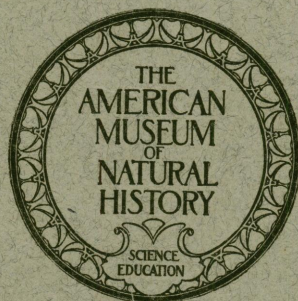


THE POST-GLACIAL HISTORY
OF
ZONOTRICHIA CAPENSIS

BY FRANK M. CHAPMAN



BULLETIN
OF
THE AMERICAN MUSEUM OF NATURAL HISTORY

VOL. LXXVII, ART. VIII, pp. 381-438

New York

Issued December 10, 1940

Article VIII.—THE POST-GLACIAL HISTORY OF
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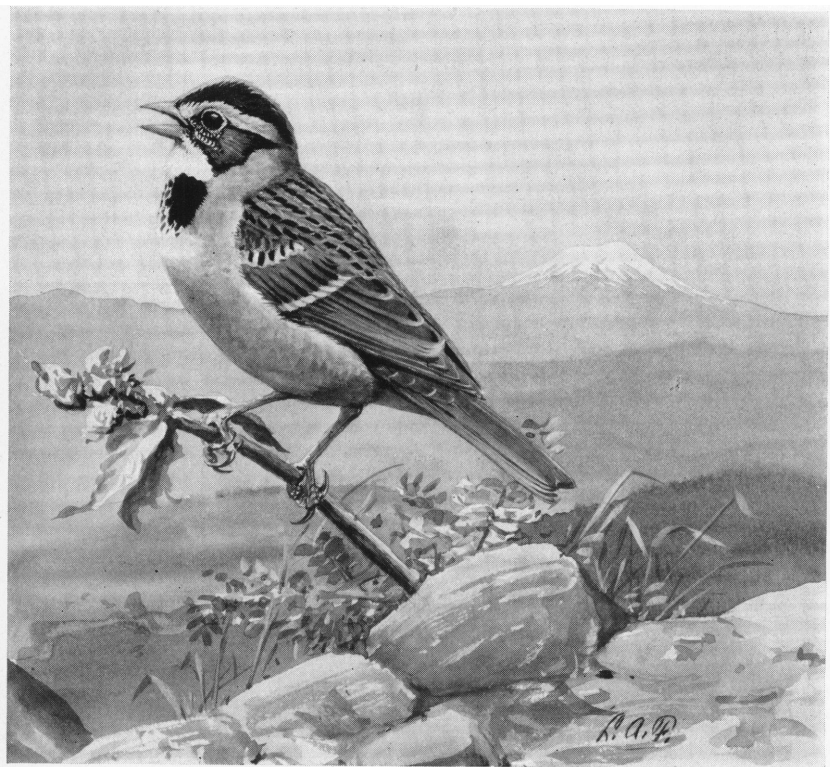


Fig. 1. *Zonotrichia capensis*.
From a drawing by Louis Agassiz Fuyertes.

CONTENTS

	I	PAGE
INTRODUCTION.....		383
ACKNOWLEDGMENTS.....		384
GENERIC RELATIONS.....		385
THE SPECIES.....		387
Seasonal Plumage Changes.....		388
Molt.....		388
Season.....		388
Fading and Wear.....		388
THE RACES.....		390
1. <i>Zonotrichia capensis septentrionalis</i>		390
2. <i>Zonotrichia capensis antillarum</i>		391
3. <i>Zonotrichia capensis costaricensis</i>		392
4. <i>Zonotrichia capensis huancabambae</i> , new subspecies.....		393
5. <i>Zonotrichia capensis peruviansis</i>		394
6. <i>Zonotrichia capensis carabayae</i> , new subspecies.....		395

	PAGE
7. <i>Zonotrichia capensis pulacayensis</i>	395
8. <i>Zonotrichia capensis antofagastae</i> , new subspecies.....	396
9. <i>Zonotrichia capensis venezuelae</i>	397
10. <i>Zonotrichia capensis insularis</i>	398
11. <i>Zonotrichia capensis roraimae</i>	398
12. <i>Zonotrichia capensis macconnelli</i>	399
13. <i>Zonotrichia capensis capensis</i>	399
14. <i>Zonotrichia capensis tocaninsii</i> , new subspecies.....	399
15. <i>Zonotrichia capensis matutina</i>	400
16. <i>Zonotrichia capensis subtorquata</i> , revised subspecies.....	401
17. <i>Zonotrichia capensis hypoleuca</i>	402
18. <i>Zonotrichia capensis mellea</i>	403
19. <i>Zonotrichia capensis chilensis</i>	404
20. <i>Zonotrichia capensis sanborni</i>	405
21. <i>Zonotrichia capensis choraules</i>	405
22. <i>Zonotrichia capensis australis</i>	406
23. <i>Zonotrichia capensis</i> , subspecies.....	410
MEASUREMENTS.....	410
JUVENAL PLUMAGE.....	412

II

DISTRIBUTION.....	413
MIGRATION.....	418
NESTING SEASON.....	420
SONG.....	421
VARIABLE CHARACTERS.....	422
General Size.....	422
Bill.....	423
Crest.....	423
Feet.....	423
Wings.....	424
Tail.....	426
General Coloration.....	427
Head-marks.....	428
Rufous Collar.....	430
Black Neck-marks.....	430
Yellow Wing-bend.....	433
Barred Under Tail-coverts.....	433
SUMMARY.....	434
REFERENCES.....	437

ILLUSTRATIONS

Fig. 1. <i>Zonotrichia capensis</i> . By Louis Agassiz Fuertes.....	381
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PHOTOGRAPHS

Fig. 2. Juvenal plumage of North American and South American species of <i>Zonotrichia</i>	386
Fig. 3. A Bolivian mutant.....	387
Fig. 4. Worn and fresh plumages of <i>Z. c. pulacayensis</i>	389
Fig. 5. Worn and fresh plumages of <i>Z. c. peruviansis</i>	390
Fig. 6. An undescribed form of <i>Z. capensis</i>	411
Fig. 7. Resemblance of juvenal to adult plumage.....	412

MAP

Fig. 8. Map indicating ranges.....	417
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PHOTOGRAPHS

Fig. 9. Pointed and rounded wings.....	425
Fig. 10. White-tipped tail.....	426
Fig. 11. Darkest and palest races.....	427
Fig. 12. Extremes in coloration of crown.....	428
Fig. 13. Racial variations in crown-markings.....	429
Fig. 14. Enclosed auriculars of <i>Z. c. antillarum</i>	430
Fig. 15. Racial variation in neck-band.....	431
Fig. 16. Barred lower tail-coverts of <i>Z. c. antofagastae</i>	433
Fig. 17. Summit and talus of Mt. Roraima.....	435

I

INTRODUCTION

When a single species is distributed throughout 4000 miles of latitude, 3000 miles of longitude and 15,000 feet of altitude, it may be assumed to encounter a wide variety of environments. And when the species concerned is responsive to its surroundings and usually exhibits a sedentariness that promotes isolation, we will not be surprised to find that it has evolved into over 20 geographical races.

Although these races extend from Mexico to Cape Horn they are apparently of such comparatively recent origin that, excepting one insular form, each one intergrades with one or more of its neighbors; not one has definitely acquired specific distinctness.

Assured of our bird's generic relations with *Zonotrichia* of North America we may assume that it is of north temperate geographic origin and in our study of its distribution we are thus aware of its approximate starting point and also of the direction followed. In short, *Zonotrichia capensis* presents an exceptionally promising subject for the study of distribution and speciation.

Other workers have dealt with the status of those members of the group that came within their respective regions and Dr. C. E. Hellmayr has presented an expert's review of the species and its races in his volume on American Fringillidae.¹

However, many of the characters of *Zonotrichia capensis* are so intangible that taxonomists have varied widely in estimating their significance. It is not surprising, therefore, that with a much more adequate collection of these birds than has heretofore been assembled, I should at times reach conclusions differing from those of my predecessors.

In nomenclature, however, Hellmayr's review establishes a sound standard which, both in technical and popular fields, I gratefully accept. I have not, therefore, been handicapped by the confusing issues of synonymy and the unsatisfactory attempts to apply nomenclatural laws, retroactively,

to cases not now susceptible of definite presentation. As a common, familiar bird, *Zonotrichia capensis* has many vernacular names. For example, "Comemaiz" in Costa Rica, "Chincol" in Chile and "Chingolo" in Argentina. When known to me I have given these in connection with the English book names, quoted from Hellmayr.

The value of studies of this nature depends primarily on their completeness. If, for example, we did not have specimens of the Chingolo from the Magellanic islands, including Cape Horn, we might conclude that its distribution was still in progress; but the fact that it has extended its range to the limit of the continent, where it nests, is evidence that it has occupied all the territory meeting its habitat requirements and hence, for the present, its distribution is essentially completed.

Again, the fact that we have specimens from throughout its known range is an assurance that, making due allowance for human fallibility, the taxonomic results reached more or less adequately present existing conditions.

To achieve this end calls for specimens and more specimens, until one is assured that he has enough material in hand properly to represent his problem in all its taxonomic and faunal aspects. Thanks to the spirit of coöperation that prevails among museums, as acknowledged beyond, I have assembled 1267 specimens of the subject of this paper. Taken from throughout its range, no undue demand has been made on the birds of any one locality.

Fortunately all the races of *Zonotrichia capensis*, except the Patagonian *Z. c. australis*, are non-migratory. While awaiting opportunity for identification by comparison, a specimen of any other race may, therefore, be given the name of the form occupying the region whence it came.

Now begins the task of identification, the backbone of the whole undertaking. The specimen is nature's reply to the combined action of environment and inheritance.

¹ Pub. No. 430, Field Mus. Cat. of Birds of the Americas, Part XI, Dec. 31, 1938, pp. 571-586.

It is the brick with which the taxonomic edifice is built. It cannot be used until it is named; to name it calls for a command of the technique of taxonomy, including experience in the field as well as in the study.

The actual comparison of specimens should be preceded by a study designed to reveal the history of the individual's growth by molt, wear and fading. These preliminary requirements having been met, there follows the actual comparison of specimens. In those finer discriminations that aim to reveal the very beginnings of speciation, the taxologist not only compares bird with bird but also, if possible, series with series. It is the cumulative effect of slight individual differences that,

in the beginning, enables us to recognize the nascent race. To the untrained eye these differences may not be appreciated. But the statement should be emphasized that such highly technical researches cannot be made by the untrained eye.

But the object of these studies is not solely the identification of specimens. It is the identification of populations rather than of their component individuals. Only when the broader questions of race and range have been at least provisionally answered are we prepared to consider the end results of the variations of populations, due to whatever course, and perpetuated through isolation, by the tests of living and by heredity.

ACKNOWLEDGMENTS

Although the collections of the American Museum contain large numbers of *Zonotrichia capensis* they are lacking in representatives from certain regions of fundamental importance. Fortunately, in every instance our want has been filled by sister museums. The Biological Survey has loaned the only Mexican specimens of *Z. c. septentrionalis* I have seen. They were collected by Nelson and Goldman and Major Goldman has given me valuable field notes concerning them. For the only specimens of this race that I have seen from El Salvador, I have to thank Mr. A. J. van Rossem, of the California Institute of Technology; and Mr. R. M. de Schauensee, of the Philadelphia Academy of Natural Sciences, has supplied the only specimens, from Honduras. To the same source I am indebted for an invaluable collection secured by Mr. M. A. Carriker, Jr., in Bolivia, including a topotypical series of *Z. c. pulacayensis*. From the Carnegie Museum, through Mr. W. E. Clyde Todd, I have received the only three authentic specimens of *Zonotrichia capensis capensis* of which I know, also specimens from Bolivia and Argentina and from otherwise unrepresented localities in Chile. Dr. Alexander Wetmore, for the U. S. National Museum, has supplied an indispensable collection from Argentina to which Mr. J. L. Peters, of the Museum of Comparative Zoölogy,

has made important additions. To the Field Museum, through Mr. E. R. Blake, I am indebted for topotypical series of *Z. c. antiofagastae* and *Z. c. sanborni* as well as for other Chilean specimens. Mr. A. R. Zotta of Museo Argentina has sent invaluable specimens from Argentina and Bolivia, and from Venezuela we have a series from Mr. William H. Phelps.

In the lists of "Specimens Examined" footnote references refer to the museum from which the specimens were borrowed, as follows: 1. Academy of Natural Sciences, Philadelphia; 2. Biological Survey; 3. Carnegie Museum; 4. Field Museum of Natural History; 5. Museum of Comparative Zoölogy; 6. United States National Museum; 7. Museo Argentina; 8. California Institute of Technology; 9. William H. Phelps Collection; all other listed specimens are contained in The American Museum of Natural History.

In addition to my obligations to other museums for the loan of material, I have also to thank my colleagues, Robert Cushman Murphy and John T. Zimmer, whose critical examination of my manuscript has added to its scope and authority. Mr. Zimmer has also been of inestimable value in attacking those taxonomic problems which yield so much more satisfactorily to two heads than to one.

GENERIC RELATIONS

Satisfactory determination of the generic status of the bird, which has been called both *Zonotrichia*, and *Brachyospiza capensis*, is of even more importance to the faunalist than to the taxonomist. To call this sparrow *Brachyospiza* gives, so far as nomenclature is concerned, no clue to its relationships or geographic origin. To call it *Zonotrichia* at once indicates its congeners and, by inference, the country of at least its recent origin.

In removing this species from the place it had long held in the genus *Zonotrichia* and creating for it the genus *Brachyospiza*, Mr. Ridgway¹ was handicapped by lack of material. His conclusions appear to have been based, largely, on Central American specimens from which certain South American races present wide variation in size and proportions. That these variations represent the differences between *capensis* and its races and the North American members of *Zonotrichia* will be shown by the appended comparison of *leucophrys* and *albicollis* with *capensis pulacayensis* of Bolivia and *c. antofagastae* of Chile.

NAME	No.	WING	TAIL	INDEX	SHORTEST
					TO LONGEST PRIMARY
<i>antofagastae</i>	5	76.0	64.4	84.7	15.0 mm.
<i>pulacayensis</i>	5	82.0	68.5	83.5	15.0
<i>leucophrys</i>	5	77.2	68.2	88.0	18.5
<i>albicollis</i>	5	75.0	70.0	94.0	15.0

Reference to this, and the larger table of measurements, will show, I think, that the mensural differences between *capensis* and its North American allies are not of generic value. Mr. A. J. van Rossem has brought this out very clearly in his paper² on the generic relations of these birds and it is unnecessary to go into this phase of the subject further. I should like, however, to say a word on certain resemblances in color which, to my mind, are of as much, or more, importance than those presented by structure.

Ridgway states that *capensis* has doubt-

less been referred to *Zonotrichia* because of "its boldly striped head." This is quite true, and he might have added that this is not the only marking in which northern and southern members of this group agree. The pattern of the head in *albicollis* and *capensis* is much the same; both also have white throats and, it appears, that the yellow wing-bend which, in varying degrees, occurs in all the North American species of *Zonotrichia* is also found in *Zonotrichia capensis*. In *Z. c. subtorquata* of southeastern Brazil, it is characteristic of the race, and, although but slightly developed, it is also found in most specimens of *antillarum* of Santo Domingo.

The white-tipped outer rectrices characteristic of *Zonotrichia querula*, and present more or less often in other North American species of *Zonotrichia*, are also not infrequently found in *chilensis* and *australis*. I am aware that both a yellow wing-bend and white tail-tip are not confined to the genus *Zonotrichia*. Nevertheless, I believe that their occurrence in these widely separated birds is not only evidence of their remote origin but, in connection with other characters, is evidence of the common ancestry and present relationships of the species. It may pertinently be added that *Melospiza* bears neither of these markings.

I agree with Dr. Wetmore³ and others that *Aimophila strigiceps* of northern Argentina is not a member of the genus *Zonotrichia*. If, as seems probable, it has been properly placed in the northern genus *Aimophila*, the nearest species of which inhabits the highlands of Costa Rica, its distributional history may, in part, resemble that of *Zonotrichia capensis*. Doubtless this may also be said of other South American fringillines, including *Buarremon*.⁴

Further evidences supplied by color of relationships between *capensis* and the northern species of *Zonotrichia* are shown by a specimen of *capensis* in the Philadelphia Academy of Sciences, collected by

¹ Auk, XV, 1898, p. 224; Bull. No. 50, U. S. Nat. Mus., I, 1901, p. 346.

² Auk, XLVI, 1929, p. 549.

³ Bull. No. 133, U. S. Nat. Mus., 1926, p. 424.

⁴ Chapman, Bull. Amer. Mus. Nat. Hist., XLVIII, 1923, pp. 243-278.

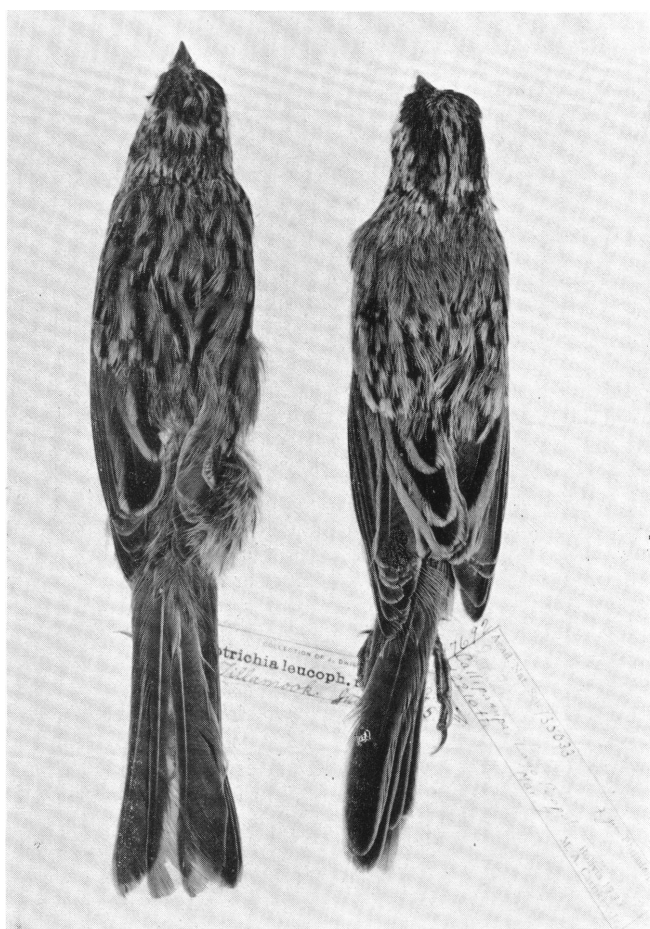


Fig. 2. Resemblance in the juvenal plumage of South American and North American species of *Zonotrichia*.

Left: *Z. leucophrys pugetensis*, Amer. Mus. Nat. Hist. 404262. ♀ ? juvenal, Tillamook, Oregon, July 20, 1915.

Right: *Z. capensis pulacayensis*, Phila. Acad. Nat. Sci. 135033. ♀ juvenal, Callipampa, Lago Poopo (12,210 ft.), Bolivia, March 7, 1938, M. A. Carriker, Jr.

M. A. Carriker, Jr., with four normal specimens of *pulacayensis*, at Entre Rios, alt. 4600 ft., Dept. Tarija, Bolivia. In this specimen the tawny color, except for a barely perceptible trace on the nape, is lacking and there is no black on the neck. The result is a bird which bears a surprising resemblance to *Zonotrichia leucophrys* in the head and underparts and to breeding *Z. querula* in the markings of the back. The latter, indeed, has a wash of tawny on the nape faintly shown in the aberrant Bolivian specimen. No one could examine

these birds without being impressed by their resemblances. (See Fig. 3.)

Continuing our comparisons, a close resemblance is found between the juvenal plumages of various races of *capensis* and of *leucophrys* that suggests common ancestry.

When, to the evidence supplied by form and color, it is added that (except in the distinct *antillarum*) the song of *capensis* strongly reminds the hearer of both that of *albicollis* and *leucophrys*, I think that we are warranted in according it a place in the genus *Zonotrichia*.



Fig. 3. A Bolivian mutant.

Except for a slight tint on the nape, the rufous color is lacking, and the black neck-marks have entirely disappeared.

Phil. Acad. Sci. 135039. Entre Rios, Tarija, Bolivia, Oct. 20, 1936, M. A. Carriker, Jr.

An extreme variation from this specimen is shown by a male from El Eden, 8300 ft., Central Andes, Colombia. The upperparts are essentially normal but the jugulum is wholly black, the breast, sides and flanks rufous, the abdomen and lower tail-coverts broadly streaked with black.

THE SPECIES

Zonotrichia capensis is a white-throated sparrow distributed throughout the greater part of unforested subtropical and temperate America from Chiapas, Mexico, to Cape Horn. It is a bird of open spaces and scattered growths, roadsides and parks, often in the heart of cities. Its song, though simple, is usually sweet and plaintive, but it is subject to both local and racial variation.

In general appearance it varies from five and a half to six and a half inches in length, has a gray crown with black lateral, malar and postocular stripes (except in one race), a gray superciliary, tawny or rufous nuchal collar, wider on the sides of the neck; fore-neck with a usually incomplete black band; back varying from sandy to dark brown

streaked with black; underparts white or whitish, laterally washed with brownish; two white or whitish wing-bars. Sexes alike in color, the female slightly smaller.

Aside from the local individual variations exhibited by this species, it shows a degree of subspecific, or geographic, variation that, as will appear in the following comparative descriptions of its 22 races, affect its size, in whole and in part, and its proportions, the color and pattern of its crown, nape, back, wing-bars, foreneck and underparts. Before attempting to learn the nature, extent and significance of these racial differences we should familiarize ourselves with the seasonal changes exhibited by the individual.

SEASONAL PLUMAGE CHANGES

Plumage change in *Zonotrichia capensis* is effected by molt, fading and wear. The action of these processes radically affects the appearance of the bird and it is essential that their nature and extent be thoroughly understood before attempting to distinguish between seasonal and geographic variation.

It goes without saying that conclusions drawn from the study of specimens should be based on comparison of series in corresponding stages of plumage. In the selection of such series a knowledge of the times of the molt and the nesting season are of much assistance.

MOLT

Zonotrichia capensis belongs in Dwight's¹ Section I, Class A, birds with an annual or single (postnuptial) molt in which the young and adults are alike or nearly alike in winter and nuptial plumages. The juvenal² or second plumage, in which the bird leaves the nest, follows the natal down and is acquired by complete postnatal molt. It is worn for possibly several weeks or longer and is succeeded by the postjuvenal molt which involves all the body feathers and the wing-coverts, but not the rest of the wing nor the tail. The bird is now in first-winter dress which resembles that of the adult. I can find no evidences of spring or prenuptial molt and, in both young and adult, breeding (nuptial) plumage is apparently acquired solely by fading and wear. The extent to which, during the nesting season, these factors express themselves is dependent on environmental conditions.

As usual, complete postnuptial molt follows the nesting season (see beyond) and the bird is again in the fresh unworn plumage which displays its characters most fully. It is, therefore, in this plumage that, when possible, comparisons designed to reveal racial differences should be made.

SEASON

To determine the age of a bird's plumage the taxonomist should have some knowledge of the annual cycle of its species. If we know when a bird nests, we will also know approximately when it molts and we are then in a position to determine the condition of a bird's plumage at a certain date in relation to its plumage for the year. All this helps us select series which are truly comparable. In the following treatment of the races of *Zonotrichia capensis* I have therefore included the available data on this subject as an aid to the systematist.

To illustrate the practical application of this information I call attention to the remarks presented under *Z. c. hypoleuca* and *Z. c. australis*. In the former I try to show that the proposed race *Z. c. "argentina"* is based on seasonal differences in color. In the latter I present the evidence which induces me to believe that there are two forms of this race, a northern as well as a southern, but in default of comparable material the northern form remains unnamed.

From this brief study of molt and nesting season we have, I trust, gained some conception of the relation between the condition of a bird's plumage and the two most important events in its calendar. Let us now begin at the conclusion of the nesting season, when the bird has just acquired the fresh plumage which best shows its characters, and learn the changes which this plumage undergoes before, at the end of a year, it is renewed.

FADING AND WEAR

It is in the back of *Zonotrichia capensis* that the racial characters and effects of fading and wear are most conspicuously shown. As before remarked, the feathers of this region have a black shaft-streak of varying width and a margin of varying shades of brown. Primarily these characters are racial, but their position on the body gives them no protection from the light and they soon show the effects of exposure. The extent and rapidity of this change is in large measure dependent on the degree of humidity or aridity under which the bird lives. In exceptionally

¹ Sequence of Plumages and Moults of the Passerine Birds of New York. Jonathan Dwight, Jr., Ann. N. Y. Acad. Sci., XIII, 1900, pp. 73-360.

² This term is defined beyond.

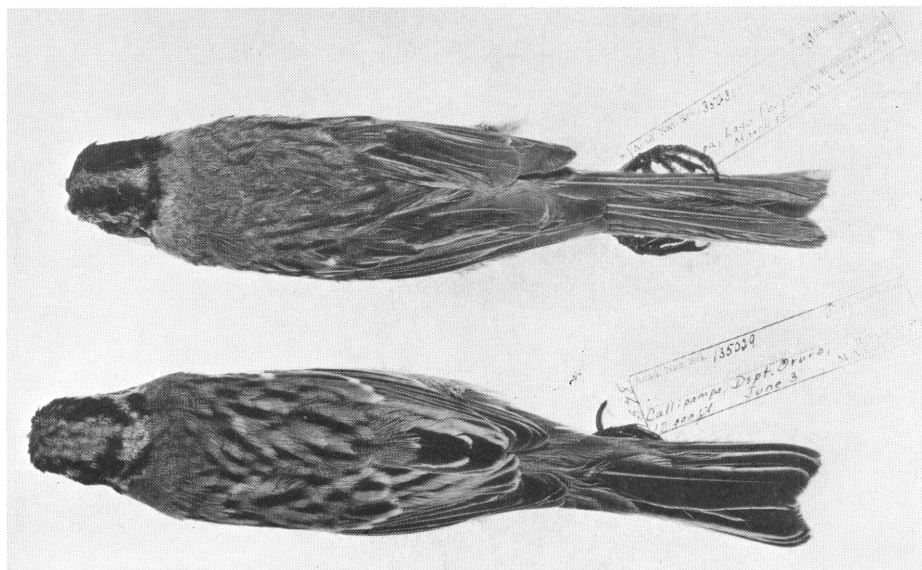


Fig. 4. Worn breeding and fresh postnuptial plumages of *Z. c. pulacayensis* from the same locality.

Upper: Phila. Acad. Nat. Sci. 135031. ♂, Callipampa, Bolivia, March 12, 1938, M. A. Carriker, Jr.

Lower: Phila. Acad. Nat. Sci. 135029. ♂, Callipampa, Bolivia, June 3, 1936, M. A. Carriker, Jr.

arid regions the comparative lack of shade and the dryness of the atmosphere tend to promote both fading and brittleness of plumage with consequent loss of color and change of form through breaking down of feather structure. By the end of the breeding season this may have produced a bird in which both the original pattern and color of the back have completely disappeared. See, for example, the accompanying photographs of fresh and worn specimens of *Z. c. pulacayensis* from Callipampa in western Bolivia and of similarly plumaged specimens of *Z. c. peruensis* from Pisco and an adjoining region on the coast of Peru. The significant fact revealed by a study of our large series of both these races is that in other parts of their range they do not show the same amount of fading and wear exhibited by the Callipampa and Pisco specimens mentioned above. It follows, therefore, that comparable series are not always composed of birds taken at the same season in their respective localities, but of birds in corresponding stage of plumage, and, when pos-

sible, this should be the stage immediately following the postnuptial molt.

The importance of this procedure is shown in Argentina where, apparently, fresh plumaged specimens from the northern part of the country (*Z. c. hypoleuca*) are not separable from similarly plumaged specimens from the Buenos Aires region (*Z. c. "argentina"*). When, however, series of birds in worn breeding plumage are compared, it is quite evident that the north Argentine series is less faded and worn than the Buenos Aires series and, consequently, that it is decidedly more rufescent. The difference is greater than that which separates numbers of subspecies in this group and might induce one to describe what, in effect, would be a seasonal subspecies.

A possibly similar case is presented by *Z. c. australis* but, as stated under that race, I lack material on which to base a satisfactory conclusion.

With these preliminary remarks I present analyses of the 22 races of *Zonotrichia capensis* here recognized, and outlines of their respective ranges.

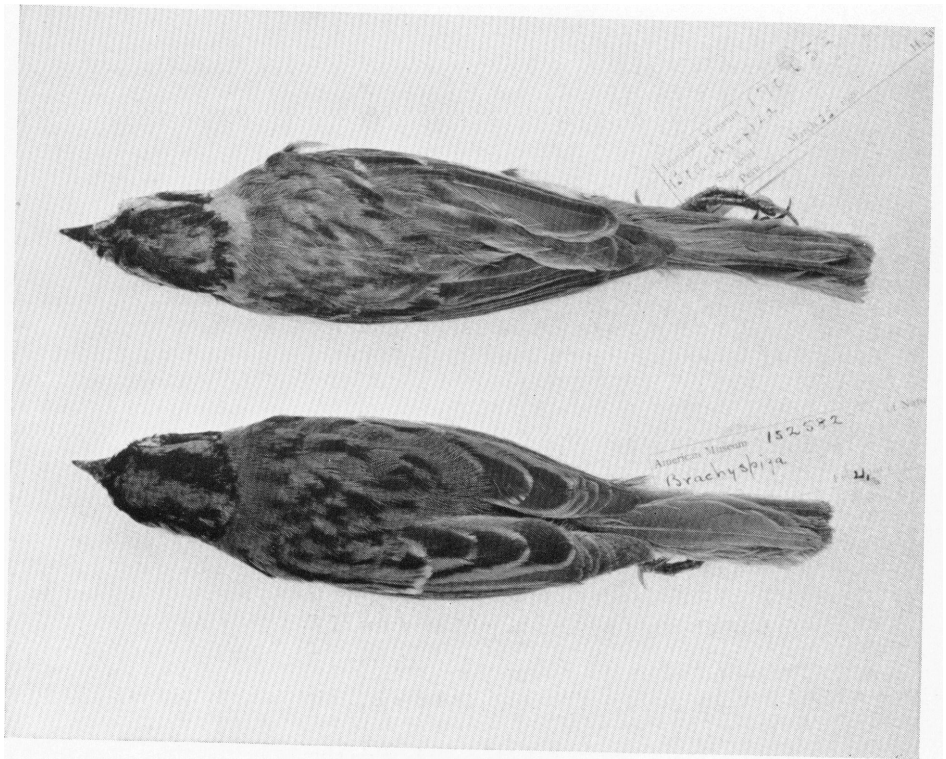


Fig. 5. *Zonotrichia c. peruviansis*.

Illustrating extent of wear in Peruvian Coastal specimens of nearly the same date.
 Upper: Amer. Mus. Nat. Hist. 170652. Pisco, Peru, March 25, 1920, H. Watkins.
 Lower: Amer. Mus. Nat. Hist. 152582. ♂, Vitarte, Huaral Peninsula, Peru, Feb. 21, 1919, H. Watkins.

THE RACES

1.—*Zonotrichia capensis septentrionalis* Griscom

GUATEMALAN SPARROW

Zonotrichia capensis septentrionalis GRISCOM, 1930, Amer. Mus. Novit., No. 438, p. 12 (Chichicastenango, Guatemala. Type in American Museum of Natural History).

SUBSPECIFIC CHARACTERS.—"Nearest *Zonotrichia capensis costaricensis* Allen in general coloration, but black streaking above much less broad and heavy, as in *peruviana*; nuchal collar less sharply defined, the rufous tinge invading the interscapular area; decidedly larger." (Griscom.)

RANGE.—Arid Subtropical and Temperate Zones, Chiapas, Mexico; Guatemala, Honduras and El Salvador.

Decrease of the tawny lateral margins of the dorsal feathers creates the effect of wider black shaft-streaks, particularly in Costa Rican birds, which appear to show the effects of wear more than those from Guatemala. Wear also more sharply defines the nuchal collar from the back. In my opinion, therefore, the color characters attributed to this race are, in part, produced by wear.

Small series from the mountains of Chiapas, Honduras and Salvador agree with Guatemalan birds in color but average slightly smaller. Traces of bars on the under tail-coverts are of not infrequent occurrence in Central American specimens.

Our Guatemalan series contains 63 specimens representing every month. We have only one specimen in excessively worn plumage (Panajachel, 4900 ft., ♀ "incubating") while two of ten from Chiapas (San Cristobal, Sept. 17 and 26) are even more worn. Our only specimen in post-nuptial molt was taken December 31 at Momostenango but adult winter plumage is evidently acquired earlier in the month.

No signs of seasonal change are shown until April after which increasing, but rarely pronounced, evidences of fading and wear are noticeable. During the first three months of the year, therefore, the plumage satisfactorily exhibits the characters of the race. I am unable to say to what extent nesting-time may be affected locally by climatic conditions but these specimens show that it is under way in July (Tepcam, 7150 ft., Aug. 11, 1, beginning postjuvénal molt) and continues at least until December (Momostenango, 6500 ft., Jan. 14, 1 ♂, just completing postjuvénal molt). It therefore roughly conforms to the wet season which, according to Griscom, lasts from May to November in the Altos, "with more or less of an interruption in August."¹

SPECIMENS EXAMINED*

(73 adults; 3 juvenals)

LOCALITIES REPRESENTED. — GUATEMALA: Antigua (5072 ft.), 3; Barrillos (5200 ft.), 4; Chichicastenango (6500 ft.), 13, 1 juv.; Finca La Primavera, 2; Finca Sepacuite, 2; La Perla (4400 ft.), 1; Momostenango (6500 ft.), 8; Nebaj, 7; Panajachel (4900 ft.), 5; Quetzaltenango (7697 ft.), 1; San Lucas (4900 ft.), 5; San Mateo (9000 ft.), 6; Tepcam (7140 ft.), 4, 2 juv.; Uspantan (6000 ft.), 1; Zanjón (9500 ft.), 1. HONDURAS: San Juancito (5700 ft.), 2¹; (6000 ft.), 1¹. MEXICO: Comitán, 2²; Pinabete, 1²; San Cristóbal, 7². SALVADOR: Los Essemiles, Chalatenango (6400 ft.), 4³; Volcán Santa Ana, Dept. Santa Ana (7200 ft.), 2³.

MONTHS REPRESENTED. — GUATEMALA: Jan., 11; Feb., 13; March, 5; April, 8; May, 8; June, 1; July, 4; Aug., 2, 1 juv.; Sept., 2; Oct., 1, 1 juv.; Nov., 1; Dec., 7, 1 juv. HONDURAS: July, 2; Aug., 1. MEXICO: Feb., 1; March, 1; Sept., 7; Dec., 1. SALVADOR: Feb., 1; March, 3; May, 2.

¹ 1932, Bull. Amer. Mus. Nat. Hist., LXIV, p. 19.

* For references to footnote numbers see p. 384.

		MEASUREMENTS	
		WING	TAIL
Chiapas,			
Mexico	2♂	67-68 (67.5)	58-58 (58)
Guatemala	5♂	68-75 (70)	58-65 (60.4)
Salvador	6♂	64-72 (68.3)	55-62 (58.5)
Honduras	2♂	66-67 (66.5)	55-59 (57)
Costa Rica	8♂	62-67 (64)	50-57 (54)

2.—*Zonotrichia capensis antillarum*
(Riley)

CONSTANZA SPARROW, SIGUA, SIGUITA

Brachyspiza antillarum RILEY, 1916, Smiths. Misc. Coll., 66, p. 2 (Constanza, Santo Domingo. Type in United States National Museum).

SUBSPECIFIC CHARACTERS.—Resembling *Z. c. septentrionalis-costaricensis*, but bend of the wing usually faintly tinged with yellow; black band on the foreneck complete; tips of wing-coverts buffish, rather than pure white; the rufous nuchal band less developed, more fused with the back, the black postocular and malar stripe usually meeting behind the gray auriculars; the sides and flanks more heavily washed with grayish olive.

RANGE.—Higher mountains of the central part of the Dominican Republic.

The completed black collar on the foreneck is the most conspicuous distinctive character of this race. In this respect it more nearly resembles the Central American races than any other forms of the species, a fact which has led to the suggestion that it may have reached Santo Domingo from Central America. On the other hand, its yellow wing-bend implies a more direct connection with the North American members of the genus, a theory I have before advanced.² In addition to its completed neck-band and yellow wing-bend, *antillarum* differs from the Central American forms in its generally darker colors, decreased rufous nuchal band, enclosed auriculars and tinted covert-tips; while, aside from a slight increase in size from the equator northward, the continental birds are essentially alike from Ecuador to Chiapas, Mexico. In short, one asks, if *antillarum* has been derived from Central America, why should it differ from *septentrionalis* and *costaricensis* so widely while they have remained so like each other? True, it has the isolation of insularity, but the present

² Bull. Amer. Mus. Nat. Hist., LXIII, 1931, p. 51.

distribution of the continental birds indicates that there have been wide gaps in their ranges ever since they retreated to them. Moreover, the descriptions by Bond and van Rossem of the songs of the Santo Domingo and El Salvador forms, respectively, indicate that they differ widely from one another.

Of the former Bond writes: "The song of the Dominican bird resembles that of a Swamp Sparrow (*Melospiza georgiana*), being utterly different from the song of the race from Curaçao and Aruba, which is rather like that of an oriole or meadow-lark";¹ while of the El Salvador bird (which he refers to *costaricensis*) van Rossem writes: "The song, as well as the general appearance and habits of these birds, was so much like *Zonotrichia gambelii* that a person ignorant of their true identity might well be convinced that he was in fact listening to, or seeing the common crowned sparrow of the north."² (See also remarks beyond under "The Black Neck-marks.")

Wetmore and Swales³ write that on May 19 Wetmore observed a female collecting nesting material while Dr. W. L. Abbott collected juvenals September 23 to 25. Our four juvenals, taken July 31 to August 4, were probably collected in the heart of the breeding season which evidently occurs during the rainy season. The post-nuptial molt, therefore, probably takes place in the fall, a period not represented in our collection. March birds, however, show but little wear and may evidently be accepted as properly representing the race.

SPECIMENS EXAMINED

(35 adults; 4 juvenals)

LOCALITIES REPRESENTED.—DOMINICAN REPUBLIC: Constanza (1200 m.), 4, 4 juv.; La Vega (1200 m.), 9; Manabás (700–900 m.), 2; Mt. Rusilla, 19; Mt. Tina, 1.

MONTHS REPRESENTED.—DOMINICAN REPUBLIC: Jan., 1; March, 19; May, 2; June, 4; July, 4, 2 juv.; Aug., 5, 2 juv.

3.—*Zonotrichia capensis costaricensis* Allen

COSTA RICAN SPARROW, COMEMAIZ (Costa Rica), EL COPETÓN (Bogotá; Mérida).

Zonotrichia capensis costaricensis ALLEN, Bull. Amer. Mus. Nat. Hist., 3, 1891, p. 374 (San José, Costa Rica. Type in American Museum of Natural History).

SUBSPECIFIC CHARACTERS.—Nearest *Z. c. septentrionalis* but smaller. Resembling *Z. c. peruviansis* but smaller, more rufescent above, rump, sides and flanks averaging browner, underparts generally less white, breast and anal region more washed with grayish or brownish; no yellow on wing-bend.

RANGE.—Arid Subtropical and Temperate Zones of Costa Rica and western Panama (also on Coiba Island), Colombia (including Santa Marta, Todd), Andean Venezuela east to Cubiro, 1800 m.; Ecuador to Peruvian boundary.

Considerable variation is shown by our 190 specimens from the wide area above outlined. Some of it is doubtless of racial value but, as already stated, our collections do not permit of its satisfactory understanding. Specimens from western Panama and the western Andes of Colombia have less tawny on the nape than the rest of the series. Twelve birds from the Cauca Valley, as a series, are paler than average *costaricensis* and thus show the variation presented by other birds from this region. Specimens from Mérida eastward to Cubiro, Venezuela, apparently belong here. Specimens from Alamor, southwestern Ecuador, are darker; those from Ibarra paler than the average. Specimens from the east slope of the Andes about Baeza seem dark; five from Oyacachi have the crown darker than the average but none of these cases is conclusive. As a whole, *costaricensis*, as here recognized, is distinguished chiefly by its comparatively soiled underparts.

Carriker writes that in Costa Rica this bird ranges from 2500 feet to timberline. He "found it breeding in great abundance on the Volcán de Irazú at an elevation of 8000 to 9000 feet"⁴ but unfortunately gives no date. However, Salvin and Godman⁵ state that "von Frantzius found this bird breeding in his garden in Costa Rica at the commencement of the rains in April. This statement is confirmed by our collection which contains specimens labelled as "breed-

¹ Check-List of Birds of the West Indies, 1940, p. 159, footnote.

² Field Mus. Pub. No. 406, 1938, p. 570.

³ U. S. Nat. Mus., 1931, p. 446.

⁴ Ann. Car. Mus., XI, p. 907.

⁵ Biol. Cen.-Amer., I, p. 371.

ing" from Aquinares, March 31, and Irazú, May 12. A juvenal specimen was taken at San José, May 31. Todd records two juvenal specimens and one in postnuptial molt taken at Ujarrás or Terraba in "September." From these data we judge that the breeding season extends from late March to September.

From Carriker (*op. cit.*, p. 316) we learn that in the Plateau region of Costa Rica, where *Z. capensis* is chiefly found, the rainy season begins about May 1 and ends the last of November. So again we discover that nesting season and wet season essentially coincide.

SPECIMENS EXAMINED

(190 adults; 23 juvenals)

LOCALITIES REPRESENTED.—COLOMBIA: Andalusia (3000 ft.), 2; Bogotá, 7, 2 juv.; Bogotá Savanna (8750 ft.), 4, 2 juv.; Caldas (2000 ft.), 2, 2 juv.; Cali (3500 ft.), 4, 1 juv.; Cauca, 1; Cerro Munchique (8325 ft.), 2; (7000 ft.), 1 juv.; Chipaque (8500–9500 ft.), 2; Choachi, 5; El Eden (8300 ft.), 3, 1 juv.; El Piñón (9600 ft.), 1 juv.; El Roble (7200 ft.), 2; Fómeque, 3; La Frijolera (5000 ft.), 1; La Guneta (10,300 ft.), 1; La Holanda (2650 ft.), 4; La Palma (5500 ft.), 1; La Sierra (6800 ft.), 1; La Tigarrera (6700 ft.), 1 juv.; Las Garces (7200 ft.), 1; Medellín, 3; Palmira (3500 ft.), 1; East of Palmira (6800 ft.), 2; Paramillo (12,500 ft.), 9; Popayán (5800 ft.) 1 juv.; Popayán, W. of (10,340 ft.), 2; Quetame (4800 ft.), 2; Ricaurte (5000–6000 ft.), 3, 1 juv.; Rio Toché (6800 ft.), 2, 4 juv.; Salento (7000 ft.), 1; above Salento (9000 ft.), 1; near San Agustín (5000 ft.), 4; San Antonio (6600 ft.), 6, 1 juv.; Santa Elena (9000 ft.), 1; Santa Isabel (12,000 ft.), 3; Valle de las Papas (10,000 ft.), 2. COSTA RICA: Agua Caliente, 1; Aquinares (3800 ft.), 2; Cartago (5000 ft.), 1; Coliblanco, 1; San José, 4 (incl. type), 1 juv.; Volcán Irazú (7000–10,500 ft.), 9; Volcán Turrialba (8500–9680 ft.), 5. ECUADOR: Alamor (4550 ft.), 9, 1 juv.; Baeza, 2, 3 juv.; Bestion (10,100 ft.), 3; Cayambé (ab. 10,000 ft.), 2, 3 juv.; Chical (10,000 ft.); El Paso (9200 ft.), 6; Gualala, 1; Huigra, 1; Ibarra (6600 ft.), 5, 3 juv.; Loja (7000 ft.), 2; (9000 ft.), 1; Mt. Chimborazo (12,000–14,000 ft.), 2; Mt. Pichincha, 2; Mocha, 1; Oyacachi, 5, 1 juv.; Papallacta Abajo, 1; Punta Sta. Ana (3650–4500 ft.), 1; Quito, 5; Salvias (3600 ft.), 1; Taraguacocha (9750–11,000 ft.), 2, 1 juv.; Valle de Cumbaya, 1; Zaruma (6000 ft.), 3. PANAMÁ: Boquete, 11, 1 juv.; Cerro Flores (3600 ft.), 1; Chiriquí, 1; Coiba, 1 juv.; Santa Fé, 3; Veragua, 1. VENEZUELA: Altamira, Trujillo (1600 m.), 1; Campos de Mérida, 1; Campos de San Cristóbal (825 m.), 1; Chochopo, Mérida (2840 m.), 2; Cubiro, Lara (1800 m.),

2; Mérida (1600 m.), 12, 1 juv.; Paramo Misisi, Trujillo (2100 m.), 9; Paramo Mucuchies, Mérida (2000 m.), 1; (3000 m.), 3; (3120 m.), 1; (3900 m.), 1; Paramo de Tamá, Villa Paez (2050 m.), 1; Timotes, Mérida (2000 m.), 2; (2800 m.), 1.

MONTHS REPRESENTED.—COLOMBIA: Jan., 14; Feb., 10, 3 juv.; March, 6, 1 juv.; April, 10, 2 juv.; May, 12, 1 juv.; June, 5, 1 juv.; July, 2; Sept., 7, 2 juv.; Oct., 5, 5 juv.; Nov., 5, 2 juv.; Dec., 2; date unknown, 10, 1 juv. COSTA RICA: Jan., 1; Feb., 2; March, 3; April, 1; May, 9, 1 juv.; Aug., 4; Sept., 2; Oct., 1. ECUADOR: Jan., 10; May, 8, 3 juv.; June, 5, 3 juv.; July, 6, 1 juv.; Aug., 11, 1 juv.; Sept., 4, 1 juv.; Oct., 7; Nov., 1; Dec., 5, 3 juv. PANAMÁ: Feb., 3; March, 1; June, 1 juv.; Aug., 5, 1 juv.; Sept., 6; date unknown, 2. VENEZUELA: Jan., 2; Feb., 4; April, 3, 1 juv.; July, 2; Aug., 1; Oct., 1; Nov., 23; date unknown, 2.

4.—*Zonotrichia capensis huancabambae*, new subspecies

HUANCABAMBA SPARROW

SUBSPECIFIC CHARACTERS.—Agreeing in general size with *Z. c. costaricensis* but bill slightly longer, central underparts whiter, breast with less, if any, grayish tinge, brownish wash of flanks and sides paler, less extensive. Similar to *Z. c. peruviansis* but smaller, foreneck-band more compact, nape well defined from back, averaging blacker, less rufescent above.

TYPE.—No. 186111, Amer. Mus. Nat. Hist.; ♂ ad.; San Felipe, 5000 ft., Rio Huancabamba, n. Peru; Oct. 3, 1924; H. Watkins.

RANGE.—Arid subtropics of northern Peru from Palambla and Huancabamba southward in the western Andes to Chugur, northwest of Cajamarca, and in the eastern Andes to the Chachapoyas region.

This is a zonal representative of *Z. c. peruviansis* which is found above it in the Puna Zone at Huamachuco, near Cajabamba, and below it on that part of Peru's coast affected by the Humboldt Current.

In the Chanchamayo Valley it is replaced by the closely allied *Z. c. carabayae* which here likewise serves as the subtropical representative of *Z. c. peruviansis* at this point occupying the Puna Zone of the Junín region.

Without regard to locality, *huancabambae* may always be distinguished from *peruviansis* by its almost constantly smaller size, the wing in the male of the former being under 70 mm. while in the latter it is over 70 mm.

With *costaricensis*, *huancabambae* agrees in size but it is notably whiter below. The line between the ranges of the two appears to be sharply drawn, a series from Alamor on the border of Peru and Ecuador having in a pronounced degree the soiled underparts of *costaricensis* while birds from the neighboring parts of Peru are equally distinguished by their comparatively white underparts.

SPECIMENS EXAMINED

(28 adults)

LOCALITIES REPRESENTED.—PERU: Cajabamba (9000 ft.), 1; Chugur (9000 ft.), 4; El Tambo (9400 ft.), 1; Huancabamba (6500 ft.), 3; Huarandosa (3000 ft.), 1; La Lejia (ab. 9000 ft.), 5; Lomo Santo (5000 ft.), 2; Palambra (3900–6500 ft.), 6; San Felipe (5900 ft.), 3; Seques (5000 ft.), 1; Taulis (8850 ft.), 1.

MONTHS REPRESENTED.—PERU: Jan., 1; Feb., 3; Mar., 2; April, 3; May, 3; June, 1; Aug., 1; Sept., 4; Oct., 6; Nov., 3; Dec., 1.

5.—*Zonotrichia capensis peruviansis* (Lesson)

PERUVIAN SPARROW, GORRION (coast),
PICHINCHO (Andes)

Pyrgita peruviansis LESSON, 1834, l'Institute, 2, p. 317 (Callao, Peru. "Location of type unknown," Hellmayr).

SUBSPECIFIC CHARACTERS.—Resembling *Z. c. huancabambae* but larger, the black dorsal stripes narrower, their margins slightly less rufescent, breast averaging whiter. Resembling *Z. c. pulacayensis* (Cuzco specimens) but smaller, less rufescent above, averaging slightly grayer above. Resembling *Z. c. carabayae* (Merced-Tulamayo specimens) but larger, paler above, whiter below.

RANGE.—Temperate and Puna zones of the Peruvian Andes at Huamachuco, south of Cajabamba, south on the tableland to the range of *pulacayensis* and on the coast from at least Trujillo to Tacna.

The name *peruviansis* (*peruviana* of earlier authors) has been applied to representatives of *Zonotrichia capensis* from southern Mexico to Chile. Adequate material, however, shows that it belongs to the Puna bird of Central Peru and the faunally comparable part of the Pacific coast from Trujillo, Prov. Libertad, south to Tacna. South of Tacna it is apparently

replaced by *Z. c. antofagastae* which, in turn, gives way to *Z. c. chilensis*; none of these races is known to intergrade with the other.

Specimens from the provinces of Arequipa and Moquegua agree in size with a topotypical series of *peruviansis* but have, as a whole, less black on the foreneck, average slightly whiter below and somewhat more rufescent above. These differences, however, are not, in my opinion, sufficiently developed to be of racial value.

Sixty-five specimens from the Peruvian coastal region represent the country from Ilo to Trujillo and every month but August–October. Collected by the late Harry Watkins and R. H. Beck for the Museum they are carefully labelled with the condition of the gonads. From these data and those supplied by the plumage, we learn that at Lima the breeding season begins late in January and at Trujillo and Ica continues until early May. Five adults from Pisco (March 24, 25) are in such excessively faded and worn condition that they are dull uniform gray above, almost without pattern. Five apparently comparable specimens from Trujillo (April 3–6) are much less denuded. Specimens taken in southwestern Peru from mid-May through June are in unworn plumage, those from Vitor in July are also unworn; but November and December specimens from Hualal begin to show seasonal change.

Twenty-one specimens from the tableland indicate that the breeding season there, as on the coast, extends from January to May.

SPECIMENS EXAMINED

(89 adults; 5 juvenals)

LOCALITIES REPRESENTED.—PERU: Aco-bamba (alt. 10,000 ft.), 2; Arequipa, 4; Cajamarca (10,000 ft.), 1; Chipa (12,400–14,000 ft.), 6; Cocachacra (sea-level), 6; Huacho, 3, 1 juv.; Huamachuco (10,400 ft.), 2; Hualal, 12; Ica, 1, 1 juv.; Ilo, 2, 1 juv.; Islay, 1; Lima, 4; Maraynioc (10,850 ft.), 7; Mazorca Island, 1; Moquegua (1367 ft.), 4; Oroya, 3; Pisco, 5, 2 juv.; Rumicruz (9700 ft.), 3; Sayán, 1; Trujillo (350 ft.), 7; Vitarte, 9; Vitor, 5.

MONTHS REPRESENTED.—PERU: Jan., 9, 1 juv.; Feb., 10; March, 14, 2 juv.; April, 12; May, 7, 1 juv.; June, 12, 1 juv.; July, 6; Nov., 6; Dec., 14.

6.—*Zonotrichia capensis carabayae*,
new subspecies

CARABAYA SPARROW

SUBSPECIFIC CHARACTERS.—Resembling *Z. c. pulacayensis* but less rufescent, much darker, the black stripes of the sides of the crown and on the back broader, the lowerparts grayer. Resembling *Z. c. peruviansis* and *Z. c. huanca-bambae*, but lowerparts, particularly the breast, grayer, upperparts more rufous.

TYPE.—No. 150012, Amer. Mus. Nat. Hist., ♂ ad., Limbani, 10,000 feet, Carabaya, southeastern Peru; Aug. 26, 1918; H. Watkins.

RANGE.—Eastern slope of the eastern Andes from at least Province of Junín at 2000 feet altitude, southward through the middle Urubamba Valley and Limbani at 10,000 feet, to Incachaca, Bolivia, at 7700 feet.

I apply this name to the form of *Zonotrichia capensis* occupying favorable localities on the eastern slope of the Andes from Peru to Bolivia. Specimens from this wide area agree in color but vary in size, those from the higher altitudes being the larger.

In northern Peru this race is represented by *huanca-bambae* of the subtropics. Specimens are lacking from northeastern Peru, eastern Ecuador and eastern Colombia to show whether it is present there.

In the Province of Junín, where this race has the wing below 70 mm., it is the southward continuation of *Z. c. huanca-bambae* of the arid subtropics of northern Peru and, like that form, it is also the subtropical representative of *peruviansis*, with which it doubtless merges in the higher parts of its range. From San Miguel Bridge on the Urubamba River and southward through Limbani to Incachaca (7700 ft.), northeast of Cochabamba, this race represents *pulacayensis*, and at the latter place it apparently intergrades with *hypo-leuca*. Doubtless more material may show a more satisfactory way of disposing of these Amazonian slope birds. Meanwhile the present treatment is offered.

SPECIMENS EXAMINED*
(45 adults)

LOCALITIES REPRESENTED.—BOLIVIA: Calabatea (4600 ft.), 2¹; Chorros (11,000 ft.), 1¹;

El Cumbre (15,200 ft.), 1; Hichuloma (10,700 ft.), 2¹; Incachaca (8000 ft.), 6¹, 6³, 3; Pongo (12,000 ft.), 1; Sandillani (6600 ft.), 2¹. PERU: Huaracundo Cañon (10,000 ft.), 1; La Merced (2600 ft.), 2; Limbani (10,000 ft.), 7; Machu Picchu (5000 ft.), 1; Ollantaytambo (9700 ft.), 1; Perené (2000 ft.), 1; Rio Seco (3000 ft.), 1; Tulumayo (4000 ft.), 5; Utcuyacu (4800 ft.), 2.

MONTHS REPRESENTED.—BOLIVIA: Jan., 2; Feb., 2; April, 2; May, 4; June, 1; Aug., 4; Sept., 1; Nov., 6; Dec., 2. PERU: May, 5; July, 4; Aug., 7; Oct., 1; Nov., 3; Dec., 1.

7.—*Zonotrichia capensis pulacayensis*
(Ménégaux)

PULACAYO SPARROW

Brachyspiza capensis pulacayensis MÉNÉGAUX, "1908," Bull. Mus. Hist. Nat. Paris, 14, No. 7, p. 341, pub. Jan. 1909 (Pulacayo and Pampas de Pazña, Lake Poopó, Oruro, Bolivia. Type in Paris Museum).

SUBSPECIFIC CHARACTERS.—One of the most tawny or rufescent races of the species; margins of feathers of the upperparts, including wings, bright ochraceous-tawny (between ochraceous-orange and ochraceous-tawny) nearly as rich in tone as the nape which blends with the back; rump and upper tail-coverts, sides and flanks, strongly tinged with the color of the back, underparts pale creamy, whiter on the abdomen. One specimen (Cuchacancha, June 16), in a series of 103, shows a very faint trace of bars on the lower tail-coverts. None shows yellow on the bend of the wing.

RANGE.—Tableland of western Bolivia and southeastern Peru; from Argentina northward to Cuzco and the Cochabamba region.

This diagnosis is based on five fresh plumaged birds in the Philadelphia Academy of Science, collected by Carrier at Oploca (11,000 ft.), Potosi, about 100 miles southeast of Pulacayo, the type-locality of this race. Six comparable specimens in the same collection from Callipampa (2), on Lake Poopó, near Pazña (locality of Ménégaux's second specimen), Llallaga and Catavi, a few miles east, may be slightly paler below but in other respects agree with the Oploca birds. The beginning of a postnuptial molt is shown by a specimen taken at Callipampa, March 7. The series of 11 birds, in unworn plumage, I accept as adequately and authentically representing *pulacayensis*. Using it as a basis for comparison I finally conclude that

* For references to footnote numbers see p. 384.

this form, with some variation, occupies the tableland of western Bolivia, and south-eastern Peru. Peruvian interandine birds, northward at least to Cuzco, average darker above and grayer below but the difference is completely bridged by individual variation.

Specimens from the Cochabamba region are not so readily named. A series of 13 from Cuchacancha (11,000 ft.), in a small enclosed valley east of Cochabamba, average obviously grayer than true *pulacayensis*. Other specimens suggest similar local variations, but in no instance do I find characters and range both sufficiently developed to meet the practical ends of nomenclature. Possibly a trained collector might discover consistent associations of cause and effect. Meanwhile I feel that the purposes of taxonomy, and probably also biology, may best be served by applying the name *pulacayensis* to all these tableland birds.

Eighty-seven specimens cover the range above outlined and represent every month. Twenty-two specimens in worn breeding plumage, taken from January 20 (Lake Titicaca) to April 22 (near Cochabamba), apparently mark the opening and close of the breeding season. Specimens from Callipampa, Lake Poopó (March 12), show the extreme of wear. From May 5 to early September little change is exhibited. Then evidence of wear is gradually shown until, in late December, the bird is again in worn breeding plumage.

Ten specimens from and above Taffí del Valle (7000–9500 ft.) west of Tucumán, Argentina, are much less tawny than topotypical *pulacayensis*. They are approached, however, by duller specimens from the Titicaca region. I refer them provisionally to *pulacayensis*. Two of them are in worn breeding plumage (Feb. 9; April 3). The remaining eight (March 24–April 3) are in postnuptial molt. The breeding season presumably ends here sooner than it does on the Bolivian tableland.

When we leave the tablelands for the east and west we will find that with lower elevation *pulacayensis* merges with *hypoleuca*, which extends eastward into the

llanos and Chaco and southward into Argentina, as is stated under that race.

Toward the west, and also the north, we discover that on the Andean slope leading to the Pacific, *pulacayensis* has developed into an exceptionally interesting form, while northward on the Amazonian side of the Cordillera it is represented by a quite different race. With both of them it intergrades. Thus, from Limbani (10,000 ft.) on the eastern slope of the Eastern Andes, about 70 miles northeast of Tira-pata, Peru, on the railway to Cuzco, we have seven specimens of a much darker form than *pulacayensis*, while from the Rio Loa, on the line of the railway between Pulacayo and Antofagasta, we have a small series of a distinct representative of *pulacayensis*. These birds are here described.

SPECIMENS EXAMINED*

(102 adults; 5 juvenals)

LOCALITIES REPRESENTED. — ARGENTINA: Taffí del Valle (7000 ft.), 6, 1 juv.; above Taffí del Valle (9500 ft.), 3, 1 juv.; Tilcara (8000 ft.), 1. BOLIVIA: Callipampa (12,000 ft.), 1¹; (12,210 ft.), 3¹, 1 juv.¹; Catavi (12,500 ft.), 1¹; Cochabamba (2500 m.), 2¹; (2500 m.), 2³; (2600 m.), 3; (2700 m.), 2; (3200 m.), 1; Cuchacancha (11,000 ft.), 13; Gauqui (12,000 ft.), 4; Llallagua (13,000–13,600 ft.), 3¹; (13,500–14,000 ft.), 1 juv.¹; Oploca (11,000 ft.), 4¹; (10,300 ft.), 2¹; Parotani (8800 ft.), 6, 2⁴; Poopó, 1 juv.; Pulque (9400 ft.), 2; Rio Cachamayo (8700 ft.), 2; Rio Mizque (5000 ft.), 1¹; Rio Pilcomayo (8000 ft.), 3; San Lorenzo (7500 ft.), 1¹; Tarata (9800 ft.), 1; Tiraque (11,000 ft.), 2¹; (5200 m.), 1³; Tujma (8200 ft.), 3; Tutimayo (10,500 ft.), 2¹; Vinto (8600 ft.), 2. PERU: Cuzco (11,000 ft.), 6; Lake Titicaca (12,500 ft.), 4; La Raya, 1; Ollantaytambo (9700 ft.), 1; Puno, 2⁴; Tica-Tica, near Cuzco (11,500 ft.), 5; Tirapata (12,700 ft.), 4.

MONTHS REPRESENTED.—ARGENTINA: Feb., 1; March, 6, 1 juv.; April, 3, 1 juv. BOLIVIA: Feb., 6; March, 5, 1 juv.; April, 4; May, 9, 1 juv.; June, 24, 1 juv.; July, 5; Aug., 1; Sept., 6; Oct., 1; Nov., 5; Dec., 3. PERU: Jan., 6; April, 1; July, 10; Oct., 3; Nov., 3.

8.—*Zonotrichia capensis antofagastae*, new subspecies

ANTOFAGASTA SPARROW

SUBSPECIFIC CHARACTERS.—Similar to topotypical *Z. c. pulacayensis* but smaller, general color above brighter, black shaft-streaks of back

* For references to footnote numbers see p. 384.

usually narrower; sides and flanks more rufescent, jugulum with more black, lower tail-coverts usually more or less barred with ochraceous-tawny (7 of 10 specimens).

TYPE.—No. 61888, Field Mus. Nat. Hist.; ♂ ad.; Rio Loa, Prov. Antofagasta, Chile; Sept. 11, 1923; C. C. Sanborn.

RANGE.—Provinces of Antofagasta and Tarapacá, Chile, from at least 7500 feet to sea-level.

The acquisition of an excellent, essentially topotypical series of *pulacayensis* shows that specimens from the adjoining Pacific slope are separable from the tableland form. Two specimens collected for the Carnegie Museum at Tocopilla, Chile, by A. C. Twomey, not only carry this form to the coast but confirm the characters shown by the Field Museum series. In addition to the differences of degree presented by this new form, it definitely introduces the character of barred under tail-coverts into the *capensis* group. Seven of our ten specimens of *antofagastae*, representing three localities, more or less clearly exhibit this mark. It is particularly well shown by a male from Tocopilla which has six distinct bars on the lower tail-coverts (see photograph, p. 433).

This race is so unlike both *peruviansis* and *chilensis* that, if it is resident on the Chilean coast, it apparently separates the ranges of these two forms in that region. No other member of the group has been recorded from between Atacama and Tacna.

SPECIMENS EXAMINED*

(10 adults)

LOCALITIES REPRESENTED.—CHILE: Canchones, 14; Pica (4000 ft.), 24; Rio Loa (7500 ft.), 54; Tocopilla, 23.

MONTHS REPRESENTED.—CHILE: March, 2; April, 1; May, 3; Sept., 4.

In order that the various races may be considered from the north southward I continue treatment of the group with *Z. c. venezuelae*.

9.—*Zonotrichia capensis venezuelae* Chapman

VENEZUELA SPARROW, CORREPORSUELO,
CHORTA (Colonia Tovar)

Zonotrichia capensis venezuelae CHAPMAN, 1939, Amer. Mus. Novit., No. 1051, p. 13 (Caracas, 5600 ft., Mt. Turumiquire, N.E. Venezuela. Type in American Museum of Natural History).

SUBSPECIFIC CHARACTERS.—Similar to *Zonotrichia capensis capensis* (P. L. S. Müller) of French Guiana, but with more black on the throat and with the ventral region and lower tail-coverts slightly paler; resembling Mérida specimens of *Zonotrichia capensis costaricensis* (Allen) but with the sides and flanks less heavily washed, the ventral region and lower tail-coverts whiter.

RANGE.—Coastal mountains of Venezuela from the Valencia-Caracas range eastward to Sucre.

Re-examination of our material leads to the conclusions regarding its relationships already presented. This is obviously not the bird found in the Mérida region, and it is equally clear that it is not *capensis capensis* from which, in addition to the characters mentioned, it is separated by about 600 miles of territory in which *Zonotrichia* is unknown.

The two birds from Caicara, on the middle Orinoco, are now contained in our collection. They were collected by George Cherrie on April 6, 1898, and recorded by him (Bull. Brooklyn Inst., II, 1916, p. 195) as the only ones observed by him during three years on the Orinoco. They are wholly typical of *venezuelae*.

In 1912 Hellmayr¹ referred this bird to the Cayenne form, *capensis capensis*, and in 1925² I followed him. In his recent monograph of American Fringillidae,³ still handicapped by lack of topotypical specimens, of which he had only a single worn trade skin (No. 41470, Amer. Mus. Nat. Hist., "Cayenne"), he presented the same provisional identification. Thanks, however, to Mr. W. E. Clyde Todd, I have had the use of three topotypical specimens of *capensis capensis* collected for the Carnegie Museum in 1917 at Oyapock, French Guiana (Nos. 64861, 65053, 65189).

¹ Abhandl. Math.-Phys. Kl. Bayr. Akad. Wiss., XXVI, No. 2, p. 88.

² Amer. Mus. Novit., No. 191, p. 11.

³ 1938, Cat. Bds. Amer., part 11, p. 584.

* For references to footnote numbers see p. 384.

These supply the material, heretofore lacking, essential to the determination of the Venezuelan birds.

Specimens taken from Aug. 5 (Guácharo) to Nov. 9 (Colonia Tovar) are in increasingly worn breeding plumage. Twenty specimens taken from March 28 (Carapas) to April 17 (Cocallar) are in unworn plumage. The period between the first and last-named dates is not represented. It seems probable, therefore, that the nesting season begins in June or July and ends in early December.

SPECIMENS EXAMINED*

(45 adults; 3 juvenals)

LOCALITIES REPRESENTED.—VENEZUELA: Bermúdez, 4; Carapas (5600 ft.), 8; El Avila (1800 m.), 1⁹; Cerro del Avila (2000 m.), 4; Cocallar (2600 ft.), 2; Colonia Tovar¹ (1800 m.), 2⁹; (1900 m.), 2, 2 juv.; Cotiza, Caracas, 2; Guacharo, Caripe, 1 juv.; Cumana, 2; Junquito (1900 m.), 3; Junquito Road (1900 m.), 2⁹; Los Cienegas de Aquilon, nearing ad.¹; Los Palmales, 2; inland from Puerto Cabello, 2; Quiribana de Caicara, 2; Sancho Orquix (1500 m.), 4⁹; El Valle (850 m.), 2.

MONTHS REPRESENTED.—VENEZUELA: Jan., 2; Feb., 3; March, 7; April, 7; June, 6; July, 2; Aug., 6, 1 juv.; Sept., 2; Oct., 5, 2 juv.; Nov., 2; Dec., 2, 1 juv.

10.—*Zonotrichia capensis insularis* (Ridgway)

CURAÇAO SPARROW

Brachyspiza capensis insularis RIDGWAY, 1898, Auk, 15, p. 321 (Curaçao. Type in U. S. National Museum).

SUBSPECIFIC CHARACTERS.—Palest known race. Resembling *Z. c. venezuelae* but paler throughout, the upperparts grayer, underparts whiter, rufous collar paler, auriculars grayer, slightly less black on the throat; bill, in Aruba specimens, slightly larger (culmen 15 mm.).

RANGE.—Islands of Curaçao and Aruba.

A well-marked form distinguished by its sandy grayness above and whiteness below. Possibly it reached its insular, coastal home when the species existed at sea-level and remained there when individuals inhabiting the continent ascended the mountains.

Our eleven specimens, taken from February to June, show no marked signs of wear.

* For references to footnote numbers see p. 384.

The nesting season, therefore, probably agrees with that of *venezuelae*.

SPECIMENS EXAMINED

(11 adults)

LOCALITIES REPRESENTED.—ARUBA, 3. CURAÇAO, 8.

MONTHS REPRESENTED.—ARUBA: April, 2; July, 1. CURAÇAO: March, 4; June, 3; August, 1.

11.—*Zonotrichia capensis roraimae* (Chapman)

RORAIMA SPARROW, KOTUMARI (Arawak)

Brachyspiza capensis roraimae CHAPMAN, 1929, Amer. Mus. Novit., No. 341, p. 5 (Philipp Camp, 6000 ft., Roraima, Venezuela. Type in American Museum of Natural History).

SUBSPECIFIC CHARACTERS.—Breast and lateral underparts gray without brown or buff; black crown-stripes broad; back darker than in *venezuelae* or *capensis*, some feathers contrastingly margined with gray; median wing-coverts wholly, greater ones largely, deep black, contrastingly tipped with white; bill averaging slightly longer and more slender than in most races (culmen 14.1 mm.). Resembling *Z. c. macconnelli* but not so dark and slightly smaller.

RANGE.—Venezuela. Subtropic slopes of Mt. Roraima; 1100 to 2200 m. Mt. Auyan-tepui; Rio Carimang, British Guiana; Rio Negro, Brazil (one record?).

This race, and its tableland representative *macconnelli*, is more isolated from its nearest neighbors than any other continental form. Although its range is separated from that of *Z. c. venezuelae* by about 300 miles, and it is too unlike that bird to intergrade by variation, it nevertheless as nearly resembles *venezuelae* as any other form. In the amount of black on the neck it is distinctly nearer to *venezuelae* than to *capensis*.

Zonotrichia is a common bird on Mt. Auyan-tepui between 1100 and 2200 m., but it was not found on Mt. Duida, possibly because the mountain is too heavily forested. We did, however, secure a single female in postnuptial molt at Uacará, on the Rio Negro near Santa Isabel, Sept. 9, 1928. I referred this specimen unreservedly to *roraimae* but the surprising discovery of a new form of *capensis* at Baião

on the lower Rio Tocantins (see beyond), prompted further study of the Rio Negro bird. It now appears that while in its general coloration above it resembles *roraimae*, in its slightly shorter culmen (13 mm.), white lores, paler underparts, comparatively small amount of black on the neck (practically none on the foreneck) it seems to be nearer the Tocantins race. Possibly it represents an as yet unknown form from Brazil north of the Amazon.

Seventy-five of our 85 specimens of this race were taken in November and December. Twenty-three of the 29 November adults are in postnuptial molt. Roughly speaking, therefore, the nesting season doubtless ends about December first. Its duration, thus, apparently agrees with that of *Z. c. venezuelae*. Molting November adults, exhibiting both the old and new plumage, show that the former does not become as greatly worn as in the races occupying more arid regions.

SPECIMENS EXAMINED

(73 adults; 12 juvenals)

LOCALITIES REPRESENTED.—BRAZIL: (?) Rio Negro, Uacará, 1. BRITISH GUIANA: Rio Carimang, 1. VENEZUELA: Mt. Auyan-tepui (1100 m.), 14; (1500 m.), 1; (1500–1800 m.), 3; (1800–2000 m.), 1; (1950 m.), 5; (2200 m.), 15; Mt. Roraima: Paulo (4000 ft.), 3; Philipp Camp (6000 ft.), 32; near Philipp Camp, 1; Rondon Camp (6800 ft.), 9; Roraima, 1.

MONTHS REPRESENTED.—BRAZIL: Sept., 1. BRITISH GUIANA: Nov., 1. VENEZUELA: Jan., 5; Feb., 6; May, 1; Nov., 36; Dec., 38.

12.—*Zonotrichia capensis macconnelli* (Sharpe)

MACCONNELL'S SPARROW

Brachyspiza macconnelli SHARPE, 1900, Trans. Linn., Soc., VIII, p. 53, Pl. IV, fig. 1 (summit of Mt. Roraima. Type in British Museum).

SUBSPECIFIC CHARACTERS.—Darkest race of the species; crown blacker than in any other, its central gray area much reduced. Resembles *Z. c. roraimae* but larger, darker above, nape deeper. Male, wing, 71; tail, 65; culmen, 14.4 mm.

RANGE.—Summit of Roraima.

A zonal representative of *Z. c. roraimae*. Their ranges are separated by the 1400 feet of vertical cliff between the upper margin of the talus and the summit of Roraima.

SPECIMENS EXAMINED

(4 adults; 1 juvenal)

LOCALITIES REPRESENTED.—Summit of Mt. RORAIMA (8600 ft.), 4, 1 juv.

MONTHS REPRESENTED.—Nov., 5.

13.—*Zonotrichia capensis capensis* (P. L. S. Müller)

CAYENNE SPARROW

Fringilla capensis P. L. S. MÜLLER, 1776, Natursyst., Suppl., p. 165—based on Bruant du Cap de Bonne Espérance—Daubenton, Pl. Enl., Pl. 386, fig. 2, "Cape of Good Hope," errore, = Ile de Cayenne, French Guiana (cf. Buffon, 1778, Hist. Nat. Ois., 4, p. 369).

SUBSPECIFIC CHARACTERS.—Similar to *Z. c. venezuelae* but with less black on the throat and crown, the lower parts slightly grayer. Similar to *Z. c. tocantinsi* but with more black on the throat, underparts not so white, sides, flanks and rump browner, rufous of nape slightly deeper, upperparts darker, more rufescent. Very near *Z. c. subtorquata* but lowerparts grayer, flanks paler, bend of the wing white.

RANGE.—Known only from Tropical Zone of lower Oyapock River, French Guiana.

Until, in 1917, the Carnegie Museum acquired three specimens of this key race from French Guiana, it appears to have been known in this country only from a discolored trade "Cayenne" skin in the American Museum. Even at this date the Carnegie specimens are the only authentic examples of *capensis capensis* that I have seen. Without them it would have been impossible to have completed this paper. Their characters are stated by the preceding comparisons with their near allies.

SPECIMENS EXAMINED*

(4 adults)

LOCALITIES REPRESENTED.—FRENCH GUIANA: "Cayenne" trade skin, 1; Pied Saut, Oyapock, 3³.

MONTHS REPRESENTED.—FRENCH GUIANA: Nov., 2; Dec., 1.

14.—*Zonotrichia capensis tocantinsi*, new subspecies

AMAZON SPARROW

SUBSPECIFIC CHARACTERS.—Similar to *Z. c. capensis* but with even less black on the throat

* For references to footnote numbers see p. 384.

(in one male, nearly absent); underparts paler, sides, flanks and rump grayer, rufous of neck slightly paler; upperparts (plumage worn) generally grayer, the margins of the dorsal feathers more sandy, less rufescent. Similar to *Z. c. roraimae* but grayer above. Center of crown and superciliaries paler, rufous of neck paler, smaller in area and more sharply defined from the back; breast, sides, flanks and rump with a faint tinge of brown, less gray than in *roraimae*. Similar to *Z. c. matutina*, but sides grayer; no yellow in wing-bend.

TYPE.—No. 431446, Amer. Mus. Nat. Hist.; ♂ ad.; Dec. 9, 1931; Baião, Rio Tocantins, Brazil; A. M. Olalla.

RANGE.—Probably local in lower Amazonia. Records from Rio Acará, Marajó, and Monte Alegre, left bank of the Amazon, by Snethlage¹ may be referable to this race.

Our specimens of this proposed new race are too worn to reveal its characters satisfactorily. It is obviously separable from *capensis* and *roraimae* but its differences from *matutina* are not so obvious. But comparison of equally worn specimens from the Tocantins and Pernambuco (2000–3000 ft.) indicates, as might be expected, that the sea-level bird from the humid Amazon is not only grayer below but darker, less sandy above than the bird from the dryer, elevated campos.

The occurrence of a form of this species on the lower Tocantins, in connection with Dr. Snethlage's record of four specimens from Acará, eastern Marajó and Monte Alegre on the northern shore of the Amazon, definitely establish this species as a resident of lower Amazonia and suggest its occurrence in the region intervening between this area and the range of true *capensis*. In this connection see my remarks under *roraimae*.

SPECIMENS EXAMINED (6 adults)

LOCALITIES REPRESENTED.—BRAZIL: Baião, Rio Tocantins, 6, Nov. 29–Dec. 10.

15.—*Zonotrichia capensis matutina* (Lichtenstein)

NORTHEAST BRAZIL SPARROW

Fringilla matutina LICHTENSTEIN, 1823, Verz., Doubl. Berliner Mus., p. 25, Sept. (Bahia,

Brazil. "Lectotype, No. 6064, from Bahia in Berlin Museum."—Hellmayr).

SUBSPECIFIC CHARACTERS.—Similar to *Z. c. capensis* but paler above, whiter below, the gray of crown averaging paler and wider, its lateral black stripes narrower. Similar to *Z. c. subtorquata* but upperparts much lighter, gray crown averaging paler and wider, its bordering black stripes narrower; bend of wing white in coastal provinces; faintly yellow in 10 of our 19 adults from Matto Grosso.

RANGE.—Northeastern Brazil, provinces of Maranhão, Piauí, Pernambuco and southward to Bahia down to "400 feet"; southwestward over the campos to Matto Grosso and Bolivia.

The near relationships of the four races of *Z. capensis* occupying the country from Cayenne to Uruguay, including Matto Grosso, northeastern Bolivia, and eastern Paraguay, is evinced not only by their general close resemblance, but by the comparatively restricted amount of black on the foreneck. In all but six of my series of 136 specimens the white throat is connected with the breast by a clear white passage whereas in more northern races the center of the foreneck is usually more or less marked with black. The more southern forms are variously intermediate in this respect, a fact we will return to later.

In view of the close resemblance existing between Cayenne and Brazilian birds it is not surprising that they have frequently been considered identical, but examination of adequate comparable series clearly shows that pale birds from the arid provinces of northeastern Brazil, south at least to Bahia and southwest to Matto Grosso, are separable from the darker form from Rio de Janeiro southward. The former represents *matutina* (type-locality Bahia) while for the latter, *Zonotrichia subtorquata* Swainson (proposed to replace *Tanagra ruficollis* Spix, 1825, preoccupied) is available. An excellent series from the campos of La Goyaz and Matto Grosso belong with the northeastern Brazil form, which apparently extended its range to Bolivia. This statement is based on five specimens from Palmaritos, about 40 miles north of Santa Cruz de la Sierra, which are obviously nearer *matutina* than they are to *hypoleuca*,

¹ Cat. Aves Amazonicas, p. 433.

which occurs not far south of Santa Cruz. They are, indeed, deeper in tone than Matto Grosso specimens.

Specimens and information supplied by the collector show that the nesting season begins in Matto Grosso in early October and continues at least until early February (Juruena, Feb. 9; nest and two eggs, Cherrie). Juvenal specimens were taken in Chapada, Matto Grosso, between October 20 (just from the nest) and May 30 (not quite grown) while in Piauhý grown juvenals were taken June 1 and July 5. A Piauhý, May 2 specimen is much worn and at this time the postnuptial molt begins there and continues until early July—fresh birds in unworn plumage, however, may be found from April (Matto Grosso) to November (Ceará) but chiefly in May to August. The breeding season, therefore, is evidently prolonged with, at least its latter part, not sharply defined.

SPECIMENS EXAMINED

(55 adults; 13 juvenals)

LOCALITIES REPRESENTED.—BOLIVIA: North Chiquitos (800 m.), 1³; Palmaritos (400 m.), 5³. BRAZIL: Bello Jardim, Pernambuco (1800 ft.), 1; Boa Nova, Bahia (2600 ft.), 2; Branco, Rio, Pernambuco (2000 ft.), 2; Chapada, Matto Grosso, 12, 7 juv.; Corrente, Piauhý (1500 ft.), 4, 1 juv.; Floriano, Piauhý (400 ft.), 2, 1 juv.; Garanhuns, Pernambuco (3000 ft.), 2; Gilbués, Piauhý (1500 ft.), 2; Goyaz (650 m.), 4; Juruena, Rio, Matto Grosso, 1; Lavras-D., Ceará (800 ft.), 1; Manga, Maranhão (86 m.), 1; Morro do Chapéu, Bahia (3600 ft.), 4, 3 juv.; Santa Rita, Bahia (1600 ft.), 3; Tabocas, Maranhão (800 ft.), 1; Tambury, Bahia (1100 ft.), 1; Tapirapoan, Matto Grosso, 1; Terézina, Piauhý (50 m.), 1; Urucum, near Corumbá, Matto Grosso, 1; Utiariti, Papagio R., Matto Grosso (1500–2500 ft.), 1 juv.; Viçosa, Ceará (2500 ft.), 3.

MONTHS REPRESENTED.—BOLIVIA: May, 5; June, 1. BRAZIL: Jan., 1, 1 juv.; Feb., 6, 1 juv.; March, 2; April, 1; May, 13, 4 juv.; June, 5, 1 juv.; July, 9, 1 juv.; Oct., 8, 3 juv.; Nov., 2, 2 juv.; Dec., 2.

16.—*Zonotrichia capensis subtorquata* Swainson

SOUTHEAST BRAZILIAN SPARROW, TICO-TICO
(von Ihering)

Zonotrichia subtorquata SWAINSON, 1837, Nat. Hist. Class. Birds, 11, p. 288, new name for *Tanagra ruficollis* Spix, 1825, from near Rio de Janeiro, Brazil (not of Gmelin, 1789). ("Type in

Munich Museum," Hellmayr.) By an obvious slip *ruficollis* of Spix is referred to as *graminea* of Wilson. Both are figured on the same page of Spix.

SUBSPECIFIC CHARACTERS.—(Minas Geraes and Rio Grande do Sul specimens) Bend of the wing with more or less sulphur-yellow; under wing-coverts and tibiae usually tinged with this color; plumage often with an olivaceous cast. Resembling *Z. c. capensis* but underparts whiter, flanks browner. Resembling *Z. c. matutina* but back notably darker, gray of crown averaging deeper, its lateral black stripes wider. Resembling *Z. c. hypoleuca* but averaging darker above and less white below.

RANGE.—Southeastern Brazil from sea-level upward, from Rio de Janeiro to Uruguay, southwest to southern Matto Grosso and southward east of the Chaco.

The yellow wing-bend is a distinctive character of this race. Usually it is obvious, at times it requires close examination to discern, but in Brazilian specimens it is rarely, if ever, wholly absent. In Paraguay and Uruguay specimens it is less pronounced or absent. It is interesting to find that, as in *Zonotrichia leucophrys nuttalli*, this marking appears as a sub-specific character.

Equally distinctive, but less constant, is the tinge of yellow on the lower wing-coverts and tibiae. I do not find these characters in *matutina* from the coastal provinces, but they occasionally appear in specimens from Goyaz and Matto Grosso. Although they are evidently wanting in *hypoleuca* from the Argentine-Bolivia boundary, some Buenos Aires region specimens show a faint trace of yellow on the wing-bend.

Our 86 specimens from southeast Brazil represent every month but February. Most of them were collected by E. Kaempfer for the Naumburg Collection, and nearly all have the condition of the gonads indicated on the label. This fact, in connection with the seasonal continuity of Kaempfer's work, makes its results particularly helpful in the study of plumages.

The first evidences of the approaching nesting season are shown by a male taken August 30 (Minas Geraes 7200 ft.) with the testes "one-half enlarged." Similar proof of breeding, or preparations to breed, is

thereafter shown by most of the specimens collected until, on November 17, in southern Rio Grande do Sul, a breeding female was taken. From this date nesting evidently continues until March. The postnuptial molt begins early in that month and no marked evidences of wear or fading are shown until early August. Mid-March to early August, inclusive, therefore, are the months when the species is in best plumage. The most worn specimens were taken by Ernest Holt on Mt. Itatiaya (alt. 2700 ft.), Dec. 20-27.

Examination of 23 specimens from Uruguay and from Paraguay, east of the Paraguay River, yields essentially similar results.

SPECIMENS EXAMINED*

(104 adults; 19 juvenals)

SPECIMENS REPRESENTED.—BRAZIL: Amambay, Rio (650 ft.), 1; As Macieiras (6000 ft.), 1; Bandeira, Pico de (3500 ft.), 1; Campanario (1100 ft.), 1; Campo Bom (400 ft.), 4; Campos São Domingos (6500 ft.), 10; Candiota (600 ft.), 2; Caparáo, Rio (3500 ft.), 2; (3000 ft.), 4; Casa Queimada (7200 ft.), 1; Conceição do Arroio, 2; Corvo (Serra da Graciosa) (2700 ft.), 2; Crystal, Pico do (Serra do Caparáo) (8200 ft.), 1; Guayra Rio Paraná (600 ft.), 1; Iguassú, Rio (2000 ft.), 1, 1 juv.; Jaguarão, Rio, south of, 1; Juparanã, Lagôa (400 ft.), 1; Nonohay (Passeo da Entrada) (2000 ft.), 2, 3 juv.; Ouro Verde (Serra de Lucindo) (2500 ft.), 3; Palmares, 1; Palmitos, 1; Petropolis, 2; Poco Preto (2500 ft.), 3; Quinta, 2; Roca Nova (Serra do Mar), 4; Salto Pirahy (450 ft.), 4; Sananduva (2000 ft.), 2; Santa Barbara de Caparáo (3000 ft.), 1; Santa Cruz (300 ft.), 1; São Francisco de Paula (3000 ft.), 5; São Lourenço, west of (400 ft.), 1; São Paulo (570 m.), 3; Sapyranga (200), 3; Serra do Caparáo (3000 ft.), 1; Serra do Itatiaya (2700 ft.), 3; Sinimbu (500 ft.), 1; Therezopolis, Organ Mts. (3200 ft.), 7, 1 juv.; Vaccaria (3000 ft.), 2, 3 juv.; Varzeas das Congonhas (5800 ft.), 2. PARAGUAY: Asunción, 1 juv.; Caaguazú, east of (1000 ft.), 1, 2 juv.; Colonia Risso, 2; Concepción, front of (500 ft.), 3 juv.; Sapucay, 3^e; Villa Rica, 2; east of Villa Rica (Colonia Independencia) (800 ft.), 1; Ygazú, Upper Rio (1000 ft.), 1. URUGUAY: Montevideo, 2^e; Rio Negro, Rio Negro, 4 juv.²; San Vicente, Rocha, 4.

MONTHS REPRESENTED.—BRAZIL: Jan., 3; Feb., 3, 1 juv.; March, 2, 3 juv.; April, 7; May, 4; June, 5; July, 10; Aug., 24; Sept., 16, 1 juv.; Oct., 2; Nov., 6; Dec., 6, 3 juv. PARAGUAY: Jan., 1, 1 juv.; Feb., 3 juv.; July, 3;

Oct., 4; Nov., 2, 2 juv.; Dec., 1 juv. URUGUAY: Jan., 4; Feb., 4 juv.; Nov., 2.

17.—*Zonotrichia capensis hypoleuca* (Todd)

WHITE-BELLIED SPARROW, CHINGOLO

Brachyspiza capensis hypoleuca TODD, 1915, Proc. Biol. Soc. Wash., 28, p. 79. (Rio Bermejo, Prov. Salta, Argentina. Type in Carnegie Museum.)

Brachyspiza capensis argentina TODD, 1920, Proc. Biol. Soc. Wash., 33, Rio Santiago, near Buenos Aires, Oct. 14, 1908.

SUBSPECIFIC CHARACTERS.—Resembling *Z. c. pulacayensis* but smaller, less rufescent, tawny nape more sharply defined from the back. Resembling *Z. c. subtorquata* (Minas Geraes and Rio Grande do Sul specimens) but averaging paler above and whiter below; bend of wing and tibia usually without trace of yellow; closely resembling *Z. c. matutina* (Matto Grosso, Brazil specimens) in color but less rufescent above; size smaller. Resembling *Z. c. carabayae* but averaging smaller and paler and with less black on the throat. Resembling *Z. c. choraules* but less sandy and more broadly streaked above; lateral black crown streaks much wider.

RANGE.—Eastern and southern Bolivia from below an altitude of 5000-7000 feet, east to the llanos and Chaco south to Bahia Blanco, Argentina, east of the range of *Z. c. choraules*.

The bird to which I apply the name *hypoleuca* inhabits an extended, highly diversified country from the llanos of Bolivia and eastern slopes of the Andes to the coast of central Argentina. Possibly more than one form has developed in this great region, but with the toptotypical area in its heart I have not found separable races either to the north or south.

The evidence seems clear that toward the north *hypoleuca* finds its representative in *pulacayensis*, which, as we have seen, occupies the tableland at least to Cuzco. The connection between the two is so close that large numbers of specimens from neutral territory may with equal truth be labelled one or the other. As one ascends the mountains, both in Argentina and adjoining Bolivia, increase in size and rufescence indicate an approach toward *pulacayensis*. It is impossible to draw a boundary where none exists, but, generally speak-

* For references to footnote numbers see p. 384.

ing, specimens from 6500 feet and upward with the wing measuring over 75 mm. in the male and 72 in the female are nearer *pulacayensis*.

Eastward of the Cochabamba region, through Chillon (5600 ft.) and Samaipata (5500 ft.), *hypoleuca* appears to intergrade with *carabayae*. Proceeding eastward and downward to the plains, we discover that, whereas a specimen taken 60 miles south of Santa Cruz de la Sierra is *hypoleuca* at its grayest, five birds from Palmarito (alt. 400 m.), about 40 miles north of Santa Cruz, are deeply rufescent above and near *matutina*, from not very distant Matto Grosso. Since these *matutina*-like birds occupy a comparatively limited area in Bolivia and a very large one in Brazil, while *hypoleuca* has a wide range in Bolivia and is unknown in Brazil, may it not be assumed that the Palmarito birds represent the former rather than the latter.

We have now to trace the relationships of *hypoleuca* toward the south. In this direction I find myself unable to stop until I reach the range of *Z. c. argentina*. My material is not conclusive but as far as it goes it reveals little difference between topotypical series of *hypoleuca* and *argentina* in fresh postnuptial plumage. In both northern Argentina and the Buenos Aires region, *Zonotrichia* undergoes its postnuptial molt in March and is in comparatively unworn plumage until July. It is at this season that I can find no pronounced difference between series from the two regions, but, as described under *subtorquata*, specimens from the Buenos Aires area are more apt to show traces of yellow on the wing-bend, evidence perhaps of Brazilian ancestors. Apparently, however, the effects of fading and wear are more noticeable at the south than at the north, for a series of twelve birds in worn breeding plumage taken in the Buenos Aires region from October 22¹ to December 15 is noticeably darker, less rufescent than a similar series taken in the type region of *hypoleuca* from October 26 to December 12. Obviously a subspecies cannot stand on seasonal characters and,

in my opinion, it would be well to suppress *argentina* until its racial standing is proved.

Dr. Wetmore records this bird from as far south as Bahia Blanca on the coast. In the interior we have no specimens from below Suncho Corral, southward from Tucumán (April 20, 25), while from Lavalle, a few miles northwest, we have a typical specimen of *choraules*. Taken July 4 it may be a winter bird and does not contribute to our knowledge of the relationships of these two birds which appear to belong to different stocks.

SPECIMENS EXAMINED*

(92 adults; 5 juvenals)

LOCALITIES REPRESENTED. — ARGENTINA: Avia Terai (350 ft.), 1; Bahia Blanca, 3²; Barracas al Sud, 3; Berazatagui, 1²; Bermejo, Rio (400 m.), 2³; Buenos Aires Prov., 3, 3 juv.; 1³; Carhué, 3²; Catamarca, 1; Chascomús, 2; Conchitas, 2⁶; Conhelo, La Pampa, 1⁷; Embarcación (1700 ft.), 3; Flores, 1; Guamini, 1²; 1 juv.²; Jujuy, 1²; La Plata, 1; Lavalle, 5²; Lavalsole, 1⁶; Las Palmas, 1²; Mar del Plata, 4; Miraflores (350 m.), 7³; Resistencia, 2²; Rosario de Lerma (4800 ft.), 1; above San Pablo (4000 ft.), 2; Suncho Corral, Santiago del Estero (800 ft.), 2; Tafi Trail (2000 ft.), 1; Tapia, Tucumán (2300 ft.), 4²; Tucumán, 1; Victorica, 1²; 1 juv.² BOLIVIA: Apolobamba, 1; Bamaipata (5500 ft.), 1¹; Bermejo (1350 ft.), 1¹; California (6600 ft.), 1; Chillon (5600 ft.), 1; Entre Rios (4600 ft.), 4; Fortín Campero (1150 ft.), 2; Guanacos, 2³; Lagunillas (3500 ft.), 2¹; La Merced (5400 ft.), 1¹; La Paz, 1; Lipeo, Rio (2100 ft.), 1¹; Padilla, 25 K.M. east of (8200 ft.), 1; Pampas de Taperas (600 m.), 1³; Samaipata (1400 m.), 1³; (5500 ft.), 2¹; Tomina (6700 ft.), 2¹; Yacuiba (450 m.), 6³.

MONTHS REPRESENTED. — ARGENTINA: Jan., 5, 1 juv.; March, 6, 1 juv.; April, 9; May, 3; June, 2; July, 6; Aug., 4; Sept., 1; Oct., 10; Nov., 5; Dec., 10, 3 juv. BOLIVIA: Jan., 1; April, 1; July, 2; Aug., 3; Sept., 4; Oct., 9; Nov., 9; Dec., 2.

18.—*Zonotrichia capensis mellea* (Wetmore)

CHACO SPARROW

Brachyspiza capensis mellea WETMORE, 1922, Proc. Biol. Soc. Wash., 35, p. 39 (80 km. west of Puerto Pinasco, Paraguay. Type in United States National Museum; examined).

SUBSPECIFIC CHARACTERS.—Resembling *Z. c. hypoleuca* but upperparts, sides and flanks gray.

RANGE.—Known only from the west side of the Rio Paraguay near Puerto Pinasco and Formosa.

¹ The type of "*argentina*" was taken Oct. 14.

* For references to footnote numbers see p. 384.

The four specimens available, including the type, are grayer than most specimens in a large series of *hypoleuca*, including topotypes. Specimens from east of the Paraguay are referable to the more richly colored *subtorquata* of southeastern Brazil. Possibly the most eastern representatives of *hypoleuca* may be sufficiently differentiated to establish a basis for Dr. Wetmore's name.

SPECIMENS EXAMINED*

(4 adults)

LOCALITIES REPRESENTED. — ARGENTINA: Riacho Pilaga, Formosa, Kilo 182, 1²; Las Lomitas, 1⁷. PARAGUAY: Puerto Pinasco, Kilo 80 West, 2².

MONTHS REPRESENTED.—ARGENTINA: Aug., 2. PARAGUAY: Sept., 2.

19.—*Zonotrichia capensis chilensis* (Meyen)

CHILEAN SPARROW, CHINCOL

Fringilla chilensis MEYEN, 1834, Nov. Act. Acad. Caes. Leop-Carol., 16, Suppl., p. 88 (Santiago, Chile. Type in Berlin Museum).

Fringilla mertonii AUDUBON, 1839, Orn. Biogr., V, p. 312 ("Upper California"). Type in Acad. Nat. Sci., Phila., examined.

SUBSPECIFIC CHARACTERS.—Agrees with *Z. c. choraules* and *Z. c. sanborni* and differs from other races in having the lateral black crown-stripes much reduced in width, usually no wider than the gray superciliary. Resembles *choraules* but darker, more rufescent above, breast slightly grayer, averaging more black on the foreneck, the crown darker gray. Resembles *sanborni* but smaller, much darker above, crown and underparts paler. In general dorsal coloration resembling *Z. c. peruviansis* but with less black on the foreneck and the sides of the crown. Resembling *Z. c. australis* but smaller, gray crown bordered laterally by black, upperparts averaging darker, feather margins cinnamon-brown rather than ochraceous-tawny.

RANGE.—Chile, from Province of Atacama southward to Elefantes Gulf; ascending to the Temperate and Puna zones at Puente del Inca (and doubtless elsewhere) and descending on the eastern slope of the Andes to at least 4800 ft. at Potrerillos.

The narrow black crown-stripes first appear in this race and are its distinguishing

character. The races with which it may possibly come in contact toward the north (*antofagastae* and *pulacayensis*) both have broad black crown-stripes. Sanborn's Sparrow, from the high Andes above Coquimbo, agrees with *chilensis* in possessing narrow black crown-stripes.

Specimens from Coquimbo and northward, in the rainless region, average slightly smaller and paler with the crown lighter gray. Of two Puente del Inca, Arg. (10,000 ft.), February birds one is in extremely worn plumage, in the other the postnuptial molt reveals the bird's resemblance to *chilensis*. As in *peruviansis*, therefore, the sea-level and Temperate Zone forms are apparently the same. In this instance, however, the bird evidently descends on the eastern slope of the range to at least 4800 ft. I agree with Wetmore¹ that specimens from Potrerillos, Prov. Mendoza (4800–6000 ft.), are referable to *chilensis* while three from near the city of Mendoza are nearer *choraules*. (See under *sanborni*.) At the south specimens from the Guaitecas group are still *chilensis* but three examples from the Gulf of Elefantes, Peninsula of Taytao (2) and Rio Huemules (1), on the east side of the Gulf, have broken black lines at the sides of the crown and, in this respect, are intermediate between *chilensis* and *australis*. Intergradation with *choraules*, which appears to be a west Argentine form of *chilensis*, probably occurs where their ranges meet.

The range of *chilensis* covers at least 24 degrees of latitude, 11,000 ft. of altitude, and both western and eastern slopes of the Andes. Moreover, in the central part of Chile seasonal differences, whether of temperature or rainfall, are not pronounced. It follows, therefore, that the breeding season is correspondingly prolonged. Our series of 75 specimens is not large enough to reveal satisfactorily its developments. Four specimens collected at Apoquimbo, near Santiago, August 21–24, have the testes enlarged and were apparently breeding or about to breed. Many birds were singing there and the central Chilean spring was fully launched. These birds are in

* For references to footnote numbers see p. 384.

¹ Bull. U. S. Nat. Mus., No. 133, 1926, p. 419.

much less worn plumage than four specimens taken at Tofo, 60 miles north of Coquimbo, September 3-8. Similarly a breeding male from Corral (Oct. 17) is not so worn as a Tofo male taken September 20.

Additional specimens in worn breeding plumage were taken as far south as the Guaitecas January 8, and on February 23 a male completing the postnuptial molt was secured by Twomey on Elefantes Gulf. On February 25 a male beginning this molt was secured at Puente del Inca (10,000 ft.), Argentina, thus showing an interesting agreement in nesting phenomena as controlled by latitude and altitude. This fact is further illustrated by two young just completing postjuvenile molt, one from Potrerillos, below Puente del Inca, March 19, the other from Puerto Montt, March 21. Adults in unworn plumage are found from early February (Tofo) to late June. From South Central Chile, Mr. D. S. Bullock of Angol writes that his nesting records extend from September 30 to December 19.

SPECIMENS EXAMINED*

(66 adults; 7 juvenals)

LOCALITIES REPRESENTED. — ARGENTINA: Potrerillos (4800 ft.), 1²; (5000 ft.), 1², 1 juv.²; (6000 ft.), 1², 1 juv.² CHILE: Ancud, 2; Angol, 3; Apoquimbo, 3; Chiloës, 1 juv.; Concon, 5²; Coquimbo Prov., 1⁴; Corral, 3; Guaitecas Islands, 2; Huemules, Rio, 1³; Isla de la Mocha, 3; Los Andes (850 m.), 2; Maquehue, Temuco, 2; Paiguano (3300 ft.), 3⁴; Palena, 1; Puente del Inca (10,000 ft.), 2, 1 juv.; Puerto Casma, 1 juv.³; Puerto Montt, 3, 2 juv.³; Pumalin, 1; Ramadilla (Copiapo Valley), 3⁴; Romero, 2⁴; San José de Maipo (3000 ft.), 1; Santiago, 2; Taytao, Peninsula of, 1³; Tofo, 13; Valparaíso, 3, 1 juv.

MONTHS REPRESENTED. — ARGENTINA: March, 3, 2 juv. CHILE: Jan., 4; Feb., 5, 2 juv.; March, 3, 3 juv.; April, 9; May, 4; June, 6; July, 4; Aug., 9; Sept., 5; Oct., 4; Nov., 5, 1 juv.; Dec., 4.

20.—*Zonotrichia capensis sanborni* Hellmayr

SANBORN'S SPARROW

Zonotrichia capensis sanborni HELLMAYR, 1932, Field Mus. Nat. Hist., Zool. Ser., 19, p. 79 (Baños del Toro, 10,600 ft., Coquimbo, Chile. Type in Field Museum).

SUBSPECIFIC CHARACTERS.—Resembling *Z. c. chilensis* but larger, back paler, cinnamon-buff

rather than tawny-olive; lowerparts cream-tinted. Six males, culmen, 11.3-12.6 (12.2); 3 females, culmen, 12.2-12.9 (12.5).

RANGE.—Known only from the type-locality (and Barriales, San Juan, Argentina).

The ten specimens examined, taken by C. C. Sanborn of Field Museum between November 9 and 16, are all in more or less worn breeding plumage. In fresh plumage it is probable that, in dorsal color, they would more nearly resemble *antofagastae*. The narrow lateral crown-stripe, however, indicates their relationship to *chilensis* of which Dr. Hellmayr has said *sanborni* may be the "altitudinal representative." It is to be remembered, however, that specimens from 10,000 ft. at Puente del Inca, Argentina, are apparently referable to *chilensis*.

After the systematic section of this paper was finished I received from Mr. A. R. Zotta of the Museo Argentino, a specimen taken January 15, 1940, at an altitude of 1600 m. in the Andes at Barriales, San Juan, Argentina. It is in greatly worn plumage, but in its narrow dorsal shaft-streaks and long, pointed wings it agrees with a specimen of *sanborni* from the type-locality. Mr. Zotta, I should add, had already referred it to that race.

Recalling Hellmayr's provisional identification of specimens from Potrerillos, above Mendoza, as *sanborni*, I have re-examined our material from that locality. It is far from satisfactory but its further study supports the conclusions already reached.

SPECIMENS EXAMINED*

(12 adults)

LOCALITIES REPRESENTED.—ARGENTINA: Barriales, San Juan, 1¹. CHILE: Baños del Toro, Prov. Coquimbo (10,600 ft.), 11⁴.

MONTHS REPRESENTED.—ARGENTINA: Jan., 1; CHILE: Nov., 11.

21.—*Zonotrichia capensis choraules* (Wetmore and Peters)

RIO NEGRO SPARROW

Brachyspiza capensis choraules WETMORE AND PETERS, 1922, Proc. Biol. Soc. Wash., 35, p. 44

* For references to footnote numbers see p. 384.

* For references to footnote numbers see p. 384.

(General Roca, Rio Negro, Arg. Type in United States National Museum; examined).

SUBSPECIFIC CHARACTERS.—Resembling *Z. c. chilensis* but lateral black crown lines averaging even narrower, crown lighter gray, median dorsal lines slightly narrower, their margins paler; underparts whiter.

RANGE.—Foothills and plains of western Argentina, breeding from Nahuel Huapí (probably) and Rio Negro to Tunuyán, Mendoza, doubtless largely resident but wandering north at least to Lavalle, Santiago del Estero (July 4).

This race appears to be a pale form of *chilensis*, northern specimens of which it closely resembles. The occurrence of *chilensis* at Puente del Inca and at Potrerillos, above Mendoza, indicates their contact. In the Llanquihue-Bariloche section the Andean divide reaches only 3000 feet altitude and the character of the country is favorable for the continuous distribution of *chilensis* from Llanquihue to Bariloche. It is true that Hellmayr records a specimen of *australis* from the first-named locality, but the date (March 17) it was collected makes it probable that the bird was a migrant.

Two of the birds collected by Mr. Peters at Bariloche on Nahuel Huapí are adults in the first stages of postnuptial molt with not enough of the new plumage grown to be of diagnostic value. One (M.C.Z. No. 85925) has the black crown-lines of *chilensis* or *choraules*. The other (M.C.Z. No. 85924), shows no trace of black feathers on the crown. Its wing, though worn, measures 78 mm., whereas that of the *chilensis-choraules* specimen measures 69 mm. The available evidence, therefore, indicates that the larger specimen is *australis*, the smaller, *choraules* or *chilensis*. A specimen (No. 83891) in the Museo Argentino, taken at Nahuel Huapí November 19, appears to be between *australis* and *choraules*.

Wetmore records *australis* as "the breeding species at Zapala, Neuquén" and found a nest there on December 7, 1921, but in November, at General Roca, about 130 miles farther east and "a few meters lower," *choraules* was the common breeding bird.

SPECIMENS EXAMINED*

(14 adults; 2 juvenals)

LOCALITIES REPRESENTED.—ARGENTINA: Bariloche, 1⁵; 1 juv.⁵; General Roca, Rio Negro, 4 (incl. type)⁶; Lavalle, Santiago del Estero (1800 ft.), 1; Mendoza, 1, 2⁶; Rio Colorado, 2⁶; Tunuyán, Mendoza, 3⁶, 1 juv.⁶

MONTHS REPRESENTED.—ARGENTINA: Feb., 1, 1 juv.; March, 4, 1 juv.; June, 1; July, 1; Aug., 3; Nov., 4.

22.—*Zonotrichia capensis australis* (Latham)

PATAGONIAN SPARROW

Fringilla australis LATHAM, 1790, Ind. Orn. I, p. 466 (Tierra del Fuego).

SUBSPECIFIC CHARACTERS.—Wing as long as and more "pointed" than in any other form of *Z. capensis*; crown without black lateral stripes, nearly uniform gray; ear-coverts largely gray, superciliar, postocular and malar stripes faint or absent; end, and terminal part of inner web of outer rectrix often narrowly white, this character sometimes present in lesser degree on one or two succeeding rectrices; dorsal coloration as in *Z. c. chilensis* but averaging slightly less rufescent, the lower parts more soiled than in *chilensis*; black on foreneck averaging as in *chilensis*, averaging more than in *choraules* and *hypoleuca*.

RANGE.—Southern end of South America, breeding from central Neuquén, Argentina, south to Cape Horn, Chile; resident in the more northern part of this area and migrating in winter as far north as southern Bolivia.

Although I have 96 specimens of this form they do not satisfactorily reveal either the geographical variations within its range, or its relations to its neighbors. In worn breeding plumage, specimens from the northern part of its breeding range differ in marking and color from others from south of Magellan Straits. The specimens are apparently comparable but whether the difference is racial or seasonal I am unable to say. Doubtless the question can be answered only by comparison of freshly plumaged specimens in which fading and wear have not had time to express themselves.

An immature female taken at Potrerillos (5000 ft.), Mendoza, March 20 is just completing the postjuvenile molt. The gray head has obscure blackish shaft-streaks but

* For references to footnote numbers see p. 384.

is clearly the head of *australis* to which, I agree with Dr. Wetmore, it should be referred. It is, however, much paler than two specimens in similar plumage taken at Punta Arenas February 4 and March 3, respectively. The latter have the feathers of the back widely striped with black and margined with snuff-brown; in the former the shaft-streaks are much narrower, the lateral margins near tawny-olive, lighter even than in comparable specimens from Bariloche and Tunuyán mentioned beyond. In connection with the differences between northern and southern specimens, already referred to, this Potrerillos specimen arouses a belief that *australis* is represented by one race on the Patagonia plains and another in the Magellan-southwest Chile region.

Probable intergradation of *australis* with *chilensis* is indicated by three specimens from Elefantes Gulf, south of the Guaitecas, and from Puerto Casma, which have the black markings on the sides of the gray crown incomplete or broken and in this respect are therefore intermediate between *chilensis* and *australis*. In general dorsal coloration they are darker than either, a difference which may represent a response to the heavy rainfall of the region. Two specimens from the Rio Huemules, on the mainland to the east, are slightly paler and hence nearer *australis* with which one of them, in head-markings, agrees, while the other has broken black crown-stripes, as in the Elefantes birds. In a less pronounced degree these detached black crown-mark-

ings are occasionally shown by specimens of *australis* from the heart of its range.

In Neuquén, Wetmore found *australis* nesting at Zapala and *choraules* at General Roca, 150 miles farther east and "a few meters lower."¹ At Bariloche, on the east end of Lake Nahuel Huapi, Peters took two adult females of *Z. capensis*, one January 31 and another February 5; both are in postnuptial molt. The first, as I have said under *choraules*, is comparatively large and lacks black on the head. I refer it to *australis* (wing 79 mm.); the second (wing 69 mm.), to either *chilensis* or *choraules*. A third Bariloche specimen, taken February 10, is in postjuvenal molt and resembles a comparable specimen of *choraules* taken at Tunuyán, Mendoza, March 24. It appears, therefore, that further field work is needed to show definitely the relations in life of the *australis-choraules-chilensis* group.

The matter is complicated by the fact that *australis* has a pronounced seasonal migration. It seems probable that *choraules*, and possibly other races, may wander to some extent in the non-breeding season. We have, for example, a specimen of *choraules* from Santiago de Estero, below Tucumán, but in *australis* there is a well-defined, regular, seasonal movement that extends at least to Tarija in southern Bolivia, about 1800 miles north of Punta Arenas.

Our collections indicate that the more southern birds begin their journey at the

¹ Bull. U. S. Nat. Mus., No. 113, 1926, p. 419.

LIST OF MIGRANTS

March 10	San Juan, Prov. San Juan, Arg.	♀
" 20	Puerto Montt, Prov. Llanquihue, Chile	♀
" 20	" " " " "	♂
" 21	" " " " "	♂
" 20	Potrerillos (5000 ft.), Mendoza, Arg.	♀ imm.
April 1	Taff del Valle (9500 ft.), Tucumán, Arg.	♂ T.N.E.
" 3	" " " " "	♂
" 6	" " " (7000 ft.), " "	♂
" 7	" " " " "	♂
" 16	Cachi, Prov. Salta, Arg.	♀
" 28	Rio Blanco, Chile	?
May 24	Potrerillos (5000 ft.), Prov. Mendoza, Arg.	♀ imm.
July 17	San Lorenzo (7500 ft.), Tarija, Bol.	♂
" 17	" " " " "	♀
" 19	" " " " "	♂
" 23	San Juan, Prov. San Juan, Arg.	♂
" 31	Media Agua, San Juan, Arg. (2200 ft.)	♂ T.N.E.

conclusion of the nesting season. This opens in late November (Huanulán, Nov. 20; Punta Arenas, Nov. 17; King Island, Nov. 28; Zapala, Neuquén, Dec. 8, 9) and lasts at least until February (Punta Arenas, March 3, postjuvenal molt nearly completed).

In order that the times and extent of this notable migration may be appreciated I select from the subsequently appended Seasonal Table of Distribution, records of those birds collected beyond the limits of their breeding range and presumably, therefore, migrants (see p. 407).

It will be observed that by March 10 the species has reached San Juan, in northwestern Argentina, and that our latest migrant record is of a male with unenlarged testes taken at Media Agua, San Juan, July 31.

We have no specimens from Punta Arenas and southward between March 12 and November 17, in other words, from the end to the beginning of the nesting season. Nevertheless, Mr. A. R. Zotta writes me he has dependable information that *australis* remains at Santa Cruz and Tierra del Fuego throughout the year, and the records from Rio Gallegos, Chubut and other localities show that the bird does not wholly desert its breeding range during the winter.

An intimate, local view of the seasonal movements of this bird is recorded by James L. Peters in his "Notes on Some

Summer Birds of Northern Patagonia" as follows:¹

"An abundant resident. These sparrows are no doubt migratory to some extent and form winter flocks of considerable size. I found them at Rio Colorado and San Antonio in August; at Maquinchao and Huanuluan they were present at the time of my arrival, though not in the numbers which arrived later in the season. For instance, the resident birds at Huanuluan were reinforced by large numbers of migrants from the north (or east) on September 6, and these numbers were further augmented by fresh arrivals on September 10. By the first of October the resident birds were well differentiated from the migrants, though they were not yet ready to commence breeding. Flocks of migrants, however, were present as late as October 21 though their numbers were much reduced. Nesting began late in November. On the 20th a nest with one egg was found, on December 2 a recently completed nest without eggs. Young three or four days old were found at Puesto Horno about December 25 and fully fledged young were first seen at Maquinchao, January 6. On January 14 a nest containing two fresh eggs was taken at Huanuluan."

Because of the migratory habits of this race the customary list of specimens examined is arranged chronologically.

¹ Bull. M. C. Z., LXV, 1923, p. 333.

MUSEUM	DATE	LOCALITY	SEX
M.C.Z.	Jan. 6	Maquinchao, Arg., Gob. Rio Negro, 2900 ft.	♀ ad.
A.M.N.H.	" 13	Londonderry Is., Chile	♀ juv.
A.M.N.H.	" 14	Obrien Is., Chile	♀ small
A.M.N.H.	" 14	Obrien Is., "	♂ juv.
U.S.N.M.	" 18	Gregory Bay, Sts. of Magellan	juv.
U.S.N.M.	" 19	Gregory Bay, Sts. of Magellan	—
U.S.N.M.	" 19	Gregory Bay, Sts. of Magellan	—
U.S.N.M.	" 20	Elizabeth	♀
U.S.N.M.	" 20	Elizabeth	♀
U.S.N.M.	" 22	Laredo Bay, Sts. Magellan	—
U.S.N.M.	" 22	" " "	—
M.C.Z.	" 31	Bariloche, Arg., Terr. Rio Negro, 2300 ft.	♀ ad.
A.M.N.H.	Feb. 4	Punta Arenas, Chile	♂ minute
A.M.N.H.	" 4	" " "	♂ small
A.M.N.H.	" 4	" " "	♀ small
A.M.N.H.	" 5	" " "	♀ small
A.M.N.H.	" 5	" " "	♀ small
M.A.	" 7	Staten Island, Arg.	breeding
M.C.Z.	" 10	Bariloche, Arg., Terr. Rio Negro, 2500 ft.	♂ imm.
A.M.N.H.	" 18	Punta Arenas, Chile	—

MUSEUM	DATE	LOCALITY	SEX
Car. Mus.	Feb. 23	Penin. of Taytao, Elefantes Gulf, Chile	♂
Car. Mus.	" 23	" " " " " "	♂
A.M.N.H.	March 3	Punta Arenas, Chile	♂ juv.
A.M.N.H.	" 10	San Juan, Arg.	♀
Car. Mus.	" 11	Magallanes, 25 mi. N.E., Chile	♂
Car. Mus.	" 11	" " " " " "	♀
Car. Mus.	" 11	Port Sarjento, Rio Huemules, Chile	♂
Car. Mus.	" 11	" " " " " "	♂
A.M.N.H.	" 12	Punta Arenas, Chile	♂ small
Car. Mus.	" 15	Puerto Casma, Chile	♂
Car. Mus.	" 20	Puerto Montt, Chile	♂
Car. Mus.	" 20	" " " " " "	♀
Bio. Sur.	" 20	Potrillo, Mendoza, Arg., alt. 5000 ft.	♀ imm.
Car. Mus.	" 21	Puerto Montt, Chile	♂
A.M.N.H.	April 1	Above Tafi del Valle, Prov. de Tucumán, Arg. (alt. 9500 ft.)	♂ T.N.E.
A.M.N.H.	" 3	Above Tafi del Valle, Prov. de Tucumán, Arg. (alt. 9500 ft.)	♂ T.N.E.
A.M.N.H.	" 6	Above Tafi del Valle, Prov. de Tucumán, Arg. (alt. 7000 ft.)	♂ T.N.E.
A.M.N.H.	" 7	Above Tafi del Valle, Prov. de Tucumán, Arg. (alt. 7000 ft.)	♂ T.N.E.
A.M.N.H.	" 16	Cachi, Prov. Salta, N. Arg.	♀
A.M.N.H.	" 28	Rio Blanco, Chile	♀
A.M.N.H.	May 18	Santa Cruz, Arg.	♀ small
U.S.N.M.	" 18	Rio Gallegos, Patagonia	♀
U.S.N.M.	" 24	Potrillo, Mendoza, W. Arg., 5000 ft.	♀ imm.
U.S.N.M.	" 27	Rio Gallegos, Patagonia	♂
A.N.S.P.	July 17	San Lorenzo, Dept. Tarija, 7500 ft., Bol.	♀
A.N.S.P.	" 17	" " " " " " " "	♂
A.N.S.P.	" 19	" " " " " " " "	♂
A.M.N.H.	" 23	San Juan, Arg.	♀
M.A.	" 28	Tilcara, Jujuy, Arg	♀
A.M.N.H.	" 31	Media, Agua, Prov. de San Juan, Arg. (2200 ft.)	♂ T.N.E.
A.M.N.H.	Aug. 1	Chubut, Valle del Lago Blanco, Patagonia	—
U.S.N.M.	" 11	Canyodon, Palo, Patagonia	♂
U.S.N.M.	" 11	" " " " " "	♂
A.M.N.H.	" 12	Rio Gallegos, Arg.	♀ small
M.C.Z.	" 15	Pto. San Antonio, Arg.	♂
A.M.N.H.	" 18	Chubut, Valle del Lago Blanco, Pat.	♂
A.M.N.H.	" 18	" " " " " " " "	♂
M.C.Z.	" 23	Maquinchao, Gob. Rio Negro, 2900 ft., Arg.	♂
A.M.N.H.	" 23	Egg Harbor, Lat. 45°S, Long. 65°W	—
U.S.N.M.	" 24	Near Mt. Tigre	?
U.S.N.M.	" 24	" " " " " "	?
U.S.N.M.	" 24	" " " " " "	?
A.M.N.H.	" 25	Angaco Sud, Prov. San Juan, Arg., 2000 ft.	?
A.M.N.H.	" 30	Chubut, Valle del Lago Blanco, Patagonia	♀
M.C.Z.	" 30	Huanuluan, Gob. Rio Negro, 3100 ft., Arg.	♀
M.A.	Sept. 1	Pampa Grande, Salta, Arg.	♂
M.C.Z.	" 2	Huanuluan, Gob. Rio Negro, 3100 ft., Arg.	♂
M.C.Z.	" 2	" " " " " "	♀
M.C.Z.	" 2	" " " " " "	♂
M.C.Z.	" 4	" " " " " "	♀
M.C.Z.	" 4	" " " " " "	♂
M.C.Z.	" 4	" " " " " "	♀
M.C.Z.	" 18	" " " " " "	♀
U.S.N.M.	" 14	Near Rio Coy, Patagonia	♀
M.A.	Oct. 26	Canhelo, La Pampa, Arg.	♂
M.C.Z.	" 3	Huanuluan, Gob. Rio Negro, 3100 ft., Arg.	♀
M.C.Z.	" 3	" " " " " "	♂
M.C.Z.	" 3	" " " " " "	♂
M.C.Z.	" 15	" " " " " "	♀
M.C.Z.	" 15	" " " " " "	♀

MUSEUM	DATE	LOCALITY	SEX
U.S.N.M.	Oct. 28	Near Coy Inlet, Patagonia	♀
U.S.N.M.	" 28	" " "	?
U.S.N.M.	" 28	" " "	?
U.S.N.M.	" 28	" " "	?
U.S.N.M.	" 28	" " "	♂
M.C.Z.	" 31	Huanuluan, Gob. Rio Negro, 3100 ft., Arg.	—
M.C.Z.	Nov. 12	" " " " "	♀
A.M.N.H.	" 17	Punta Arenas, Chile	♀ large
A.M.N.H.	" 28	Kingl, South, Chile	♂ large
M.C.Z.	" 30	Huanuluan, Gob. Rio Negro, 3100 ft., Arg.	♀
M.C.Z.	Dec. 2	" " " " "	♂
Biol. Sur.	" 8	Neuquén: Zapala, Arg.	♂ ad.
Biol. Sur.	" 9	" " "	♂ ad.
M.C.Z.	" 10	Huanuluan, Gob. Rio Negro, 3100 ft., Arg.	♂
A.M.N.H.	" 23	False Cape Horn, Chile	♀ distinct
A.M.N.H.	" 23	" " "	♀ setting
A.M.N.H.	" 26	Punta Arenas, Chile	♀ imm.
A.M.N.H.	" 26	" " "	♀ imm.
A.M.N.H.	" 30	Cape Horn, Chile	♂
			breeding
A.M.N.H.	" 31	" " "	♀ distinct

MEASUREMENTS

(In millimeters)

TOPOTYPICAL SERIES OF MALES

SUBSPECIES	NUMBER	WING	TAIL	RATIO TAIL TO WING	CULMEN
<i>septentrionalis</i>	5	68-75 (70)	58-65 (60.4)	85.7	12.0-13.0 (12.5)
<i>antillarum</i>	5	65-70 (66.6)	62-66 (63.2)	94.8	13.0-14.5 (13.7)
<i>costaricensis</i>	8	62-67 (64.3)	50-57 (54)	84.4	12.2-13.0 (12.6)
" <i>Ecuador</i>	5	62-64 (63)	51-53 (51.8)	82	11.5-12.8 (12.1)
<i>huancabambae</i>	7	65-72 (68.1)	55-59 (56.7)	83.2	13.2-13.9 (13.2)
<i>peruviansis</i>	9	69-74 (72)	58-65 (60)	83.3	12.8-14.2 (13.5)
<i>carabayae</i>	7	66-74 (70.4)	55-64 (58.3)	82.7	12.5-14.1 (13.4)
<i>pulacayensis</i>	7	80-84 (82)	65-73 (68.5)	83.5	12.5-12.9 (13.7)
<i>antofagastae</i>	5	74-78 (76)	61-66 (64.4)	84.7	12.0-13.2 (12.5)
<i>venezuelae</i>	5	64-66 (65)	53-58 (55.6)	85.5	12.3-13.2 (12.7)
<i>insularis</i>	5	62-70 (65)	52-59 (56)	86.0	13.7-15.0 (14.2)
<i>roraímae</i>	5	61-67 (64)	54-64 (58.2)	91.0	13.0-14.1 (13.5)
<i>macconnelli</i>	2	71	65	91.0	13.8-14.3 (14)
<i>capensis</i>	2	65-66 (65.5)	55	84.0	12.0-13.3 (12.6)
<i>tocantinsi</i>	5	62-67 (63.6)	51-61 (55.6)	87.3	12.0-13.8 (12.9)
<i>matutina</i>	7	62-66 (64.4)	55-61 (57)	88.5	12.0-13.6 (12.8)
<i>subtorquata</i>	7	66-72 (68.7)	58-64 (61)	88.8	13.2-14.2 (13.8)
<i>hypoleuca</i>	8	65-71 (70)	56-62 (57.2)	81.4	12.0-12.6 (12.5)
<i>mellea</i>	2	69	57	83.0	12.0-12.5 (12.2)
<i>chilensis</i>	7	74-80 (77)	58-61 (61)	80.0	11.0-12.9 (12.1)
<i>sanborni</i>	7	78-85 (81.8)	60-64 (62)	76.2	11.3-12.9 (12.2)
<i>choraules</i>	5	75-79 (76.6)	60-64 (62)	80.9	12.3-12.1 (12.5)
<i>australis</i>	6	79-85 (81.6)	59-63 (61.3)	75.0	11.0-12.2 (11.8)

23.—*Zonotrichia capensis*, subspecies?

No. 519020 of the American Museum, which was received in the Rothschild Museum collection, is an apparently undescribed race of *Zonotrichia capensis*. It is labelled in ink on a piece of cut card "7379. h" and on the reverse, in one hand, "*Zonotrichia matutina* Taboga." To this,

evidently another hand, using a pencil, has imposed a comma on the period and added the word "Panama."

With the aid of evidence supplied from similar labels attached to other Rothschild birds now in the American Museum, Miss P. M. Thomas of the Rothschild Museum Staff, identifies the label of specimen No.



Fig. 6. An undescribed form of *Zonotrichia capensis* said to have come from Taboga Island. Amer. Mus. Nat. Hist. 519020. Taboga, Panama.

519020 as part of the card of either A. D. or Edward Bartlett of London; the former, superintendent of the London Zoo (1850-97), the latter, a well-known collector of South American birds in the late sixties. These facts suggest that our bird was labelled in London but they throw no further light on its history, or the site of its capture.

The characters of this unique specimen are its small size and pale coloration. In both respects, singularly enough, it is nearer to *Zonotrichia capensis insularis*, of Curaçao and Aruba, than to any other race. It essentially agrees with *insularis* above but has less black on the throat. The sex is not stated but assuming that it is a fe-

male, it is still smaller than *insularis*; wing, 60; tail, 51; tarsus, 18.5 mm.

The only Taboga of record, in Central or South America, is the island of that name in Panama Bay about six miles off the mainland. It contains about 3000 acres of sparsely grown hills, rather a small area to support an island race, but soundings suggest that it may once have included the neighboring islands of Taboguilla and Uravá, and that they all may have been connected with the mainland. In any event, Mrs. Gladys C. Barnard, of Pedro Miguel, Canal Zone, who, at our request, has recently visited Tabogain search of *Zonotrichia*, reports that the bird was not observed.

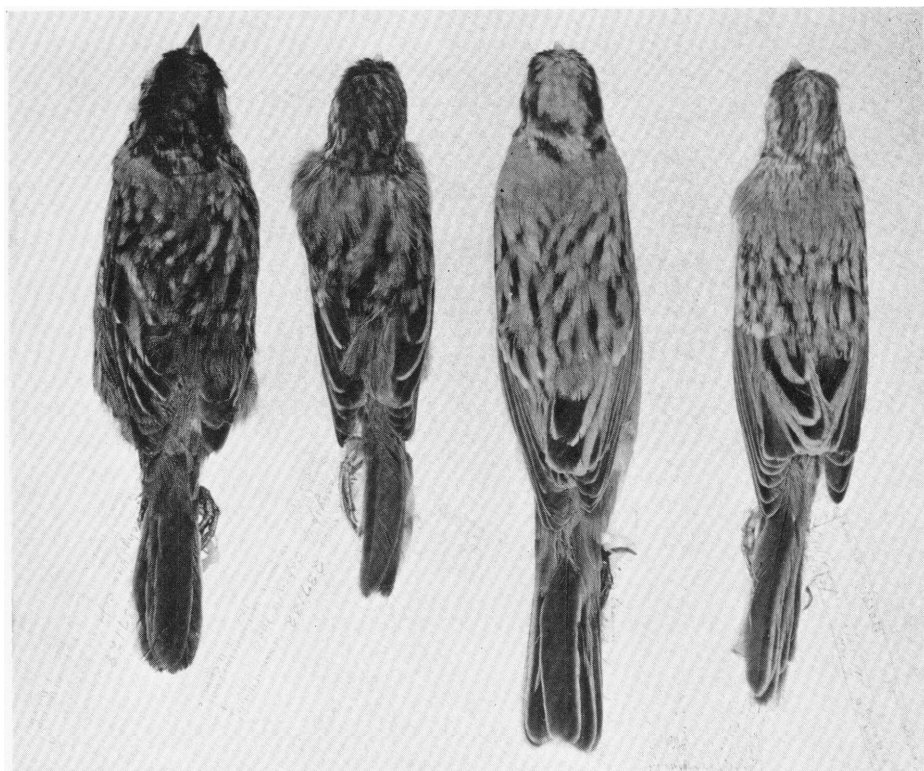


Fig. 7. Resemblance of juvenal to adult plumage; illustrating the inheritance of an environmental character.

Zonotrichia c. macconnelli

1. Amer. Mus. Nat. Hist. 237128. ♂ adult, Summit of Mt. Roraima, Venezuela, Nov. 18, 1927, T. D. Carter.

2. Amer. Mus. Nat. Hist. 237132. ♀ juvenal, Summit of Mt. Roraima, Nov. 25, 1927, T. D. Carter.

Zonotrichia c. pulacayensis

3. Phila. Acad. Nat. Sci. 135029. ♂ adult, Callipampa, Bolivia, June 3, 1936, M. A. Carriker, Jr.

4. Phila. Acad. Nat. Sci. 135033. ♀ juvenal, Callipampa, Bolivia, March 7, 1938, M. A. Carriker, Jr.

JUVENAL PLUMAGE

The descriptive term "juvenal," as here used, is not synonymous with the adjective or noun juvenile. The latter may be applied to any creature which is not mature; the former, as defined by Dwight,¹ is applicable only to passerine birds in their second plumage, or to the plumage itself,

that is, the plumage following the natal down.

In general tone of color the juvenal plumage of *Zonotrichia capensis* more or less resembles that of its parents. That is, dark races, like *antillarum* and *roraimae*, have dark young, while paler races, like *matutina*, have pale young. In short, the juvenal plumage reflects the characters of that of the adult. There is even an easily recog-

¹ The Sequence of Plumages and Moults of the Passerine Birds of New York. 1900, Ann. N. Y. Acad. Sci., XIII, p. 106.

nizable difference between the juvenals of *matutina* and *subtorquata*, and in the latter the faint yellow wing-bend is usually present.

The juvenal differs from the adult plumage in the absence of black and gray on the head, rufous on the nape and sides of the neck and black on the neck. The crown is brown streaked with black and with an ill-defined median line; the superciliary is gray to buff, the back resembles in color that of the adult but the feathers are softer, their barbs looser; the wings and tail are much as in the adult but usually browner; the wing-coverts are not so black, their tips not so white or well-developed; the underparts, particularly the breast and sides, are streaked with black, the belly is whiter. The wings and tail agree in size with those of the adult.

How long this plumage is worn is unknown. Dwight states that in the Song Sparrow it "is worn for several months." The fact that 129 specimens (about one-tenth of our entire collection) are in juvenal

plumage shows that it is not transitory. However, the fact that our collection has been made chiefly on the nesting-ground should be considered in this connection.

At the postjuvenal molt the rectrices and remiges are retained, but the rest of the plumage, including the wing-coverts, is replaced. The succeeding, or first-winter, plumage resembles the adult or postnuptial plumage, but in the younger bird the remiges and rectrices are usually browner, the wing-coverts not so black, their tips less sharply white.

Compared with juvenals of the North American species of *Zonotrichia* the young of *capensis* more nearly resembles that of *leucophrys* than it does that of *albicollis*; while among the South American races the juvenal of *pulacayensis* most nearly resembles young *leucophrys*. This resemblance, indeed, is so close that comparable juvenals of the two species are to be distinguished in color chiefly by the darker auriculars of the South American bird.

II

DISTRIBUTION

Assuming that the evidence supplied by form, color, pattern, voice and range warrants us in placing our bird in the genus *Zonotrichia*, the belief follows that geographically it originated in the North Temperate Zone, where its four congeners¹ live today. In "Remarks on the Origin and Distribution of the *Zonotrichiae*"² Mr. Rudyerd Boulton suggests that these birds may have originated in Central America in the Early Tertiary and thence spread both northward and southward. Mr. Boulton, however, is writing of physical origin while we are concerned with geographical origin, events separated by some millions of years. Furthermore, Mr. Boulton treats the subject of the present paper as generically distinct from *Zonotrichia* under the name *Brachyspiza* and sends it to South America from Central America direct while I would have it accompany what I believe to be its congeners to North America before it be-

gan its Ice Age journey to the southern continent. It seems to me that the slight degree of differentiation shown by *Zonotrichia capensis* indicates a comparatively recent entrance into South America and therefore supports the second, rather than the first theory.

Granted the concept of North America as a base from which the invasion of South America started and we seek the factors that prompted it.

In a preglacial or interglacial period we may think of *Zonotrichia capensis* as having a more or less restricted summer range in the interior of North America, much like that of Harris' Sparrow (*Zonotrichia querula*) today. Its movements, therefore, would be more definitely influenced by a changing climate than if it had ranged from Atlantic to Pacific, as *Zonotrichia albicollis* and *Z. leucophrys* do today. Retreating before the falling temperature of a growing Ice Age, with other similarly affected birds, it entered the funnel of Mexico and was

¹ *Zonotrichia albicollis*, *Z. leucophrys* and races, *Z. querula* and *Z. coronata*.

² The Auk, XLIII, 1926, pp. 326-332.

started on its southern journey. In a paper on "The Upper Zonal Bird-Life of Mts. Roraima and Duida"¹ I called attention to the influence exerted by the low temperatures of the Ice Age in forcing animals southward. In suggesting that a form of our sparrow (*Zonotrichia capensis antillarum*), resident in the highlands of Santo Domingo, may have reached there direct from North America, rather than through Central America, I referred to the existence of representatives in the Greater Antilles, as breeding birds, of such northern species as the Sandhill Crane (*Grus americana*), Bob-white (*Colinus virginianus*), Ivory-billed Woodpecker (*Campephilus principalis*), Flicker (*Colaptes auratus*), and, most significant among several other species that might be included here, the boreal White-winged Crossbill (*Loxia leucoptera*) now found in the highlands of Santo Domingo that shelter *Zonotrichia capensis antillarum*. An equally impressive instance, probably occurring during this period, of southward range extension of an unquestionably northern species, is supplied by the presence of the Horned Lark (*Otocoris alpestris peregrina*) on the Savanna of Bogotá, Colombia.

Obviously, climatic conditions that forced the walrus southward to the coast of Georgia and the musk-ox to Virginia, Kentucky, Arkansas and Texas must have had a profound and widespread effect on the distribution of the fauna. This has been convincingly shown by Dr. George Gaylord Simpson in his paper on the Pleistocene mammals of Florida. Dr. Simpson² writes:

"The advance of the ice-sheet made a large part of North America almost uninhabitable and another large part inhospitable to most mammals. Southward movement of the mammalian hordes was inevitable. Even aside from the animals which might migrate to great distances, a surging impulsion would be transmitted so that species or individuals which never lived near the glaciated areas would yet be urged southward by the pressure of concentrated populations north of them."

Resulting from this concentration of mammalian life in the Florida peninsula Dr. Simpson records, by groups, the 66 species of land mammals then inhabiting Florida and estimates that "at least seventy-five species were present . . ." Of this number there remain today "probably about two-fifths of the Pleistocene fauna." This marked reduction in number Dr. Simpson attributes to a variety of causes but chiefly to the effects of glaciation. In this connection his paper should be consulted.

No ornithologist has treated this subject more fully and satisfactorily than Mr. Ludlow Griscom³ in his memoir on Guatemalan bird-life. On page 71 of this authoritative work Mr. Griscom states: "When we recall the outline of the Glacial Period and its effects in Central America and the Andes presented in an earlier Chapter [see pp. 28, 34, 54], it requires no elaboration to see that the great migration southward of mammals and birds affected the entire New World. The increasing refrigeration of the climate steadily rendered more lowlands southward available for occupation by northern species escaping the ice. At the same time mountain species of tropical origin must have descended once more to lower levels, from which tropical species must have emigrated or become extinct." Quoting also from page 63: "At its maximum development, at least, the avifauna of the Subtropical Zone in Central America descended to sea-level and had consequently a chance to pass continuously from Mexico to Colombia. With the close of the Ice Age, the survivors of this experience gradually regained their present altitudes. . ."

Having thus supplied a motivating factor for the southward travels of *Zonotrichia capensis* we may attempt to trace the bird's route. What follows has in large part been presented in the systematic part of this paper but it is repeated here in order to give a more connected history of *Zonotrichia*'s invasion of South America from Central America.

Beginning at its now most northern station, in Guatemala, and adjoining parts of Mexico, Honduras and El Salvador we at

¹ Bull. Amer. Mus. Nat. Hist., LXIII, 1931, p. 51.

² Amer. Nat., LXV, May-June, 1931.

³ Bull. Amer. Mus. Nat. Hist., LXIV, 1932.

once observe that the bird has occupied the highlands of the arid, or unforested Subtropic and Temperate zones, where, apparently, true to inherited climatic predilections, it finds the comparatively low temperature which is congenial to it.

But when, from this starting point, we attempt to follow our sparrow's trail southward, we find that the bird is unrecorded from between the highlands of El Salvador and those of Costa Rica and western Panama. This gap in *Zonotrichia's* distribution we accept as evidence that the journey was made at or near sea-level when the temperatures of the higher life-zones, under the influence of glaciation, had descended to the coastal region.

It was not until a recurring warmer climate, following the gradual disappearance of the Ice Age, permitted the temperate zone to return to its normal elevation in the mountains, that the sparrow accompanied it upward. Where proper heights and habitats were lacking, the sparrow had no suitable country to retreat to, and from such areas it is now missing.

Continuing our southward journey, between Veragua and the Andes of northwestern Colombia, again we discover that *Zonotrichia* is lacking, possibly because the intervening country is so heavily forested that even when the altitude is favorable, the region is not adapted to *Zonotrichia's* occupation.

There is one significant exception to be made to this statement: The Gorrion, here known as "Comemaiz," exists today on Coiba Island, 30 miles off the coast of western Panama. Here again we have evidence that its journey was made at or near sea-level. Hence, when the birds of the neighboring mainland ascended the mountains of Veragua, those of Coiba were left isolated—a bit of "glacial drift." The same story may be told of the Gorrones that inhabit the islands of Curaçao and Aruba off the Venezuelan coast, where they also exist as relics of an earlier age.

Reaching Colombia we find that the Andes has offered a highway for the extension of our sparrow's range, both to the south and east. Proper habitat require-

ments have been found in the Paramo or Puna Zone, the arid or semi-arid Temperate Zone, as well as at those subtropical altitudes where scanty rainfall prohibits forest growth. Under such conditions characteristic subtropic birds are absent and Temperate Zone species are found below the usual level of their zone. I have heretofore¹ termed such stations temperate, but in the present connection the correct altitude seems more definitely conveyed by terming them subtropical.

Omitting heavily forested regions, including the Amazonian basin, *Zonotrichia* is distributed practically continuously from Colombia to Cape Horn. North of about 7° S. lat. it is found only at the altitudes named but where the Humboldt Current is effective it descends to the coast and thereafter is found from sea-level to the puna.

It is unexpected to discover that *costaricensis* reaches the Ecuador-Peru boundary where it is replaced by *huancabambae* of the Subtropical Zone of northern Peru. In the Temperate and Puna zones and on the part of the Peruvian coast sufficiently influenced by the Humboldt Current, *huancabambae* is represented by the larger *peruiensis*, which, on the tableland in the Cuzco region, gives way to *pulacayensis*. Thence southward this large race occupies the puna of Peru and Bolivia to northwestern Argentina. On the subtropical Amazonian slopes of the Andes *huancabambae* is continued by a dark, variable form which I have called *carabayae*, and on the Pacific slopes of the north Chilean Andes *pulacayensis* becomes *antofagastae*, a distinct race separating *peruiensis* from *chilensis* and unknown to intergrade with either.

Before proceeding farther south, we may return to Colombia to follow the route of *Zonotrichia* thence eastward into Venezuela. The Costa Rica-Colombian race reaches the Santa Marta mountains and ranges through the Méridan Andes of Venezuela, at least to Cubiro. It is unknown from the comparatively low area between Barsiquemeto and the coast range above Puerto Cabello where it reappears as

¹ Bull. Amer. Mus. Nat. Hist., XXXVI, 1917, p. 315.

Z. c. venezuelae, which, with a break between the Caracas Andes and Barcelona, extends eastward to the mountains of Sucre.

I have already spoken of *insularis* of Curaçao and Aruba, which appears to be a representative of *venezuelae*.

The absence of *Zonotrichia* from Trinidad, where altitudes exist as high as those it inhabits in northeastern Venezuela, suggests that the bird reached this region after the island was separated from it.

South of the Venezuelan coastal range our bird has found refuge from the return of a warmer climate in the mountain group of which Auyan-tepui, Roraima and Merumé are parts. Here, from 3500 feet upward, it is a common bird.

During the period of invasion it evidently reached the country to the east, but in default of a suitable area to which it might retreat before a rising temperature, it apparently exists there today at but few localities. Mr. E. R. Blake, of the Field Museum, writes me that he did not find *Zonotrichia* in British Guiana while collecting extensively there in 1937, or in his 1939 expedition to the British Guiana-Brazilian boundary, when he reached an altitude of 3000 feet. The three Carnegie Museum specimens from the lower Oyapock are, therefore, the only ones I have seen from east of the Merumé mountains.

Except along the river, that part of Brazil lying between the Guianas and the Amazon is ornithologically unexplored and we do not know whether or not *Zonotrichia* occurs in it. But the genus is recorded by Snethlage from Monte Alegre, on the left bank of the lower Amazon, and on Marajo Island and we have found the form described as *Zonotrichia capensis tocantinsi* on the lower Tocantins.

From this low ground the bird has reached the campos of Brazil where, at elevations of from 1500 to 3000 feet, and locally higher, it has evidently found conditions to its liking. From Maranhão southward it occupies the entire country south of the forests of Amazonia, appearing as *Z. c. matutina* in the northeast provinces, and Matto Grosso to Bolivia, and as *Z. c.*

subtorquata in southeastern Brazil, Uruguay and eastern Paraguay.

The Andean and the Brazilian routes meet in Bolivia, as described under *Z. c. hypoleuca*, and the species continues thence to Cape Horn. South and east of the range of *hypoleuca*, in northern and eastern Argentina, we enter the range of *choraules* which extends to northern Patagonia and there merges by contact or geographic intergradation with *australis*.

In the Andes, and on the Pacific slopes and coast north of Chile, we encounter *Z. c. chilensis* which, except for the highly localized *sanborni* in the puna of northern Chile, is found to southern Chile where it intergrades with *australis*. The exact relationships of the latter form to its neighbors is not satisfactorily known.

On reaching Cape Horn, whence we have nesting specimens, we are impressed by the fact that our enterprising sparrow has extended its range to the very limits of the continent. If additional territory were available it doubtless would have occupied it. We conclude, therefore, that under existing conditions the distribution of *Zonotrichia capensis*, at least in its major aspects, is completed.

Since but a single race of this species now inhabits southern Mexico and adjoining Central America, we may assume that when, according to our theory, it reached this area from the north, it then numbered only the ancestral form of the species. Now as we review its descendants throughout the continent in which it settled, we find that they number twenty or more; and also that, with the possible exception of the Patagonian *australis*, not one has achieved specific distinctness. We are further impressed, therefore, with the fact that as evolution measures time, we are dealing with current history.

In considering the part played by widely diverse environments and isolation in the production and development of these nascent species we ask what is the time relation here between range and race?

When we compare the observed rapidity of range-extension with the unknown rate of speciation, we conclude that *Zonotrichia capensis* had reached a large part of the

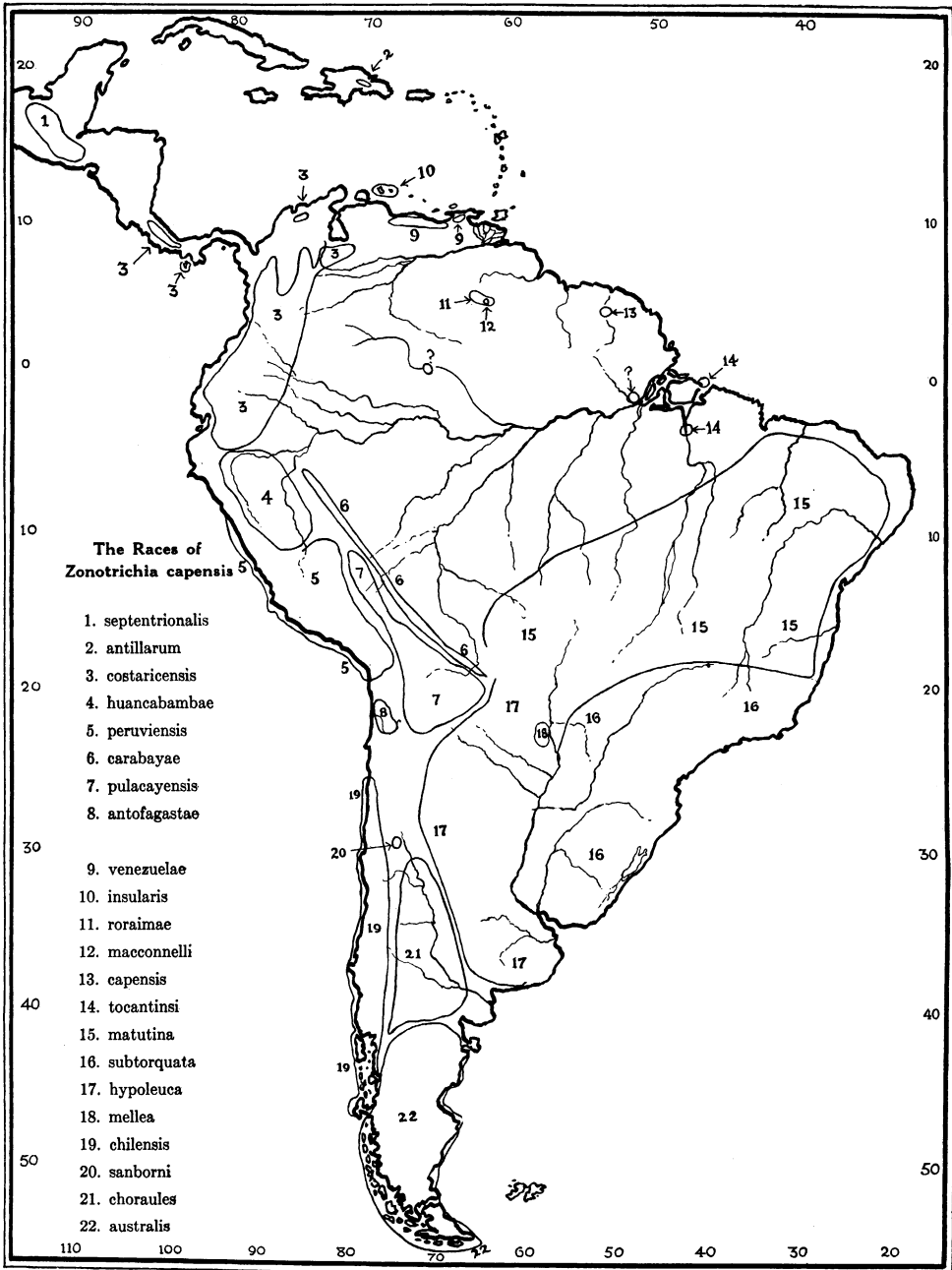


Fig. 8. Map of West Indies, Central and South America indicating ranges of the races of *Zonotrichia capensis*.

territory it now occupies before it exhibited visible response to the influences of its new environments. Our records show numerous instances in which introduced species, under favorable conditions, have acquired an extensive range in an amazingly short time. I refer particularly to the history in North America of the European Starling (*Sturnus vulgaris*). First released in Central Park, New York City, just 50 years ago, it now is found throughout the eastern United States, a wider area than that inhabited by many native species. On the other hand, I recall no American species, or even subspecies, the age of which has been determined. In Egypt, however, basing his estimate on studies of the climatic changes in the valley of the Nile, R. E. Moreau¹ concludes that "5000 years is not far from the minimum required for the development of an ornithological race."

Merely to present the subjects of distribution and evolution in a comparative light I should say that under existing conditions *Zonotrichia capensis*, starting from southern Mexico, might have acquired its present continental range in a few hundred years, while an unknown period was required for the development of its first race.

When we see the bird in its haunts today we are impressed by the belief that it occupies an ecologic niche largely its own.

This is especially true of cities where it seems as much at home as a House Sparrow (*Passer domesticus*) and evidently encounters little or no competition from other species. True, the cities were not there when the bird entered the country but its successful occupation of them today is proof of its adaptability. From the beginning, therefore, this fertile, responsive species has found a land where, because its own family is poorly represented, there have been no serious checks on its increase and dispersal.

The earlier stages of its invasion were doubtless made at or but a few thousand feet above sea-level, and under the impulsion of climatic urge. Possibly it was not until it had reached a latitude beyond the influence of Ice Age temperatures that its advance was determined by its annual increase in numbers.

While the first birds to become resident in latitudes south of the isothermal adjustments incident to a declining glaciation have presumably been under environmental influences longer than the later, more southern settlers, we assume that the total time required for essentially complete colonization was too short to have played any part in degree of speciation. Indeed, we observe that the most southern birds, and presumably therefore the last to become resident, are the most highly differentiated.

MIGRATION

Zonotrichia capensis australis, of Patagonia and Magellanica, is the only race of its species known to be definitely migratory. Data concerning the time and distance of its seasonal movements have been presented in connection with its systematic treatment. Other aspects of the subject may be discussed here.

No evidence of altitudinal migration has been found in our large collection. Available records show surprising stability in altitudinal temperatures. Macconnell's Finch, of the summit of Mt. Roraima, has not been taken in the habitat of *Z. c.*

roraimae on the slopes of the mountain only 1400 feet lower. The race of the Bolivia-South-Peru puna (*Z. c. pulacayensis*) has not been found with the races which inhabit the lower slopes of its range. In short, with the possible exception of *Z. c. choraules*, all the allies of *australis* appear to be resident. This fact supports the belief that *australis* itself became migratory in response to conditions which it encountered on arriving at the then southern limit of its range. We have no means of determining the latitude of this limit or of the conditions prevailing there; but since Patagonia was heavily glaciated it seems

¹ *Ibis*, 1930, p. 239.

not improbable that *australis* did not at first occupy all of the area which it now inhabits; and, if this be true, it is also probable that the mean annual temperature was lower then than it is at present.

In default of data to verify this assumption, we turn to current climatic conditions to learn how they may affect the movements of *Zonotrichia* today. Thus we find at Punta Arenas a mean annual temperature of 43.5° F. with July and January (winter and summer) means of 34.7° F. and 52° F., respectively. The difference of 17.3° is sufficient to produce marked changes between summer and winter climates and the food-supply of the former must be greatly reduced in the latter. The seasonal differences in flora, chiefly from the ornithologist's view-point, are summarized by Crawshaw in his "Birds of Tierra del Fuego." Of birds, he remarks (p. xxvii) "The majority are only summer visitors." Migration in this region, therefore, is not confined alone to *Zonotrichia*, but to those species which, as nestlings or adults, require food of a kind and in a quantity not to be found in winter. The climatic changes, whether of higher temperature or increased rainfall, that in acting on both flora and fauna, add to the food-supply, also bring the migrating bird into bearing. Its period of fruition conforms to that in which plants yield their crops and insects multiply. On this agreement in the period of productivity with the greatest abundance of food depends the bird's success in seasonal extension of range. It follows, therefore, that throughout its range, from 16 degrees north, to 56 degrees south of the equator, *Zonotrichia*'s nesting season must vary in time so that, whether resident or migratory, it will produce its young when there will be enough food for itself and its offspring. Consequently, we find that in Costa Rica, governed by the time of rainy season, the bird nests from March to September, while in the Magellan region, controlled by temperature, the breeding time is from November to February. At intervening latitudes there is the same adjustment between season and periodic productivity. This agreement is also maintained by the House Sparrow (*Passer domesticus*)

in southern Argentina, of which James L. Peters writes:¹ "It has adapted its time of breeding and assumption of breeding plumage to coincide with the reversed seasons of the south temperate zone."

In Rio Negro, Argentina, at the more northern part of its range, *australis*, as a species, is resident. Whether the individual birds are resident or whether the breeding birds move north while their places are taken by individuals from farther south is unknown. Possibly those found there in winter may have bred in Magellanica while the summer birds may migrate to northern Argentina and Bolivia. We also have August specimens of *australis* from the coast south of S. lat. 50, where possibly favorable conditions for wintering may prevail. In any event, it is an interesting fact that as *australis* reaches the northern Argentine from the South Temperate Zone the Bobolink (*Dolichonyx oryzivorus*) is leaving it for the North Temperate Zone. With the former it is late autumn, with the latter, early spring.

Why the Bobolink should extend its fall migration to winter in northern Argentina may forever remain unknown. But we may at least suggest that when *Zonotrichia capensis* acquired the habit of migrating northward to winter in southern Bolivia its breeding area may have been much farther north than it is now. Patagonia, we know, was heavily glaciated and it is quite possible may not have been habitable when *Zonotrichia* first reached this part of South America. The bird, therefore, may have settled in central Argentina, where climatic conditions were then sufficiently severe to enforce migration and Bolivia was much nearer its breeding range than it is today.

Whether the Ice Age induced the Bobolink to extend its winter range south of Amazonia to a region adapted to its habits, is a subject for speculation, but the history of *Zonotrichia capensis* seems so well documented by races marking the stages of the bird's geographical and physical development that the origin of its migratory habits seems open to explanation.

¹ Bull. Mus. Comp. Zool., LXV, No. 9, 1923, p. 331.

Unlike the Bobolink, therefore, we may trace its development from a non-migratory species, until its range-extension brought it under the climatic influences which then, as today, seem responsible for those seasonal adaptations to space that we term migration.

MEAN WINTER AND SUMMER TEMPERATURES

	JULY	JAN.
Punta Arenas, Chile	34.7 F.	52 F.
Santiago, Chile	46	67.2
Buenos Aires, Argentina	49	73.5
Salta, Argentina	53	71.6
Arequipa, 7611 ft., Peru	56.9	58.4
Quito, 9350 ft., Ecuador	55	55

NESTING SEASON

From the data already presented it will be observed that where marked seasonal differences in temperature are lacking, the time of the nesting season coincides with that of the wet season. Diverse topography and other reasons may cause this to vary widely in a limited area with a corresponding variation in the breeding period of the birds affected. This might produce differences in the nesting season of birds of contiguous areas and thereby create a barrier to their interbreeding.

In Colombia, for example, the range of *Zonotrichia* covers four distinct mountain ranges, two large, definitely separated valleys, and 10,000 feet of altitude.

In my "Distribution of Bird-Life in Colombia," after commenting on the lack of data, I write:¹

"Two types of the seasonal distribution of rain are commonly recognized in Colombia. In one, a wet season of six months' duration is followed by a dry season of equal length. In the other, wet seasons each of three months' duration are separated by dry seasons of equal length.

"Under the first-named condition, rain usually falls from May or June to November or December, and the season is termed 'invierno' or winter; while the months from November or December to May or June are dry and the season is known as 'verano' or summer.

"North of latitude 8° the seasons are characterized by one dry and one rainy period; south of this latitude two rainy and two dry seasons are the rule. The comparatively arid Caribbean Fauna possesses therefore but one rainy season, while the humid Cauca-Magdalena Fauna has

two, annually. There is, however, much irregularity both north and south of latitude 8°, while the amount of variation in annual precipitation at stations separated by only a few miles may exceed 300 inches!"

It is obvious, therefore, that if *Zonotrichia's* nesting time is dependent on the rainy season, its date must vary as widely and as abruptly as the rains themselves. I can recall finding the sparrows on one side of a mountain range in song and hence presumably breeding, or about to breed, while on the other slope they were silent and probably, therefore, not breeding.

Although we have 106 specimens of *Zonotrichia* from Colombia, they merely serve to confirm the variability in nesting season which we should expect to accompany a corresponding variability in the rainy season. These birds represent every month but August. Most of them were secured by American Museum collectors and have the condition of the sexual organs written on their labels. Excepting August, these data show that birds with enlarged gonads were taken in every month but May and December, while birds in juvenal plumage represent every month but January and July.

It follows, therefore, that in Colombia as a whole, *Zonotrichia* breeds throughout the year, but this does not imply that the breeding season at any one locality extends throughout the year. To associate a bird with its year would require prolonged, intensive collecting. Then the variations suggested by our specimens from the Cauca Valley, the southwestern part of the coastal Andes, the eastern slope of the eastern Andes and elsewhere, might be definitely understood and we should doubtless dis-

¹ Bull. Amer. Mus. Nat. Hist., XXXVI, 1917, p. 81.

cover that Colombia possesses several as yet undescribed races of *Zonotrichia capensis*.

Where, as shown above, two annual wet seasons occur in the same region it is conceivable that should one part of a population nest in one season and another part in the other, a climatic isolation might be developed which would give opportunity for speciation.

But the dates of rainy seasons, at least in my experience, vary so widely from year to year, and many species of birds are so responsive to climatic influences that, in my opinion, effective barriers to interbreeding would not be established by the theoretical conditions named. Moreover, the fact that *Zonotrichia capensis* has two, or even three, broods with a correspondingly prolonged nesting season would further tend to prevent seasonal segregation. (But on this subject consult Landsborough Thomson, Bull. B. O. C., 427, 1939, pp. 31-39, with contained references.)

A summary of nesting seasons is appended. Details will be found in the discussion of specimens under the races.

Zonotrichia capensis septentrionalis

Salvador: Breeding in "full swing" in May (van Rossem). Continues until December (skins).

Zonotrichia capensis antillarum

Santo Domingo: At least May to September (Wetmore and skins).

Zonotrichia capensis costaricensis

Costa Rica: March to at least September (skins).

Zonotrichia capensis peruiensis

Peru: February to May (Stolzmann); coastal region, January to May; tableland, January to May? (skins).

Zonotrichia capensis venezuelae

June to December (skins).

Zonotrichia capensis insularis

Probably same as that of *venezuelae*.

Zonotrichia capensis roraimae

Probably same as that of *venezuelae*.

Zonotrichia capensis matutina

Matto Grosso, Brazil: October to February (skins and specimens).

Zonotrichia capensis subtorquata

November to March (skins).

Zonotrichia capensis hypoleuca

Buenos Aires: October to March . . . "I have known these birds to breed in April and May, and these very late nests escape the infliction of parasitical eggs" (Sclater and Hudson, Arg. Orn., I, p. 58).

Northern Argentina: October to February (various authors and skins).

Zonotrichia capensis chilensis

Angol: September 30 to December (Bullock).

Coronel: End of September to December (Pässler, J. f. O., 1922, p. 477).

Zonotrichia capensis australis

Huanaluan: November 20 to — (Peters).

Punta Arenas: Late November to February (skins).

SONG

Unless one be a disciple of Albert Brand, birds' songs are difficult to record in a manner permitting of satisfactory comparison. Objective description and syllabification may sometimes be employed, but at the best they are inadequate.

To Hudson the song of *Zonotrichia capensis*, heard near Buenos Aires, ". . . is very composed of a chipping prelude and four long notes, three uttered in a clear thin voice, the last a trill." Stolzmann, writing from Peru, resorts to

the use of syllables, as follows: "Le chant est court et peu varié, composé à peine de quelque syllabes qu'on pourrait traduire par: Pi-piu, pi-trschi." (Orn. du Pérou, III, 1886, p. 47). Stolzmann also states that there is much local variation in the song of *Zonotrichia* in Peru, a fact confirmed by my colleague J. T. Zimmer. Other ornithologists have commented on the geographical variation in the voice of this bird in various parts of its range. Bond, for example, states that the song of

the Santo Domingo race, *antillarum*, "consists of a pleasant trill, beginning deliberately and terminating rapidly in quality very like that of the North American Swamp Sparrow (*Melospiza georgiana*); it may be described as a full-throated 'wis-wis-wis-wiswiswis.'"

This association of type of song with locality is an indication of the birds' seden-

tariness and in connection with the time of the breeding season, of which song is an expression, might aid in creating a measure of isolation. Without regard to local variations, North American bird students have found a strong reminder in certain notes of *Zonotrichia capensis* to those of *Z. leucophrys* and *Z. albicollis* (particularly the former) a fact which has served to emphasize their apparent relationships.

VARIABLE CHARACTERS

GENERAL SIZE.—Comparison of the measurements of parts shows that total length (the measurement of the whole) is not always indicated by the measurements of parts. Thus the race with nearly the longest wing has the shortest bill, while the bird with the longest bill may have nearly the shortest tail.

Comparative size, therefore, can probably best be expressed in total length. Lacking measurements of birds in the flesh I have taken them from properly made skins, selecting, when possible, series prepared by the same collector. While the results obtained are from one-third to one-half an inch shorter than if the specimen had been measured before skinning, for comparative purposes they are, I believe, more dependable than a series secured by a number of collectors in various ways from birds in various stages between extreme flexibility and *rigor mortis*.

The most important fact, apparently revealed by these total length measurements, is that the smallest birds are found at or near the equator and that from this point

there is an increase in size toward both the north and the south. Thus, from Alamor Ecuador, 4° S. lat., alt. 5000 ft., seven males average 134 mm. in length, while northward, an equal number from Costa Rica and Guatemala average 140.5 and 142.4 mm., respectively. On the other hand, toward the south, seven males from the Lima, Peru, region average 142 mm., from the tableland of southwestern Bolivia, 161 mm., and from Punta Arenas, Chile, 145.1 mm.

Although the latter locality is some 35° south of Bolivia, it is at sea-level, while our Bolivian birds were collected at an altitude of from 12,500 to 13,500 feet. Apparently, therefore, greater altitude has here been more effective in increasing size than greater latitude. It should, however, be noted that the wing in the Punta Arenas bird (81.6 mm.) is essentially as long as in the Bolivian race (82).

The extent of variation in size of parts is presented in the table of measurements. Here I append a summary of the figures mentioned above.

MEASUREMENTS OF TOTAL LENGTH FROM SKINS OF MALES

RACE	LOCALITY	TOTAL LENGTH
<i>Zonotrichia c. costaricensis</i>	Alamor, S.W. Ecuador	130-140 (134)
" " "	Costa Rica	135-145 (140.5)
" " <i>septentrionalis</i>	Guatemala	135-148 (142.4)
" " <i>peruviansis</i>	Lima region, Peru	139-143 (142)
" " <i>pulacayensis</i>	S.W. Bolivia, alt. 12,500-13,500 ft.	157-166 (161)
" " <i>chilensis</i>	Central Chile, near sea-level	140-160 (147.7)
" " <i>australis</i>	Punta Arenas, Chile	144-146 (145.1)

BILL.—The bill of *Zonotrichia capensis* is typically fringilline in shape but, relatively, slightly large. The average length of the culmen in 17 races of *capensis* is 13.2 mm., in the larger *Zonotrichia albicollis* it is 12.7 mm. Measured from the base of the culmen, it ranges from 11 to 14.3 mm. in length. While the 3.3 mm. shown by this variation does not produce an impressive result, it is, nevertheless, 25 per cent of the average for the species.

Individual or intra-racial variation is small but so constant that bill measurements are often of diagnostic value or possess some special significance. For example, *costaricensis* ranges from Costa Rica to the Ecuador-Peru boundary and at that point becomes *huancabambae*. The color differences between the two races are slight but obviously important, since they are accompanied by differences in the size of the bill which, in *costaricensis*, measures from 12.2 to 13 mm. (av. 12.6) and in *huancabambae* varies from 13.2 to 13.9 mm. (av. 13.2). Only six-tenths of a millimeter separates the averages, still the minimum and maximum measurements for the two races do not overlap, and the fraction of a millimeter in bill length is, therefore, of diagnostic value.

A general survey of the preceding table of measurements reveals the unexpected fact that *australis* has a smaller bill than any other race of the species, although in general size it is nearly the largest race. The largest-billed birds, following the law governing the size of this member in representative island forms, inhabit the islands of Santo Domingo, Curaçao and Aruba. With these birds we may also place the two Mt. Roraima races which are so isolated by their mountain habitat that they are essentially insular forms.

These birds, therefore, support the results obtained by Dr. Robert Cushman Murphy¹ who has shown that 77.8 per cent of all North American passerine insular races are large-billed, while 100 per cent of the island species have larger bills than their closest mainland relatives.

I agree with Dr. Murphy that "for the

present, such a problem" (to which I refer the case of decrease in bill-size shown by *Z. c. australis*) "bids fair to stump geneticists and 'environmentalists' alike."

CREST.—Under a variety of stimuli *Zonotrichia capensis* erects the feathers of the crown forming a small crest. Hence its common name in the Bogotá-Mérida region, of *copetón* (from *copete*, meaning tufted).

The feathers concerned are of the same length in both sexes and we assume therefore that the feather-raising habit has no sexual significance. There appears, however, to be a slight geographic variation in this character. In Central American specimens the longest crown feathers average 9 mm. in length, but in Bolivian, Chilean and Patagonian birds they average 10.5 mm. Possibly this increase may be associated with the larger size and longer rectrices and remiges of the southern races.

In *Zonotrichia albicollis* and *Z. leucophrys* corresponding measurements are proportionately smaller, averaging 8.2 and 8.7 mm., respectively. In *Zonotrichia querula* the average is 10 mm. All measurements are taken from adult males in unworn plumage.

The use of the crown-feathers by North American members of the genus *Zonotrichia* is described by Dr. Thos. S. Roberts as follows: "When annoyed or startled it [the White-crowned Sparrow] may raise the feathers of the crown into a low crest, as do also, though less conspicuously, the White-throated and Harris's Sparrows" (Birds of Minnesota, II, p. 425).

FEET.—What I have to say here is largely expressed in the accompanying table of measurements. As with its bill, the feet of *Zonotrichia capensis* appear to be slightly disproportionally large. Note how closely they approach, or, in selected instances, even equal, the North American species of *Zonotrichia*. As with its bill, the feet of *australis* are disproportionally small.

The extremes are presented by *capensis* and *pulacayensis*, the former, from 5° N. at sea-level, being smallest, the latter, from 20° S. at an altitude of about 11,500, being largest.

¹ Science, Vol. 88, 1938, p. 539.

FOOT MEASUREMENTS OF *Zonotrichia*

	TARSUS	MIDDLE- TOE AND NAIL	HIND- TOE AND NAIL
		NAIL	NAIL
<i>costaricensis</i>	23.0	18.5	14.0
<i>antillarum</i>	24.0	18.5	14.0
<i>insularis</i>	21.7	19.1	15.7
<i>roraimae</i>	23.5	19.5	13.5
<i>capensis</i>	20.0	16.8	13.5
<i>locantinsi</i>	20.5	16.8	13.8
<i>subtorquata</i>	23.5	19.0	13.5
<i>hypoleuca</i>	22.0	17.7	14.0
<i>pulacayensis</i>	24.1	19.1	16.0
<i>sanborni</i>	23.0	17.5	14.2
<i>chilensis</i>	20.5	17.5	13.5
<i>australis</i>	21.6	18.5	14.7
<i>leucophrys</i> (U. S. A.)	23.0	18.0	14.2
<i>albicollis</i> (U. S. A.)	23.4	19.0	15.0
<i>querula</i>	24.0	19.5	15.5

WINGS.—The wing, in the races of *Zonotrichia capensis*, varies in size and shape from the comparatively short, "rounded" wing of a sedentary bird to the larger, "pointed" wing of an active one. For example, accepting *costaricensis* as typical of the short-winged races, we find that in the male, the wing averages 64 mm. in length while in *australis*, of the Magellan region, it averages 81 mm. in length. The tail, however, of the southern bird does not show a corresponding increase in dimensions. In *costaricensis* it averages 54 mm. in length, or 10 mm. shorter than the wing, while in *australis* it averages 61 mm. in length, or 20 mm. shorter than the wing. In other words, compared with *costaricensis* the wing in *australis* shows a gain of nearly 25 per cent, the tail, of only seven per cent.

We recall now that *costaricensis* and its short-winged allies are pronouncedly sedentary. The Curaçao sparrow, *insularis*, for example, is known only from two small islands. Macconnell's sparrow is restricted to the summit of Mt. Roraima. But *australis*, we have learned, is highly migratory, nearly 2000 miles separating the extremes of its summer and winter homes in Cape Horn and Bolivia, respectively. The Curaçao and Roraima races might conceivably exist as flightless species, but in order to make its long journey twice annually, *australis* needs a relatively dependable, powerful organ of flight.

In the relation between habit and form the sedentary and migratory races present

us with a problem of the apparent effects of disuse and use.

All the northern birds are short-winged. We know nothing of their ancestry and have therefore no starting point from which to connect the past with the present. But with the southern *australis*, on the other hand, still existing evidence demonstrates the development of a long wing from a short one.

Beginning at the Equator with *costaricensis* there appears to be a steady increase in the size and change in the shape of the wing from Equatorial to South Temperate latitudes. This result, it should be noted, does not agree with the statement of Bernard Rensch, who writes: "the relative wing-length of the birds changes in the manner, that the races of warmer territory relatively, that is, in the proportion to total length, have larger wings than the races of the same subspecific group which live in a colder zone."¹

The long wing of *australis*, therefore, is not an abrupt differentiation, but apparently marks the culmination of an increase in size which began just south of the Equator and developed progressively until a maximum was reached in high latitudes combined with high altitudes.

When therefore *australis* reached the latitude where seasonal change had increased the habitable area of the world during the summer, it was already prepared to enter a region from which, later in the year, it was forced to retreat by returning winter. If this view be correct, its long, pointed wing is not the result of migratory habits, but its migratory habits were made possible by its possession of a long, pointed wing. But *australis* is not the only southern race of *Zonotrichia capensis* with a long, pointed wing.

In 1932, Dr. C. E. Hellmayr described a well-marked race of *capensis* collected by C. C. Sanborn, of the Field Museum, at Baños del Toro (alt. 10,600 ft.) in the Andes above Coquimbo, Chile. Reference to the table of measurements (p. 410) will show that in size, tail-wing index and shape

¹ Das Prinzip Geographischer Rassenkreise und das Problem der Artbildung," p. 148.

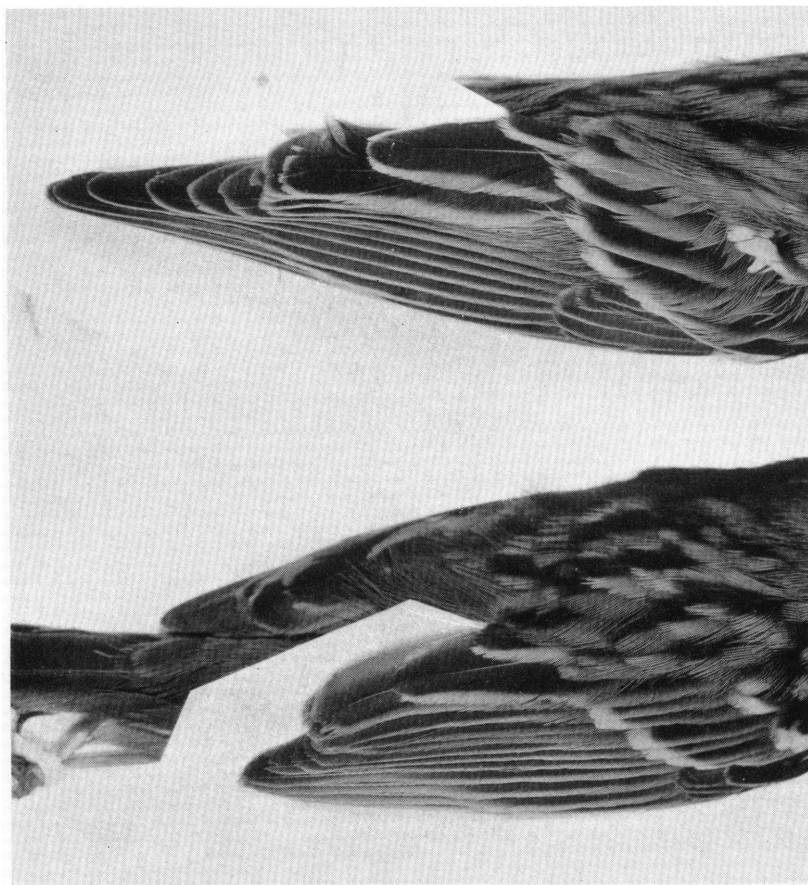


Fig. 9. Showing pointed wing of a southern race; rounded wing of a northern race.

Upper: *Zonotrichia c. australis*. Amer. Mus. Nat. Hist. 166182. Punta Arenas, Feb. 18, 1915, R. H. Beck.

Lower: *Z. c. costaricensis*. Amer. Mus. Nat. Hist. 122772. ♂, El Roble (8000 ft., above Fusugasuga), April 5, 1913, G. O'Connell. (Enlarged about one-third.)

of wing *sanborni* agrees with *australis*. The new bird is not rare. Sanborn secured a dozen specimens of it at the type locality within a week. Nevertheless, although its characters readily distinguish it from other races, it is apparently known only from Sanborn's specimens and one other. Thus, with all the equipment for travelling possessed by *australis*, *sanborni* appears to be as sedentary as a northern race. Hence we have two races with wings of equal length, one of which is migratory

while the other is sedentary. In connection, therefore, with the gradual increase in the length of the wing from the Equator southward, we apparently are forced to conclude that in neither *australis* nor *sanborni* is habit responsible for wing-length.

Table showing increase in size and change in form of the wing of *Zonotrichia capensis* from Equatorial to South Temperate latitudes. Average measurements (in millimeters) of five specimens:

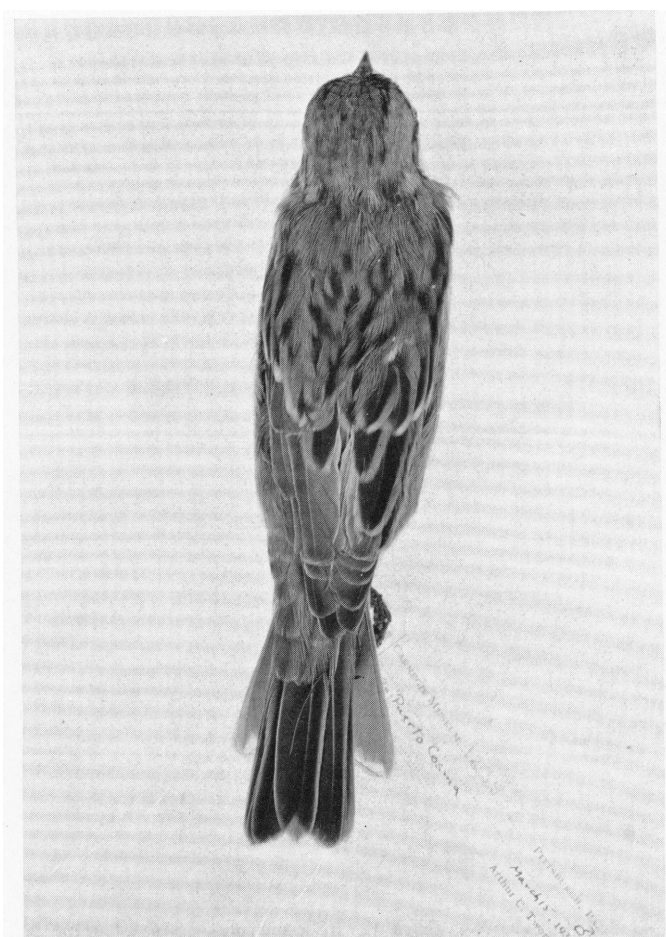


Fig. 10. *Zonotrichia c. australis*.

To show traces of black in the crown and white tips on the inner webs of outer tail feathers in an adult specimen completing the postnuptial molt.

Carnegie Mus. 123533. ♂, Puerto Casma, Chile, March 15, 1939, Arthur C. Twomey.

RACE	WING	TAIL	RATIO TAIL TO WING	SHORT- EST TO LONGEST PRIMARY	LOCALITY	LENGTH RELATIVE		
						TOTAL LENGTH	OF WING	WING- LENGTH
<i>costaricensis</i>	64.3	54	84.4	11	Ecuador	134	64.3	47.9
<i>peruviansis</i>	72	60	83.3	14	Punta Arenas, Chile	145	81.6	56.3
<i>antofagastae</i>	76	64.4	84	15				
<i>chilensis</i>	77	61	80	18				
<i>sanborni</i>	81.8	62	76.2	19				
<i>australis</i>	81.6	61.3	75	21.6				

TAIL.—The extreme average measurements of the tail are 54 mm. in *costaricensis* and 68.5 mm. in *pulacayensis*; whereas, in the same forms the wing averages 64.3 and 82 mm. The proportions, however, remain essentially the same, the per cent of tail to wing in *costaricensis* being 84.4, in

Table showing increase in size and in length of wing from Equatorial to South Temperate latitudes:

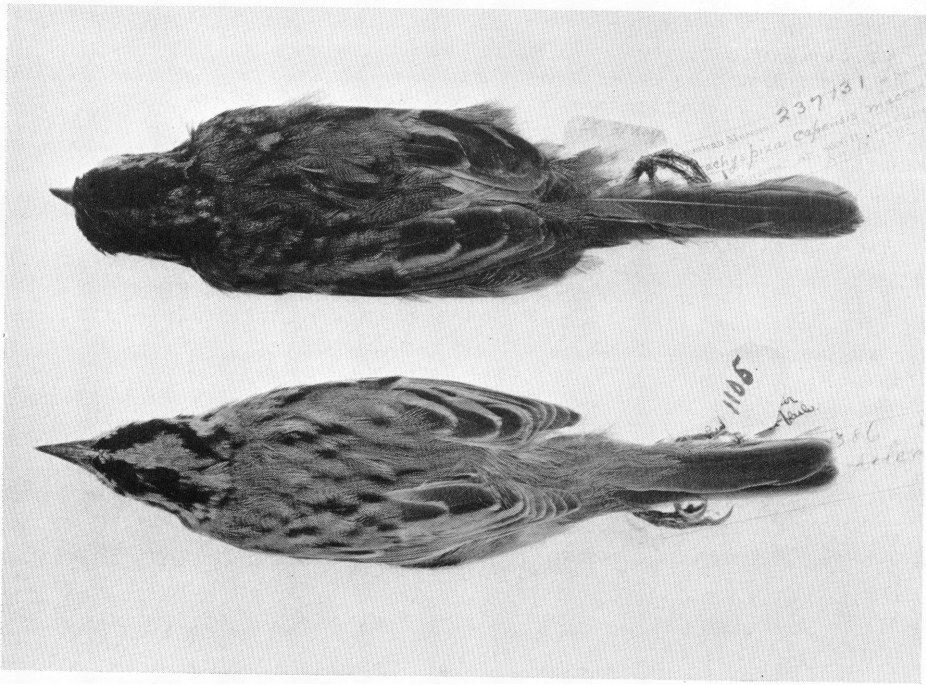


Fig. 11. The darkest and the palest races of *Zonotrichia capensis*.

Upper: *Z. c. macconnelli*. Amer. Mus. Nat. Hist. 237131. ♀, Summit of Mt. Roraima, Nov. 18, 1927, T. D. Carter.

Lower: *Z. c. insularis*. Amer. Mus. Nat. Hist. 73386. ♂, Curaçao, Venezuela, June 26, 1896, Wm. H. Phelps.

pulacayensis 83.5 mm. In *sanborni* and *australis* the tail shows less increase in length (61.3–62 mm.) while the wing is practically as long as in *pulacayensis* (81.6–81.8 mm.). Thus the tail in these races is only 75 and 76.2 mm. per cent of the wing, respectively. A proportionately longer tail, therefore, is apparently not essential to the effectiveness of a longer wing.

In color the tail is constant at the north but as we proceed southward there is a very slight and gradual increase in the grayish margin to the terminal part of the inner web of the outer one or two feathers. In a specimen from Ilo, in southwestern Peru, this marking, though only little more than a millimeter in width, becomes pure white and well defined from the web it borders. This tendency to develop a definite white tip and margin to the outer tail-feathers is more pronounced in *chilensis*

and in *australis* it is found in about two-thirds of the specimens examined.

It is significant that a similar marking is often found in *Zonotrichia albicollis*; in *Z. leucophrys* and *Z. coronata* it is less frequent and not so well developed, but in *Z. querula* it is of regular occurrence and often more pronounced than in *albicollis*.

The occurrence of this minor character in all the North American species of *Zonotrichia* is proof of its antiquity, and its appearance in the most remote races of *capensis* is an additional evidence that they share a common ancestry with their North Temperate congeners.

GENERAL COLORATION.—The oldest as well as the newest characters of *Zonotrichia capensis* are probably found in the pattern and color of its mantle, or to be more definite and restricted, of its back. The generally brown, black-streaked markings of

this small but conspicuous area are common not only to scores of sparrows but to many, perhaps most species of terrestrial birds. This "grass-marking," as Abbott Thayer called it, is probably of protective value and may be considered the product of a natural selection dating from an early period of the bird's evolution.

On the variations in this simple theme of a black shaft-streak margined by brown or gray, hundreds of species and races have been founded. There is some variation in the width and degree of blackness of the shaft-streak but it is chiefly the range of shade and tint in its margin that distin-

being paler in arid, darker in more humid regions.

One-half of the twenty-two races of *Zonotrichia capensis* herein recognized are founded wholly, or in part, on differences in the color of the back which appear to be associated with environment. As I have already pointed out, the palest race occupies the arid islands of Curaçao and Aruba, the darkest, Mt. Roraima, and the form on the cloud-wrapped summit of this mountain is darker than the one on its less humid sides.

The form of arid northeastern Brazil is paler than the one of more humid south

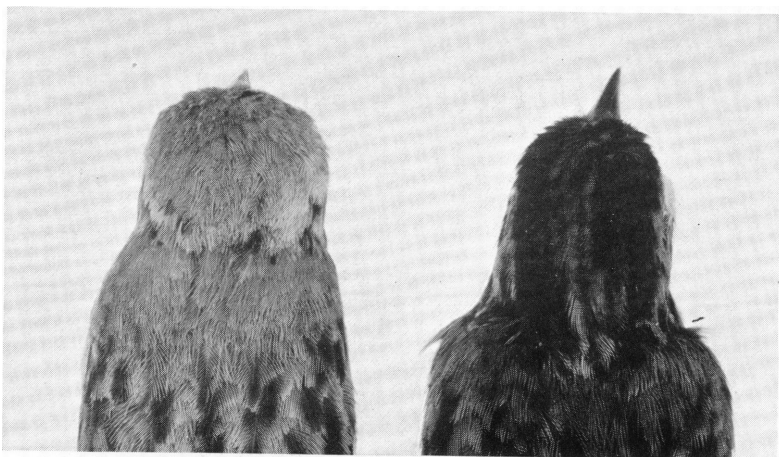


Fig. 12. Showing extremes in the coloration of the crown.

Left: *Zonotrichia c. australis*. Amer. Mus. Nat. Hist. 166182. ♂, Punta Arenas, Feb. 18, 1915, R. H. Beck.

Right: *Z. c. macconnelli*. Amer. Mus. Nat. Hist. 237131. ♀, Mt. Roraima, Nov. 18, 1927, T. D. Carter.

guishes the form. Thus we speak of a "dark" bird or a "pale" bird, a "tawny" bird or a "gray" bird according to the tone of these markings. It is this feature I have referred to as probably the newest of the markings of *Zonotrichia capensis*. Whereas the general fringilline pattern seems as old as the bird itself, these shades or tints seem to belong to the race or population that bears them and to be connected with the existing influences of its environment. Comparative aridity and humidity appear to be its most effective agents, and *Zonotrichia capensis* follows the law among birds of

eastern Brazil. The race of the Bolivian tableland exhibits a marked rufescence which is even more pronounced on the adjoining Pacific slopes. The difference appears to be recent but the reason for it is not obvious. As a whole this range in general color is not wide; by no means so great as it is in *Melospiza melodia*, a fact which supports the belief that the *capensis* group is comparatively recent.

HEAD-MARKS.—With the exception of *Zonotrichia capensis australis*, of the tip of the continent, all the races of *capensis* have the crown laterally striped with black which

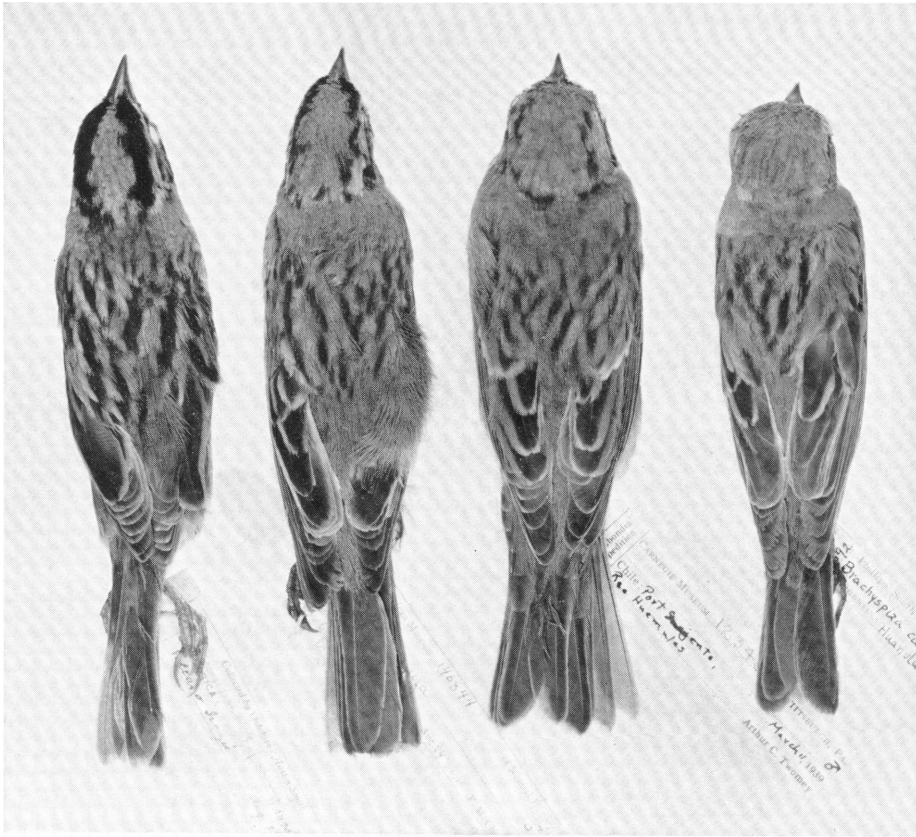


Fig. 13. Racial variations in the markings of the crown between Costa Rica and Argentina.

1. *Zonotrichia c. costaricensis*. Amer. Mus. Nat. Hist. 393136. ♀, Irazú, Costa Rica, Aug. 2, 1924, Austin Smith.
2. *Z. c. chilensis*. Amer. Mus. Nat. Hist. 146844. ♂, Apoquimbo, Chile, Aug. 24, 1916, F. M. Chapman.
3. Intermediate *chilensis* and *australis*. Carn. Mus. 123499. Rio Huemules, Chile, March 11, 1939, A. C. Twomey.
4. *Z. c. australis*. Mus. Comp. Zool. 85892. Huanuluan, Arg., Sept. 2, 1920, J. L. Peters.

extends to the nape. Traces of this black sometimes appear in *australis*, usually nuchally.

Until we reach Chile there is no widespread variation in these crown-stripes. In connection with the increased blackness of *roraimae* they are somewhat wider in that race. In *macconnelli*, from the tableland of Mt. Roraima, they reach their extreme of development, and, in some specimens, almost cover the crown.

Southward there is a very gradual but inconstant decrease in black until, in southwestern Peru, Bolivia and Brazil slightly

narrower head-lines are obvious. In *pulacayensis* of Bolivia this change might be considered an approach to the thin-lined *chilensis*. But there is still a gap between the two. A bird from the Copiapo Valley, my most northern specimen of *chilensis*, has the typically narrow lateral stripes of that race, and this character continues without change south to the Guaitecas Islands. Molting adults, with incompletely feathered wings, from Elefantes Gulf (Feb. 23, one) and Puerto Casma (March 15, one) have crown-stripes intermediate between those of *chilensis* and

australis. A specimen in the Museo Argentino, taken at Nahuel Huapí, Nov. 19, seems also intermediate. Thus wherever the range of *chilensis* closely approaches that of *australis*, the two appear to intergrade, but whether it is intergradation by contact or geographical variation I am unable to say.

At the south, therefore, *chilensis* loses its head-marks in the gray crown of *australis*, but at the northern border of its range, it is still unknown to merge with its neighbors. The same remarks probably also apply to *Z. c. choraules*.

Associated with the lateral crown-stripes

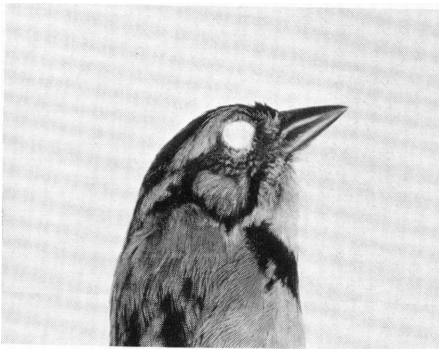


Fig. 14. *Zonotrichia c. antillarum*.
Auriculars enclosed by postocular and malar.
Amer. Mus. Nat. Hist., 164771. ♂, Mt.
Rusilla, S. D., March 5, 1917, R. H. Beck.

are the black postocular and malar stripes. In *antillarum* the latter encircles the auriculars posteriorly and meets the former. In the continental forms this mark, when present, leaves the auriculars open in the rear.

These cheek marks are spoken of as associated with the crown-stripes because they are both, apparently, subject to the same laws and disappear together in *australis*.

RUFIOUS COLLAR.—I recall no other American bird with a mark wholly similar to the tawny or rufous collar worn by every race of *Zonotrichia capensis*. Aside from seasonal changes, it varies some in degree of rufescence, in extent, and in the manner of meeting the back, but it is never absent and, on the whole, is a fairly constant character. It is least developed in *antillarum*

and *macconnelli*, most developed in *pulacayensis* and *antofagastae*, particularly the latter, in which, in fresh plumage, it fuses broadly with the foreback and spreads widely on the side of the breast.

The universality of this character, throughout *capensis*, is doubtless an indication of its antiquity; its relation to the rufous color found on most immature and winter specimens of *Zonotrichia querula* is purely a matter of speculation.

BLACK NECK-MARKS.—All the races of *Zonotrichia capensis* have black on the neck. In *antillarum*, of Santo Domingo, this appears as a complete band, wholly separating the throat from the breast. In all the continental races this black is more or less broken. In the more eastern forms it is reduced to small black patches at each side of the neck. The center of the neck is then open and the white of the throat reaches the breast. This variation is sufficiently constant to rank as a contributing racial character. I therefore briefly review its range and extent.

The Santo Domingo bird is most closely approached (I am referring only to neck-marks) in Central America. Many of our 116 adults from that region have the marks nearly coalesced, in others they are wholly open, but in only two (one from Guatemala, one from Salvador) are they fully closed.

In Santo Domingo, on the other hand, they are entirely closed in 32 of 35 adult specimens and very nearly closed in the remaining three.

Costa Rican specimens are essentially like *septentrionalis*. In Colombia and Ecuador there is a slight decrease in black.

In *huanacabambae*, of northern Peru, there is an evident change, the neck-mark being more compact in outline. About the Lima and Junín regions there is a return to the Costa Rica type, but in southwestern Peru a small decrease is apparent.

With an ascribed range of over 700 miles on the Andean tableland, from Cuzco to northwestern Argentina, the specimens referred to *pulacayensis* show obvious decrease in black from the north southward. Eight of a topotypical series of twelve have the neck open and of ten from Taff del Valle, Argentina, all are open.

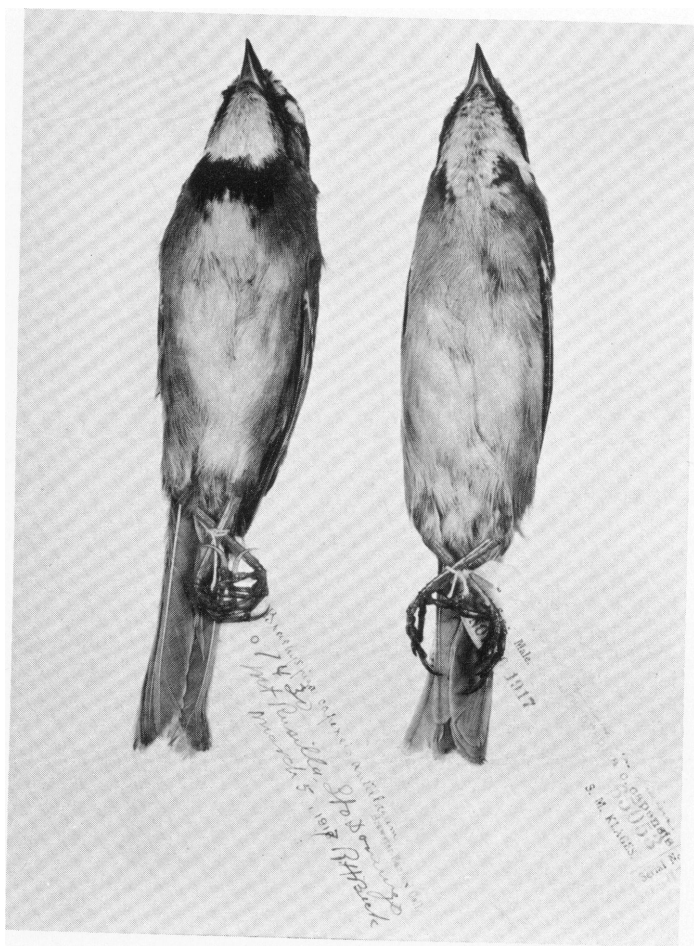


Fig. 15. Racial variation in the neck-band.

Left: "Closed" neck of *Z. c. antillarum*. Amer. Mus. Nat. Hist. 164780. Mt. Rusilla, Santo Domingo, March 5, 1917, R. H. Beck.

Right: "Open" neck of *Zonotrichia c. capensis*. Carn. Mus. 65053. ♂, Pied Saut, Oyapock, Fr. Guiana, Nov. 30, 1917, S. M. Klages.

Up to this point the decrease in black southward, down the Andes, if slight, has been steady, but leaving southwestern Bolivia to descend to the range of *antofagastae* on the western slope of the Andes and coast of northern Chile, we find a marked increase in black. Only one of ten specimens is open. In most of the others the lateral neck-patches are large and the area between throat and breast more or less spotted.

We return now to Venezuela to follow

the black neck variations southward through eastern South America:

Northeastern Venezuela (*venezuelae*) resembles Colombia but *insularis*, with four open throats in a series of eleven, has somewhat less. It is worthy of comment that in this, the second of our two insular forms, the neck-band should show no approach to that of *antillarum*.

The birds of Roraima and Auyan-tepui are much like those of Andean Venezuela, but, beginning with *capensis* of French Guiana, at a single jump, we reach the

northern limit of an area in which black is at the minimum. This extends throughout the whole of Brazil and in Argentina it includes the range of *hypoleuca* and *choraules*, that is, all the country east of the Andes to the northern limits of *australis*. In most of these birds the throat is open, or nearly open, and the neck-mark seems to be disappearing. In a number of specimens it has nearly gone. The difference between these birds of the plains and those of the Andes, from Mexico to Bolivia, is pronounced.

Returning to the higher mountains of northwestern Argentina, we find in the bird of that region the neck-marks are as much reduced as in *hypoleuca*. A connection is therefore established between the two types and we ask whether these northwest Argentine birds represent *pulacayensis* or *hypoleuca*.

Crossing now to Chile we observe a marked increase in black. Twenty-four specimens of *chilensis* from throughout its range resemble *peruensis* from southwestern Peru; three of them have the neck open. In *sanborni*, of the puna above Coquimbo, there is a slight average increase in black, although three out of ten have open necks, but in *choraules* there is evidently less black and an obvious close resemblance to *hypoleuca*, eight out of thirteen being open. This brings us to *australis* in which it seems evident that 15 specimens from the northern limit of its range (Huanuluan, Rio Negro) have less black than 13 from its southern limit, eight of the former and none of the latter having the neck open. The northern birds are very close to *choraules*, the southern are nearer *chilensis*.

From this survey we learn that while there is an obvious difference between the opposite extremes in the development of the black neck-marks, the change from one to the other is usually so gradual that we are unable to associate it with a cause. Broadly speaking, these marks are largest in the mountain-inhabiting races from Central America southward to the Bolivian puna and northern Chile, and eastward through northern Venezuela to Roraima; they are smallest in the lowland-inhabiting

races from French Guiana through Brazil to central Argentina. In the Chilean and Patagonian races they are intermediate.

Only the Santo Domingo race has the central ends of the neck-marks completely fused. In this respect, therefore, it most closely resembles the Central American races, a fact which has prompted the suggestion that it may have reached Santo Domingo from that country. But in spite of the fact that in this character the insular and Central American birds intergrade by variation, I feel that they are related through a common North American ancestor rather than directly.

While the wholly gray head of *australis* is the most distinctive racial character of the species, *antillarum* differs more widely from the group than any other member of it. Only one other race (*subtorquata*) has yellow on the wing-bend; no other race has the malar stripe reaching the post-ocular, a complete neck-band, tinted wing-covert tips, or so little rufous on the nape. Moreover, the song of *antillarum* is said to differ widely from the prevailing mainland type. It is true that as an island-inhabiting form *antillarum* has been more effectively isolated than any of the continental forms. But it is also true that *septentrionalis* is apparently not connected with *costaricensis* and that the birds of Costa Rica and western Panama are widely separated from those of Colombia. Nevertheless, there is only slight racial difference from Chiapas to Costa Rica and none from western Panama to Colombia. Again, barring the gray head of *australis*, one may say that *antillarum* has more distinctive characters than any other race of its species. If this be true, it is apparently not closely related to the Central American birds in which comparatively little differentiation appears to have occurred.

Since a more or less complete neck or breast band was acquired by *Zonotrichia capensis* under unknown conditions and for unknown purposes, we are unable to explain its origin. Abbott Thayer would have classed it as a "ruptive" marking acquired through natural selection for protective purposes. But the fact that in *Zonotrichia capensis* it is most highly developed

where predators are fewest and that it is apparently disappearing throughout a large part of the bird's range, does not support this theory.

I am unable, indeed, to suggest its function, if any. Nevertheless, it is evidently subject to law and a record of its changes forms a part of the history of the species to which it belongs.

It apparently has no connection with the head-marks which, as we have seen, disappear in *australis* though the neck-marks

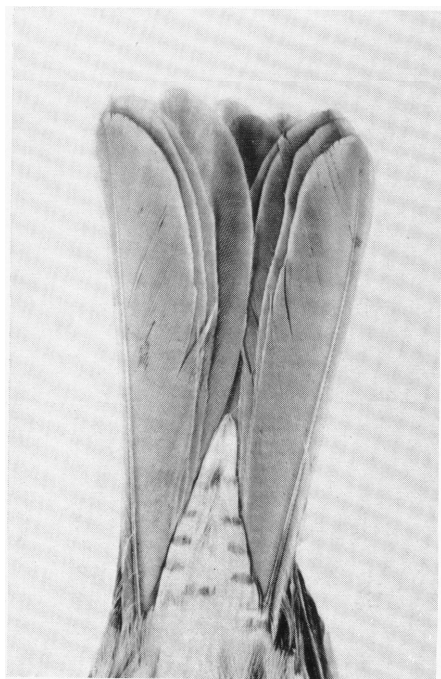


Fig. 16. *Zonotrichia c. antofagastae*.

To show barred lower tail-coverts.
Carn. Mus. 123651. ♂ ad., Tocapilla, Chile,
March 28, 1939, Arthur C. Twomey.

remain. In the Philadelphia Academy's unique Bolivian specimen, on the contrary, the head-marks remain and the neck-marks are wanting.

YELLOW WING-BEND.—All the North American species of *Zonotrichia* have more or less yellow on the bend, or edge, of the wing. This mark also occurs in *Zonotrichia capensis subtorquata* of southeastern Brazil and in *Z. c. antillarum* of Santo Domingo.

In the former it occurs in all but two of our large series from southeastern Brazil. It is present in Uruguay specimens from Rocha, Rio Negro and Montevideo, and a Paraguay specimen from Villa Rica, but is lacking in Paraguay specimens from Colonia Risso, Sapucay, Colonia Independencia, Caaguazú and Iguassú.

In *matutina* it appears faintly in specimens from Piahuary (2), Bahia (1), Chapada (6, one nesting) and Goyaz (3). In *hypoleuca* it appears in Buenos Aires and La Valle, Argentina specimens (3, one with eggs). Doubtless all these instances have a common origin. I find it in no other part of the continental range of *Zonotrichia capensis*. In the Santo Domingo race it is present faintly, but unquestionably, in all our specimens.

The appearance of this evidently deep-seated, persistent, heritable character may be regarded as further evidence of the relation of *Zonotrichia capensis* to its North American congeners. It also shows how a group mark may remain dormant for an incalculable period and then appear in a race remote from its nearest similarly marked ally.

BARRED UNDER TAIL-COVERTS.—Barred under tail-coverts have not before been recorded in the genus *Zonotrichia* and their discovery in *Z. capensis* at first suggested the appearance of a character new to the group. They have been found in 17 out of 64 specimens of *septentrionalis*, traces of them have been observed in other Central American examples, and in seven of ten specimens of *antofagastae*. In the latter race they are not only more frequent, but they are better developed.

While this unfringilline feature may be restricted to the species *Zonotrichia capensis*, it is not restricted to any one race of that species, and its occurrence in races as widely separated from one another as *antofagastae* of Chile and *septentrionalis* of Guatemala indicates that it is an ancient, rather than a recent character. It is true that it may have arisen independently in each of these races but the theory of its origin in a common ancestor seems to me to be more plausible.

SUMMARY

It is our thesis that a North American sparrow impelled by the influences of a glacial climate has emigrated southward and become resident, in the favorable parts of Central and South America, from Mexico to Cape Horn. Starting as a raceless species it now numbers twenty or more geographic representatives, none of which has certainly acquired specific standing. In other words, its variations are apparently of comparatively recent origin.

Zonotrichia capensis seems to have been exceptionally well qualified for this great experiment in colonization. Its climatic and habitat requirements, while easily met, are definite, and its movements have usually been governed by them. The greater part of a continent offered it favorable opportunity for range extension under conditions designed to promote speciation. The bird itself is fertile and adaptive and, impelled by the needs of a growing population, it has entered countries which offered it many unfilled ecologic niches and possessed few or no species of similar wants and habits. Influenced primarily by decreasing temperature, it continued onward after the glacial born impulse ceased to be effective, crossed the Equator, and, under the urge of an expanding population, left a settled country to enter one that was uninhabited by its kind until it finally reached the limit of the land. There it found climatic seasons which were congenial in summer but from which it retreated in winter and thus developed the habit of migration. It seems probable, therefore, that it was not until this great emigration was concluded, and the birds became breeding residents of the regions they had entered, that as a species, the bird became subject to the influences of its environment. In this connection also we must remember that permanent conditions were not established in the more northern part of the bird's range until a preglacial climate had returned.

If this theory of manner of settlement be true, it follows that, as a rule, the existing races have not been derived one from the other, but that each is the independent re-

sponse to its own environment. Hence the boundaries of their ranges and the kind and degree of their racial differences are indications of the extent and nature of the forces which have produced them. Doubtless, following possible environmental changes, there have been minor adjustments both in range and relationships. But I believe that, on the whole, each race is the product of the region it now occupies. The close relationship of nearly all the races to the group complex and the relation which frequently exists between cause and effect apparently support this view.

But whatever the causes, the effects, as seen by the taxonomist, are presented in the systematic section of this paper with its accompanying diagrammatic distributional map. It appears that from the north southward form succeeds form creating a distributional pattern for which Julian Huxley has proposed the term "geocline."¹

The evidence, supplied chiefly by specimens and geography, shows that, with a single exception, all the continental forms intergrade with one or more of their neighbors. And so close is the group relationship that, assuming the breeding seasons were the same, every form might be given new neighbors and interbreeding would still continue. In this possible rearrangement, however, each form, presumably, would occupy a range of which it was not the product and intergradation, therefore, would doubtless occur by contact rather than by environment.

The exception mentioned is here recorded as *Zonotrichia capensis australis*, which nests from Neuquén to Cape Horn. Throughout the greater part of this area it is the only representative of the group, but at the northern and northwestern limits of its range its relations to *Z. c. choraules* and *Z. c. chilensis* are not clear. Additional specimens and, particularly, field-work are needed in order to reach acceptable conclusions here. Meanwhile, it should be remembered that the region occupied by *australis* has probably been subjected to greater climatic change than any other part

¹ Nature, Vol. 142, 1938, p. 219.

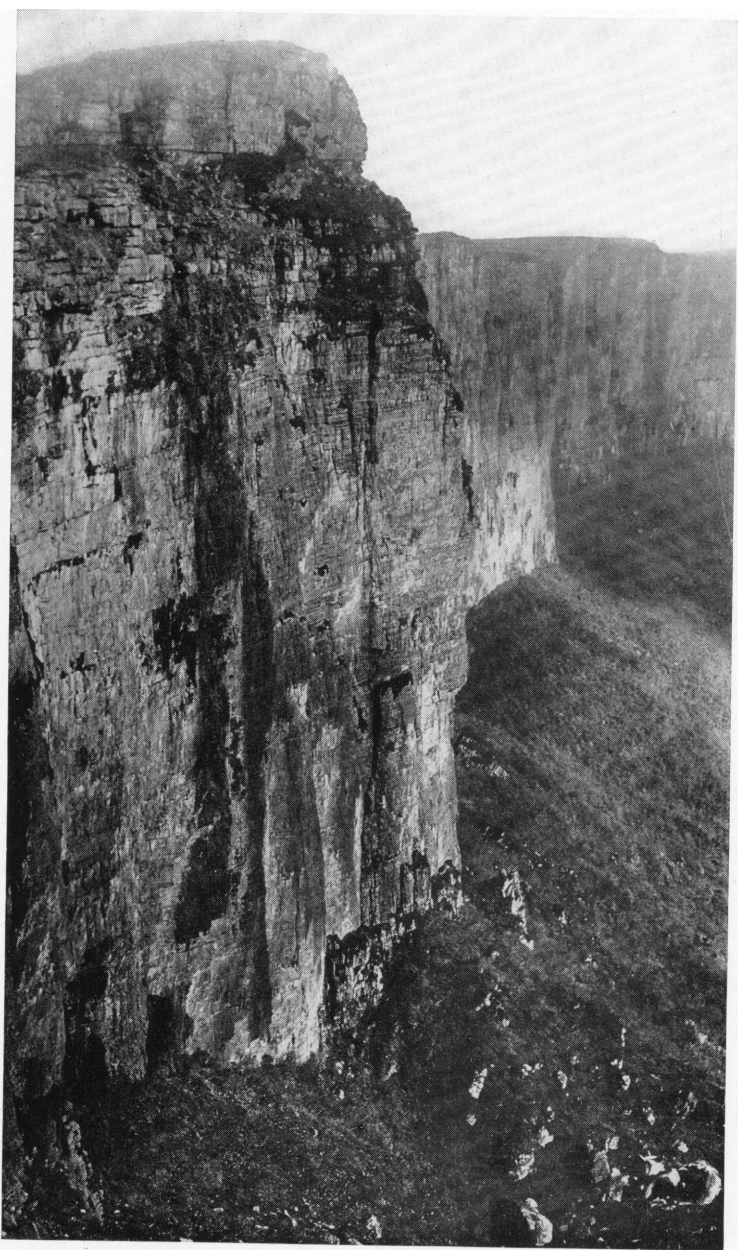


Fig. 17. Summit and Talus of Mt. Roraima, showing homes of two races of *Zonotrichia capensis*. *Zonotrichia capensis macconnelli* occupies the summit, *Z. c. roraimae*, the talus; their ranges are separated by the intervening 1400 foot cliff. (Bull. Amer. Mus. Nat. Hist., LXIII, 1931, p. 39.)

of South America since *Zonotrichia capensis* entered the continent. Whether these changes may have temporarily isolated *australis* or otherwise altered its surroundings is unknown. In any event, the fact remains that it is the most distinct member of the *capensis* group.

It will be observed that although both are treated as subspecies of *capensis*, intergradation by contact is obviously prohibited with our two insular forms—*insularis* of Aruba and Curaçao and *antillarum* of Santo Domingo. Under the unreasoning application of the law of interbreeding, the birds would be ranked as species; but it seems far more logical to treat such cases separately on their merits, and the decision reached should reflect not only the experience and judgment of the taxonomist but also his ability and fairness in assembling and weighing all the evidence available.

In the present cases, *insularis* so closely resembles *venezuelae* of the adjoining mainland that the two forms intergrade by individual variation and their racial relation is evident. The status of *antillarum* cannot be determined so satisfactorily. As elsewhere stated, this bird possesses a unique combination of characters, some of which are peculiar to it. In habit and voice it also differs markedly from its mainland allies. Whether or not it would intergrade with them can only be surmised, but it is so obviously a member of the *capensis* group that, in my judgment, its relationship is best expressed by a trinomial. Having supplied the geographical variations of *Zonotrichia capensis* with names and ranges and thereby made them, at least provisionally, tangible entities, we may attempt to name the principal environmental factors responsible for the development of their respective distinguishing characters.

First place, I am confident, will here be accorded isolation. Isolation is the handmaid of heredity. Given isolation, with or without conditions that stimulate organic variation, in time we may look for speciation. But given variation without isolation and we may look in vain for an accumulation of these differences that mark the beginnings of races.

The most effective isolation is insular.

Witness the life of the Galápagos and of countless other islands. We have just seen that one of the most distinct races of *Zonotrichia capensis* inhabits the island of Santo Domingo, while Aruba, 16 miles off the mainland of Venezuela, and nearby Curaçao have a race of their own. The upper life-zones of mountains may serve as aerial islands effectively isolating by climate or topography the forms inhabiting them. Recall the race confined to the summit of Mt. Roraima by 1400 feet of vertical rock wall.

Isolation may be created by unsuitable habitat. Plains-inhabiting species do not enter forests and forest-livers are equally wanting on plains. Organic isolation may be found in the heart of large populations where the inhabitants are protected from contact with neighboring races by an area of intergradation at the periphery of their respective ranges. On the other hand, isolation may be local, confining small populations to limited areas, as with *Z. c. sanborni*. The Cuchacancha Valley, near Cochabamba, illustrates the early stages in the development of this type of isolation. It was the power of the continent to supply many and diverse types of isolation that made it the ideal home for *Zonotrichia capensis* to develop its career in speciation.

Assured, then, of the protecting and promoting powers of isolation we look for the results of the creative factors in the environment of *Zonotrichia capensis*. These are the variations on which the races are founded. As might be expected, they are not highly developed but are merely modifications of already existing characters which create differences of degree. Races, in whole or part, are larger or smaller, darker or paler. Pattern of marking is affected by change in pigmentation without change in color. Characters long dormant may reappear. Only in the barring of the lower tail-coverts do we find a feature which may possibly be of post-glacial age.

Those characters which are commonly associated with climate can be attributed to the action of a definite environment. Thus larger size usually accompanies decrease in temperature with either latitude or altitude, while paler or darker colors are

associated with relative aridity or humidity, respectively.

But for variations in the extent of the black crown-lines and neck-bands, or the resurrection of the yellow wing-bend, etc., no cause is evident. These heritable characters, or mutations, are the products of a practically universal tendency to depart from the norm which, when sufficiently developed in populations, form the basis of races.

Meanwhile the nascent form must constantly meet the tests of living. Doubtless desirable characters are selected and undesirable ones rejected, but there must be others, neither useful nor harmful, which play a neutral rôle. Possibly differences in shade and tint may have protective value. But the wide variation in the black neck-markings, for example, suggests that their presence or absence plays no part in the life of the species. Nor can one discover from a dried skin the function of the yellow wing-bend or barred coverts. At this point, therefore, we may well turn

from the dead to the living birds and continue our study of *Zonotrichia capensis* in its haunts.

I conclude this attempt to place the house of *Zonotrichia capensis* in order and to outline its history, with two pertinent quotations which express surprising agreement in the views of an environmentalist of 60 years ago and of a geneticist of today. In 1877, in an article on "The Influence of Physical Conditions in the Genesis of Species," Dr. J. A. Allen wrote: "That varieties may and do arise by the action of climatic influences, and pass on to become species, and that species become, in like manner, differentiated into genera, is abundantly indicated by the facts of geographical distribution and the obvious relation of local forms to the conditions of environment."¹ In 1937, Dr. T. Dobzhansky wrote: "... the molding of the hereditary variation into racial, specific, generic, and other complexes, is due to action of the environment through natural selection and other channels to be discussed below."²

REFERENCES

- References to the literature of *Zonotrichia* are included in the synonymy of Hellmayr's "Catalogue" of the American Fringillidae (1938). To those already given I add here fuller citations of the works consulted in the preparation of this paper.
- ALLEN, JOEL A.
1877. The Influence of Physical Conditions in the Genesis of Species. *Radical Review*, I, pp. 108-140.
- BOND, JAMES
1936. Birds of the West Indies. *Acad. Nat. Sci., Phila.*
1940. Check-List of Birds of the West Indies. *Acad. Nat. Sci., Phila.*
- BOULTON, RUDYERD
1926. Remarks on the Origin and Distribution of the Zonotrichiae. *The Auk*, XLIII, pp. 326-332.
- CARRIKER, M. A., JR.
1910. An Annotated List of the Birds of Costa Rica Including Cocos Island. *Ann. Carn. Mus.*, VI.
- CHAMBERLIN, THOMAS C., AND
SALISBURY, ROLLIN D.
1906. *Geology*, Vol. III, Chap. XIX.
- CHAPMAN, FRANK M.
1917. Distribution of Bird-Life in Colombia. *Bull. Amer. Mus. Nat. Hist.*, XXXVI.
1923. Mutation Among Birds in the Genus *Buarremon*. *Bull. Amer. Mus. Nat. Hist.*, XVIII, pp. 243-278.
1931. The Upper Zonal Bird-Life of Mts. Roraima and Duida. *Bull. Amer. Mus. Nat. Hist.*, LXIII, pp. 1-135.
- CLAYTON, H. HELM (Compiler)
1929. *World Weather Records*. Smith. Misc. Coll., Vol. 79, May 29, South America.
- CRAWSHAY, RICHARD
1907. Birds of Tierra del Fuego. Bernard Quaritch. London.
- DICKEY, DONALD R., AND VAN ROSSEM, A. J.
1938. The Birds of El Salvador. *Zool. Ser., Field Mus. Nat. Hist.*, Vol. 23, March 21, Publ. 406.
- DOBZHANSKY, THEODOSIUS
1937. *Genetics and the Origin of Species*. Columbia Univ. Press.
- DWIGHT, JONATHAN, JR.
1900. The Sequence of Plumages and Moults of the Passerine Birds of New York.

¹ *Radical Review*, I, 1877, p. 139.

² *Genetics and the Origin of Species*, 1937, p. 120.

- Ann. N. Y. Acad. Sci., Vol. XIII, Oct., pp. 73-360.
- GRISCOM, LUDLOW
1932. The Distribution of Bird-Life in Guatemala. Bull. Amer. Mus. Nat. Hist., LXIV, May 7.
- HELLMAYR, CHARLES E.
1938. Catalogue of Birds of the Americas. Part XI, Ploceidae-Catamblyrhynchidae-Fringillidae. Zool. Ser., Field Mus. Nat. Hist., Vol. XIII, Pt. XI, Publ. 430, Dec. 31.
- HUDSON, W. H.
1888-1889. In Sclater and Hudson's Argentine Ornithology, I, p. 58.
- HUXLEY, JULIAN
1938. Clines: An Auxiliary Taxonomic Principle. Nature, Vol. 142, p. 219.
- MOREAU, R. E.
1930. On the Age of Some Races of Birds. Ibis, pp. 229-239.
- MURPHY, ROBERT CUSHMAN
1938. The Need of Insular Exploration as Illustrated by Birds. Science, Vol. 88, Dec. 9, pp. 533-539.
- PÄSSLER, R.
1922. In der Umgebung Coronel's (Chile) Beobachtete Vögel, Beschreibung der Nester und Eier der Brutvögel. Journ. für Ornith., pp. 430-482.
- PETERS, JAMES L.
1923. Notes on Some Summer Birds of Northern Patagonia. Bull. Mus. Comp. Zool., LXV, May, pp. 277-337.
- RENSCH, BERNARD
1929. Das Prinzip Geographischer Rassenkreise und das Problem der Artbildung. Berlin.
- RIDGWAY, ROBERT
1898. Descriptions of Supposed New Genera, Species, and Subspecies of American Birds. I. Fringillidae. The Auk, XV, p. 224. [An author's edition of 100 copies of this paper was issued May 13, 1898.—Edd.]
1901. Bull. U. S. Nat. Mus., No. 50, Part I. Fringillidae. July 1, p. 346.
- ROBERTS, THOMAS S.
1932. The Birds of Minnesota, Univ. of Minn. Press, II, p. 425.
- SALVIN, OSBERT, AND
GODMAN, FREDERICK DU CANE
1879-1904. Biologia Centrali-Americana. Aves., I, p. 370.
- SHARPE, R. BOWDLER
1888. Catalogue of the Passeriformes in the British Museum. Fringillidae, XII. London.
- SIMPSON, GEORGE G.
1931. Origin of Mammalian Faunas as Illustrated by that of Florida. Amer. Nat., LXV, May-June.
- STOLZMANN, JEAN
1886. In Taczanowski's Orn du Pérou, III, p. 47.
- THAYER, G. H.
1910. Concealing Coloration in the Animal Kingdom. Macmillan Co., New York.
- THOMSON, LANDSBOROUGH
1939. Bull. Brit. Orn. Club, 427, pp. 31-39.
- VAN ROSSEM, A. J.
1929. The genus *Brachyspiza* not Distinct from *Zonotrichia*. The Auk, LXVI, pp. 548-550. (See also 1938, Dickey, Donald R.)
- WETMORE, ALEXANDER
1926. Observations on the Birds of Argentina, Paraguay, Uruguay, and Chile. Bull. No. 133, U. S. Nat. Mus.
- WETMORE, ALEXANDER, AND
SWALES, BRADSHAW H.
1931. The Birds of Haiti and the Dominican Republic. Bull. No. 155, U. S. Nat. Mus.

