

BULLETIN
OF THE
American Museum of Natural
History.

Vol. IV, 1892.

NEW YORK :
Published by order of the Trustees.
1892.

WM. C. MARTIN PRINTING HOUSE,
No. 111 John Street,
New York.

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DATES OF PUBLICATION OF AUTHOR'S
SEPARATES.

Art. I, Feb. 25, 1892. Art. II, March 8, 1892. Art. III and IV, March 25, 1892. Art. V, April 6, 1892. Art. VI, May 9, 1892. Art. VII, May 17, 1892. Art. VIII, May 19, 1892. Art. IX, June 6, 1892. Art. X, July 1892. Art. XI, Oct. 20, 1892. Art. XII, Oct. 18, 1892. Art. XIII, Oct. 18, 1892. Art. XIV, Dec. 29, 1892. Art. XV, Dec. 27, 1892. Art. XVI and XVII, Dec. 29, 1892. Art. XVIII, Dec. 30, 1892.

Besides the author's separates, and in addition to the regular edition of the Bulletin, 100 copies were issued in signatures as printed, each signature bearing at the bottom of the first page the date of publication.

Article I.—A PRELIMINARY STUDY OF THE GRACKLES OF THE SUBGENUS QUISCALUS.

By FRANK M. CHAPMAN.

The seventeen members of the genus *Quiscalus* fall into three natural groups, or subgenera, which are known as *Holoquiscalus*, *Megaquiscalus*, and *Quiscalus*. *Holoquiscalus* contains nine species, which range through the West Indies to Trinidad, Cayenne, and Venezuela; *Megaquiscalus* contains five species, which range from Virginia southward along our eastern coasts, through Mexico and Central America to Bogota in Colombia, two of which enter our limits,—*Quiscalus major*, as just stated, reaching Virginia, while its southern limit is marked by the northern boundary of the range of *Quiscalus macrourus*, or about the mouth of the Colorado River in Texas. The subgenus *Quiscalus* contains three forms, which are wholly North American and bear no close relationships to the other members of the genus. *Quiscalus æneus* breeds from the Rio Grande Valley to northern British America and from the eastern slope of the Rockies to the western slope of the Alleghanies, while from Massachusetts to Nova Scotia it reaches the Atlantic seaboard; *Quiscalus quiscula aglæus* is typically represented from New Orleans to Charleston and southward to the extreme point of the Florida peninsula; and *Quiscalus quiscula* breeds from the northern limit of the range of *aglæus* northward to the southern limit of the range of *æneus* in the lower Connecticut and Hudson River Valleys. Its northern limit, therefore, coincides with the boundaries of the Carolinian fauna.

These three birds form a group so widely separated from its nearest allies that its origin is not now determinable. A part of their range corresponds with that of *Quiscalus macrourus* and *Q. major*, and it is probable that, like these birds, they have been derived from neotropical ancestors.

Quiscalus æneus was described as a species by Mr. Ridgway in 1869, since which time it has been variously ranked as a species or subspecies by different writers, who either believed in or were

unconvinced of its intergradation with *quiscula*. A question has also arisen, among those who regarded the two birds as only subspecifically separable, concerning the manner in which their intergradation is accomplished. Is one bird an imperfectly differentiated offshoot of the other, and are the connecting intergrades geographical intermediates, or have we here two distinct species whose intergradation is due to interbreeding where the confines of their respective habitats adjoin? In other words, the question is one of geographical variation versus hybridization, and the object of this paper is to present the facts of the case so far as they are determinable by the material available for study.

The generous and active coöperation which the specialist receives in bringing together large series of specimens for detailed comparison is an important and characteristic feature of ornithological research in America. The uniform courtesy with which a request for the loan of material is granted enables the student to form at once much larger collections than through his own unaided efforts he could gather in years. Thus, through the assistance of fellow-workers, I have examined over 800 specimens of our Grackles, but, I regret to say, even this large number has proved insufficient to complete the chain of facts, without which we cannot hope to draw satisfactory and final conclusions concerning the exact relationships of the birds under consideration. The concluding table gives the number of specimens I have examined and from whom they were received. To each of the gentlemen mentioned therein I desire to express my very hearty thanks for the aid they have so freely given me. To Mr. Brewster, Mr. Ridgway, Dr. Warren, Dr. Avery, Mr. Austin F. Park, and Mr. J. T. Park, I am particularly indebted for especial efforts in my behalf.

Before proceeding to a discussion of the relationships of the three birds it will be necessary to give some attention to their coloration and diagnostic characters. It may here be mentioned that all the comparisons have been based entirely on breeding males; that is, on birds taken later than April 15, a date when nesting has begun and the migration is practically over.

Quiscalus æneus.

ADULT MALE IN THE BREEDING SEASON.—The following description of a typical male is based on the examination of eighteen breeding specimens, from Erie, Penn., Wheatland, Ind., and Mt. Carmel, Ill. Head and neck purplish steel blue, more purplish anteriorly; back, rump, and underparts rich, metallic olivaceous bronze, or brassy bronze; upper and under tail-coverts purplish brassy; tail reddish purple, the exposed portions of the feathers with brassy reflections; primaries blackish, secondaries and wing-coverts of the same color as the tail, but the colors are richer and more intense, the coverts broadly tipped and edged with brassy.

Variations.—Head and Neck: The variations of the head and neck are the same as those which occur in *quiscula*; that is, there are three types of coloration with their various degrees of intergradation. Briefly, these are (1) the purple type, with more or less bronzy reflections, this closely resembling the color of the same parts in *aglaeus*; (2) the steel-green or bluish-green, and (3) the steel-blue or purplish-blue, previously described, which occurs in about twenty-five per cent. of the specimens examined.

Back and Underparts.—The colors of the neck and body are very clearly defined; there is, however, an occasional slight overlapping of the steel blue on the bronze, the result being a few purple-tipped bronze feathers at the line of juncture of the two colors; the back and underparts themselves vary only in intensity and brilliancy of coloration; earlier in the season they are brighter and more brassy, later darker and more deeply olivaceous bronze.

Wings and Tail.—The wings and tail present no variations other than those incident to wear and exposure of plumage.

ADULT FEMALE IN THE BREEDING SEASON.—The following description of a typical female is based on the examination of thirteen breeding specimens from Erie, Penn., Kankakee marshes, Ind., and Mt. Carmel, Ill. The differences existing between male and female specimens of *æneus* consist simply in brilliancy of coloration. The pattern of coloration is exactly the same; the purple, blue, or steel blue of the head and neck are as sharply defined in the female as in the male; the back always shows at least a trace of bronze, and the brightest specimens cannot be distinguished from dull-colored or worn males.

Quiscalus quiscula.

ADULT MALE IN THE BREEDING SEASON.—The following description of males is based on the examination of fifty-one breeding specimens from West Chester, Penn. The range of variation in *quiscula*, as represented by this series from one locality, is so great that it is not possible to select a specimen which shall serve as a type for the description of the species. There are three distinct phases of coloration, which may be termed (1) the bottle-green, (2) the bronze-purple, and (3) the brassy bluish-green. Between these phases there is

every degree of intergradation, and the result is a confusion of characters which require detailed description.

Two specimens of this series agree with phase No. 1, or the bottle-green phase; they have the head and neck steel blue; but so far as coloration goes, in other respects, closely agree with true *aglaeus*.

Fifteen specimens are typical of phase No. 2, or the purple-bronze phase. In this phase the head is either purple, steel blue, or steel green; the feathers of the back and underparts are widely margined with bronzy purple, there is a subterminal iridescent band, and a concealed base, varying from brassy bronze to bronzy purple. The rump varies from bronze, or brassy bronze, to bronzy purple, in two specimens the feathers are tipped with iridescent spots; the upper tail-coverts are bronzy purple; the wings and tail agree in coloration with phase No. 1, but are heavily glossed and margined with bronzy purple. Eleven specimens are intermediate between phases No. 1 and No. 2, the intergradation being effected by a decrease in the width of the bronze-purple terminal bar characteristic of the feathers of the back in phase No. 2, followed by a proportionate increase in the width of the bottle-green bar of phase No. 1. Held in certain lights these intermediate specimens may appear typical of either phase as one receives the green or bronze-purple reflections from them. In phase No. 3 (nine specimens) the brassy bluish-green phase, the head and neck agree in coloration with phase No. 2; the change in the color of the feathers of the back is effected by the substitution of a brassy bluish-green terminal bar for a bronze-purple one, by the less clear definition of the iridescent subterminal band, by an increase in the width and constancy of the basal brassy bronze, which in two specimens is not concealed, the terminal brassy bluish-green being then proportionately reduced. In four specimens the rump and lower back are brassy bronze or olivaceous bronze; in the remaining four it is brassy bronze with purplish reflections; in one of the last four the feathers of the rump have terminal iridescent spots; the upper tail-coverts, wings and tail agree with those of phase No. 2. Thirteen specimens are intermediate between phases No. 2 and No. 3, these intergrades being produced by a mingling of the bronze-purple and brassy bluish-green colors of the back. Phases No. 1 and No. 3 do not intergrade directly, No. 2 being a transitional phase between them.

ADULT FEMALE IN THE BREEDING SEASON.—The following description of the female is based on the examination of sixteen breeding specimens from West Chester, Penn. The female in *quiscula* presents fully as much variation in color as the male, the less conspicuous coloring, however, renders it difficult to properly determine the color phases corresponding to phases of the males. The head is variously purple, steel blue or steel green; seven specimens have the feathers of the back basally purple, bronze purple, or brassy bronze, with subterminal iridescent bars and terminal bands of bronze purple or brassy bluish-green; five specimens are dull, lustreless bronze with slight purplish reflections; four specimens are intermediate between these two phases. The variations of the rump, wings, and tail correlate with those of the back.

Quiscalus quiscula aglæus.

ADULT MALE.—So far as coloration goes *Quiscalus quiscula aglæus* represents the extreme development of phase No. 1 of *Quiscalus quiscula*. The differences in color which exist between Washington and Chester County, Penn., specimens of this phase and examples from South Florida consist in the greater average intensity of the green of the back, the southern birds being, as a rule, slightly darker, and in the color of the head. In Florida birds this part varies from a steel blue to bronzy purple, the last being the prevailing color, while in the northern bird steel blue is the prevailing shade. Many Florida birds, however, can be exactly matched in color by northern specimens. Further variation in my series of sixty males from Southern Florida is shown in the direction of phase No. 2 of *quiscula*, of which there are two specimens, while twelve others are intermediate between phases 1 and 2; No. 1, therefore, being represented by forty-six specimens, or seventy-six per cent., while in Chester County only four per cent. of the specimens can be referred to this phase.

ADULT FEMALE.—The females of *aglæus* do not present so wide a range of variation as do the females of *quiscula*. The most highly-colored specimens, however, are brighter than the extremes in *quiscula*. Such specimens have the feathers of the back rich purple basally, while the tips are occupied by an iridescent band.

In size *aglæus* averages smaller than either *æneus* or *quiscula*, but has the bill actually as well as proportionately longer. The succeeding table of measurements shows in detail the differences in size which exist between the three forms.

Lack of a large series of breeding specimens has, in the present case, forced me to use winter birds. With little doubt, however, they represent the resident bird, and in any event all of the phases mentioned are shown by summer males.

YOUNG BIRDS.—Young birds of the three forms in first, or nestling, plumage are indistinguishable from one another, but when the first plumage is fully grown slight purplish or bronzy reflections may, in *quiscula* and *æneus*, give some indication of parentage. Of *aglæus* my only young specimen is in incomplete first plumage. Soon after the acquisition of the first plumage a complete molt, including wing and tail-feathers, occurs, and the bird passes at once into the full adult plumage with a head which may be purple, steel blue or steel green, showing that the variation in the color of the head is not due to age.

I have found no evidence of a molt in the spring.

MEASUREMENTS.—The differences in size, which exist between these three forms, are too slight to be of diagnostic value in individual cases, the range of variation in either form completely overlapping the average differences. Still a study of average measurements, based on series of specimens taken throughout the range of each form, develops some points of interest.

Quiscalus æneus presents a slight but regular increase in size northward, the accompanying table showing in detail the differences in dimension of specimens taken throughout its habitat. On the whole it appears to be a somewhat smaller bird than *quiscula*, with perhaps a slightly longer tarsus. A comparison of the average measurements of District of Columbia specimens with those of Mt. Carmel, Ill., and Wheatland, Ind., examples, and of the West Chester, Penn., series with the series from Erie, may be considered to show the differences in size which exist between the two species.

In *aglaeus* and *quiscula*, in passing from the South northward, we find about the same increase in size shown by *æneus*; the wing and tail become longer, the bill thicker, but the length of this member decreases; Florida specimens (*aglaeus*) having an actually, as well as relatively, longer bill than northern specimens. A series of twenty-five birds from Shelter Island, N. Y., present an exception to the rule of increase in size northward, and average smaller than the Washington specimens. Most of the Long Island birds, however, were taken in June, and their apparently smaller size may be due to worn plumage.

AVERAGE MEASUREMENTS OF BREEDING MALES OF *Quiscalus quiscula* AND
Quiscalus quiscula aglaeus.

LOCALITY.	No of Speci- mens.	Wing.	Tail.	Tarsus.	Expos'd Culmen	Depth of Bill at Nostril.
Indian River, Fla.	24	5.38	4.90	1.45	1.25	.42
District of Columbia.	11	5.62	5.14	1.44	1.20	.47
West Chester, Penn.	50	5.66	5.18	1.47	1.18	.46
Shelter Island, N. Y.	25	5.56	4.94	1.46	1.17	.45

AVERAGE MEASUREMENTS OF BREEDING MALES OF *Quiscalus æneus*.

LOCALITY.	No of Specimens.	Wing.	Tail.	Tarsus.	Expos'd Culmen	Depth of Bill at Nostril.
San Antonio, Tex.....	2	5.34	4.70	....	1.23	.49
Cook County, Tex.....	2	5.47	4.83	....	1.19	.47
Warner, Tenn.....	6	5.50	5.11	....	1.18	.44
Bell, Ky.....	2	5.54	5.28	1.48	1.20	.46
Mt. Carmel, Ill.....	3	5.56	5.16	1.49	1.16	.44
Wheatland, Ind.....	3	5.51	5.31	1.48	1.12	.45
Erie, Penn.....	8	5.60	5.09	1.53	1.15	.44
Fort Snelling, Minn....	3	5.59	4.91	1.53	1.17	.46
Pembina and Ft. Rice, N. Dak....	3	5.65	5.24	....	1.17	.44
Vicinity of Cambridge, Mass.....	21	5.62	5.04	1.46	1.21	.47
Vermont, Maine & New Brunswick.	9	5.71	5.36	1.45	1.19	.46

SUMMARY.—In order that the discussion of the inter-relationships of the three forms just described may be easily followed, it is important that their plumages should be thoroughly understood. Omitting all reference to the color of the head as too variable a character to be used in diagnosis, we may know *æneus* as a bird in which the back and underparts are metallic brassy, or olivaceous bronze without iridescent bars in any part of the plumage. *Quiscula* assumes three phases of coloration which merge into one another in the order named: first, the bottle-green; second, the bronze-purple; and third, the brassy bluish-green. In each of these phases the feathers of the back and underparts are banded with iridescent bars of varying extent. *Quiscalus quiscula aglæus* represents the highest development of phase No. 1 of *quiscula*. Keeping these points of difference before us, we may follow the variations presented by each form throughout its range.

BREEDING RANGE OF *Quiscalus æneus*.—I shall here consider *æneus* only as my material typically represents it, its relationships and intergradation may be treated of through *aglæus* and *quiscula*. The description given of a typical series of *æneus* covers all the variations presented by a series taken throughout its range, and it will not be necessary to discuss these specimens in detail. Briefly it may be said that for a bird having so wide a breeding range *æneus* presents remarkably slight variations, either in color or size.

The localities represented by breeding specimens (see the accompanying map) are the following :

Texas, San Antonio, (Attwater), Cook County (Ragsdale). **Louisiana**, Clinton (Kohn). **Alabama**, Greensboro' (Avery). **Tennessee**, Warner, Hickman County (Park). **Kentucky**, Bell, Christian County (Bacon). **Illinois**, Mt. Carmel (Ridgway). **Indiana**, Wheatland (Ridgway). **Pennsylvania**, Erie (Sennett), Meadville (Sennett). **Michigan**, Oden (Brewster), Petoskey (Dwight). **Minnesota**, Fort Snelling (Mearns). **Dakota**, Fort Rice (Allen), Pembina (Coues). **Wyoming**, Laramie Peak (Hitz). **Colorado**, Denver (Henshaw), Fountain (Aiken). **Montana**, Fort Custer (Bendire). **British America**, Fort Resolution (Kennicott), Great Slave Lake, Big Island (Reid). **Ontario**, Hamilton (McIlwraith). **New York**, Leyden, Lewis County (Fisher), Locust Grove (Fisher), St. Regis Lake (Roosevelt). (**Hudson Valley**, **Massachusetts** and **Connecticut** will be considered under *quiscula*.) **Vermont**, Middlebury (Knowlton). **Maine**, Calais (Boardman), Oxford County (Brewster), Ft. Fairfield (Dwight). **New Brunswick**, Woodstock (Adney), Hillsborough (Dwight).

Mr. William Palmer¹ observed Grackles, which undoubtedly were *æneus*, at St. John's, N. F. A line connecting the two most northern points from which the species has been recorded, therefore, corresponds closely with the northern limit of trees.

Distribution during the Migratory Season and in the Winter.—During both the spring and fall migrations *æneus* occurs east of the Alleghanies, but the centre of abundance in the winter seems to be the lower Mississippi Valley ; and the bird is apparently unknown from the South Atlantic seaboard. In the Atlantic States, Aiken, South Carolina, is the most southeastern locality represented ; there are no specimens from Georgia, and the species has never been recorded from Florida. There are numerous specimens from Alabama, Louisiana, and Texas—the most southern locality represented in the last-named State being Banquette, near Corpus Christi. There is no record from Mexico, but at Eagle Pass Mr. Negley² reports the species as arriving in the spring from the South, and there can be no doubt, therefore, that some birds winter south of the Rio Grande.

The eastward extension of *æneus* through New York and Massachusetts to the Atlantic coast, and thence northward to

¹ Proc. U. S. Nat. Mus., XIII, 1890, p. 263.

² Cooke, Bird Migration in the Miss. Valley, 1888, p. 175.

New Brunswick, renders its habitat unique among North American birds. This singular eastern distribution, however, is in a measure paralleled by that of *Lanius ludovicianus*, and has probably occurred in the same manner.¹ The Loggerhead Shrike has apparently reached northern New England by passing from the Mississippi Valley eastward along the Great Lakes, and is thus regularly found breeding in central New York and northern New England, but is known only as a migrant in the lower Hudson and Connecticut River Valleys.

BREEDING RANGE AND RELATIONSHIPS OF *Quiscalus quiscula aglæus* AND *Quiscalus quiscula*.—We will here ignore the distinction created by the name *aglæus* and consider *quiscula* as a species ranging from the southern extremity of Florida northward to the Connecticut River Valley. We have already seen that in southern Florida phase No. 1 of *quiscula*, or the bird known as *aglæus*, reaches its highest development, while phase No. 2 is barely represented, and No. 3 is entirely wanting. We may now trace the distribution and relationships of these phases with one another and with *æneus* by considering in geographical order the entire series of specimens at our disposal. It will soon be evident that without a large number of examples the exact status of the birds of any one locality cannot be accurately determined.

Northern Florida.—Three specimens from Gainesville (Bell and Chapman) are referable to phase No. 1, one is intermediate; and two agree with phase No. 3. Two specimens from Rosewood (Maynard), two from the lower Suwanee River (Chapman), and one from Talahassee (Brewster), represent phase No. 1, while a second specimen from the last-mentioned locality is intermediate between phases Nos. 1 and 2.

Georgia.—A single specimen from St. Mary's (Brewster) is typical of phase No. 1.

Alabama.—Sixteen specimens, collected by Dr. Avery at Greensboro', are, in some respects, different from any I have examined. For the present, however, they may be classified as

¹Cf. Merriam, Bull. N. O. C., III, 1878, p. 55.

follows: Phase No. 1, two; intermediates, six; phase No. 2, seven, while the sixteenth specimen, taken July 17, 1889, is typical *æneus*. Unfortunately the late date at which this bird was secured renders its breeding at Greensboro' open to question, and it is not improbable it may be a wanderer from a more northern locality.

A male from Anniston (Avery) is intermediate between phases Nos. 1 and 2.

A male from Coosada (Brown) is referable to phase No. 1.

Louisiana.—Of seventeen males from New Orleans, Madisonville, and Mandeville (Kohn, Fisher and Galbraith), eight are referable to phase No. 1, seven are intermediates, while the remaining two are typical of phase No. 2. From Clinton, about fifty miles northwest of New Orleans, there is a specimen of *æneus* taken by Mr. Kohn, June 6, 1888. The specimen has the anterior interscapulars lightly tipped with bluish green, but the difference from typical *æneus* is so slight that it is difficult to say whether this variation is purely individual or not.

Dr. F. W. Langdon records "*Quiscalus quiscula*" as probably breeding in West Baton Rouge Parish.¹ I have not seen the specimens on which this record is based, and cannot say, therefore, which phases of *quiscula* they represent.

Mr. C. W. Beckham has recorded *æneus* as occurring in April at Bayou Sara,² but does not state that he found it breeding.

Tennessee.—Eleven specimens taken from "one colony" at Warner, Hickman County, by J. F. Park, are all typical *æneus*. Dr. Fox writes me concerning his record of the occurrence of *æneus* and *quiscula* at Rockwood, Roane County, that "the birds were not breeding at the time they were shot." He further says that "the first flock was seen March 16, and none were met with again until the 26th, after which a flock could be found on or near a certain large tree every day of my stay." The specimens collected by Dr. Fox are now in the United States National Museum, and have been loaned me by Mr. Ridgway. The March specimens we may ignore as probable migrants, but it

¹ Journ. Cincinnati Soc. Nat. Hist., IV, 1881, p. 150.

² The Auk, IV, 1887, p. 303.

is quite probable that two males, taken April 11 and 16 respectively, represent the resident form. The first is *quiscula* intermediate between phases 1 and 2, the second typical of phase 2.

Kentucky.—The specimens on which Dr. L. O. Pindar based his interesting record of the breeding of *quiscula* and *æneus* in separate colonies in Fulton County¹ are unfortunately not now in existence.

Dr. Pindar writes me : "I have secured and perfectly identified specimens of each variety, and have found the nests and eggs of each; *æneus* far outnumbers *quiscula*, and during the breeding season they keep apart from each other." Fulton County is in western Kentucky, on the Mississippi River, and it is not impossible that this locality may represent a northern extension of a phase of *quiscula* in the Mississippi Valley.

The importance of this record is evident, but its exact bearing on the question at issue cannot be determined until we know what phase of *quiscula* occurs in Fulton County.

Two specimens from Bell, Christian County, southwestern Kentucky (Bacon), are typical *æneus*.

South Carolina.—Nine specimens taken throughout the year, near Charleston (Wayne), are typical of phase No. 1 of *quiscula* (= *aglaeus*), which, Mr. Wayne writes me, is the only form that breeds in his vicinity.

North Carolina.—A male taken at Raleigh, June 19 (Brimley), agrees with phase No. 3. This, it will be observed, is the first appearance of this phase.

District of Columbia.—In a series of sixteen specimens taken at and near Washington, three (Fisher and Richmond) are referable to phase No. 1, six (Fisher, Jouy and Richmond) are intermediates between this phase and phase No. 2, two (Richmond) agree with phase No. 2, and four (Fisher) are intermediates towards phase No. 3. The last-named phase is not represented, and the sixteenth bird is a typical example of *æneus*, taken April 17, 1886, by Mr. C. W. Richmond. In 'The Auk,'

¹ The Auk, VI, 1889, p. 314.

Vol. V, p. 19, Mr. Richmond has recorded the capture of this bird, and also of another of the same species, taken April 6, 1887. Both were secured "in a grove of cedars occupied by a colony of Purple Grackles."

Maryland.—Of three specimens from Sandy Spring (Fisher) two are intermediate between phases Nos. 1 and 2, and one is typical of phase No. 3.

Pennsylvania.—In the splendid series of fifty-one breeding males collected in Chester County by Dr. B. H. Warren and Mr. G. W. Roberts, we for the first time find all three phases of *quiscula* associated, and can thus study their inter-relationships to better advantage. Of phase No. 1 there are two typical specimens, which are connected with phase No. 2 by eleven specimens, showing every stage of intergradation. Fifteen specimens are typical of phase No. 2, which in turn is connected with phase No. 3 by thirteen intermediates. Of phase No. 3 there are nine specimens, while one specimen is intermediate between this phase and *æneus*.

In going westward and northwestward from Chester County, and thus approaching the range of true *æneus*, we find *quiscula* represented by phase No. 3 or its intermediates. Thus at Carlisle (Baird) one specimen is intermediate between phases Nos. 2 and 3 and one agrees with phase 3. One example from Dauphin County (Warren) is referable to phase No. 3; one from Centre County (Warren) is intermediate between phase No. 3 and *æneus*, while three specimens from Williamsport (Koch and Warren) are respectively referable to intermediates between phases Nos. 2 and 3, phase No. 3, and intermediates between this phase and *æneus*. From Athens I have two specimens which are between phase No. 3 and *æneus*; from Towanda (Dwight) one example of *æneus*, and from Port Jervis (Dwight), on the northeastern boundary of the State, two specimens, one of which is between phase No. 3 and *æneus*, while the other is *æneus*.

New Jersey.—Of eight specimens from Monmouth County (Zerega), Princeton (Scott and Nicholas), and Raritan (Southwick), four agree with phase No. 2, two are intermediate and two agree with phase No. 3. In a series of seven specimens from

Morristown (Thurber) two are referable to phase No. 2, two are intermediate between this phase and phase No. 3, and three agree with phase No. 3. This locality is interesting as being the last one in which phase No. 2 is typically represented.

New York.—In passing up the Hudson River Valley *quiscula* again approaches the habitat of *æneus*, and the intergradation of the two birds is at once rendered evident. Three specimens from New York City (Dwight) are phase No. 3, one from Westchester County (Fisher) is between this phase and *æneus*, one from Sing Sing (Fisher) agrees with phase No. 3, and a second specimen is intermediate towards *æneus*. Two examples from Highland Falls (Mearns) are *æneus*, while of seven specimens from Troy (A. F. Park) one is referable to phase No. 3—its known northern limit in the Hudson River Valley,—four are intermediates towards *æneus* and two are typical *æneus*.

We may conclude our analysis of specimens by following *quiscula* from the east end of Long Island northward up the Connecticut River Valley into Massachusetts.

Long Island.—The collections of Mr. Brewster, Mr. Dutcher and the American Museum furnish a series of forty-one beautifully prepared skins which were collected by Mr. W. W. Worthington at Shelter Island. This series is most instructive and clearly shows phase No. 3 of *quiscula* to be connected with true *æneus* by such finely graduated steps that it would here be impossible to draw a line between them. Phase No. 2 has now disappeared, and we have only four specimens intermediate between it and phase No. 3. Phase No. 3 here reaches the highest stage of its development and is represented by twenty-nine specimens or (with its intergrades towards *æneus*) ninety per cent. of the whole as against twenty per cent. in Chester County, Pennsylvania. Seven specimens are intermediate between phase No. 3 and *æneus*, of which there is one typical specimen taken June 16, 1886.

Connecticut.—The Long Island specimens have prepared us for what the Connecticut series unquestionably proves, that is, the complete intergradation of phase No. 3 of *quiscula* with *æneus*. Of fifteen specimens, collected by Mr. Sage at Portland, five are

TABLE SHOWING THE DISTRIBUTION OF *Quiscalus quiscula* AND ITS SEVERAL PHASES, BASED ON BREEDING MALES.

LOCALITY.	<i>Quiscalus quiscula.</i>						<i>Quiscalus aneus.</i>
	Phase No. 1 = <i>aglaus</i> .	Intermediates.	Phase No. 2.	Intermediates.	Phase No. 3.	Intermediates.	
South Florida	46	12	2				
North Florida	8	2	2				
St. Mary's, Ga.	1						
Greensboro', Ala.	2	6					1
Anniston, Ala.		1					
Coosada, Ala.	1						
New Orleans, La.	8	7	2				
St. Tammany Parish, La.							
Clinton, La.							1
Warner, Tenn.							5
Rockwood, Tenn.		1	1				
Bell, Ky.							2
Charleston, S. C.	9						
Raleigh, N. C.					1		
District of Columbia	3	6	2	4			
Sandy Spring, Md.		3			2		
Chester County, Penn.	2	11	15	13	19	1	
Carlisle, Penn.				1	1		
Dauphin County, Penn.					1		
Centre County, Penn.						1	
Williamsport, Penn.				1	1	1	
Athens, Penn.						2	
Towanda, Penn.							1
Port Jervis, N. Y.						1	1
Monmouth County, N. J.			1				
Princeton, N. J.			2	2	1		
Raritan, N. J.			1		1		
Morristown, N. J.			2	2	3		
New York City, N. Y.					3		
Westchester County, N. Y.						1	
Sing Sing, N. Y.					1	1	
Highland Falls, N. Y.							2
Troy, N. Y.					1	4	2
Shelter Island (L. I.), N. Y.				4	29	7	1
Portland, Conn.					5	5	5
East Hartford, Conn.					3	5	2
Woods Holl, Mass.					2	14	10
Taunton, Mass.					1		
Monomoy Island, Mass.						1	
Framingham, Mass.					3	2	
Quincy, Mass.						2	5
Cambridge, Mass.					1		4
Belmont, Mass.							3
Lexington, Mass.							1
Watertown, Mass.							3

referable to phase No. 3, five are intermediates between it and *æneus*, and five are typical *æneus*. Of ten specimens, collected by Mr. W. E. Treat at East Hartford, three agree with phase No. 3, five are intermediates and two are *æneus*.

Massachusetts.—Twenty-six specimens from Woods Holl (Edwards) are for the most part without date, but are evidently spring birds. They further illustrate the gradual replacement of *quiscula* by *æneus*. Only two specimens agree with phase No. 3, fourteen are intermediate between it and *æneus*, while ten specimens are true *æneus*.

Other Massachusetts specimens show that phase No. 3 of *quiscula* is occasionally found even as far north as Cambridge; beyond this, however, *quiscula* in any phase of plumage appears to be unknown, and true *æneus* is found alone. One example from Taunton (Cahoon) agrees with phase No. 3; one from Monomoy Island (Cahoon) is intermediate between this phase and *æneus*; three specimens from Framingham (Eastman) are referable to phase No. 3, while two others from the same place are intermediates towards *æneus*; two specimens from Quincy (Frazar) are intermediate between phase No. 3 and *æneus*, while five additional specimens from the same locality are typical *æneus*; one example from Cambridge agrees with phase No. 3, the known northern limit of this phase, while four other specimens from Cambridge (Brewster), three from Belmont (Brown), one from Lexington (Maynard), and three from Watertown, are all true *æneus*.

CONCLUSIONS.—We may briefly summarize this review of our Grackles as follows: (1) *Quiscalus æneus*, throughout a breeding range which extends from the Rio Grande Valley to British America and New Brunswick, varies in coloration only in that comparatively limited part of its habitat adjoining the area occupied by *Quiscalus quiscula*, with which, at least from Pennsylvania to Massachusetts, it completely intergrades. (2) *Quiscalus quiscula*, an extremely variable form, assumes three phases of coloration, the first reaches its extreme development at the southern limit of the bird's range where the third phase is unknown, while the third phase is most highly developed at the bird's northern limit, where

the first phase is unknown. The second phase connects the first and third, and is rarely found at either extreme, but is most abundant near the centre of the bird's habitat where, it is to be noted, all three phases, with their connectants, occur together. (3) The exact relationships of *quiscula* and *æneus* in the lower Mississippi Valley and northward along the Alleghanies to Pennsylvania are not at present known. (4) In the Alleghanies of Pennsylvania, in the Hudson Valley from Sing Sing to Troy, in eastern Long Island, in Connecticut, and in Massachusetts as far north as Cambridge, *quiscula* and *æneus* completely intergrade. (5) This intergradation is in every instance accomplished through phase No. 3 of *quiscula*.

Here, then, are the apparent facts of the case ; the evidence of to-day is still incomplete, the history of the past may be forever hidden by the veil of time.

It is, of course, inadvisable to theorize from insufficient data, and while I confess no satisfactory solution of the entire problem has presented itself to me, it will not be out of place to try and define its terms as they appear in the light of our present knowledge. First, is *æneus* a species? The aspect of the whole subject depends upon our reply to this question. We have proven beyond doubt that *æneus* and *quiscula* do intergrade; if now we can show their specific distinctness, it follows as a matter of course that their intergradation is due to causes other than those which produce intergradation among subspecies. If *æneus* and *quiscula* are only subspecifically separable, *quiscula* is undoubtedly an offshoot or subspecies of *æneus*. Why then, assuming this to be the case, should this form prove remarkably constant throughout an immense area, and then in a comparatively limited portion of its habitat become abruptly differentiated into three color phases, the extremes of which are as widely separated from each other as *æneus* is from either. Are there any known climatic or geographic conditions which will account for this change? To be more explicit, we find typical *æneus* is the only form which breeds at Warner, Tenn., while at Greensboro', Ala., 200 miles south, *quiscula* is the breeding form. Are there any environmental causes which will differentiate *quiscula* from *æneus* in this intervening area? If so, their action has certainly not been

MAP SHOWING THE DISTRIBUTION AND AREAS OF INTERGRADATION OF *Quiscalus cenus* AND *Q. quiscula*.

shown in the case of more susceptible species. Or, again, in the vicinity of New York *quiscula* is the common form, while in the region about Boston *æneus* is the prevailing bird. Have we among the species which breed at both localities any other instances presenting similar variation? Finally, we have seen that at certain localities *quiscula* and *æneus*, and their intergrades, occur in about equal numbers. Have we among North American birds any instance in which two subspecies are found breeding and intergrading at the same locality?

These are fair test questions, based on known facts in the history of *æneus*. If we can answer them satisfactorily in the affirmative, there is nothing unusual in the case, and *æneus* and *quiscula* simply conform to laws which obtain among undoubted subspecies. If, on the contrary, the case is without parallel, and environmental conditions will not account for the intergradation of these birds, can we do otherwise than admit their specific distinctness and explain their intergradation by hybridization?

For myself, I have no doubt that the latter view is the correct one. Certainly it explains the case in a far more satisfactory manner than do any other influences to which, so far as we know, the birds are subjected. Nor do I see any good reason why we should refuse to admit hybridization as a factor in the evolution of what we term species. There can be no question that, in spite of our test-book assertions to the contrary, we place too high a value on this word 'species.' And while we recognize the 'plasticity' of animal forms and their ready response to the influences of environment, we have been loth to admit that, so far as regular interbreeding was concerned, they are not distinct creations.

Difference in habit under what must necessarily be similar conditions will ever be an effectual barrier against the indiscriminate mixing of even closely-allied birds. But when two species whose natural economy, song, nidification, etc., are the same, and which agree in structural details and differ only in coloration, inhabit contiguous regions, is it unnatural that they should at first occasionally, and in the end regularly, interbreed? The evidence in proof of such intergradation is gradually accumulating, and in the future I think we shall be forced to recognize hybridization

not only as a means which unites known forms, but which also gives rise to new ones.

I would not be understood as advocating an appeal to this cause whenever the facts of a case are apparently not to be explained by recognized evolutionary factors. 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 is because of this too frequently unwarranted application of the hybridization theory that most ornithologists have refused to admit its now evident importance. It seems to me, however, that given sufficient data on which to base any theory of the relationships of two intergrading forms, and provided they are not so slightly differentiated that individual variation overlaps the differences which separate them, 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.

It is true that such evidence can be derived only from extensive collections and careful field observations, but until both have been made, are we warranted in advancing any explanation of the relationships of connected forms.

NOMENCLATURE.—There result from this study two nomenclatural problems which are not easy of solution. The first relates to *Quiscalus quiscula*. This name conveys no exact meaning, and unless I have examined the specimens, in no instance have the published records of this bird been of service to me.

The only way out of this difficulty, which I see, is to adopt the method we use in writing of dichromatic species and follow the bird's name by its color-phase; or, in labeling, the numerals 1, 2, or 3 may be used to designate their respective phases. I have followed this plan in determining the material used in the present connection, adding the fraction $\frac{1}{2}$ for intermediate specimens.

The second question is, shall we use a binomial or trinomial appellation for birds which intergrade by hybridizing? I would urge the former rather than the latter; first, because trinomials have been applied solely to subspecies, as we understand the term; whereas, in the case of hybridizing forms, the birds are species, and, so far as we can judge, have not been differentiated one from the other, but may be of equal age, or the offshoots of different ancestral stock; further, the intergradation is accomplished by a cause so different from that which gives rise to subspecies that the birds should not be nomenclaturally treated as such. Second, because hybridization, even on the most extended scale, differs from more or less frequent hybridization only in degree, and if we employ trinomials in the first instance there is no reason why we should not use them in every case where a complete connection between two species can be shown by a set of hybrid intermediates. In which case we should, for example, be obliged to say *Helminthophila pinus chrysoptera*!

To conclude, I have termed this paper 'A Preliminary Study,' because the available material has not been sufficient to enable me to present the subject in its entirety. The hybridization of *quiscula* and *æneus*, to my mind at least, is an established fact, but the results of this hybridization, as shown in the color-phases of *quiscula*, cannot be satisfactorily explained until we have numerous specimens from the lower Mississippi Valley northward along the Alleghanies to Pennsylvania. Indeed, specimens from any locality will be of assistance in a further study of the relationships of these birds, and I would earnestly request the loan of breeding male Grackles which I have not already examined. These may be sent to me at the American Museum of Natural History, New York City, whence they will be returned with as little delay as possible.

SOURCES AND NUMBER OF SPECIMENS EXAMINED.

American Museum of Natural History	132
J. W. Atkins, Key West, Fla.	6
H. P. Attwater, Rockport, Texas.	3
W. C. Avery, M.D., Greensboro', Ala.	19
C. Carrington Bacon, Bell, Ky.	2
William Brewster, Cambridge, Mass.	162
Cincinnati Society of Natural History, Cincinnati, Ohio.	5

Columbia College, New York City.....	40
William Dutcher, " ".....	11
J. Dwight, Jr., " ".....	13
A. K. Fisher, M.D., Washington, D. C.....	38
August Koch, Williamsport, Penn.....	8
Gustav Kohn, New Orleans, La.....	20
T. McIlwraith, Hamilton, Ont.....	2
E. A. Mearns, M.D., Fort Snelling, Minn.....	9
Austin F. Park, Troy, N. Y.....	17
J. T. Park, Warner, Tenn.....	11
Princeton College, Princeton, N. J.....	32
G. H. Ragsdale, Gainesville, Texas.....	2
W. C. Rives, M.D., New York City.....	2
George W. Roberts, West Chester, Penn.....	20
J. Rowley, Jr., New York City.....	3
J. H. Sage, Portland, Conn.....	42
George B. Sennett, New York City.....	22
United States National Museum.....	174
B. H. Warren, M.D., West Chester, Penn.....	49
A. T. Wayne, Charleston, S. C.....	1
<i>Total</i>	845