

A FURTHER REVIEW OF THE AVIAN FAUNA
OF CHESTER COUNTY, SOUTH CAROLINA.¹

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CONCLUDING OBSERVATIONS ON MIGRATIONS.²

THE conclusions reached in this portion of the article, while based on the observations of fourteen years in Chester County, South Carolina, have been tested and corroborated by the facts bearing upon the migration of North American birds found throughout the literature, and by a study of the earlier southward movements at Monterey Bay, California, from the latter part of June to near the end of August, 1892.

I. Variability in the Occurrence of Transient Migrants.

Variability in the occurrence of transient migrants in a given locality may be said to be of two sorts, that which is periodic and that which is erratic.

Periodic Variability.— This is illustrated in such birds as habitually occur more sparingly in this region in the southward migration than in the northward, and *vice versa*: examples, the Bobolink and Yellow Palm Warbler, most abundant in spring, and the Chestnut-sided, Blackburnian, and Palm Warblers, most abundant in autumn. Such seasonal variation in abundance can be explained only in two ways, either the majority pass to one side or else they pass over without stopping. It seems highly improbable that smaller land birds of abundant and extended distribution uniformly pass directly over this locality without being fairly represented in some stage of their movement, for it appears hardly possible that there should be so nice an adjustment of suc-

¹ Concluded from Vol. VIII, pp. 49-59, 167-173, and Vol. IX, pp. 28-39.

² Read in part before the Eleventh Congress of the American Ornithologists' Union held in Cambridge, Mass., Nov. 21-23, 1893.

cessive waves every year as to lead to such a result, particularly in species in the southward migration, like the Canadian Warbler, having a breeding range similar to that of others occurring regularly, as the Black-throated Blue and Blackburnian Warblers. On the other hand, there might easily be a shifting of the line of migration to the eastward or westward. This is exemplified in the Bobolink, which is abundant along the South Carolina coast in autumn, but only so in the interior of the State in spring. Of birds breeding in the mountains to the northward — habitually rare or absent here in the southward migration — the case might be somewhat different, for the first migratory movement might take them to the region below, stragglers only dropping by the way. The failure of northern born representatives of species like the Rose-breasted Grosbeak and Canadian Warbler to appear later, regularly here or in the country below the fall-line in this State and North Carolina, considered in connection with the fact of the habitual occurrence of other species breeding in the mountains, tends, however, to prove that a more westerly route is pursued in such instances, the trend of the mountains probably being followed, only the outskirts of movements reaching the Piedmont Region. In spring, in the northward migration, the Rose-breasted Grosbeak and Canadian Warbler apparently bear further to the eastward bringing this locality more in their path. The abundance of the Blackburnian and Palm Warblers in autumn, like the scarcity of the Bobolink, is also seemingly attributable to deflection to the eastward.

It does not follow because absence or rarity in successive years through the whole course of a migration may be due to shifting of route that waves may not pass directly over a locality without their being manifested through the stopping of the birds. Such a phenomenon in actual occurrence was witnessed by me at Monterey Bay, California, during August, 1892. An extensive movement of Northern Phalaropes took place during the first week of the month. The height of the movement was during the forenoon of the second day, when there was a continual succession of flocks moving rapidly down the coast. They flew but a few feet above the water, following the shore-line of the Bay, rounding Point Pinos, and heading steadily southward.

They kept well away from the land. None were seen nearer than a mile, most were out beyond two miles. At midday, over several square miles, a few solitary individuals were seen on the water. All the others had disappeared, had passed over without stopping. On the 10th a second and apparently greater flight began, reaching its height on the 12th. As before, all flew steadily southward along the line of the shore. They came nearer to the land, however, on the day of greatest abundance, a heavy fog having set in. When it lifted it was seen that the inshore edge of the movement was within five hundred yards of the surf at Point Pinos — a sort of local shifting having transpired. The flocks were quite noisy as they passed onward through the fog. The constant utterance of their call notes not improbably aided those further out to keep their course. No stragglers were noticed on the water during the fog or after it. All had passed over. From the 15th onward there were feeble movements along, but no rushes. The birds were inclined to approach the shore nearer than at first, and loiterers were found quite numerous upon the water. Perhaps these later birds were not the tired ones that had dropped by the way and resumed their journey, nor those that had been delayed in starting, but arrivals from stations further north, the advance guard of others that subsequently followed, as I was informed, and made the Bay a resting place.

On land such a migration as described would readily have escaped notice in its earlier stages. The concealment afforded by the vegetation would cause stragglers to be overlooked, and the greater perils and the artificial and natural obstructions would necessitate a higher flight being maintained.

To summarize: When a smaller land species is habitually rare or absent in this locality through the whole course of either movement, it is held, aside from the influences of environment, that the cause lies in the shifting of the line of flight to the eastward or westward, not in a continual passing over of successive waves.

Erratic Variability. — Lateness of arrival, unusual scarcity or absence, exceptional abundance or occurrence, exemplify erratic variability. These irregularities of migration may reasonably be attributed to variableness in the location of isolated communities, variation, eastward or westward, of starting point bringing about

variation of route, and to meteorological conditions, occasioning deflected, arrested, regurgitated, and involuntary movement.¹

An instance of deflected migration appears to be afforded in the presence of the Bobolink here in unwonted numbers in August, 1887, after a violent gale along the North Carolina coast. Perhaps additional instances are found in the relative abundance in different springs of the Rose-breasted Grosbeak, and also of the Canadian Warbler, and in their casual presence in autumn. The 'tidal wave' mentioned by Drs. Coues and Prentiss in 'Avifauna Columbiana' (pp. 31, 32) seems to have been due to deflection—deflection apparently from the Appalachian Highlands. The height of the 'wave' was doubtless increased by a subsequent arresting of its progress through cold to the northward.

Local deflection occasioned by fog has incidentally been referred to in the Northern Phalaropes at Monterey Bay. A more striking illustration was furnished in two purely pelagic species in the same locality. On the morning of August 4 a heavy bank of fog which had been resting over the ocean beyond the headlands set into the Bay. I was out on the Bay, several miles off Point Pinos, at the time. Soon after the coming of the fog a number of Shearwaters were seen a little further out, flying rapidly seaward. In a short time they were followed by others, singly, in little companies, and in straggling flocks of considerable size. As the fog became denser it was seen that their line of movement was bearing more and more toward the south shore. Their flight was near the surface of the water, and, as there was a heavy swell, when the boat was in the trough, as they suddenly appeared in the fog over the crest of a wave, it seemed almost as if they emerged from the wave itself. When the boat was sighted, if too near, they would diverge from it so as to pass to one side, but without altering

¹ Destruction of bird life by storms, especially during migration over extended bodies of water, has not been enumerated as among the probable causes of erratic variability, for the mortality would have to be very great indeed, far above the average, to be generally appreciable along the avenues of migration. There would have to be wholesale extermination among the legions of a species to produce marked diminution, which could only be followed by continued scarcity during recuperation—an event that has not come within the range of my observation. The disastrous effects of the elements would be more readily perceived on the breeding grounds.

their general course, which was directly out to sea. There was no going and coming from rookery to feeding places as in Brandt's Cormorant. Their flight was all one way, parallel with the coast-line that would lead southward. The specimens taken showed that both the Dark-bodied and Pink-footed were represented, the former predominating. After an hour or two the fog began to break along the south shore, and as it rapidly retreated seaward, the line of movement receded, the birds keeping just without the denser mist.

The arresting of the progress of a movement in a locality would necessarily present the appearance of extraordinary migration — such as is often termed a 'bird wave.' An apparition of this kind has been reported by Mr. Philip Cox (Auk, VI, p. 241). The actual stoppage of a vast army of Robins, Song Sparrows, and Slate-colored Juncos by a snow storm was witnessed by him one morning in April, 1885, near Newcastle, New Brunswick. When occasion for migration was urgent its interruption just below a locality in the northward movement or just above it in the southward might be expected sometimes to bring about a twofold result — scarcity or absence for a time in the locality, as there would be no necessity for an early stop, and a wave of augmented proportions in the territory in which the first pause was made. The varying size of waves when the highway of migration is clear may, perhaps, in part be thus accounted for, by previous damming up and concentration. The apparent smallness of a wave may not improbably be due sometimes to its centre of abundance not resting in a locality, it being above or below or to one side of it during the halt. During the reign of ice and snow, interruption of northward progress not infrequently results in a regurgitated movement, when occurring to the northward of this locality, as has been stated in previous portions of this article, having the appearance of a wave from below. In this connection, see 'Report on Bird Migration in the Mississippi Valley,' pp. 29, 30.

An exemplification of involuntary migration is seemingly afforded in the great flight of Killdeers that appeared suddenly along the New England coast in the latter part of November, 1888 (Chadbourne, Auk, VI, p. 255). This movement was apparently from the southward, in the path of a storm.

Variability imputed to variableness in the location of isolated communities, entailing variation in paths of movement, is yet to be spoken of. Upon such ground appears to be explained the lateness of arrival from the south of the Yellow-throated Warbler in years when other early migrants were not belated — a variation within narrow limits in the route pursued by the vanguard being the probable cause of tardiness. In the years of early occurrence there was no indication that the migration of this species was obstructed, either by influences in this locality or above it. The conditions seemed especially favorable, rather than adverse.

The reported wandering northward of hornotines in certain species (as the American Egret and Little Blue Heron — Rep. Bird Migr. Miss. Vall., pp. 82, 83) presents a curious phase of erratic movement. A sort of irregular migration is manifested in the occurrence of 'accidental visitants.' It is surprising, rather than otherwise, that birds do not stray more frequently from their normal range, considering the possibilities of their being storm-driven or of becoming bewildered and losing their course. As movements pass over and around localities it follows that a station in advance may sometimes be occupied earlier than an intervening one.

To recapitulate: Periodic variability — habitual absence or habitual comparative scarcity in one movement and customary presence or customary greater abundance in the opposite — in this locality is ascribed, aside from the influences of environment, to semi-annual change in line of migration, a different route being followed in the northward movement than in the southward. Erratic variability — irregular and uncertain occurrence, in transient migrants — is attributed to variation of route through variation, eastward or westward, in the location of isolated communities, and to diverting meteorological agencies, causing deflection and interruption of movement, the former manifested particularly through the presence or increased abundance of species whose ordinary highway of migration lies further to the east or west, the latter by the stoppage of progress in the locality, above, or below it, resulting sometimes in regurgitated and involuntary migration.

Local Causes, affecting Distribution, producing the Appearance of Irregularity of Migration.— Causes underlying local

distribution often tend to give the appearance of exceptional abundance, or the opposite, rendering more apparent, or less so, the movements that are taking place without obstructing them. Influences affecting the food-supply are most potential. Wilson's Snipe is particularly abundant here in the northward movement during wet seasons, the rain increasing the limited food area by rendering the high 'black-jack' lands boggy. September 6, 1888, it rained heavily for seven hours, terminating a drought that had been prevailing and converting the level 'black-jack' fields of recently sown oats into swampy flats. An isolated patch of four or five acres, immediately after the rain, held more Pectoral Sandpipers than it was ever my fortune to see before in this locality at one time. Until the ground was dried this spot was a rendezvous for passing Sandpipers, the species varying from day to day. Such birds are seldom seen here away from mill-ponds, as congenial haunts are wanting, though sometimes observed high overhead in the flush of migration. Nighthawks, Chimney Swifts, and Swallows are most conspicuous during migration in damp weather. Excessive rain causes the American Woodcock to appear more numerous when migrating through its desertion of the low grounds. An especial instance was during the latter half of August, 1887, which was a month of continual rains.

The fields of heading oats attract passing flocks of Bobolinks in May. In September when the crop is being harrowed in, the Killdeers, in the height of southward migration, occupy the same ground—a plantation devoted to this grain showing an abundance to be observed nowhere else in the neighborhood. A large bed seeded to clover the first of May in a yard in the town of Chester, became the scene of quite a gathering of Indigo Buntings, mostly males, one season. They reached the number of a score and remained until all the seeds were eaten up. Their presence excited some comment, and curious were the explanations advanced to account for it, whence they came being a mystery.

Variability as occasioned by Topographical Conditions.—As is well known, localities on the same parallel, owing to different topographical features, often exhibit diversity in time of occurrence similar to that arising from difference in latitude. The appearance of north-bound migrants along the course of the larger rivers earlier than in the adjacent territory in the Missis-

sippi Valley is frequently alluded to in the 'Report on Bird Migration.' In this locality this is seen in miniature, the first arrivals from the south in many species usually being found along the streams leading to the Broad and Catawba Rivers and the Low-Country. On the coast, in the northward movement, birds, as a rule, appear sooner than in the Piedmont Region. For example, Dr. Coues mentions the occurrence of the Tree Swallow in numbers at Fort Macon, N. C., in January (Proc. Acad. Nat. Sci. Phila., 1871, p. 21). In this locality none have ever been seen before March. The loitering of species along the coast in autumn lengthens out their period of migration, the closing movements taking place later than in the Piedmont Region.

II. Variability in the Occurrence of Breeding and Winter Residents Independent of Failure of Food or Severity or Mildness of Season.

Isolated Communities.—The spirit of gregariousness is a marked feature in bird life. It is manifested after the breeding season in the woodland groups of associated Titmice, Chickadees, Kinglets, etc., in the winter assemblages of Vesper Sparrows, American Crows, Meadowlarks, or Robins, and in the congregation of the highly gregarious species, as the 'Blackbirds' and the Passenger Pigeon, and in a lower degree in the breeding colonies where the birds are generally dispersed within circumscribed limits, as in the Grasshopper Sparrow, and perhaps as in the Scarlet Tanager as observed by myself at Cæsar's Head (Auk, VIII, p. 329) and other birds similarly restricted. As the spirit to concentrate is so dominant, and as there is local distribution even within the narrow bounds of a neighborhood, it is not strange that there should be local distribution involving larger areas, particularly where a species is not sufficiently abundant to fully occupy a territory, either through actual paucity, or because the territory is on the borders of the habitat. So it happens that toward the extremes of range the individuals of a species, in many birds at least, are inclined to aggregate into isolated communities, being more or less plentiful in a particular locality while the

surrounding country is not inhabited, or at best but very sparsely so. Thus in this vicinity the Robin has been found to be of rare occurrence in the breeding season except in a single locality where a colony has flourished for years. The Grasshopper Sparrow, though very common, is likewise local here as a summer resident. At northern extremes of breeding range this gathering into isolated communities appears to be illustrated in the Blue Grosbeak, Mockingbird, and Carolina Wren. In winter time it is conspicuously exemplified in the Robin. Here in Chester County they may be wanting in December and January, and yet be abundant in a locality far to the northward. This, too, when the bulk of the species on the Atlantic Slope winters to the southward of this region. Certain essentially trans-Appalachian species are inclined to be very local on this side of the mountains, as the Dickcissel in summer and Leconte's Sparrow in winter. Henslow's Sparrow and Bewick's Wren appear to afford examples of local distribution where a species, in the aggregate of individuals, is not sufficiently abundant to populate the region embraced within the central portions of its range. As has been indicated, isolated communities vary in character. A single company or a small colony may alone represent a species in a locality, or numerous flocks may occur, as is sometimes the case in the Robin, or there may be general dispersion, as in Bewick's Wren. It may be queried whether an incipient disposition to gregariousness, perhaps limited chiefly to contemporaneous migratory movement, may not be a factor in the geographical distribution of many birds, in the more common species it being manifested by dispersion over widespread areas, and in the rarer, either by restriction within narrow boundaries, or by segregation into isolated communities or local centres of distribution.

It remains to be said that local distribution dependent strictly upon environment is not to be confounded with the isolated communities spoken of. Uncongenial situations are not inhabited. Land birds do not resort to water, nor do typical woodland birds frequent the fields.

Variability in the Location of Isolated Communities.— While the Robin may breed locally year after year in the same locality, other species also local here in distribution may occur

irregularly, being present for one or more seasons and then rare or absent for a varying period.¹ The Dickcissel is a remarkable example. During the first half dozen years I paid attention to the birds of this section it was not observed, then it was common locally for two summers. Afterwards it was not met with though my observations were continued six years longer.² A parallel on a smaller scale, immediately under the eye, appears to be supplied in the shifting of breeding grounds, as observed here in the Meadowlark — a particular field being in favor for a single season or longer and then deserted and another, perhaps a mile or two away, occupied. In lapse of time there may be a returning to former haunts. The Meadowlark is also more numerous in some summers than others. This fluctuation in abundance is esteemed to be but a more extended shifting of breeding grounds — the position of isolated communities varying so that different localities are occupied in different seasons. As the increase is abrupt instead of gradual it is obvious that the fluctuations do not arise from destruction of the birds. It has not been determined that storms in any way influence the location of isolated communities.

The irregularity here in winter of the Robin, Bewick's Wren, and certain other birds has been commented upon at length in a former part of this article, and explained also on the ground of variability in location of isolated communities. A parallel in miniature seems to be found in the restricted distribution of some of the less abundant winter birds of this neighborhood, particular situations being frequented for the season to the exclusion of others apparently equally attractive. That migration does not fail to take place in the Robin or Bewick's Wren when either is wanting in winter is proven by their occurrence during the height of migration. The presence of the

¹ I speak with some positiveness of the absence of birds, as I have had opportunity for thorough observation, not having been trammelled by the restrictions prevailing in more thickly settled communities.

² Instances of its erratic appearance or abandonment are not wanting in other localities. Cf. Langdon (Ohio), *Abst. Proc. Linn. Soc. N. Y.*, No. 5, p. 11; Butler, 'Birds of Indiana,' p. 77; Coues and Prentiss, 'Avifauna Columbiana,' p. 67; Merriam (Connecticut), *Trans. Conn. Acad.*, IV, p. 43; Trotter (vicinity of Philadelphia), *B. N. O. C.*, IV, p. 235; Lloyd (western Texas), *Auk*, IV, p. 294; Dutcher (Long Island), *ibid.*, VI, p. 137; etc.

Robin locally far north where the snow covers the ground for months dispels, too, all idea that its absence is due to removal wholly to the southward.

Cold and warmth apparently affect only the winter migratory movements of isolated communities, not otherwise controlling location in any particular locality in the normal winter range. For example, Bewick's Wren may be rare here during December and January in a mild winter and quite common during a severe one, or the opposite may be true, in either case the species being fairly numerous during the height of migration. In the phenomenally mild winter of 1889-90 they were absent until the close of December when a slight movement occurred, apparently the advance of an isolated community from below, for there was unmistakable northward movement in other species. The height of its migration was reached in March as in ordinary years. The sudden influx of Robins in the early part of January, 1887 (Auk, IX, p. 29) with the coming of snow, and their disappearance on the return of milder weather seems to have been an instance of migratory movement of a large community from above, for the regular northward migration took place at the usual time. Severer December and January snows, too, have failed, before and since, to occasion such intrusions. It is a curious fact that migration should take place in the Robin with the advent of snow at the South while flocks remain during the entire winter "in the valleys among the White Mountains, where snow covers the ground from October to June, and where the cold reaches the freezing-point of mercury" (Brewer, *Hist. N. A. Birds, Land Birds*, I, p. 26).¹ The explanation I would offer is, that the birds which visited us had been residing below the snow-line and were dependent on account of their great numbers chiefly upon the ground for food, and when the ground was covered by snow, they had no alternative but to remove southward and await its disappearance. The closing words, which I have omitted, in the quotation just cited, "attracted by the abundance of berries," explain their presence in New Hampshire.

Food as bearing upon the location of isolated communities remains to be considered. In 'off years' of species whose absence is attributed to variability in location of such communities there has

¹ See Auk, VIII, p. 317, for instance of Robins wintering in numbers in Quebec.

been no visible failure of food in this locality. The winter migratory movements of the Robin prove that a host may find ready subsistence where few or none have been previously sojourning. It is evident that abundance of food alone does not insure presence. When limited in numbers only a small area can be thickly inhabited, no matter how inviting the surrounding region may be. As some place must be selected when birds are not sufficiently abundant to populate the whole region temporarily available for residence, choice is made, though it may be a temporary one, as is the case in the Red-winged Blackbird here locally in winter, or it may be more permanent, as in the Robin, here in summer, or, in a smaller way, as in the Prairie Horned Lark (Auk, VIII, pp. 57, 58). Below the territory where snow is frequent, there must be wide opportunity for selection, but where the ground is covered for a long time, only such places as afford food on trees, etc., can be inhabited.

The absence of the Red-headed Woodpecker in Lewis County in northeastern New York (Merriam, B. N. O. C., III, p. 124) in winters when there were no beechnuts left on the trees, is a circumstance bearing directly upon this point. That this Woodpecker should winter in numbers, locally, in New York, even in the severest seasons, and in Vermont (Knowlton, B. N. O. C., VII, p. 63), and be absent here from October to April for successive years, may seem singular. In the abandonment of this locality in winter, however, it does not present any different feature than is exhibited in the Robin. The literature abounds in references to the erratic distribution and movements of this Woodpecker. The explanation appears simple. It is a bird that is distributed in isolated communities, and the communities vary in location, in the adjustment localities remaining untenanted for a varying period. Its absence in this vicinity in winter is understood to signify that the summer residents have departed, that the migrants have passed on, and that winter birds have centred elsewhere. Scarcity or abundance in summer is explained by shifting of position of breeding communities, and in the height of migration, by variation of lines of movement.

With the exception of the Dickcissel, the irregular breeding and winter birds mentioned above have been of habitual occur-

rence during the height of their migration. There are other birds that are uncertain in migration as well as at other seasons, as the Red-breasted Nuthatch here and the American Crossbill in the lower part of the State (Wayne, Auk, IV, pp. 287-289). This inconstancy seems attributable to a shifting of the lines of movement so that these localities are reached in some years and not in others. Both species are of local distribution in the breeding season here at the South, being confined apparently to the higher mountains. The irregularity reported by Dr. Cooper (Proc. U. S. Nat. Mus., II, p. 243) in Lawrence's Goldfinch, Lazuli Bunting, and Western Bluebird seems but further illustration of variability in location of isolated communities. Additional instances in Chester County in winter appear to be afforded in the Short-eared Owl, Purple Finch, Pine Siskin, Towhee, Palm Warbler, and Brown Creeper. In the breeding season the tendency to variability is not so great as in winter; witness the Robin in this locality. The Passenger Pigeon exemplifies variability in a high degree. Where there are great numbers food doubtless enters as an immediate factor in their movements, their erratic mode of migration being accentuated by necessity of continually seeking new feeding grounds. Fear of persecution probably causes them to avoid many localities, particularly in the location of their 'nestings.'

Where there has been no great change wrought in the face of a region, it is an open question whether much of the alleged extension of range of birds may not be simply shifting of isolated communities within ordinary limits of habitat.

Summary.—In species of uncertain occurrence in the height of migration, irregularity in breeding or winter residence that cannot be attributed to severity or mildness of season or to failure of food is ascribed to variation in lines of movement (facilitated by local distribution), the migration being regularly performed, but routes varying so that the same localities are not visited every season; in species of habitual occurrence in the height of migration, such irregularity is ascribed to variation in location of isolated communities at extremes of habitat—the birds in both cases not being sufficiently abundant to populate the whole region embraced within their range, thus necessitating choice of abode, which often results in absence in localities that have been favored in other seasons.

The abrupt occurrence in the depth of winter of a species that subsequently appears in greater numbers in the height of northward migration is imputed to migratory movement of an isolated community, the birds coming from the north if cold and from the south if warm.

(To be concluded.)

DESCRIPTIONS OF FIVE NEW BIRDS FROM MEXICO.

BY E. W. NELSON AND T. S. PALMER.

Megascops pinosus, sp. nov.

Type No. 131517, ♂ juv., U. S. National Museum, Department of Agriculture Collection, from Las Vigas, Vera Cruz, Mexico, June 9, 1893. Collected by E. W. Nelson. (Original No. 1235.)

Measurements: Wing, 132 mm. (5.20 in.); tail 61.5 mm. (2.38 in.); tarsus, 28 mm. (1.18 in.).

Color.—Crown including ear tufts, neck and back, with upper tail coverts, dark clove brown obscurely mottled and faintly barred with dull cinnamon with faint traces of dull grayish. About the neck behind is a narrow collar in which the feathers are distinctly barred with grayish and dull cinnamon. Feathers of chin, cheeks, ear coverts, lores and sides of forehead grayish white irregularly and finely barred and mottled with blackish brown. Entire lower surface except chin barred with grayish white and clove brown, the white bars being shaded or washed in part, particularly along the flanks, with pale cinnamon. In many instances the brown bars are connected by fine shaft-lines of brown which do not affect the general pattern. The barring on the throat and upper breast is finer or narrower than elsewhere. The rest of under surface has the alternate light and dark bars, three of each on each feather, of equal width and strongly contrasted. This produces a strong pattern of coarse light and dark barring which is quite unlike that of any other member of this group known to us. The feathering of feet and tarsus is dull grayish mottled with dark brown. Toes scantily feathered. Quills clove brown with a series of light, semi-circular and subquadrate spots along margin of