

Article XXII.—THE *BÆOLOPHUS* BICOLOR-ATRICRISTATUS GROUP.

BY J. A. ALLEN.

Instances of hybridization among birds, in a state of nature, are of well known occurrence, not only between closely allied or congeneric species, but between species remotely related, as between birds of different genera, notably among grouse and ducks. There are also many recorded instances of such mesalliance between different genera of song birds, as finches, warblers, swallows, etc. Such cases, however, are in the main sporadic, and are not commonly looked upon as of any great biologic importance. Under artificial conditions, as with birds confined in aviaries, or through man's interference, crosses between not only allied species, but even between species of widely different genera, may be obtained.

Hybridization in a state of nature, and habitually over large areas where the breeding ranges of the hybridizing species adjoin or overlap, has been satisfactorily demonstrated in comparatively few instances — perhaps in only two or three among North American birds. One is the well-known instance of the two North American species of *Colaptes*, which interbreed along the whole line of junction of their breeding areas, from Texas to the Saskatchewan.¹ The second is the almost equally famous case of two species of *Helminthophila*, *H. pinus* and *H. chrysoptera*, which freely interbreed in northern New Jersey, southeastern New York, and southern Connecticut, and probably also westward where their breeding ranges overlap. The third is the tentative instance of the Purple Grackle and Bronzed Grackle,—*Quiscalus quiscula* and *Q. æneus*,—investigated by Mr. Chapman in 1892,² and recently reëxamined by Mr. Ridgway.³ The suggestion was made by Mr. Chapman that *Q. æneus* and *Q. agelaius* are distinct species, and that *quiscula* is the mixed product of the two through interbreeding. Mr. Ridgway favors the same hypothesis, agreeing fully with the view set forth by Mr. Chapman.

When intergradation between previously supposed "good species" began to force itself upon the attention of ornithologists, through the accumulation

¹ Cf. Allen, The North American Species of the Genus *Colaptes*, considered with special Reference to the Relationships of *C. auratus* and *C. cafer*. Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, pp. 21–44, with map.

² A Preliminary Study of the Grackles of the subgenus *Quiscalus*. Bull. Am. Mus. Nat. Hist., IV, pp. 1–20, with map.

³ Birds of North and Middle America, Part II, 1902, pp. 214, 215.

of material from many new localities, twenty to thirty years ago and hence before geographical variation had become well known, a favorite method of disposing of intergrades was to consider them as merely "hybrids." As Chapman has said: "To call an intermediate a 'hybrid' is an easy way of answering what may be a difficult question. But unless the hybridization has been proven, it is a reply which gives no information whatever, and proves a stumbling-block to more thorough investigation." "It seems to me, however," he continues, "that given sufficient data on which to base any theory of the relationships of two intergrading forms, . . . we should not be in doubt as to whether they are connected through the action of purely environmental causes or by the more direct action of hybridization. The nature of their intermediate characters, the fact that these characters do not correlate with environmental influences, the presence of both species in the area occupied by their intergrades, all should furnish evidence which will enable us to distinguish between hybrids and geographical intermediates."¹

Indeed, the fashion, so prevalent twenty years ago, of considering 'intergrades' as 'hybrids' between different 'species' rather than as connecting links between geographic phases of one and the same species, has practically become a feature of the past history of ornithology. Yet, as noted above, there are cases of intergradation that do not conform to any known conditions or methods of geographic intergradation, but do conform to known conditions and results of hybridization.

An assumed fourth case of intergradation through hybridization is furnished by the two forms of Crested Titmouse inhabiting central and southern Texas. One is the common Tufted Titmouse, *Bæolophus bicolor*, of the eastern United States, which ranges from the Atlantic coast to the Great Plains; the other is the Black-crested Titmouse, *Bæolophus atricristatus*, of eastern Mexico, which ranges from the highlands of Vera Cruz northward to central Texas. The breeding ranges of the two forms adjoin, or overlap, over a considerable area in southern and central Texas, where occur intermediates of rather peculiar and inconstant characters. These intermediates were first made known in 1887 by the late George B. Sennett, from specimens collected along the Aransas River in Bee County. On six specimens collected by Mr. J. M. Priour, April 4, 7, and 9, 1886, he based (Auk, IV, 1887, pp. 28, 29) his two subspecies, *Parus atricristatus castaneifrons* and *Parus bicolor texensis*, referring four of the specimens to the former and two to the latter, after comparison with a large series of true *atricristatus* on the one hand and true *bicolor* on the other. These birds all have

¹ Bull. Am. Mus. Nat. Hist., IV, 1902, p. 18.

the frontlet or forehead more or less chestnut instead of black as in *bicolor*, or white as in *atricristatus*. In '*castaneifrons*' the crest is blackish, but not as deep black as in *atricristatus*; in the male type of *texensis* the crest is distinctly darker than in *bicolor*, strongly tending to blackish; in the female type of *texensis* the darkening of the crown is scarcely perceptible. In two (the males) of the four specimens referred to *castaneifrons* the forehead is dull rufous-chestnut; in the other two (the females) it is white suffused with pale buff or cream-color; in the two *texensis* specimens the forehead is dull chestnut in both. In general size, in the size of the bill, and in general coloration, there is nothing to distinguish either subspecies from *bicolor* on the one hand or *atricristatus* on the other, the differences being confined to the forehead and crest.

Mr. Ridgway, in his 'Birds of North and Middle America' (part III, 1904, p. 386), treats both these forms as "hybrids," saying: "Any pronounced rusty tinge to the color of the forehead indicates, in the writer's opinion, admixture of *B. bicolor* blood. This reaches its extreme development in individuals corresponding to *Parus atricristatus castaneifrons* Sennett and *P. bicolor texensis* Sennett, the former comprising those with a black crown and crest and deep rusty or chestnut forehead, the latter those with a gray crown and crest and rusty or chestnut forehead. That these are all merely hybrids between *B. atricristatus sennetti* and *B. bicolor* is almost certain from the fact that they occur together in the same localities along with the two hypothetical parent species; furthermore, the National Museum collection contains two pairs shot at San Antonio, by Mr. H. P. Attwater, the males of which are typical *B. a. sennetti* and the females *B. b. texensis*."

Whatever may be the origin of these intergrades between *B. bicolor* and *B. atricristatus*, it is evident that Mr. Sennett's subspecies *castaneifrons* and *texensis* are but individual phases or degrees or stages of one and the same thing.

In order to understand the interrelationships of *B. bicolor* and *B. atricristatus* the two forms may be first considered from the standpoint of the geographic variation exhibited by each form.

GEOGRAPHIC VARIATION.

General Coloration.—In general coloration *B. bicolor* and *B. atricristatus* are essentially similar, both being gray above, varying in the breeding season from slaty gray in *bicolor* to olive gray in *atricristatus*; both are brownish gray in immature plumage, but *bicolor* is the more strongly so.

The gray tends more to slaty gray in *bicolor* and to greenish gray in *atricristatus*. But *bicolor* has generally a brownish olivaceous shade on the back in fresh adult plumage, instead of the greenish olivaceous shade present in the fresh adult plumage of *atricristatus*. This soon fades out in both, so that breeding specimens of the two forms are often indistinguishable in the color of the back. Both forms are also similar in color below, being dull white with the sides and flanks cinnamon-rufous, which tint varies greatly in intensity in different individuals of the same form.

The two marked features of differentiation are (1) the color of the forehead, and (2) the color of the crown and crest feathers.

Forehead.—In *B. bicolor* the color of the forehead varies from deep pure black to dull black bordered or suffused with rusty brown; in *B. atricristatus* it varies from clear white to creamy or buffy white.

Crown and Crest.—In *B. bicolor* the crown and crest are gray, of a little deeper and darker tint than the back; in *B. atricristatus* the crown and crest are black, in abrupt contrast with the back. The difference in these two features is radical—not of degree but of contrast. Also the crest is generally fuller and longer in *atricristatus* than in *bicolor*.

Individual Variation in Color of the Forehead.—In *B. bicolor* the color of the forehead is subject to a wide range of individual variation throughout the range of the species, birds with the forehead pure deep black occurring everywhere with birds in which the forehead is 'sooty' black or rusty brownish black. The rusty tint may be limited to the edges of the black area and barely perceptible, or it may form a conspicuous outer border, or the whole forehead may be distinctly or even strongly rusty beneath the surface of the feathers. In such cases the lores are frequently buffy white.

In the Atlantic States and westward to the Mississippi Valley the variation in the color of the forehead seems to be partly individual and partly sexual, and not to any appreciable degree geographical, specimens with the black frontlet suffused with rusty being not more frequent in the Carolinas and Florida than in New Jersey or Ohio. In eastern Kansas and Louisiana the few specimens at hand all show brown in the frontlet, while in Texas (Brasoria, Matagorda, Bexar, Lee, Victoria, and Uvalde Counties) specimens without more or less brown in the black of the forehead are exceptional, and the amount of brown suffusing the black is generally much greater than in even the most extreme examples from the Atlantic States.

In *B. atricristatus*, from the Valley of the Lower Rio Grande southward, the forehead is generally clear white, varying, however, through creamy white to cream-buff. The type locality of the species is the Lower Rio Grande Valley, somewhere between Brownsville and Rio Grande City, Texas. In a series of 25 specimens from southern Cameron County, Texas

(hence practically topotypes), about two-thirds have the forehead clear white; in the others it has distinctly a creamy suffusion, which in some specimens is conspicuously strong ('*castaneifrons*' Sennett). The white frontlet also varies in width, through the posterior feathers being often tipped minutely with black, and in a few there is an extremely narrow median line of black running forward from the black of the crown to the base of the culmen. Some 50 specimens or more from Nuevo Leon and Tamaulipas are exactly similar to Brownsville specimens as regards the forehead. In a series of 40 specimens from Hidalgo County (Hidalgo and Lomita Ranch on the Rio Grande), fifty miles above Brownsville, more than one-third have the white forehead more or less tinged with a creamy suffusion, often strongly so, and about one-fourth have black tips to a portion of the frontal feathers, or a fine black median line, or both. At points further north and west, as in Live Oak, Frio, and Concho Counties, the buffy suffusion increases in strength and frequency, and the black of the crest becomes paler and more restricted (typical '*castaneifrons*'). In a series of 14 specimens from Frio River (exact point not known but probably Uvalde Co.), one only has the forehead white; in the others it ranges from a pale creamy tint to ochraceous, with a reduced amount of black on the crest feathers. In the Bed County series all of the adults have the forehead more or less suffused, varying from buff to rusty-chestnut. (This series furnished the types of both *castaneifrons* and *texensis* of Sennett!). The black on the crown varies from dusky brown to nearly the normal amount of black in *atricristatus*.

Six specimens from Travis County all have the frontlet chestnut; in two the crest is black, in the others the crest is gray like the back, or mixed gray and black. In another specimen ("Brownsville," but locality unquestionably erroneous) the forehead is deep chestnut, divided mesially by a strong black line; the crest is gray.

Color of Crown and Crest.—In *B. bicolor* the crown and crest, as already said, are dark gray, distinctly darker than the back, but rarely showing any tendency to blackish; exceptional specimens show dark shaft-streaks, more frequently present in southern than in northern examples. A specimen from Hollis Hill, Florida, has each feather of the crest *broadly centered with blackish*. In specimens of *B. atricristatus* from Mexico and the Lower Rio Grande Valley the crest feathers are longer and the black is more intense and shining than in specimens from further northward in Texas, where the black becomes more restricted in area and less intense, and the crest feathers are relatively shorter. Also the whitish forehead becomes more strongly suffused with buff, markedly so in about 25 per cent. of the specimens examined.

Size.—In both *B. bicolor* and *B. atricristatus* there is a marked decrease,

in size from the north southward, as in most other birds of northern origin. As in numbers of other birds of similar range, there is in *B. bicolor* relatively a slight increase in the length of the bill in southern birds as compared with northern birds. While Florida birds have the wing and tail each 5 to 7 mm. shorter than New Jersey birds, the culmen is fully as long or slightly longer than in the larger northern birds. *B. bicolor* appears to reach its maximum size in eastern Kansas (Fort Leavenworth, Council Grove, etc.), and an eastern Kansas race was long since provisionally named *Parus missouriensis* by Baird. The small Florida form has also been separated by Bangs as a subspecies *floridanus*, chiefly on the ground of its smaller size and relatively larger bill.

B. atricristatus reaches its maximum size in the northern part of its range, in southwestern central Texas, where it completely intergrades in size with *B. bicolor*. Although *B. bicolor* is much larger in the average than *B. atricristatus*, Texas and Florida specimens of *bicolor* are quite as small as the northern representatives of *B. atricristatus*.

As shown in the tables of measurements given below, in *B. bicolor* from northern New Jersey and Pennsylvania, the wing averages in 10 males about 82 mm. (78–85), and the tail about 74 mm. (73–80) in length, while in 16 males from northern Florida the corresponding measurements are: wing, 76 (71–78); tail, 67 (65–72). The average of 5 males from eastern Kansas is: wing, 83, tail, 75; of 8 males from San Antonio, Texas, wing, 80, tail, 74; 6 males from Lee County, Texas, average slightly smaller. In the females the corresponding measurements are about 3 to 5 mm. less for each locality.

In *B. atricristatus* (*sennetti* Ridgw. = *castaneifrons* Senn.) males from Concho, Jeff Davis (Fort Davis), Leon, Bexar, Uvalde, and Nueces Counties range in average length of wing from 76.5–77 (74–80), averaging slightly larger than *bicolor* from various central and eastern Texas localities, but with the maximum in individual specimens far overlapping the minimum in *bicolor*. In true *atricristatus* from the Lower Rio Grande Valley in Texas and the adjoining border of Mexico the average length of wing falls to 71–71.6, or about 5 mm. below the average in the northern form of *atricristatus*. In central Tamaulipas and central Nuevo Leon, there is a further slight decrease of 1–2 mm. in the average wing length (65–69, 15 males).

In specimens of mixed character, from Bee, Live Oak and Bexar Counties, the average is very close to the average of *atricristatus sennetti*. The length of the wing and tail at different localities is summarized in the subjoined tables, comprising 110 specimens of the former and 162 of the latter.¹

¹ The measurements of specimens from the localities enclosed in brackets are from Ridgway's 'Birds of North and Middle America,' Part I, 1901, pp. 382 and 385.

MEASUREMENTS OF *Bæolophus bicolor* AND *B. atricristatus*.***Bæolophus bicolor.****Males, eastern localities.*

	No. of specimens.	Wing.	Tail.
Morristown, N. J.	8	82 (78-85)	74.9 (73-80)
Beaver Co., Pa.	4	82.3 (81-83)	74.3 (74-75)
Circleville, Ohio	2	78 (75-81)	73 (72-74.5)
S. Ill. and S. Ind.	8	80 (77-82)	74.3 (71-77)
Washington, D. C.	8	79.3 (77-80.5)	74 (71-78)
Mitchell Co., N. C.	2	80 (79-81)	75 (72-81)
Frogmore, S. C.	1	80	73.5
Gainesville, Fla.	3	74 (73-76)	69.3 (67-71)
Rosewood, Fla.	1	78.5	72
Fort Myers, Fla.	2	72 (71-73)	65 (65-65)
[Florida.]	10	77.6	66.4
Clinton, La.	2	75.5 (75-76)	71.5 (71-72)
[Louisiana, Mississippi, and Alabama.]	4	79.3	68.2

Males, western localities.

Council Grove, Kan.	2	84.3 (84-84.5)	76 (74-78)
[Eastern Kansas.]	3	82.5	73.3
Lee County, Texas.	6	79.3 (77-81)	71.3 (68-74)
San Antonio, Texas.	8	80 (77-82)	74.3 (71-77)
Matagorda Co., Texas.	1	78	70

Females, eastern localities.

Morristown, N. J.	2	77 (75-80)	72.5 (72-73)
Circleville, Ohio.	4	78 (73-80)	68.5 (67-79)
Wheatland, Ind.	3	76.3 (75-77)	69 (68-70)
Washington, D. C.	5	76 (75-78)	71 (71-72)
Summerville, S. C.	1	79	72
Kershaw Co., S. C.	4	76 (74-77)	69.5 (68-71)
Frogmore, S. C.	1	75	68
Augusta, Ga.	4	74.7 (72-76)	69.3 (69-72)
Gainesville, Fla.	3	74 (73-76)	69.3 (67-71)
Rosewood, Fla.	4	75.4 (74-78)	69.8 (65-76)
[Florida.]	8	76.4	67.9
[Louisiana.]	1	75	65

Females, western localities.

[Eastern Kansas.]	1	82	70
Lee Co., Tex.	4	75 (74-77)	66.5 (65-71)
San Antonio, Texas.	3	74	66.3 (64-72)

Bæolophus atricristatus.*Males.*

[Central Texas. ¹]	10	77.1 (75-79.5)	66.9 (64.5-68.5)
Bexar Co., Tex.	3	74 (72-75)	68 (67-69)
Concho Co., Tex.	2	76.5 (75.5-77.5)	70.3 (69.5-73)
Travis Co. (Austin), Tex.	4	75.5 (73-78)	70 (68-72)
Jeff Davis Co. (Fort Davis), Tex.	3	77 (70-75)	69 (67-71)
Uvalde Co., Tex. ²	8	76.3 (74-80)	70.4 (68-73)
Bee Co., Tex. ³	10	76.5 (73-78)	69.7 (65.5-71.5)
Nueces Co., Tex. ⁴	8	76 (74-77)	71.8 (69-74)
Kinney Co. (Fort Clark), Tex.	3	74.3 (73-76)	67.7 (65.5-71)
Webb Co. (Laredo), Tex.	5	74 (70-75)	69 (66-72)
Hidalgo Co. (Hidalgo and Lomita), Tex. ⁵	14	70 (67-72)	65 (61-72)
Cameron Co. (Brownsville and vicinity), Tex.	10	71.6 (68-76)	65.3 (61-68)
[Brownsville, Tex.]	9	70.8	61.9
Northern Nuevo Leon	5	71.4 (70-73)	66.2 (65-67.5)
Central Nuevo Leon	6	70.8 (68-73)	66.5 (63-69)
Central Tamaulipas	6	71.5 (65-75)	65.7 (60-70)
[Tamaulipas to Vera Cruz.]	5	69.5	58.3

Females.

[Central Texas.]	9	72.7 (70-76)	64.5 (61-69)
Bexar Co. Tex.	3	71 (70-73)	66.3 (66-67)
Concho Co., Tex.	2	75.4 (74.5-77)	69 (66-72)
Travis Co. (Austin), Tex.	1	72.8	66
Uvalde Co., Tex.	6	73.8 (68-74.5)	67 (65-69)
Bee Co., Tex.	6	75 (74-78)	66.5 (62-69)
Kinney Co. (Fort Clark), Tex.	3	71.3 (70-72)	66 (65-67)
Webb Co. (Laredo), Tex.	5	70.5 (69-73)	65.8 (63.5-67.5)
Hidalgo Co., Tex.	5	65.4 (63-67)	63 (62-64)
Cameron Co., Tex.	6	68 (66-72)	63.4 (60-70)
[Brownsville, Tex.]	4	70.8	61.9
Central Nuevo Leon.	6	68 (66-70)	64.3 (62-67)
[San Luis Potosi.]	1	65.5	55.5

SUMMARY AND CONCLUSIONS.

In geographic variation the differences that characterize conspecific subspecies are differences of degree, affecting size or color, usually both. In the two or three thoroughly known cases of hybridity in wild North American birds, the differences (except in the matter of size), between the

¹ *Bæolophus atricristatus sennetti* Ridgway.

² *Parus atricristatus castaneifrons* Sennett.

³ *Parus atricristatus castaneifrons* Sennett, and *Parus bicolor texensis* Sennett, about an equal number of each.

⁴ Labeled *P. a. castaneifrons* by Sennett.

⁵ All labelled *Parus atricapillus* by Sennett, as are also all Cameron County specimens.

hybridizing species are radical, both in the pattern of markings and the color, as in the two hybridizing Flickers (*Colaptes*) and the two hybridizing Warblers (*Helminthophila chrysoptera* and *H. pinus*); in the case of the Grackles (*Quiscalus*) the conditions as to coloration are somewhat different there being a less striking difference in pattern and color. In the two species of *Bæolophus* there is again a radical difference in pattern, one having a black crest and a whitish frontal band, and the other a gray crest and a black frontal band.

These two species meet in Texas: on the coast, at the mouth of the Nueces River; in the interior along the 98th meridian, from the Nueces River northward, probably to the northern limit of the range of *B. atricristatus*. The line of contact of the two species coincides remarkably close with the junction of the humid and arid divisions of Texas, as shown by Mr. Vernon Bailey on his map of the Life Zones of Texas.¹ Well-marked 'intergrades' occur over apparently a rather narrow zone (apparently about 50 to 100 miles in width), trending nearly north and south, from Bee and Live Oak Counties to Lampassas County, or for a known distance of about 200 miles. Bee, Live Oak, Bexar, and Travis Counties are the only points from which, at present, material is available for examination; but similar conditions may be expected to occur along the junction of the ranges of these two species from Refugio,² San Patricio and Bee Counties to Young County, or for probably about 300 miles.

While these two species completely merge geographically, as already shown, as regards size and general coloration, both decreasing in size and becoming somewhat modified in other respects from the north southward, like hundreds of species of other birds inhabiting the same geographical areas, the radical distinctions furnished by the color of the crest and frontal band remain practically unchanged until the ranges of the two species are actually in contact. The final blending of the two is not along a line of very marked geographic intergradation, nor is the manner of final intergradation of a geographic character. The same localities furnish, at several known and quite widely separated points, birds of pure blood of both species, and intergrades having almost every possible combination of the strikingly dissimilar features of the two species. There are gray-crested and black-crested birds with a chestnut frontal band, paling nearly to whitish or darkened with blackish; and also birds with every kind of crest from gray to black: gray shaded with black, the gray and black about

¹ North American Fauna, No. 25, 1905, plate 1.

² James J. Carroll, in his 'Notes on the Birds of Refugio County, Texas' (Auk, XVII, 1900, p. 348) records *Parus bicolor texensis* Sennett as "very common" in Refugio County, and does not record from there either *bicolor* or *atricristatus*. This would imply that all the birds examined by Carroll during a four years' field experience "during the winter and spring" were intermediates or hybrids.

equally developed, and black with the feathers merely edged with gray, and clear black, the frontal band being in all more or less rufous; also occasional birds with the frontal band greatly reduced in width, or nearly obsolete.

After careful study of all the available material from Texas representing *Bæolophus bicolor* and *B. atricristatus* (about 200 specimens),¹ I accept Mr. Ridgway's view,² that the birds showing mixed characters are hybrids and not geographic intergrades.

SUBSPECIES OF THE *Bæolophus bicolor-atricristatus* GROUP.

As already shown, there is about the normal amount of geographic variation in size and general coloration in both *B. bicolor* and *B. atricristatus*. It seems, however, too slight in *bicolor* to warrant its separation into subspecies, although the difference in size between northern and southern specimens is quite marked. The maximum size of *bicolor* appears to be reached in the northern part of its trans-Mississippi range, where also slightly paler coloration may be expected. But available material for examination from this region is at present lacking.

B. atricristatus presents about the same range of geographic variation in size as *bicolor*, with, however, rather more pronounced color differences; the northern form is not only much larger and grayer than the southern, but has a shorter crest, with the black area more restricted and duller, and it has, apparently, rather definite geographic limits — Texas, north of the Lower Rio Grande Valley, and from about Eagle Pass westward and northward. The type of *B. atricristatus* came from some point on the Rio Grande between Brownsville and Rio Grande City.³ Mr. Ridgway (*l. c.*) has characterized this larger northern form under the name *Bæolophus atricristatus sennetti*, he claiming that Sennett's *Parus atricristatus castaneifrons* and *Parus bicolor texensis* were both based on hybrids, the former on four specimens and the latter on two specimens, all collected at the same time and place on the Aransas River, in Bee County, about 15 miles southeast of Beeville.⁴ Later Mr. Sennett received a large number of birds from various parts of southwestern Texas which he labelled *Parus atricristatus castaneifrons*. This series covers the known range of Mr. Ridgway's sub-

¹ See *infra*, under 'Material Examined,' where the localities and character of the intergrades are stated in detail.

² Birds of North and Middle America, Part III, 1904, p. 386, footnote.

³ Type locality, as given by Cassin, "Texas, upon the Rio Grande, discovered by Mr. John Woodhouse Audubon." An examination of J. W. Audubon's 'Western Journal: 1849-1850' (1906), Chap. II, shows that Audubon must have obtained the type somewhere below Rio Grande City.

⁴ *Fide* Becham, Proc. U. S. Nat. Mus., Vol. X, 1887, p. 692, on the authority of the collector, John M. Priour.

species *sennetti*, so that the name *castaneifrons*, as used by Sennett on his labels, exactly equals the much later *sennetti* of Ridgway. Mr. Sennett labelled all of his Lower Rio Grande and Mexican specimens *atricristatus*, thus sharply discriminating between the two races.

Mr. Ridgway did not have Mr. Sennett's series for examination, not even his types of *castaneifrons* and *texensis*. As assumed by Mr. Ridgway, however, all these types are unquestionably hybrids, the male type of *castaneifrons* having the forehead bright chestnut and the black of the crest dull, much restricted, and mixed with gray; in the female the forehead is much duller and the crest merely blackish washed with gray. This being the fact, it is perhaps better to accept for the large northern race of *atricristatus* the name *sennetti* rather than *castaneifrons*.

MATERIAL EXAMINED.

I am greatly indebted to the kindness of the authorities of the U. S. National Museum and the Bureau of the Biological Survey for a large part of the specimens recorded below, without the aid of which this investigation could not have been undertaken. I am also indebted to Dr. J. Dwight, Jr., for the loan of a number of important specimens used in the present connection.

The letters A, B, and N, at the left of the entries indicate the sources from which the material was received, as follows: A = American Museum of Natural History; B = Biological Survey; N = U. S. National Museum.

Under the heading, 'Specimens of Mixed Character,' many of the intermediate specimens are mentioned in some detail.

The total number of specimens examined is about as follows: Biological Survey, 92; U. S. National Museum, 101; American Museum of Natural History, 296. Total 489. They are divided by species and geographically as follows:

Bæolophus bicolor, from localities east of the Mississippi, 121; from localities west of the Mississippi, 5; from Texas, 39. Total, 165.

Bæolophus atricristatus atricristatus, from Texas, 82; from Mexico, 52. Total 134.

Bæolophus atricristatus sennetti. 88.

Bæolophus a. sennetti + *bicolor*. 102.

Bæolophus bicolor, from East of Mississippi River.

A. Westchester, N. Y.	1	B. Georgetown, S. C.	1
A. Morristown, N. J.	13	A. Summerville, S. C.	5
A. Maplewood, N. J.	1	A. Chester C. H., S. C.	1
A. Erie, Pa.	2	A. Aiken, S. C.	2
A. Crafton, Pa.	1	A. Frogmore, S. C.	2
B. Beaver Co., Pa.	5	A. Hobcaw Point, S. C.	1
B. Fulton Co., Pa.	1	N. Augusta, Ga.	3
B. Bedford Co., Pa.	1	N. Kershaw Co., Ga.	5
A. Circleville, O.	6	A. Gainesville, Fla.	12
N. Wheatland, Knox Co., Ind.	4	N. Lake Trafford, Fla.	1
N. Mt. Carmel, Ill.	2	A. Rosewood, Fla.	4
N. Parkersburg, Ill.	1	N. Big Lake George, Fla.	2
N. Jacksonville, Ill.	2	A. Hollis Hill, Fla.	1
N. Bardstown, Ky.	1	N. Fort Gardner, Fla.	1
N. Lexington, Ky.	1	B. Galton, Ala.	1
N. Rockwood, Tenn.	4	B. Chautauqua, Miss.	1
N. Laurel, Md.	3	N. Bay St. Louis, Miss.	2
A. N. Washington, D. C.	14	B. Belair, La.	1
N. Gainesville, Va.	2	A. Clinton, La.	2
B. Cape Charles, Va.	1	A. Madisonville, La.	1
A. Mitchell Co., N. C.	6		

Bæolophus bicolor, from West of Mississippi River.

B. Marble Cave, Mo.	1	B. Savanna, Ind. Terr.	1
A. Council Grove, Kans.	2	B. Mt. Scott P. O., Okla.	1

Bæolophus bicolor, from Texas.

B. Texarkana, Bowie, Co.	1	N. Hemstead, Washington Co.	1
A. Grigsby's Bluff, Orange Co.	3	N. San Antonio, Bexar Co.	9
B. Jasper, Jasper Co.	1	B. Columbia, Brasoria Co.	1
N. Rice, Navarro Co.	1	A. Brasoria County	1
B. Sour Lake, Hardin Co.	1	B. Matagorda, Matagorda Co.	3
B. Waco, McLennan Co.	2	A. " " "	4
B. Conroe, Montgomery Co.	2	B. Inez, Victoria Co.	1
A. Giddings, Lee Co.	6	A. Victoria Co.	2

Bæolophus atricristatus atricristatus.

Texas.

B. Brownsville, Cameron Co.	6	A. Lomita Ranch, Hidalgo Co.	34
N. " "	3	B. " " "	1
A. Cameron Co. (mostly from Brownsville)	16	A. Hidalgo, Hidalgo Co.	7
A. Rio Grande City, Starr Co.	11	B. " "	1
B. Paisano, Starr Co.	2	B. Dimmitt Co.	1

Mexico.

A. Boquillo, Nuevo Leon.	7	A. Victoria, Tam.	1
A. Boque Negro, "	1	A. San Fernando River, Tam.	1
A. San Pedro Mines, "	6	A. Fernando de Presos, "	1
A. Montemorelos, "	1	A. Xicoteucatl, "	1
B. Monterey, "	4	A. Soto le Marina, "	1
A. " "	3	B. Camargo, "	1
A. Rio San Juan, "	2	B. Alta Mira, "	1
B. Rodriguez, "	5	B. Sabinas, Coahuila	1
B. Cerro de la Silla, "	4	B. Valles, San Luis Potosi	2
B. Rio de Ramo, "	1	B. Papantla, Vera Cruz	1
B. Linares, "	1	N. Mirador, "	1
B. Matamoras, Tam.	1	N. Mexico (Verreaux spec.)	1
B. Victoria, "	3		

Bæolophus atricristatus sennetti.

(All from Texas.)

B. Cotulla, La Salle Co.	3	N. Medina Co.	1
B. Ingram, Kerr Co.	2	N. Boerne, Kendall Co.	1
B. Del Rio, Valverde Co.	1	N. Leon Springs, Bexar Co.	6
B. Langtry "	1	N. San Antonio, Bexar Co.	9
B. Fort Davis, Jeff Davis Co.	4	A. Nueces River (County ?) ¹	11
A. " "	5	A. Paint Rock, Concho Co. ²	10
B. Davis Mts., Reeves Co.	1	A. Laredo, Webb Co.	12
B. San Diego, Duval Co.	1	N. " "	1
B. Chisos Mts.	1	A. Rio Frio (Uvalde Co. ?) ¹	13
B. Locker's Rancho	1		

Specimens of Mixed Character (Central Texas).

N. San Antonio, Bexar Co.	10
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Of 27 specimens from this locality, 9 are typical *bicolor*, 9 are fairly typical *atricristatus sennetti*, 5 approach more or less the '*texensis*' phase, 3 are '*texensis*,' and 1 is '*castaneifrons*.'

N. Leon Springs, Bexar Co., about 20 miles north-northwest of San Antonio	1
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Of 6 specimens, 5 are of the *atricristatus* type and 1 is a good '*castaneifrons*.'

N, A. Fort Clark, Kinney Co.	21
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All are referable to *atricristatus sennetti*, except that about 25 per cent. have the frontal band too strongly suffused with rufous to be typical.

B. Cisco, Eastland Co.	13
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All have black crests, but in most of them the black is dull and the feathers edged with gray, especially in the females, but also in some of the males; the forehead is more strongly suffused with brownish than is usual in the *atricristatus* group, and the posterior rows of feathers of the frontlet are conspicuously tipped with blackish. They agree with the large series in the Sennett collection labelled by him '*castaneifrons*.'

A. Corpus Christi, Nueces Co.	1
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¹ Labelled *castaneifrons* by Sennett.

² Part labelled *castaneifrons* and part *atricristatus* by Sennett.

Frontal band white; crest feathers blackish, more or less edged with gray. Mr. Chapman collected this specimen and reported seeing one *bicolor*. (Bull. Am. Mus. Nat. Hist., III, 1891, 327.)

B. Mouth of Nueces River 1

Frontal band very narrow, strongly chestnut; crest feathers with the black restricted and edged with gray.

A. Bee County, near Beeville 26

There are 16 adults and 10 in first plumage. Of the adults, 12 are labelled as *Parus bicolor texensis* by Mr. Sennett, and 4 as *P. atricristatus castaneifrons*. They include the original 6 specimens on which *texensis* and *castaneifrons* were based, and 10 others received later. The 10 young birds were all identified by Mr. Sennett as *texensis*. The 4 original specimens of *castaneifrons* have the black of the crest much restricted and dull, the feathers more or less gray-edged, especially in the females. In two of them the forehead is bright reddish; in one (sexed ♂), it is buffy white, as pale as in many specimens of true *atricristatus*, the crest small and dull blackish; in the other (sexed ♀) the forehead is rusty buff and the black of the crest feathers is greatly restricted and dull grayish black in general effect.

In the 10 adult '*texensis*' specimens the crest is gray washed with blackish, faintly in three of the specimens; the forehead is chestnut in all, varying from rather strong clear chestnut to pale chestnut, in one suffused with blackish, in two very pale rusty chestnut. The 10 young birds ('*texensis*' Sennett) have the whole crown faintly dusky, but decidedly darker than the back (as in all young birds of the *bicolor-atricristatus* group) and there is generally a very narrow blackish frontlet, with a slight buffy suffusion.

In other words, the whole Bee County series of adults consists of 'intermediates,' showing a wide range of individual variation. In some there is only the merest trace of blackish in the crest, grading up to a crest as full and as black as in specimens from other localities that would be unhesitatingly referred to Ridgway's *B. atricristatus sennetti*. In none is the forehead black, but in one the 'chestnut' suffusion is no greater than in some Rio Grande specimens of true *atricristatus*.

A. Travis County (Austin and vicinity) 6

In this series of 6 specimens (2 from Dr. Dwight's Coll.), no two are very nearly alike. Two may be described as nearly typical *bicolor* with the frontal band narrow and deep reddish chestnut instead of black. Another has the forehead dingy gray tinged with rusty mesially and a dull blackish crest. A fourth has the frontal band of normal width (twice as broad as in the others), dull chestnut tinged with dusky, especially on the posterior third; the crest is gray with all the feathers broadly centered with blackish. A fifth has a bright reddish narrow frontal band, and the crest suffused with blackish. The other has the frontal band almost obsolete, and of a dingy buffy gray; the crest is full and black, about as in average examples of *B. atricristatus sennetti*.

A. "Brownsville," Texas (locality obviously erroneous; Lawrence Coll.) 1

Crest and general coloration as in *bicolor*; frontal band broad, bright reddish chestnut, with the feathers conspicuously tipped with black. The chestnut of the frontal band greatly predominates over the black; otherwise the specimen is *bicolor*, and was so identified by Mr. Lawrence.

B. Seguin, Guadalupe Co. 1

A female with the black of the crest much restricted and the frontal band buffy, the feathers black-tipped.

- A. Paint Rock, Concho Co., Texas 2
 Two specimens in a series of 10 have the forehead chestnut and the crest feathers gray-edged.
- A. Lampassas Co., Texas 1
 A yellowish brown frontal band and the crest feathers much edged with gray.
- A. Rio Frio (county not stated) 13
 In a series of 13 specimens, the forehead is yellowish brown in most of them, and the black of the crest is rather restricted and the feathers often gray-edged, particularly in the females.
- A. Live Oak Co., Texas 5
 All but one have the forehead buff, strongest in the male; crest in the male with the black restricted and some of the feathers gray-edged; crest in the females dull blackish gray.

