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THE DICKCISSEL (SPIZA AMERICANA) OF THE ILLINOIS PRAIRIES.

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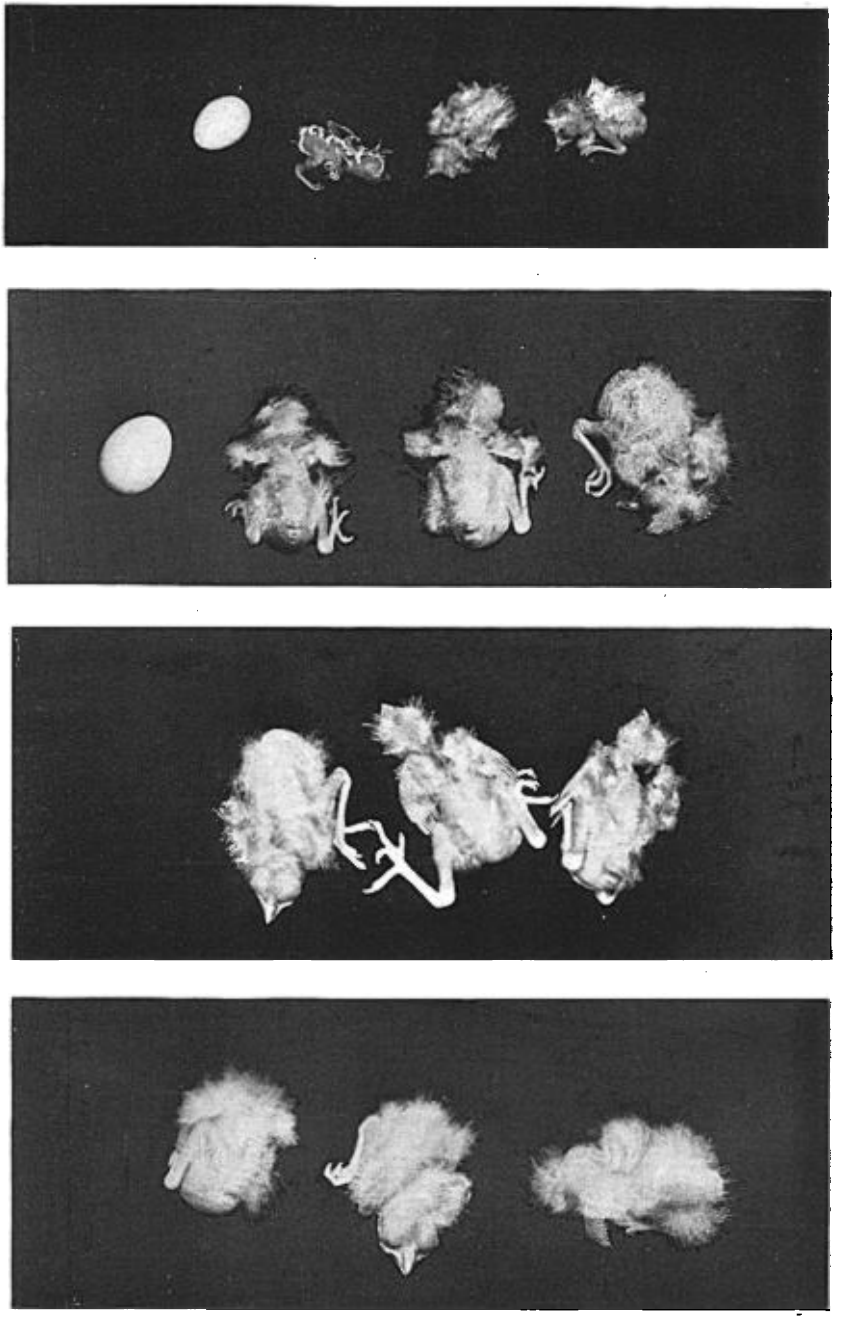
Plates V–XIII.

(*Concluded from p. 26*)

VIII. FOOD.

THE following account of the food of the Dickcissel is based upon an examination of the contents of the stomachs and crops of birds collected near Atwood, Illinois, and upon observations made in the field during the nesting season. The author is indebted to Mr. E. R. Kalmbach of the U. S. Biological Survey and to Mr. A. N. Caudell of the U. S. Bureau of Entomology for the identification of the crop and stomach contents of 19 of the 33 birds obtained. The stomachs were taken from birds collected chiefly in August, a season of the year when insects and seeds form the most important part of the food of the Dickcissel.

The stomachs and crops contained vegetable matter to the amount of 68 per cent, the animal food constituting only 32 per cent of the entire contents. Examinations by the U. S. Biological Survey show that 44 of 250 stomachs collected during May to August, chiefly in Kansas but some from Minnesota, Wisconsin, and Texas, contained 70 per cent animal and only 30 per cent



A BROOD OF YOUNG DICKCISSELS.

(*a*). Sterile Egg; One Young a Few Hours Old; Two Young One Day Old.
(*b*). One and Two Days Old.
(*c*). Three and Four Days Old.
(*d*). Another Brood Two Days Old with Natal Down at its Best.

vegetable matter, a ratio almost the reverse of that shown by my birds. The stomachs from Illinois, excepting four specimens, were taken from young birds of the year. This fact may be correlated with the larger amount of vegetable matter in the stomachs, as young inexperienced birds are not so adept as their parents in finding or in capturing insects. It is natural to expect such birds to depend on food which is more abundant and more easily obtained than live animal matter. Seeds, the chief and practically only vegetable matter eaten, were present everywhere in limitless quantities during August, the time at which the birds were collected.

About 53 per cent of the vegetable matter or 36 per cent of the entire contents of the stomachs was made up of seeds of weeds that are of no value to man, many of which, indeed, are a nuisance to agriculture.

There were nine species of weeds represented of which two species of *Chaetochloa glauca* and *C. viridis* made up 33 per cent of the entire contents of the stomachs. *Syntherisma sanginuale* was represented by 1.6 per cent, three species of *Polygonum* (*convolvulus, persicaria* and *aviculare*) 0.6 per cent, while seeds of *Stellaria media* and sedge grass were present in small numbers.

Unfortunately, for the good reputation of the Dickcissel, the grain amounted to 32 per cent of the entire contents; this quantity being divided between wheat (6.5 per cent) and oats (25.5 per cent). No grain was found in the stomachs of adult birds.

The animal matter consists of insects with traces of spiders and phalangids. The large number of Orthoptera found in the stomachs (28 per cent) and the fact that at least traces of grasshoppers were found in all stomachs except one maintain the reputation the Dickcissel holds as a destroyer of these insects. The Orthoptera found all belong to two families: the Acrididae, which comprised 26 per cent, and the Locustidae, which were present in the amount of only 2 per cent of the entire contents. Species of *Melanopus* were the commonest grasshoppers found in the stomachs. A cricket, *Nemobius fasciatus*, was taken from the beak of an adult bird.

The Lepidoptera, chiefly caterpillars, amounted to 3 per cent, the Coleoptera, though represented by traces of eight or more

species, were in amounts (0.2 per cent) too small to be of great importance. There were traces of two flies, two species of ants and an Ichneumon fly, all in small quantities.

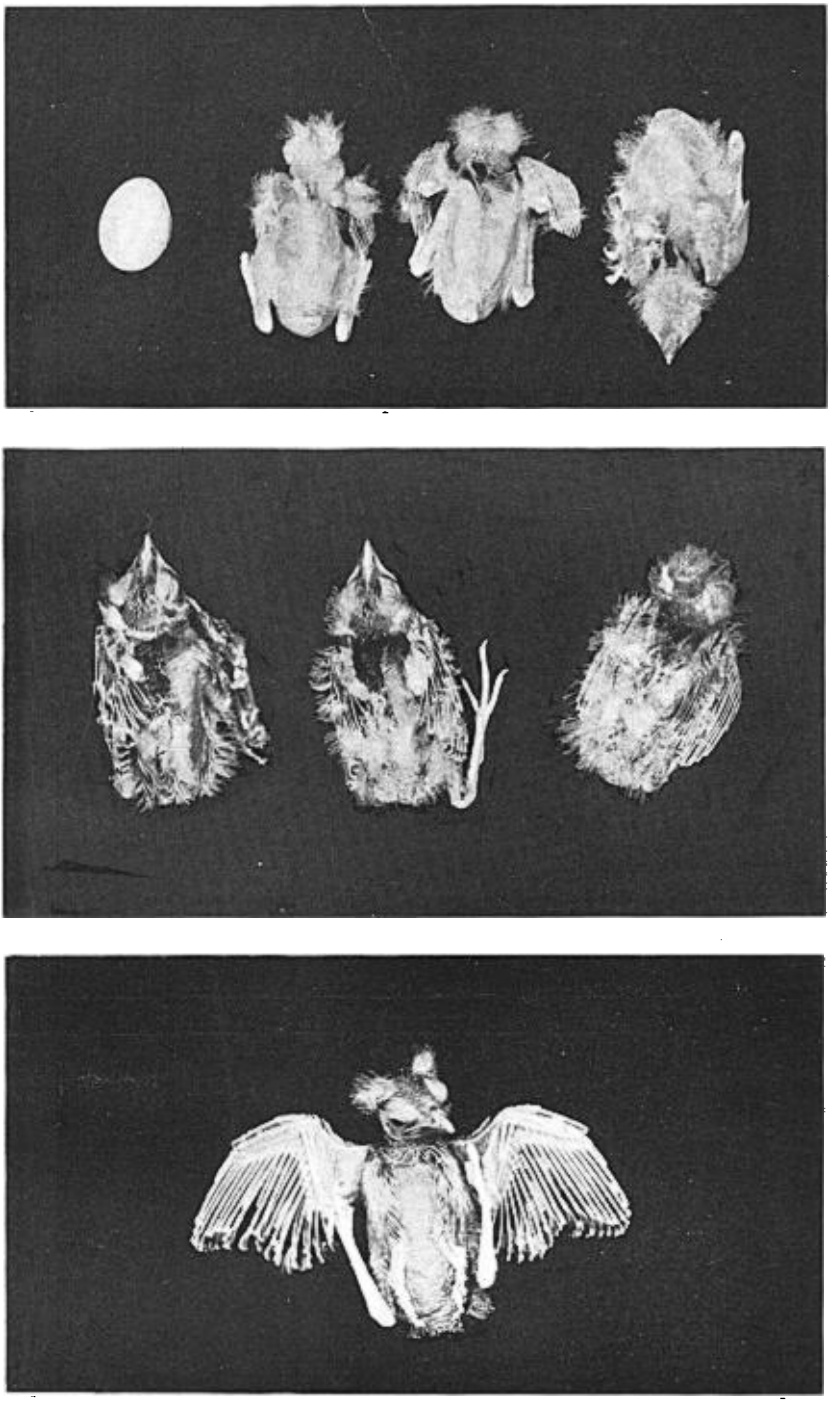
The results of the examination of the stomach contents are clearly in favor of the Dickcissel. It is true that 32 per cent of the food examined was grain, but this is counterbalanced by the 36 per cent of weed seeds. In addition, there stands in the credit column of the Dickcissel 32 per cent of insects, mostly the destructive grasshoppers. In regard to the grain, it is important to note that the stomachs were taken at a time when the oats and wheat had been removed from the fields for threshing. It is probable the grain eaten represents a waste product. But more might have been eaten if examination had been made before harvesting. The small amount of grain which I have seen Dickcissels eat in the field before harvest time was taken from heads or panicles which were lying on the ground, a product which cannot be gathered by the binder and therefore is classed as waste.

The results obtained from the examination of the stomach contents give us much that is interesting regarding the food of the Dickcissel, but they are not all the evidence in the case of the Dickcissel versus man. The daily observations made at the nests when the young were being fed deserve an equal amount of consideration. It is not until we consider the feeding habits during the nesting season that the Dickcissel receives the full credit it deserves as a destroyer of insects, especially grasshoppers.

The first food delivered to the newly hatched Dickcissels were small green Lepidopterous larvae; sometimes soft-bodied, winged insects were the first bits of food to be received by the young. Though scores of these larvae and insects were delivered by the adult birds there were very few present in the stomach contents of the adult birds examined. One female made regular trips every few minutes to an elm tree from which she was obtaining bright green caterpillars two to three centimeters in length the species of which I was unable to determine. It is probable that these caterpillars constituted as much as 90 per cent of the food of the young birds during the first two days of their existence. When under observation the female made an average of ten trips an hour which means, if this average was maintained, that these

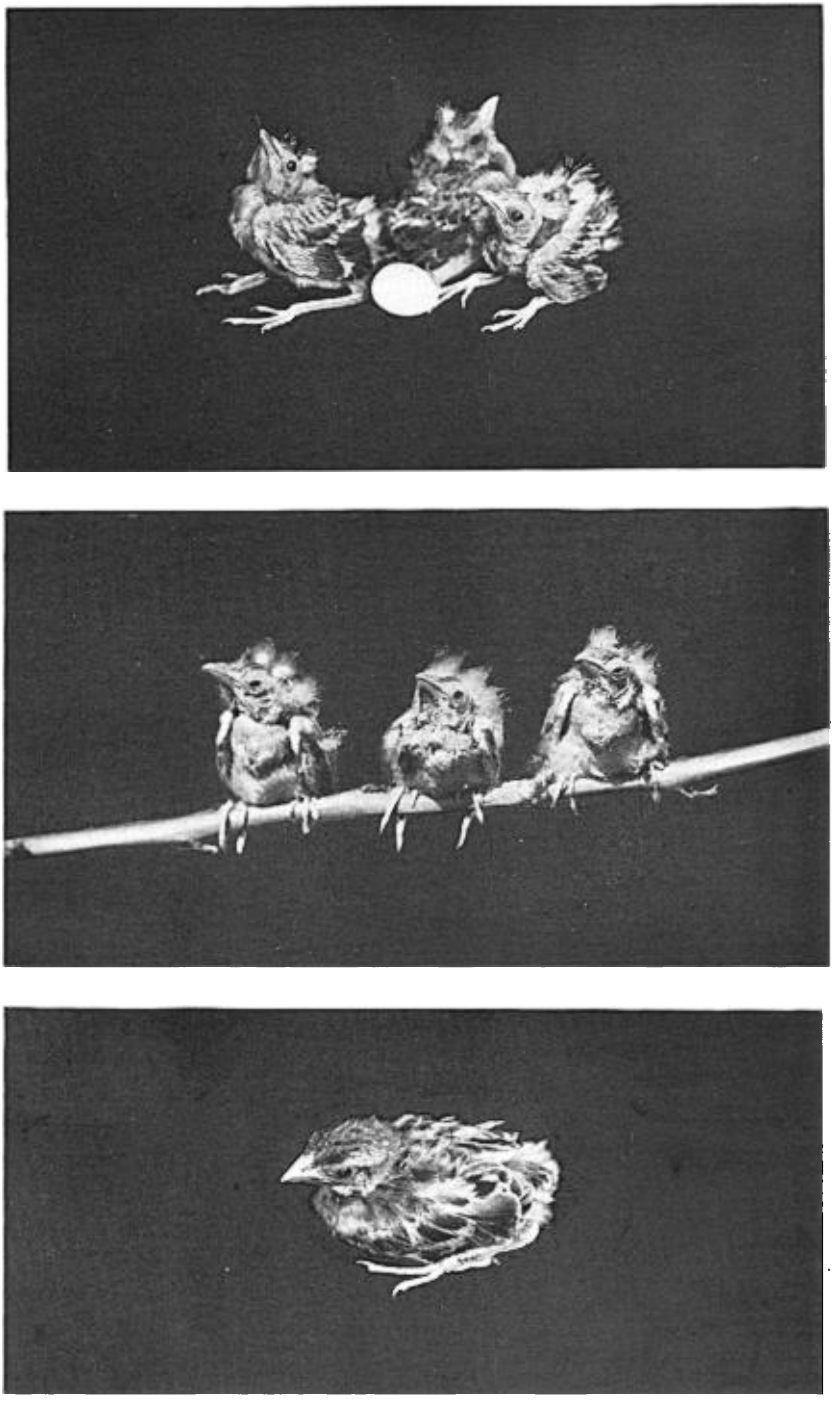
nestlings were indirectly responsible for the destruction of more than one hundred larvae during a single day. On the third and fourth days other insects were added to the diet of the young. There were a number of aphids, a few winged insects which could not be identified, and a considerable number of small grasshopper nymphs. With this addition of other insects there was, of course a correspondingly smaller number of caterpillars eaten.

From the fifth day until the young left the nest four days later, the food was practically all grasshopper nymphs and adults. These grasshoppers were taken from a nearby clover field which was being overrun by them. Many of the clover stems were, stripped of their leaves by the ravages of these insects. During the last days spent by the young in the nest, grasshoppers were delivered at the rate of one every three or four minutes. A conservative estimate shows that about two hundred grasshoppers were eaten each day by the two adult birds and their four young. If each Dickcissel family in Illinois averaged as well as did these birds, then the more than a million Dickcissels destroyed about 100,000,000 grasshoppers in a single day during this period of the nesting season. If each grasshopper according to an estimate made by Professor Lawrence Bruner, entomologist of the Nebraska Experiment Station, eats about one and a half times its own weight or about .05 ounces of grass per day, then a hundred million grasshoppers destroy about 156 tons. The price of hay during the summer of 1918 was about thirty dollars per ton. Hence the Dickcissels of Illinois during the active period of the nesting season save the state about $4,680.00 daily by the destruction of grasshoppers alone. These figures have a meaning which no one can fail to understand. Though the great value of these birds may not be fully known to the average farmer, the Dickcissel, nevertheless, is a favorite with many of them. No farmer wantonly destroys these birds nor does he willingly permit anyone else to do so. With such a strong popular sentiment already in their favor the Dickcissels are destined to continue their great increase in numbers.



A Brood of Young Dickcissels.

(*a*). Sterile Egg; Young Four and Five Days Old.
(*b*). Six and Seven Days Old.
(*c*). Six Days Old.



A BROOD OF YOUNG DICKCISSELS.

(*a*). Seven and Eight Days Old.
(*b*). Eight and Nine Days Old.
(*c*). Ten Days Old.

IX. LIFE HISTORY.

A.—The Nest.

In Central Illinois the first nests of the Dickcissel may be found during the last week of May, soon after the bulk of the individuals have arrived at their summer haunts. The author's earliest record is of a nest found May 22, 1899, in a meadow of clover and timothy near Atwood, Illinois. The earliest nest reported by Mr. I. E. Hess at Philo, Illinois, is one with five eggs, found May 31, 1896. Mr. T. E. Musselman, of Quincy, Illinois, found a nest and four eggs near a putting green on the Quincy Golf links as early as May 21, 1918. Though nests are not uncommon in May, the Dickcissel does not reach the height of its nesting season until June and July. At this time practically every meadow in central Illinois has several pairs of these interesting birds. The latest record reported by Mr. Hess is that of a nest with four eggs found August 1, 1898, near Philo. On August 12, 1918, the author found a nest with four eggs in a clover field near Atwood; this is the latest record I have of a nest containing eggs. (Plate I, Fig. *b*.)

The usual and most typical location for the nest of the Dickcissel in Central Illinois is in a thick growth of grass or other low dense vegetation. The nest, if not placed where there is a natural depression of the earth, is supported but a few inches above the ground. It is usually so well hidden by the rank growth of clover, grass or weeds that great effort is often required to locate it. Meadows provide the larger number of nesting sites, but the Dickcissel is by no means confined to them, for it sometimes selects a very different place which may be remote from clover and grass fields. The following list of situations containing nests of the Dickcissel, which came under my direct observation, reveals the diversity in choice which may be exhibited by different individuals.

As the table shows the largest number of nests were found in the meadows or in places containing vegetation approaching that present in the clover or grass fields. About an eighth of the nests observed were in situations radically different from that ordinarily found in the meadows. Of these ten nests, all except

two were found late in the season and probably represented a second attempt at nesting, after the mowers and reapers had exacted their toll of nests from the meadows and grain fields. One of the nests found in a thorn bush early in the season was undoubtedly so placed because of the wet, swampy condition of the ground at that time of year. The nests located in shrubs and trees were at various heights ranging from about two feet to a little more than six feet from the ground, the highest having been found in a tall hedge. Though nests are sometimes placed at considerable distances from the ground, these do not represent a typical or usual situation for the Dickcissel.

TABLE XI.

LOCATIONS OF DICKCISSEL NESTS.

Classification of situations	number of nests (containing eggs or young) found	
A. Meadows or situations resembling meadows.		
1. Meadows		
Clover	28	
Timothy and other grasses	17	
Alfalfa	5	
2. Weeds and grass along fences or between cultivated fields	8	
3. Wheat and clover	2	
4. Weeds and grass along roadsides	2	
5. Wild roses or vines growing among grass and weeds	6	
Total		68
B. Situations radically different from conditions found in meadows.		
1. Hedge fences (osage orange)	5	
2. Scrub apple tree	2	
3. Thorn bush	2	
4. Small crabapple tree	1	
Total		10
Grand Total		78

The nests are somewhat crude in general appearance, but, nevertheless, are substantial structures (Plates I and IV). There is little variation in size or shape, the average measurements of ten typical nests being as follows—outside diameter 12.2 cm., inside diameter 6 cm. by 6.8 cm., outside depth 6.3 cm., inside depth 4.6 cm. The materials used seem to be those which are near at hand and, as a consequence, the composition varies according to the building material available in the immediate surroundings. Though the nests are firm and well made, those built above ground are often so insecurely attached to their support that the least disturbance may dislodge them. Two nests which were under daily observation had to be firmly tied to the vines in which they were built in order to prevent an untimely ending of the young birds.

One nest was found in the process of construction. In this case the female gathered all of the materials and performed all the work of constructing and shaping the nest. All that the male contributed was his song, which perhaps served as a source of encouragement to his mate. The nest was completed in four days and two days later the first egg was laid.

B.—The Eggs.

The eggs of the Dickcissel are pale blue, similar to those of the Bluebird (*Sialia s. sialis* (Linn.)). The average measurements and weight of twenty eggs are as follows:

Average long diameter	2.13 cm.
Average short diameter	1.61 cm.
Average weight	2.76 grams.

The number of eggs in a set varies from three to five, but four is the usual number. Out of twenty-nine nests containing eggs, five had three eggs, eighteen had four and six had five eggs each. Three of the five nests containing only three eggs were under daily observation and no more eggs were added but one or more eggs may have been destroyed before observations were begun.

A large number of sterile eggs were found during the course of these studies. Six out of eleven nests, studied during the summer of 1918, contained one or more sterile eggs. In each of four of

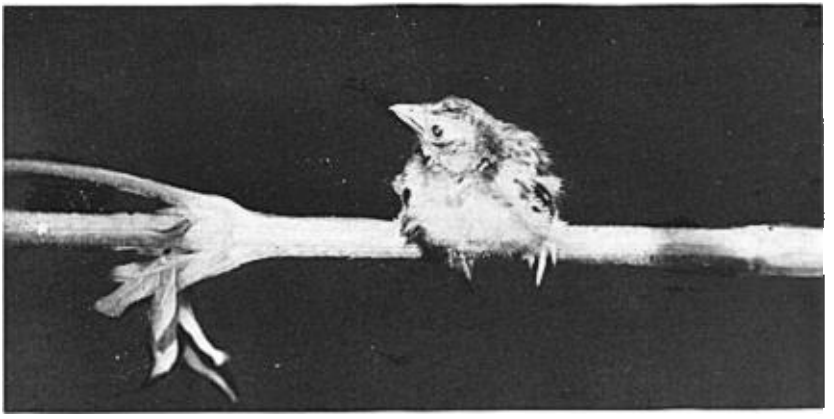
the six nests there was one sterile egg, in another there were two and in the sixth only one egg out of the five proved to be fertile. It was thought possible that the eggs had been chilled or that the embryo had been otherwise killed, but an examination of the contents of the unhatched eggs proved that development had never been initiated or at least had not proceeded to an appreciable degree.

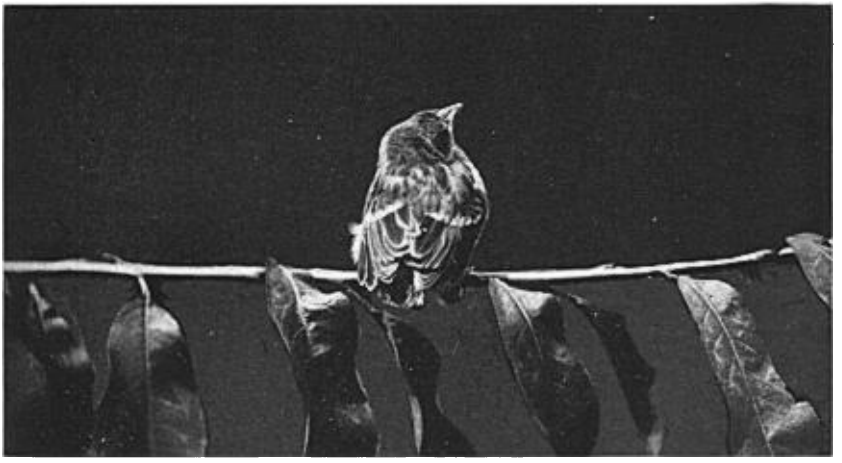
Unfortunately, the exact time required for incubation was not ascertained, since the only nests in which the dates of the laying of the eggs were known were destroyed by some animal, presumably a skunk. One of the eggs of a nest containing three apparently freshly laid eggs which was first seen July 1, hatched during the morning of July 11. Consequently, at least ten to eleven days, and possibly more, are required for incubation. When the embryo is fully developed and ready to emerge the egg shell and membranes break around the entire circumference midway between the blunt and more pointed ends. The break seems to be made by the exertions of the struggling embryo to straighten its neck and to extend its legs in an effort to free itself. After the egg is cracked (Plate IV, fig. a), it is a matter of only a few minutes before the young entirely frees itself. A freshly hatched Dickcissel is anything but a handsome creature (Plate V, fig. a). At this time it is naked except for the patches of natal down, which, when wet and matted, are practically negligible as a covering.

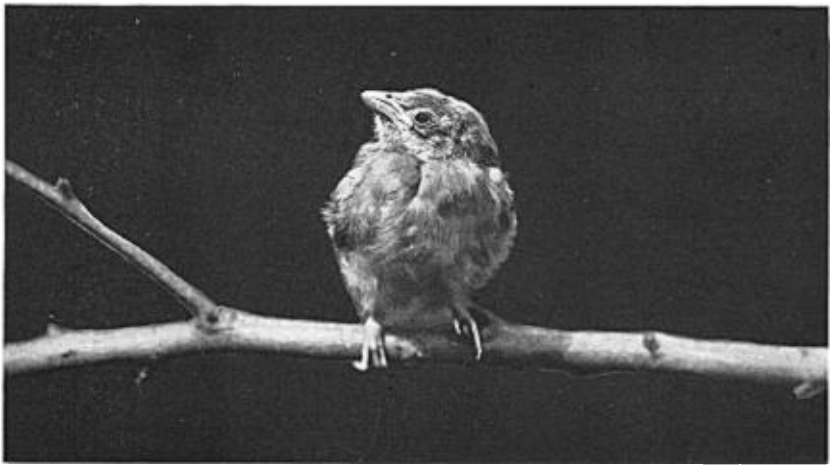
C.—Natal Plumage.

The natal plumage, or down, of the Dickcissel when dry is pure white, there being no traces of the brown or gray tinges so commonly seen in the down of other passerine birds.

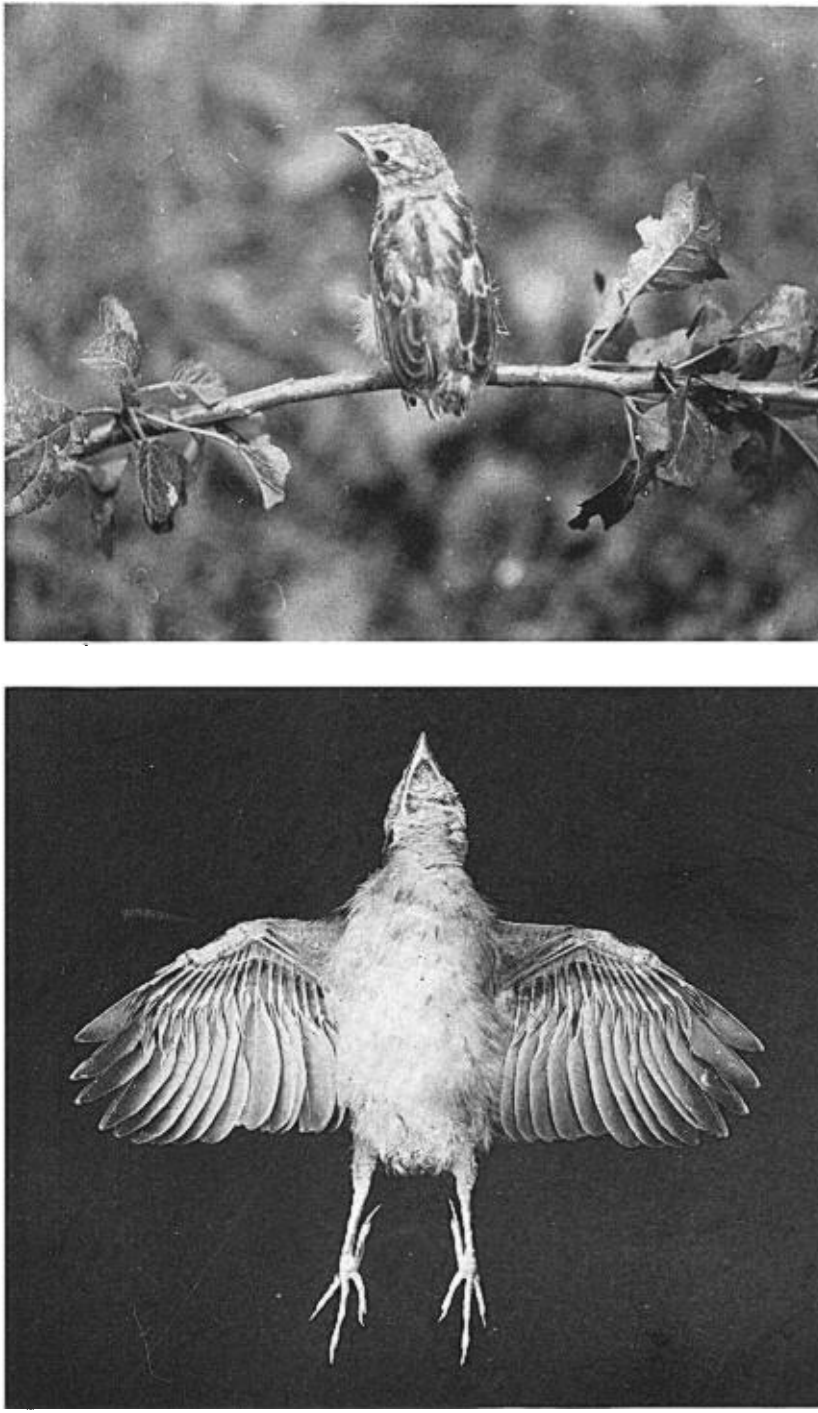
There are twelve distinct tracts or areas of down found on the upper surface of the bird as follows,—three small areas located on the dorsal-posterior part of the head, 1 median, 2 lateral, which collectively may be known as a head tract; one tract on each scapular region; two smaller tracts on the dorsal side of each wing; one elongated tract in the mid-dorsal line and one shorter tract on each side running parallel to the mid-dorsal tract. There is no down on the ventral aspect of the body, the entire underparts being naked until the juvenal plumage appears.







YOUNG DICKCISSEL FROM SAME BROOD.
(*a*) and (*b*). Eleven Days Old.
(*c*). Twelve Days Old.



YOUNG DICKCISSEL FROM SAME BROOD.
Fourteen Days Old. (Six Days after Leaving the Nest.) Juvenal Plumage.

The natal down is retained throughout the period the young remain in the nest; sometimes parts of it persist after the young have left the nest for several days, as filaments at the apices of the feathers of the juvenal plumage. The postnatal moult is usually completed at about the ninth to the twelfth day after hatching, or one to three days after the young leave the nest. (Plate VII, fig. c.)

D.—Juvenal Plumage

The first feather papillae of the juvenal plumage to appear are those of the primaries and secondaries (alar or wing tract), which protrude through the epidermis of the wing on the second day after hatching (Plate V, fig. c). All the other tracts both dorsal and ventral are well defined by protruding papillae at the end of the fourth day (Plate VI, fig. a). Those of the head tract and caudal or tail tract are the last to appear.

The growth of the feather papillae is extremely rapid and by the end of the sixth day those of the alar tract begin to unsheath at the outer tips (Plate VI, figs. b and c.). The unsheathing of the feathers now progresses very rapidly and by the end of the tenth day the exposed tips of nearly all the contour feathers are unsheathed (Plate VII, fig. c.). The time of appearance and the rate of growth of the feathers of the various tracts are shown in Table XII.

The table of measurements is one of a series of tables made for each of eighteen fledgelings representing five different broods. This table was selected because it is typical of the series and is more complete than the others for the period following the time after the young had left the nest. The fledgeling from which the measurements were taken left the nest eight days after hatching, but was found on each of the six succeeding days, thus enabling me to make, as far as I know, the most complete series of measurements on record of a wild passerine bird living in nature under normal conditions. This Dickcissel, having been seen and handled so many times, became an intimate friend, and it was a cause of no little regret to the author that it failed to appear after the measurements and pictures were taken on August 1, 1918. The measurements of a bird eighteen days old, also given in the

TABLE XII.

WEIGHTS IN GRAMS AND MEASUREMENTS IN CENTIMETERS OF DICKCISSEL NESTLING NO. 1 FROM THE DAY IT HATCHED UNTIL IT WAS FOURTEEN DAYS OLD. THIS BIRD IS SHOWN IN THE REPRODUCTIONS GIVEN IN PLATES V TO IX INCLUSIVE. THE BIRD EIGHTEEN DAYS OLD (PLATE X) IS FROM ANOTHER BROOD.

	Time spent in the nest								Out of the nest						
Days old	1	2	3	4	5	6	7	8	9	10	11	12	13	14	18
Bill	.38	.65	.80	.85	.90	.93	.98	1.0	1.04	1.12	1.12	1.14	1.15	1.15	1.25
Wing	.8	1.2	1.6	2.3	3.0	3.6	3.7	4.2	4.4	4.7	4.9	5.2	5.8	6.0	6.7
Length	3.8	4.6	5.3	6.2	6.7	7.3	7.5	7.6	8.0	8.4	8.9	9.2	10.0	10.5	13.3
Tail	–	–	–	.01	.06	.25	.35	.40	.45	.50	.60	.95	1.3	1.5	3.8
Extent	3.4	4.9	6.1	9.5	11.6	14.4	16.1	17.0	17.4	18.5	19.6	20.4	21.0	21.8	22.8
Tarsus with middle toe	1.6	2.0	2.7	3.5	3.8	4.0	4.2	4.4	4.5	4.5	4.5	4.5	4.6	4.6	4.6
3rd or front middle toenail	.15	.20	.29	.30	.40	.42	.43	.44	.46	.48	.50	.50	.50	.50	.52
1st or hind toenail	.19	.28	.35	.48	.50	.52	.55	.56	.59	.62	.65	.68	.68	.68	.70
6th Primary	–	–	.2	.29	1.5	2.2	2.4	2.5	2.7	3.0	3.5	3.7	4.2	4.4	4.8
2nd Secondary	–	–	.3	.8	1.3	1.8	2.2	2.3	2.3	2.7	3.0	3.3	3.7	3.8	4.4
Papillae or feathers of ventral tract	–	–	–	.24	.32	.40	.55	.76	.95	1.00	1.12	1.22	1.25	1.25	1.50
Of dorsal tract	–	–	–	.20	.34	.48	.70	1.18	1.39	1.48	1.52	1.57	1.60	1.65	1.70
Of head tract	–	–	–	.05	.09	.12	.28	.55	.60	.60	.61	.61	.62	.63	.68
Weight in grams	2.8	4.7	7.2	10.3	11.7	13.0	15.7	18.0	18.5	18.8	19.1	20.3	21.9	22.5	26.6

above table were made from a marked young of another brood in which the complete history was known up to the ninth day, the time it left the nest. The measurements of this eighteen-day-old bird up to the ninth day are similar in all essentials to those shown in Plates V–IX made at the corresponding ages.

Table XIII, compiled from the measurements given in Table XII, is helpful in comparing the average growth per day of the young made during different periods of time.

TABLE XIII.

AVERAGE GROWTH PER DAY OF YOUNG DICKCISSEL IN CENTIMETERS AND GRAMS.

	Average growth per day for 1st 8 days (In nest).	Average growth per day from 8th to 18th day (out of nest).	Average growth per day for 18 days.
Bill	.077 cm.	.025 cm.	.048 cm.
Wing	.425	.250	.328
Length	.475	.570	.528
Tail	.078	.335	.247
Extent	1.700	.580	1.080
Tarsus with middle toe	.350	.010	.167
Third or front middle toe-nail	.035	.008	.020
First or hind middle toe-nail	.046	.011	.028
Sixth primary	.383	.230	.290
Second secondary	.333	.110	.259
Papillae or feathers of the ventral tract	.104	.055	.084
Papillae or feathers of the dorsal tract	.196	.031	.100
Papillae or feathers of the head tract	.100	.013	.042
Weight	1.900 gms.	.810 gms.	1.322 gms.

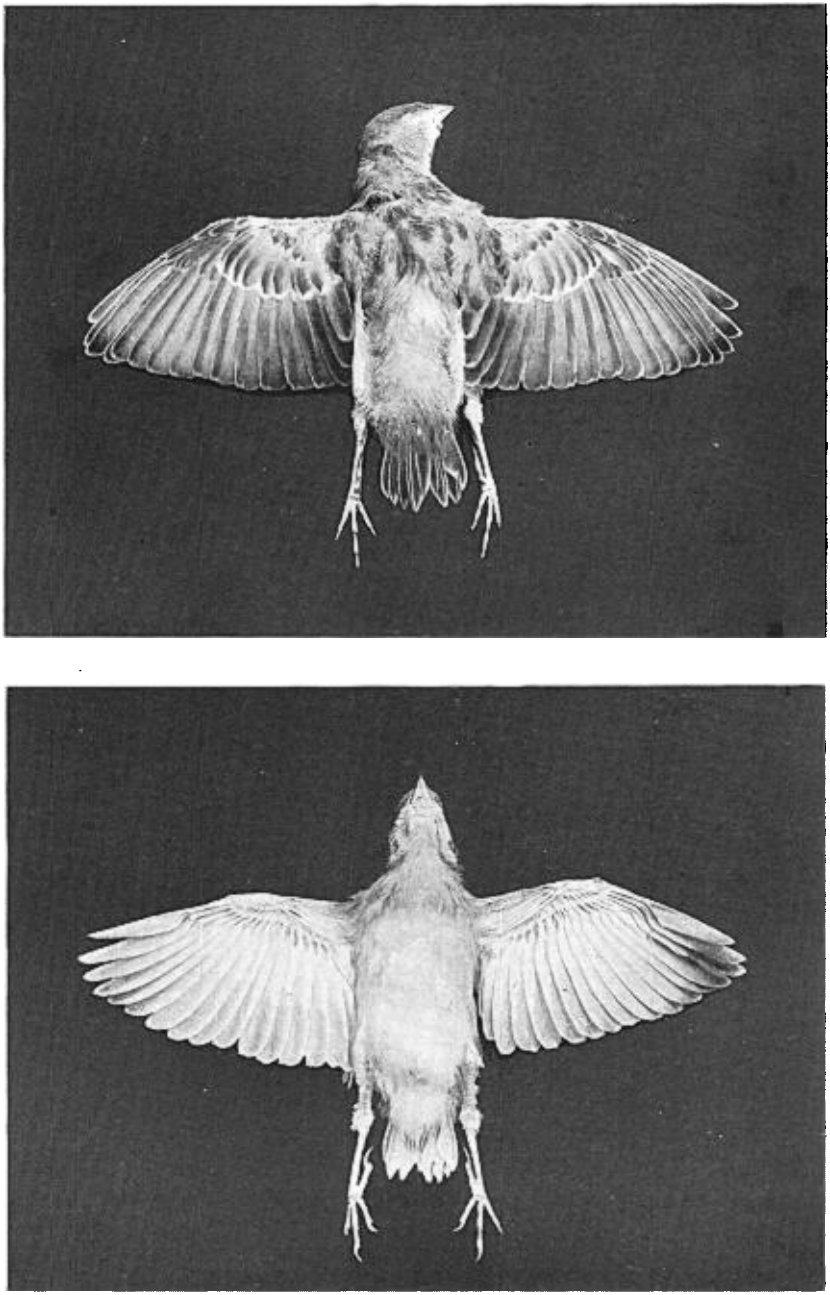
An examination of the above table at once reveals the fact that the growth of such parts as the tarsus and nails is practically completed by the time the young leave the nest: whereas, the tail, which is more than fifteen centimeters long in the adult, is less than one half of a centimeter in length at this time. The period required for development is closely correlated with the time at

which the bird acquires the use of the respective parts. The legs and toes are called upon to serve the bird the moment it leaps from the nest, whereas a long tail would be a nuisance in the crowded nest and is not at all essential until flight is attempted. The relations of growth to the age of the bird are well shown in the accompaning curves representing growth of parts of young Dickcissel, plotted from data contained in Table XII. The numbers on the abscissa represent days and those on the ordinate indicate the units of growth in centimeters. The curves represent the growth made by the following parts respectively: 1. bill; 2. tail; 3. second secondary; 4. tarsus with toe; 5. wing; 6. length and 7. extent. It will be noticed that in nearly all cases growth was slightly retarded, represented by a dip in the curve, at the eighth day, the time this bird left the nest.

The weight of the young Dickcissel while in the nest increases at the rate of almost two grams per day, but it is less than half that amount for the few days after it leaves the nest. In one extreme case the bird lost in weight; evidently it either received less food or else expended it in energy, probably the latter.

The young of the Dickcissel leaves the nest on the eighth to the tenth day after hatching. From five nests under daily observation two of the broods left at the end of eight and nine days respectively (one or more eggs hatching a day later than the others); two broods left on the ninth day; and of a fifth brood of four young, three disappeared on the eighth day, and one remained in the nest until ten days old.

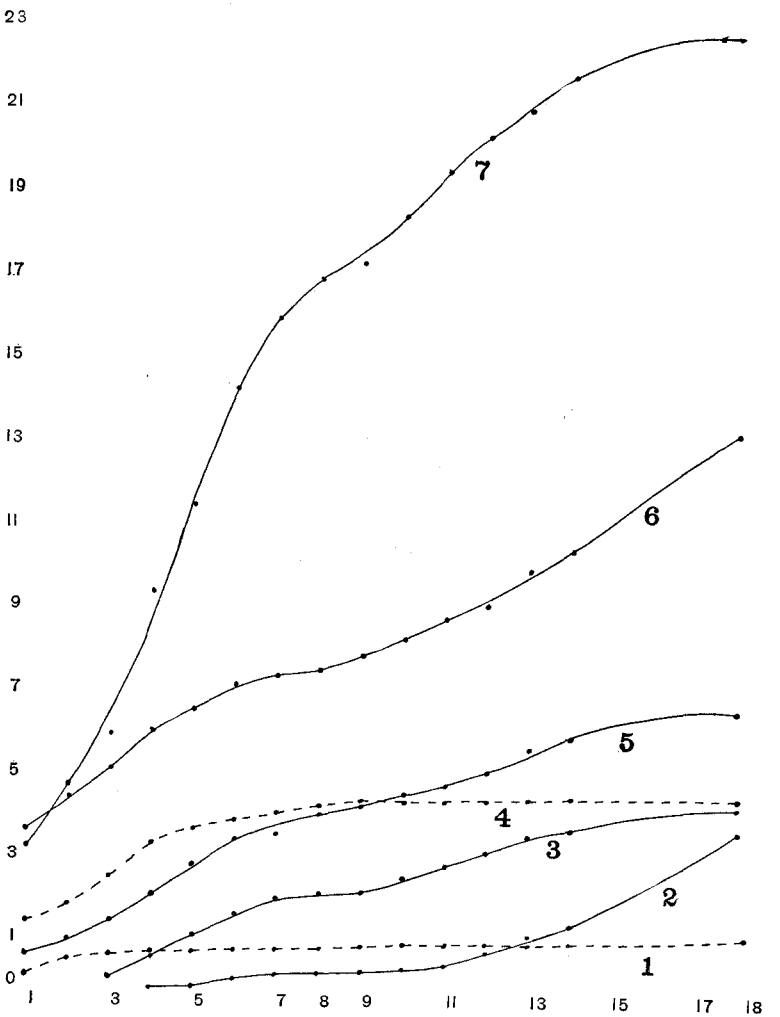
Each of the eighteen Dickcissel nestlings of the five broods noted above was tagged with a number in the hope that it might be again captured for further study during the same season or in some subsequent year. Many of the birds were seen from one to six days after they left the nest, thus making it possible to obtain complete and consecutive measurements, descriptions and photographs of the young for nearly a week after they had left the nest. The young, though often at a considerable distance from the nest, were easily located by watching the feeding operations of the mother. It became increasingly difficult, however, to find them as they acquired the ability to fly or to run quickly through the grass and weeds. A tagged bird eighteen



A YOUNG DICKCISSEL.

Eighteen Days Old. (Ten Days after Leaving the Nest.) Juvenal Plumage.

days old (Plate X, figs. a. and b.) was collected in a field a mile away from its home, an incident which helps explain the difficulty in securing the older stages of the young tagged birds. An attempt



was made to study one brood by tying one end of a string to the leg of the nestling and the other to the base of a weed stalk. The

female continued to feed the young as if they were free. That they grew and flourished is evidenced by the daily increase in weights and measurements. All three birds of this brood, however, either escaped or were taken by some animal during the night of the fifth day. Since this method gave the birds but a small chance against natural enemies, such as the cat and skunk, and since it was at best abnormal, it was not repeated.

At the time the young Dickcissel leaves the nest the natal down is a conspicious element in the contour of the juvenal plumage (Plate VII, fig. b.). These downy tufts, which are attached to the apices of the feathers, are, however, soon worn off after the young begins an active life among the tangled grasses and weeds of the meadow (Plate VII, fig. c.).

The following description of the juvenal plumage is based on a study of the young at about the time the latter leave the nest. As in the case of the descriptions of the adults, the colors were determined by means of Ridgway's 'Color Standards and Nomenclature.' The numbers and letters following the color names correspond respectively to Ridgway's color, hue number, and tone. While considerable care was exercised in comparing these colors, they are at best merely approximations.

The upper parts buffy brown (17‴i) shading to sepia (17″m) on the crown; feathers of the back fuscous-black (13⁗m) edged and tipped with cinnamon-buff (17″b); unsheathed parts of primaries and secondaries mouse gray (15⁗′k) to chaetura black (17⁗m) narrowly margined with pallid neutral gray (67⁗′f); wing coverts olivaceous black (3) (23⁗′m) with broad margins of cream color (19′f); edge of wings, superciliary and malar stripes light ochraceous-buff (15′b), but in some of the younger fledgelings these parts approach an orange-buff (15d) and even a deep chrome (17b) in color; chin and lower breast light buff (17′f) shading to a lighter tint on the belly; breast and upper portion of flanks chamois (19″b), but in the younger specimens in which the feathers of the ventral tracts have just unsheathed and before they have been exposed to strong light the breast approaches buff-yellow (19d) in color. None of the birds of this age have black streaks in the feathers of the breast; the beak and legs are pale flesh color (7′f), but these parts become darker as

the bird grows older. Although the young Dickcissel is unable to fly at the time it leaves the nest, it acquires the ability very quickly and within two or three days, when the bird is about 11 days old (Plate VIII, figs. a. and b.), it is able to go from 100 to 150 feet in a single flight. This distance was sometimes exceeded in test flights when the bird was given the advantage of a start from an elevated perch.

The Dickcissel undergoes several changes by the fourteenth day. The natal down is entirely lost in all individuals of this age, and even earlier if the birds are allowed to live a normal life in the grass fields. The general coloration of this stage of the juvenal plumage is similar to that of the bird eight or nine days old, but is duller in tone. There is none of the rich ochraceous-buff which is so conspicious in the recently unsheathed feathers. This change in color is not brought about by a moult, but apparently is due to a chemical change caused by either light or exposure to air or both. The unsheathing of the feathers in a Dickcissel 14 days old is so far advanced that from a casual examination of the contour it seems complete. Many of the feathers, however, such as the primaries and secondaries of the alar tract, still retain a portion of their sheaths (Plate IX, fig. b.). This unsheathing proceeds slowly; even in a bird 18 days old, the outer primaries are not completely freed of their envelopes (Plate X, fig. b.).

The dorsal plumage of an eighteen day old Dickcissel (Plate X, fig. a) is very similar in coloration to that found in the bird fourteen days old described above. The ventral aspect of the older bird, however, differs from the younger as follows,—bordering the sides of the throat in the older bird are two well defined fuscous malar stripes, which extend posteriorly towards the breast. The sides of the chamois colored breast are distinctly streaked with fuscous. In the center of the breast, many of the feathers have narrow but distinct median fuscous stripes, all of which, at the age of eighteen days, are completely concealed from view by the overlapping tips of the feathers. A close examination of the breast region reveals other similiarly marked feathers in various stages of development. These new feathers are representatives of the first winter plumage and are destined to replace those of the juvenal phase. The feathers of the breast of the birds in

the first winter plumage differ from those of birds in the juvenal stage not only in color but also in having a coarser texture. The transition from the juvenal to the first winter plumage is not so sharply defined, however, as the change from the nuptial to the adult winter plumage, which involves a complete post-nuptial moult. In the former there is only a partial post-juvenal moult, which occurs so gradually that it is difficult to say at what age the juvenal plumage ends and the first winter plumage begins.

Birds in the transitional states between the juvenal and first winter plumages were collected during the last week of June and the first week of August; representatives of the first and second broods, respectively.

A study of specimens, collected during various times of the summer, leads me to believe that the transition from the juvenal to the first winter plumage is a more prolonged process in birds of the first brood than it is in those reared late in the season. No young birds were found in the completed first winter plumage before the last week of July. At this time, though it was possible to obtain a graded series of birds from the juvenal to the first winter plumage, there was a predominance of two types of young: those with the completed first winter plumage and those still in the juvenal stage having few or no feathers of the winter plumage fully developed. This condition substantiates the statements that two broods are reared during each nesting season.

The post-juvenal moult, which includes all but the primaries, secondaries and rectrices, is well advanced in young birds five to eight weeks old, but not nearly all the feathers of the first winter plumage are fully developed by this time.

The following description is based on 5 birds (Plate XI, fig. a) ranging from 5 to about 8 weeks old. (The names of the colors used in the description were determined like the preceding with the aid of Ridgway's standards).

Males and females are similar in coloration. Crown, back and sides of the neck and rump buffy brown (17‴i) or olive-brown (17‴k); crown streaked with fuscous-black (13⁗m); back snuff brown (15″k) and light clay color (17″a), the feathers with large-conspicuous streaks of black. Primaries, secondaries and tail feathers as described in the juvenal plumage. Greater and lesser

wing coverts and tertiaries fuscous-black (13′′′′m) broadly margined with sayal brown (15′′i), but in some specimens the coverts are edged with tawny (13′i); edge of the wing and line over the eye yellow ocher (17′a); auriculars, breast and flanks buffy brown (17′′′i); breast and flanks streaked with black; throat and chin cartridge buff (19′′f) margined by malar streaks or stripes of black; broad short maize yellow (19f) bands lateral to the black malar stripes; lower breast and belly light cream color (19′f); unstreaked crissum or under tail coverts light buff (17′f).

In young birds estimated to be more than eight weeks old, (Plate XI, fig. b), in which the first winter plumage is practically complete the following changes are to be noted. The yellow of the bend of the wing, malar and superciliary stripes more extensive and approaches a buff-yellow (19d) tint; throat warm buff (17′d); breast empire yellow (21b) or light orange-yellow. In some specimens a yellow wash extends down to the region of the belly. In one female and one male bird there was a small obscured patch of chestnut brown which sharply divided the buff of the throat and the yellow of the breast (specimens 62 and 77, Plate XI, fig. b). The lesser and greater wing coverts vary from cinnamon-rufous (11′i); to bay (7m). The streaks of the breast not as conspicuous as in younger birds. In all other respects the older birds of the first winter plumage are similar to those five to eight weeks old.

Some of the young are partially dependent on the adults for food up to the time they have attained the full first winter plumage. I have often seen females at the roosts feeding young in the most advanced stages of the winter plumage. In this way the family groups retain their identity even after the birds are congregated in immense flocks preceding their migration to the south.

ADDITIONAL DATA

RELATIVE TO BIRDS SHOWN IN THE PLATES.

Of the two nests shown in Plate I, the upper one was located in a timothy field and was made up entirely of dried grass stems; the stems on the outside were coarser than those comprising the lining. The base of the nest rested upon leaves and dried grasses, which formed the natural covering of the ground. The dew-berry vine growing up over the nest

afforded excellent protection from the hot rays of the sun and from the violent rain storms. These vines are very abundant in the fields of southern Illinois, where they are often utilized by birds not only for nesting sites but also for food. In the vines a few yards distant from this nest were two nests of the Field Sparrow containing young. The other nest was in a second growth clover field and constituted the latest record I have of a nest containing eggs (August 12, 1918). It was made of corn husks and rootlets, remnants from the corn grown in the same field during the preceding year. The upper nest shown in Plate III, was located among the weeds of fallow ground and was made chiefly of roots with a few coarse grasses on the upper rim. This nest was supported about eight inches above the ground by tall weed stalks. The second nest was built about five feet above ground in a thick cluster of wild grape vines which were clinging to a number of small trees. It was composed of stems of weeds and grass, corn husks, grape bark and leaves, all of which were materials present in abundance on the ground near the nest. The Dickcissel utilizes whatever is close at hand and seldom, if ever, goes any great distance for its nesting materials.

This nest later became so badly infested with mites that the young were almost killed by them. The same mites, though less abundant, were found in a large number of nests. The mite according to Nathan Banks of the Museum of Comparative Zoology is probably a new species of *Liponysus* allied to the common poultry mite.

Plate IV, figure a shows a nest and four eggs of the Dickcissel found July 15, 1918, in the tall weeds and grass along a public road near Atwood, Douglas County, Illinois. The picture as here reproduced shows the nest as it appeared on July 17, when one of the embryos was in the act of breaking the shell. This Dickcissel home furnished many of the notes used in the discussion of behavior in the sixth chapter of this paper.

The nest was made of clover and stems of weeds, corn husks, and leaves. It was lined and covered with straw and dried grass. The interior measurements of the nest were 6 cm. x 6.5 cm. in diameter and 4.5 cm. deep. The measurements and weights of the eggs were as follows:

No.	Long diameter	Short diameter	Weight
1	2.12 cm.	1.66 cm.	2.84 grams
2	2.14 cm.	1.64 cm.	2.98 grams
3	2.08 cm.	1.65 cm.	2.85 grams
4	2.20 cm.	1.65 cm.	2.66 grams

Egg no. 4 was sterile.

The nest shown in Plate IV, fig. b when found on July 21, 1918, contained one young, one embryo just emerging, and two eggs. One of the eggs hatched on the following day, but the fourth was sterile. Two of the birds shown in the nest are four days old and the other three days old.

Plate V figure a, shows the young birds and a sterile egg from the same nest photographed July 18, 1918. The young are arranged in the order in which they were hatched. The young on the extreme right the first to hatch, is the one shown in Plate IV fig. a, in the act of emerging from the shell. The first bird at its left was hatched a few hours later, and the one on the extreme left next to the egg, was hatched on the following day about ten minutes before the photograph was taken. This bird weighed 2.8 grams before it had received any food from the mother. Its weights and measurements on this and successive days are given in Table XII. The same three young are shown in the other figures on Plates V and VI and are arranged in the same order, the oldest bird always on the right, the youngest on the left of the group. The sterile egg is included in many of the figures to serve as a means of comparing the relative sizes of the young. In preparation for photographing them, the young were removed from the nest and placed on a background of black cloth in order to show the parts to better advantage.

In Plate V figure b, taken July 19, 1918, the bird to the right is two days old, and has the first feather papillae of the juvenal plumage broken through the epidermis in the region of the alar tract. Figure d, represents birds two days old, taken from another series, to show the natal down at its best and also the protruding feather papillae of the primaries in the alar tract.

Figure c, shows the original brood at the age of three and four days. Photograph taken July 31, 1918. At this age the young exhibit considerable activity when removed from the nest, the legs are in almost constant motion. The eyes of these birds four days old, are already open, but they are closed when the birds are brought into strong light. The feather papillae are present in all the main feather tracts, those of the wings are considerably lengthened. For measurements, see table XII.

Plate VI, illustrates the same birds, the two at the right in figure a, being five days old, the other four and all feather tracts well defined by projecting papillae. Photograph taken July 22, 1919.

In figure b, the birds are respectively six and seven days old. Photographed July 24, 1918. The feather papillae have now undergone great development and some of them are beginning to unsheath at the tips. The natal down is becoming less important as a covering. Note the great development of the tarsus and toes, well shown in nestling No. 2, in the middle of the group. See table XII for measurements of nestling No. 1, on the left. All nestlings at this age were banded in addition to the marks made by clipping the tips of certain toe nails to aid in identifying the birds after they left the nest. In figure c the six days old bird is placed on its back to show the relative development of the feathers of the ventral tract at this age. The tips of most of the feathers are unsheathed. Persisting tufts of natal down in the head tract are well shown here.

In Plate VII figure a, taken July 25, 1918, the young Dickcissels are seven and eight days old. In this picture the younger bird is on the right.

The egg shown here is the same one shown in earlier photographs. It was left in the nest until after the latter had been abandoned by the young which occurred on July 26. The young seem to have the instinct of fear suddenly developed at this age. This fear seems to be greatly increased when they hear the warning notes of the adults. Observe the awkward legs, which are almost as long as those of the adult.

Figure b, shows the birds eight and nine days old, and was taken July 26, 1919, the last day that they spent in the nest. Birds of this age are unable to fly but they make good use of their legs, which are now fully developed. The feathers of all parts of the body have progressed in the process of unsheathing to such an extent that they now form an effective covering and protection. For a complete description of the plumage of the Dickcissels of this age see text page 176 and for measurements consult table XII, page 172. In figure c, a young Dickcissel ten days old is shown. Notice how the natal down has been worn away by a day among the weeds and grass. These birds were easily found by watching the feeding operations of the female, while the tags and nail marks identified them.

Plate VIII figures a and b, show a bird eleven days of age. This individual was able to fly 100 to 150 feet in a single flight, and when placed on a perch as shown in figures it often exceeded this distance. For a description of this stage of the juvenal plumage see text page 177. In figure c, the bird is twelve days old, and the feathers of the ventral tract are entirely unsheathed. Birds twelve days old are very active and it required no little patience and care to secure pictures of them.

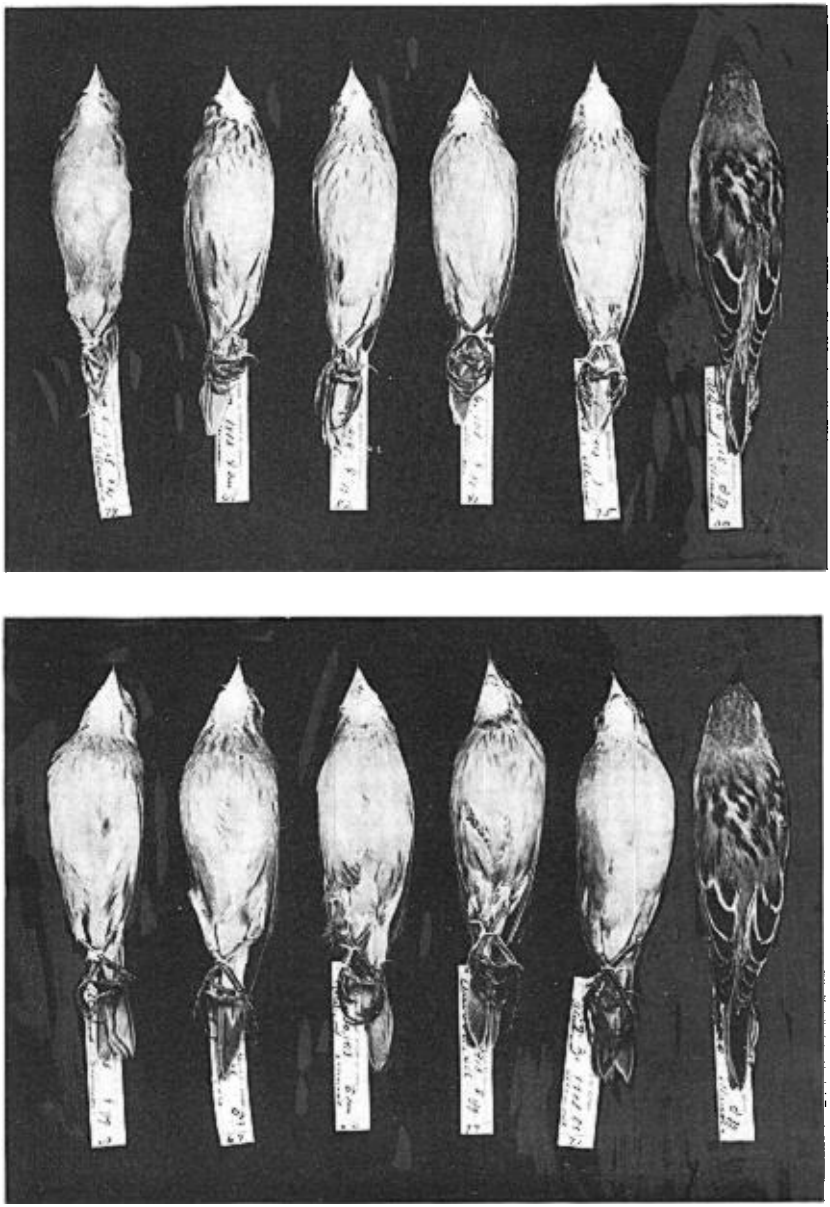
Plate IX, represents a Dickcissel fourteen days old, or six days after it had left the nest. The general coloration of the juvenal plumage of a bird fourteen days old is much duller as compared with the young at the time they leave the nest when the feathers are newly unsheathed. All are now unsheathed excepting the basal portions of the primaries and secondaries while the tail feathers have reached a centimeter and a half in length and are shown plainly in the general contour of the bird.

The ventral view shows the loose flimsy texture of the feathers of the ventral tract in the juvenal plumage which is in marked contrast to the feathers of the first winter plumage, in which the barbules are more closely and firmly interlocked. The partially spread wings show the relative amount of unsheathing of the feathers. See table XII for measurements.

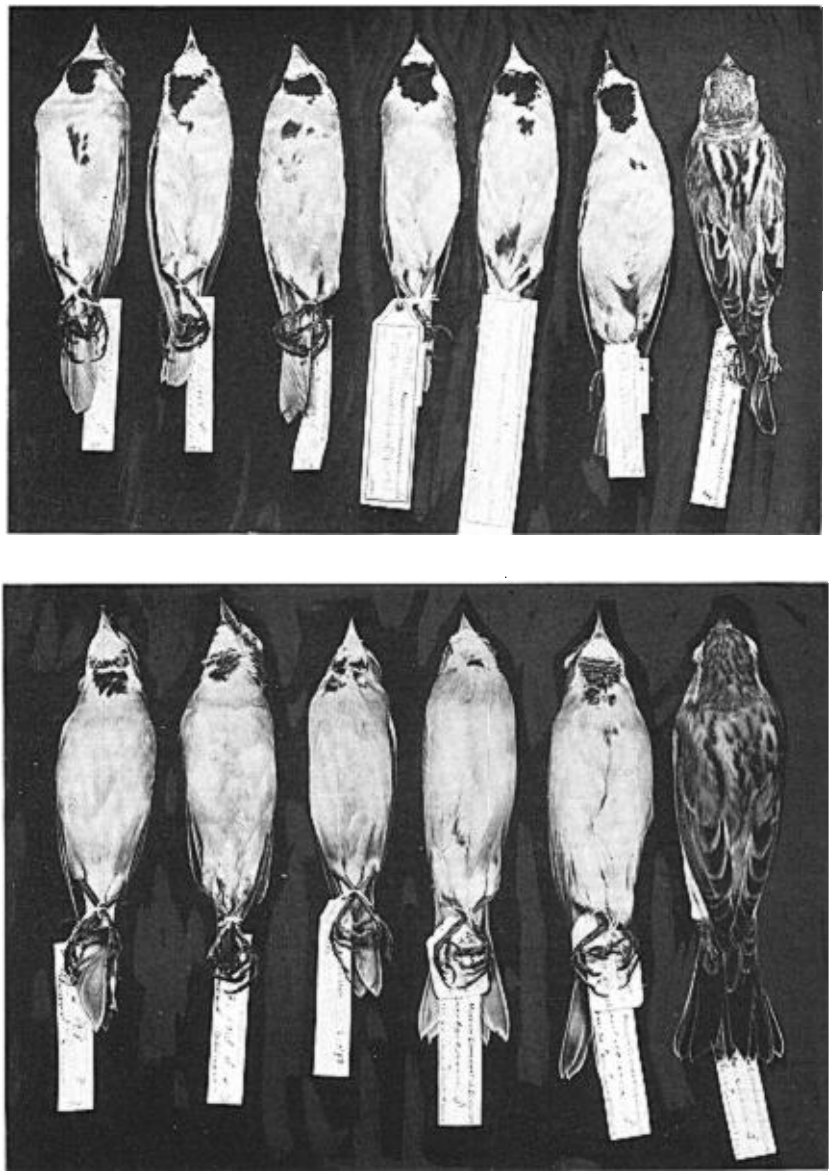
In Plate X, a Dickcissel in juvenal plumage eighteen days old, or ten days after having left the nest is shown. Note the great increase in the length of the tail, a growth correlated with its increased ability to fly.

This bird was able to fly almost as well as the adults with which it was associated. This tagged bird was collected about a mile away from the nest in which it was reared. See table XII for measurements and text page 177 for description.

Plate XI, shows twelve skins of the Dickcissel representing stages from the juvenal to the completed first winter plumage.

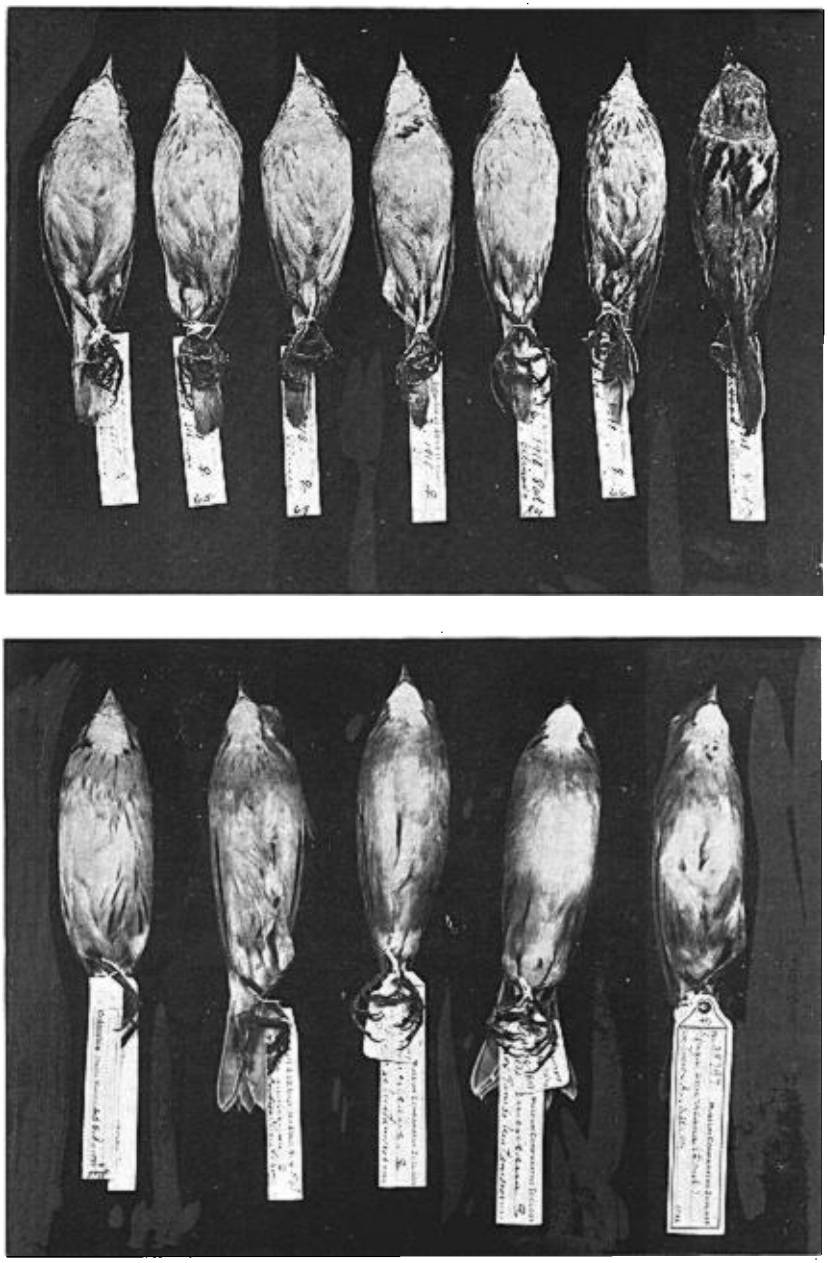


SKINS OF THE DICKCISSEL.
Showing Transition from Juvenal to First Winter Plumage.



MALE DICKCISSELS.

(*a*). Adult Nuptial Plumage.
(*b*). Adult Winter Plumage.



FEMALE DICKCISSELS.
(*a*). Adult Nuptial Plumage.
(*b*). Adult Winter Plumage.

Specimen No. 78 at the extreme left upper row is a female eighteen days old in juvenal plumage. All of the others are in progressive stages of the first winter plumage arranged in order, the more advanced stages being to the right. The youngest of these, a female five weeks old (specimen No. 61), has well defined streaks in the region of the breast and flanks but has very little yellow on the breast and belly. As one goes from the younger to the more advanced stages, of the first winter plumage, the streaks become less prominent and the yellow deeper in color and more extensive in area. The markings of the dorsal aspect of a bird in the first stages of the winter plumage is shown by specimen No. 80 at the extreme right. The lower row represents more advanced stages of the transition, birds which are estimated to be more than eight weeks old. See text page 178 for description.

MEASUREMENTS IN CENTIMETERS OF BIRDS SHOWN IN PLATE XI UPPER ROW

Specimen number..	78	61	82	81	75	80
Sex.....	♀	♀	♀	♀	♀	♂
Date collected (1918).....	Aug. 5	July 30	Aug. 6	Aug. 6	Aug. 2	Aug. 6
Age.....	18 days	5 weeks	About 6 to 8 weeks			
Bill.....	1.25	1.45	1.50	1.45	1.42	1.50
Wing.....	6.70	7.40	7.40	7.50	7.40	8.70
Length.....	13.30	15.75	15.80	16.10	16.25	17.80
Tail.....	3.80	5.55	5.65	5.30	5.40	6.30
Extent.....	22.80	24.50	23.60	24.30	24.60	27.50
Tarsus with toe....	4.60	4.40	4.50	4.60	4.80	4.90
Tip to tip of toes...	3.70	3.70	3.80	3.70	3.60	4.10
Third or front middle toe nail.....	.52	.60	.70	.62	.60	.68
First or hind toe nail.....	.70	.80	.80	.80	.78	.82
Sixth primary.....	4.80	5.15	5.00	5.10	5.00	5.50
Third secondary...	4.40	4.60	4.65	4.40	4.50	5.00
Weight (grams)....	26.60	29.50	28.60	31.13	27.10	36.70

LOWER ROW

Specimen number	68	67	62	77	71
Sex	♀	♂	♂	♀	♂
Date collected (1918)	Aug. 1	Aug. 1	July 30	Aug. 4	Aug. 2
Bill	1.40	1.55	1.55	1.50	1.45
Wing	7.60	8.40	7.95	8.10	8.20
Length	16.25	17.90	16.70	17.30	17.10
Tail	5.70	6.90	5.68	6.20	5.85
Extent	25.10	27.20	26.10	27.00	26.40
Tarsus with toe	4.70	4.90	4.72	4.90	4.90
Tip to tip of toes	3.90	3.90	3.90	3.90	4.20
Third or front middle toe nail	.70	.60	.61	.70	.70
First or hind toe nail	.82	.84	.86	.85	.90
Sixth primary	5.10	5.55	5.10	5.70	5.30
Third secondary	4.50	5.10	4.90	4.90	4.80
Weight (grams)	28.47	36.46	29.50	36.00	32.65

Plate XII represents a series of adult males, upper row in nuptial, lower in winter plumage. For measurements and description of specimens collected in Illinois see p. 15 and 16.

Plate XIII shows the adult females, the upper row in nuptial and the lower in winter plumage. Measurements and description of the former will be found on p. 16.

The latter are five skins from the collection of the Museum of Comparative Zoology and from left to right are as follows:

1. Colombia (Santa Marta) Feb. 11, 1898.
2. Corpus Christi, Texas, March 11, 1894.
3. Tamps, Matamoros, Mexico, Aug. 18, 1908.
4. Tamps, Matamoros, Mexico, Aug. 26, 1908.
5. Tucson, Arizona, Sept. 11, 1884.

The author cannot be positive whether these skins represent the adult or first winter plumage, as he has no osteological or other reliable characters upon which to base determinations of age. Nos. 1 and 2 as listed above more nearly approach Dr. Dwight's meagre description, than do the other three.

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