

Article IV.—BIRD REMAINS FROM THE CAVES OF PORTO RICO

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INTRODUCTION

As an outcome of a Natural History Survey of the Island of Porto Rico undertaken by the New York Academy of Sciences in coöperation with the Insular Government of Porto Rico, Mr. H. E. Anthony of The American Museum of Natural History, in June and July 1916, made extensive collections of the mammals of the island, more especially from deposits of bones found in caverns. The existing native mammalian fauna (belonging to the order Chiroptera) was enriched by remarkable species of ground sloths, insectivores, and rodents, now extinct but represented bountifully by bones preserved in cave deposits. In this rich material, now well known through publications by Mr. Anthony¹ on the subject, were encountered remains of birds embracing a considerable amount of material. I am indebted to Mr. Anthony and to the authorities of the American Museum for the privilege of studying this collection of bird bones, of especial interest to me since from December 1911 to September 1912 I was engaged in field studies of the living avifauna of Porto Rico. These bird bones came into my hands in 1919, but prolonged absence in the field in other work delayed the completion of a final report on the collection.

The species of birds included in the Porto Rican Cave fauna as covered in this collection number 42, of which 6 have been described as new, 5 from bones alone and one, a whippoorwill, discovered by its skeletal remains, named from a skin formerly considered as belonging to another species. An additional species (*Nesotrochis debooyi*) I characterized a few years ago from material secured in kitchen middens on the islands of St. Thomas and St. Croix. In all, seven extinct species of birds are covered in this report.

¹Ann. New York Acad. Sci., XXVII, Aug. 9, 1916, pp. 193-203; Bull. Amer. Mus. Nat. Hist., XXXV, Nov. 16, 1916, pp. 725-728; idem, XXXVII, Jan. 29, 1917, pp. 183-189; idem, Sept. 7, 1917, pp. 565-568; Mem. Amer. Mus. Nat. Hist., New Series, II, part 2, Oct. 12, 1918, pp. 333-435. See also J. A. Allen in Ann. New York Acad. Sci., XXVII, Jan. 25, 1916, pp. 17-22.

OCCURRENCE OF BONE DEPOSITS

From Mr. Anthony's account¹ the following quotation will indicate the conditions under which the deposits containing bones of birds were found.

The fossil remains were encountered at depths of a few inches from the top down to as deep as nine feet. Often but little scraping was necessary to uncover bones although in this connection it is necessary to state that the natives of the island are in the habit of digging out the bat guano from the caves and frequently take the earth from the floor of the caves as fertilizer. Thus the height of the earth in any cave may not always be considered with certainty as the maximum depth of the deposit. However the height of the original deposit is generally betrayed by a discolored ring around the walls of the cave. . . . As a general rule the specimens were found in dry caves in the limestone in the mountainous part of the island. Caves up on the sides of small hills yielded the most bones and the size of the cave was immaterial. . . . The Cueva Catedral near Morovis . . . occupies the top of a small hill and the ceiling of the cave has fallen through letting in considerable light. This cave has two large entrances and is a large open chamber filled to a depth of several feet with earth and many fallen fragments of limestone. At one side there is a deep deposit of fine powdery soil, almost pure bat guano in spots, sloping rather steeply down from the back wall of the cave. . . . Throughout a stratum of several inches to a foot or more in thickness this deposit was literally packed with small bones of mammals, birds, reptiles and amphibians. In some spots the bones were interlaced almost in hundreds and a quart of earth required some minutes to pick over. In the crevices between the larger blocks of limestone and in the irregularities in the cave floor were especially rich pockets of those bones.

A small number of bones of birds were secured from what is known as the Toraño Cave near Utuado (covered by collecting numbers 2, 3, and 4). Near the Hacienda Jobo, also in the vicinity of Utuado, birds were collected in one large cavern and two smaller caves near by (collecting numbers 5, 5.2, 5.3). Specimens of birds from this region, however, were relatively few. The bulk of the collection was taken in Cueva Catedral (collecting number 8), with considerable material from Cueva Clara (No. 7) and a less amount from Cueva San Miguel (No. 6), all located near the town of Morovís. Both of the regions where collections were made lie on the northern, more humid, side of the mountain range that passes east and west through the island. Utuado and the surrounding region are in the drainage of the Rio Grande de Arecibo and occupy a well-forested tract of somewhat broken hills. Morovís, on a branch of the Rio Ciales, lies in somewhat similar country but in a region that is rougher and more broken. Study of the present avifauna and of historical accounts written after the discovery of Porto Rico indicate

¹'Indigenous Land Mammals of Porto Rico,' Mem. Amer. Mus. Nat. Hist., New series, II, part 2, Oct. 12, 1918, pp. 338-339.

that most of the northern slopes of the island were heavily forested, with openings confined to small glades save where open savannas marked marshy localities on the coastal plain. In the northwest near Quebradillas there is a more arid open section, as the northeast trades cross the island in that region without being deprived of their moisture through elevation along mountain slopes. The cavern deposits, however, come from the humid, forested region and represent the ancient avifauna of that section.

FORMATION AND AGE

An examination of the species represented in the cavern collections shows that most of them were of small size; in fact, bones of birds larger than a thrush or blackbird are comparatively few in number. It is evident that the great mass of these small bones have come from pellets or casts of owls. The formation of owl pellets is a process well known to naturalists. The birds forage for prey, which, in case of warm blooded vertebrates, is swallowed in lumps with bones and a large part of the feathers or fur that form the bodily covering. When all nutritive matter has been absorbed the remaining indigestible portions are cast up or regurgitated in the form of pellets containing the bones encased in masses of feathers and fur. These collect in considerable amounts about favorite roosts of owls. During years past, in studying the food of owls, I have examined several thousand such pellets for the purpose of identifying the species of vertebrates represented by bones therein. Considerable familiarity with the degree of preservation of such material enables me to say without hesitation that the small-bone deposits in the Porto Rican caves have come largely, if not entirely, from such a source.

At the present time there is found in Porto Rico the naked-footed owl, *Gymnasio nudipes nudipes* (Daudin), a species that preys to some extent on birds and that is partial to caverns. As numerous remains of this owl were found with the other bones, there can be no question but that it was instrumental in bringing in a considerable proportion of the small-vertebrate debris. The discovery of remains of the Porto Rican barn owl, *Tyto cavatica* Wetmore, adds another to aid in this work, as barn owls are noted as frequenters of caverns. The short-eared owl, *Asio portoricensis* Ridgway, though reported by natives to dwell in caves, must have been confused with the barn owl, as short-eared owls universally are inhabitants of grassy savannas. Bones of birds too large to have been carried in by owls, found in small numbers, may have reached resting places with the other material as the prey of man or through accident.

The fact that these bones have been deposited in casts from owls renders the question of their probable age a difficult one. With all tendinous attachments dissolved away by digestive action, absence of tendon ends or fatty matter in the bone is of no value as a criterion of antiquity. Bones that survive the vigor of strigine digestive juices are durable, as I have observed on many occasions, and, unless covered with limelike excrement and so subject to the corrosive action of the acid present in the renal excreta, show no tendency to rapid decay. The cave deposits under discussion yield bones varying from a few that are still white and obviously modern to others stained dark brown, perhaps from a leach from overlying deposits of bat guano. The majority are dull buff in color and frequently are very brittle. On first consideration I was inclined to place the age of the bulk of this material at from one hundred to one thousand years. On reconsideration I believe that some of the remains, especially when found under breccia, may range back for two thousand years or even for a considerably longer period. Under the accounts of some of the species of birds at present extinct I have included notes that indicate their existence within historic times. At Cayey and again at Mameyes I heard of an animal, described as light in color and without a tail, that had disappeared during the boyhood of the grandfathers of the old men telling the tales. In the light of later discoveries this may indicate that *Isolobodon portoricensis* Allen, an agouti-like animal, existed still at the close of the eighteenth century.

THE CAVERN AVIFAUNAS

CUEVA CATEDRAL

From the Cathedral Cave remains of 35 species of birds were identified, all of small or moderate size, as shown in the following tabulation.

LIST OF SPECIES FROM CUEVA CATEDRAL

| | |
|---------------------------------|-------------------------------|
| <i>Cerchneis sparveria</i> | <i>Setochalcis noctithera</i> |
| <i>Accipiter striatus</i> | <i>Tyrannus dominicensis</i> |
| <i>Gallinago anthonyi</i> | <i>Tolmarchus taylori</i> |
| <i>Oreopeleia montana</i> | <i>Myiarchus antillarum</i> |
| <i>Oreopeleia larva</i> | <i>Blacicus blancoi</i> |
| <i>Chamepelia passerina</i> | <i>Petrochelidon fulva</i> |
| <i>Zenaida zenaida</i> | <i>Margarops fuscatus</i> |
| <i>Patagiænas leucocephala</i> | <i>Mimus polyglottos</i> |
| <i>Patagiænas squamosa</i> | <i>Mimocichla ardosiacea</i> |
| <i>Chlorænas inornata</i> | <i>Vireosylva calidris</i> |
| <i>Saurothera vieilloti</i> | <i>Dendroica adelaidæ</i> |
| <i>Melanerpes portoricensis</i> | <i>Dendroica coronata</i> |
| <i>Gymnasio nudipes</i> | <i>Mniotilta varia</i> |

| | |
|----------------------------------|---------------------------------|
| <i>Cæreba portoricensis</i> | <i>Nesospingus speculiferus</i> |
| <i>Agelaius xanthomus</i> | <i>Spindalis portoricensis</i> |
| <i>Icterus portoricensis</i> | <i>Loxigilla portoricensis</i> |
| <i>Holquiscalus brachypterus</i> | <i>Tiaris olivacea</i> |

Pigeons were common and were represented by seven species, including the extinct *Oreopeleia larva*. With these were considerable numbers of bones of the Porto Rican woodpecker (*Melanerpes portoricensis*), of four flycatchers, a swallow, a thrasher, a mockingbird, and a thrush, with three blackbirds, two tanagers (one of these, *Nesospingus speculiferus*, in great abundance), two finches, a vireo, a honey creeper, and three wood warblers. Two of the latter, the black and white warbler (*Mniotilta varia*) and myrtle warbler (*Dendroica coronata*) are migrant (at least in modern times) from the North American Continent. The largest birds in this collection are large pigeons, and the sparrow hawk and Antillean sharp-shinned hawk.

CUEVA CLARA

The fauna from Cueva Clara, while less varied, still numbered 27 species of birds, including several not encountered in Cathedral Cave, as is shown by the following enumeration.

LIST OF SPECIES FROM CUEVA CLARA

| | |
|--------------------------------|---------------------------------|
| <i>Dendrocygna arborea</i> | <i>Melanerpes portoricensis</i> |
| <i>Gallus gallus</i> | <i>Gymnasio nudipes</i> |
| <i>Nesotrochis debooyi</i> | <i>Selochalcis noctithera</i> |
| <i>Porzana flaviventris</i> | <i>Tyrannus dominicensis</i> |
| <i>Gallinago anthonyi</i> | <i>Tolmarchus taylori</i> |
| <i>Oreopeleia montana</i> | <i>Margarops fuscatus</i> |
| <i>Oreopeleia larva</i> | <i>Mimus polyglottos</i> |
| <i>Chæmpelia portoricensis</i> | <i>Mimocichla ardosiacea</i> |
| <i>Zenaida zenaida</i> | <i>Agelaius xanthomus</i> |
| <i>Patagianas leucocephala</i> | <i>Icterus portoricensis</i> |
| <i>Patagianas squamosa</i> | <i>Nesospingus speculiferus</i> |
| <i>Chloranas inornata</i> | <i>Spindalis portoricensis</i> |
| <i>Saurothera vieilloti</i> | <i>Coturniculus savannarum</i> |

Parts of a tree-duck and remains of the large extinct rail (*Nesotrochis*) may indicate that this cavern was the resort at times of Indians, while a few bones of the domestic fowl suggest more modern visitors. Seven species of pigeons are noted. From bones of the yellow-shouldered blackbird (*Agelaius xanthomus*) and grasshopper sparrow (*Coturniculus savannarum*) we may conjecture that open savannas were found near at hand. Other species offer little worthy of comment save the presence of the yellow-bellied rail, the snipe (*Gallinago anthonyi*), and remains of the naked-footed owl, probably the marauder responsible for

the other small-bird remains. The whippoorwill (*Setochalcis noctithera*) is represented in this cavern as in the Cathedral Cave.

CUEVA SAN MIGUEL

The San Miguel Cave in this same region has a smaller fauna, as it included only five species.

LIST OF SPECIES FROM CUEVA SAN MIGUEL

| | |
|----------------------------|-------------------------------|
| <i>Nesotrochis debooyi</i> | <i>Mimocichla ardosiaacea</i> |
| <i>Chlorænas inornata</i> | <i>Corvus pumilis</i> |
| <i>Gymnasio nudipes</i> | |

These belong to diverse groups and include as the most interesting species the small crow (*Corvus pumilis*) that is today extinct. The large extinct rail, the plain pigeon, the naked-footed owl, and the Porto Rican thrush conclude the tale of species for this locality.

Of the 42 species of birds identified from the entire collection 40 come from these three caves near Morovís so that these give a fair idea of the avifauna at a time before the region had been markedly changed by the invasion of the Caucasian race.

CUEVA TORAÑO

The Toraño Cave, with a representation of eight forms of birds, offers the largest array of avian species of the caverns investigated in the Utuado district.

LIST OF SPECIES FROM CUEVA TORAÑO

| | |
|-----------------------------|-------------------------------|
| <i>Dendrocygna arborea</i> | <i>Oreopeleia larva</i> |
| <i>Polyborus latebrosus</i> | <i>Tyto cavatica</i> |
| <i>Nesotrochis debooyi</i> | <i>Gymnasio nudipes</i> |
| <i>Oreopeleia montana</i> | <i>Mimocichla ardosiaacea</i> |

Among these may be noted a tree-duck and a few fragments of a Caracara (*Polyborus latebrosus*). The extinct rail and two pigeons occur here also, together with the extinct Porto Rican barn owl, the naked-footed owl, and the Porto Rican thrush. The birds found are of moderate to large size and are poorly represented.

CAVES ON THE HACIENDA JOBO

The three caverns investigated on the Hacienda Jobo yielded in all only three species.

LIST OF SPECIES FROM HACIENDA JOBO

| Cave No. 1 | Cave No. 2 |
|----------------------------|---------------------------|
| <i>Chlorænas inornata</i> | <i>Chlorænas inornata</i> |
| Cave No. 3 | |
| <i>Cerchneis sparveria</i> | |
| <i>Nesotrochis debooyi</i> | |

In two instances the plain pigeon was the only species discovered; in the remaining cave were fragments of the sparrow hawk and of the large land rail.

The total fauna from the Utuado region comprises only 11 species, a poor showing in comparison with the findings from the three caverns near Morovís. Indications are that conditions in the Utuado region were less favorable for the preservation of small fragile bones.

The entire cave avifauna adds six species, all extinct, to the known list of Porto Rican birds and is responsible for the discovery of a seventh form, the whippoorwill.

ANNOTATED LIST OF SPECIES

ANATIDÆ

1. *Dendrocygna arborea* (Linnæus)

The West Indian tree-duck is represented in the present collection by the proximal end of a right ulna taken from the cave on the property of Don Gervacio Toraño near Utuado, and by fragments of a skull found in Cueva Clara near Morovís. The latter shows some sign of having been subjected to fire. In it the attachment of the sub-orbital bar is evident at the lower end of the post-orbital process, though the bar itself, diagnostic of the skull in the genus *Dendrocygna*, has been lost. No peculiarity is evident in these specimens. The species occurs at the present time in small numbers in Porto Rico.

FALCONIDÆ

2. *Cerchneis sparveria* (Linnæus)

In Cueva Catedral the sparrow hawk was represented by right and left humeri, and a right metacarpus from a somewhat immature bird, while from cave No. 2 at the Hacienda Jobo near Utuado comes an ulna. Modern sparrow hawks from Porto Rico, common residents on the island, belong to the subspecies *loquacula*, described by Mr. J. H. Riley.¹

BUTEONIDÆ

3. *Polyborus latebrosus* Wetmore

The type of the Porto Rican caracara is a fragmentary right metacarpus (Fig. 1), discovered together with the proximal end of a right ulna in a cave on the property of Don Gervacio Toraño near Utuado. The original description² of this species was as follows.

¹Smiths. Misc. Coll., Quart. Iss., XLVII, part 2, Nov. 8, 1904, p. 284.

²Proc. Biol. Soc. Washington, XXXIII, Dec. 30, 1920, pp. 77-78.



Fig. 1. *Polyborus latebrosus*.

Proximal end of right metacarpus (type), anterior view, natural size. From Cueva Toraño.

CHARACTERS.—Metacarpus similar to that of *Polyborus cheriway* (Jacquin)¹ but slightly larger; first metacarpal proportionately higher, more massive especially at the base (when viewed from behind), and with less inward flexure at the tip (Fig. 2); proximal end of third metacarpal with surface slightly excavated to form a concavity; excavation anterior to pisiform process more distinctly delimited; inner margin of condyle raised in a distinct crest.

DESCRIPTION.—Type, Cat. No. 4921, Dept. Vert. Pal., American Museum Nat. Hist., proximal end of right metacarpus, from cave on the property of Don Gervacio Toraño, near Utuado, Porto Rico, collected July 2, 1916, by H. E. Anthony.

Metacarpus with first metacarpal strong and massive especially at the base; head produced and slightly enlarged at extremity, showing a very slight inward flexure; articular surface for pollex broadened, supported by a basal buttress; a slight notch posteriorly at base marking junction with second metacarpal; two minute foramina on either side at base; a shallow anterior carpal fossa on posterior face; outline of carpal articulation viewed from inner side forming part of an ellipse with axis vertical, the posterior margin forming one side of the ellipse; upper margin here produced in a distinct ridge; posterior carpal fossa slight; pisiform process low; internal ligamentous fossa deeply impressed; a distinct elongate fossa on inner surface anterior to pisiform process, sharply marked by inner extension of margin of third metacarpal as a distinct ridge; base of second metacarpal strong and heavy; lower surface of third metacarpal distinctly excavated so that it is concave.

MEASUREMENTS.—(Of type). Extreme height (through crest of first metacarpal) 16 mm.; length of first metacarpal 9.2 mm.; diameter of base of first metacarpal (behind expansion for pollex) 2.5 mm.

RANGE.—Known only from cave on the property of Don Gervacio Toraño near Utuado, Porto Rico. (Extinct.)

The discovery of the extinct Porto Rican caracara marks a considerable extension of range for the genus *Polyborus* in the West Indies. Its nearest neighbor, the familiar *Polyborus cheriway*, is found now in Cuba and the Isle of Pines and on the south occurs in Trinidad and some of the small, arid islands off the coast of Venezuela. The fragments representing *P. latebrosus*, while small, are so distinctive that there has been no hesitation in assigning to them a specific name, though the portion of an ulna mentioned is of little value in comparison, as it indicates only that *latebrosus* was larger than *P. cheriway* (Jacquin) and smaller than *P. plancus* Miller.



Fig. 2. *Polyborus latebrosus*.

Right metacarpus (type). View of face of proximal articulation, slightly larger than natural size. From Cueva Toraño.

¹Compared with specimens of *P. cheriway* from Florida.

From *Polyborus plancus* Miller (represented by skeletons from Patagonia) the metacarpus of *latebrosus* differs in having the first metacarpal (when viewed from behind) more slender, especially at the base, the crest on the inner margin of the condyle stronger, the notch at the outer margin of the proximal condyle lower so that it is found at the line of ankylosis of the first and second metacarpals instead of above that point, and the lower surface of the third metacarpal more excavated at the base. In general, it may be said that *P. latebrosus* appears to stand in an intermediate position between *P. cheriway* and *P. plancus*, but that it is distinct from either. It may be noted that it shows no particular affinity with *P. lutosus* Ridgway from Guadeloupe Island off the coast of Lower California, a skeleton of which is available for comparison.

The skeletal material of *P. cheriway* used in the present studies comes from Florida. Skins of this species from Brazil and Venezuela that I have examined show that caracaras from that region are smaller and have weaker bills than those from North America, as has been pointed out by Outram Bangs and G. K. Noble.¹ These authors separate the larger North American bird from *Polyborus cheriway cheriway* (Jacquin) of northern South America as *Polyborus cheriway auduboni* Cassin. As the remains of *Polyborus latebrosus* from Porto Rico are larger even than those of *P. c. auduboni* from Florida (the type locality of Cassin's bird), there is no reason to suppose that the differences ascribed to *latebrosus* are those characterizing caracaras of the typical subspecies *cheriway* from South America.

After careful study of skeletons of *Polyborus cheriway*, *plancus*, and *lutosus*, and *Ibycter ater*, I have no hesitation in placing *latebrosus* in the genus *Polyborus*, although we may perhaps expect to find remains of carrion hawks of the genus *Ibycter* in the West Indies. The differences existing in the metacarpus in these two groups as shown in the material at hand may be summarized as follows.

- a. Outline of inner margin of condyle distinctly oval; tubercle on outer margin longer, less elevated; a distinctly excavated pit above pisiform process... *Ibycter*.
- aa. Outline of inner margin of condyle more angular, more rounded than oval; tubercle on inner margin shorter, more elevated; pit above pisiform process absent or only slightly impressed..... *Polyborus*.

It is to be hoped that further remains of *Polyborus latebrosus* may come to light. These should be encountered in the drier, more open areas of the southern side of Porto Rico, or in the slightly arid stretches near Quebradillas, regions well suited to the needs of these carrion hawks,

¹Auk, XXXV, 1918, p. 443.

which would hardly have found a congenial environment in the heavy rain forests that in former years covered much of the northern part of the island.

4. *Accipiter striatus* Vieillot

Remains of the Antillean sharp-shinned hawk were found in Cueva Catedral, where a broken right humerus and a left tibio-tarsus, nearly complete, were collected. These bones may be attributed to the well-marked subspecies *Accipiter striatus venator* Wetmore,¹ the form of this small, bird-eating hawk found on Porto Rico. In identification comparison has been made with skeletons of *A. s. striatus* from Santo Domingo. The bones from Cueva Catedral are small in size and in all probability represent a male individual. As in some of the Santo Domingan specimens examined, the humerus from Porto Rico has the lower margin of the crista inferior produced until it forms an abrupt right angle with the margin of the shaft. In general outline, appearance, and size, the humerus is closely similar to that of *Cerchneis sparveria* (family Falconidæ) but may be told at a glance by the position of the nutrient foramen. In *Accipiter* this opening lies immediately below the head of the bone opposite the lower part of the crista superior. In *Cerchneis* the foramen is on the shaft of the bone below its center.

The Porto Rican sharp-shinned hawk has been known until now only from the type specimen, secured near Maricao, and from two other individuals observed but not collected in this same locality. These bones from near Morovís are, therefore, important in giving an additional locality from which this bird has been recorded.

PHASIANIDÆ

5. *Gallus gallus* (Linnaeus)

A right coracoid, obviously fresh in appearance, from Cueva Clara near Morovís comes from a medium-sized domestic fowl. At first glance this bone suggests the guinea fowl, which is said to have been introduced into Porto Rico through the agency of Genoese slave-ships. The bone in question, however, has a large pneumatic foramen near the lower end (on the inner dorsal surface) as in the genus *Gallus*, while the coracoid in the Numididæ (judging from specimens of *Numida meleagris* and *Agelastes meleagrides*) is non-pneumatic and has no such foramen.

¹Proc. Biol. Soc. Washington, XXVII, July 10, 1914, p. 119:

RALLIDÆ**6. *Porzana flaviventris* (Boddaert)**

A right femur was secured in Cueva Clara near Morovís. This bone, slender and delicate in form, is typically ralline in configuration and proportions, and may be recognized at a glance as from a member of that group. It is similar to the femur in a yellow-bellied rail collected in Haiti by Dr. P. Bartsch (U. S. Nat. Mus. No. 225936). The femur from Cueva Clara differs only in slightly greater length, as it measures 26 mm., while the modern specimen from Haiti is only 23.5 mm. long.

The proportionate length of tarsus and femur in small rails is of some interest. In a specimen of *Creciscus cinereiceps* Ridgway (U. S. Nat. Mus. No. 19163) the tarsus measures 31.5 mm. and the femur 32 mm. In a skeleton (coll. A. W., No. 285) of *Porzana carolina* (Linnæus) the tarsus measures 33 mm., the femur 36 mm. Tarsi in four skins of *P. flaviventris* from Cuba, Jamaica, and Porto Rico vary from 22.5 mm. to 24.5 mm. The relative proportions of the two bones in these species is seen to be more or less constant, the femur being slightly longer than the tarso-metatarsus.

In modern times the yellow-bellied rail has been recorded in Porto Rico only from the coastal plain, at the Laguna de Guanica, along the Rio Arcibo, and near Bayamon. The femur from near Morovís represents apparently the highest point from which the species has been known.

7. *Nesotrochis debooyi* Wetmore

This large ralline species described originally¹ from bones secured in kitchen middens on islands of St. Thomas and St. Croix was found in four localities as follows.

Cueva Clara, one entire left femur, distal end of another from the right side; lower end of a right tibio-tarsus; and part of a sacrum.

Cueva San Miguel, one entire left tibio-tarsus and part of another; and a left humerus.

Cave "5.3," one left tibio-tarsus.

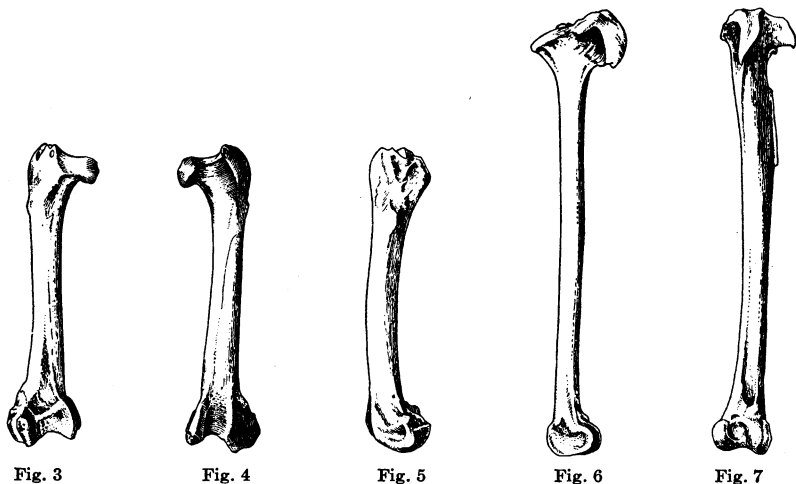
Toraño Cave, July 1, 1916, a left humerus and the lower end of a metatarsus.

These specimens mark a considerable extension of range for this bird, and also afford a further insight into its osteology as it was described originally from femora and tibio-tarsi alone. The material at hand from different islands, so far as may be seen, apparently all belongs to one species as, although considerable variation in size is apparent, this seems

¹Proc. U. S. Nat. Mus., LIV, 1918, p. 516.

individual (perhaps connected with sex) and may not be correlated at present with any one of the three geographic areas from which the bird is now known.

The femora from Porto Rico are much more robust than the femur from St. Thomas selected as type in the original description of the species. The specimen that is entire has the following measurements (measurements of type given in parentheses for comparison): Length, 81 mm. (76.5); transverse diameter through center of head, 19.5 mm. (17); transverse diameter through medullary foramen, 8 mm. (7.5); intercondylar diameter, 18.5 mm. (16.6¹). The configuration of the bone (Figs. 3, 4, and 5) is the same as in the type save that in the Porto Rican specimens the processes are more heavily sculptured.



Nesotrochis debooyi

- Fig. 3. Posterior view of left femur, one-half natural size. From Cueva Clara.
 Fig. 4. Anterior view of left femur, one-half natural size. From Cueva Clara.
 Fig. 5. External view of left femur, one-half natural size. From Cueva Clara.
 Fig. 6. Internal view of left tibio-tarsus, slightly less than one-half natural size. From Cueva San Miguel.
 Fig. 7. Anterior view of left tibio-tarsus, slightly less than one-half natural size. From Cueva San Miguel.

Measurements of the two entire tibio-tarsi from Porto Rico are as follows: Length, 114 mm., 120.5 mm.; breadth through lower end of peroneal ridge, 9.5 mm., 9 mm.; greatest breadth through condyles, 13.7 mm., 12 mm.²; length of articular face of peroneal ridge, 20.5 mm., 20 mm.²

¹Not exact owing to imperfection in specimen.

²Not exact because of wear.

At first glance the tibio-tarsi (Figs. 6 and 7) from Porto Rico seem stronger than those from St. Thomas, the type locality of *debooyi*. A broken bone from St. Thomas, however, indicates a specimen as heavy as those from Porto Rico, while the series from St. Croix all average almost as large as the Porto Rican bones. At present, therefore, I am inclined to consider these remains as indicative only of individual variation in a single species.

A left tibio-tarsus from cave 5.3 shows evidence of scraping near the upper end of the shaft, apparently through human agency. The flattened space that has been ground off is cut so deeply that it has formed an irregular oblong opening into the inner canal.

The bit of a tarso-metatarsus, fragmentary and badly worn though it is, offers more of interest as it is a portion of the skeleton hitherto unknown. The distal third of the bone remains, with the two lateral trochleæ broken away, leaving only the trochlea for the third toe in place. The lower end of the tarsus was compressed and flattened, with a large foramen below the groove between second and third trochleæ. In form it resembles the tarso-metatarsus of *Aramides ypecaha* but is broader and has the base supporting the laterally placed fourth trochlea long, sloping more gradually into the shaft of the bone. The remaining trochlea is slightly stronger than in an adult female of *ypecaha*.

The fragment of a pelvis from Cueva Clara consists merely of the anterior half of the sacrum from which the ilia have been broken away. The bone agrees in form with that in *Aramides ypecaha* but is heavier, indicating that the pelvic region, in keeping with the strongly muscled legs of the bird, was larger and more strongly built. The fragment shows a part of the free anterior articular surface, and on the left side has a trace of the ilium still adherent to it. The lateral processes indicate five fused vertebræ, the last of which has been nearly broken away. The lower surface of the bone near its center is very slightly excavated as in *Aramides*. In *Gallirallus australis* the lower surface of this bone is distinctly ridged through the center so that the ventral excavation is double.

The humeri (Figs. 8 and 9) are among the most interesting finds in these deposits as they give further clue to the affinities of this strange species. The bone is slender, strongly curved, with the shaft more or less cylindrical and with little flattening. The caput humeri is set at a very oblique angle with the shaft, showing a slight articular surface remarkable for being broadened posteriorly and narrowed anteriorly, instead of the reverse as is usually the case. The tuberculum externum is slightly

produced. The incisura capitis is a broad groove with nearly perpendicular walls and a slightly hollowed floor, notable for its backward extension on the outer side due to the posterior expansion of the caput humeri. The notch in the humeral head at the anterior end of the sulcus is slight. The internal tuberculum, present only in one specimen, is strong, with the inferior crest reduced to a small tubercle. The depression marking the fossa subtrochanterica is very slight and is impressed mainly in the side

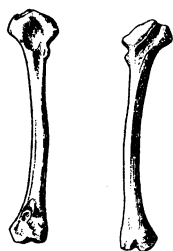


Fig. 8

Fig. 9

Nesotrochis debooyi

Fig. 8. Anterior view of left humerus, one-half natural size. From Cueva San Miguel.

Fig. 9. Posterior view of left humerus, one-half natural size. From Cueva San Miguel.

of the internal tubercle, with no lateral or posterior continuation owing to the reduction of the inferior crest. There is no pneumatic foramen. The crista superior is slight and weak, more reduced than in *Gallirallus*. Its outer external margin is distinctly concave instead of convex, and the crest sinks into the shaft at once. The articular surface for the pectoral tendon is reduced to a small area barely larger than that marking the attachment for the supracoracoidal muscle. The latter, due to the restriction of the pectoral facet stands out prominently. The shaft of the bone below the head is triangular in cross-section to near the center, where it becomes rudely terete. Above the distal extremity it is compressed as is usual. The ridge for the attachment of the latissimus dorsi is well marked.

The usual opening for the nutrient foramen on the inner side is indicated by an imperforate pit, located nearer the center of the shaft than is usual in rails. There is a small canal near the lower end of the subtrochanteric fossa. The ectepicondylar process is stronger than ordinary in rails, and the shaft of the bone is less flattened at this point than usual. The radial trochlea, though well developed, has the sulcus for the anconeus lateralis deep, forming a furrow with raised outer margin extending over the inner and dorsal surfaces to the end of the process. The ulnar trochlea is comparatively slight, with the entepicondylar process strong and heavy in proportion. The popliteal depression is broad and flattened, but is only slightly impressed. The entire humerus, while similar in type to that of *Aramides*, has the small muscle attachments and weakened configuration found in *Gallirallus*.

In the original description of *Nesotrochis debooyi*, based on leg bones alone, comparison was made mainly with *Aramides cayanae*. Note was made of the resemblance of the new species to the weka rail, *Gallirallus australis*, a resemblance due mainly to the strong robust development of

the lower limb in *Nesotrochis*. In the present review I have available a complete skeleton of *Aramides ypecaha* (female) that I collected at Lazcano in eastern Uruguay on February 7, 1921. It is readily apparent that *Nesotrochis*, though distinct from the wood-rails, is allied to them. When compared with *A. ypecaha*, the largest species in the genus, bones of the lower limb are similar in general form but are heavier and have all processes much more strongly developed. After careful study I consider *Nesotrochis* as a highly specialized offshoot from the primitive stock that has produced *Aramides* and closely allied (but not ancestral) to that group of species. If we consider *Aramides* as of South American origin, as seems logical at present, then *Nesotrochis* may be considered as another of the interesting remnants of the ancient West Indian fauna that has been derived from South America. Study of the wing bones indicates that the species was flightless, a defect that may have led to its extermination, as the bird, judging from the occurrence of bones in kitchen middens, was used as food by the aborigines. In Porto Rico I heard frequently of the hunting in former times of the *Carao* or limpkin (*Aramus vociferus*) by natives, who, during the early morning hours, followed this bird on foot, with aid of dogs, through dew drenched vegetation until, its feathers thoroughly soaked so that it could not fly, the quarry was tired out and captured alive. One may wonder whether part, if not all, of these hunting tales may not have related to the taking of the flightless wood-rail *Nesotrochis*, rather than to the strong-winged limpkin, a species that takes to wing at the slightest alarm.

SCOLOPACIDÆ

8. *Gallinago anthonyi* Wetmore

This snipe was noted first in remains from Cueva Catedral, where a right humerus (type), a left humerus, a left metacarpal, a right coracoid, two right and one left tarso-metatarsi, and the distal portions of one right and one left tibio-tarsus were found. In the remains from Cueva Clara the species was represented by a left humerus. This material is sufficient to give a fair idea of the limb bones of this bird.

The original description of *Gallinago anthonyi*¹ was as follows.

CHARACTERS.—Humerus (Figs. 10, type, and 11) similar to that of *Gallinago delicata* (Ord), but distinctly larger and longer; ectepicondylar process shorter; crista superior relatively smaller.

¹Proc. Biol. Soc. Washington, XXXIII, December 30, 1920, p. 78.

DESCRIPTION.—Type, Cat. No. 4922, Dept. Vert. Pal., American Museum Nat. Hist., right humerus, from Cueva Catedral, near Morovis, Porto Rico, collected in July, 1916, by H. E. Anthony.

Humerus with head comparatively broad, crista superior relatively low and slightly developed, projecting outward nearly at right angles to shaft, with the projecting margin strongly rounded in outline; fossa subtrochanterica rather shallow; no pneumatic foramen; nutrient foramen situated well above middle of bone 17 mm.

from extremity of caput humeri; shaft comparatively strong, much flattened and broadened toward distal end; base of ectepicondylar process low, summit distant 5.6 mm. from extremity of radial condyle (tip of process broken away); depression for brachialis inferior broad and well marked; ulnar condyle elongate.

MEASUREMENTS.—(Of type). Total length, 43.4 mm.; greatest breadth of head 10.7 mm.; lateral diameter of shaft at center 3.4 mm.; intercondylar breadth, 7 mm.

RANGE.—Known from Cueva Catedral and Cueva Clara, near Morovis, Porto Rico. (Extinct.)

When compared with *Gallinago delicata* (Ord), which may be taken as representative of the ordinary snipes of the genus, the humerus in *anthonyi* is longer and larger, the ectepicondylar process is proportionately shorter, the distal end of the bone relatively broader, and the crista superior relatively smaller. The same distinctions hold for *G. paraguayæ* and *braziliensis*.

The humerus from Cueva Clara (Fig. 11) is

distinctly larger than the type (Fig. 10) and has the following dimensions: Total length, 44.3 mm.; greatest breadth of head, 11.5 mm.; lateral diameter at center of shaft, 3.6 mm.; intercondylar breadth, 8.2 mm. The condyles of the type are somewhat worn, so that the intercondylar breadth was originally more than the dimension given for that specimen. The second humerus from Cueva Catedral is so near in size to the one from Cueva Clara that there is no need to detail its measurements.

The coracoid assigned to *anthonyi* is broad and strong, with prominent lines indicated for muscle attachment. It is similar to the coracoid of the other snipes available (the species enumerated in the paragraph above) but is longer, stronger, and heavier. There is a deep excavation on the external posterior face of the acrocoracoid, and the glenoid facet is elongate and strong. A strong, hooklike projection arising from the

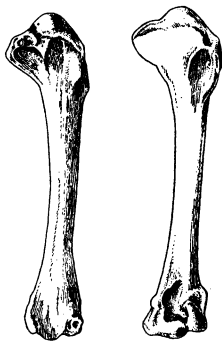


Fig. 10

Fig. 11

Gallinago anthonyi

Fig. 10. Posterior view of right humerus (type), about natural size. From Cueva Catedral.

Fig. 11. Anterior view of left humerus, about natural size. From Cueva Clara.



Fig. 12. *Gallinago anthonyi*.
Anterior view of left metacarpus, natural size. From Cueva Catedral.

acrocoracoid evidently met the furculum. The procoracoid is produced upward. The lateral process or wing has been broken away. The bone indicates a bird of strong robust body. The total length of the bone (acrocoracoid to center of articular facet) is 23 mm.

The metacarpal (Fig. 12) is stronger and heavier than in *G. delicata* and the other species available, though the general configuration is similar. The second and third metacarpals are much heavier throughout, particularly the latter, which is much broader when viewed from below. The external groove is relatively wider and more heavily defined. The specimen measures as follows: Total length, 27.6 mm.; height through first metacarpal, 7.3 mm.; height through center, 5.1 mm.

The two tibio-tarsi are worn to such an extent that they offer little that is worthy of comment save to note that they average greater in size than *G. delicata* and the other species with which comparison is made. Both bones have the heads missing but in one a part of the peroneal ridge is present. The shafts are slender, yet strong. The condylar ends articulate perfectly with the heads of the tarso-metatarsi that are next described. These tibio-tarsi offer no measurements of value because of their worn and broken condition.

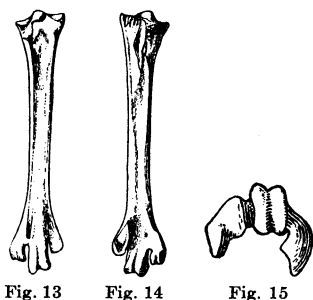


Fig. 13

Fig. 14

Fig. 15

Gallinago anthonyi

Fig. 13. Anterior view of right tarso-metatarsus, natural size. From Cueva Catedral.

Fig. 14. Posterior view of right tarso-metatarsus, natural size. From Cueva Catedral.

Fig. 15. Distal outline of trochlea of right tarso-metatarsus, twice natural size. From Cueva Catedral.

The three tarso-metatarsi of *Gallinago anthonyi* are of a type to be expected from study of the bones that have been mentioned previously. In conformation (Figs.

13, 14, and 15) they suggest the tarso-metatarsus of other snipe, more especially *Gallinago braziliensis* but, while bones of the two species are similar in length, those of *anthonyi* are heavier and more robust. The inner trochlea is broader and heavier in proportion to those supporting the middle and outer toes, and the talon has a deeper excavation on the inner side. The shaft is strong and broad throughout; otherwise the bone offers no peculiarities. Measurements of the two nearly perfect bones are as follows: Total length, 34.8, 35.6 mm.; smallest transverse diameter of shaft, 2.8, 2.8 mm.; breadth of head, 5.9, 6.4 mm.; breadth across trochleæ, 6.6, 7 mm.; (depth through talon indeterminate). It will be noted that one specimen is slightly larger than the other, a difference due perhaps to sex.

The presence of remains of a snipe distinctly larger than the Wilson's snipe (that occurs in Porto Rico in fair numbers during winter) is one of the most interesting finds in the present collection. Though a part of the bones representing it are old and stained, others are light and rather fresh in appearance and do not appear to have great age. The relationships of *Gallinago anthonyi* to some of the larger South American snipes is at present uncertain through lack of comparative material. It is possible that the present species may have some affinity with the peculiar group of species of comparatively restricted range termed the "semi-woodcocks" by Seebohm, so-called because they seem to combine the characters of snipes and woodcocks. Of these the giant snipe (*Gallinago undulata*), a species of truly enormous size as it is almost as large as a ruffed grouse, is said to range (in two subspecies) in swamps from Guiana south through Brazil into northern Argentina. Two other species (*G. jamesoni* and *G. imperialis*) are found in the Paramo of the northern Andes, while a third (*G. stricklandi*) is known in Tierra del Fuego and Chile. These are sometimes included in the genus *Homoptilura* distinct from true *Gallinago*. The low elevation of the ectepicondylar process of the humerus in *G. anthonyi*, with other characters of form that distinguish it from other species of *Gallinago* proper at hand, are an indication of difference that may possibly ally *anthonyi* with some of these South American types of obviously archaic origin, a matter, however, that may be settled only when further material illustrating the peculiar South American species has been examined.

COLUMBIDÆ

9. *Oreopeleia montana* (Linnæus)

The ruddy quail-dove was represented from Cueva Catedral by five femora and seven humeri, from Cueva Clara by a left femur, and from Cueva Toraño by the distal end of a right tarso-metatarsus and a left coracoid. (Specimens from the last-named locality were collected July 1.) The humeri from Cueva Catedral are all from juvenile birds in which the ends of the bones were still soft, so that the usual bony processes are mainly gone and the bone appears soft and spongy. In fact, most of the bones listed seem to come from immature individuals. This quail-dove today is still fairly common in Porto Rico in coffee plantations and other forested tracts, though sadly decimated in numbers by the mongoose and by hunting on the part of natives.

10. *Oreopeleia larva* Wetmore

The type (Fig. 16) selected in describing the extinct *Oreopeleia larva*¹ was a left tarso-metatarsus from Cueva Catedral. Following is a complete list of the bones identified as belonging to this quail-dove.

Cueva Catedral: 3 right and 6 left tarso-metatarsi, 4 right and 2 left tibio-tarsi, 3 right and 1 left femora, 1 right metacarpal, 1 left coracoid, the fused vertebræ from a pelvis, and a synsacrum.

Cueva Clara: 1 right and 3 left tarso-metarsi, 2 left tibio-tarsi, a right coracoid, and a right metacarpal.

Cueva Toráo: 2 right tarso-metarsi, and 2 right tibio-tarsi.

Though some of these bones are fragmentary, it will be seen that the new species was based on abundant material.

The original description was as follows.

CHARACTERS.—Metatarsus similar to that of *Oreopeleia leucometopius* Chapman from Santo Domingo, but distinctly longer.

DESCRIPTION.—Type, Cat. No. 4923, Dept. Vert. Pal., American Museum Nat. Hist., left metatarsus, from La Cueva Clara, near Morovís, Porto Rico, collected in July, 1916, by H. E. Anthony.

External glenoid facet (Fig. 17) concave, with a high external border near center, rudely elliptical in outline; internal glenoid facet also with high external border, nearly circular in form; intercondylar prominence strong, in form resembling a truncated cone, with the apical surface sloping anteriorly; anterior semilunar groove very slight; anterior surface of bone below head excavated in a long groove that lies mainly on the inner side; both external and internal superior foramina present, the first penetrating through to opposite side; tubercle for insertion of tibialis anticus tendon slight; outer anterior margin ridged to a point below the anterior groove where the entire bone shows a broad flattened surface; inner crest of talon very slightly indicated; outer crest strong and heavy with the posterior semi-lunar groove well developed; outer head of talon with one median perforation and two external grooves, that are not closed; posteriorly the talon is produced in a thin sharp ridge that descends rapidly to merge with the body of the bone at the anterior third of its length; junction of talon with shaft marked externally by a low ridge that curves anteriorly; internal margin of bone produced anteriorly as a thin plate that slopes in a curve to join the talon, and that has a sharp outer margin; shaft greatly flattened distally; a raised line extending from the crest of the talon down the center of the shaft behind to curve outward finally to the base of the outer trochlea; another less definite line passes to the inner trochlea; inner trochlea (Fig. 18) produced outward and backward as an



Fig. 16. *Oreopeleia larva*.

Anterior view of left tarso-metatarsus (type), slightly less than natural size. From Cueva Clara.



Fig. 17. *Oreopeleia larva*.

Proximal view of head of left tarso-metatarsus (type), slightly more than twice natural size. From Cueva Clara.

¹Proc. Biol. Soc. Washington, XXXIII, Dec. 30, 1920, p. 79.



Fig. 18. *Oreopeleia larva*. Distal outline of trochleæ of left tarso-metatarsus (type), twice natural size. From Cueva Clara.

angular projection with a flattened lateral point; middle trochlea projecting well beyond other two, rounded in outline, flattened laterally, with excavated sides and a deep median channel; outer trochlea strong and heavy, produced outwardly and posteriorly and excavated behind, where it is also heavily grooved; a large external inferior foramen and a faintly indicated internal one.

MEASUREMENTS.—(Of type). Total length 39.5 mm., smallest transverse diameter of shaft 2.5 mm., breadth of head 6.7 mm., breadth across trochlea 7 mm., depth through talon 6.5 mm.

RANGE.—Known from Cueva Clara and Cueva Catedral near Morovis, and a cave on the property of Don Gervacio Toraño near Utuado. (Extinct.)

Oreopeleia larva was a quail-dove of moderate body frame (slightly larger than *O. montana*, but smaller in frame than *Geotrygon versicolor*), characterized by its long slender tarsus, a character that in combination with others allies it to *Oreopeleia caniceps* of Cuba and *O. leucometopiis* Chapman (recently described¹ from specimens collected by R. H. Beck on Mt. Tina and at Tubano and Las Canitas, Province of Azua, Santo Domingo). This species is placed without question in the genus *Oreopeleia*. *Geotrygon versicolor* of Jamaica has the extremities of the metatarsus larger than in *larva*, the transverse diameter across the tibial articulation is broader, and the bone at this point is heavier. *O. larva* has the whole metatarsus seemingly more slender than in the Jamaican bird. The tibio-tarsus of *O. larva* is much stronger and heavier than that of *O. montana*, surprisingly so in fact, so that for a time I was uncertain of the identity of these bones. Two complete specimens measure 62 mm. and 62.5 mm. respectively. Though robust in form when compared with *O. montana*, these bones are slenderer and more elongate than in the tree pigeons.

The resemblance of *O. larva* to *Oreopeleia martinica* from the central Lesser Antilles is closer. No skeleton of *martinica* is at hand at present, but study of the tarsus in skins furnishes sufficient points of distinctness between the two species. The tarso-metatarsus in *martinica* (measured from the outer margin of the proximal head to the end of the middle trochlea) is usually shorter than in *larva* but in one specimen (U. S. Nat. Mus. No. 75176, male) it equals 38 mm. However, in *O. martinica* the toes are long and strong and the trochleæ supporting them correspondingly heavy, a character that serves to differentiate the two species without trouble. When compared with *Oreopeleia leucometopiis*, also represented only by skins, the resemblance is marked. The metatarsal

¹Bull. Amer. Mus. Nat. Hist., XXXVII, May 14, 1917, p. 327.

bone in *larva* has the same slender form and small trochlea found in *leucometopius*, a species characterized by rather short toes. The total length of the tarso-metatarsus in four complete specimens of *larva* varies from 38 mm. to 38.5 mm. Dr. Chapman gives the length of the tarsus in five males of *leucometopius* as 34 mm. and in five females as 32 mm. In a male of the same species in the U. S. National Museum, collected by Dr. W. L. Abbott, the tarsus measures 34 mm., and in a female from the same source 35.5 mm. The tarsus in *Oreopeleia caniceps* is slightly longer, as it ranges in males (six specimens) from 32 mm. to 37 mm. with an average length of 34 mm.¹

The two modern quail-doves known from Porto Rico, *Oreopeleia montana* and *O. chrysis*, may be dismissed in the present connection with the statement that they are smaller birds of a different type. *Oreopeleia mystacea*, of which one specimen is known from the island of Culebra, east of Porto Rico, was also a species with decidedly shorter tarsus.

The skeletal elements associated with the tarsi taken as representing *O. larva* show little save that they indicate a bird of larger, slightly heavier frame than *O. montana* but less robust than *Geotrygon versicolor*.

Quail-doves as a whole are ground inhabiting species of forest habitat. *Oreopeleia larva* would seem from its structure to have been a form of similar habit that flourished in the primitive forests of Porto Rico and perhaps became extinct only with the destruction of tree growth during the later history of the settlement of the island.

11. *Chæmepelia passerina* (Linnæus)

In the remains from Cueva Catedral are right and left femora and tibio-tarsi, a right humerus, and a broken right metacarpal of the ground dove, perhaps all from one individual. Two left humeri come from Cueva Clara. These bones exhibit no notable peculiarity. The modern ground dove from Porto Rico, one of the commoner birds of the island, is placed in the subspecies *C. p. trochila* (Bonaparte), a form that ranges from Porto Rico through the Lesser Antilles north of St. Vincent.

12. *Zenaida zenaida* (Bonaparte)

The Zenaida dove was commonly represented in both Cueva Catedral and Cueva Clara, while additional bones come from Cueva Toraño, and a single humerus from San Miguel cave. The humerus in this bird is large and strong in proportion to its size, so much so that for a time I

¹Ridgway, 1916, 'Birds of North and Middle America,' VII, p. 471.

was uncertain as to its identity through lack of comparative material. It is characterized by elevation of the ectepicondylar tubercle as in *Zenaidura* and *Ectopistes*. The modern Zenaida dove, abundant in the island of Porto Rico, where it has the habits, notes, and appearance of a mourning dove is distinguished as *Z. z. lucida* Noble.

13. *Chlorænas inornata* (Vigors)

The plain pigeon was well represented in the material studied, as bones more or less complete were found in Cuevas Catedral, Clara, San Miguel, and in the two caves explored on the Hacienda Jobo near Utuado. The remains consists of limb bones and parts of sterna and are to be distinguished from those of related pigeons by their large size and robust form.

In comparison of humeri of *Chlorænas inornata* with those of *Patagienas squamosa* and *P. leucocephala* the following differences are noted.

a. Olecranal fossa shallow, inner wall merging with adjacent entepicondylar process in a gentle slope (forming a basin-like depression) . . . *Chlorænas inornata*.

aa. Olecranal fossa deeper, inner wall abrupt, forming a distinct pit at base of entepicondylar process *Patagienas squamosa*. *Patagienas leucocephala*.

It may be noted that in the band-tailed pigeon, *Chlorænas fasciata* the olecranal pit is developed as in *Patagienas*. *C. fasciata*, like *P. squamosa* and *P. leucocephala*, is a bird that performs extended flights either to seek new food supplies or in migration. *C. inornata*, on the other hand, is more sedentary and apparently is resident in the Greater Antillean islands where it occurs, as several subspecies have been described. (It is probable that Cuban and Santo Domingan birds now listed as one may prove separable when sufficient material is available.) The form of the inner margin of the olecranal fossa would seem, therefore, to be correlated with exercise of flight.

The modern plain pigeon from Porto Rico is distinguished as *Chlorænas inornata exsul* Ridgway. The species as a whole ranges through Cuba, Isle of Pines, Jamaica, Santo Domingo, and Porto Rico, but is far from common in the latter island at the present day.

14. *Patagienas leucocephala* (Linnæus)

A right femur and part of a left one from Cueva Clara, slightly smaller than similar bones in *P. squamosa*, are taken as representing this species. The white-crowned pigeon is today one of the more common of the larger pigeons in Porto Rico. It is encountered in numbers in the hills and in forested regions near the coast, where it is said to be migrant in part to and from other Antillean islands.

15. *Patagioenas squamosa* (Bonnaterre)

Represented by a broken femur and parts of two right metacarpals from Cueva Catedral, and a tarso-metatarsus and femur from Cueva Clara. These limb bones are similar to those of *P. leucocephala* but are slightly larger.

The humerus in pigeons of the families Treronidæ, Columbidae and Peristeridae is a characteristic bone to be confused with that of no other group of birds save the parrots. The peculiar, sharply triangular crista superior projecting from the stout heavy shaft is diagnostic. In addition, the extensor metacarpi radialis longus inserts on the humerus on a distinct tubercle that may be called the ectepicondylar tubercle, separated by a distinct space from the expanded radial condyle. Its elevation varies. In *Zenaidura* and *Ectopistes* it is higher than in others. In the Gouridae the attachment of the tendon is low and does not form a tubercle on the shaft, as it is on a true ectepicondylar process continuous with the condylar region of the humerus.

The humerus in parrots is closely similar to that in pigeons. In general, the crista superior in such groups as *Ara* and *Amazona* is more angular, and the ectepicondylar tubercle broader, with its area of tendinous attachment extending around on the upper surface of the bone, not restricted to the outer margin as in pigeons. In addition, in parrots the pit for the brachialis inferior is much longer.

The scaled pigeon remains today fairly common in forested districts.

CUCULIDÆ

16. *Saurothera vieilloti* Bonaparte

The lizard cuckoo, a species that may be considered tolerably common at present, was represented in Cueva Catedral by one right and four left tarso-metatarsi, a left femur, left humerus, and left metacarpal, while in the remains from Cueva Clara were a left tarso-metatarsus and a left tibio-tarsus. A broken tarso-metatarsus was found in Cueva Toraño. It is worthy of note that the cuckoo remains from these caves are those of the forest inhabiting *Saurothera* rather than of the ani (*Crotophaga*), a bird frequenting more open country. It is believed that anis have been extending their range through the West Indian Islands within modern times so that it is barely possible that *Crotophaga* was not represented in the Porto Rican avifauna at the time of these deposits.

The tibio-tarsus of *Saurothera* is characterized by a strong anterior curvature with small development of the proximal crests. It differs from that of *Crotophaga* in the longer peroneal ridge that extends farther down on the shaft.

PICIDÆ**17. *Melanerpes portoricensis* (Daudin)**

A left humerus and two right tibio-tarsi come from Cueva Clara, while in Cueva Catedral was found an assortment of bones from at least eighteen or twenty individuals. The majority of these are the heavier limb-bones. Much individual variation in size is evident in studying this series, and one might think that two species were represented if it were not for the manner in which the bones intergrade in series from large to small. Tibio-tarsi vary in length from 30.5 mm. to 33.5 mm., and femora from 20.5 mm. to 23.5 mm. A small number of bones are stained very dark brown and appear much older than others. These older bones frequently are larger than more modern specimens. There is in particular one tibio-tarsus of maximum size that, if complete, would measure not less than 34.5 mm. in length. The Porto Rican woodpecker has remained abundant in the coffee plantations of the hills since the destruction of the primeval forests.

BUBONIDÆ**18. *Gymnasio nudipes* (Daudin)**

This small owl was abundantly represented in Cueva Clara and Cueva Catedral, while humeri were identified in the material from Cueva San Miguel and Toraño. The bones at hand exhibit great variation in size, as is usual among small owls; in that respect these bones of *Gymnasio* equal the series of skeletons of *Otus asio* in the collection of the National Museum. A metatarsus from Cueva Catedral represents a fledgling individual, as it has the spongy structure common to bones of young birds. Among other metatarsi are two that appear quite recent, as they have the hardened posterior tendons still held in place by a calcareous cement. Humeri from Cueva Clara vary from 41.5 mm. to 47 mm. in length, which will give an idea of the variation indicated in these specimens.

This owl is encountered in fair numbers in Porto Rican forests today and also frequents caverns to some extent. As the majority of the bird bones examined show evidence of having come from owl pellets, *Gymnasio* was probably responsible for many of the remains, especially of the large numbers of such small birds as the tanagers, woodpeckers, thrushes, and thrashers. Responsibility, however, was divided with the barn owl and the share to be attributed to these separate species is problematical.

TYTONIDÆ

19. *Tyto cavatica* Wetmore

The Porto Rican barn owl is represented by the proximal three-quarters of a left metatarsus (Fig. 19, the type) with the inner crest of the talon missing, about one-third of a right metatarsus, the upper half of a right tibio-tarsus, and the lower end of another. Apparently at least two individuals are represented. This material comes from individuals that were fully grown but that were less than one year old. All of the specimens were found in the Toraño cave.

The original description of the species was as follows.¹

CHARACTERS.—Metatarsus (Figs. 19 and 20) similar to that of *Tyto glaucops* (Kaup) from Santo Domingo, but with internal head of talon larger and much longer, the lower margin more elongated; tubercle for insertion of tibialis anticus tendon heavier.

DESCRIPTION.—Type, Cat. No. 4924, Dept. Vert. Pal., American Museum Nat. Hist., proximal three-fourths of a left metatarsus from cave on the property of Don Gervacio Toraño, near Utuado, Porto Rico, collected July 2, 1916, by H. E. Anthony.

Metatarsus with base supporting inner head of talon long, sloping gradually below, and truncate in front (crest of talon missing in type); posterior semi-lunar groove deep and narrow; anterior semi-lunar groove shallow; inner glenoid facet moderately impressed and concave; outer glenoid facet smooth without marked depression; entire posterior face of bone deeply grooved; ridge bearing inner head of talon swung over slightly toward center from inner margin, with a marked depression on inner face of the crest; outer side of metatarsus flattened, with angular margins, becoming narrower in a curving line toward head of

bone, and expanding again slightly to support outer glenoid surface; anterior surface of bone excavated proximally in an elongate, roughly triangular groove; tubercle for insertion of tibialis anticus long and strong, extending well toward head of bone; lower end of bone with a distinct forward flexure; no osseous loop for extensor digitorum communis tendon.

MEASUREMENTS.—(Of type). Lateral diameter of head across articular surface 10 mm.; lateral diameter of shaft near center 4 mm.; length of base of inner head of talon 8.7 mm.

RANGE.—Known only from cave on property of Don Gervacio Toraño, near Utuado, Porto Rico. (Extinct.)

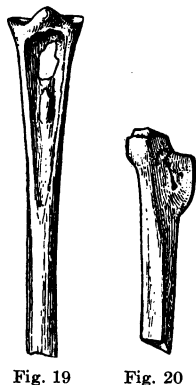


Fig. 19 Fig. 20

Tyto cavatica

Fig. 19. Anterior view of proximal portion of left tarso-metatarsus (type), natural size. From Cueva Toraño.

Fig. 20. Internal face of proximal end of right tarso-metatarsus, natural size. From Cueva Toraño.

¹Proc. Biol. Soc. Washington, XXXIII, Dec. 30, 1920, p. 80.

The inner crest of the talon is broken and lost in the metatarsus selected as the type specimen. It is, however, complete in the second metatarsus, where its strong heavy form may be easily appreciated when compared with the weaker development characterizing *Tyto glaucops*. The long base and sloping angles of the inner crest of the talon in *Tyto cavatica*, save for smaller dimensions, resemble almost exactly the condition found in *Tyto perlata*, so that on first glance it might be supposed that *cavatica* was in reality merely a smaller insular form of *perlata*. In *perlata*, however, the inner crest of the talon is swung over until the head lies nearly above and parallel to the median line of the bone, with the external face of the talon on a marked slant from the perpendicular. In *glaucops* and *bargei* (here taken as representative of the smaller forms of barn owl) this ridge has the outer face much less oblique, as the line of the crest is less strongly appressed toward the median line. In this character and in its small size *cavatica* resembles the small West Indian barn owls and is to be ranked as a separate species with them.



Fig. 21. *Tyto cavatica*.
External view
of distal end of
right tibio-tarsus,
natural size. From
Cueva Toráo.

The tibio-tarsal remains exhibit a few characters of interest. The head of this bone in *glaucops* differs primarily from *perlata* in the greater size and extent of the laterally directed outer anterior crest. The bird from Porto Rico has this crest even more developed than in *glaucops*, with the upper external angle slightly produced. The lower end of the bone (Fig. 21) shows a broad attachment for the distal end of the tibia, as is usual, and in general is similar to that in other barn owls.

While travelling in Porto Rico in 1912 I made frequent inquiry of natives regarding *Asio portoricensis*, an owl that I did not find in life. Two stories were current regarding the "Mucaro real," the common name for the short-eared owl. One related that it was found in grassy places or damp marshes, while near Utuado it was said to inhabit small caves on abruptly sloping hills and to appear only at night. To this last I did not give great credence, as it was contrary to the established habit of short-eared owls in other regions. With the record of bones of the barn owl from this same region, the apparent discrepancy is cleared, as it is evident at once that the cave-haunting bird must have been *Tyto cavatica*. Barn owls are retiring in habit and secretive in choice of haunts, so that it is barely possible that the species still lingers in isolated caverns in that region. Though such possibility may be remote, it is worthy of consideration on the part of those who may chance to have opportunity to visit the locality.

The presence of the barn owl in caverns on this island may go far to explain the abundant remains of small birds and rodents found in such deposits as that excavated in Cueva Catedral. On examination of the bird bones from this cave, I was convinced that they were from regurgitated pellets, and the remains of the little bare-legged owl, common among the other fragments, seemed to indicate that it was the responsible agent. The discovery of *Tyto cavatica*, however, gives the whole affair a different aspect and leads one to wonder whether or not the small "mucaro" may not have fallen at times into the talons of his larger relative.

CAPRIMULGIDÆ

20. *Setochoalcis noctithera* Wetmore¹

Humeri of a whippoorwill representing an unknown insular species were among the first finds in the material from Cueva Catedral, and the bird was described from a study skin preserved in the Field Museum of Natural History, apparently the only existing complete specimen of this interesting species. In all, one left and two right humeri, with a left metacarpal belonging to *S. noctithera*, were found in Cueva Catedral, while two more humeri came from Cueva Clara. These two points are the only definite localities known for the occurrence of the species, as the type skin was marked simply Porto Rico.

The humerus in *S. noctithera* (Fig. 22) is similar to that in *Setochoalcis vocifera vocifera* (Wilson) but is distinctly shorter, with fossa subtrochanterica less in extent, ridge of tuberculum medium weaker, foramen pneumaticum larger and more exposed, incisura capitis with sides more abrupt forming a more acute angle at the base, and tuberculum superior less elevated, shaft slightly more curved. The metacarpal is smaller than in *vocifera*. These differences are relative but are readily seen on close comparison.

The country people in Porto Rico told me on several occasions of a bird that in former times called loudly and continuously at night, that no one ever was able to see. When abroad after dark, the tale proceeded, it was well for the ungodly among men to guard his speech against profanity (certain vulgar words being especially taboo), as otherwise the strange bird overhearing him might take offense and descend to kill the offender. The night caller had not been heard for many years, however,



Fig. 22. *Setochoalcis noctithera*. Anterior view of right humerus, natural size. From Cueva Catedral.

¹Proc. Biol. Soc. Washington, XXXII, Dec. 31, 1919, p. 235.

so that freedom of speech, profane or otherwise, was open to all by night as well as by day. It is possible that this tale of direct punishment of the sinful may refer to the former occurrence of *Setochalcis noctithera*, as it may be supposed that the Porto Rican whippoorwill, like other related species, had a persistent call note given during the hours of darkness, though that it had any active part in oversight of human morals is hardly to be presumed. The species may still exist in small numbers, as a small goatsucker flushed in a tract of forest near Rio Piedras in December 1911 may have been the present bird. None were heard singing during a period of ten months spent in field work on the island so that, if still existent, the Porto Rican whippoorwill must be very rare.

TYRANNIDÆ

21. *Tyrannus dominicensis* (Gmelin)

The symphysis of a mandible and a right humerus from Cueva Catedral, and a left humerus from Cueva Clara were the only remains of the gray kingbird identified. The species has probably gained its present status as one of the abundant Porto Rican birds since the former forested areas have been destroyed, as it is a bird of open country.

22. *Tolmarchus taylori* (Selater)

The Porto Rican patchary was present as a small series of bones from Cueva Catedral, with many other passerine remains. A left humerus was found in Cueva Clara. The tarso-metatarsus in large tyrants is characterized by the large size and inward extension of the inner trochlea, and its marked separation from the middle trochlea. In addition, the inner trochlea is extended distally beyond the level of the outer one. Tarso-metatarsi of the patchary from Cathedral cave measure from 22.5 mm. to 23.5 mm., a length that, with the greater breadth across the trochlea, serves to distinguish them from the shorter, less heavy tarso-metatarsi of *Tyrannus dominicensis*. Larger size in general serves to differentiate tarso-metatarsi, humeri, and tibio-tarsi of *Tolmarchus taylori* from those of *Tyrannus dominicensis*, as the structure in the two species is very similar. Tibio-tarsi may be distinguished from those of higher, oscinine passerines (Fringillidæ, Tangaridæ and Icteridæ) by their lack of the prominent inner ridge lying on the inner face of the shaft of the bone opposite to and in the same plane as the peroneal ridge. This same inner ridge is extensively developed in the Picidæ. The ulna of *Tolmarchus* is shorter than that of the gray kingbird.

With the clearing of forest areas the gray kingbird, a bird of the open, has become much more abundant than the *Tolmarchus* on Porto Rico, a condition that was reversed formerly if the abundance of remains of the two species among the small bird bones found in Cueva Catedral is any criterion.

23. *Myiarchus antillarum* (Bryant)

An entire upper mandible, complete save for the ossified nasal capsules, was found in Cueva Catedral. This is a common forest-inhabiting species.

24. *Blacicus blancoi* Cabanis

The distal half of a right tibio-tarsus, a tiny fragment from a small bird, comes from Cueva Catedral. This species is known only from the western half of Porto Rico and is here recorded at the most eastern point in its range on the north slope of the mountains. In 1912 I found it at Ciales only a few miles farther west; the present record is a slight extension in the known occurrence of the species.

HIRUNDINIDÆ

25. *Petrochelidon fulva* (Vieillot)

The cliff swallow is recorded on the basis of two humeri from Cueva Catedral. The species is a common inhabitant of the mouths of caverns during the breeding season and ranges in feeding over the forests and open fields.

MIMIDÆ

26. *Margarops fuscatus* (Vieillot)

The pearly-eyed thrasher, at present a rare species on the main island of Porto Rico, may formerly have been more abundant, as remains of eighteen or twenty individuals come from Cueva Catedral and other fragments from Cueva Clara. The species was among the three or four most frequently represented in the former locality. In Porto Rico today this thrasher is rare, though it is one of the most abundant birds on the nearby islands of Desecheo, Vieques, and Culebra.

27. *Mimus polyglottos* (Linnæus)

Eleven humeri, nine from the right side, and a few bones from the lower limb were found in Cueva Catedral and four other fragments in Cueva Clara. These are characterized by small size in comparison with mockingbirds from eastern United States. In the humerus of *Mimus*

polyglottos the shaft on the dorsal surface immediately behind the tuberculum superior is sharply angular. The pit of the brachialis inferior is narrow and restricted.

According to present usage, mockingbirds from Porto Rico are placed in the subspecies *Mimus p. orpheus* (Linnæus). The species is common at present.

TURDIDÆ

28. *Mimocichla ardosiacea* (Vieillot)

One of the most abundant species in the deposits in Cueva Cathedral was the Porto Rican thrush. Forty right and twenty-six left humeri were secured from this one cave, together with a considerable number of other bones. Other remains come from Cuevas Clara, Toraño, and San Miguel, indicating that the bird was common and well distributed at the time these deposits were made. Bones of this species are in a number of cases equal in size to those of the robust pearly-eyed thrasher (*Margarops fuscatus*), and in some cases it is difficult to distinguish between the two species. The premaxilla in *Mimocichla* (represented by one specimen from Cathedral Cave) is more slender and has the line of the culmen strongly ridged, with the ridge extending back on the nasal process. In *Margarops* the premaxilla is heavier, with the posterior part (of the culmen) flattened. Distinction between the two genera in the humerus is very slight and at times doubtful owing to individual variation. Small differences are as follows: In *Mimocichla* the tip of the tuberculum medium is more extended, the concavity between it and the tuberculum inferior more curved. When viewed from the end the caput humeri has the highest point in the curve of its dorsal surface external, toward the crista superior. The channel between radial and ulnar trochleæ is narrower and deeper.

Tarso-metatarsi in specimens of *Mimocichla* from Cathedral Cave are of maximum length. Measurements of total length of entire specimens are 41.5, 42, 41.5, 42, 40, 41, 42.8 and 40.5 mm. These measurements exceed by from 1 to 1.5 mm. the usual tarsal measurement taken from study skins because of the proximal projection of the ankylosed centrale rising between the inner and outer articular facets on the proximal end of the bone. According to figures given by Mr. Ridgway,¹ the tarsus in this bird varies from 36 mm. to 40.5 mm., with an average of 39.5 mm. for males and 37.4 mm. for females.

¹'Birds of North and Middle America,' IV, 1907, p. 81.

Metacarpals of *Mimocichla* differ from those of *Margarops* in being slightly narrower and more slender. On the inner side at the distal end the groove or depression between the fused ends of *m.* 2 and *m.* 3 is smooth in *Mimocichla*, but in *Margarops* has a raised margin at its beginning so that the depression is set off as an elongate pit.

The Porto Rican thrush, recognized at present as the subspecies *Mimocichla a. portoricensis* (Bryant), is a common bird in country districts.

CORVIDÆ

29. *Corvus pumilis* Wetmore

While in Porto Rico I heard rumor in one or two regions of a form of crow, other than the ordinary *Cuervo* (*Corvus leucognaphalus*) of the island—a smaller, to me more or less mythical species, distinguished under the name of “solitario,” said to have been found many years before in wooded areas on the hill slopes below Lares. The discovery in Cueva San Miguel near Morovís of the ulna upon which the present name is based corroborates these stories and gives two known species of the genus *Corvus* in Porto Rico.

Following is the original description of *Corvus pumilis*.¹

CHARACTERS.—Ulna (Fig. 23) similar to that of *Corvus palmarum* Württemberg, but distinctly longer, olecranon relatively longer, heavier and broader at tip; external margin bounding carpal articulation more produced; and shaft compressed to form an angular margin on inner side directly above carpal articulation.

DESCRIPTION.—Type, Cat. No. 4925, Dept. Vert. Pal., American Museum Nat. Hist., right ulna, from Cueva San Miguel, near Morovís, Porto Rico, collected in July, 1916, by H. E. Anthony.

Ulna with olecranon produced and strong, tip broad and blunt on the end, where it is impressed by an indistinct shallow pit; internal glenoid surface broadly elliptical, placed obliquely to the axis of the bone and with a shallow raised margin; external glenoid surface produced as a thin flattened plate, with outer margin slightly rounded and postero-external edge produced to form a right angle; insertion of external portion of triceps marked by an angular ridge; a distinct external ridge with an acute margin on shaft immediately below head; shaft with a slight external convexity; nutrient foramen on inner surface, 25 millimeters from extremity of olecranon; papillæ for attachment of secondaries fairly prominent; external margin of carpal head produced, extending slightly beyond margin of shaft.

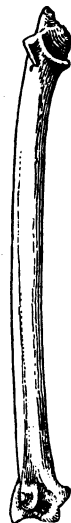


Fig. 23. *Corvus pumilis*.
Inner face of right ulna (type), natural size. From Cueva San Miguel.

¹Proc. Biol. Soc. Washington, XXXIII, Dec. 30, 1920, p. 81.

MEASUREMENTS.—(Of type). Total length 68 mm., diameter of shaft on external surface 4 mm.

RANGE.—Known only from Cueva San Miguel near Morovís, Porto Rico. (Extinct.)

The species is known at present only from the ulna that served as the type. *Corvus pumilis* was intermediate in size between *Corvus palmarum* of Santo Domingo and *C. leucognaphalus* (known from Santo Domingo, Porto Rico and St. Croix¹). The ulna in three females of *C. leucognaphalus* taken in Porto Rico measures 75 mm., and in a fourth 76 mm. As males in *leucognaphalus* are distinctly larger than females, these represent minimum measurements for this species. The type of *pumilis* is only 68 mm. long, a size that places it well without the limit of variation for the modern crow known as a living bird from Porto Rico. In a skeleton of a male of *Corvus palmarum* the ulna is only 62 mm. long so that *pumilis* cannot be closely allied with that species, nor with either *C. minutus* of Cuba or the peculiar slaty *C. jamaicensis* of Jamaica. Apparently *C. pumilis* was about as large as the fish crow (*Corvus ossifragus*) of the United States, a species that differs decidedly from it in conformation of the ulna. *C. pumilis* has the ulna intermediate in a way between *leucognaphalus* and *minutus*. It agrees with *leucognaphalus* in the development of the strong, produced olecranon, and with *minutus* in the more angular lower margin of the external glenoid plate. From both it is readily distinguished by the greater compression of the inner margin of the shaft above the distal end.

It is hoped that additional bones of this interesting bird may come to light. With the discovery of *pumilis* two forms of crow, one large and one small, are known from Cuba, Santo Domingo, and Porto Rico, carrying the distribution of this combination well through the Greater Antilles. It remains to be seen whether an additional species may not be found from deposits in Jamaica and whether crows formerly may not have ranged part way through the Lesser Antilles. As noted above, *C. leucognaphalus* has been identified in kitchen midden deposits on St. Croix, and it is possible that in former times crows ranged even farther through the Antilles toward the South American Continent.

VIREONIDÆ

30. *Vireosylva calidris* (Linnæus)

Represented by three tibio-tarsi and two humeri from Cueva Cathedral. Bones of this species are distinctly larger than those of *Vireo-*

¹See Wetmore, 1918, 'Bones of Birds collected by Theodoor de Booy from Kitchen Midden Deposits in the Islands of St. Thomas and St. Croix,' Proc. U. S. Nat. Mus., LIV, pp. 521-522.

sylva olivacea, a species for which there is a very doubtful record for Porto Rico but which has at present no valid standing in the list of species known from the island. The three tibio-tarsi of *V. calidris* from Cueva Catedral measure 28 mm., 28.5 mm., and 28.5 mm. respectively, while in three specimens of *V. olivacea* the tibio-tarsus ranges from 26 mm. to 26.8 mm. The humeri from Cueva Catedral are distinctly larger than in *V. olivacea*. *V. calidris* is a common bird of the forests, that forsakes Porto Rico, presumably for more southern localities, during the winter season.

MNIOTILTIDÆ

31. *Dendroica adelaidæ* Baird

A left humerus of Adelaide's warbler, a resident species, was found in Cueva Catedral. This resident warbler today is locally common.

32. *Dendroica coronata* (Linnæus)

The myrtle warbler, a common winter visitant to Porto Rico, was represented by a left humerus from Cueva Catedral.

33. *Mniotilta varia* (Linnæus)

A tibio-tarsus of this familiar migrant from North America was found in Cueva Catedral. This bone is similar in length in *Compsothlypis americana* and *Dendroica magnolia* and, save for its different form, might be confused with them. The tibio-tarsus of *Mniotilta* is distinguished from that of these two by stronger shaft, and distal broadening toward the extensor bridge, as well as by the broadened excavation between procnemial and ectocnemial ridges, differences arising from the climbing habit of the present bird.

CEREBIDÆ

34. *Cæreba portoricensis* (Bryant)

Though the honey creeper is the most abundant of small birds in Porto Rico today, it is represented only by a broken cranium and part of a tibio-tarsus from Cueva Catedral, a fact due perhaps to the fragile nature of the bones in its skeleton. The cranium shows no appreciable difference from modern skulls. Superficially this cranium resembles that of small warblers in whose range Porto Rico is included. On careful comparison, however, *Cæreba* is found to differ from slender-billed warblers (*Mniotilta*, *Compsothlypis*, and *Dendroica*) in having the lachrymal region more expanded laterally, a broadening that includes the anterior end of the frontal adjacent to the lachrymal. This enlargement extends

as two lateral anterior protuberances on the frontal, at the cranio-facial hinge, that bound a distinct depression, rudely elliptical in outline, intruding slightly upon the posterior end of the nasal. In addition, the lachrymal in *Cæreba* is much larger than in warblers.

ICTERIDÆ

35. *Agelaius xanthomus* (Sclater)

The yellow-shouldered blackbird was represented by a humerus in Cueva Clara and by assorted fragments from nine or more individuals in Cueva Catedral. The form of skull in this species is markedly different from that found in the *Agelaius phæniceus* group including the more slender-billed *A. tricolor*, as in *xanthomus* the premaxilla extends more nearly in the plane of the palate and is not abruptly deflexed to form a distinct angle at the corner of the mouth. The formation in *A. xanthomus* is thus similar to that in the genus *Icterus*. Premaxillæ of *xanthomus* from Cathedral Cave strongly suggest those of *Icterus portoricensis*, but on close scrutiny it is seen that *A. xanthomus* differs in being slightly broader and less attenuate apically, in having a broader, heavier nasal process, and in possessing a shorter, more rounded nasal opening. A distinct line in the narial opening marks the broken ankylosis of the internasal septum.

This species is common in open localities where palms growing on hill slopes offer suitable cover and nesting sites.

36. *Icterus portoricensis* (Bryant)

The tree-haunting oriole, still an abundant species in Porto Rican forests, suffered heavily from the depredations of owls inhabiting Cueva Catedral, as remains of twenty or more individuals, comprising a large number of bones, come from that cavern. A single femur encountered in Cueva Clara is taken as representing this species, although it is larger than normal. This oriole is of the type with elongated external narial aperture, resembling *I. wagleri*, from which, however, it differs in more slender, elongate premaxilla. The difference from such types as *I. galbula* and *bullocki* that have the narial aperture shorter and more rounded is marked. The processus angularis posterior in *I. portoricensis* is broad, strong, and much elongated, more so than in other orioles available at this time as skeletons. The cranium is distinguished by the thin outer margin of the processus zygomaticus squamosi that extends backward nearly to the end of the shallow temporal depression, by the smoothly rounded basitemporal plate, narrow frontal region between the orbits, and by the divergent positions of the foramina for the vena capitis that lie on the rim of the foramen magnum.

37. *Holoquiscalus brachypterus* (Cassin)

The Porto Rican blackbird, today common in the open fields of the lowlands, was represented only by a broken metatarsus from Cueva Catedral.

TANGARIDÆ

38. *Nesospingus speculiferus* (Lawrence)

Strange to state, the Porto Rican tanager, known as one of the rarest of native birds of the island, was the species most abundantly represented in Cueva Catedral, where remains of over one hundred individuals were identified. A few additional bones were encountered in Cueva Clara. In the large series from Cueva Catedral there is considerable variation in size, indicative of sexual differences that may be noted readily in examining a series of skins. Thus, in eighty-two premaxillæ certain individuals of maximum size may be set aside as unquestionable males. The nasal septum in *Nesospingus* (Fig. 24) has a tendency to ossify and become attached, as is shown by the raised line between the two narial openings. This internasal line broadens to form a small process just anterior to the plate of the ethmoid. Mandibles (Fig. 25) and fragments of the cranium represent this tanager without question.



Fig. 24



Fig. 25

Nesospingus speculiferus

Fig. 24. Lateral view of upper mandible, natural size. From Cueva Catedral
 Fig. 25. Lateral view of lower mandible, natural size. From Cueva Catedral.

In identifying bones of the lower limb, femora, tibio-tarsi, and tarso-metatarsi there has been doubt in the assignment of many specimens. In *Loxigilla*, *Icterus*, and *Nesospingus* from Porto Rico these bones seem more or less similar and grade into one another in size and form almost imperceptibly, in spite of the fact that these genera represent three groups among the nine-primaried oscines. The specimens of these bones from Cueva Catedral have been allotted after prolonged study of minute differences but, in spite of the care used, I am not certain that part of those assigned to *Nesospingus* may not belong elsewhere. The distinction between *Nesospingus* and *Loxigilla* is especially puzzling.

The large number of bones of the Porto Rican tanager in the present collection may be explained readily when it is known that the birds gather in flocks at nightfall, and roost in chosen clumps of palms where their only shelter is in seed clumps, axils of leaves, the spathes surrounding seed heads, or the central spike. In such situations the birds make easy prey to night feeding owls. Once such a roost was located, it would

be easy for an owl to return again and again, so that the inroads of these rapacious birds may have had a decided effect upon the abundance of *Nesospingus*, or may indeed account for the scarcity of this bird.

While studying this material I had occasion to examine a body of *Nesospingus speculiferus* (U. S. National Museum, Cat. No. 225083) collected in Porto Rico on the mountain El Yunque in 1900, and preserved in alcohol by Dr. C. W. Richmond. As the species is rare in collections, even in the form of skins, the following notes on this dissection may be of interest.

The two portions of the muscle latissimus dorsi were contiguous throughout, with the line of demarcation between so slight that the two parts seemed almost fused. The anterior part arose from the outer margin of the dorsal extremity of the neural spine on the fourteenth cervical vertebra (the vertebra bearing the second free rib) and on the first dorsal immediately behind it. The posterior portion of the muscle had a similar origin on the four dorsal vertebræ that follow. There was no trace of attachment for the latissimus dorsi on the dorsal vertebra bearing the last pair of ribs (that do not reach the sternum), which was fused with the anterior end of the pelvis. The posterior half of the muscle was thin and attenuate, so that it was difficult to trace. The anterior portion was heavier and thickened appreciably toward the point where it separated from the body. The two parts narrowed rapidly toward this point, so that the resulting slip was not more than 1.5 mm. broad though the origin extended through a space of 15 mm.

Other points in the anatomy were developed as usual in the birds of this group. The gall-bladder measured 8 mm. in length, the cylindrical spleen 8 mm. long by 1.5 mm. in diameter. The intestine was wide and large throughout. Its total length was 190 mm., with a distance of 21 mm. between the insertion of the cæca and the anus. The paired cæca were cylindrical in form and measured 11 mm. long by 1 mm. in diameter.

39. *Spindalis portoricensis* (Bryant)

The Porto Rican spindalis was represented in Cueva Catedral by bones of ten or more individuals, and in Cueva Clara by two pairs of humeri. The species is common at present.

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40. *Loxigilla portoricensis* (Daudin)

Fragments of several of these birds including two premaxillæ and seven lower mandibles were identified from Cueva Catedral. This grosbeak is a shy resident of hillside thickets.

41. ***Tiaris olivacea*** (Linnæus)

The abundant small grassquit (separated as the subspecies *bryanti* in Porto Rico) was represented by two humeri found in the deposits in Cueva Cathedral. The species has the humerus more slender than in *Tiaris bicolor*, a form of which (subspecies *omissa*) also occurs on the island.

42. ***Coturniculus savannarum*** (Gmelin)

Two humeri of the grasshopper sparrow come from Cueva Clara. The insular form of this bird, locally common, is now known as *C. s. borinquensis* Peters.

