 12 field sparrows, 11 juncos, 3 chipping sparrows, a grasshopper sparrow, and a savanna sparrow. Seventy percent of their food was weed seed, and the proportion would have been much larger if the birds collected in April could have been taken in March, for they had eaten of the abundant April insects almost to the exclusion of seeds.

Field observations.—The mere examination of stomachs does not give an adequate notion of the extent and the methods of weed-seed eating. It was not feasible to collect stomachs enough to show the characteristics of all the birds of the farm. A few minutes' field observation, however, would often tell what a large flock was doing in cases where it would have been impossible to collect more than a few individuals. Several notes are cited below to illustrate the sparrow's work, which begins, as has already been said, before the seeds are ripe, and continues throughout fall and winter and even far into spring.

In a rank weedy growth of crab-grass and green fox-tail grass in the truck plot of lot 3 a flock of 20 juncos was watched for half an hour, November 15, 1899, as they breakfasted on seeds. At this time most of the seeds had fallen and the birds picked them up under the plants instead of taking them from the stalks as the chipping sparrows had done in August. On the following day the same flock, with about an equal number of white-throated sparrows and song sparrows, flew to the wheat stubble of lot 3, beside the negro cabin, and busily gathered fallen seeds of ragweed which had made a rank growth there.

This weed is troublesome at Marshall Hall; it chokes the crops on truck lands, gains a foothold in pastures, making milk bitter and unsalable, and is so pestiferous in hayfields that it has to be removed by a gleaner. Fortunately, however, it is palatable to seed-eating birds, and it probably furnishes them a larger proportion of their food than any other plant on the farm, a fact which doubtless prevents much greater trouble and loss. Another harmful weed is broom-sedge. It is ruinous to mowing and pasture, and spreads so readily that if undisturbed it would in time take possession of all the fields (Pl. XIV, fig. 2). Juncos, field sparrows, tree sparrows, and probably

FIG. 28—Field sparrow.

other species check it to some extent. As has been said before, field sparrows and tree sparrows are usually to be found associated with it. In the higher part of the hog lot a flock of field sparrows (fig. 28) during the middle of November, 1899 and 1900, spent most of their time swaying on broom-sedge stalks, from which they were busily extracting seeds. Sometimes a bird alighting on a plant would bend it to the ground and hold it down with its feet while picking out the seeds; seldom would one feed from the ground in any other manner. At the same time a flock of about 30 field and tree sparrows along Persimmon Branch behind the truck plot of lot 3 were also feeding on broom-sedge.

An interesting illustration of tree sparrows' habits was noticed on the Hungerford farm during a heavy snowstorm in the third week of February, 1900. Here and there, where the whiteness of the field was pierced by phalanxes of dry broom-sedge, a flock of a dozen or more tree sparrows found good cheer in spite of the driving flakes. From one brown patch to another they flew, clinging to the plants while they plucked out the seeds, seldom leaving a stalk unexplored. Frequently two would feed from a single stalk, while a third, made thrifty by the wintry dearth, hopped in the snow below searching for scattered seeds. The snow whirled in clouds across the field, but these little creatures, inured to northern tempests, worked on with cheerful, hardy industry. Several days later a flock of more than 200 sparrows, chiefly juncos and tree sparrows, with some song sparrows and white-throats, were observed feeding on a piece of truck land between two bushy brooks where weeds grew rank, in places overtopping a man's head. The snow beneath was everywhere delicately marked with interlacing tracks, which showed how thorough had been the search for food. One space 50 yards square had hardly a square yard that was free from the prints of tiny feet. The main harvest of ragweed seeds lay buried under the snow, but remnants still clung to the stalks, and lamb's-quarters and amaranth were well laden. Under all these plants thickly scattered chaff and seed coats bore witness to the birds' work.

FIG. 29.—Goldfinch.

WEED DESTRUCTION BY OTHER BIRDS.

Goldfinch.—Goldfinches (fig. 29) would be as valuable as sparrows if they were as numerous. Like sparrows, they destroy weeds throughout the year. In spring their first fresh supply comes from the dandelion. On May 18, 1899, three males and two females hopped about among the dandelion globes in the Bryan front yard, every now and then perching crosswise on the stalks and devouring the seeds. In June goldfinches often visited the field daisy (*Erigeron ramosus*), and in July the purple aster (*Vernonia*) and the wild carrot (*Daucus carota*). In these cases they appeared to be picking out immature seeds, and

one bird that was shot contained a soft mass of such food. The habit of feeding on thistles, which has given the species its common name of 'thistle bird,' was well exemplified one day in August, 1898. A thistle on which a goldfinch had been feeding was examined and on its leaves and the ground beneath 67 seeds were counted. They appeared perfect, but close inspection showed a slit through which the meaty kernel had been deftly removed. On the 30th and 31st of August, 1898, the goldfinch was seen eating seeds of the sow thistle and of wild lettuce. September 7, 1896, six birds were banqueting on seeds of beggar-ticks which had appropriated several square rods in an outfield and threatened to give trouble in subsequent seasons. Four youngsters, so recently fledged that they allowed me to approach within 10 feet of them, gave an excellent opportunity (September 21, 1896) to observe how goldfinches feed on ragweed. Often they would all alight on the same plant at once, then they would wrench off the seeds, crack them, extract the meat, and drop the shell, their actions resembling those of a canary at its seed cup. In one instance three alighted on a very small plant, which under their weight bent to the ground. Nothing daunted, they clung to the sprays, heads downward, until they touched the earth, then, shifting their position so as to hold the stems under their feet, went on with their meal.

About the middle of November, 1900, a flock of 300 goldfinches were noted perching in luxuriant ragweed on truck land of the Hungerford farm, industriously stripping off seeds. The work of such an army must have caused decided limitation of the next year's growth. During the third week of February, 1900, a flock of about 50 were seen in a tangle of trumpet creeper on the edge of the bluff (Pl. VI, fig. 1). They were clinging to the long, partly opened pods, extracting seeds, and the refuse of their meal made a continual flurry of floating empty seed wings. During four minutes six birds that were somewhat isolated dropped 57 of these seed wings. Feeding on the trumpet creeper proved to be habitual with the goldfinch and must have prevented many seeds from spreading inland over lot 3 before the prevailing river winds. The plant is a mischievous weed at Marshall Hall. In 1898 it choked out the oats in one part of a patch and twined around nearly half the cornstalks in a field near the river. It was bad in truck plots during 1899 and 1900, and always makes the breaking up of old pastures a serious undertaking for man and horse. It may be mentioned in passing that the downy woodpecker has also been seen picking out these winged seeds, as well as taking mullein and ragweed seeds from the stalk.

Purple Finch.—The purple finch, though it habitually feeds in trees, often destroys seeds of noxious plants. On the 15th and 16th of November, 1900, a thicket of giant ragweed that had made a 10-foot growth in the Bryan kitchen garden (Pl. XIV, fig. 1) was gay with a flock of 30 finches that hung on the sprays while they stripped off the

seeds as the goldfinches had. One bird that was watched with a glass ate 15 seeds in three minutes.

Chickadee.—The Carolina chickadee, though largely insectivorous, was also frequently seen hanging head downwards in ragweed plants wrenching off seeds.

Cardinal.—The cardinal, when observed on arable land, was a denizen of hedgerows. It was not abundant like finches and sparrows, but was not uncommon in loose flocks of ten or a dozen. In company with sparrows it often foraged a little way out from cover for the larger weed seeds, and was seen picking up seeds of both small and giant ragweed. It has a peculiar habit, shared by the fox sparrow, and seen sometimes in the song sparrow and the white-throat, of cracking and eating the seeds of berries and other fleshy fruits; a habit probably useful, especially when seeds of the blackberry and other fruiting plants that invade cultivated land are selected.

Blackbirds.—The large flocks of crow blackbirds on the farm, often numbering from 2,000 to 3,000, have been previously referred to. If they were not notorious grain thieves they would be famous weed destroyers. Even as it is they were sometimes seen eating weed seeds, and in spring, when grain is lacking, they probably do considerable good. During fall and spring of the years 1899, 1900, and 1901, flocks of from 50 to 100 cowbirds, and often several hundred red-winged blackbirds, and occasionally as many as a thousand rusty blackbirds, assembled on the farm. They fed on ragweed of wheat stubble and among weeds of truck areas, and doubtless destroyed an incalculable number of seeds. The cowbird and the red-winged blackbird, according to Professor Beal, feed on weed seed to the extent of more than half their annual food and during most of the colder half of the year at least four-fifths.

Meadowlark.—The meadowlark, though it gets two-thirds of its living from insects, has in the colder months a voracious appetite for seeds. On the Hungerford farm in November, 1899 and 1900, were two flocks of meadowlarks, and on the Bryan farm a single flock somewhat scattered, numbering altogether about 50 individuals. They usually divided their time among the weeds of cornfields both old and new, the ragweed of wheat stubble, and the miscellaneous weeds of truck land. On one occasion birds were seen eating seeds of pigeon-grass in the last situation, and on another picking up seeds of ragweed.

Mourning Dove.—After the breeding season there were three flocks of doves and three of bobwhites distributed like the meadowlarks. Each flock of doves contained between 20 and 30 individuals. One, on the Bryan place, fed in weedy old cornfields, and, after the wheat had been harvested, amid the ragweed of wheat stubble, which by August was 18 inches high. A bird killed from this flock had eaten, in addition

to other food, seeds of yellow sorrel, spotted spurge, crab-grass, and pigeon-grass. Another, on the upper part of the Hungerford place, foraged in the ragweed of wheat and oat stubble, and in a heavy crop of crab-grass and pigeon-grass in a cornfield that was being harvested. The stomach of one of these birds, taken November 17, 1899, contained 150 ragweed seeds, and another 300 crab-grass seeds. The third, on the lower part of this farm, were not seen in stubble-fields, but frequented forests of weeds in certain orchards and truck plots, and apparently made their whole fare on the seeds. During the heavy snow of February, 1900, doves fed in a wind-swept pasture, sometimes appearing to pick up weed seeds, and sometimes assembling in two pits 10 feet in diameter and 6 feet deep, where abundantly fruited plants of pokeberry were growing. At five different times the flock, numbering more than 20, was flushed from the pits. Footprints and red stains on the snow showed that they were eating berries and probably their seeds, some of which were found on the ground after the snow had melted. Fruit-eating birds, which take the berries of this plant, void the seeds uninjured and thus disseminate them, but doves grind them to atoms by the powerful action of their gizzards.

Bobwhite.—One covey of the bobwhites, which has already been described as feeding largely on wheat in its season, lived on the upper part of the Hungerford place; another, still larger, which to judge from its droppings took practically no grain, lived on the lower part; and a third lived on the Bryan farm. One bird from the first covey, 7 from the second, and 5 from the third were shot and examined. These 13 had taken weed seed to the extent of 63 percent of their food. Thirty-eight percent was ragweed, 2 percent tick-trefoil, partridge pea, and locust seeds, and 23 percent seeds of miscellaneous weeds, such as pigweed, sheep sorrel, Pennsylvania persicaria, climbing false buckwheat, trumpet creeper, paspalum, jewel-weed, and pigeon-grass. Though the stomachs and crops were not well filled, the birds had eaten 5,582 weed seeds. One crop contained 400 pigweed seeds, another 500 seeds of ragweed. The latter seeds, which are cracked open by most birds, are swallowed whole by bobwhites and doves, in spite of the spiny processes which beset them. One bobwhite, in addition to other food, had consumed 550 seeds of sheep sorrel; another 640 seeds of pigeon-grass; and several 50 to 100 seeds of jewel-weed.

Extent of weed-seed destruction.—Inspection of an acre of truck land between two converging bushy brooks on the Hungerford farm (November 16, 1899), gave a very satisfactory idea of the autumn work of weed-destroying birds. Crab-grass and pigeon-grass formed a low undergrowth, while lamb's-quarters, pigweed, and giant ragweed from 6 to 10 feet high rose in a thick weed forest. A flock of 15 quail foraged in the center of the area, 25 doves were scattered over the upper end, and fully 200 native sparrows scurried about at the

lower end, while a band of 300 goldfinches clung to the ragweed stalks plucking off seeds. If we make the fair assumption that the birds remained on this acre of plenty long enough to obtain a full meal, we can reckon approximately the destruction wrought. At a moderate estimate 20 seeds apiece may be allowed for the goldfinches, 100 for the sparrows, providing that they were from crab-grass or pigeon-grass, and 500 for the doves and bobwhites, or a total of 46,000 seeds destroyed at a single breakfast.

In the last week of April an attempt was made to ascertain what proportion of the weed seeds ripening on the farm had been consumed during the previous half year. In the wheat field of lot 4, where at the beginning of October there had been scores of seeds on every ragweed plant, it was difficult to find in a fifteen-minute search half a dozen remaining. In the truck plot of lot 3, which had borne a thick growth of pigeon-grass, examination of an area where there had been hundreds of seeds the autumn before would sometimes fail to disclose one, and in a mat of crab-grass in the same field frequently not one was left out of a thousand present in October.

VII.—SPECIES.

Having discussed under the heads of insects, flesh, fruit, grain, and weed seed the elements that entered into the food of the birds at Marshall Hall, we may now enumerate the birds themselves and indicate as far as possible the economic status of each with reference to this particular farm.[a]

WATER BIRDS.

The data concerning water birds are so limited as almost to preclude anything more than a list of species.

GREBES.

The horned grebe (*Colymbus auritus*) has been noted on the river at Marshall Hall in December on two occasions. A pied-billed grebe (*Podilymbus podiceps*) was diving in the bay where the shore curves up to the calamus swamp December 12, 1900 (Pl. III, fig. 1). During November and December as many as a dozen grebes may often be seen on the Mount Vernon flats, on the Virginia side of the river. Grebes feed much less on fish than is popularly understood, and probably do little harm to fisheries. The large proportion of vegetable matter in their food renders them excellent eating, the flesh resembling that of the adult pigeon in taste. They are difficult to secure, however, as their diving habit protects them from all but the most persistent gunners.

[a] Whenever lists of species of birds are given the figure placed after a name indicates the number of stomachs of that species which were examined.

LOONS.

The common loon (*Gavia imber*) and the red-throated loon (*Gavia lumme*) have been noted at Marshall Hall by Mr. William Palmer.

MURRES.

The Brünnich murre (*Uria lomvia*) has been noted at Marshall Hall by Mr. William Palmer.

GULLS AND TERNS.

The herring gull (*Larus argentatus*) and the ring-billed gull (*Larus delawarensis*) occur on the river in the colder half of the year. During March and the first half of April it is not uncommon to see from a dozen to twenty gulls floating between the farm and Mount Vernon (Pl. XVII, fig. 2), apparently busy fishing. The common tern (*Sterna hirundo*) and the black tern (*Hydrochelidon nigra surinamensis*) have also been noted at Marshall Hall.

DUCKS, GEESE, AND OTHER WATER FOWL.

The following species of water fowl were noted on the river at Marshall Hall:

Red-breasted merganser (*Merganser serrator*).
Hooded merganser (*Lophodytes cucullatus*), 2.
Mallard (*Anas boschas*).
Black duck (*Anas obscura*).
Baldpate (*Mareca americana*), 1.
Green-winged teal (*Nettion carolinensis*).
Blue-winged teal (*Querquedula discors*).
Shoveller (*Spatula clypeata*).
Pintail (*Dafila acuta*).
Wood duck (*Aix sponsa*).
Redhead (*Aythya americana*).
Canvasback (*Aythya vallisneria*), 1.
Scaup duck (*Aythya marila*).
Lesser scaup duck (*Aythya affinis*), 1.
Golden-eye (*Clangula clangula americana*).
Buffle-head (*Charitonetta albeola*).
Old-squaw (*Harelda hyemalis*). Noted by Mr. William Palmer.
Canada goose (*Branta canadensis*).
Whistling swan (*Olor columbianus*), 1.

Ducks were so abundant here before the civil war that they were regularly counted on for the larder. As late as 1864 and 1865 it was not uncommon in November to find a flock of 150 scaup ducks in the little bay by the calamus swamp, and in the same place ten years earlier as many as 15 canvasbacks were killed at a shot. It is now rare for half a dozen ducks of the commonest species to settle in the bay. Across the river on the Mount Vernon flats (Pl. XVII, fig. 2), where there is an abundance of wild celery (*Vallisneria spiralis*), flocks of from 25 to 200 ducks are occasionally seen, but they are so continuously fusiladed from launches that run down from Washington and Alexandria that they are soon killed or driven away. Much worse slaughter is wrought by the 'big' gun at night or in the early dawn. These 'big' guns are in reality cannon mounted in gunning skiffs.

FIG. 1.—BOBWHITE.

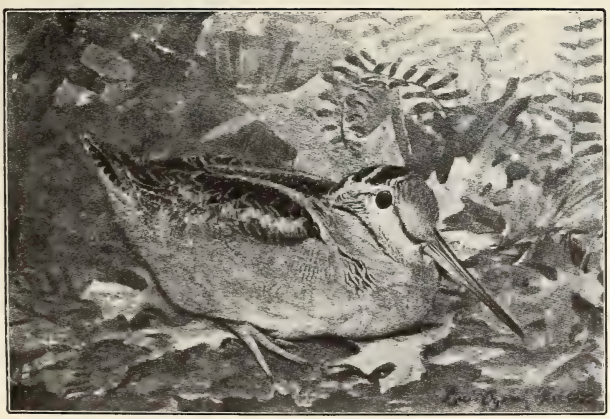


FIG. 2.—WOODCOCK.

FIG. 1.—BROOM-SEDGE OF LOT 2, FREQUENTED AT NIGHT BY BOBWHITES.

FIG. 2.—PARTRIDGE PEA OVERSPREADING PASTURE OF LOT 4, EATEN EXTENSIVELY BY BOBWHITES.

The pines in the background were defoliated by the pine saw-fly in the spring of 1900.

They are loaded with a pound of shot that kills at 200 yards or more. The use of the big gun is unlawful, but duck pot hunters have often eluded the authorities by throwing the gun overboard, having previously attached a string and a large cork, so as to insure subsequent recovery. Shooting from launches, which is also frequent and very destructive in this vicinity, is against the law in many places, and should be generally prohibited.

The stomach of a baldpate that was taken March 22, 1902, contained only sprouting wild rice and the stems of some aquatic plants. Two hooded mergansers collected November 15, 1900, had fed exclusively on small fish. A lesser scaup duck taken on the same day had eaten the claw of a blue crab and 75 snails (mostly *Amnicola altiles*, with a few *Goniabosis virginicus* and *Planorbis albus*). The stomach of a canvasback killed the day previous contained 100 seeds of bulrush (*Scirpus*). A whistling swan killed November 16 had in its stomach one bulrush seed and a mass of wild celery leaves about as large as the ball of a man's thumb. The latter plant is abundant in shallow water about Marshall Hall, and gives the characteristic flavor to canvasbacks and other water fowl that feed on it.

HERONS.

The following herons were noted:

Least bittern (*Ardetta exilis*).
Great blue heron (*Ardea herodias*).
Little blue heron (*Ardea cærulea*).
Green heron (*Ardea virescens*), 2.
Black-crowned night heron (*Nycticorax nycticorax nævius*), 1.

The last three species eat fish extensively, but also take other food. One of two green herons that were collected contained, besides fish, a large spider, a giant water bug (Belostomatidæ), and 20 dragon-flies (Agrionidæ).

RAIL.

The toothsome little sora rail (*Porzana carolina*) is found during August and September amid the wild rice of the calamus swamp. The stomach of one, when examined, contained 200 wild rice seeds.

COOT.

The coot (*Fulica americana*) eats mainly wild celery, pond weed (*Potamogeton*), and other vegetable food, and is not to any marked degree piscivorous, as has been shown by the examination of stomachs. It is frequently caught at Marshall Hall in fishermen's nets. A coot was shot on November 2, 1901. It had been feeding on wild celery tubers or stolons, and in consequence had a most delicious flavor. It was perhaps not quite equal to the canvas-back, but was certainly not inferior to the redhead. The coot should in time take the place on

the table of ducks and other waterfowl that are fast becoming exterminated. Coots may be bought in Washington at the rate of three for 25 cents, while canvas-backs in good condition can not be had for less than $3 a pair.

Dr. B. W. Evermann, who has recently made a careful study of the coot, says:

I have been very much interested in the coot as an article of food. The opinion of those who have put themselves on record in the books is almost unanimous that the coot is worthless as food. And inquiry among my ornithological friends here in Washington resulted in my finding only two or three who had ever tasted coot. The majority of them seemed to regard eating coot very much as we regard eating crow—a thing not to be thought of!

But my friends Dr. Fisher and Mr. William Palmer admit that they have eaten coot and like it. They even say they regard coot as not at all inferior to the famous canvas-back duck, and in this I agree with them fully. Coot, particularly young ones, skinned and fried, or even old ones parboiled, then baked, are quite as delicious as any duck I ever ate.

It is, however, doubtless true that the delicacy of flavor, not only of the coot, but also of the canvas-back and all other ducks, is largely determined by the kinds of food they get. The wild celery (*Vallisneria spiralis*) is sufficiently abundant in Lake Maxinkuckee to give to the coot frequenting that lake a delicate flavor which has received high praise from all who are familiar with it.[a]

SHORE BIRDS.

Woodcock (*Philohela minor*, Pl. XV, fig. 2) are not uncommon at Marshall Hall. On both the Marshall Hall and Hungerford farms there are wooded dells of less than an acre in extent containing small, sluggish, marshy streams communicating with the Potomac. In these places during July woodcock are always to be found. They do not feed much in the dells, but at dusk forage out in the neighboring cornfields, and so destroy harmful insects. Thus, one bird, shot June 26, 1899, in this spot, had eaten wireworms and cutworms in addition to earthworms, fly larvæ, and May-flies. At the junction of two bushy brooks on the lower part of the Hungerford place, woodcock occur in the fall, and one collected November 15, 1900, had in its stomach two beetle larvæ, one grape seed, and two seeds of bastard pennyroyal.

Just below the Hungerford farm is a wooded swamp of a dozen acres where woodcock are also to be found. It is impossible to penetrate into this swamp more than a few rods without sinking to the knees in a black ooze composed of decayed vegetation. Woodcock are not found in this soft morass, but are confined to the edges and along a tiny alder-fringed stream which issues from a spring at the head of the swamp. A favorite feeding ground, located where this stream enters the forested body of the swamp amid elders, magnolias, ashes, willows, and maples, was inspected in July, 1902, and in an area

[a] Osprey, Vol. I (new series), No. 4, p. 64, April, 1902.

a rod wide by several long the ground was found to be splashed with the chalk-like droppings of the birds, and in spots a foot or more in diameter had been probed to such an extent by their long bills that it reminded one of a colander. The holes thus made were from 1 to 2 inches in depth. An examination of the earth showed that there was a compacted layer of black decaying leaves from one-fourth of an inch to 1 inch in depth. Below the layer of leaves, some of which were not so rotted but that they retained their integrity, was found moist, yellowish-gray sand. Twenty examinations of the ground were made, each within a few inches of a spot marked by the borings, in order to secure specimens of invertebrates on which the woodcock subsists. The ground was dug up to the depth of several inches, and in the region where the leaves and sand met, large numbers of earthworms, spiders, snails, hydrophilid beetles, ground-beetles and their larvæ, and the larvæ of tipulid flies were unearthed. All of these have been taken from the stomachs of woodcock collected elsewhere. A search was made out in the middle of the swamp, where the black humus is from 6 inches to 3 feet in depth, but no food of any consequence could be found, which may account for the absence of woodcock in the middle of the swamp.

On the creeks below Marshall Hall woodcock are abundant, and during the fall of 1901 were slaughtered in enormous numbers. Laws limiting the bag per day and prohibiting summer shooting are greatly needed in this county.

A Wilson snipe (*Gallinago delicata*) was flushed from the swamp on the upper part of the Hungerford farm April 14, 1899.

Two yellowlegs (*Totanus flavipes*) were noted on October 5, 1901, flying along the shore near the calamus swamp.

Solitary sandpipers (*Helodromas solitarius*) and spotted sandpipers (*Actitis macularia*) were observed most often in May. One of the latter birds, which was killed May 16, 1900, had eaten one large black ant, two ground-beetle larvæ, and a dozen May-flies.

Two killdeers (*Ægialitis vocifera*) were seen on the farm April 11, 1899, and one July 24, 1902.

The turnstone (*Arenaria morinella*) has been noted by Mr. O. N. Bryan.

GALLINACEOUS BIRDS.

On the Bryan farm a covey of bobwhites (*Colinus virginianus*, Pl. XV, fig. 1) was found during the fall and winter of 1901 along Persimmon and Partridge branches. They fed in the wheat stubble on the west side of lot 3 (Pl. XII, fig. 2) and slept in the thick broom-sedge of the west side of lot 2 (Pl. XVI, fig. 1). Another covey, which usually inhabited lot 5, could occasionally be seen feeding on the luxuriant growth of partridge pea in lot 4 (Pl. XVI, fig. 2). More of these

birds than usual escaped from gunners, and the following spring (1902) bred about the farm. One pair was located on the edge of the calamus swamp, one on the river bluff near the cabin, one in the middle of lot 4, two on the edge of the woods of lot 5, two along the western boundary fence of the farm, and several along Persimmon and Partridge branches. They were still incubating during the last week of June. The cocks, mounted on fence posts or the lower branches of trees, were whistling their 'Bob White' incessantly. When a cock approached its mate while it was on its nest, it uttered the soft rally note so familiar to the sportsman in the fall. This was followed by a caterwauling much more unbirdlike than that of the yellow-breasted chat. One of its noises resembled that made by a cat calling a kitten. Another suggested the scolding of a caged gray squirrel. Others sounded like a combination of the alarm notes of a hen grouse with chicks and the strident cries of a guinea hen. It also uttered a loud, rasping noise such as might have been emitted by a whip-poor-will with a cracked voice.

In their feeding these birds picked dewberries, gathered scattered grain in wheat stubble, and caught grasshoppers, ground-beetles (*Harpalus pennsylvanicus*), and potato beetles.

The nest of the pair located in lot 4 was discovered on July 10 in the center of the lot amid some thick timothy. It contained eggs which were subsequently destroyed by crows. Young bobwhites are usually hatched before this time at Marshall Hall, according to the reports of farmers, generally during the last week of June; but although a thorough search for young was made up to the 12th of July none were found. Observations were suspended until the 24th, when three broods were found; the first but a day or two out of the shell, the others several days older, but still unable to fly. The older broods were pointed by a dog, and the mother birds flew up and fell flopping a few yards distant, feigning broken wings, while their striped chicks peeped squeakingly and ran with surprising swiftness for cover. In order to ascertain the food habits of these young without killing them, I collected some of their droppings and subsequently examined them. The remains of the food thus found proved to be entirely animal matter, and consisted of ants, true bugs, grasshoppers, ground-beetles, weevils, leaf-eating beetles, other beetles, spiders, and thousand-legs.

Thirteen bobwhites were shot in the middle of November, 1899, 1900, and 1901. Vegetable matter formed 78 percent of their food, and of this all but 8 percent, composed of white-oak acorns, wild fruit, and fruit seeds, was weed seeds. Animal matter amounted to 19 percent, and consisted of 1 spider, 1 true bug (*Alydus eurinus*), 1 parasitic wasp (*Tiphia inornata*), 1 sphinx caterpillar (*Deilephila galii*), 1 cutworm, 1 small ground-beetle, and a larva of another species, 1

12-spotted cucumber-beetle (*Diabrotica 12-punctata*), 1 potato-beetle (*Doryphora 10-lineata*), 7 leaf-hoppers (*Proconia*), and 14 grasshoppers (2 *Xiphidium* and 12 *Melanoplus*).

The freedom with which the bobwhite, regardless of cover, roams about large fields—pastures, meadows, or wheat, tobacco, corn, or truck lands—is very striking. The rapidity with which it moves from point to point, whether by flying or running, makes it less dependent on cover than most of the birds of the farm, and causes it to feed over far more territory than they. As an enemy of insect pests and a destroyer of weed seed it has few equals on the farm. It is the custom at Marshall Hall to shoot these birds for market, where they bring 15 cents apiece, a price that scarcely compensates for the loss of their services.

The ruffed grouse (*Bonasa umbellus*), though rather rare, was found breeding here, and in one instance a bird of the species was seen flying over the Bryan house.

The wild turkey (*Meleagris gallopavo fera*) occurs as a straggler at intervals of several years. A fine gobbler was seen at 4.30 a. m. May 16, 1900, in lot 4, but it quickly disappeared amid the wheat. The next morning it was seen in lot 2; but on discovery it rose and flew to the woods behind the calamus swamp.

PIGEONS AND DOVES.

A specimen of the passenger pigeon (*Ectopistes migratorius*) collected at Marshall Hall by Mr. O. N. Bryan was donated by him to the Smithsonian Institution in 1892.

The mourning dove (*Zenaidura macroura*) has already been shown to be preeminently a seed eater. It consumes great quantities of weed seed and is a useful species on the farm. Three stomachs were collected.

VULTURES.

The turkey buzzard (*Cathartes aura*) is a useful scavenger. Its work on the Bryan farm at Marshall Hall has been described (see p. 53).

HAWKS.

The following hawks were noted:

Marsh hawk (*Circus hudsonius*), 1.
Sharpshinned hawk (*Accipiter velox*).
Cooper hawk (*Accipiter cooperi*).
Red-tailed hawk (*Buteo borealis*).
Red-shouldered hawk (*Buteo lineatus*), 1.
Broad-winged hawk (*Buteo platypterus*), 1.
Golden eagle (*Aquila chrysaëtos*).[a]
Bald eagle (*Haliæetus leucocephalus*).
Sparrow hawk (*Falco sparverius*).
Osprey (*Pandion haliaëtus carolinensis*).

The species which are injurious to poultry, game, and fish and those which are useful in destroying noxious rodents have already been dis-

[a] Recorded on authority of Robert L. Ferguson, of Washington, D. C.

cussed (see pp. 50–55). A stomach of each of the following hawks was examined: Marsh hawk, red-shouldered hawk, and broad-winged hawk. The first contained a meadow mouse; the second, part of a crayfish and 2 frogs; and the third, 2 beetles—a May-beetle (*Lachnosterna*) and a tumblebug (*Geotrupes splendidus*)—part of a meadow mouse, and the remains of 4 short-tailed shrews and a snake (*Storeria*).

A young broad-winged hawk, old enough to fly, which was kept for several weeks, exhibited interesting feeding habits. When a live mouse was placed in the cage, the hawk pounced on it with both feet, sinking its talons into the mouse's vitals, but not once using its beak until after the death struggle. As soon as the mouse had been struck the hawk uttered continual high-keyed shrieks, spread its wings and tail, and pressed them against the ground so as to make an inclosure or tent, the opening of which it guarded with its beak. No such spreading of the wings and tail took place when the prey consisted of big moths, grasshoppers, or beetles. When a three-quarters-grown English sparrow was placed in the cage the hawk struck it a blow with one foot, clutching and killing it instantly. Still gripping the sparrow, it pulled the head off with its beak and swallowed it. Next it ripped open the body cavity and ate the whole digestive tract at one mouthful. Then, beginning with one leg, it finished the sparrow in four more mouthfuls.

The sparrow hawk is the most useful destroyer of insect pests (grasshoppers), while the marsh hawk is the most valuable enemy of injurious rodents. During the fall the latter may be seen skimming over the fields, pouncing upon meadow mice and remaining for some time in the grass eating its prey. This habit has made it an easy mark for the farmers at Marshall Hall, who, on seeing it drop into the grass to feed, have been accustomed to run, often several hundred yards, and shoot it as it rises.

OWLS.

Three short-eared owls (*Asio accipitrinus*) which were killed during November, 1899, 1901, and 1902, contained nothing but meadow mice.

The barred owl (*Syrnium varium*) occurs at Marshall Hall, but is not common.

On May 30, 1892, Mr. E. A. Preble, of the Biological Survey, collected 3 young and 2 adult screech owls (*Megascops asio*) and a great horned owl (*Bubo virginianus*) near the mouth of the calamus swamp on the Bryan farm. Screech owls are of much economic value, owing to the fact that they feed largely on insects and do not destroy birds or poultry. The stomachs of those taken by Mr. Preble contained May-beetles and lizards. In the stomach of the great horned owl were the remains of several dung-beetles, insects of neutral effect on agriculture. As a rule, this bird takes few insects of any kind and is very injurious to poultry.

CUCKOOS.

One black-billed cuckoo (*Coccyzus erythrophthalmus*) and 2 yellow-billed cuckoos (*Coccyzus americanus*, fig. 30) were collected on the Bryan farm in the latter half of May. They had eaten 1 spider, 1 click-beetle, 1 sap-beetle (*Euphoria inda*), 2 rose-chafers (*Macrodactylus subspinosus*), 10 locust leaf-mining beetles (*Odontota dorsalis*), 20 beetles of the firefly family, 1 skipper butterfly (*Eudamus*), 20 caterpillars, of which 18 were the repulsive, large, spiny, black larvæ of the mourning-cloak butterfly (*Vanessa antiopa*), 4 bugs, of which 1 was a green soldier bug (*Nezara hilaris*), and another *Metapodius femoratus*, 10 May-flies, and 20 black insects related to the dobson and known as *Sialis infumata*. Rose-chafers, which are very destructive insects, are eaten by only a few birds. The skipper and cabbage butterflies were the only butterflies eaten by Marshall Hall birds. The larvæ of

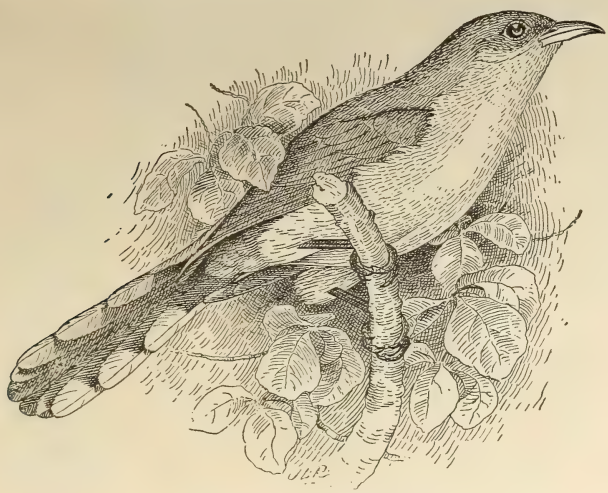


FIG. 30.—Yellow-billed cuckoo.

the mourning-cloak butterfly are often selected by cuckoos, as are also other hairy and spiny caterpillars that other birds avoid. Caterpillars, largely in such forms, make half of the cuckoo's food, grasshoppers and their allies about a third, and beetles, with small numbers of miscellaneous insects, the remaining sixth. The cuckoo is not abundant on the farm. It is undoubtedly the most useful of the exclusively insectivorous birds found at Marshall Hall, because of the protection it gives to the foliage of forest and orchard.

KINGFISHERS.

One pair of kingfishers was seen continually along the shore of lots 1 and 2 (Pl. III, fig. 2), and another pair nested in the sandy bluff of the Hungerford farm. The food of the bird has already

been mentioned in connection with the piscivorous habits of birds (see p. 53). The stomachs of 5 nestlings were examined.

WOODPECKERS.

The following woodpeckers were noted at Marshall Hall:

Downy woodpecker (*Dryobates pubescens*), 13.
Yellow-bellied sapsucker (*Sphyrapicus varius*), 2.
Pileated woodpecker (*Ceophlœus pileatus*).
Red-headed woodpecker (*Melanerpes erythrocephalus*), 1.
Red-bellied woodpecker (*Melanerpes carolinus*).
Flicker (*Colaptes auratus*), 2.

The stomachs of 13 downy woodpeckers were collected. All contained insects and 2 fruit—the berries of smilax and poison ivy. Ants appeared to be the favorite food, having been eaten by all the birds except one. Beetles and their larvæ had been eaten by 8 birds. The kinds selected were click-beetles, ground-beetles (*Amara*), darkling-beetles (*Helops æreus*), and longicorn-beetles (*Elaphidion*). Caterpillars, including *Catocala*, were found in 3 stomachs; miscellaneous insects, principally fly-like insects, in 4; snails in 2, and spiders in 7. Vegetable food amounted to one-fourth of the whole, a proportion probably diminished by the fact that 4 of the stomachs were those of young birds. As the downy woodpecker feeds largely on wood-boring insects and other species that infest tree trunks, it is useful in woodland and orchard.

The yellow-bellied sapsucker (fig. 31) is the cause of all the maledictions that have been heaped on the woodpecker tribe. It secures a large part of its food by drilling holes in tree trunks to serve as wells for collecting the sap on which it feeds. In examining 81 stomachs of this woodpecker, Professor Beal found that sapwood or alburnum formed 23 percent of their contents, a circumstance that indicates the importance of sap in the economy of this species. Sap itself can not be detected unless the stomach is examined immediately, which is impracticable in the case of stomachs sent to the Department of Agriculture.

Several authors have mentioned the fact that this bird kills birches. The following field notes show the manner in which it works injury to apple trees:

In the summer of 1895 there was on the Bryan farm a little orchard of 9 apple trees, about twelve years old, that appeared perfectly healthy. In the fall sapsuckers tapped them in many places, and during spring and fall of the next four years they resorted to them regularly for supplies of sap. Observations were made (October 15, 1896) of two sapsuckers in adjoining trees of the orchard. From a point 20 feet distant they were watched for three hours with powerful glasses to see whether they fed to any considerable extent on ants and

other insects that were running over the tree trunks. In that time one bird seized an ant and the other snapped at some flying insect. One drank sap from the drills 30 and the other 41 times. Later in the day one drilled 2 new holes and the other 5. The holes were made in more or less regular rings about the trunk, one ring close above another, for a distance of 6 to 8 inches. The drills were about a quarter of an inch deep, and penetrated the bark and the outer part of the wood.

FIG. 31.—Yellow-bellied sapsucker.

In November, 1900, 7 of the 9 trees were dead and the others were dying. A strip of bark 7 inches long by 2 wide, where the sapsuckers had worked in 1896, was torn off and found to contain 84 drills, an average of 6 to the square inch. Many of them were so close together that the tissue between had broken down, leaving rents in the bark an inch or two long, and in some places almost girdling the tree. The loss of sap must have been an exhausting drain, but it was not the sole cause of death. Beetles of the flat-headed apple borer, attracted by the

exuding sap, had oviposited in the holes, and the next generation, having thus gained an entrance, had finished the deadly work begun by the sapsuckers. Holes made by birds are sometimes closed by burl-like knobs of wood, but if they remain open the death of the tree from borers is very likely to result. In the case of the trees killed at Marshall Hall, galleries made by borers had honeycombed the wood beneath the section of bark riddled by the sapsuckers.

Only 2 stomachs of sapsuckers were collected. They were taken during the middle of November, 1899 and 1900, and contained several dung-beetles (*Aphodius*) and the fruit of woodbine and red cedar.

The red-headed woodpecker is not common at Marshall Hall, though it was seen in small numbers every fall. One specimen taken Novem-

FIG. 32.—Flicker.

ber 29, 1900, among the swamp oaks south of lots 4 and 5, had eaten gall insects (Cynipidæ) and many bits of the woody tissue of the gall. This woodpecker makes about half its food on vegetable matter, largely mast with some berries, and selects for its insect food chiefly beetles, ants, and grasshoppers. It is, on the whole, useful.

The flicker (fig. 32), though nesting on the farm, was common only during migration, when it was seen in flocks of from 6 to 12. A stomach collected in the middle of November, 1899, contained 10 ground-beetles (including *Anisodactylus*, *Harpalus pennsylvanicus*, and *Pterostichus sayi*), 5 ants, 1 sow bug, 1 black cricket and skin, and 20 seeds of woodbine berries. The flicker is somewhat more insectiv-

FIG. 1.—BLUEBIRD AT EDGE OF NEST WITH GRASSHOPPER IN MOUTH.

From photograph by Rev. P. B. Peabody.

FIG. 2.—FORMER NESTING SITE OF BLUEBIRDS ON LAWN AT BRYAN FARM.

The hole used by the birds may be seen about halfway to the top of the tree against which the gun is leaning. As in Plate I Mount Vernon is to be seen in the distance.

orous than the redhead. Its vegetable food usually consists of a little mast and a good deal of wild fruit. It is less of a woodpecker than any other species of the family, for it is much less arboreal and spends a large part of the time on the ground securing ants with its long sticky tongue. As many as 5,000 ants have been taken from one stomach. So important is this article of diet that it forms three-fourths of the insect food of the species.

WHIP-POOR-WILLS, NIGHT-HAWKS, SWIFTS, AND HUMMING-BIRDS.

Whip-poor-wills (*Antrostomus vociferus*) and night-hawks (*Chordeiles virginianus*), two exclusively insectivorous species, are highly useful. The former was frequently heard, and the latter was frequently seen in late summer as it soared over the farm after ants.

The chimney swift (*Chætura pelagica*) is, as might be expected, wholly insectivorous. Three birds collected July 18, 1898, had caught the following insects on the wing: One small bee (Andrenidæ), 3 bugs (Heteroptera), and 34 weevils (*Sitones hispidulus*).

The ruby-throated hummingbird (*Trochilus colubris*) feeds on insects and the nectar of flowers. During the last of May it visited the flowers of the persimmon, in June the honeysuckle, and later tobacco and the trumpet creeper. A bird that was shot fresh from a trumpet flower had eaten 1 little green bee (Andrenidæ) and 1 minute spider.

FLYCATCHERS.

The following species of flycatchers have been noted at Marshall Hall:

Scissor-tailed Flycatcher (*Muscivora forficata*). Noted by Mr. O. N. Bryan.
Kingbird (*Tyrannus tyrannus*), 16.
Great crested flycatcher (*Myiarchus crinitus*), 4.
Phœbe (*Sayornis phœbe*), 3.
Wood pewee (*Contopus virens*), 11.
Acadian flycatcher (*Empidonax virescens*), 1.

Sixteen kingbirds were collected from May 28 to July 30. Insects formed 71 percent and fruit 29 percent of their food. The fruit consisted of cherries, sassafras, wild and cultivated mulberries, elder, and blackberries. The proportion of insect food was not so large as is typical for the species, a circumstance resulting probably from the readiness with which fruit could be obtained. Beetles constituted 37 percent of the food, grasshoppers and crickets 23 percent, ants and bees 4 percent, parasitic wasps 2 percent, miscellaneous insects, including caterpillars and bugs, 3 percent, and spiders 2 percent. Among the miscellaneous insects were a stink bug (*Hymenarcys nervosa*), an assassin bug (*Sinea diadema*), and a whole cabbage butterfly (*Pieris rapæ*). The bees included small wild species (Andrenidæ) and drones

of honey bees. The parasitic wasps included forms of the families Ichneumonidæ and Scoliidæ. Of the beetles, which were by all means the most interesting element of the insect food, ground-beetles (including *Anisodactylus* and *Cratacanthus dubius*) furnished 2 percent, tiger-beetles, soldier-beetles (*Chauliognathus pennsylvanicus*), and dung-beetles (*Atænius* and *Aphodius*) 3 percent, and injurious beetles of the following species 30 percent:

Rose-chafer (*Macrodactylus subspinosus*).
Southern June-beetle (*Allorhina nitida*).
Shining leaf-chafer (*Anomala*).
Sad flower-beetle(*Euphoria melancholica*).
Long-horned beetles (including *Leptura*).
Locust leaf-mining beetle (*Odontota dorsalis*).
Blister-beetle (*Epicauta cinerea*).
Asparagus-beetle (*Crioceris asparagi*).

Asparagus-beetles and blister-beetles are scarcely ever eaten by other birds and rose-chafers seldom; hence the service rendered by the kingbird in destroying these insects and others of an injurious character in large numbers makes it one of the most valuable allies of the farmer.

Of the remaining flycatchers collected, the wood pewee and the Acadian flycatcher are purely insectivorous, and the phœbe and the great crested flycatcher, though subsisting chiefly on insects, quite often, especially in late summer, vary their fare with fruit.

One Acadian flycatcher was collected. It had eaten a spider, a parasitic wasp, a long-horned beetle, a leaf-beetle (*Crepidodera*), and a banded-winged horsefly (*Chrysops*).

Of 11 wood pewees all had taken beetles, including click-beetles, long-horned beetles (*Leptura rubrica*), dung-beetles (*Onthophagus pennsylvanicus*), soldier-beetles (*Chauliognathus pennsylvanicus*), locust leaf-mining beetles (*Odontota dorsalis*) and a related leaf-beetle (*Hæmonia nigricornis*), and weevils of the species *Phytonomus punctatus* and *Sphenophorus zeæ*. Seven had destroyed parasitic wasps, including Braconidæ, Evaniidæ, Ichneumonidæ (*Mesostenus* and others), and Scoliidæ (*Tiphia inornata*); 4 had eaten flies (*Chironomus*, *Sapromyza vulgaris*, *Lucilia cæsar*, and other muscid flies); 1 had taken a moth; and 3 had eaten, respectively, a caddis-fly, a May-beetle, and a spider. Although the wood pewee destroys large numbers of injurious insects, especially beetles, it feeds so eagerly on the useful parasitic wasps that its scarcity at Marshall Hall was perhaps fortunate for the owners of the farms.

Three phœbe (fig. 33) stomachs were collected. Their contents were chiefly beetles of the following kinds:

Anisodactylus.
Cicindela.
Chauliognathus pennsylvanicus.
Canthon.
Aphodius inquinatus.
Onthophagus pennsylvanicus.
Lachnosterna.
Odontota dorsalis.
Orsodachna atra.
Collops quadrimaculatus.
Lema trilineata.

In smaller numbers the birds had eaten flying ants, parasitic wasps, and other wasps, bugs, caddis-flies, and spiders. One had tasted blackberries.

Four great crested flycatchers were collected in May. Their stomachs contained May-flies, ants (*Camponotus pennsylvanicus* and other forms), parasitic wasps (Ichneumonidæ, Scoliidæ (*Tiphia*) and Evaniidæ), bugs (*Euschistus* and *Nezara hilaris*), and beetles (Curculionidæ, Elateridæ, *Cicindela sexguttata*, *Dicerca*, and *Odontota dorsalis*). Despite their

FIG. 33.—Phœbe.

taste for parasitic wasps both phœbe and great crested flycatcher are in the main useful on account of the large number of insect pests they destroy.

HORNED LARKS.

When the horned lark (*Otocoris alpestris*) occurred at Marshall Hall, as it did occasionally in severe winter weather, it subsisted almost entirely on seeds, largely weed seeds, often with waste grain. A bird collected during the severe blizzard of February, 1900, was feeding in a wind-swept cowyard, where it secured a bit of a kernel of corn, 4 seeds of lamb's-quarters, 8 of crab-grass, 10 of bastard pennyroyal, and 12 of ragweed.

BLUE JAYS AND CROWS.

Six blue jays (*Cyanocitta cristata*, fig. 34) were collected in May and November. All except one had taken insects. Beetles were the most important element and comprised *Chlænius æstivus*, *Lachnosterna*,

Euphoria fulgida, *Onthophagus*, Elateridæ, and Curculionidæ. The less important element was composed of parasitic wasps, May-flies, and grasshoppers (Locustidæ). One bird had eaten a snail and one a spider. One had taken mulberries and all had eaten acorns. Mast formed half the total volume of food. None of these six specimens had eaten grain, which usually enters into the blue jay's food to some extent, and in certain localities in New Hampshire that came under direct observation furnished a significant part of it. The blue jay takes about three times as much vegetable as animal food. It appears to do no harm at Marshall Hall and consumes a fair quantity of injurious beetles, grasshoppers, and caterpillars.

The common crow (*Corvus americanus*) was much more numerous on the farm than the fish crow (*Corvus ossifragus*). Four stomachs of the former species were collected. In the case of this bird, which, as has been shown, attacks poultry and grain (see pp. 50 and 65), protection

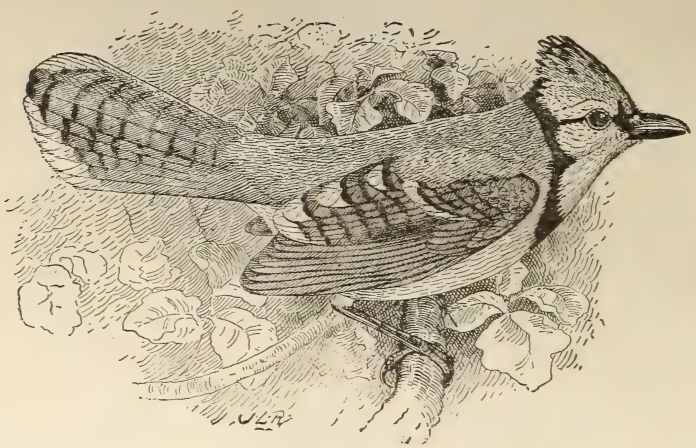


FIG. 34.—Blue jay.

is not desirable at Marshall Hall. Elsewhere the species may do as much good as harm, perhaps even more, but here local conditions make encouragement of its presence incompatible with prudent farming.

MEADOWLARKS, BOBOLINKS, AND COWBIRDS.

The meadowlark (*Sturnella magna*) is one of the class of highly useful birds. It is commonly supposed to be largely vegetarian, but it really takes about three times as much animal matter as vegetable. One-third of this major part is usually composed of grasshoppers, though these insects were not abundant enough at Marshall Hall to enter largely into the food of the 7 meadowlarks collected. Injurious beetles and caterpillars, however, were taken in customary quantities. The meadowlark, which is commonly regarded as a game bird at

Marshall Hall, is frequently shot, and its valuable work as a destroyer of weed seed and insects is thus often cut off.

When the bobolink (*Dolichonyx oryzivorus*, fig. 35) tarries on the farm in its southward migration it lives wholly on the wild rice of the calamus swamp, but on its return journey in May it eats injurious insects and weed seed of the wheat and clover fields. Six stomachs were collected in May.

The cowbird (*Molothrus ater*), as has been shown by Prof. F. E. L. Beal,[a] takes three times the volume of seeds that it takes of insects. Both of the 2 stomachs examined contained grasshoppers (*Xiphidium* and *Melanoplus*) and 1 of them leaf-hoppers, two elements character-

FIG. 35.—Bobolink.

istic of the insect food of the species. The bird does little damage to grain fields, and renders much service with other birds in reducing the weed-seed harvest of the farm.

BLACKBIRDS AND ORIOLES.

The red-winged blackbird (*Agelaius phœniceus*, fig. 36), however destructive to grain it may be elsewhere, does no damage in the grain-fields at Marshall Hall. Its insect food, which is to its vegetable food as one to three, is composed largely of weevils, caterpillars, and grass-

[a] Bobolink, Blackbirds, and Grackles. Bull. No. 13, Biological Survey, Dept. of Agriculture, p. 29, 1900.

hoppers. Its good work among weeds has been previously described (see p. 77). Eight stomachs were examined, but with little significance of result, for the temporary abundance of May-flies had diverted the birds from insect pests.

One stomach of the rusty blackbird (*Scolecophagus carolinus*) was collected April 14, 1899. It contained beetles (*Harpalus* and *Sitones*), 1 caterpillar, 1 small bee, and some waste corn. The character and extent of weed-seed destruction by rusty blackbirds on the farms at Marshall Hall has been shown on p. 77.

Crow blackbirds (*Quiscalus quiscula*) have been proved by examination of thousands of stomachs to take fully twice as much vegetable as animal food, the vegetable food being chiefly grain and fruit. And at Marshall Hall, after the young were established in life and the hosts of Northern birds, including the subspecies *Quiscalus quiscala æneus*, had arrived, systematic pillage of grain fields took place (see p. 67), which could be checked only by the shotgun. Twenty-five stomachs of the species were examined.

FIG. 36.—Red-winged blackbird.

The orchard oriole (*Icterus spurius*) is a summer resident at Marshall Hall and may usually be found nesting during the breeding season to the extent of a dozen pairs, though the present summer (1902) formed an exception to this rule, the usual number being reduced to 2 or 3. The food of this species, as shown in 11 stomachs collected during May and June, was composed of 91 percent animal matter and 9 percent vegetable matter. The latter part was nearly all mulberries; the former was distributed as follows: Fly larvæ, 1 percent; parasitic wasps, 2 percent; ants, 4 percent; bugs, 5 percent; caterpillars, 12 percent; grasshoppers, including a few crickets, 13 percent; beetles, 14 percent; May-flies, 27 percent; spiders, 13 percent. Thus beneficial insects—parasitic wasps—formed only 2 percent of the food, and injurious species—caterpillars, grasshoppers, and harmful beetles—amounted to 38 percent.

The Baltimore oriole (*Icterus galbula*) is also a highly insectivorous, useful species, but occurs at Marshall Hall only during migration. One bird was collected May 29, 1896. It had eaten mulberries, 2 small wasps, 2 fall webworms, 1 click-beetle, and 15 locust leaf-mining beetles.

FINCHES AND SPARROWS.

One purple finch (*Carpodacus purpureus*) was collected (February 20, 1900) from a flock feeding on cedar berries. Examination revealed, therefore, only remains of this fruit.

Specimens of the red crossbill (*Loxia curvirostra minor*) and the white-winged crossbill (*Loxia leucoptera*) were collected at Marshall Hall by Mr. O. N. Bryan, who presented them to the U. S. National Museum.

Eleven goldfinches (*Astragalinus tristis*) were collected. Insects (caterpillars) had been eaten by only one, practically all the food consisting of seeds, principally weed seeds. The goldfinch is probably the most useful seed-eater on the farm.

Several pine siskins (*Spinus pinus*) were seen December 1, 1901, in company with goldfinches.

The following native sparrows were noted:

Vesper sparrow (*Poœcetes gramineus*).
Savanna sparrow (*Ammodramus sandwichensis savanna*), 1.
Grasshopper sparrow (*Ammodramus savannarum passerinus*), 10.
Henslow sparrow (*Ammodramus henslowi*), 1.
White-throated sparrow (*Zonotrichia albicollis*), 17.
Tree sparrow (*Spizella monticola*), 9.
Chipping sparrow (*Spizella socialis*), 61.
Field sparrow (*Spizella pusilla*), 31.
unco (*Junco hyemalis*), 11.
Song sparrow (*Melospiza melodia*), 36.
Lincoln sparrow (*Melospiza lincolni*).
Fox sparrow (*Passerella iliaca*).

From May to September, inclusive, half the food of field, song, chipping, and grasshopper sparrows consists of insects. The grasshopper sparrow is the most insectivorous of the four, but a description of the insect food taken by it at Marshall Hall will serve, because of similarity, to indicate that of the other three. The main part was composed of beetles, caterpillars, and grasshoppers. The beetles included *Sitones hispidulus*, *Drasterius*, *Systena elongata*, *Systena blanda*, *Colaspis brunnea*, *Anisodactylus*, and *Atænius*. The caterpillars belonged chiefly to the family Noctuidæ, including many cutworms and army worms. Caterpillars of the family Geometridæ were occasionally eaten. The grasshoppers were of the genera *Xiphidium*, *Scudderia*, *Melanoplus*, *Hippiscus*, and *Dissosteira*. The following bugs also had been eaten: *Corizus*, *Trichopepla semivittata*, *Hymenarcys nervosa*, and *Alydus pilosulus*. Spiders were frequently taken.

The chipping and field sparrows sometimes destroy small numbers of useful parasitic wasps, and the song sparrow now and then eats the less beneficial smaller ground-beetles. The insectivorous habits of all

these native species are, on the whole, however, extremely valuable to man. The consumption of weed seeds, the chief service of these birds as well as of those that visit the farm only in the colder season, has already been emphasized (see p. 72). For a detailed account of the food habits of sparrows the reader is referred to 'The Relation of Sparrows to Agriculture.'[a] As there shown, and as set forth in the first part of this bulletin (see p. 17), the English sparrow differs radically in habits from the native sparrows and is a pest that should be exterminated.

One towhee (*Pipilo erythrophthalmus*) was taken September 9, 1896. Its stomach was found to contain a locust leaf-mining beetle, a weevil, a ground-beetle, a bug, a cricket, 6 ants, and remains of broken seeds.

Ten cardinals (*Cardinalis cardinalis*) were collected from February to November, inclusive, with the omission of March. Twenty-two percent of their food consisted of animal matter (insects and spiders) and 78 percent of vegetable matter (half fruit and half seeds). Of the minor proportion, bugs formed 1 percent; spiders, May-flies, and grasshoppers, each 2 percent, and beetles 15 percent. The beetles were as follows: *Agrilus egenus*, *Dicerca obscura*, *Macrodactylus subspinosus*, *Donacia*, *Odontota dorsalis*, *Hyperplatys aspersus*, *Anisodactylus agricola*. On November 29, 1901, two cardinals were noted eating seeds of the tulip tree.

One stomach of the indigo bird (*Cyanospiza cyanea*) was examined. It held 1 beetle (*Agrilus egenus*) and a little vegetable débris.

TANAGERS.

At Marshall Hall tanagers were never detected pilfering cultivated fruit, as they have often been known to do elsewhere.

One summer tanager (*Piranga rubra*), collected August 5, 1898, had eaten wild blackberries, a bee (*Agapostemon*), and a scoliid wasp.

Three scarlet tanagers (*Piranga erythromelas*), taken in May and August, had fed exclusively on insects, which comprised a bee (*Halictus*), parasitic wasps, white ants, a soldier bug (*Nezara hilaris*), click-beetles, darkling-beetles (*Helops micans*), and the sad flower-beetle (*Euphoria melancholica*).

SWALLOWS.

The following swallows were noted:

Purple martin (*Progne subis*), 2.
Barn swallow (*Hirundo erythrogastra*), 10.
White-bellied swallow (*Tachycineta bicolor*), 5.
Bank swallow (*Riparia riparia*), 6.
Rough-winged swallow (*Stelgidopteryx serripennis*), 7.

[a] The Relation of Sparrows to Agriculture. Bull. No. 15, Biological Survey, Dept. of Agriculture, Washington, 1901.

Thirty swallows, collected between the middle of May and the middle of August, had eaten nothing but insects. Parasitic wasps and bees formed 2 percent of their food (less than usual with aerial feeders), bugs 3 percent, May-flies 8 percent, beetles 13 percent, white ants 21 percent, ants 33 percent, and miscellaneous insects, principally flies with a few bugs, 20 percent. The forms selected were bees of the family Andrenidæ, and parasitic wasps of the families Scoliidæ, Ichneumonidæ, and Chalcididæ. The beetle food was interesting, for besides click-beetles, dung-beetles (*Aphodius inquinatus*, *Hister*, *Atænius*, and *Onthophagus pennsylvanicus*), weevils of several species, and metallic woodborers (*Agrilus*), it included the engraver beetles (among them *Tomicus cacographus*), which are destroyed by only few other birds. The food of swallows is peculiar in its lack of caterpillars and grasshoppers, which are so important to the subsistence of other birds. As with flycatchers, the number of flies taken is generally overestimated. In the stomachs examined were found snipe-flies (Leptidæ), golden-green flesh-flies (*Lucilia cæsar*), and other muscidæ, with an occasional banded-winged horse-fly (*Chrysops*).

CEDAR BIRDS.

The cedar bird (*Ampelis cedrorum*, fig. 37) is the most frugivorous of the Marshall Hall birds. More than four-fifths of its food was

FIG. 37.—Cedar bird.

fruit, the remainder insects. Though often troublesome elsewhere, it does no harm here, and accomplishes some good through its slightly insectivorous habit. Five stomachs were collected in May. One contained cherries, one mulberries, and a third smilax berries. Insects (locust leaf-mining beetles and May-flies) were found in three.

SHRIKES.

The impaling of grasshoppers and mice by the loggerhead shrike (*Lanius ludovicianus*) near the storage barn has already been mentioned (see p. 54). The only other field observation was on October 23, 1901, when a shrike near the same place was seen to kill a garter snake (*Eutainia*) 13 inches long. Owing to the small number of shrikes at Marshall Hall no specimens were taken, but in order to investigate the feeding habits some experiments were carried on with a captive bird given me by Mr. William Palmer. The habit the bird has of impaling prey has been the subject of considerable speculation, some writers maintaining that it gibbets its victims alive for the pleasure of watching their death struggles, and others that it slaughters more game at a time than it can eat and hangs up the surplus to provide against a time of want. This theory of prudent foresight may explain why it kills more game than it can eat, but, as the experiments showed, it does not touch the real reason why it impales its prey.

On the day after the shrike in question was captured a dead mouse was offered it. The shrike raised its wings, moved its tail up and down petulantly after the manner of the phœbe, and then seized the mouse and dragged it about for several minutes, trying to wedge it into first one and then another corner of the cage. Failing in this effort, it tried to impale the mouse on the blunt broken end of a branch that had been placed in the cage for a perch, but the body fell to the floor. Then it tried to hold the mouse with its feet and tear it to pieces, but its feet were too weak. A nail was now driven into the cage so as to expose the point. Immediately the shrike impaled its prey, fixing it firmly, and then fell to tearing and eating ravenously. Several days later the nail was removed and a piece of beef was given to the shrike. By dint of hard work it managed to hold the beef with its feet, so that it could bite off pieces; but it much preferred to have me do the holding, when it would perch on my wrist and pull off mouthfuls in rapid succession. These experiments indicate that the shrike is unable to tear to pieces food that is not securely fixed. Hawks can grip their food with their powerful talons and then easily tear it into pieces small enough to be swallowed, but the shrike's feet have not a sufficiently vigorous clutch to permit this method.

A series of experiments in feeding insects to this shrike was also carried out. If the bird was very hungry it did not impale insects. When offered a grasshopper (*Hippiscus*) at such times, it would clutch it with one foot, and, resting the bend of its leg on the perch, bite off mouthfuls and swallow them. When not very hungry it impaled grasshoppers and caterpillars (*Sphinx catalpæ*). Such prey as the thousand-legs, centipedes (*Lithobius*), house-flies, and blow-flies (*Cal-*

liphora vomitoria), and in a single instance, a mourning-cloak butterfly, it ate at a single gulp, but very large insects, such as tumblebugs (*Copris carolina*), it always impaled. It refused larvæ of the mourning-cloak butterfly, the forest tent caterpillar, the fall webworm, and the tussock moth. It would not eat a skin-beetle (*Trox*), but took with relish May-beetles (*Lachnosterna*), flower-beetles (*Trichius piger*), and long-horned beetles (*Monohammus*). Insects provided with especial protective devices were used in some of the experiments. Drone and worker honey bees were eaten, but with no apparent relish. The highly flavored cabbage bug (*Murgantia histrionica*) was rejected, but its near relative (*Euschistus*), a stink bug, was greedily devoured. The investigation of insect food was concluded with tests by means of certain beetles possessing ill-flavored, highly irritating secretions. A burying-beetle (*Silpha inæqualis*), a 12-spotted cucumber-beetle (*Diabrotica 12-punctata*), and a blister-beetle (*Epicauta vittata*), were refused, but an oil-beetle (*Meloe angusticollis*), provided with very powerful irritating secretions, was eaten with relish. The moth of the salt-marsh caterpillar, an insect with a vile odor, was also very palatable. The green ground-beetle (*Calosoma scrutator*), which throws out a nauseous volatile, acid fluid, highly irritating, was tried. When this big insect was placed in the cage, the shrike seized it by the prothorax, bit it vigorously and knocked off its head, and then impaled the body. The beetle's pungent odor filled the room, but the shrike removed the elytra with its bill, and after swallowing the thorax bolted the abdomen at a gulp. In the next experiment a *Calosoma* was so presented to the shrike that the latter had to seize it by the tip of the abdomen. The beetle ejected its irritating ill-smelling secretion full in the bird's face. The shrike staggered an instant, then flew to the farther side of the cage, apparently in distress. It was several days before it dared to accept another *Calosoma*.

A series of experiments with mice, birds, and other vertebrates was also made. When a live mouse was placed in the cage the shrike gave chase, half running, half flying. It soon caught the animal by the loose skin of the back, but quickly let go because the little rodent turned on it savagely. In the next attack it seized the mouse by the back of the neck and bit through the skull into the base of the brain, causing instant death. (A broad-winged hawk experimented with at the same time always killed its victims with its talons, never touching them with its beak until they were dead.) A honey-locust perch, set with sharp thorns 2 inches long, had been put into the shrike's cage, and on this it fixed the mouse, a thorn entering below the shoulder blade and passing out through the breast. Then (10 a. m.) it ate the brains. At 10.30 it picked from twenty to thirty mouthfuls of hair from the hind quarters, made incisions and removed the skin, and then ate the large muscles. By 11.30 it had devoured the whole body,

including viscera and skin. Several days later the shrike dispatched a live English sparrow about as it had the mouse, and impaled the carcass. Then it plucked the breast and ate the pectoral muscles, the lungs, and the heart. Live snakes (*Storeria dekayi*) and lizards (*Sceloporus undulatus*) were also fed to the shrike. A toad was put into the cage, and it attacked it, but soon desisted in evident distress, caused probably by the toad's irritating secretions. Frogs and salamanders (*Plethodon*) it relished. Goldfish and bass 2 or 3 inches long it killed, impaled, and ate.

It disgorged indigestible parts of its food in pellets, after the manner of hawks and owls. Pellets of insects were not compact and fell to pieces readily, but those made of remains of mice or birds were firm and kept their shape. When it was fed on May-beetles it disgorged a pellet in one hour and twenty minutes; when fed on a mouse, in three hours. The latter pellet was 7 by 18 millimeters in size and shaped like an olive seed. The largest one ejected contained the remains of a bird and a snake and measured 33 by 11 millimeters. When vertebrates had been eaten their bones were found inside the pellet and the fur, feathers, or scales outside.

VIREOS.

Twenty-five vireos were collected, including 2 warbling vireos (*Vireo gilvus*), 10 white-eyed vireos (*Vireo noveboracensis*), and 13 red-eyed vireos (*Vireo olivaceus*). Ninety-one percent of their food consisted of insects and 9 percent of fruit (mulberries and sassafras). Parasitic wasps formed 2 percent, ants and other Hymenoptera 6 percent, May-flies 4 percent, caterpillars 15 percent, bugs 17 percent, beetles 28 percent, miscellaneous insects 8 percent, and spiders 11 percent. The Hymenoptera, other than ants, comprised jointworm flies, saw-fly larvæ, ichneumon flies, and bees of the genus *Halictus*. The beetles included the following kinds:

Typophorus canellus.
Diabrotica 12-punctata.
Odontota dorsalis.
Mordella 8-punctata.
Symphora rugosa.
Ecyrus dasycerus.
Leptura zebra.
Hyperplatys aspersus.
Anomala.
Crepidodera.
Colaspis brunnea.
Coptocycla bicolor.
Limonius quercinus.
Agrilus.
Helops venustus.
Helops micans.
Tanymecus confertus and other Rhynchophora.

The bugs were stink bugs (*Podisus*), leaf-hoppers (*Jassidæ*), and scale insects (*Kermes*). The yellow-throated vireo (*Vireo flavifrons*) has been noted at Marshall Hall by Mr. William Palmer. All the vireos are very useful protectors of forest and fruit trees.

WARBLERS.

The list of warblers noted at Marshall Hall is given below:

Black and white warbler (*Mniotilta varia*).
Worm-eating warbler (*Helmitherus vermivorus*), 1.
Northern parula warbler (*Compsothlypis americana usneæ*), 1.
Yellow warbler (*Dendroica æstiva*), 7.
Black-throated blue warbler (*Dendroica cærulescens*).
Myrtle warbler (*Dendroica coronata*), 2.
Magnolia warbler (*Dendroica maculosa*), 2.
Chestnut-sided warbler (*Dendroica pensylvanica*).
Black-poll warbler (*Dendroica striata*), 11.
Yellow-throated warbler (*Dendroica dominica*).
Black-throated green warbler (*Dendroica virens*).
Pine warbler (*Dendroica vigorsi*).
Yellow palm warbler (*Dendroica palmarum hypochrysea*). Noted by Mr. William Palmer.
Prairie warbler (*Dendroica discolor*), 1.
Oven-bird (*Seiurus aurocapillus*), 1.
Water-thrush (*Seiurus noveboracensis*), 2.
Louisiana water-thrush (*Seiurus motacilla*), 1.
Kentucky warbler (*Geothlypis formosa*).
Maryland yellow-throat (*Geothlypis trichas*), 13.
Yellow-breasted chat (*Icteria virens*), 4.
Hooded warbler (*Wilsonia mitrata*). Noted by Mr. William Palmer.
Wilson warbler (*Wilsonia pusilla*), 1.
Canadian warbler (*Wilsonia canadensis*), 1.
Redstart (*Setophaga ruticilla*), 5.

Of the food of the 53 specimens collected 96 percent consisted of insects and 4 percent of fruit. The insect food was distributed as follows: Beetles, 21 percent; ants, wasps, and bees, 18 percent; May-flies, 16 percent; caterpillars, 14 percent; bugs (leaf-hoppers, scale insects, and true bugs) 6 percent; miscellaneous insects, including flies, a few grasshoppers, and others, 8 percent; spiders, 11 percent; and miscellaneous invertebrates, principally snails, 2 percent. Of the 21 percent of beetles 3 percent were useful forms, 5 percent neutral, and 13 percent injurious. The following beetles were identified:

Chlænius (larva).
Harpalus (larva).
Anisodactylus rusticus.
Chaulio'gnathus.
Staphylinidæ.
Ptinidæ:
Ligyrus gibbosus.
Euphoria.
Serica vespertina.
Aphodius.
Atænius.
Limonius quercinus.
Cerambycidæ.
Notoxus bicolor.
Bruchidæ.
Rhynchophora (Otiorhynchidæ, *Apion*, etc.).
Xanthonia villosula.
Systena elongata.
Crepidodera helxines.
Odontota dorsalis.

The Hymenoptera comprised the following: 11 percent of the total food, ants, and small bees (*Andrena* and *Halictus*); 4 percent useful

parasitic wasps (*Tiphia inornata* and Ichneumonidæ), and 3 percent jointworm-flies and larvæ of saw-flies. The bugs were scale insects, leaf-hoppers, and true bugs, including *Lygæidæ*, *Sinea diadema* and *Podisus*. In several instances warblers had fed on the eggs of bugs.

Some differences naturally appeared between the food of the purely arboreal species and that of the more terrestrial. Water-thrushes took ground-beetles. Maryland yellow-throats secured more grasshoppers than were taken by arboreal warblers. The yellow-breasted chat, larger than the other species, ate such large beetles as *Ligyrus* and *Euphoria*. It also fed on larvæ of ground-beetles, which are outside the feeding range of strictly arboreal warblers. In a chat's stomach elderberries were found, and in the stomachs of two myrtle warblers collected in February was the fruit of red cedar. The arboreal warblers other than the myrtle warbler are probably almost purely insectivorous.

Most of the warblers of the genus *Dendroica* destroy immense quantities of insects. As an illustration of their value in this regard an extract is quoted from a letter concerning the palm warbler received by the Biological Survey from Mr. Robert H. Coleman:

> I counted the number of insects he caught in a minute and found it varied from 40 to 60 per minute. He spent at least four hours on our piazza, and in that time must have gathered in about 9,500 insects.

MOCKINGBIRDS, CATBIRDS, THRASHERS, AND WRENS.

The mockingbird (*Mimus polyglottos*, fig. 38) was usually seen at Marshall Hall only in fall and spring, but during 1902 a pair nested near the cow barn. In the middle of November, 1899, two stomachs were collected. One contained the skin and 25 seeds of pokeberries and another 34 of the same seeds, the leg of an ant, and the remains of a larval ground-beetle. The bird's selection of ants and ground-beetles shows affinity in food habits with its nearest relative, the catbird. Both species are highly frugivorous, and where abundant in fruit-growing districts may do some harm.

The catbird (*Galeoscoptes carolinensis*) is the most numerous bird during the breeding season on the Bryan farm at Marshall Hall. The examination of 74 stomachs, collected from May to August, inclusive, showed that 41 percent of the food consisted of animal matter and 59 percent of vegetable matter. The latter part comprised the following fruits: Cultivated cherries, wild black cherries, black raspberries, dewberries, blackberries, strawberries, mulberries, pokeberries, elder berries, blueberries, and the berries of sassafras, woodbine, and catbrier. Of the animal matter, snails and thousand-legs composed 1 percent, spiders 2 percent, parasitic wasps 1 percent, ants 6 percent, caterpillars 6 percent, beetles 10 percent, May-flies 14 percent, and miscellaneous insects 1 percent, including grasshoppers, bees (*Halictus*

and *Andrena*), bugs (*Euschistus*, *Corimelæna*, etc.), and flies (Tipulidæ and *Calliphora vomitoria*, the caddis-flies and larvæ of saw-flies). The caterpillars were cutworms (*Agrotis* and *Nephelodes violans*), and in several cases such bristly larvæ as *Spilosoma*. The parasitic wasps were Ichneumonidæ and scoliid wasps (*Tiphia inornata*). Ants are

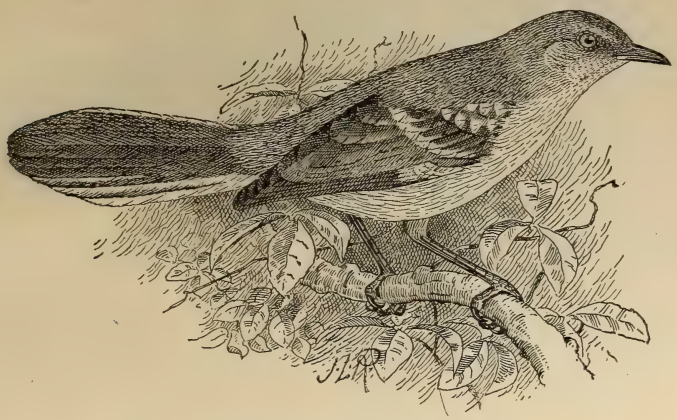


FIG. 38.—Mockingbird.

a characteristic element of the food. In the present instance they included *Lasius*, *Tetramorium*, *Formica subsericea*, and *Camponotus pennsylvanicus*. The coleopterous food is interesting because four-fifths of it consisted of injurious beetles. The list of beetles identified is as follows:

Lachnosterna.
Anomala lucicola.
Dichelonycha.
Onthophagus pennsylvanicus.
Aphodius.
Odontota dorsalis.
Longitarsus.
Hæmonia nigricornis.
Corymbites pyrrhos.
Monocrepidius auritus.
Anisodactylus rusticus.
Brachylobus lithophilus.
Cychrus stenostomus.
Harpalus.
Chlænius.
Staphylinus cinnamopterus.
Chauliognathus.
Hister.
Tenebrionidæ.
Epicærus imbricatus.
Tanymecus confertus.

Were cherries, blackberries, and raspberries raised for market on the farm in large quantities, the host of catbirds with their highly frugivorous habits might do harm, but as this is not the case they not only cause no loss but are beneficent through their destruction of insect pests.

The brown thrasher (*Toxostoma rufum*, fig. 39), which is not common on the Marshall Hall farm, is somewhat more insectivorous than its relative the catbird. Only one stomach was collected. This contained black raspberries, cherries, a cricket, a ground-beetle, and a May-

beetle. May-beetles appear to be relished by the thrasher and are destroyed wholesale where the bird is abundant.

FIG. 39.—Brown thrasher.

The house wren (*Troglodytes aëdon*, fig. 40) takes no vegetable food. Twenty stomachs were collected from May to August, inclusive. They

FIG. 40.—House wren.

showed the food to have been distributed as follows: Grasshoppers and crickets, 27 percent; moths, cutworms, measuring worms, and allied

larvæ, 19 percent; beetles, 11 percent, including Carabidæ, Cerambycidæ, Tenebrionidæ, Elateridæ (*Drasterius*), Scarabæidæ (*Aphodius*), Rhynchophora, and Chrysomelidæ (*Systena elongata*, etc.); bugs (true bugs—including *Myodocha serripes*—and a few leaf-hoppers), 9 percent; ants, 8 percent; May-flies, 2 percent; miscellaneous insects, 2 percent; spiders, 21 percent; and snails, 1 percent.

The winter wren (*Olbiorchilus hiemalis*) was observed hunting for insects and spiders in brush piles, but no stomachs were collected.

The long-billed marsh wren (*Cistothorus palustris*), though like the house wren it eats nothing but insects, can not be expected to help crops because of the remoteness of its marshy habitat. Five birds were collected. Spiders and beetles (*Calandra oryza*, *Donacia*, *Hippodamia maculata*) formed the major part of their food. The minor part was composed of true bugs, leaf-hoppers, flies, parasitic wasps, and ants.

One Carolina wren (*Thryothorus ludovicianus*) was collected. It had eaten caterpillars, grasshoppers, and beetles (longicorns and leaf-beetles, including *Odontota dorsalis*).

CREEPERS AND NUTHATCHES.

The brown creeper (*Certhia familiaris americana*) plays a useful part in ridding tree trunks of insect vermin. One stomach was taken. It contained such beetles as *Helops æreus* and *Bruchus hibisci*, sawflies, flying ants, spiders, and seeds of the scrub pine.

Two other beneficent gleaners of tree-trunk insects are the nuthatches (*Sitta carolinensis* and *Sitta canadensis*). Both were observed at Marshall Hall, but no specimens were collected. Prof. E. Dwight Sanderson has shown that the white-bellied nuthatch feeds on both seeds and insects. He found it eating ragweed and sunflower seeds, corn, and a very small amount of mast. His observations show it to be very fond of bugs and their eggs, and that it selects most often such Tingitidæ as *Piesma cinerea*, Reduviidæ, Coreidæ, and Jassidæ. Its beetle food includes Carabidæ, Elateridae, Scarabæidæ, and Buprestidæ. Ants (Myrmicidæ) are taken in large numbers. It also catches some parasitic wasps (Braconidæ) and frequently secures stone-flies, dragon-flies, and true flies.[a]

TITMICE.

One tufted titmouse (*Parus bicolor*) was collected July 9, 1898. It had eaten several blueberries, a longicorn beetle, and a large cutworm.

Seven Carolina chickadees (*Parus carolinensis*) were taken during February, April, July, and August. Vegetable matter—mulberry seeds, pine seeds, and ragweed seeds—was present in four stomachs. All the birds had eaten insects. One had eaten 1 bee (Andrenidæ), 2

[a] Auk, Vol. XV, pp. 144–148, 1898.

ants, 3 insect eggs, 3 spiders, and 3 caterpillars (measuring worms, Geometridæ and hairy Arctiidæ, which are usually avoided by birds). One of the stomachs examined contained katydid eggs and two others eggs of the wheel-bug. Between 200 and 300 eggs of the fall canker-worm have been found in the stomach of a black-capped chickadee and 450 eggs of a plant-louse in that of another. The eating of insect eggs is a characteristic habit of the chickadee, and makes the bird, small as it is, one of the most effective destroyers of insect pests. It is of particular value in the orchard, and every horticulturist would do well to encourage it.

KINGLETS.

The golden-crowned kinglet (*Regulus satrapa*) and the ruby-crowned kinglet (*Regulus calendula*) are useful insectivorous midgets. They were observed at Marshall Hall, but were not killed.

GNATCATCHERS.

Three blue-gray gnatcatchers (*Polioptila cærulea*) were collected. They had eaten longicorn beetles, joint-worm flies, caddis-flies, and several minute flies (unindentified Diptera).

THRUSHES.

The wood thrush (*Hylocichla mustelina*), Wilson thrush (*Hylocichla fuscescens*), hermit thrush (*Hylocichla guttata pallasi*), gray-cheeked thrush (*Hylocichla aliciæ*), and olive-backed thrush (*Hylocichla ustulata swainsoni*) were noted at Marshall Hall—the first as a breeding bird, the last four as migrants.

Three stomachs of the gray-cheeked thrush were taken May 15, 1900. They contained saw-fly larvæ, ants, caterpillars, May-flies, ground-beetles, weevils, and scarabæid beetles (*Anomala*, *Atænius*, *Lachnosterna*, and *Serica*).

Two olive-backed thrushes, also collected in May, had eaten ants (*Camponotus pennsylvanicus*), wasps (*Tiphia inornata*), ground-beetles, darkling-beetles (*Helops*), and ground-spiders (Lycosidæ).

The robin (*Merula migratoria*, fig. 41) is seen on the farm only during the colder half of the year. One bird collected in the blizzard of the third week of February, 1900, had fed on smilax berries. Field observations and the examination of stomachs collected elsewhere show that somewhat more than half of the robin's food is fruit. That which it takes at Marshall Hall, however, consists merely of wild berries. In the second week of April, 1899, 8 birds were collected. Five had eaten ground-beetles, and four, secured in a field that was being plowed, had taken large quantities of the larvæ of the ground-beetle, *Harpalus caliginosus*, which as before stated has lately been found harmful to

strawberries. The other beetles eaten were darkling-beetles (*Opatrinus*), and two clover weevils (*Sitones hispidulus* and *Phytonomus punctatus*). One robin had fed on the pupa of a dipterous insect and two had picked up cocoons of a tineid moth. Several had destroyed cutworms and army worms. Two had eaten 6 cutworms apiece.

The robin is abundant and is most useful. It is the scourge of the insects that infest the open cultivated fields of the farm. Unfortunately it usually gets little credit for its virtues, is outlawed for vices that it does not possess, and is shot in large numbers for food.

Bluebirds (*Sialia sialis*, Pl. XVII, fig. 1) breed but sparingly at Marshall Hall on account of the persecutions of the English sparrow. By twenties and thirties they visit the farm in spring, autumn, and even winter. Two birds were taken February 20, 1900, and five on the

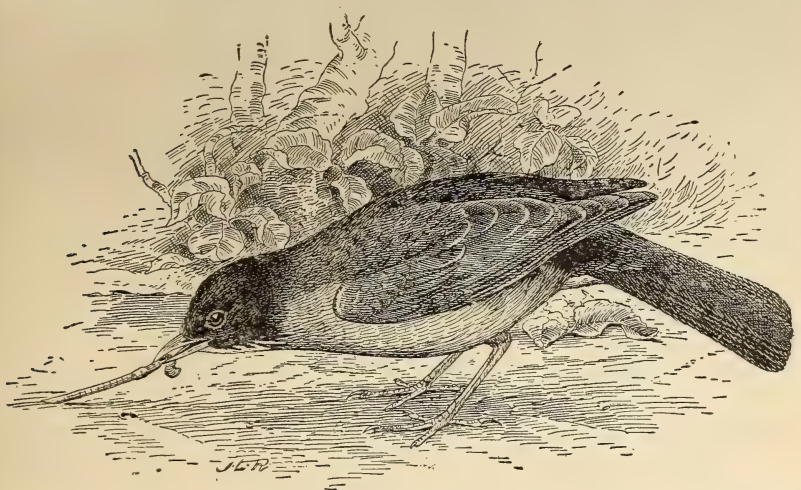


FIG. 41.—Robin.

19th of the previous November. Six of these had eaten fruit, which constituted rather more than half of all the food. It was composed of the berries of bittersweet, woodbine, cedar, sumac, and poison ivy. One had eaten 8 poison ivy berries and 25 cedar berries—apparently a pretty large dose of stimulating drugs. All had eaten insects. Their selection had fallen on such highly flavored species as ground-beetles (*Harpalus*), stink bugs (Pentatomidæ), and other bugs, including *Alydus pilosulus*. One had eaten a dung-beetle (*Aphodius*). Grasshoppers and crickets had also entered into their fare. Caterpillars, including bristly Arctiidæ and cutworms, had been the prey of all. It is a pleasant duty to report that this bird, so popular throughout the land, is, through its excellent work as a destroyer of noxious insects, well worthy the protection and encouragement it

receives. Bluebirds no longer nest on the Bryan farm, though a few pairs with their broods enter it during the summer to feed. But they were abundant there until ousted by the English sparrows, and nested all about the place. A characteristic nesting spot in an old stump on the front lawn of the house is shown in Pl. XVII, fig. 2. One of the most serious charges that can be brought against the English sparrow is the usurpation of the dooryard homes of these beautiful, gentle, and highly useful birds.

VIII.—SUMMARY.

The following conclusions are drawn solely with reference to the relationship of birds to the farmers at Marshall Hall; and while to a certain extent they indicate the general relationship of birds to agricultural interests, yet special conditions, of these particular farms as well as any others, sometimes have a modifying influence that must be taken into account.

At Marshall Hall the English sparrow, the sharpshinned and Cooper hawks, and the great horned owl are, as everywhere, inimical to the farmers' interests and should be killed at every opportunity. The sapsucker punctures orchard trees extensively and should be shot. The study of the crow is unfavorable in results so far as these particular farms are concerned, partly because of special conditions. Its work in removing carrion and destroying insects is serviceable, but it does so much damage to game, poultry, fruit, and grain that it more than counterbalances this good and should be reduced in numbers. The crow blackbird appears to be purely beneficial to these farms during the breeding season and feeds extensively on weed seed during migration, but at the latter time it is very injurious to grain. More detailed observations are necessary to determine its proper status at Marshall Hall.

The remaining species probably do more good than harm, and except under unusual conditions should receive encouragement by the owners of the farms. Certain species, such as flycatchers, swallows, and warblers, prey to some extent upon useful parasitic insects, but on the whole the habits of these insectivorous birds are productive of considerable good. Together with the vireos, cuckoos, and woodpeckers (exclusive of the sapsuckers), they are the most valuable conservators of foliage on the farms. The quail, meadowlark, orchard oriole, mockingbird, house wren, grasshopper sparrow, and chipping sparrow feed on insects of the cultivated fields, particularly during the breeding season, when the nestlings of practically all species eat enormous numbers of caterpillars and grasshoppers.

The most evident service is the wholesale destruction of weed seed. Even if birds were useful in no other way, their preservation would

still be desirable, since in destroying large quantities of weed seed they array themselves on the side of the Marshall Hall farmer against invaders that dispute with him, inch by inch, the possession of his fields. The most active weed destroyers are the quail, dove, cowbird, red-winged blackbird, meadowlark, and a dozen species of native sparrows. The utility of these species in destroying weed seed is probably at least as great wherever the birds may be found as investigation has shown it to be at Marshall Hall.

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