

times, coming from thickets like the first, but farther away from sloughs, though not from water, since these woods are full of pools of all sizes and depths.

The soil of the St. Francis basin is a light sand, several feet in depth, resting on a clayey subsoil. It is a peculiarity of the trees of this region, especially the sweet gum (*Liquidambar styraciflua*) to rot at the point where sand and clay touch. In this condition the tree is easily blown over, and in its fall the roots take up the surface soil, causing an excavation a few feet deep and several yards wide, a convenient receptacle for the water, a miniature pond with impermeable bottom. Such pools are scattered in countless numbers throughout the woods on the higher levels, while all depressions are naturally of a very swampy character.

In such woods the Water Thrush is not confined to the water courses as in other parts of Missouri, but is found in every part of the wood; so are the Prothonotary, the Parula, the Cerulean, and apparently also the Swainson Warblers. It is here that the Ovenbird, the Pipilo, the Blue-winged Yellow Warbler and the Catbird are restricted to the oases of high ground, while the Hooded and Kentucky Warblers, the Maryland Yellowthroat, and especially the White-eyed Vireo, are at home and abundant on high as well as on low ground, the two last named even in the slough itself.

From a week's tramp through the region I came to regard the Swainson Warbler as a regular, though not common, denizen of the swampy woods of Dunklin County, Missouri.

BIRD MIGRATION AT GRINNELL, IOWA.

BY LYND S JONES.

I. SPRING MIGRATION.

EVER since the inauguration of systematic study of bird migration by Prof. W. W. Cooke in 1884, it has been my purpose to collect sufficient data to determine the sequence of arrival of the various migratory birds at Grinnell, Iowa, where

my studies of the subject began and continued up to the summer of 1890. With my removal to Ohio in the fall of 1890, and consequent cessation of further study at Grinnell, the purpose to put into permanent and accessible form the results of that work has grown and finally taken definite shape in the present paper.

No one can realize more than I the insufficiency of the data collected for a final decision upon the points treated. But the conclusions logically reached from a study of these notes may furnish an impetus for further work in the same line.

From one to eight or even ten hours were spent in the field nearly every day from January until July, and from August until December. An early morning and a late afternoon hour were found to be the most fruitful. Very often this morning and evening work was supplemented by a midday hour, always with note-book and field-glass for ready use, and a gun for emergencies.

My work was chiefly confined to a region nine miles in diameter near Grinnell, Iowa, latitude $41^{\circ} 44'$. The center of this region lay at my home in a small natural grove three miles northwest from Grinnell, on the line between Poweshiek and Jasper counties.

This grove is of about one hundred acres extent, and is noted in all that region as a place where more species and individuals of birds can be found than anywhere in miles around. It covers five rather high hills which slope to the north and west, and is abruptly terminated on the north by a small stream which flows at the foot of these hills. It is bounded on the south by cultivated fields. The width is about one-half the length, the greater axis running east and west.

The grove abounds in sheltered nooks and tangled undergrowth, but has no swamp nor pool of still water. Oak, hickory, and black-walnut trees are the most numerous, with a fair supply of lindens, poplars, elms, hackberries, wild cherry, cottonwood, locusts and willows. Hawthorn, prickly ash, wild crabapple, wild plum and the black haw abound in thickets; while the hazel bush is the prevailing underbrush. Wild berry bushes are abundant. Wild grape, 'bitter sweet,' and Virginia creeper

vines are everywhere. Natural groves occur at intervals of four or five miles in the country at large.

This part of Iowa is in the rolling prairie region, the stream beds lying about seventy-five feet below the hilltops. The general direction of the principal streams is southward. Originally small ponds were to be found in the bottomlands, and a few on the upland divides; but these have disappeared in the vicinity of Grinnell, leaving no natural bodies of water. Within the limits of Grinnell there are three or four small ponds which are visited by large numbers of water-fowl and shore-birds every year. The flooded streams in spring also attract many.

Every farm has its orchards and shade trees, very few being without either osage orange or willow hedges both as street boundaries and inland field boundaries. Each has its pasture lot, hay lot, and cultivated fields. A few small patches of virgin soil still remain. 'Sloughs,' or bogs, are small and thickly overgrown with sedges and rushes. The once numerous and extensive 'cat-tail' bogs are nearly gone.

The percentages of all sorts of surfaces are as follows: Under actual cultivation, 35 per cent; pasture land, 20 per cent; hay land, 10 per cent; timber, including orchards, hedges and shade trees, 20 per cent; neglected fields, 5 per cent; bog land, 5 per cent; virgin soil, 5 per cent. With the addition of a small lake or large river with accompanying swamps, no better field could be desired for a study of the inland birds.

Grinnell lies upon a narrow water-shed in the central part of the State, which is the highest surface on its parallel in the State east of Des Moines. The direction of this water-shed is nearly north and south. The only apparent effect of such an elevated position is the somewhat later arrival of most species than at stations less elevated on the same parallel. It will be seen, however, that some species common in the less elevated localities are not so at Grinnell, elevation being the only physical feature not common to both. To the southward there is nothing to interfere with the continuous flight of the migrating host of birds.

It thus appears that the region is a very favorable one for many groups of birds, but less so for others. The scarcity of

timbered tracts of large extent is rather a boon than a detriment, because the woodland fauna is much more restricted and condensed than would otherwise be the case. Every copse of trees is swarming with the Warblers and Kinglets in their season. The broad fields are teeming with Sparrows, Larks and Bobolinks. Here is the paradise of the White-rumped Shrike among the osage orange hedges. Every farm has its colony of Bronzed Grackles. Cowbirds are so familiar that they cease to be interesting! Woodpeckers, Flycatchers and Wrens abound; and Swallows and Swifts and Nighthawks are constantly skimming the fields. The Whip-poor-will and the Thrushes find congenial retreats in the deeper woods; while the Robin and Bluebird are everywhere. At favorable times during the migrations, the air is alive with Ducks, Geese and Cranes passing northward in immense flocks; the Sandpipers being not less numerous for a brief period. Grebes, Rails and Herons are often seen; while flocks of Gulls, Comorants, and Pelicans, and even Swallow-tailed Kites, are sometimes noted; but they are not to be depended upon as regular migrants. Horned Larks, Grouse, Hawks, and Owls are permanent residents; as well as the Crow, Blue Jay, Chickadee, White-bellied Nuthatch, and some of the Woodpeckers.

In the accompanying charts, many species belonging to the bird fauna have been omitted because they would be of no value in the scheme. Of one hundred and seventy species recorded as strictly migratory at Grinnell, only one hundred and ten appear on the charts. The first year's work — 1885 — is also omitted because it has already been published in Prof. W. W. Cooke's 'Report on Bird Migration in the Mississippi Valley.'

In these charts an attempt has been made to indicate not only the dates of arrival and departure, so far as they come within the limits of the chart, but the time of arrival or departure, or both, of the bulk of each species. This is indicated by the heavier portion of the lines opposite the name of each species, the lighter portion indicating simply its presence. Some species are common on the first day of arrival; others are not so for days or weeks, while some never become common.

| SPRING MIGRATION AT GRINNELL, IOWA. | | | | | |
|-------------------------------------|----------------|----------------|----------------|----------------|----------------|
| | 1886 | 1887 | 1888 | 1889 | 1890 |
| | FEB. MAR. APR. | FEB. MAR. APR. | FEB. MAR. APR. | FEB. MAR. APR. | FEB. MAR. APR. |
| <i>Lanius borealis</i> | | | | | |
| <i>Amphisp. cedrorum</i> | | | | | |
| <i>Colaptes plicatus</i> | | | | | |
| <i>Spizella monticola</i> | | | | | |
| <i>Junco hyemalis</i> | | | | | |
| <i>Zenaidura macroura</i> | | | | | L. 5-19 |
| <i>Cathartes americana</i> | | | | | |
| <i>Anas boschas</i> | | L. 5-6 | | | L. 5-4 |
| <i>Branta canadensis</i> | | | | | |
| <i>Sitta sialis</i> | | | | | |
| <i>Myiama migratoria</i> | | | | | |
| <i>Quiscalus p. oregonus</i> | | | | | |
| <i>Scotophilagus carolinus</i> | | | | | |
| <i>Spizella magna</i> | | | | | |
| <i>Agelaius phoeniceus</i> | | | | | |
| <i>Anas carolinensis</i> | | | | | |
| <i>Lanius vociferans</i> | | | | | |
| <i>Molothrus ater</i> | | | | | |
| <i>Lanius excubitorides</i> | | | | | |
| <i>Pipilo erythrophthalmus</i> | | | | | |
| <i>Sagorinus phœbe</i> | | | | | |
| <i>Colaptes auratus</i> | | | | | |
| <i>Ammodramus s. ssp. arizonæ</i> | | | | | |
| <i>Taco spurius</i> | | | | | |
| <i>Accipiter cooperii</i> | | | | | |
| <i>Circus hudsonicus</i> | | | | | |
| <i>Calcarius lapponicus</i> | | | | | |
| <i>Anas mexicana</i> | | | | | |
| <i>Passerella iliaca</i> | | | | | |
| <i>Philoela minor</i> | | | | | |

| SPRING MIGRATION AT GRINNELL, IOWA. | | | | | | | | | | | | |
|-------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 1886 | | 1887 | | 1888 | | 1889 | | 1890 | | | |
| | MAR. | APR. | MAY. | MAR. | APR. | MAY. | MAR. | APR. | MAY. | MAR. | APR. | MAY. |
| <i>Melospiza fasciata</i> | | | | | | | | | | | | |
| <i>Spizella pusilla</i> | | | | | | | | | | | | |
| <i>Carduelis purpureus</i> | | | | | | | | | | | | |
| <i>Troglodytes hiemalis</i> | | | | | | | | | | | | |
| <i>Spinus pinus</i> | | | | | | | | | | | | |
| <i>Ceryle alcyon</i> | | | | | | | | | | | | |
| <i>Piranga sibilis</i> | | | | | | | | | | | | |
| <i>Regulus calendula</i> | | | | | | | | | | | | |
| <i>Satrapa</i> | | | | | | | | | | | | |
| <i>Spizella socialis</i> | | | | | | | | | | | | |
| <i>Sayornis nigricans</i> | | | | | | | | | | | | |
| <i>Melospiza palustris</i> | | | | | | | | | | | | |
| <i>Procoptes grammacus</i> | | | | | | | | | | | | |
| <i>Zonotrichia albicollis</i> | | | | | | | | | | | | |
| <i>Ammodramus heslowii</i> | | | | | | | | | | | | |
| <i>Troglodytes aedon</i> | | | | | | | | | | | | |
| <i>Chondestes grammacus</i> | | | | | | | | | | | | |
| <i>Dendroica coronata</i> | | | | | | | | | | | | |
| <i>Parotibicus rufus</i> | | | | | | | | | | | | |
| <i>Ammodramus vociferus</i> | | | | | | | | | | | | |
| <i>Tachycineta bicolor</i> | | | | | | | | | | | | |
| <i>Chondestes pelagica</i> | | | | | | | | | | | | |
| <i>Ammodramus passerinus</i> | | | | | | | | | | | | |
| <i>Polyptila caerulea</i> | | | | | | | | | | | | |
| <i>Petrochelidon lunifrons</i> | | | | | | | | | | | | |
| <i>Dendroica palmarum</i> | | | | | | | | | | | | |
| <i>Falco americanus</i> | | | | | | | | | | | | |
| <i>Chalidon erythrogaster</i> | | | | | | | | | | | | |
| <i>Compsopteryx americana</i> | | | | | | | | | | | | |
| <i>Actitis macularia</i> | | | | | | | | | | | | |

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| | SPRING MIGRATION AT GRINNELL, IOWA. | | | | |
|------------------------------------|-------------------------------------|---------------|---------------|---------------|---------------|
| | 1886 | 1887 | 1888 | 1889 | 1890 |
| | APR. MAY JUNE | APR. MAY JUNE | APR. MAY JUNE | APR. MAY JUNE | APR. MAY JUNE |
| <i>Vireo flaviventris</i> | | | | | |
| " <i>gilvus</i> | | | | | |
| <i>Turdus</i> <i>h. swainsonii</i> | | | | | |
| <i>Passerina cyanea</i> | | | | | |
| <i>Cislawharus s. bellii</i> | | | | | |
| <i>Sayurus motacilla</i> | | | | | |
| <i>Troglodytes a. pinus</i> | | | | | |
| <i>Vireo bellii</i> | | | | | |
| <i>Dendroica tigrina</i> | | | | | |
| <i>Sylvania pusilla</i> | | | | | |
| <i>Junco blackburnii</i> | | | | | |
| <i>Coccyzus erythrophthalmus</i> | | | | | |
| " <i>americanus</i> | | | | | |
| <i>Dendroica striata</i> | | | | | |
| <i>Chondestes virginianus</i> | | | | | |
| <i>Trochilus colubris</i> | | | | | |
| <i>Tinga mimasilla</i> | | | | | |
| <i>Parus carolinus</i> | | | | | |
| <i>Empidonax acadicus</i> | | | | | |
| " <i>tracillu</i> | | | | | |
| <i>Hylocichla ustulata</i> | | | | | |
| <i>Sialia mexicana</i> | | | | | |

When the line representing a species begins on the line separating two years, it indicates that the species was present all winter; and the end of such a line on a line separating two years, indicates that the species remains all summer. In a few cases a species not a summer resident remained longer than the last month indicated on the chart; its final departure is recorded in figures in the last space for the year, opposite its name.

The species are arranged on the chart in the order of their average arrival for the five years. If a species, as the Flicker in 1890, has been present all winter in very limited numbers in especially favored localities, account is taken only of the first migrating individuals, the dotted line indicating the presence of the few winter birds. When apparent irregularity is evidently due to the scarcity of the species, as in the case of Sparrow Hawk, its position is determined by the three earlier and more regular dates of arrival.

Bird movements are profoundly influenced by the weather. With the charts illustrating the bird movements before us, and a parallel running account of the weather, we shall be enabled to see the force of this influence.

During the five years from 1886 to 1890 inclusive, January opened very cold with more or less snow, and continued cold, with a few warm days, closing with below zero weather every year except 1890. This year a thaw began on the 27th of the month and ended February 7, after taking away ten inches of snow.

With the one exception of 1890, February also opened cold and snowy. In 1886 there was a warm period beginning on the 6th and closing on the 18th, followed by six cold days with north-west winds. The month closed very warm. In 1887 there was no warm period of any consequence during the whole of the month. But in 1888, after two weeks of continuous cold weather, there were three moderately warm days centering on the 13th, and another short period of warmth from the 22d to 24th, the month closing cold. In 1889 there was a slight thaw on the 21st, and another on the 28th, but the ground was bare during the last half of the month, with no severe weather. The remarkable warm period of 1890, ending February 7, has already been

mentioned. Besides another short warm period centering on the 14th, the month was cold.

Turning to the charts, no movement of any sort is seen until February, January not appearing on the charts for that reason. In February, 1886, there is a movement of three species northward about the 18th, at the close of the first extensive warm period. In 1887 no movement occurred, the month being cold throughout; 1888 shows a very decided movement of four species, about the 22d, during a warm period; 1889 shows two movements during its two warm periods; and 1890 two, the first one caused by the late January thaw, the other by the only other warm period.

In the same manner March movements may be correlated with March weather. In 1886 there were two decided movements, the first occupying the middle of the month, the other the 25th or thereabouts. The early part of the month was warm, followed on the 17th by a cold period, with a few days, centering on the 25th, of warm weather, closing cold. In 1887 the first movement of the year occurred on the first of the month, closely followed by a second movement, ending with a slight third movement. The first and second movements occurred during the same warm period, ending on the 12th; the last movement during the early part of a warm period late in the month. The early part of March was cold in 1888, and no movement occurred until the 15th, during a warm period of six days. Late in the month another warm period and another movement occurred. March opened warm in 1889, then became cold, and warm again on the 22d to the end of the month. At these times movements occurred. In 1890 there is the remarkable phenomenon of a whole month without any movement whatever after the first seven birds had arrived. But the last half of February and the first half of March were unusually and persistently cold. When the warm period did come, on March 15, the birds flocked in!

April is a variable month, without definite weather limits. From March, on the one hand, it receives warm or cold periods as the case may be, and on the other hand it merges into distinctively May weather. The birds properly belonging to it are

among the more hardy of the later arrivals, and are therefore not so greatly influenced by the comparatively moderate changes of weather. Hence, even during what must be called cold periods, many species move northward. During long warm periods there is no massing of species such as appears in March or May. But really severe weather is, of course, followed on the first warm days afterward by large numbers of belated birds moving northward.

Thus, in 1886, April weather was very mild until the 23d, when a cold period closed the month. The chart shows a very scattered movement without definite 'wave' boundaries. Even after the cold period had begun, several species were moving. April in 1887 shows a well marked 'wave' during the second week while the weather was warm. Then a rather scattered movement occurs during a cold period beginning on the 13th and ending on the 23d. The closing warm period extended into May, causing a great bird wave of thirty-six arrivals within eight days. April in 1888 shows greater irregularity. The month was a cold one, with the earlier and later days warmer. The earlier warmth had been felt in March and so lost its effect for April. The birds pushed forward in spite of the inclement weather, arriving in small and scattering groups. But with the later favoring warmth the host arrived, smaller than the preceding year, yet a respectable company of twenty-four. April's one warm wave in 1889, from the 14th to 21st, scarcely made a perceptible impression on the scattering migrants. The dates are scattering. In 1890 there were no marked changes of temperature. The weather was generally favorable to bird movements. The only well marked movement occurred about the 6th; other dates are very scattering.

To May belongs the one great movement of the year. April usurped a part of this in 1888, encroaching slightly in 1887. The weather varied considerably in the five years. May in 1886 opened warm, with a cold period from the 14th to 17th, the last two days being cold. May in 1887 opened with the first day warm, followed by five cold days, these followed by high temperature until the 17th, when three more cold days intervened. The month closed cold and wet. In 1888 the

6th and 7th were warm, and the 21st to the end of the month, the remaining time being cold. In 1889 the first half of May was warm, with the 15th, 20th and 29th cold. In 1890 only one cold period occurred,—about the 8th. Thus, in 1886, 1889 and 1890, when either the latter part of April was cold, or else there were no marked changes of temperature during late April and early May, the May movement occurred during the second week. While in 1887 and 1888 the very decided warm wave of late April caused a much earlier movement.

May has another movement which occurs during the second or third week. By that time the weather has become sufficiently settled so that bird movements are hardly affected by the changes which occur.

June is the month of final reckoning. No species arrive, but tardy ones leave for more northern nesting grounds. The weather is always warm and balmy.

This hasty survey of the weather with the migration movements, shows us that the more decided changes of temperature greatly influence bird movements; but the less decided changes do not greatly influence some species. This leads us to the consideration of such species as are not dependent upon the weather to any considerable extent. These arrive upon nearly the same date year after year. They are as follows :—

- March 19 (two days). Towhee, Cooper's Hawk, Cowbird, White-rumped Shrike.
- March 28 (two days). Field Sparrow, Purple Finch.
- April 5 (two days). Purple Martin, Ruby-crowned Kinglet, Chipping Sparrow, Belted Kingfisher.
- April 28 (two days). Oven-bird, Dickcissel, Kingbird, Palm Warbler, Wood Thrush.
- May 3 (two days). Chestnut-sided Warbler, Yellow Warbler, Rose-breasted Grosbeak, Red-eyed Vireo, Catbird, Orchard Oriole, Baltimore Oriole.
- May 19 (two days). Traill's Flycatcher, Black Tern.

In addition to these groups, which migrate at certain fixed times, and of course in company in a certain sense, there are similar groups which are more irregular with regard to fixed dates, but which move in company no less regularly. To these

no definite dates can be given. The first of these groups is made up of the Bluebird, Canada Goose, and Mallard. They form the first bird 'wave' of the season, sometimes accompanied by the next group which forms the second wave. The Robin, Bronzed and Rusty Grackles, Killdeer and Marsh Blackbird form the second group.

The first may be called the February group, the second the early March group. Following these is the group of March 19th already given, and another belonging to late March composed of Fox, Song, and Harris's Sparrows, and Phœbe.

April's first group has been given above (April 5). Three species, Swamp and Grass Sparrows and Bartram's Plover, belong to the middle of the month. The late April group belongs to the class of regulars.

The May movements become so condensed that a difference of a very few days in arrivals throw them into different groups, or out of all of them. Thus an early May group consisting of Redstart, Least Flycatcher and Nashville and Tennessee Warblers differs from the May 3 group. There is an earlier middle of May group and a later middle group besides the regular one of the 19th. The species belonging to the first of these are Warbling and Yellow-throated Vireos, and Indigo Bunting; those belonging to the later are Bell's Vireo, Crested Flycatcher and Yellow-billed and Black-billed Cuckoos.

Each year has a certain number of 'bird waves' that are well marked as such. The years 1886, 1888 and 1890 each had seven, and 1887 and 1889 six. But the time of their occurrence varies from year to year. The second wave of 1890 occurred fully two weeks earlier than the first one of 1887, and no later than the first of any other year. Fluctuations are due to the weather.

The number of species composing a wave also varies at different times during a season. The first wave rarely exceeds three species, while the late April or early May wave often reaches thirty moving species.

These waves are not necessarily formed by either of the foregoing groups, though they may sometimes be so formed; but they may consist of either or both combined with species too irregular

to be assigned to any group. Hence, a given species may be found in either one of two or more waves in successive years. The species which always migrate in company, but at irregular times in successive years, are more likely to be found in the same relative wave each year than any others. Phœbe came with the third wave each year except one. Meadowlark, assigned to no group, came with the first wave once, the second twice, and the third once.

The term "bird wave" has been freely used. What is a bird wave? In his excellent 'Report on Bird Migration in the Mississippi Valley,' on page 26, Prof. W. W. Cooke thus defines it:—

"(1) A 'bird wave' may be considered to consist of a very large number of individuals of one or many species, which suddenly invade a certain area. . . .

"(2) Certain species known to be migrating in company on a given day may be considered to constitute a 'wave.'"

Hence, a 'bird wave' consists of not only the species *arriving* at a certain time, but also all which are found to be increasing or decreasing in numbers, or departing northward. All of these movements are represented on the charts. There are other movements of scarcely less importance in the migrations which cannot be so represented. Such are the movements of individual birds of resident, winter visitor, transient and summer resident species, without any apparent increase or decrease of the numbers in a given locality. It is evident that such belong to the 'bird wave,' even though the charts take no account of them. Hence, a bird wave is often, if not always, much larger than can be shown by any graphical representation. This unrepresented movement has been of great service in determining the bird waves of apparently small extent. In the larger movements its value is less evident, but it has a no less active part.

Taking all sorts of movements together, there are two periods of maximum bird activity during the migrations. The first one occurs during the middle of March, when the first really spring warmth sweeps over the country. The second occurs during the first half of May. This one is finely shown on the charts. During this period there is a massing of species which is almost bewil-

dering. The species which arrive during this time are among the most common of the bird fauna, and are represented by large numbers of individuals.

It is interesting to note the average number of moving species for each month during the five years. Of those which first arrived there were four in February, seventeen in March, thirty in April, forty-one in May, and none in June. Of those which arrived the previous month and became common, or those which decreased in numbers but did not finally depart until the following month or later, there were none in February, five in March, five in April, four in May, and none in June. Of those which departed to more northern breeding grounds, there were none in February, two in March, ten in April, eighteen in May, and two in June.

Adding these three sets together, the total number of moving species by months is for February four, March twenty-four, April forty-five, May sixty-three, June two. Of the whole average movement there is for February 2.8 per cent, March 17.3 per cent, April 33.4 per cent, May 45 per cent, June 1.5 per cent. Deducting from April the late April arrivals of 1887 and 1888 which properly belong to May, and adding them to May, there is left for April 27.6 per cent, and for May 50.8 per cent. Half of the whole spring movement occurs in May! These percentages are based only upon species. If individuals were taken into account the percentage for May would be much higher. When we remember that nearly all of the species which arrive in May have come before the beginning of the third week, some conception can be formed of the magnitude of the 'early May wave.'

March, April, and May are the months of bird migration. February cannot be wholly counted out, but June records might almost be considered accidental. March species are larger, stronger and hardier, April species transitional, and May species smaller, weaker and more delicate, but more numerous.

The irregularity in the arrival of individuals of the same species is one of the first notable things about the migrations. Males and females do not travel together. My notes upon the movements of the sexes, and upon the arrivals of old and young males are pretty full, covering fully five years. Notes on the

movements of young females, as distinguished from old females, are too few to be of value.

From these notes it appears that the length of time between the arrival of the first males and first females differs at different times during the season, weather playing an important part. It is longer early and shorter late. Speaking generally, the first females arrived a little later than did the bulk of the males. In March this is from a week to three weeks; in April a little over a week, and in May about five days. There is a gradation from the longer period into the shorter, of course. It is generally believed that young birds migrate later than old ones. I have no general notes bearing upon the subject; but a great deal of careful study, in this line, was given to certain species, the young males of which were more readily distinguished from the old males and females. Prominent among these were Rose-breasted Grosbeak, Scarlet Tanager, Ruby-crowned Kinglet, Wilson's Warbler and the Orioles. In the case of these species, the old males arrived first, followed in about four days by the young males; the females arriving a little later still. All of these belong to the later arrivals.

I am not prepared to say that the young males of other species migrate at relatively the same time. The few notes which I have bearing upon the subject would seem to indicate that they do, at least among the smaller birds which arrive in late March, April and May. That subject will bear much more investigation.

There were two notable exceptions to this sequence of arrival of old males, young males, and females. One was in May, 1889, when the last great wave was checked by the cold weather of late April. The other in March, 1890, when a month intervened between the second and third waves. At these times not only most of the summer residents, but also many of the transient species arrived mated. Not all individuals, but very many of them. We would expect mating to begin as soon as the females appeared among the host, wherever it might be upon the northward journey, just as it does under normal conditions. In these two instances the weather northward must have been such that the males could not move forward; but southward, favorable to the movement of the females already begun. This state of

weather continued long enough would bring the later migrants up with the earlier ones, and bring about the state of affairs above mentioned.

There are recorded in my notes several instances of birds arriving mated. But these are isolated cases of individual pairs. They do not affect the main question. All exceptions must be considered rare, when the whole bird population is taken into account.

Most birds arrive singing. The first intimation we have of approaching spring is the true song of the Prairie Horned Lark, the 'booming' of the Prairie Chickens and the weird voices of the Owls. The warm days of January are their first signals for heralding spring. Some birds are not singing when they appear. A notable example is Dickcissel. When my studies of the migrations began, I did not know the first individuals of this bird which came in the spring. It was not until Mr. Otto Widmann, now of Old Orchard, Mo., then Superintendent of Migration in the Mississippi Valley, told me that the actions of the first arrivals were very different from what I was accustomed to later in the season, and that the queer chirping note really belonged to Dickcissel, that I realized that a bird could arrive silent. Henslow's Sparrow is another silent arrival, beginning its song only when the females arrive. I have many times failed to hear song notes from several of the transient Warblers during their entire stay. There are many other examples.

Nothing has been said about the night migrations. Not a little attention has been given to that phase of the subject, but my notes are not of a character to warrant any discussion of it at this time. More study of the night migrations here in Ohio will enable me to make far more than is now possible of those taken in Iowa, just as the years of study of the diurnal migrations in Ohio have thrown light upon Iowa notes. Conditions are different here at Oberlin, with the lake so near northward. Without the comparisons which this region affords, and the broadening of the field of view which it gives, the subject seemed almost unworthy of consideration at such length. I hope sometime to draw a number of interesting comparisons between the movements at Grinnell, Iowa, and at Oberlin, Ohio.

It must be distinctly understood that all of the foregoing facts, as well as those which are to follow on 'Fall Migration,' are local, relating only to the vicinity of Grinnell, Iowa. Everything given has been taken from notes which were made in the field, weather excepted. The effect of weather could have been more clearly shown from weather records extending over the whole Mississippi Valley; but these were not accessible.

BIRDS OF SAN FERNANDO, LOWER CALIFORNIA.

BY A. W. ANTHONY.

THE region embraced within the limits of the present paper has for its center the old abandoned copper mines of San Fernando, one league south of the ex-mission of the same name which is situated about twenty-five miles from the Pacific coast of the peninsula, in about latitude $29^{\circ} 30'$. It has an approximate altitude of fifteen hundred feet above sea level and is the center of one of the most barren of the Lower Californian deserts. At the old San Fernando mission is found a little marshy ground and a few pools of salty, alkaline water that is so disgusting that even mules from more favored lands to the north refuse to drink it until forced to do so by continued thirst. There is enough, however, to nourish a very respectable growth of mesquite, cat-claw and palo verde which extends down the narrow valley for a mile or more below the old ruins of the mission. The mining camp is separated from this, the only water and verdure for forty-five miles, by a low rocky range of hills about three miles in extent. The mines are on the edge of a somewhat open country, which extends to the coast at San Carlos in a series of mesas and level valleys. At the mines, and in two of the arroyos between that point and the coast, wells had been dug and a limited quantity of water obtained at about eight feet in depth. The only natural surface water other than that at the mission was a small tank