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The Non-Passerine Pleistocene
Avifauna of the Talara Tar Seeps,
Northwestern Peru

Kenneth E. Campbell, Jr.

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ROYAL ONTARIO MUSEUM
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KENNETH E. CAMPBELL, JR. **The Non-Passerine Pleistocene
Avifauna of the Talara Tar Seeps,
Northwestern Peru**

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KENNETH E. CAMPBELL, JR. is a Curator at the George C. Page Museum, Natural History Museum of Los Angeles County, California.

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To Pierce Brodkorb

The Non-Passerine Pleistocene Avifauna of the Talara Tar Seeps, Northwestern Peru

Abstract

The Talara Tar Seeps are a localized series of fossil-bearing deposits of late Pleistocene age that are located in northwestern Peru, approximately 04°33'S, 81°7'W. The deposits lie on a marine terrace believed to be of Sangamon age. They have been dated at ca 13,900 B.P..

A discussion of processes of entrapment in tar pits suggests that oil seeping onto the ground surface may act as an animal trap in different ways under varying conditions and, for any given oil seep, through time. The effectiveness of any specific oil seep as a trap may also vary for different types of animals at any given time.

The non-passerine portion of the palaeoavifauna from the Talara Tar Seeps, i.e., that portion reported on here, consists of over 6,200 specimens representing a minimum of 744 individuals of 13 orders, 24 families, 67 genera, and 89 species. Six new genera and 21 new species are described. The following families are represented, with the number of identified species for each (numbers of new species are in parenthesis): Tinamidae, 1; Podicipedidae, 2; Phalacrocoracidae, 2; Ardeidae, 6(1); Plataleidae, 4(2); Ciconiidae, 2; Anatidae, 9(4); Vulturidae, 6(3); Accipitridae, 7(2); Falconidae, 6(1); Cracidae, 1; Rallidae, 1; Charadriidae, 7(2); Scolopacidae, 14(3); Phalaropodidae, 3(1); Jacanidae, 1; Burhinidae, 1; Thinocoridae, 3(1); Laridae, 2; Columbidae, 4; Psittacidae, 1; Tytonidae, 1; Strigidae, 3; Caprimulgidae, 2(1). The taxonomic positions of two previously recognized palaeospecies are altered; *Archeoquerquedula lambrechtii* Spillman is synonymized with *Anas bahamensis* Linnaeus, and *Morphnus woodwardi* Miller becomes *Amplibuteo woodwardi* (Miller). Diagnostic osteological characters are given in all cases where necessary to justify species identification.

The coast of northwestern Peru where the Talara Tar Seeps are located is desert today. Very rare, unpredictable rains may occur during the summer, generally following the occurrence of an oceanic phenomenon known as *El Niño*. During the winter a continuous cloud cover with no precipitation, a condition referred to as a *garúa*, prevails. The non-passerine portion of the palaeoavifauna suggests that during the Wisconsin glaciation northwestern Peru was a savanna woodland, or a savanna with extensive riparian forests. At the end of the Wisconsin, climatic shifts brought about the current desert

conditions in the area, and resulted in the extinction of 23 per cent of the non-passerine species of the avifauna.

The palaeoavifauna from the asphalt deposits of Rancho La Brea, California, which are similar in age, includes 98 non-passerine species, compared with the 89 non-passerine species found in the Talara deposits. Sixteen species are common to both localities. Twenty-three per cent of the non-passerine species known from Talara are extinct, in contrast with 17 per cent of the non-passerine species known from Rancho La Brea.

The high degree of similarity between the palaeoavifaunas of the Talara Tar Seeps and the asphalt deposits of La Carolina, Ecuador, suggests that deposition may have occurred simultaneously at the two sites. The similarity also suggests that climatic conditions at the two sites were comparable during the Wisconsin, just as they are today; and that the two sites underwent the same desertification process at the end of the Wisconsin.

(Pleistocene; avifauna; Talara Tar Seeps; tar pits; Peru; avian systematics)

Resumen

Los "Talara Tar Seeps" son una serie localizado de depósitos fosilíferos de asfalto del Pleistoceno tardío que están en el noroeste del Perú, aproximadamente 04°33'S, 81°7'W. Los depósitos están sobre una terraza marítima que piensan data de la Sangamon. Los depósitos de asfaltos datan de aproximadamente 13,900 años ante de presente.

Una discusión de los procedimientos de entrampamiento en lagunajos de la brea sugiere que petróleo que mana sobre la superficie de la tierra puede ser una trampa de animales en modos diferentes con condiciones variantes y, por una lagunajo particular, durante tiempo. La efectividad de un lagunajo de la brea particular puede variar tambien segun animales de diferentes tipos a un tiempo especificado.

La porción de la avifauna de los "Talara Tar Seeps" que está discutido aqui, es decir los no paserinos, contiene mas de 6,200 espécimenes representando a mínimo 744 individuos de 13 ordenes, 24 familias, 67 géneros, y 89 especies. Seis géneros nuevos y 21 especies nuevas están descritos. Las familias siguientes están representadas, con el número de especies identificado por cada uno (el número de especies nuevos por familia está en parentesis): Tinamidae, 1; Podicipedidae, 2; Phalacrocoracidae, 2; Ardeidae, 6(1); Plataleidae, 4(2); Ciconiidae, 2; Anatidae, 9(4); Vulturidae, 6(3); Accipitridae, 7(2); Falconidae, 6(1); Cracidae, 1; Rallidae, 1; Charadriidae, 7(2); Scolopacidae, 14(3); Phalaropodidae, 3(1); Jacanidae, 1; Burhinidae, 1; Thinocoridae, 3(1); Laridae, 2; Columbidae, 4; Psittacidae, 1; Tytonidae, 1; Strigidae, 3; Caprimulgidae, 2(1). La posición taxonómica de dos paleoespecies reconocidas previamente está cambiada. *Archeoquerquedula lambrechtii* Spillman está en sinonimia con *Anas bahamensis* Linnaeus y *Morphnus woodwardi* L. Miller está

cambiado a *Amplibueto woodwardi* (L. Miller). Características osteológicas diagnósticas están presentados en todos casos donde es necesario para justificar la identificación de una especie.

La costa del noroeste del Perú donde están los “Talara Tar Seeps” es un desierto en el presente. Lluvias muy raras y no predicables pueden ocurrir durante el verano, generalmente sequiente la ocurrencia de un fenómeno marítimo que se llama El Niño. Durante el invierno una capa ininterrumpida de nubes y neblina, pero sin precipitación, prevalece. Esta se llama garúa. La porción no pasarina de la paleoavifauna sugiere que durante la helamiento Wisconsin el noroeste del Perú fué una sabana arbolada, o una sabana con bastante ribereño. Al fin del Wisconsin cambios climáticos causaron las condiciones de un desierto en la región y dieron por resultado la extinción del 23 porciento de las especies no paserinas de la avifauna.

La paleoavifauna de los depósitos de asfaltos de Rancho la Brea, California, que son similar en edad incluye 98 especies no paserinas en comparación con las 89 especies no paserinas de los depósitos de Talara. Hay 16 especies que se encuentran en ambas localidades. Ventitres porciento de las especies no paserinas que se conocen de Talara están extintos, en comparación con 17 porciento de las especies no paserinas que se conocen de Rancho La Brea.

La semejanza de alto grado entre las paleoavifaunas de los “Talara Tar Seeps” y los depósitos de asfaltos de La Carolina, Ecuador, sugiere que la deposición fué simultánea en las dos localidades. La semejanza sugiere tambien que las condiciones climáticas en las dos localidades fueron comparables durante el Wisconsin como en el presente y que las dos localidades sobrellevaron el mismo procedimiento de desierto desarrollado al fin del Wisconsin.

Résumé

Les “Talara Tar Seeps” sont des séries localisées de dépôts fossilifères de la dernière partie de la période pleistocène et se trouvent au nord-ouest de Pérou, approximativement à 04°33'S, 81°7'W. Les dépôts sont situés sur une terrasse marine, datant sans doute de la période sangamon. Ces dépôts datent d'environ 13,900 ans.

Une étude sur la façon dont les animaux furent pris au piège suggère que l'infiltration du goudron sur la surface de la terre peut être un piège d'animaux de plusieurs manières, selon de différentes conditions pendant une longue période de temps. L'efficacité de chaque infiltration, en tant que piège, varie selon les différents types d'animaux et le moment de l'enlèvement.

La paléoavifauna des “Talara Tar Seeps,” ne comprenant pas les passereaux est celle que nous étudions ici. Elle consiste de plus de 6,200 specimens représentant un minimum de 744 oiseaux de 13 ordres, 24 familles, 67 genres, et 89 espèces. Six nouveaux genres et 21 nouvelles espèces sont décrits ici. Les familles suivantes sont représentées, avec le nombre d'espèces, identifiées pour chaque famille (nombres des nouvelles espèces entre parenthèses):

Tinamidae, 1; Podicipedidae, 2; Phalacrocoracidae, 2; Ardeidae, 6(1); Plataleidae, 4(2); Ciconiidae, 2; Anatidae, 9(4); Vulturidae, 6(3); Accipitridae, 7(2); Falconidae, 6(1); Cracidae, 1; Rallidae, 1; Charadriidae, 7(2); Scolopacidae, 14(3); Phalaropodidae, 3(1); Jacanidae, 1; Burhinidae, 1; Thinocoridae, 3(1); Laridae, 2; Columbidae, 4; Psittacidae, 1; Tytonidae, 1; Strigidae, 3; Caprimulgidae, 2(1). La position taxonomique de deux paléoespèces reconnues sont changées: *Archeoquerquedula lambrechtii* Spillmann devient un synonyme de *Anas bahamensis* Linnaeus, et *Morphnus woodwardi* L. Miller, devient *Amplibuteo woodwardi* (L. Miller). Les caractères ostéologiques sont décrits dans les cas où il est nécessaire de justifier l'identification des espèces.

La côte nord-ouest de Pérou où se trouvent les "Talara Tar Seeps" est une région désertique à notre époque. Pendant l'été, les pluies sont rares et imprévisibles, faisant suite généralement à un phénomène océanique connu sous le nom de "El Niño." Pendant l'hiver, il ne pleut pas, mais le temps est toujours nuageux. Cette condition est connue sous le nom de "garúa." La portion de la paléoavifauna, (excepté les passereaux) fait penser que pendant la période glaciaire du Wisconsin, la partie nord-ouest de Pérou était une savanne boisée, avec même des forêts le long des rivières. A la fin de la période glaciaire du Wisconsin, le changement de climat amena les conditions désertiques de cette région, et provoqua l'extinction de 23 pour cent des espèces dont il est question ici.

La paléoavifauna des dépôts d'asphalt de Rancho La Brea, California, datant approximativement du même âge, comprend 98 espèces (sans compter les passereaux), comparé à 89 dans les dépôts de Talara. Seize espèces se trouvent aux deux endroits. Vingt-trois pour cent des espèces connues de Talara sont éteintes, comparé à dix-sept pour cent à Rancho La Brea.

L'importante similarité entre les "Talara Tar Seeps" et des dépôts d'asphalt de la Carolina, en Equateur, indique que ces dépôts datent de la même période, que les conditions climatiques étaient semblables pendant la période glaciaire du Wisconsin et qu'elles le sont encore aujourd'hui; elles devinrent désertiques à la fin de la période glaciaire du Wisconsin.

Introduction

When one considers the large number of publications on fossil mammals from South America it is clear that palaeontologists have long been active and involved with the study of fossils from that continent. Studies on fossil birds from South America, however, have been few and far between.

Most of the published works are very old, centred in the decades surrounding the turn of the century. There are at present 77 palaeospecies of birds recognized from South America, with 70 coming from Argentina, three from Ecuador, two from Brazil, and one each from Colombia and Chile (Brodkorb, 1963, 1964, 1967, 1971; Campbell, 1976; Simpson, 1972). While most of the palaeospecies that were described around 1900 were valid species according to the standards considered adequate at that time, a re-evaluation of these taxa using the much more rigorous standards of today would probably result in a substantial reduction in their number. This re-evaluation has recently been accomplished with the fossil penguins by Simpson (1972).

The oldest avian palaeospecies known from South America is the Upper Cretaceous diving bird *Neogaeornis wetzeli* Lambrecht (1929), recorded from two localities in Chile. An additional, as yet undescribed, Cretaceous bird has recently been discovered in Argentina (pers. comm., Pierce Brodkorb). The remaining recognized palaeospecies are distributed temporally as follows: Eocene, 3; Oligocene, 15; Miocene, 29; Pliocene, 12; and Pleistocene, 17. The major published works describing avian palaeospecies from South America are those of Ameghino (1891, 1895, 1899, 1901, 1905), Moreno and Mercerat (1891), Mercerat (1897), Rovereto (1914), Kraglievich (1931), and Simpson (1972). All but 16 of the recognized extinct taxa are described in those papers, the remainder being scattered through the following 14 publications: Ameghino (1882, 1887), Lambrecht (1929), Ameghino and Rusconi (1932), Patterson (1941), Rusconi (1946), Spillmann (1942), A.H. Miller (1953), Howard (1955), Cattoi (1957), Rusconi (1958), Patterson and Kraglievich (1960), Craycraft (1970), Campbell (1976).

Approximately 155 neospecies have been recorded as fossils from South America, with at least 25 species being recorded from more than one locality. The largest number (102) were recorded from the late Pleistocene to Recent cave deposits of Minas Gerais, Brazil, by Winge (1887), while the second largest collection described (43 neospecies) was that from the late Pleistocene deposits of La Carolina, Ecuador (Campbell, 1976). The other major papers in which neospecies are recorded are those of Ameghino (1891), Lambrecht (1933), and Wetmore (1935). In addition to those from Brazil and Ecuador, neospecies have been reported from Argentina (14), Bolivia (1), Chile (1), Peru (7), and Venezuela (14). Additional publications reporting the occurrence of neospecies are as follows: Clarke (1882), Moreno and Mercerat (1891), Stresemann (1924), and Kraglievich and Rusconi (1931). The palaeospecies described by Lönnberg (1902) is synonymized herein with a neospecies.

The present work grew out of the collections of fossil material from numerous surface tar seeps in northwestern Peru which were made by Dr. A. Gordon Edmund, Dr. Roy Lemon, and R.R. Hornell of the Royal Ontario Museum, Toronto, Canada, during January and February, 1958. The materials collected included extensive

samples of plant, invertebrate, and vertebrate remains. The collections came from tar seeps located in the La Brea-Pariñas oil field, near Talara, Peru (Fig. 1). These deposits are referred to as the "Talara Tar Seeps" to avoid confusion with the similar deposits at Rancho La Brea, California. This report is the first on the avian remains of the deposit and is concerned with the non-passerine portion of the avifauna. Additional work needs to be completed before the passerine species are satisfactorily identified.

The Talara Tar Seeps are located in Departamento de Piura, just west of the Pan American Highway, km 1125, approximately 10 km west of the southern end of the

Fig. 1 Map of northwestern Peru showing location of the Talara Tar Seeps.

Amotape Mountains, 37 km due east of the Pacific coast at Punta Pariñas, the westernmost point of South America, and 18 km southeast of Talara. The site is marked on maps as the town of La Brea, but only a cemetery remains. The tar seeps were first worked by pre-Columbian Indians, who used the natural asphalt in their road construction programme. Spaniards made extensive use of the pitch later, developing it into a considerable economic resource. The first oil well in South America was drilled at the site in 1862, although at the present time there are no active wells nearby. Unfortunately, fossiliferous material is presently being removed and used as patching material for nearby roads.

The non-passerine avifauna described herein is quite diverse, containing representatives of 13 orders, 24 families, 67 genera, and 89 species. Of the species recorded, 53 are represented by 5 or more specimens, 43 by 10 or more specimens, 17 by 15 or more specimens, and 10 species are represented by over 100 specimens. The species represented by the most specimens is *Anas bahamensis*, of which there are 2,864 bones from a minimum of 243 individuals. Unfortunately, 20 of the species are represented by only one specimen. While this does not bear on the accuracy of the identification of these species, a larger sample size is always preferred and is more convincing for a large number of readers. Honest scepticism of conclusions drawn from small sample sizes is quite understandable. However, the identification of each species recorded herein is based on clearly diagnostic material.

The habitat requirements of the neospecies represented range from the semi-arid conditions found at the site today (*Forpus coelestis*, *Thinocorus rumicivorus*) to year-round standing water surrounded by some type of forest (*Dendrocygna autumnalis*, *Cairina moschata*). Many species that require very wet conditions for feeding and/or reproduction, such as the grebes (two species), herons (six species), ibises (three species), and ducks (nine species) are represented. Also requiring similar very wet conditions are the 17 charadriiform species that are winter migrants from North America.

Nineteen species of diurnal raptors are represented, most of them probably drawn to the site by the attraction of dead or dying animals trapped in the pools of oil or tar. The size of these predatory birds ranged from the giant condors (three species) to the small kestrel, *Falco sparverius*. Of this group, two species of the condors have become extinct since the time of deposition of the fossils, as well as one very large vulture, two giant eagles, and one caracara. Three other raptors are recorded that probably represent extinct species, but which must remain unnamed until additional comparative material of living species is available.

The owls are represented by four neospecies, all of which are at present widely distributed in North and South America, and elsewhere in some cases. In terms of specimens and individuals the Great Horned Owl, *Bubo virginianus*, is the most abundant species of owl (110 specimens), but the Barn Owl, *Tyto alba*, is not far behind (83 specimens). The remains of these two species are more abundant than those of any other species of bird of prey, with the exception of the two species of caracaras which are, or were, diurnal carrion feeders.

The doves are also represented by four species, two of which are very common. The Croaking Ground-Dove, *Columbina cruziana*, is represented by 578 specimens from at least 68 individuals, which makes it the most abundant species of dove present in the collection. This dove is at present found in large flocks in areas with small to moderate vegetation cover throughout northwestern Peru.

The remaining species represented are from several families and make up a very diverse group. They are from such groups as the tinamous, cormorants, curassows, rails, thick-knees, gulls, and nighthawks. Again, they represent a group of species with habitat requirements ranging from standing water (cormorants) to forest (curassows) to semi-arid desert (thick-knees).

The first palaeospecies of the families *Thinocoridae* and *Caprimulgidae* are described herein. Also described as new are six genera and 19 additional species. As indicated by the samples from the Talara Tar Seeps, approximately 25 per cent of the avifauna of northwestern Peru has become extinct during the short time since the fossils were deposited about 14,000 years ago.

This paper is intended primarily as a systematic description of the avian species found at the Talara Tar Seeps. An attempt has been made to state clearly how closely related species differ osteologically, so as to facilitate the labour of later workers in the field. In a paper in preparation I will discuss in detail the palaeoecological implications of the palaeoavifauna of the Talara Tar Seeps for northwestern Peru, and northwestern South America.

Materials and Methods

The fossil specimens from the Talara Tar Seeps were loaned by the Royal Ontario Museum (designated as ROM), Toronto, Canada, to which most will be returned at the termination of this study. A representative sample will be placed in the Collection of Pierce Brodkorb, Department of Zoology, University of Florida.

The type of one species of *Anas* described herein was taken from the collection of fossil birds from the Late Pleistocene of La Carolina, Ecuador. While that collection has been described earlier (Campbell, 1976) I thought it best to delay formally describing this species until it could be done in conjunction with the other new species of *Anas*. As the material from La Carolina is on loan to me, the holotype is uncatalogued pending its ultimate disposition.

Nearly all modern skeletons used for comparative purposes were prepared by maceration. Skeletons that have been prepared by dermestid beetles are often not free of all tendinal materials, and the grease or fats found on the surface may obscure the fine detail of a bone.

Osteological terminology was taken primarily from Howard (1929). Fisher (1946), Fisher and Goodman (1955), and Owre (1967) were also consulted.

All measurements were taken with vernier dial calipers accurate to 0.05 mm, and rounded off to the nearest 0.1 mm. The following abbreviations are used in the tables and text: M, mean; n, number of specimens measured; OR, observed range. All measurements given in the text are in mm.

Geology

Site Description

The geology of northwestern Peru has been discussed by Bosworth (1922), Iddings and Olsson (1928), Travis (1953), and Lemon and Churcher (1961). Additional information is presented by Sheppard (1937) in his discussion of the geology of Ecuador. The following is a brief summary of the geology of the Talara region based on these works.

The current major oil-producing area of Peru is known as the La Brea-Pariñas oil field, which straddles the 4th parallel. The oil field occupies the westernmost part of the South American continent, and lies between the Pacific Ocean on the west and the Amotape Mountains, a small outlier of the Andes Mountains, to the east. The Amotape Mountains and basement rocks of the coastal area consist of Pennsylvanian quartzites, graywackes, argillites, and shales. Directly upon these lie a series of Cretaceous rocks in excess of 2700 M in thickness. The Cretaceous sediments consist of a lower series of limestones, and an upper series of shales, sandstones, and conglomerates.

The main oil-producing rocks are of Eocene age, and consist of approximately 4,600 M of marine clastic sediments. Shales, sands, and a few conglomerates are present in these sediments that originated during the orogenic uplift of the Andes Mountains directly to the east. These sediments are highly faulted and of complex structure as a result of post-depositional orogenic movement.

Early, or perhaps Middle, Pleistocene to Recent marine deposits overlie the Eocene rocks and consist of well stratified marls, limestones, calcareous sands, coquinas, and pebble beds. These deposits occupy three wave-cut terraces, named the Mancora Tablazo (highest and oldest), the Talara Tablazo (middle terrace, not much younger than the Mancora Tablazo), and the Lobitos Tablazo (lowest and youngest). The terraces represent periods of marine encroachment followed by orogenic uplift, which was greater in the north than in the south, giving the terraces a southward tilt. The deposits are thickest in the north and thin southward, with a maximum thickness of 16 to 25 M. The Talara Tar Seeps rest on the Mancora Tablazo (Fig. 2). Their age, as determined by radiocarbon dating, has been given as ca 13,900 B.P. (Churcher, 1966). Recent deposits consist of large alluvial breccia fans from the Amotape Mountains, valley terraces, sand dunes, and Recent marine deposits.

Processes of Entrapment

Of all the different ways that organisms can be fossilized, perhaps the one most likely to preserve the remains of an animal with little or no alteration is for the living animal to become mired in a surface flow of oil, or its distillate, tar. The term "tar seep" is a misnomer because tar itself does not seep from the ground. Rather, it is liquid petroleum, or crude oil, that escapes to the surface through cracks in the rocks that overlie the petroleum deposit. Once the crude oil is exposed to the atmosphere, the lighter, more volatile hydrocarbon compounds evaporate, leaving behind the heavier hydrocarbon compounds that make up what is referred to as tar, and after further distillation, asphalt. Since oil seeps can act as traps in different ways at different times, depending on the condition of the oil or tar and the type of organism

Fig. 2 Overview of the Talara Tar Seeps, northwestern Peru, looking north. The strata indicated by the long arrow are representative of deposits formed by the horizontal type of oil seep. The short arrow indicates the wedge-shaped, lensing type of deposit seen in close-up in Fig. 5.

involved, a short consideration of the ways that oil seeps may serve as traps is appropriate.

First, a simple pool of fresh crude oil may be expected to be an effective, although selective, trap. Mammals should be able to distinguish between pools of oil and water before entering them because they usually move slowly on the ground and possess well-developed olfactory organs that allow them to smell the normally odiferous crude oil. If the oil should be floating on water, and under such circumstances perhaps being less detectable, it is reasonable to expect a few mammals to wade into the water and become covered with oil. The size of the animal may then determine if it is able to escape successfully, or be trapped. A pool of oil is a much deadlier trap for birds, however, because from the air a pool of oil looks exactly like a pool of water. Because they move rapidly through the air and generally lack well-developed olfactory organs, birds would perceive the oil as water and alight. A bird could land either in the pool, as would a duck, or on the shore, after which it might wade into the pool, as would a sandpiper. If the pool were pure oil it might be reasonable to expect a wading bird to detect this and stay out after landing on the shore. Detection might be more difficult if there is a thin layer of oil on the surface of the water. In either case, once a bird moves into a pool of oil or oil-covered water it is in serious trouble, primarily because of the oil coating the feathers. This makes the feathers useless for, and even a hindrance to, locomotion. Unlike a mammal that might blunder into a pool of oil and still walk out, a bird cannot fly with oil-covered feathers, as anyone experienced with modern oil spills can attest. Struggling simply ensures that more oil will cover the feathers and hasten the end result, which can only be entombment. If the pool is of water with only a light coating of oil a bird might escape, only to perish elsewhere as a result of poisoning from oil inadvertently swallowed while being preened from the feathers.

A second type of trap may be formed after the oil has been exposed at the surface for a period of time and, as a result, has lost the most volatile hydrocarbons. At this stage it forms a more sticky substance, more properly referred to as tar, which, depending on its depth, can be expected to trap any size of mammal or bird. The "stickiness" of the tar would tend to hold the animal, much like flypaper is used to trap flies. Struggling only tends to make an animal mired in the tar sink deeper. An added factor with oil as it approaches the consistency of tar is the degree to which its effectiveness as a trap increases as the air temperature rises. From late evening through the early morning the cool air temperature will tend to solidify the tar, making it quite safe to move around on. If an animal fails to leave the tar before it warms up, or if it should attempt to traverse during mid-day the same area it did during the night, it could very well become trapped. During this stage, the oil, or tar, may act to entrap birds and mammals in a more similar manner than in the first type of trap, and not select between the two groups.

Animals trapped by tar at this stage probably act as an attractant that lure carnivores, raptors, and both mammalian and avian scavengers onto the tar. Because tar is much denser than crude oil, it would take a longer time for trapped animals to sink, or to be completely covered if the tar is deep enough, than in a pool of oil. Diurnal predators and scavengers would be attracted to the trapped animals at just those times when they themselves would be likely to be trapped, while nocturnal predators and scavengers would feed at times when the tar would be least "sticky".

A third type of trap can be formed when debris covers the tar, making it

undetectable. This occurs when enough of the volatiles have evaporated, leaving behind residual hydrocarbons dense enough to support sand, dust, leaves, or other light material that may fall on the surface of the tar. Under these conditions the tar is undetectable, and when the air temperature is low, the tar with its camouflaged surface may be able to support almost any size of organism. When warm, however, the debris forms a thin crust which may give way, allowing the animal to sink into the sticky tar under the crust from which it cannot escape. This type of trap is probably of less significance for trapping birds than it is for larger mammals. However, if a large mammal floundered enough to break up the covering crust surrounding it before dying, scavenging birds could then be trapped in the freshly exposed tar when they came to feed on the carcass. An example of a mammal trapped in a deep horizontal flow that had been covered with a crust of sand is shown in Fig. 3. Illustrated here is a goat that had walked out onto the sand and dust covered tar, only to have the crust give way under it. As the goat is only partially buried in the tar, it can act as an attractant for carnivores or scavengers, and only that portion of the skeleton actually buried will be preserved.

There are two ways that oil may collect after seeping onto the surface to form a pool that acts as a trap. One way is for the oil to spread over a large horizontal area, forming either a shallow pool or thin coat on the ground surface. A deep pool may form if there is abundant oil. If these types of pools are very shallow they will not be able to effectively trap large mammals, but they will still be very effective in trapping any birds that might land on them believing them to be water. If this type of flow is too shallow to allow the animal to be completely covered, only a portion of the skeleton will be preserved. An example of this partial preservation is illustrated in Fig. 4, which shows an Olivaceous Cormorant (*Phalacrocorax olivaceus*) that landed in a shallow layer of oil. The bird and the oil surrounding it were covered with some of the sand, silt, or dust, that is blown about a great deal in the semi-arid environment after it was trapped. The skull of this cormorant is already badly weathered and it will not become fossilized. Other parts of the skeleton as well may not become fossilized, since it is only half buried in the tar. An illustration of a fossil deposit that formed from a horizontal flow is shown in Fig. 2.

A second way that oil may collect on the surface is for it to fill a natural depression. The commonest depressions to be found on the flat, wave-cut terraces in this region would be the channel bottoms of streams, or gullies. In order for a pool of oil to gather in a stream channel it would have to be dry, or at least carrying only a small amount of water. This condition would be expected if rainfall in the vicinity was limited to a few months a year. If a slow movement of water existed in a channel filled with oil or tar, the effectiveness of the pool as a trap would be increased because mammals that would otherwise stay away might be drawn in by the water.

The pools that formed in the channels were probably deeper than the horizontal flows, and were therefore, able to trap larger mammals. It is also likely that there were, at a minimum, riparian forests that followed the streams out of the Amotape Mountains, where they most likely originated. The deepest pools of oil can be expected to form where a stream is undercutting its channel bank, and some of the animals moving about in the vegetation above such a steep slope can be expected to fall into the pools below. An example of the lense-shaped type of fossil deposit that would form in a stream channel is shown in Figs. 5.

It is evident from the fossil deposits illustrated in Figs. 2 and 5 that both types of

Fig. 3 View of a goat that was trapped in a horizontal flow when the covering crust of sand and silt broke under its weight.

Fig. 4 View of an Olivaceous Cormorant, *Phalacrocorax olivaceus*, recently entombed in a surface layer of tar.

Fig. 5 Close-up view of the fossil deposit, showing lensing type of deposition and abundance of fossil material.

deposits were formed at the Talara Tar Seeps. Although there are no active oil seeps in the area now, oil and water currently escaping from abandoned oil wells attract both vertebrate and invertebrate animals and act as active traps. Windblown sand and dust usually form a crust over most of the oil seeping onto the horizontal surfaces. Persistent large pools of oil occur only in areas where man has excavated the natural asphalt for road material or museum collections.

The preservation of the fossils is very good, and in numerous cases broken specimens could be pieced back together, even though the pieces were sometimes separated at the time of collection. The avian specimens range in size from complete humeri of condors to those of swallows. Small specimens are not lacking, as there are an estimated 2,500 to 3,000 specimens of passerines in the collection that are being worked on. Numerous skulls of various species are also present in the collection. The excellent condition of these specimens indicates that there has been little or no post-depositional alteration of the fossils. Since tar becomes very difficult to move once it has passed to the asphalt stage it can be assumed that the present deposits were formed *in situ*, and that there has been no selective sorting or alteration of the faunal composition once the bones were immersed in the tar. Any process of selection operating to produce more specimens of one species than another would be a direct result of the habitat preferences and/or behavior patterns of the respective species, and which of the three types of traps described earlier was involved. The possibility of predator or scavenger preference for a given species must also be taken into consideration as a selective force working to reduce the number of specimens of a species fossilized. For additional information on entrapment in pools of oil or tar see Stock (1956).

Systematic List

The following systematic list details the non-passerine species known from the Talara Tar Seeps, as summarized in Table 1. Nomenclature used above the species level is primarily that of Brodkorb (1963, 1964, 1967, 1971). Except where otherwise noted, species distributions are taken from Meyer de Schauensee (1966).

The following osteological diagnoses are based on as many comparative specimens of each species that I considered reasonable, or necessary, to obtain. In many cases the series available is admittedly too small, and this should be kept in mind when using osteological characters given for each species. This problem was greatest when comparative skeletons of South American species were involved, as many species are simply not to be found in North American collections. The lack of comparative material from the South American avifauna has been particularly significant in working with certain taxonomic groups, such as the accipitriform species, and it has permitted the referral of three fossil species to genera only because of a lack of available specimens of all species of certain genera. It is hoped the diagnoses will stand the test of time, but I will not be surprised if future work leads to some alterations.

In some instances specimens are thought to represent immature individuals. This conclusion is based on the pitted appearance of the surface of the bone and incomplete ossification of the articular facets.

No characters are listed for a species if the fossil specimens do not vary significantly from living representatives of the species, and if the species is sufficiently distinct from related species to minimize the possibility of error in identification.

Order Tinamiformes (Huxley)

Family Tinamidae Gray

***Crypturellus* Brabourne & Chubb**
***Crypturellus* cf. *transfasciatus* (Sclater & Salvin)**
Pale-browed Tinamou

Material

Proximal end of one right humerus. ROM 13033.

Remarks

At the present time *C. transfasciatus* occurs from the equator in western Ecuador south to Tumbes and Piura in northwestern Peru. It is the only tinamou found in the dry deciduous forests that surround the semi-arid and arid regions of southwestern Ecuador and coastal Peru. The fossil specimen corresponds to the estimated size of the humerus of *C. transfasciatus*, but as no skeletal material was available for comparison the specimen is only tentatively referred to that species.

Order Podicipediformes (Fürbringer)

Family Podicipedidae (Bonaparte)

***Podiceps* Latham**
***Podiceps dominicus* (Linnaeus)**
Least Grebe

Material

One complete right coracoid, 1 nearly complete left femur, proximal end of 1 left femur, proximal end of 1 left tarsometatarsus. ROM 13034–13036, 13100. The 4 specimens represent a minimum of 2 individuals.

Remarks

The present range of *P. dominicus* includes northwestern Peru.

[illegible]

Podilymbus Lesson
Podilymbus podiceps (Linnaeus)
Pied-billed Grebe

Material

Proximal end of 1 right humerus, 1 nearly complete right femur, proximal end of 1 right femur, 1 complete left tarsometatarsus. ROM 13101–13104. The 4 specimens represent a minimum of 2 individuals.

Remarks

The present range of *P. podiceps* includes northwestern Peru, and I would expect to find this grebe on almost any body of fresh water in coastal Peru, although perhaps not in large numbers.

Order Pelecaniformes Sharpe
Suborder Sulae Sharpe
Family Phalacrocoracidae (Bonaparte)

Phalacrocorax Brisson
Phalacrocorax olivaceus (Humboldt)
Olivaceous Cormorant

Material

Two maxillae, distal halves of 2 right and 2 left mandibles, 5 right and 2 left scapulae, 5 complete right and 11 complete left coracoids, humeral ends of 1 right and 3 left coracoids, sternal ends of 2 right and 4 left coracoids, 2 complete left humeri, proximal ends of 2 right and 4 left humeri, distal ends of 7 right and 6 left humeri, proximal ends of 3 right and 2 left ulnae, distal ends of 5 right and 2 left ulnae, proximal ends of 5 right and 2 left radii, distal ends of 4 right and 1 left radius, 3 complete right and 1 complete left carpometacarpus, proximal ends of 1 right and 1 left carpometacarpus, 4 complete right and 4 complete left femora, proximal end of 1 left femur, distal ends of 1 right and 1 left femur, 2 complete right and 1 complete left tibiotarsus, proximal ends of 1 right and 2 left tibiotarsi, distal ends of 1 right and 3 left tibiotarsi, 8 complete right and 8 complete left tarsometatarsi, proximal ends of 3 left tarsometatarsi, distal ends of 1 right and 2 left tarsometatarsi. ROM 13105–13237. The 133 specimens represent a minimum of 15 individuals.

Characters

Phalacrocorax olivaceus differs from *P. bougainvillii* and *P. gaimardi* by having a larger premaxillary and mandible.

Postcranial elements of *P. olivaceus* are generally smaller than those of *P. gaimardi*, although size ranges of the two species overlap. They are much smaller, and especially more slender, than those of *P. bougainvillii*. Compared with *P. bougainvillii* and *P. gaimardi*, *P. olivaceus* has scapula with (1) glenoid facet distinctly triangular (more rounded in *P. bougainvillii* and *P. gaimardi*); (2) acromion wide and moderately long (wide and long in *P. bougainvillii*, narrow and moderately

long in *P. gaimardi*); (3) protrusion on lateral surface of shaft distal to glenoid facet round and prominent (elongated and only slightly raised, if any, in *P. bougainvillii* and *P. gaimardi*).

Coracoid with (1) shaft very slender (very robust in *P. bougainvillii*, slender in *P. gaimardi*); (2) bicipital attachment narrow and deeply concave (wide and moderately to slightly concave in *P. bougainvillii* and *P. gaimardi*); (3) procoracoid short and rounded (moderate to long, stouter, and more angular in *P. bougainvillii* and *P. gaimardi*); (4) attachment of Lig. humero-coracoideum anterius superius deep (superficial in *P. bougainvillii* and *P. gaimardi*); (5) humeral end narrow (wide in *P. bougainvillii* and *P. gaimardi*).

Humerus with (1) pneumatic fossa moderately excavated (deeply excavated in *P. bougainvillii* and *P. gaimardi*); (2) deltoid crest small, smoothly rimmed (larger and locally angular in *P. bougainvillii* and *P. gaimardi*); (3) attachment of M. extensor metacarpi radialis inset in shallow depression (located on raised platform in *P. bougainvillii*; inset in depression in *P. gaimardi*, but bordered distally by large ectepicondylar prominence); (4) attachment of anterior articular ligament with moderate slope (lesser slope in *P. bougainvillii*, greater slope in *P. gaimardi*).

Ulna with (1) internal cotyla narrow (wider in *P. bougainvillii* and *P. gaimardi*); (2) external cotyla wide and moderately long (long and narrow in *P. bougainvillii*, short and narrow in *P. gaimardi*); (3) external condyle of moderate width and length (narrow and long in *P. bougainvillii*, moderately wide and short in *P. gaimardi*); (4) carpal tuberosity moderately large (large in *P. bougainvillii* and *P. gaimardi*).

Radius with (1) insertion of M. biceps moderately deep (very deep in *P. bougainvillii* and *P. gaimardi*); (2) projection extending from lateral end of carpal facet sharp and pointed (only slightly developed in *P. bougainvillii* and *P. gaimardi*).

Carpometacarpus with (1) external rim of carpal trochlea small (much wider in *P. bougainvillii*, slightly wider in *P. gaimardi*); (2) process of metacarpal I narrow (broad in *P. bougainvillii* and *P. gaimardi*); (3) pollical facet wide (narrower in *P. bougainvillii* and *P. gaimardi*).

Femur with (1) iliac facet small (larger in *P. bougainvillii* and *P. gaimardi*, even though the femur is shorter in *P. gaimardi*); (2) internal condyle slightly angular distally (more rounded, and rotated posteriad, in *P. bougainvillii* and *P. gaimardi*); (4) shaft slender (much heavier in *P. bougainvillii* and *P. gaimardi*).

Tibiotarsus with (1) outer cnemial crest wide and short (wide and long in *P. bougainvillii*, narrow and short in *P. gaimardi*); (2) shaft slightly to moderately concave distal to internal articular surface (deeply concave in *P. bougainvillii*, slightly to moderately concave in *P. gaimardi*); (3) internal condyle short and moderately wide (long and wide in *P. bougainvillii*, long and narrow in *P. gaimardi*); (4) size very small.

Tarsometatarsus with (1) internal cotyla short, narrow, and moderately concave (longer, wider, and more concave in *P. bougainvillii* and *P. gaimardi*); (2) inner extensor groove wide (narrow in *P. bougainvillii* and *P. gaimardi*); (3) external trochlea narrow (wide in *P. bougainvillii* and *P. gaimardi*); (4) distal foramen of moderate size (smaller in *P. bougainvillii*, much larger in *P. gaimardi*).

Remarks

Phalacrocorax olivaceus is generally distributed throughout South America, and is common in coastal lagoons, marshes, lakes, and rivers. The osteological comparisons

were made between four specimens of *P. olivaceus*, 16 specimens of *P. bougainvillii*, and three specimens of *P. gaimardi*.

Phalacrocorax bougainvillii (Lesson)
Guanay Cormorant

Material

Distal end of one right humerus. ROM 13238

Remarks

Phalacrocorax bougainvillii is a marine species that breeds on offshore islands and comes ashore only rarely, and then usually only during times of distress (Murphy, 1936). The population of this species numbers in the millions, and it undergoes wide fluctuations. At times, when the population crashes, the beaches are literally covered with corpses. This happens whenever the warm current known as El Niño appears. The single specimen in the collection suggests that this species can be regarded as a rare straggler inland in the Talara region.

Order Ardeiformes (Wagler)
Suborder Ardeae Wagler
Family Ardeidae Vigors

Ardea Linnaeus
Ardea cocoi Linnaeus
White-necked Heron

Material

One right scapula, proximal ends of 1 right and 1 left carpometacarpus, distal ends of 2 left carpometacarpi, distal end of 1 right tarsometatarsus. ROM 13239–13244. The 6 specimens represent a minimum of 2 individuals.

Remarks

The largest living South American heron, *A. cocoi* is generally distributed over the entire continent. It is found in coastal marshes and lagoons in Peru, although only in small numbers.

Casmerodius Gloger
Casmerodius albus (Linnaeus)
Common Egret

Material

Two complete right and 2 complete left coracoids, humeral ends of 2 right coracoids, 1 right scapula, 1 complete left carpometacarpus, proximal end of 1 left

carpometacarpus, distal end of 1 right tibiotarsus, distal end of 1 right tarsometatarsus. ROM 13245–13255. The 11 elements represent a minimum of 4 individuals.

Remarks

Generally distributed over all of South America, *C. albus* is common in coastal marshes and lagoons of Peru.

Egretta T. Forster
Egretta thula (Molina)
Snowy Egret

Material

Two right scapulae, 2 complete right coracoids, proximal end of 1 left humerus, 1 complete right femur, proximal end of 1 right femur. ROM 13256–13262. The 7 specimens represent a minimum of 2 individuals.

Additionally, the following specimens are identified to genus only: one complete right and 2 complete left carpometacarpi, distal ends of 3 left tibiotarsi, proximal end of 1 right tarsometatarsus, distal ends of 3 right and 5 left tarsometatarsi. ROM 13263–13277.

Characters

The three species of *Egretta*, *E. thula*, *E. (Hydranassa) tricolor*, and *E. (Florida) caerulea*, are extremely difficult to separate osteologically. Characters used to identify the fossil specimens of *E. thula* are given below, but intraspecific variation is so great that even these characters may prove to be invalid if sufficient series are examined.

Compared with *E. caerulea* and *E. tricolor*, *E. thula* has scapula with (1) thickness between acromion and coracoidal articulation moderate, but variable (similar in *E. caerulea*, slightly thicker in *E. tricolor*); (2) length of acromion base moderate (less in *E. caerulea*, greater in *E. tricolor*).

Coracoid with (1) curvature of coracohumeral surface slight to moderate as traced by central groove (similar in *E. caerulea*, very slight in *E. tricolor*); (2) angle between internal edge of furcular facet and triosseal canal slightly more than 90° (much larger in *E. caerulea*, and the area is well rounded; slightly larger in *E. tricolor*).

Humerus with (1) distal end of attachment of M. proscapulohumeralis surrounded by attachment of M. triceps, external head (not surrounded in *E. caerulea*, roughly similar in *E. tricolor*); (2) external attachment of M. supracoracoideus short and deep (short and shallow in *E. caerulea*, long and shallow in *E. tricolor*).

Carpometacarpus with (1) intermuscular line between pollical facet and pisiform process lying near pollical facet (similar in *E. caerulea*, positioned posteriorly in *E. tricolor*). No characters were found that reliably separated the carpometacarpi of *E. thula* from those of *E. caerulea*. The three fossil specimens could thus be separated from *E. tricolor*, but assignment to either *E. thula* or *E. caerulea* was not possible.

Femur with (1) iliac facet narrow anteroposteriorly (narrow to moderate width in *E. caerulea*, broader in *E. tricolor*); (2) external condyle flat dorsally (similar in *E. caerulea*, extending farther dorsad in *E. tricolor*); (3) distal end broad (narrow in *E. caerulea*, broad in *E. tricolor*).

Tibiotarsus with (1) rotular crest low (low in *E. caerulea*, higher in *E. tricolor*); (2) external condyle slightly undercut dorsoproximally (not undercut in *E. caerulea*; slightly, or not, undercut in *E. tricolor*). As no reliable characters were found to separate the tibiotarsi of *E. thula* and *E. tricolor*, the specimens are referred to genus only.

No reliable characters for separating the tarsometatarsi of the three species of *Egretta* were found. For this reason the specimens are referred to genus only.

Remarks

Generally distributed over almost all of South America, *E. thula* is common in coastal lagoons and marshes of Peru.

I have chosen to lump *Egretta*, *Hydranassa*, and *Florida* because of the very close similarity in their osteology. If the three cannot be reliably distinguished at the species level they should not be considered distinct genera. The comparisons were made using more than 10 specimens of each species.

Egretta caerulea (Linnaeus)

Little Blue Heron

Material

One complete left coracoid. ROM 13278.

Remarks

Generally distributed over almost all of South America, *E. caerulea* is found in coastal lagoons and marshes of Peru, but not in such large numbers as *E. thula*.

Syrigma Ridgway

Syrigma sanctimartini sp. nov.

Fig. 6A

Holotype

Complete left coracoid. ROM 12892.

Diagnosis

Coracoid agrees with that of *Syrigma* and differs from that of all other genera of South American herons by having (1) head broad and slightly peaked in medial view (subangular to subrounded); (2) brachial tuberosity prominent and angular; (3) triosseal canal very deep adjacent to glenoid facet; (4) attachments of M. coracobrachialis anterior and Lig. humero-coracoideum anterieus superius deep, elongated and notched, with center of latter lying parallel to, and roughly in line with,

anterior edge of shaft; (5) protrusion internal to glenoid facet large, bordering ventral side of triosseal canal; (6) external side of shaft with slight ridge running ventrad from middle of head.

Coracoid differs from that of *S. sibilatrix* (Temminck) by having (1) coracohumeral surface short, displacing dorsal-most point of head posteriad; (2) furcular facet larger; (3) brachial tuberosity larger; (4) humeral end with medial side flatter (locally more convex and concave in *S. sibilatrix*); (5) protrusion internal to glenoid facet smaller; (6) head thicker between attachment of Lig. humero-coracoideum anterius superius and anterior furcular facet; (7) glenoid facet rotated posteriad, lengthening distance from external edge of glenoid facet to anterior edge of shaft; (8) external sternal facet much higher. Measurements of the holotype, with those of one male specimen of *S. sibilatrix* in parentheses, are as follows: length, 42.3 (41.6); head to scapular facet, 13.3 (13.5); proximal depth, 9.5 (9.2); least depth of shaft, 4.2 (4.3).

Etymology

This species is named for José de San Martín, who proclaimed Peruvian independence at Lima on July 28, 1821.

Remarks

The genus *Syrigma* is represented by one living species in South America, *S. sibilatrix*, which occurs only east of the Andes. The presence of a second, extinct species west of the Andes suggests that perhaps the climate west of the Peruvian Andes was more favourable during the late Pleistocene than it is today. *Syrigma sanctimartini* is the first palaeospecies of the genus to be described.

Legitimate concern may be expressed about the validity of this new species, and some to be described later, because of the small number of specimens of living species used for comparisons. Intraspecific variability can be a very serious problem in identifying a species from a single bone, but it is much more of a problem in certain groups than in others. I believe that in general the osteological variation within a group is correlated with how specialized it is; i.e., the narrower the niche, the less the osteological variation, and the broader the niche, the greater the osteological variation. The importance attached to any given character, i.e., its reliability, is dependent on the species involved.

After examining very carefully thousands of bones of over two hundred species of birds, I believe I can determine what degree of variation can be expected in any given species by looking at a few specimens, and by knowing how specialized it is. Exceptions, of course, can always be found. Certain types of osteological characters, such as size, shape, and position of muscle scars and ligamental attachments, may be very reliable characters for some species and of no value whatsoever for other species. Other types of osteological characters, however, such as the spatial orientation of the proximal end of a bone compared with the distal end, or the size, shape, and position of articular facets, are much less likely to vary greatly between individuals. Size as a distinguishing osteological character at the species level is no more or no less reliable than many other characters; it all depends on the group in question.

I have described species herein as new only when I believed the characters being used were not subject to intraspecific variation. While I used such characters to

support my conclusions, I have also included in the diagnoses how perhaps less reliable characters differed between the living species and the species being described. I can only hope that my conclusions will be verified when sufficient series of specimens of the living species can be assembled and the actual degree of variation is determined. Caution has been the by-word in naming new species, as evidenced, I believe, by the number of species herein which have not been named.

Nycticorax T. Forster
Nycticorax nycticorax (Linnaeus)
Black-crowned Night Heron

Material

Middle third of 1 left mandible, 1 right and 3 left quadrates, 4 right and 3 left scapulae, 1 complete right coracoid, humeral ends of 9 right and 4 left coracoids, proximal end of 1 left humerus, proximal end of 1 right ulna, distal ends of 2 right and 3 left ulnae, distal end of 1 left radius, proximal end of 1 left carpometacarpus, 1 complete right femur, proximal ends of 1 right and 1 left femur, distal ends of 3 right and 5 left tibiotarsi, 1 complete right and 1 complete left tarsometatarsus, proximal end of 1 right tarsometatarsus, distal ends of 2 right and 3 left tarsometatarsi. ROM 13279–13331, 19532. The 54 specimens represent a minimum of 10 individuals.

Characters

All elements of *Nycticorax nycticorax* examined are separable from elements of all species of *Egretta* by size, those of *Nycticorax* being either much longer, shorter, wider, or stouter than corresponding elements of *Egretta*. Compared with *Nyctanassa* Stejneger and *Tigrisoma* Swainson, *Nycticorax* has scapula with (1) coracoidal articulation large (large and subrounded in *Tigrisoma*, smaller in *Nyctanassa*); (2) glenoid facet round (broad oval in *Tigrisoma*, narrow oval in *Nyctanassa*); (3) acromion moderately deflected externally (less in *Tigrisoma*, more in *Nyctanassa*).

Coracoid with (1) triosseal canal moderately inset (slightly inset, if any, in *Tigrisoma* and *Nyctanassa*); (2) glenoid facet large (much smaller in *Tigrisoma*, of similar size in *Nyctanassa*); (3) dorsal surface of head notched by deep concavity in medial view (rounded in *Tigrisoma*, notched and more angular in *Nyctanassa*); (4) anterior end of head moderately rotated externally (rotated less in *Tigrisoma*, much more in *Nyctanassa*).

Humerus with (1) attachment of M. proscapulohumeralis elongated and moderately inset (oval and inset only slightly in *Tigrisoma* and *Nyctanassa*); (2) pneumatic fossa very shallow (moderately deep in *Tigrisoma* and *Nyctanassa*); (3) dorsal edge of attachment of external head of triceps curving away from capital shaft ridge distal to attachment of M. latissimus dorsi posterioris (extends farther proximad on capital shaft ridge in *Tigrisoma* and *Nyctanassa*).

Ulna with (1) olecranon narrow (broad in *Tigrisoma*, similar in *Nyctanassa*); (2) external cotyla large, with small ridge leading distad (smaller, without ridge in *Tigrisoma* and *Nyctanassa*); (3) external condyle long (short in *Tigrisoma*, moderate in *Nyctanassa*); (4) carpal tuberosity moderately long (long in *Tigrisoma*, short in *Nyctanassa*).

Radius with (1) palmar surface of distal end moderately excavated (slightly excavated in *Tigrisoma*, greatly excavated in *Nyctanassa*); (2) tendinal groove broad and deep (narrower and not as deep in *Tigrisoma* and *Nyctanassa*); (3) carpal facet broad (narrow in *Tigrisoma* and *Nyctanassa*).

Carpometacarpus with (1) internal ligamental attachment of pisiform process and ligamental attachment of ulnare confluent (separated in *Tigrisoma* and *Nyctanassa*); (2) corner on distal end of internal rim of carpal trochlea small (large in *Tigrisoma*, absent in *Nyctanassa*); (3) carpal trochlea moderately wide (wider in *Tigrisoma*, similar in *Nyctanassa*); (4) process of metacarpal I slender (stouter in *Tigrisoma* and *Nyctanassa*).

Femur with (1) proximal lateral face curving mediad (curvature slightly less in *Tigrisoma*, much less in *Nyctanassa*); (2) concavity distal to posterior edge of iliac facet deep (moderate concavity in *Tigrisoma*, slight concavity in *Nyctanassa*); (3) posterior intermuscular line curving internally to base of internal condyle (lies more in center of shaft and does not curve in *Tigrisoma*, does not curve as far internally in *Nyctanassa*); (4) gap between external condyle and origin of M. gastrocnemius, pars externa, wide (ridge present between the two in *Tigrisoma*, slight gap in *Nyctanassa*).

Tibiotarsus with (1) internal articular surface large (similar in *Tigrisoma*, smaller in *Nyctanassa*); (2) inner cnemial crest short and thick (long and of moderate width, tapering distad, in *Tigrisoma* and *Nyctanassa*); (3) ridge leading to postermost corner of internal articular surface absent (present in *Tigrisoma*, absent in *Nyctanassa*); (4) internal condyle undercut dorsally (not undercut in *Tigrisoma* and *Nyctanassa*); (5) internal condyle flaring extensively internally (flaring much less in *Tigrisoma* and *Nyctanassa*).

Tarsometatarsus with (1) shaft large (more slender in *Tigrisoma*, much more slender in *Nyctanassa*); (2) cotylae and trochleae wide (narrow in *Tigrisoma* and *Nyctanassa*); (3) internal edge of shaft angular (rounded in *Tigrisoma* and *Nyctanassa*).

Remarks

Nycticorax nycticorax is generally distributed throughout South America, including coastal rivers, swamps, and lagoons of Peru. On the basis of osteological comparisons listed above I believe *Nycticorax* and *Nyctanassa* are unquestionably distinct genera. Comparative material included ten specimens of *Nycticorax nycticorax*, eight of *Nyctanassa violacea*, one of *Tigrisoma lineatum*, and two of *T. fasciatum*.

Suborder Plataleae Newton

Family Plataleidae Bonaparte

Subfamily Threskiornithinae (Richmond)

Theristicus Wagler

Theristicus wetmorei sp. nov.

Fig. 6B, C

Holotype

Complete left coracoid. ROM 12890.

Referred Material

Fragmentary proximal end of 1 right humerus. ROM 12891. The 2 specimens represent a minimum of 1 individual.

Diagnosis

Coracoid agrees with that of *Theristicus* and differs from that of all other genera of South American ibises (with possible exception of *Cercibis* Wagler which was unavailable for comparison), by having (1) head long and subangular in medial view; (2) attachment of M. coracobrachialis anterior moderately deep, long, with narrow posterior section and a much wider anterior section; (3) attachment of Lig. humero-coracoideum antierius superius shallow and confluent with anterior section of attachment of M. coracobrachialis anterior; (4) coracohumeral surface broad, of almost uniform width; (5) head very wide, with external and internal sides roughly parallel; (6) brachial tuberosity large, well rounded; (7) glenoid facet large, with widest area immediately dorsal to scapular facet; (8) shaft with anterior edge immediately dorsal to sternal facet flattened and rotated slightly internally; (9) anterior external sternal facet with large posterior protrusion.

Coracoid differs from that of *Theristicus caudatus* (Boddaert) by having (1) coracohumeral surface much shorter, giving a more rounded head with lower profile in medial view; (2) attachments of M. coracobrachialis anterior and Lig. humero-coracoideum antierius superius shallower; (3) procoracoid deeply concave internally; (4) shaft with anterior edge immediately dorsal to sternal facet more flattened and less rotated internally; (5) external sternal facet and external distal angle much shorter; (6) concavity between external sternal facet and flattened anterior edge of shaft shallow. Measurements of the holotype, with those of three male specimens of *T. caudatus* in parentheses, are as follows: length, 50.5 (52.0–54.3; mean 52.8); head to scapular facet 19.9 (20.8–21.1; mean, 20.9); proximal depth, 12.9 (13.7–14.1; mean, 13.8); least depth of shaft, 8.5 (9.0–9.1; mean, 9.1).

Characters

Humerus agrees with that of *Theristicus* and differs from that of all other genera of South American ibises examined by having (1) pneumatic fossa shallow; (2) internal tuberosity short; (3) median crest very prominent.

Humerus differs from that of *T. caudatus* by having (1) internal tuberosity shorter; (2) attachment of M. coracobrachialis posterior rotated toward axis of shaft; (3) median crest more prominent; (4) attachment of Lig. humero-coracoideum antierius inferius positioned more anconally. The specimen is too broken to yield accurate measurements.

Etymology

This species is named for the late Dr. Alexander Wetmore of the United States National Museum in recognition of his lifetime dedication and service to ornithology.

Remarks

Theristicus is represented by one living species in South America, *T. caudatus*, which occurs over almost the entire continent, including cultivated areas of coastal Peru

(Koepcke, 1970). No significant differences were seen between specimens of *T. c. caudatus* and *T. c. branickii* examined. Although no specimens of *T. c. melanopsis* were available, I doubt that it would vary significantly from *T. c. caudatus* or *T. c. branickii*. *Theristicus wetmorei* is the first described palaeospecies of the genus.

***Eudocimus* Wagler**
***Eudocimus peruvianus* sp. nov.**
Fig. 7 A-F

Holotype

Complete left tarsometatarsus. ROM 12917.

Paratype

Distal end of 1 left tarsometatarsus. ROM 12918.

Referred Material

One right scapula, distal end of 1 left humerus, proximal ends of 2 radii, 1 complete left femur, proximal end of 1 right femur, 1 complete right tibiotarsus (immature), distal end of 1 right tibiotarsus. ROM 12919–12926. The 10 specimens, including holotype and paratype, represent a minimum of 2 individuals.

Diagnosis

Tarsometatarsus agrees with that of *Eudocimus* and differs from that of all other genera of South American ibises (with possible exception of *Cercibis* which was unavailable for comparison) by having (1) shaft long, moderately stout; (2) cotylae, trochleae, and hypotarsus moderately compressed.

Tarsometatarsus differs from that of *Eudocimus albus* Wagler by having (1) shaft with channelling of anterior face very shallow, deepest on external side, with proximal ligamental attachment raised to level of sides of shaft (shaft with anterior face deeply channelled, deepest on internal side, with proximal ligamental attachment lying below level of sides of shaft in *E. albus*); (2) intercotylar prominence larger, more rounded, and rotated dorsad; (3) proximal end wider and distal end narrower (when compared with specimen of *E. albus* of same, or greater, length); (4) cotylae slightly longer and wider; (5) groove between intercotylar prominence and external cotylae distinct; (6) hypotarsal ridges extend farther distad and form a “V”; (7) internal side of hypotarsus, and shaft anterior to internal side of hypotarsus, more excavated; (8) attachment of external ligament prominent, positioned posteriorly; (9) convexity at anterior end of internal trochlea slightly developed; (10) depth of middle trochlea less; (11) external trochlea with external face large, extending less posteriad.

For measurements, see Table 2. Measurements of the holotype are as follows: length, 100.8; proximal width, 13.7; distal width, 12.7; least width of shaft, 5.3; width of middle trochlea, 4.9.

Table 2 Measurements of the scapula, humerus, radius, femur, tibiotarsus, and tarsometatarsus of *Eudocimus peruvianus* sp. nov. and Recent *E. albus*; and of the scapula, tibiotarsus, and tarsometatarsus of *E. albus* from the Talara Tar Seeps (in mm).

			<i>Eudocimus peruvianus</i> sp. nov.	<i>Eudocimus albus</i> Talara Tar Seeps	Recent
Scapula ¹					
Proximal	OR		11.9	11.0	9.3–11.8
Height	M		—	—	10.9
	n		1	1	5
Proximal	OR		3.5	3.7	3.1–4.1
Width	M		—	—	3.7
	n		1	1	5
Humerus					
Distal	OR		17.2		14.6–17.8
Width	M		—		16.3
	n		1		5
Depth of	OR		8.9		7.9–9.9
External	M		—		8.9
Condyle	n		1		5
Radius					
Proximal	OR		5.6–5.9		4.3–5.4
Width	M		5.8		4.9
	n		2		5
Femur					
Length	OR		59.0		56.1–67.1
	M		—		62.9
	n		1		5
Proximal	OR		11.9–12.2		10.8–13.5
Width	M		12.1		13.2
	n		2		5
Distal	OR		12.6		11.1–13.8
Width	M		—		12.4
	n		1		5
Least	OR		5.3		5.0–6.5
Width of	M		—		5.8
Shaft	n		1		5
Tibiotarsus					
Length	OR		141.0		102.3–141.8
	M		—		127.3
	n		1		5

		<i>Eudocimus peruvianus</i> sp. nov.	<i>Eudocimus albus</i> Talara Tar Seeps		Recent
Distal	OR	10.6–11.0	9.5–10.4		8.5–10.6
Width	M	10.8	9.9		9.8
	n	2	2		5
Least	OR	5.2–5.4			4.4–5.4
Width of	M	5.3			5.0
Shaft	n	2			5
Depth of	OR	11.3–11.7	10.0–11.8		9.2–12.1
Internal	M	11.5	10.9		10.8
Condyle	n	2	2		5
Tarsometatarsus					
Length	OR	100.8			73.0–103.8
	M	—			92.7
	n	1			5
Proximal	OR	13.7	12.4		10.2–12.8
Width	M	—	—		11.8
	n	1	1		5
Distal	OR	12.7	11.2		10.4–13.3
Width	M	—	—		12.1
	n	1	1		5
Least	OR	5.3			4.6–5.4
Width of	M	—			4.9
Shaft	n	1			5
Width of	OR	4.6–4.9	4.2		4.0–5.0
Middle	M	4.8	—		4.6
Trochlea	n	2	1		5

¹ Scapular measurements that can be used consistently with all avian species are difficult to find because the highly irregular shape of the proximal end varies considerably between taxa. Measurements used here are as follows: Proximal height—distance from tip of acromiom process to most ventral point of glenoid facet. Proximal Width—perpendicular distance from a line drawn between most internal points of acromiom and glenoid facet, to the most external point of acromiom or glenoid facet, whichever is greater.

Characters

Eudocimus peruvianus differs from *E. albus* by having scapula with (1) distal end of glenoid facet slightly elevated above surface of shaft, and rotated ventrad only slightly (elevated and rotated ventrad more in *E. albus*).

Humerus with (1) attachment of anterior articular ligament broader, extending less distad; (2) attachment of M. pronator brevis located farther distally; (3) internal condyle projecting less distad, more palmarly; (4) intercondylar groove shallower.

Radius with (1) capital tuberosity larger; (2) ligamental papillae smaller; (3) bicipital attachment a very deep pit; (4) ulnar facet larger.

Femur with (1) anterior intermuscular line straight, lying near external side of shaft (curved and positioned medially in *E. albus*); (2) iliac facet shorter; (3) concavity distal to posterior edge of iliac facet shallower; (4) trochanter projecting less anteriorly; (5) internal flexure of shaft proximal to internal condyle greater; (6) ridge leading to posterior corner of internal condyle much smaller, with more curving edge; (7) external condyle smaller, less rounded.

Etymology

This species is named for Peru, the country in which it was first discovered.

Remarks

Eudocimus ruber differs more from *E. albus* and *E. peruvianus* than the latter two do from each other, thus a detailed comparison with *E. ruber* is not considered necessary. Eleven specimens of *E. albus* from Florida were available for comparison.

Eudocimus peruvianus is the first palaeospecies of the genus described from the New World. Its presence in the same deposit as *E. albus*, whose current range does not quite reach so far south as the fossil site, poses the interesting question of whether the two species were sympatric or had seasonally overlapping ranges. Neither of the two species occurs in very large numbers in the collection.

Eudocimus albus (Linnaeus)

White Ibis

Material

One left scapula, 1 complete left coracoid, humeral ends of 2 left coracoids, distal end of 1 right ulna, 1 complete right carpometacarpus, distal ends of 2 left tibiotarsi, proximal end of 1 right tarsometatarsus, distal end of 1 right tarsometatarsus. ROM 13332–13340; 19520. The 10 specimens represent a minimum of 3 individuals.

Remarks

Eudocimus albus occurs today in the northernmost part of coastal Peru, western Ecuador, Colombia and Venezuela. The specimens listed above did not differ noticeably from the comparative material from Florida.

Subfamily Plataleinae Bonaparte

Ajaia Reichenbach
Ajaia ajaja (Linnaeus)
Roseate Spoonbill

Material

Proximal end of 1 right carpometacarpus. ROM 13341.

Characters

Carpometacarpus with (1) metacarpal I long and slender; (2) posterior carpal fossa elongated and very deep; (3) pollical facet moderately wide; (4) size large.

Remarks

Ajaia ajaja is widespread in South America, and has been recorded from northwestern Peru.

Suborder Ciconiae Bonaparte
Family Ciconiidae (Gray)
Subfamily Ciconiinae Gray

Jabiru Hellmayr
Jabiru mycteria (Lichtenstein)
Jabiru

Material

One cranium, 1 sternal fragment, proximal ends of 2 left scapulae, symphyseal area of 1 furculum, portions of 3 right and 4 left coracoids, distal ends of 1 right and 1 left humerus, proximal ends of 2 left ulnae, distal ends of 2 right and 2 left ulnae, distal ends of 2 right and 1 left radius, proximal end of 1 left carpometacarpus, distal ends of 2 right carpometacarpi, 5 right and 1 left carpal digit, proximal end of 1 left tibiotarsus, distal ends of 3 right and 4 left tibiotarsi, proximal ends of 1 right and 2 left tarsometatarsi, distal ends of 3 right and 1 left tarsometatarsus. ROM 13342–13388. The 47 elements represent a minimum of 5 individuals.

Remarks

Only isolated individuals of *Jabiru mycteria* have been recorded on the coast of southern Peru, where the species is regarded as a trans-Andean vagrant. The specimens represented here may also represent trans-Andean vagrants or they may represent individuals that moved southward from the moister coastal regions of southern Ecuador. Although there are no recent records of *Jabiru* in Ecuador, I see no reason why it may not have been there in the past, or why it may not be there now.

Subfamily Mycteriinae American Ornithologists' Union

***Mycteria* Linnaeus**
***Mycteria americana* Linnaeus**
Wood Stork

Material

Proximal end of 1 left carpometacarpus. ROM 13389.

Remarks

Mycteria americana has been recorded from northwestern Peru, but not from the remainder of coastal Peru. The scarcity of fossil specimens of *M. americana* may indicate a lack of the type of wooded swamps they prefer for nesting and roosting. The single specimen probably represents a rare vagrant.

Order Anseriformes Wagler
Suborder Anseres Wagler
Family Anatidae Vigors
Subfamily Dendrocygninae Reichenback

***Dendrocygna* Swainson**
***Dendrocygna autumnalis* (Linnaeus)**
Black-bellied Tree Duck

Material

Portions of 2 crania, 1 frontal, 4 right and 7 left quadrates, 3 left articulars, 1 right and 5 left mandibular fragments, 15 right and 14 left scapulae, 13 complete right and 21 complete left coracoids, humeral ends of 5 right and 4 left coracoids, sternal ends of 2 left coracoids, 2 complete right and 2 complete left humeri, proximal ends of 14 right and 12 left humeri, distal ends of 17 right and 12 left humeri, 2 complete right and 1 complete left ulna, proximal ends of 6 right and 6 left ulnae, distal ends of 8 right and 7 left ulnae, 1 complete left radius, proximal ends of 5 right and 4 left radii, distal ends of 9 right and 8 left radii, 12 complete right and 10 complete left carpometacarpi, proximal ends of 4 right and 10 left carpometacarpi, 7 complete right and 4 complete left femora, proximal ends of 4 right and 5 left femora, distal ends of 1 right and 1 left femora, distal ends of 14 right and 4 left tibiotarsi, 1 complete right tarsometatarsus, proximal ends of 1 right and 1 left tarsometatarsus, distal ends of 4 right and 5 left tarsometatarsi. ROM 13390–13688, 19521–19522. The 301 specimens represent a minimum of 33 individuals.

Characters

The larger size of its elements distinguishes *D. autumnalis* from *D. viduata* (Linnaeus). Although *D. bicolor* (Vieillot) is usually smaller than *D. autumnalis*, the

two species overlap in size. Characters of *D. autumnalis* used to separate it from *D. bicolor* are listed below. Generic characters are also given for the scapula, radius, and ulna, elements not studied by Woolfenden (1961). Three specimens of each species were available for the comparisons.

Scapula of *Dendrocygna* with (1) glenoid facet long and narrow, lacking an anteroventral projection. Scapula of *D. autumnalis* with (1) acromion longer than in *D. bicolor*; (2) glenoid facet longer and more elevated.

Coracoid with (1) angle between furcular facet and edge of triosseal canal much smaller; (2) brachial tuberosity less rounded; (3) head more rounded in medial view; (4) attachment of Lig. humero-coracoideum antierius superius larger.

Humerus with (1) proximal and distal ends much wider; (2) deltoid crest longer and more flaring; (3) internal tuberosity much larger; (4) ectepicondylar prominence more rounded; (5) attachment of anterior articular ligament higher; (6) entepicondyle much larger.

Ulna of *Dendrocygna* with (1) external cotyla large; (2) bicipital attachment large and prominent; (3) carpal tuberosity very large. Ulna of *D. autumnalis* with (1) olecranon much thicker than in *D. bicolor*; (2) internal cotyla larger; (3) distal end of external cotyla more rounded; (4) external condyle longer; (5) carpal tuberosity larger.

Radius of *Dendrocygna* with (1) shaft immediately posterior to head very narrow; (2) ulna facet narrow and U-shaped; (3) capital tuberosity large; (4) carpal facet narrow, with distinct anconal projection centrally located. Radius of *D. autumnalis* with (1) capital tuberosity smaller than in *D. bicolor*, but with more prominent shaft flaring more abruptly to meet a wider distal end.

Carpometacarpus with (1) process of metacarpal I larger; (2) lobe at end of external rim of carpal trochlea more prominent; (3) area of fusion between metacarpal II and metacarpal III longer; (4) internal rim of carpal trochlea larger.

Femur with (1) head rotated dorsad, and concavity between iliac facet and head greater; (2) iliac facet larger and more irregularly shaped; (3) trochanter larger and more prominent; (4) distal end wider; (5) ligamental attachment at base of fibular condyle more prominent; (6) condyles larger; (7) rotular groove deeper.

Tibiotarsus with (1) shaft reasonably straight and stout (in *D. viduata* and *D. bicolor* there is a greater internal concavity and distal third of shaft has greater convexity directed posteriad); (2) inner cnemial crest larger; (3) condyles not reflected antieriad.

Tarsometatarsus with (1) intercotylar prominence less prominent; (2) cotylae large; (3) external edge of hypotarsus longer, positioned proximally; (4) external trochlea slightly narrower, but middle and internal trochleae wider; (5) internal trochlea projecting less distad.

Remarks

Dendrocygna autumnalis has been recorded in western Ecuador south to the southernmost coastal province, El Oro, and occasionally on the coast of Peru (Koepcke, 1970). However, it was not recorded by Marchant (1958) on the Santa Elena Peninsula of Ecuador. The presence of this species may indicate an abundance of vegetation surrounding the fossil site at the time of deposition because of the species preference for quiet waters surrounded by forests (Delacour, 1954).

Subfamily Tadorninae Reichenbach

“Humerus with (1) fairly prominent capital shaft ridge directed toward external tuberosity; (2) area of origin of external head of triceps relatively narrow; (3) deltoid crest relatively large and flaring, and in lateral view more rounded, or if an abrupt bend occurs, it lies more posteriad; (4) deltoid crest extending farther distad; (5) head rotated so that external tuberosity is higher.” (Woolfenden, 1961: 108).

Nannonetta gen. nov.

Diagnosis

Humerus agrees with that of all living species of the subfamily Tadorninae and differs from that of all other species of the family Anatidae by having the diagnostic subfamilial characters listed by Woolfenden (1961).

Humerus resembles that of *Lophonetta* Riley and differs from *Chloephaga* Eyton and *Neochen* Salvadori by having (1) head more rounded in anconal view; (2) external tuberosity reduced and elongated; (3) external head of triceps only slightly, if any, undercutting head; (4) deltoid crest shorter and less flaring; (5) capital groove rotated internally, reducing size of internal tuberosity and increasing size of head; (6) attachment of anterior articular ligament less elevated; (7) shaft flaring less to meet ectepicondyle; (8) internal condyle elongated, less bulbous.

Humerus differs from that of *Lophonetta* by having (1) attachment of M. supracoracoideus on external tuberosity proportionately more elongated; (2) capital groove narrower and straighter; (3) deltoid crest shorter and less flaring, with sharp angle at its midpoint; (4) bicipital crest shorter and more rounded; (5) pneumatic fossa completely rimmed by heavy bone, such that distal edge is elevated above floor of bicipital crest; (6) pneumatic fossa with highest point located under tip of internal tuberosity (under median crest in *Lophonetta*); (7) capital shaft ridge reduced; (8) shaft with greater palmar flexure in distal quarter, such that a line drawn along anterior edge of shaft would almost bisect distalmost point of ectepicondyle (bisects anterior edge of ectepicondyle in *Lophonetta*); (9) ectepicondylar prominence smaller, with narrow ridge along proximal portion; (10) ectepicondyle less rounded and more V-shaped, extending farther distad; (11) attachment of anterior articular ligament wider than it is long (longer than wide in *Lophonetta*), less elevated, and located farther distad; (12) entepicondyle more prominent and rounded, not as large, with larger entepicondylar prominence and external curvature to anconal side; (13) condyles more rounded, giving deeper and narrower intercondylar groove; (14) external condyle shorter, retaining internal flexure found in *Lophonetta*, but lacking distinct ridge leading internally from tip of condyle; (15) shaft widening more gradually toward distal end.

Type species

Nannonetta invisitata sp. nov.

Etymology

From Greek, *nannus*, dwarf, and *netta*, feminine, duck.

Nannonetta invisitata sp. nov.

Fig. 8A, E, 9A, E,
10A, D, G, 11A, E

Holotype

Complete right humerus. ROM 13689.

Paratypes

One complete right and 3 complete left humeri, proximal ends of 6 right and 5 left humeri, distal ends of 2 right and 7 left humeri. ROM 13690–13713.

Referred Material

Three right and 4 left scapulae, 8 complete right and 7 complete left coracoids, humeral ends of 2 right and 1 left coracoid, 4 complete right and 3 complete left ulnae, proximal ends of 5 right and 3 left ulnae, distal ends of 5 right and 3 left ulnae, 2 complete left radii, proximal ends of 3 left radii, distal end of 1 right radius, 3 complete right and 2 complete left carpometacarpi, proximal ends of 2 right and 6 left carpometacarpi, 2 complete right and 2 complete left femora, proximal end of 1 right femur, 1 complete left tibiotarsus, distal ends of 4 right tibiotarsi, 4 complete right and 5 complete left tarsometatarsi, proximal end of 1 left tarsometatarsus. ROM 13714–13800. The 112 specimens, including holotype and paratypes, represent a minimum of 10 individuals.

Diagnosis

As for genus. For measurements see Table 3. Measurements of the holotype are as follows: length, 68.6; proximal width, 14.7; distal width, 11.0; least width of shaft, 5.2.

Characters

All elements of *Nannonetta invisitata* agree with the humerus in resembling *Lophonetta* more than *Chloephaga* or *Neochen*. *N. invisitata* differs from *Lophonetta specularioides* by having scapula with (1) coracoidal articulation proportionately more prominent, confluent with glenoid facet; (2) intermuscular line between attachments of *M. rhomboidius superficialis* and *M. subscapularis* better developed; (3) glenoid facet rotated such that it faces more anteriorly and distal end is displaced dorsad.

Coracoid with (1) head projecting less anteriorly; (2) width of head much greater; (3) glenoid facet flaring less laterally; (4) scapular facet larger.

Ulna with (1) attachment of anterior articular ligament more oval and less elongated; (2) external cotyla shorter but wider; (3) external condyle longer but less prominent; (4) carpal tuberosity more prominent.

Radius with (1) capital tuberosity more prominent, and shaft more constricted immediately distal to it; (2) carpal facet less curved; (3) shaft with internal flexure at distal end.

Carpometacarpus with (1) attachment of *M. flexor carpi ulnaris brevis* deeper; (2) external scapho-lunar ligamental attachment small, lying proximal to ridge extending

Table 3 Measurements of the scapula, coracoid, humerus, radius, ulna, carpometacarpus, femur, tibiotarsus, and tarsometatarsus of *Nannonetta invisitata* gen. et sp. nov. and *Lophonetta specularioides* (in mm).

		<i>Nannonetta invisitata gen. et sp. nov.</i>	<i>Lophonetta specularioides</i>
Scapula			
Proximal	OR	8.2–9.0	11.9–12.9
Height	M	8.6	12.5
	n	7	3
Proximal	OR	2.5–2.8	3.6–3.8
Width	M	2.6	3.7
	n	7	3
Coracoid			
Length	OR	34.3–36.4	45.4–51.0
	M	35.4	49.1
	n	14	3
Head to	OR	11.8–13.0	16.7–19.2
Scapular	M	12.3	18.2
Facet	n	18	3
Proximal	OR	6.2–7.6	9.5–10.1
Depth	M	6.9	9.8
	n	18	3
Least	OR	3.5–4.0	5.1–5.7
Depth of	M	3.8	5.5
Shaft	n	15	3
Length of	OR	13.4–14.9	17.7–20.3
Sternal	M	14.2	19.4
Facet	n	4	3
Humerus			
Length	OR	61.9–68.6	95.3–101.8
	M	65.0	99.5
	n	4	3
Proximal	OR	13.9–14.7	19.0–22.4
Width	M	14.5	21.1
	n	16	3
Distal	OR	9.9–11.0	14.5–15.7
Width	M	10.5	15.3
	n	14	3
Least	OR	4.6–5.2	6.1–6.5
Width of	M	4.9	6.3
Shaft	n	11	3

		<i>Nannonetta invisitata gen. et sp. nov.</i>	<i>Lophonetta specularioides</i>
Radius			
Length	OR	51.5–52.9	82.6–86.8
	M	52.2	85.1
	n	2	3
Proximal Width	OR	3.5–3.9	4.9–5.2
	M	3.6	5.0
	n	5	3
Distal Width	OR	4.8–5.2	6.1–7.3
	M	5.0	6.9
	n	3	3
Ulna			
Length	OR	54.7–58.0	89.3–94.7
	M	56.3	92.1
	n	4	3
Proximal Width	OR	7.1–7.7	10.0–11.8
	M	7.4	10.9
	n	11	3
Distal Depth	OR	6.3–7.6	9.5–10.8
	M	7.0	10.2
	n	14	3
Least Width of Shaft	OR	3.4–4.0	4.8–5.6
	M	3.7	5.1
	n	7	3
Carpometacarpus			
Length	OR	38.4–41.2	57.1–60.7
	M	40.3	59.1
	n	5	3
Height Through Metacarpal I ¹	OR	9.2–9.9	12.9–15.0
	M	9.5	14.2
	n	12	3
Proximal Width	OR	4.1–4.6	5.9–6.7
	M	4.4	6.4
	n	12	3

Continued on page 40.

		<i>Nannonetta invisitata gen. et sp. nov.</i>	<i>Lophonetta specularioides</i>
Least	OR	3.3–4.6	3.9–4.8
Width of	M	3.6	4.5
Shaft	n	5	3
Length of	OR	4.9–5.3	8.9–9.1
Distal	M	5.2	9.0
Fornix	n	5	3
Femur			
Length	OR	36.9–37.3	52.6–59.1
	M	37.1	56.1
	n	3	3
Proximal	OR	7.5–8.0	9.9–11.2
Width	M	7.7	10.5
	n	5	3
Distal	OR	8.0	11.7–12.9
Width	M	8.0	12.5
	n	3	3
Least	OR	3.2–3.3	4.8–5.8
Width of	M	3.2	5.3
Shaft	n	5	3
Tibiotarsus			
Length	OR	58.5	85.7–95.4
	M	—	92.1
	n	1	3
Proximal	OR	6.6	9.6–10.4
Width	M	—	10.0
	n	1	3
Distal	OR	6.5–6.9	9.4–10.4
Width	M	6.6	10.0
	n	5	3
Least	OR	2.8	4.3–4.7
Width of	M	—	4.4
Shaft	n	1	3
Depth of	OR	7.2–7.3	10.5–11.0
Internal	M	7.3	10.8
Condyle	n	5	3

		<i>Nannonetta invisitata gen. et sp. nov.</i>	<i>Lophonetta specularioides</i>
Tarsometatarsus			
Length	OR	33.6–38.5	51.0–56.9
	M	35.3	54.3
	n	7	3
Proximal Width	OR	6.8–7.4	10.3–10.9
	M	7.1	10.7
	n	9	3
Distal Width	OR	7.2–7.8	10.4–11.0
	M	7.5	10.8
	n	7	3
Least Width of Shaft	OR	3.5–3.8	4.0–4.5
	M	3.6	4.3
	n	10	3
Width Middle Trochlea	OR	2.8–3.3	4.6–5.0
	M	3.1	4.8
	n	9	3

¹ Height through Metacarpal I refers to the anteroposterior distance perpendicular to the long axis of the carpometacarpus as measured through metacarpal I.

from external cuneiform ligamental attachment to proximal fornix, and lying very close to external cuneiform ligamental attachment [the large size and posterior position of this attachment in other genera of the subfamily Tadorninae is listed as a subfamilial character by Woolfenden (1961)]; (3) lobe at end of external rim of carpal trochlea, beginning at notch in rim, very long and prominent; (4) internal rim of carpal trochlea more prominent, giving more rounded proximal end in internal view; (5) internal ligamental fossa deeper; (6) area of fusion of metacarpal I and metacarpal II much shorter both proximally and distally.

Femur with (1) neck more constricted; (2) area between anterior corner of trochanter and head more concave but similarly curved, not angular; (3) ridge on posterior surface of shaft leading to external condyle more prominent; (4) fibular condyle similar in shape, but less produced proximad; (5) external condyle well rounded where joined by fibular condyle (pointed in *L. specularioides*); (6) pit for M. tibialis anticus positioned more distad; (7) ridge on shaft leading distad to internal condyle, as traced by intermuscular line, less developed; (8) lip of internal condyle larger.

Tibiotarsus with (1) rotular crest forming straight line (curved in *L. specularioides*); (2) outer cnemial crest thickened on distal side; (3) intermuscular line curving internally proximally to approach attachment of M. flexor digitorum longus (curves less internally in *L. specularioides*); (4) external ligamental attachment elliptical (similar in *L. specularioides*), but positioned more proximad.

Tarsometatarsus with (1) anterior lip on internal cotyla more undercut; (2) intercotylar prominence with greater anterior, but smaller dorsal component; (3) posterior border of internal cotyla with more distinct lip; (4) trochleae very spread (similar in *L. specularioides*, but internal and external trochleae turned slightly more mediad); (5) external rim of external trochlea less elongated; (6) internal side of middle trochlea lacking prominent internally directed ridge.

Etymology

Latin, *invisitata*, not seen before, unknown.

Remarks

Two extinct anseriform genera from North America have been assigned to the subfamily Tadorninae. These are *Anabernicula* Ross (1935) (*A. minuscula* Wetmore, *A. gracilentia* Ross, *A. oregonensis* Howard and *A. robusta* Short) and *Brantadorna* Howard (1963) (*B. downsi* Howard). From the descriptions given by Ross (1935), Wetmore (1924), Howard (1963, 1964), and Short (1970) it is readily apparent that *Nannonetta* is distinct from *Anabernicula* and *Brantadorna*, and that *Anabernicula* and *Brantadorna* appear to resemble *Tadorna* much more than *Nannonetta* or *Lophonetta*.

Nannonetta differs from *Anabernicula* and *Brantadorna* by having humerus with (1) head more rounded in anconal view; (2) capital shaft ridge much reduced; (3) external tuberosity reduced and elongated.

Coracoid with (1) angle between furcular facet and line drawn along the procoracoid smaller.

Carpometacarpus with (1) length of metacarpal I much greater.

The capital shaft ridge and external tuberosity of the humerus are much less prominent in *Lophonetta* than in *Tadorna*. Similarly, the capital shaft ridge and external tuberosity are much less prominent in *Nannonetta* than in *Lophonetta*. *Nannonetta*, then, appears to represent one extreme of the variation found within the subfamily Tadorninae, with *Tadorna* representing the opposite extreme and *Lophonetta* occupying the central position. The intermediate position of *Lophonetta* can be seen in many of its elements, not just the humerus.

Despite the large differences between *Nannonetta* and *Tadorna*, and the variance with a few subfamilial characters listed by Woolfenden (1961), the majority of the subfamilial characters displayed by *Nannonetta* agree with those of the subfamily Tadorninae. Therefore, I believe *Nannonetta* belongs within that subfamily. *N. invisitata* then becomes the smallest representative of the subfamily known, being approximately two-thirds the size of *Tadorna* and *Lophonetta*. Three specimens of *Lophonetta specularioides* were used for the osteological diagnoses.

***Chloeophaga* Eyton**
***Chloeophaga melanoptera* (Eyton)**
Andean Goose

Material

One right quadrate, 1 right and 2 left scapulae, 4 complete right and 2 complete left

coracoids, humeral ends of 1 right and 3 left coracoids, 1 complete left humerus, proximal ends of 1 right and 4 left humeri, distal ends of 1 right and 5 left humeri, shaft of 1 left humerus, 1 complete right ulna, proximal end of 1 right ulna, distal ends of 5 right and 4 left ulnae, proximal ends of 1 right and 1 left radius, distal ends of 3 left radii, 4 complete right and 1 complete left carpometacarpus, proximal ends of 4 right and 2 left carpometacarpi, 1 complete pelvis, 2 complete right and 1 complete left femur, proximal ends of 2 right and 4 left femora, distal ends of 4 right and 4 left femora, proximal ends of 2 left tibiotarsi, distal ends of 3 right and 6 left tibiotarsi, 1 complete left tarsometatarsus, proximal ends of 2 right and 2 left tarsometatarsi, distal ends of 2 right and 1 left tarsometatarsus. ROM 13801–13891. The 91 specimens represent a minimum of 7 individuals.

Remarks

Chloephaga melanoptera is primarily resident in the high Andes, living up to the snow line. Individuals do, however, move to lower elevations during the non-breeding season. It has not been recorded in the Andes closer than 100 miles south of the fossil site (Koepcke, 1970). Since *C. melanoptera* feeds almost exclusively on grass and is seldom seen on water (Delacour, 1954), the presence of an abundant ground cover of vegetation near the fossil site would seem to be more likely to attract this species than a body of water surrounded by sparse vegetation.

A number of the specimens appear to represent immature individuals.

Subfamily Anatinae (Vigors)

“Humerus with (1) capital shaft ridge obsolete; (2) pneumatic fossa opening, containing bony struts; (3) ectepicondyle typically equal or subequal in height to entepicondyle.” (Woolfenden, 1961: 109).

Cairina Fleming *Cairina moschata* (Linnaeus) Muscovy Duck

Material

One right articular, 4 left scapulae, 2 complete right coracoids, humeral end of 1 right coracoid, proximal ends of 2 right humeri, distal ends of 2 right and 1 left humerus, 2 complete right ulnae, proximal end of 1 left ulna, distal ends of 1 right and 3 left ulnae, proximal ends of 1 right and 1 left radius, distal ends of 1 right and 1 left radius, 1 complete left carpometacarpus, proximal ends of 1 right and 1 left carpometacarpus, distal ends of 2 right tibiotarsi, 1 complete left tarsometatarsus, proximal end of 1 left tarsometatarsus, distal ends of 2 left tarsometatarsi. ROM 13892–13924. The 33 specimens represent a minimum of 4 individuals.

Remarks

Cairina moschata, a forest duck, occurs on the arid coast of Peru only by accident. It has been recorded only once, near Lima. Marchant (1958) did not report it from the arid Santa Elena Peninsula of Ecuador. Chapman (1926) found this species near the

coast only 35 km north of the Peru-Ecuador border, and less than 200 km from the fossil site, but in a completely different type of habitat.

The sedentary habits of this species would seem to indicate either that its range extended much farther south than today, increasing the number of stragglers, or that it was a resident. If *Cairina* was a resident at the site its preference for water surrounded by forests would indicate a considerable amount of vegetation in the area.

***Anas* Linnaeus**
***Anas talarae* sp. nov.**

Fig. 8C, F, 9B, F, G,
10B, F, 11C, G

Holotype

Complete left humerus (internal tuberosity and bicipital crest broken). ROM 12904.

Referred Material

One right scapula, 2 complete right coracoids, 1 complete right and 1 complete left ulna, distal end of 1 right ulna, proximal end of 1 left radius, distal end of 1 right radius, proximal end of 1 right carpometacarpus, distal ends of 1 right and 1 left tibiotarsus, 1 complete left tarsometatarsus. ROM 12905–12916. The 13 elements, including holotype, represent a minimum of 2 individuals.

Diagnosis

Humerus agrees with that of *Anas* and differs from that of all other genera of subfamily Anatinae by having those characters of the genus as described by Woolfenden (1961).

Compared with the humerus of living species of *Anas*, the holotype is characterized by having (1) head of humerus small, profile rounded in palmar view, and projecting more anconally than distad (similar in *Anas* (*Callonetta*) *leucophrys* Vieillot; large, subrounded, and projecting more distad than anconally in *Anas* (*Amazonetta*) *brasiliensis* Gmelin, *A. crecca* Linnaeus, and *A. cyanoptera* (Vieillot); (2) head without inflection (similar in *A. leucophrys*, *A. crecca*, and *A. cyanoptera*; head inflected in *A. brasiliensis*); (3) internal tuberosity broken, but appearing prominent (similar in *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*; reduced in *A. leucophrys*); (4) attachment of M. coracobrachialis posterior forming short, broad shelf, not extending down median crest (moderate to long, broad, usually not forming shelf, and usually extending down median crest in *A. leucophrys*, *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*); (5) median crest prominent (similar in *A. leucophrys* and *A. brasiliensis*; slender to moderately prominent in *A. crecca* and *A. cyanoptera*); (6) pneumatic fossa elongated, not entering into internal tuberosity (moderately elongated, not entering into internal tuberosity in *A. brasiliensis*; slightly elongated and entering into internal tuberosity in *A. leucophrys*, *A. crecca*, and *A. cyanoptera*); (7) deltoid crest not flaring, with depression at distal end (similar in *A. crecca*; flaring, without depression in *A. leucophrys* and *A. brasiliensis*; not flaring, without

depression, and reduced in size in *A. cyanoptera*); (8) attachment of *M. pectoralis superficialis* rotated palmarly (similar in *A. brasiliensis*; not rotated in *A. leucophrys*, *A. crecca*, and *A. cyanoptera*); (9) shaft with moderate internal curvature immediately distal to bicipital crest, giving moderately sigmoid shaft (similar in *A. leucophrys*; sharp internal curvature in *A. brasiliensis*, giving strongly sigmoid shaft; similar length and curvature in *A. leucophrys*; short and wide, with very slight anterior shaft); (10) impression of *M. brachialis anticus* relatively deep, oriented at small angle to axis of shaft (deep in *A. brasiliensis*; shallow in *A. leucophrys*, *A. crecca*, and *A. cyanoptera*; oriented at large angle to axis of shaft in all); (11) attachment of anterior articular ligament longer than wide (width roughly equal to length in *A. leucophrys*, *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*); (12) entepicondyle rotated so internal side faces anterodistad (rotated strongly anteriad in *A. leucophrys* and *A. brasiliensis*; rotated slightly to moderately anteriad in *A. cyanoptera*; not rotated in *A. crecca*); (13) entepicondyle rounded distally, not produced (subrounded distally and very produced in *A. leucophrys*; subangular distally and moderately produced in *A. brasiliensis*; angular to subangular distally and moderately produced in *A. crecca* and *A. cyanoptera*); (14) internal tip of external condyle broken (undercut in *A. leucophrys*, *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*); (15) olecranon fossa long (similar in *A. leucophrys* and *A. cyanoptera*; short in *A. brasiliensis* and *A. crecca*).

For measurement see Table 4. Measurements of the holotype are as follows: length, 56.4; proximal width, 13.0; distal width, 9.2; least width of shaft, 4.3.

Characters

Compared with living species of *Anas*, *A. talarae* is characterized by having scapula with (1) acromion of moderate length, narrow with strong anterior curvature (wide, of similar length and curvature in *A. leucophrys*; short and wide, with very slight anterior curvature in *A. crecca*; long and wide, with moderate anterior curvature in *A. cyanoptera*); (2) glenoid facet of moderate length and narrow, lacking strong projection to anteroventral corner (similar, but long, in *A. leucophrys*; long and wide, with prominent anteroventral corner in *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*); (3) attachment of Lig. furculo-scapulare dorsale oval, located dorsal to midline of shaft (similar in *A. leucophrys*, *A. brasiliensis*, and *A. crecca*; elongated and situated ventral to midline of shaft in *A. cyanoptera*).

Coracoid with (1) coracohumeral surface long, relatively wide, not widening markedly anteriad, with moderate curvature, and positioned internally close to edge of triosseal canal (short, narrow, not widening markedly anteriad, of moderate curvature, positioned slightly internally in *A. leucophrys*; long, wide, widening markedly anteriad, of slight curvature, and positioned internally in *A. brasiliensis*; long, narrow, moderate to marked widening anteriad, of slight to moderate curvature, not positioned internally in *A. crecca* and *A. cyanoptera*); (2) attachment of Lig. humero-coracoideum antierius superius slightly elevated (similar in *A. leucophrys* and *A. brasiliensis*; not elevated in *A. crecca* and *A. cyanoptera*); (3) scapular facet small and elongated (similar in *A. leucophrys* and *A. brasiliensis*; large oval in *A. crecca* and *A. cyanoptera*).

Ulna with (1) distal lip of external cotyla broad, extending moderately distad (similar in *A. brasiliensis*; internal side of external cotyla extends distad much farther than external side in *A. leucophrys*, *A. crecca*, and *A. cyanoptera*); (2) ridge leading

to shaft from carpal tuberosity large (similar in *A. crecca*; slight to moderate ridge in *A. leucophrys*, *A. brasiliensis*, and *A. cyanoptera*).

Radius with no distinguishing characters other than size.

Carpometacarpus with (1) process of metacarpal I low (i.e., short antero-posteriorly) and of moderate length (i.e., proximodistally) (low, with distal edge sloping sharply proximad in *A. leucophrys*; high and short in *A. brasiliensis*; of moderate height and length in *A. crecca* and *A. cyanoptera*); (2) proximal edge of metacarpal I sloping sharply proximad (similar in *A. leucophrys* and *A. cyanoptera*; moderate slope in *A. crecca*; slight slope in *A. brasiliensis*); (3) internal face of metacarpal I slightly excavated (similar in *A. crecca*; moderately to deeply excavated in *A. leucophrys*, *A. brasiliensis*, and *A. cyanoptera*); (4) proximal area of fusion of metacarpal II and metacarpal III very long (long in *A. leucophrys* and *A. brasiliensis*; short in *A. crecca* and *A. cyanoptera*); (5) external rim of carpal trochlea rounded proximally (subangular to angular in *A. leucophrys*, *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*); (6) area covered by external cuneiform ligament markedly convex (similar in *A. leucophrys*; slightly convex in *A. brasiliensis*; flat in *A. crecca* and *A. cyanoptera*); (7) posterior carpal fossa of essentially uniform width (similar in *A. leucophrys* and *A. brasiliensis*; wide distally, narrowing gradually proximad in *A. crecca*; wide proximally and distally with central constriction in *A. cyanoptera*).

Tibiotarsus with (1) external face of distal end flat (similar in *A. leucophrys*, *A. brasiliensis*, and *A. crecca*; flat or slightly concave in *A. cyanoptera*); (2) internal condyle flaring mediad (not flaring in *A. leucophrys*, *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*).

Tarsometatarsus with (1) intercotylar prominence broad (similar in *A. leucophrys*, *A. brasiliensis*, *A. crecca*, and *A. cyanoptera*); (2) shaft narrowing sharply immediately distal to internal cotyla (similar in *A. leucophrys*, *A. brasiliensis*, and *A. crecca*; narrows gradually in *A. cyanoptera*); (3) hypotarsus short (similar in *A. leucophrys* and *A. crecca*; long in *A. brasiliensis* and *A. cyanoptera*); (4) anterior face of shaft straight in lateral view (similar in *A. cyanoptera*; slight concavity in *A. brasiliensis* and *A. crecca*; moderate concavity in *A. leucophrys*); (5) internal trochlea projecting distad without turning externally (similar in *A. leucophrys*, *A. brasiliensis*, and *A. cyanoptera*; turned slightly externally in *A. crecca*).

Etymology

This species is named for the town of Talara, Peru, from which the fossil site also takes its name.

Remarks

Anas talarae and the following two new species of *Anas* are compared with *A. leucophrys*, *A. brasiliensis*, *A. crecca*, and *A. cyanoptera* because the fossil species are all small, differing only slightly in size among themselves, and the above four living species represent the smallest forms of the genus. Although *A. crecca* does not reach South America it was used rather than *A. discors*, which does reach South America, because the two species are extremely difficult to separate osteologically, and of the two the former has smaller individuals. *A. talarae* is the *Anas* species 1 reported from La Carolina, Ecuador (Campbell, 1976). The numbers under each element correspond in the comparisons of all three new species.

***Anas amotape* sp. nov.**

Fig. 8B, G, 9C, H,
10C, E, H, 11B, F

Holotype

Complete left humerus. ROM 12927.

Paratypes

One complete right and 1 complete left humerus, proximal ends of 1 right and 1 left humerus, distal ends of 2 right and 1 left humerus. ROM 12928–12934.

Referred Material

One left scapula, 2 complete right and 4 complete left coracoids, 1 complete right ulna, proximal ends of 2 left radii, 1 complete left carpometacarpus, proximal ends of 1 right and 1 left carpometacarpus, proximal end and shaft of 1 right femur, distal ends of 5 right and 1 left tibiotarsus, 1 complete left tarsometatarsus. ROM 12935–12955. The 29 specimens, including holotype and paratypes, represent a minimum of 5 individuals.

Diagnosis

Humerus agrees with that of *Anas* and differs from that of all other genera of the subfamily Anatinae by having those characters of the genus as described by Woolfenden (1961).

Compared with the humerus of other species of *Anas* the holotype is characterized by having (1) head large, profile subrounded in palmar view, and projecting more anconally than distad; (2) head not inflected; (3) internal tuberosity reduced; (4) attachment of M. coracobrachialis posterior moderate to long, broad, forming slight shelf, extending down median crest; (5) median crest prominent; (6) pneumatic fossa round, entering moderately into internal tuberosity; (7) deltoid crest long, very flaring, without depression at distal end; (8) attachment of M. pectoralis superficialis not rotated palmarly; (9) shaft with sharp internal curvature immediately distal to bicipital crest, giving strongly sigmoid shaft; (10) impression of M. brachialis anticus extremely shallow, oriented at large angle to axis of shaft; (11) attachment of anterior articular ligament high and very small; (12) entepicondyle rotated moderately anteriad; (13) entepicondyle rounded distally, not produced; (14) internal lip of external condyle not undercut, but with slight ridge leading internally; (15) olecranol fossa short.

For measurements see Table 4. Measurements of the holotype are as follows: length, 65.2; proximal width, 14.1; distal width, 9.7; least width of shaft, 4.5.

Characters

Compared with other species of *Anas*, *A. amotape* is characterized by having scapula with (1) acromion long and wide, with moderate anterior curvature; (2) glenoid facet long and wide, with anteroventral corner not projecting; (3) attachment of Lig. furculo-scapulare dorsale round, located in midline of shaft.

Table 4 Measurements of the scapula, coracoid, humerus, radius, ulna, carpometacarpus, femur, tibiotarsus, and tarsometatarsus of *Anas talaræ* sp. nov. (excluding femur), *Anas amotape* sp. nov., *Anas sanctaehelenæ* sp. nov. (coracoid, humerus, tibiotarsus, and tarsometatarsus only), *A. leucophrys*, *A. brasiliensis*, *A. cyanoptera*, and *A. crecca carolinensis* (in mm).

		<i>Anas talaræ</i> sp. nov.	<i>Anas amotape</i> sp. nov.	<i>Anas sanctaehelenæ</i> sp. nov.	<i>Anas leucophrys</i>	<i>Anas brasiliensis</i>	<i>Anas cyanoptera</i>	<i>Anas crecca</i>
Scapula	Proximal	OR	7.4	8.4	7.1	9.5	7.5-9.6	7.3-8.1
	Height	M	—	—	—	—	8.3	7.7
		n	1	1	1	1	5	8
Proximal	Width	OR	2.4	2.5	2.0	3.0	2.4-2.7	2.5-3.0
		M	—	—	—	—	2.5	2.7
		n	1	1	1	1	5	8
Coracoid	Length	OR	31.7	32.9-33.7	30.7	32.8	32.6-39.8	31.5-34.1
		M	—	33.4	—	—	35.1	32.6
		n	1	3	1	1	5	8
Head to	Scapular	OR	10.9	10.7-11.6	10.3	11.2	10.8-13.5	10.8-11.5
	Facet	M	—	11.2	—	—	11.8	11.1
		n	1	4	1	1	5	8
Proximal	Depth	OR	6.4	5.9-6.5	5.7	6.6	6.2-7.5	6.1-7.0
		M	—	6.3	—	—	6.7	6.3
		n	1	4	1	1	5	8
Least	Depth of	OR	3.2-3.7	3.4-3.9	3.3	4.3	3.3-4.1	3.2-4.0
	Shaft	M	3.5	3.6	—	—	3.7	3.6
		n	2	6	1	1	5	8
Length of	Sternal	OR		12.2-13.5		12.4	12.7-16.0	12.8-14.4
	Facet	M		12.9		—	13.7	13.6
		n		2		1	5	8

Humerus

Length	OR	56.4	61.1–65.2	57.7	59.8	74.8	61.0–71.5	55.9–59.5
	M	—	63.1	—	—	—	64.6	57.9
	n	1	2	1	1	1	5	8
Proximal Width	OR	12.7	13.2–14.1	12.3–13.1	13.5	17.0	12.7–15.7	12.5–13.2
	M	—	13.5	12.7	—	—	13.6	12.8
	n	1	4	2	1	1	5	8
Distal Width	OR	9.2	9.6–10.1	9.1–9.4	9.7	12.6	9.1–11.7	8.3–9.7
	M	—	9.8	9.2	—	—	9.9	9.3
	n	1	5	2	1	1	5	8
Least Width of Shaft	OR	4.3	4.3–4.8	4.4	4.7	5.8	4.4–5.1	4.2–4.7
	M	—	4.6	—	—	—	4.6	4.4
	n	1	5	1	1	1	5	8

Radius

Length	OR				50.7	61.5	46.8–56.7	44.2–46.6
	M				—	—	50.5	45.8
	n				1	1	5	8
Proximal Width	OR	3.2	3.6–3.7		3.3	4.3	3.1–4.0	3.1–3.3
	M	—	3.7		—	—	3.4	3.2
	n	1	2		1	1	5	8
Distal Width	OR	4.5			4.6	5.7	3.9–5.3	4.2–4.5
	M	—			—	—	4.6	4.3
	n	1			1	1	5	8

Ulna

Length	OR	53.0–53.6	56.0		54.7	66.3	50.6–61.1	48.3–51.1
	M	53.3	—		—	—	54.4	50.2
	n	2	1		1	1	5	8

Continued on page 50.

		<i>Anas italaræ</i> sp. nov.	<i>Anas amotape</i> sp. nov.	<i>Anas sanctæhelenæ</i> sp. nov.	<i>Anas leucophrys</i>	<i>Anas brasiliensis</i>	<i>Anas cyanoptera</i>	<i>Anas crecca</i>
Proximal Width	OR	6.8	7.6		6.8	8.9	6.6-8.5	6.2-6.9
	M	—	—		—	—	7.1	6.6
	n	1	1		1	1	5	8
Distal Depth	OR	6.5-6.7	7.6		6.9	8.6	6.7-8.2	6.6-7.0
	M	6.6	—		—	—	7.1	6.8
	n	3	1		1	1	5	8
Least Width of Shaft	OR	3.2-3.5	3.8		3.4	4.4	3.3-3.9	3.3-3.6
	M	3.4	—		—	—	3.5	3.4
	n	2	1		1	1	5	8
Carpometacarpus								
Length	OR		39.1		37.6	46.0	36.0-43.9	34.5-37.1
	M		—		—	—	38.9	36.2
	n		1		1	1	5	8
Proximal Width	OR	4.0	4.3		3.9	4.9	3.9-4.7	3.8-4.1
	M	—	4.3		—	—	4.1	3.9
	n	1	3		1	1	5	8
Height Through Metacarpal I	OR	8.6	8.9		8.3	11.0	8.7-10.2	8.4-9.0
	M	—	8.9		—	—	9.2	8.7
	n	1	2		1	1	5	8
Least Width of Shaft	OR	3.2	3.0-3.3		3.2	3.8	2.8-3.7	2.8-3.3
	M	—	3.1		—	—	3.3	3.1
	n	1	2		1	1	5	8
Length of Distal Fornix	OR		4.7		4.9	7.2	4.9-6.8	4.5-5.3
	M		—		—	—	6.1	5.1
	n		1		1	1	5	8

Femur	Length	OR	33.6	43.4	31.5–38.3	31.9–33.6
		M	—	—	34.8	32.9
		n	1	1	5	8
	Proximal Width	OR	7.1	9.3	6.1–7.5	6.1–6.8
		M	—	—	6.7	6.6
		n	1	1	5	8
	Distal Width	OR	7.4	9.1	6.5–8.4	6.7–7.3
		M	—	—	7.2	6.8
		n	1	1	5	8
	Least Width of Shaft	OR	2.9	3.4	2.8–3.2	2.6–3.0
		M	—	—	2.9	2.8
		n	1	1	5	8
Tibiotarsus	Length	OR	55.1	67.7	53.1–64.5	52.7–56.5
		M	—	—	57.7	54.4
		n	1	1	5	8
	Proximal Width	OR	6.1	7.4	5.2–6.9	5.5–6.0
		M	—	—	6.1	5.7
		n	1	1	5	8
	Distal Width	OR	5.8	7.5	5.4–6.7	5.3–5.8
		M	—	—	5.9	5.5
		n	1	1	5	8
	Least Width of Shaft	OR	2.7	3.5	2.5–2.9	2.4–2.8
		M	—	—	2.7	2.6
		n	1	1	5	8
	Depth of Internal Condyle	OR	6.6	8.9	6.3–7.8	6.0–6.6
		M	—	—	6.8	6.3
		n	1	1	5	8

Continued on page 52.

		<i>Anas talarae</i> sp. nov.	<i>Anas amotape</i> sp. nov.	<i>Anas sanctaehelenae</i> sp. nov.	<i>Anas leucophrys</i>	<i>Anas brasiliensis</i>	<i>Anas cyanoptera</i>	<i>Anas crecca</i>
Tarsometatarsus								
Length	OR	30.8	35.6	29.5	29.9	38.4	31.3-35.5	28.1-31.8
	M	—	—	—	—	—	32.8	29.6
	n	1	1	1	1	1	5	8
Proximal Width	OR	6.6	7.3	6.6	6.5	7.8	6.1-7.0	5.7-6.2
	M	—	—	—	—	—	6.3	5.9
	n	1	1	1	1	1	5	8
Distal Width	OR	6.3	7.2	6.2	6.5	7.7	5.5-6.7	5.7-6.0
	M	—	—	—	—	—	6.2	5.8
	n	1	1	1	1	1	5	8
Least Width of Shaft	OR	3.0	3.5	2.9	3.0	3.9	2.7-3.3	2.5-3.0
	M	—	—	—	—	—	3.1	2.8
	n	1	1	1	1	1	5	8
Width of Middle Trochlea	OR	2.9	3.2	2.8	2.9	3.7	2.6-3.3	2.5-2.9
	M	—	—	—	—	—	2.7	2.7
	n	1	1	1	1	1	5	8

Coracoid with (1) coracohumeral surface wide and of moderate length, with moderate to marked widening anteriad, moderate to marked curvature, and positioned slightly internally; (2) attachment of Lig. humero-coracoideum antierius superius elevated; (3) scapular facet large oval.

Ulna with (1) internal side of external cotyla extending much farther distad than external side; (2) ridge leading from carpal tuberosity to shaft very small.

Radius with no distinguishing characters other than size.

Carpometacarpus with (1) process of metacarpal I long and low; (2) proximal edge of metacarpal I sloping slightly proximad; (3) proximal area of fusion of metacarpal II and metacarpal III long, and distal area of fusion short (distal area short in *A. leucophrys*; long in *A. brasiliensis* and *A. crecca*; very long in *A. cyanoptera*); (4) internal face of metacarpal I slightly excavated; (5) external rim of carpal trochlea subangular proximally; (6) area covered by external cuneiform ligament markedly convex; (7) posterior carpal fossa wide distally, narrowing abruptly proximad.

Femur with (1) head large, projecting mediad (small to moderate sized head projecting mediad in *A. leucophrys*, *A. crecca*, and *A. cyanoptera*; very large head projecting equally dorsad and mediad in *A. brasiliensis*); (2) attachment of M. ilio-trochantericus medius very long (long in *A. leucophrys*; of moderate length in *A. brasiliensis* and *A. crecca*; short in *A. cyanoptera*); (3) iliac facet curving sharply mediad posteriorly (moderate curvature in *A. leucophrys* and *A. brasiliensis*; slight if any curvature in *A. crecca* and *A. cyanoptera*).

Tibiotarsus with (1) external face of distal end markedly concave; (2) internal condyle not flaring mediad.

Tarsometatarsus with (1) intercotylar prominence broad; (2) shaft narrowing sharply immediately posterior to internal cotyla; (3) hypotarsus long; (4) anterior face of shaft straight in lateral view; (5) internal trochlea turned moderately externally.

Etymology

This species is named for the Amotape Mountains, an outlier of the Andes Mountains, that overlook the fossil site.

Anas sanctaehelenae sp. nov.

Fig. 8D, 9D, 11D, H

Holotype

Complete left humerus. Uncatalogued.

Type Locality

La Carolina, Ecuador (Campbell, 1976).

Paratypes

Proximal end of 1 right humerus, distal end of 1 right humerus. ROM 12899–12900.

Referred Material

One complete left coracoid, distal end of 1 left tibiotarsus, 1 complete right

tarsometatarsus. ROM 12901–12903. The 5 specimens, excluding holotype but including paratypes, represent a minimum of 1 individual.

Diagnosis

Humerus agrees with that of *Anas* and differs from that of all other genera of the subfamily Anatinae by having those characters of the genus as described by Woolfenden (1961).

When compared with the humerus of other species of *Anas*, the holotype is characterized by having (1) head large, profile rounded in palmar view, and projecting more distad than anconally; (2) head not inflected; (3) internal tuberosity reduced; (4) attachment of M. coracobrachialis posterior short broad shelf, not extending down median crest; (5) median crest moderately prominent; (6) pneumatic fossa slightly elongated, entering only slightly into internal tuberosity; (7) deltoid crest long, moderately flaring, without depression at distal end; (8) attachment of M. pectoralis superficialis not rotated palmarly; (9) shaft with moderate internal curvature immediately distal to bicipital crest, giving moderately sigmoid shaft; (10) impression of M. brachialis anticus shallow, oriented at large angle to axis of shaft; (11) attachment of anterior articular ligament as wide as it is long; (12) entepicondyle rotated moderately anteriad; (13) entepicondyle rounded distally, not produced, very small; (14) internal tip of external condyle not undercut, but with slight ridge present leading internally; (15) olecranol fossa short.

For measurements see Table 4. Measurements of the holotype are as follows: length, 57.7; proximal width, 12.3; distal width, 9.1; least width of shaft, 4.4.

Characters

Compared with other species of *Anas*, *A. sanctaehelenae* is characterized by having coracoid with (1) coracohumeral surface short, narrow, widening moderately anteriad, of moderate curvature, and not positioned internally; (2) attachment of Lig. humero-coracoideum antierius superius elevated; (3) scapular facet large oval.

Tibiotarsus with (1) external face of distal end flat; (2) internal condyle flaring mediad.

Tarsometatarsus with (1) intercotylar prominence slender; (2) shaft narrowing sharply immediately posterior to internal cotyla; (3) hypotarsus short; (4) anterior face of shaft markedly convex in lateral view; (5) internal trochlea strongly turned externally.

Etymology

This species is named for the Santa Elena Peninsula of Ecuador, where the La Carolina site is located.

Remarks

The holotype of *Anas sanctaehelenae* is from La Carolina, Ecuador, not the Talara Tar Seeps. The Ecuadorian specimen was chosen for the holotype because of its completeness, and the lack of a complete specimen in the Talara material. The paratypes and all referred material are from the Talara Tar Seeps. *A. sanctaehelenae* is the *Anas* species 3 reported from La Carolina (Campbell, 1976).

Anas bahamensis Linnaeus
Bahama Pintail

Material

Portions of 14 crania, 5 frontals, 9 right and 11 left quadrates, 3 right and 3 left articulares, 5 right and 7 left mandibular fragments, 122 right and 106 left scapulae, 172 complete right and 128 complete left coracoids, humeral ends of 71 right and 87 left coracoids, 35 complete right and 34 complete left humeri, proximal ends of 86 right and 104 left humeri, distal ends of 103 right and 110 left humeri, 71 complete right and 64 complete left ulnae, proximal ends of 69 right and 61 left ulnae, distal ends of 87 right and 78 left ulnae, 14 complete right and 19 complete left radii, proximal ends of 83 right and 61 left radii, distal ends of 52 right and 41 left radii, 135 complete right and 103 complete left carpometacarpi, proximal ends of 73 right and 73 left carpometacarpi, 29 complete right and 21 complete left femora, proximal ends of 22 right and 25 left femora, distal ends of 11 right and 7 left femora, 5 complete right and 4 complete left tibiotarsi, proximal ends of 26 right and 15 left tibiotarsi, distal ends of 102 right and 91 left tibiotarsi, 60 complete right and 65 complete left tarsometatarsi, proximal ends of 17 right and 19 left tarsometatarsi, distal ends of 24 right and 21 left tarsometatarsi. ROM 13925–16788. The 2,864 specimens represent a minimum of 243 individuals.

Characters

Only two species (*A. bahamensis* and *A. discors* Linnaeus) of the subfamily Anatinae have been previously recorded from northwestern Peru, although I have seen *A. cyanoptera* (subspecies not determined) near Ciudad de Piura, Departamento de Piura (4 October 1971). *A. bahamensis* is easily separated on size from these two species, including the larger subspecies of *A. cyanoptera*, *A. c. orinomus*.

Anas flavirostris Vieillot, *A. georgica* Gmelin, *A. puna* Tshudi, and *A. platalea* Vieillot also occur in Peru today, but not in the northwestern section. *A. bahamensis* is readily separable from *A. puna* and *A. platalea* by numerous osteological characters, and from the smaller *A. flavirostris* by size. Elements of *A. bahamensis* are usually smaller than those of *A. georgica*, the most closely related species, but the two species overlap in size. *A. bahamensis* differs from *A. georgica* by having scapula with (1) concavity dorsal to proximal end of glenoid facet deep; (2) acromion longer.

Coracoid with (1) coracohumeral surface narrower and shorter; (2) head more rounded in medial view; (3) procoracoid projecting farther dorsad.

Humerus with (1) capital groove narrower; (2) internal tuberosity projecting less anconally; (3) attachment of Lig. humero-coracoideum anterius inferius smaller and positioned anconally on internal tuberosity; (4) concavity immediately external to attachment of M. proscapulohumeralis much narrower; (5) ectepicondylar prominence larger; (6) entepicondyle smaller; (7) external condyle narrower.

Ulna with (1) olecranon longer; (2) external cotyla smaller, with distal projection smaller; (3) internal cotyla more concave.

Radius with (1) capital tuberosity smaller; (2) ligamental prominence narrower, more distinct, and situated more laterad.

Carpometacarpus with (1) process of metacarpal I slightly longer and more rectangular, lacking sharp anterior curvature; (2) posterior carpal fossa larger; (3) internal scapholunar ligamental attachment on proximal end of metacarpal III usually positioned proximally; (4) proximal area of fusion of metacarpal II and metacarpal III shorter.

Femur with (1) head smaller; (2) iliac facet narrower; (3) internal condyle not as deep; (4) external condyle not as deep, more rounded, and extending farther proximad.

Tibiotarsus with (1) concavity between internal articular surface and rotular crest shallower; (2) area between proximal internal ligamental attachment and flexor attachment slightly convex (very convex in *A. georgica*); (3) condyles less deep.

Tarsometatarsus with (1) cotylae smaller; (2) external ligamental attachment positioned proximally; (3) trochleae less compressed; (4) middle trochlea extending less proximad.

Remarks

Anas bahamensis is widespread throughout tropical and subtropical South America, and is capable of rapidly colonizing temporary bodies of water in large numbers, even in very arid areas (Marchant, 1958). It is very characteristic of coastal lagoons and where found is present in large numbers. The large number of fossil specimens of this species represents almost one-half of the collection of fossil non-passerine birds from this site.

Spillman (1942) described *Archeoquerquedula lambrechtii* from late Pleistocene deposits of the Santa Elena Peninsula of Ecuador. Although I have not seen his material, I do have a number of topotypes and these agree with *Anas bahamensis*. Spillman did not describe any of the elements referred to *A. lambrechtii*, but he did figure a skull. From his figure it is possible to determine that the length of the orbit is greater than the distance from the posterior edge of the orbit to the parietal. Of the species of *Anas* found in South America this condition occurs only in *A. bahamensis*. In all other species the distance from the posterior edge of the orbit to the parietal is greater than the length of the orbit. Therefore, I suggest that *Archeoquerquedula lambrechtii* be synonymized with *Anas bahamensis*.

Subfamily Oxyurinae Phillips

Nomonyx Ridgway

Nomonyx dominicus (Linnaeus)

Masked Duck

Material

One complete left humerus. ROM 16789.

Remarks

Nomonyx dominicus has been recorded as far south in western Peru as Lambeyeque,

and Marchant (1958) reported it as scarce on the arid Santa Elena Peninsula of Ecuador. It is sedentary in habits, but strays great distances. It would appear from the single specimen that *N. dominicus* was not a regular resident at or near the fossil site.

Discussion of Family Anatidae

The nine species of waterfowl found in the Talara Tar Seeps avifauna represent slightly more than 10 per cent of the total number of non-passerine species known from the avifauna and give a good indication of what the habitat was like during the period of entrapment. Although some of the species are well-known colonizers of temporary ponds (*Anas bahamensis*), or widely wandering species (*Nomonyx dominicus*), others indicate either the presence of grasses in abundance (*Chleophaga melanoptera*) or forests (*Dendrocygna autumnalis* and *Cairina moschata*).

The most interesting species are the four that became extinct. Special note should be made that they are all of very small size. The large to moderate number of elements representing each species, and the recognition of three of the four species in late Pleistocene deposits of southwestern Ecuador, is sufficient to remove any doubt that they are indeed separate species. This is particularly fortunate when considering the possibility of confusion among the three new small species referred to the genus *Anas*.

It is possible that the four extinct species were derived from similarly sized, i.e., small, ancestral species. However, the fact that the four species are all small also suggests the possibility that there may have been strong competition for available food resources. Schoener (1969, 1970) has constructed a model, using species of West Indies *Anolis*, demonstrating how species of similar size may converge toward a smaller size when in competition for food. Additional selective pressures contributing to the evolution of small sized individuals within a species would result from regular periods of extreme food stress because, other things being equal, small individuals require less food than large individuals. In this geographic region it is easy to visualize extreme food stress resulting from drought conditions. On the basis of the large number of specimens of ducks present in the deposit, however, I believe that there was sufficient water present to maintain resident populations of each species for a long period of time.

The late Pleistocene age of the fossil deposits suggests that the four extinct species were endemic to northwestern Peru and, in all but one case, to southwestern Ecuador (Campbell, 1976). It also suggests that their extinctions were related in some way to the disappearance of suitable habitats. It is difficult to understand why not one species was able to survive elsewhere for such a short period of time, in the same way the five recorded extant species of widespread anatids have survived, unless the four species were endemic to the indicated region. Water is one of the most important factors in the ecology of ducks, and it must have been present when the fossil specimens were deposited. It is not present at the site now. The removal of the water supply would result in local extirpation of wide-spread species and the extinction of endemic species dependent upon water. If the four species were endemics, there must have been a sufficient period of habitat stability for their speciation. However, the process of speciation resulting in the three extinct species of *Anas* may have happened as rapidly as it now appears to be occurring in *A. cyanoptera*, where one finds three allopatric subspecies of quite different size classes in northern South America (Snyder and Lumsden, 1951).

There is, of course, the possibility that future discoveries of fossil sites will show that one or more of the four extinct species were not endemic to the area as believed. I do not think that this in itself would alter the conclusions reached concerning the habitat at the Talara Tar Seeps during the time of deposition of the fossils, however, primarily because of the additional supportive evidence from other members of the known avifauna.

The three new species referred to the genus *Anas* tend to fill in some of the larger gaps in osteological characters between typical *Anas* and *Anas* (*Callonetta*) *leucophrys* and *Anas* (*Amazonetta*) *braziliensis* noted by Woolfenden (1961). For this reason I have considered the latter two species and the three new species of the subfamily Anatinae as members of a larger, more inclusive genus *Anas* rather than proposing new genera for the new intermediate forms.

Order Accipitriformes (Vieillot)
Suborder Sarcoramphi (Ridgway)
Family Vulturidae (Illiger)

***Geronogyps* gen. nov.**

Diagnosis

Tarsometatarsus agrees with that of *Vultur* Linnaeus and *Gymnogyps* Lesson by having (1) intercotylar prominence large; (2) anterior metatarsal groove very deep with large attachment of M. tibialis anticus located immediately distal to proximal foramina; (3) hypotarsus flattened, roughly triangular in shape, with central ridge leading distad; (4) shaft robust, rectangular, widening proximad and distad to meet articular surfaces; (5) external and internal trochleae much smaller than middle trochlea and turned slightly toward midline of shaft; (6) size large.

Tarsometatarsus differs from that of *Vultur* and *Gymnogyps* by having (1) intercotylar prominence very high and narrow (low and broad in *Vultur*, high and of moderate width in *Gymnogyps*); (2) internal cotyla very deep, narrow, with very high, almost straight internal edge (deep, wide, internal edge moderately curved in *Vultur*; deep, of moderate width, with internal edge rounded in *Gymnogyps*); (3) external cotyla round, with articular surface extending onto external anterior metatarsal ridge (very elongated with articular surface restricted in *Vultur*, oval with articular surface restricted in *Gymnogyps*); (4) hypotarsus narrow, deeply grooved, moderately notched externally, with central ridge leading distad narrow (broad, very deeply grooved, deeply notched externally, with central ridge broad in *Vultur*; of moderate width, moderately grooved, moderately notched externally, with central ridge broad in *Gymnogyps*); (5) anterior metatarsal groove of moderate width and appears slightly pneumatic proximal to attachment of M. tibialis anticus (wide and highly pneumatic in *Vultur*, narrow and moderately pneumatic in *Gymnogyps*); (6) attachment of M. tibialis anticus very large, with length equal to or exceeding length of anterior metatarsal groove proximal to it (of moderate size, wider than long, much shorter than proximal portion of anterior metatarsal groove in *Vultur*; of moderate size, length greater than width, much shorter than proximal portion of anterior

metatarsal groove in *Gymnogyps*); (7) attachment of M. extensor hallucis longus located approximately halfway between base of anterior metatarsal groove and top of internal metatarsal ridge (located near top of internal metatarsal ridge in *Vultur* and *Gymnogyps*); (8) external anterior metatarsal ridge broad and rounded and internal anterior metatarsal ridge of moderate width but with sharp proximal edge (broad, rounded external, and narrow, moderately rounded internal anterior metatarsal ridge in *Vultur*; both internal and external anterior metatarsal ridges broad and rounded in *Gymnogyps*); (9) shaft moderately depressed external to hypotarsus (slightly, if any, depressed in *Vultur*, moderately to deeply depressed in *Gymnogyps*); (10) shaft transversely concave posteriorly at midpoint of shaft (flat to rounded in *Vultur*; flat to slightly concave in *Gymnogyps*); (11) shaft widens slightly to moderately to meet internal cotyla, widens abruptly to meet external cotyla (widens abruptly to meet both external and internal cotylae in *Vultur*, widens moderately to abruptly to meet internal cotyla and abruptly to meet external cotyla in *Gymnogyps*); (12) shaft widens much more to meet internal trochlea than it does to meet external trochlea, placing middle trochlea off centre (widens equally to both internal and external trochleae, placing middle trochlea near midline of shaft in *Vultur*; similar in *Gymnogyps*); (13) internal trochlear surface small (large in *Vultur*; moderate to large in *Gymnogyps*); (14) internal trochlea extending distad to almost reach distalmost point of middle trochlea (does not project as far distad in *Vultur* and *Gymnogyps*); (15) internal trochlea with rounded posterior edge (posterior edge arrow shaped, directed posteriad in *Vultur*; arrow shaped, directed posterioproximad in *Gymnogyps*); (16) middle trochlea short (moderate to long in *Vultur* and *Gymnogyps*); (17) external trochlear surface large, not delimited sharply anteroproximally (moderate, sharply delimited anteroproximally in *Vultur*; moderate to large, moderately delimited anteroproximally in *Gymnogyps*); (18) external trochlea with distinct posteroproximal corner to posterior edge (rounded in *Vultur*; rounded to prominent proximal projection in *Gymnogyps*); (19) external trochlear notch moderately wide (very wide in *Vultur*; moderately wide in *Gymnogyps*).

Type Species

Geronogyps reliquus sp. nov.

Etymology

From Greek, *gerontos*, genitive of *geron*, old man, and *gyps*, masculine, vulture.

Geronogyps reliquus sp. nov.

Fig. 12A, B, 14A, 15A, B, 17A, C, E,
18B, C, 19A, B, C, D, 20A

Holotype

Complete right tarsometatarsus. ROM 12986.

Paratypes

Complete right tarsometatarsus and distal end of 1 right tarsometatarsus. ROM 12987–12988.

Referred Material

Portions of 2 sterna, 1 complete left coracoid, 2 left coracoids lacking heads, humeral end of 1 right coracoid, sternal end of 1 left coracoid, shaft and distal end of 1 left humerus, proximal end of 1 right humerus, distal end of 1 right humerus, proximal end of 1 left ulna, distal end of 1 left ulna, proximal ends of 1 right and 1 left radius, distal ends of 1 right and 2 left radii, proximal end of 1 right carpometacarpus, distal end of 1 left tibiotarsus, proximal ends of 4 right femora, distal ends of 2 right femora. ROM 12989–13013. The 28 specimens, including holotype and paratypes, represent a minimum of 4 individuals. In addition, the following elements are tentatively referred to this species but cannot be assigned with certainty: 2 left articulars, 1 left quadrate, portion of 1 cranium. ROM 13014–13017.

Diagnosis

As for genus. For measurements see Table 5. Measurements of holotype are as follows: length, 121.8; proximal width, 25.4; distal width, 29.0; least width of shaft, 13.8; width of middle trochlea, 10.9.

Characters

Sternum with (1) ventral lip of coracoidal sulcus markedly concave along ventral edge, matching short external anterior sternal facet of coracoid (not concave in *Vultur* and *Gymnogyps*); (2) carinal apex situated very far distally (situated short distance distally in *Vultur*, moderate distance in *Gymnogyps*); (3) carina large (of moderate size in *Vultur* and *Gymnogyps*); (4) ventral manubrial spine very broad (broad in *Vultur*, narrow in *Gymnogyps*).

Coracoid with (1) coracoidal fenestra lacking (present in *Vultur* and *Gymnogyps*); (2) shaft leading distad from external corner of glenoid facet forming large ridge (slight to moderate in *Vultur*, very slight in *Gymnogyps*); (3) shaft with internal contour very concave between procoracoid and anterior sternal facet (not as concave in *Vultur* and *Gymnogyps*); (4) external portion of anterior sternal facet short, distinctly set off from base of shaft distally (long, not distinctly set off in *Vultur* and *Gymnogyps*); (5) procoracoid directed internally along plane of glenoid facet (directed more anteriad in *Vultur* and *Gymnogyps*).

Humerus with (1) head narrow (wide in *Vultur*, narrow in *Gymnogyps*); (2) capital shaft ridge dropping off sharply on both sides (shaft more rounded in *Vultur* and *Gymnogyps*); (3) attachment of M. proscapulohumeralis brevis elevated (not elevated in *Vultur*, elevated or not elevated in *Gymnogyps*); (4) pectoral attachment very prominent (less prominent in *Vultur*, more similar in *Gymnogyps*); (5) deltoid crest flaring distally (not flaring as much in *Vultur* and *Gymnogyps*); (6) shaft ventral to M. pectoralis superficialis not depressed (depressed in *Vultur*, not depressed in *Gymnogyps*); (7) external condyle wide and short (narrow and long in *Vultur* and *Gymnogyps*); (8) internal condyle short (very long in *Vultur*, moderately long in *Gymnogyps*); (9) ectepicondylar prominence long, moderately produced proximad (of moderate length, not produced distad, greatly produced and angular proximally in *Vultur*; short, greatly produced and rounded in *Gymnogyps*); (10) internal condyle moderately rotated anteriad, giving moderately flexed distal end (greatly rotated in *Vultur*, moderately rotated in *Gymnogyps*); (11) impression of M. brachialis anticus moderately deep (very deep in *Vultur* and *Gymnogyps*).

Ulna with (1) olecranon of moderate size (very large in *Vultur*, small to moderate in *Gymnogyps*); (2) attachment of anterior articular ligament small, not extending far distad (large, extending very far distad in *Vultur*; large, extending far distad in *Gymnogyps*); (3) area between external and internal condyles flat in external view (internal condyle projects slightly farther distad in *Vultur* and *Gymnogyps*); (4) carpal tuberosity large, joins shaft abruptly (large in *Vultur*, small in *Gymnogyps*, merges more gently with shaft in both).

Radius with (1) bicipital attachment large (small in *Vultur* and *Gymnogyps*); (2) bicipital tubercle large (large in *Vultur*, very small in *Gymnogyps*); (3) capital tuberosity bordered internally by deep notch, pierced by large nutrient foramen (shallow in *Vultur*, moderate in *Gymnogyps*, nutrient foramen small to moderate in both); (4) external corner of distal end rounded (flattened so angle is formed at external end of carpal facet in *Vultur*, more rounded in *Gymnogyps*); (5) tendinal groove bordered externally by high ridge (very slight ridge in *Vultur*, moderate ridge in *Gymnogyps*); (6) distal end with external edge curving sharply palmarly (almost straight in *Vultur* and *Gymnogyps*).

Carpometacarpus with (1) process of metacarpal I low (i.e., short anteroposteriorly), curving sharply proximad (high, with moderate proximal curvature in *Vultur*; moderately high, with slight proximal curvature in *Gymnogyps*); (2) external ligamental attachment a small deep pit bordered posteriorly by raised area (of moderate size, lying in a pit, with no raised area posteriorly in *Vultur* and *Gymnogyps*).

Femur with (1) trochanter of moderate size, subrounded (large, well rounded in *Vultur*; of moderate size, subrounded in *Gymnogyps*); (2) attachment of M. obturator externus deep (larger, not as deep, positioned similarly in *Vultur*; similar size, not as deep, located more posteriorly in *Gymnogyps*); (3) attachments of M. ilio-trochantericus medius and M. iliacus confluent and with surface ribbed (separate and not ribbed in *Vultur* and *Gymnogyps*); (4) concavity immediately distal to posterior edge of iliac facet deep, bordered externally by large protuberance (shallow, very small protuberance in *Vultur*; very deep, moderate sized protuberance in *Gymnogyps*); (5) distal end of internal condyle subrounded in medial view (more rounded in *Vultur*; less rounded in *Gymnogyps*); (6) rotular groove moderately undercut distally (deeply undercut in *Vultur*, moderately undercut in *Gymnogyps*).

Tibiotarsus with (1) internal condyle short anteroposteriorly (long in *Vultur* and *Gymnogyps*); (2) distal internal ligamental attachment very deep (deep in *Vultur*, moderately deep in *Gymnogyps*).

Etymology

Latin, *reliquus*, remaining, left over.

Remarks

The tarsometatarsus is traditionally made the holotype of fossil accipitriform species when available, and the sum of many tarsometatarsal characters of *Geronogyps reliquus* establishes it as a distinctive genus and species. Additional very apparent large differences found in the other available elements strengthen this belief; i.e., the shape of the sternum and the manner of articulation with the coracoid, the absence of a coracoidal fenestra, and the confluent ribbed attachments of M. ilio-trochantericus

Table 5 Measurements of the scapula, coracoid, humerus, radius, ulna, carpometacarpus, femur, tibiotarsus, and tarsometatarsus of *Gymnogyps californianus*, Recent *Vultur gryphus*, *V. gryphus* from the Talara Tar Seeps (excluding scapula, humerus, and carpometacarpus), *Gymnogyps howardae* sp. nov. (excluding carpometacarpus and femur), and *Geronogyps reliquus* gen. et sp. nov. (excluding scapula) (in mm).

		<i>Gymnogyps howardae</i> sp. nov.		<i>Gymnogyps californianus</i>	<i>Vultur gryphus</i>		<i>Geronogyps reliquus</i> gen. et sp. nov.
					Recent	Talara Tar Seeps	
Scapula							
Proximal Height	OR	27.5		27.2	28.6–30.5		
	M	—		—	29.5		
	n	1		1	2		
Proximal Width	OR	8.5		8.1	7.4–9.6		
	M	—		—	8.5		
	n	1		1	2		
Coracoid							
Length	OR	96.2		102.6	98.2–98.8	103.1	89.4
	M	—		—	98.5	—	—
	n	1		1	2	1	1
Head to Scapular Facet	OR	43.2		46.9	50.5–51.3	52.0	44.0–51.9
	M	—		—	50.9	—	47.9
	n	1		1	2	1	2
Proximal Depth	OR	25.5		28.1	29.8–30.3	30.0	25.7–28.2
	M	—		—	30.1	—	26.9
	n	1		1	2	1	2
Least Depth of Shaft	OR	14.8–18.1		16.4	16.6–18.0	16.9	13.9–14.9
	M	16.4		—	17.3	—	14.4
	n	2		1	2	1	3
Length of Sternal Facet	OR			38.6	43.3–44.1	42.5	
	M			—	43.7	—	
	n			1	2	1	

Humerus

Length	OR	256.0–265.0.	273.0	265.0–292.0	
	M	260.5	—	278.5	
	n	2	1	2	
Proximal Width	OR	52.5–54.3	55.7	62.6–63.4	55.7
	M	53.4	—	63.0	—
	n	2	1	2	1
Distal Width	OR	46.4–49.0	51.1	55.1–55.6	48.5
	M	47.6	—	55.4	—
	n	5	1	2	1
Least Width of Shaft	OR	18.2–19.6	23.0	21.2–21.8	
	M	19.1	—	21.5	
	n	3	1	2	

Radius

Length	OR	298.0–328.0	304.0		
	M	313.0	—		
	n	2	1		
Proximal Width	OR	15.6–15.7	14.1	14.6	13.2–13.4
	M	15.7	—	—	13.3
	n	2	1	1	2
Distal Width	OR	24.3–24.4	22.8	24.1	22.7–24.3
	M	24.4	—	—	23.4
	n	2	1	1	3

Ulna

Length	OR	313.0–341.0	319.0		
	M	327.0	—		
	n	2	1		

Continued on page 64.

<i>Gymnogyps howardae</i> sp. nov.		<i>Gymnogyps californianus</i>	<i>Vultur gryphus</i>		<i>Geranogyps reliquus</i> gen. et sp. nov.
			Recent	Talara Tar Seeps	
Proximal	OR	29.3-31.9	33.7-36.3	33.5-34.0	30.1
Width	M	30.6	35.0	33.8	—
	n	2	2	2	1
Distal	OR	23.6-25.3	26.7-28.8		25.3
Depth	M	24.5	27.7		—
	n	2	2		1
Least	OR		14.3-15.4		
Width of	M		14.9		
Shaft	n		2		
Carpometacarpus					
Length	OR	139.0	132.2-140.3		
	M	—	136.2		
	n	1	2		
Proximal	OR	16.5	17.2-17.4		15.4
Width	M	—	17.3		—
	n	1	2		1
Height	OR	35.3	36.3-38.9		32.6
Through	M	—	37.6		—
Metacarpal I	n	1	2		1
Least	OR	13.2	13.0-14.6		
Width of	M	—	13.8		
Shaft	n	1	2		
Length of	OR	14.4	18.1-20.5		
Distal	M	—	19.3		
Fornix	n	1	2		

Femur

Length	OR	143.6–158.3	137.7	
	M	150.9	—	
	n	2	1	
Proximal Width	OR	37.6–38.5	32.3	37.3
	M	38.0	—	—
	n	2	1	1
Distal Width	OR	37.9–41.1	35.3	37.9
	M	39.5	—	—
	n	2	1	1
Least Width of Shaft	OR	18.0–19.5	17.3	
	M	18.7	—	
	n	2	1	

31.7–32.8
32.2
3
34.1–34.7
34.4
2

Tibiotarsus

Length	OR	216.0–242.0	214.0	213.0
	M	229.0	—	—
	n	2	1	1
Proximal Width	OR	28.6–30.6	28.7	30.0–31.1
	M	29.6	—	30.6
	n	2	1	2
Distal Width	OR	25.1–27.1	25.1	23.9–26.1
	M	26.1	—	25.0
	n	2	1	4
Least Width of Shaft	OR	13.9–15.3	14.7	14.1
	M	14.6	—	—
	n	2	1	1
Depth of Internal Condyle	OR	24.9–26.2	22.5	22.9–24.6
	M	25.6	1	23.9
	n	2	1	4

22.5
—
1

<i>Gymnogyps howardae</i> sp. nov.			<i>Gymnogyps californianus</i>	<i>Vultur gryphus</i>		<i>Geronogyps reliquus</i> gen. et sp. nov.
				Recent	Talara Tar Seeps	
Tarsometatarsus						
Length	OR	118.5–122.0	117.8	118.8–134.7		121.8–124.5
	M	120.3	—	126.7		123.1
	n	2	1	2		2
Proximal Width	OR	25.8–29.9	26.7	27.5–29.8	30.0	25.4–26.3
	M	27.0	—	28.7	—	25.8
	n	7	1	2	1	2
Distal Width	OR	29.5–34.0	29.8	30.7–33.6		29.0–30.0
	M	31.3	—	32.1		29.5
	n	4	1	2		2
Least Width of Shaft	OR	13.4–13.5	14.0	13.7–14.7		13.8
	M	13.5	—	14.2		13.8
	n	2	1	2		2
Width of Middle Trochlea	OR	10.6–12.1	11.1	12.1–12.9		10.6–11.6
	M	11.3	—	12.5		11.0
	n	6	1	2		3

medius and M. iliacus of the femur. From the above diagnosis of the tarsometatarsus it is evident that *Geronogyps reliquus* resembles *Gymnogyps* more than *Vultur*. Two specimens of *Vultur gryphus* and one of *Gymnogyps californianus* were available for comparison of characters.

***Gymnogyps* Lesson**
***Gymnogyps howardae* sp. nov.**

Fig. 13A, 14B, 16A, B,
17B, D, 18A, 19E, 21A

Holotype

Complete right tarsometatarsus. ROM 12956.

Paratypes

One complete left tarsometatarsus, proximal ends of 2 right and 3 left tarsometatarsi, distal ends of 1 right and 3 left tarsometatarsi. ROM 12957–12966.

Referred Material

Portion of 1 sternum, 1 left scapula, 1 complete right coracoid, 1 right coracoid lacking head, 1 complete right and 1 complete left humerus, shaft and distal end of 1 right humerus, proximal end of 1 left humerus, distal ends of 1 right and 2 left humeri, proximal ends of 1 right and 1 left ulna, distal ends of 1 right and 2 left ulnae, distal end of 1 right radius, distal ends of 2 left tibiotarsi. ROM 12967–12985. The 30 specimens, including holotype and paratypes, represent a minimum of 4 individuals.

Diagnosis

Tarsometatarsus agrees with that of *Gymnogyps* and differs from that of *Vultur* and *Geronogyps* by having those characters of *Gymnogyps* listed in description of *Geronogyps reliquus*.

Tarsometatarsus differs from that of *Gymnogyps californianus* (Shaw) and *G. amplus* L. Miller (Collection of Pierce Brodkorb No. PB498, Reddick, Florida) by having (1) intercotylar prominence with prominent concavity on external side (slight to deep groove present in *G. californianus* and *G. amplus*); (2) internal cotyla with moderately curved posterior rim (moderately to sharply curved in *G. californianus* and *G. amplus*); (3) hypotarsus extending internally to at least middle of internal cotyla (does not extend as far internally in *G. californianus* and *G. amplus*); (4) posterior projection of external cotyla large (small to large in *G. californianus* and *G. amplus*); (5) ridge leading distad from hypotarsus very prominent, extending distad for more than third of length of bone, with deep depression of shaft on both sides (moderately prominent, extending distad for less than third of length of shaft, with depression internally greater than that externally in *G. californianus* and *G. amplus*); (6) anterior metatarsal groove with marked concavity distal to attachment of M. tibialis anticus (no noticeable concavity to *G. californianus* and *G. amplus*); (7) anterior metatarsal ridges well rounded and approximately equal in size (external anterior metatarsal ridge larger and more rounded than internal anterior metatarsal

ridge in *G. californianus* and *G. amplus*); (8) internal anterior metatarsal ridge continues distad and forms a marked corner to shaft that ends at base of internal rim of middle trochlea (is not traceable as a distinct corner in *G. californianus* and *G. amplus*); (9) internal trochlea long, large, rotated posteriad, with longest part of posterointernal edge directed posteroproximad (short, small to large, not rotated as much posteriad, with sharp to rounded posterointernal edge directed more posteriad than proximad in *G. californianus* and *G. amplus*); (10) middle trochlea very long, lying parallel to main axis of shaft, rims straight, and ending posteriorly in gradual taper (short, distal end turned slightly inward from main axis of shaft, rims flaring and terminating posteriorly more abruptly in *G. californianus* and *G. amplus*); (11) external trochlea short, not extending as far distad as internal trochlea, rotated slightly posteriad, trochlear surface very long anteriorly, with posterior edge well rounded and directed posteriad (long, extending as far distad as internal trochlea, rotated slightly, if any, posteriad, trochlear surface short, with posterior edge directed posteriad or proximad in *G. californianus* and *G. amplus*).

For measurements see Table 5. Measurements of the holotype are as follows: length, 122.0; proximal width, 26.9; distal width, 30.2; least width of shaft, 13.5; width of middle trochlea, 11.1.

Characters

Sternum with (1) ventral manubrial spine narrow (wider in *G. californianus*); (2) ventral lip of coracoidal sulcus curved along ventral edge (less curvature in *G. californianus*, straight in *Vultur*).

Scapula with (1) internal surface very concave anteriorly (less in *G. californianus*, similar in *Vultur*); (2) distal end of dorsal acromion edge greatly elevated above shaft (similar, but not quite as sharply set off in *G. californianus*; moderately elevated, merging gradually with shaft in *Vultur*).

Coracoid with (1) anterior sternal facet with small dorsal slope (moderate slope in *G. californianus*, sharp slope in *Vultur*); (2) scapular facet moderately elevated above shaft (slightly elevated in *G. californianus*, greatly elevated in *Vultur*); (3) head narrow (similar in *G. californianus*, wide in *Vultur*).

Humerus with (1) head narrow (slightly wider in *G. californianus*); (2) attachment of *M. proscapulo humeralis brevis* elevated (not elevated in *G. californianus*); (3) capital groove dividing base of median crest and capital shaft ridge (does not extend as far distad in *G. californianus*); (4) internal tuberosity moderately prominent (very prominent in *G. californianus*); (5) deltoid crest small, with anconal side very concave (larger, with anconal side less concave in *G. californianus*); (6) shaft moderately robust (very robust in *G. californianus*); (7) internal condyle small (large in *G. californianus*); (8) external condyle moderately produced distad (very produced in *G. californianus*); (9) ectepicondylar prominence short, distinctly set off from shaft distally (long, not distinctly set off from shaft in *G. californianus*); (10) entepicondyle moderately produced (more produced in *G. californianus*); (11) impression of *M. brachialis anticus* deep (very deep in *G. californianus*).

Ulna with (1) olecranon of moderate size (short, narrow, but deep in *G. californianus*); (2) attachment of anterior articular ligament long, elevated, and terminating abruptly (long, not elevated, terminating gradually in *G. californianus*); (3) internal condyle projecting slightly distal to external condyle (projects moderately

distal to external condyle in *G. californianus*); (4) carpal tuberosity long (shorter in *G. californianus*).

Radius with (1) ulnar depression moderately deep (shallow in *G. californianus*); (2) shaft widening very abruptly internally for carpal facet (widens more gradually in *G. californianus*).

Tibiotarsus with (1) distal internal ligamental attachment moderately deep (moderately deep in *G. californianus*, deep in *Vultur*); (2) internal condyle not flaring internally at anteroproximal end (similar in *G. californianus*, flares internally in *Vultur*).

Etymology

This species is named for Dr. Hildegarde Howard in recognition of her many outstanding contributions to avian palaeontology.

Remarks

The appearance in the fossil record of a South American species of *Gymnogyps* poses the question of its relationships with the *G. amplus*–*G. californianus* line of North America. The continent of origin of the genus is then drawn into question, but must remain uncertain until specimens of an earlier period are found.

Vultur Linnaeus *Vultur gryphus* Linnaeus Andean Condor

Material

One complete right coracoid, distal end of 1 right humerus, proximal ends of 1 right and 1 left ulna, distal end of 1 right ulna, proximal end of 1 left radius, distal end of 1 left radius, proximal end of 1 left femur, distal ends of 3 left femora, 1 complete right tibiotarsus, proximal end of 1 right tibiotarsus, distal ends of 2 right and 1 left tibiotarsus, proximal end of 1 left tarsometatarsus. ROM 16790–16806. The 17 specimens represent a minimum of 3 individuals.

Remarks

Vultur gryphus is found almost throughout the Andes of South America and often on the Pacific coast.

Discussion

In addition to the two species of living condors, eight large extinct vulturid species have been described from the Pliocene and Pleistocene of North and South America, one each in the two living genera and the other six in extinct genera. The possibility of one or more of these extinct North American species being identical to an extinct form from the Talara Tar Seeps requires a discussion of their characters.

Three extinct monotypic genera, *Pliogyps* Tordoff, *Breagyps* Miller and Howard, and *Antillovultur* Arredondo are known in the subfamily Vulturinae (Illiger).

Pliogyps fisheri Tordoff is much smaller than any of the *Talara* specimens, and additional characters listed by Tordoff (1959), such as a very large internal trochlea and a broad, rounded hypotarsal ridge, indicates that this species is not similar to any of the *Talara* species.

The distinctions among *Breagyps*, *Vultur*, and *Gymnogyps* have been described (L. Miller, 1910; Miller and Howard, 1938; Howard, 1974) and the characters of *Gymnogyps* listed hold for *G. howardae*. An inspection of the illustrations of *Breagyps clarki* (L. Miller, 1910: 9; Howard, 1974) immediately reveals large differences between that species and *Geronogyps reliquus*. No specimens of *Breagyps* were available for comparison. The following characters of the tarsometatarsus of *Breagyps* are most significant in distinguishing it from *Geronogyps*: (1) intercotylar prominence of similar height, but more rounded and broader; (2) shaft widening equally internally and externally for proximal articular surfaces, giving symmetrical appearance; (3) internal trochlea not extending nearly so far distad as middle trochlea; (4) internal intertrochlear notch wide.

Antillovultur was described from the late Pleistocene of Cuba (Arredondo, 1971; see also, Arredondo, 1976) on the basis of a fragmentary tarsometatarsus and the distal end of a humerus. The original description distinguishes this genus from *Vultur* and *Gymnogyps*. The following characters of *Antillovultur*, as determined from illustrations of the holotype, distinguish it from *Geronogyps*: (1) tubercle for tibialis anticus smaller, positioned more toward midline of anterior metatarsal groove, and with distal portion prominently elevated, constricting anterior metatarsal groove; (2) anterior metatarsal groove narrower and more clearly defined; (3) internal anterior metatarsal ridge very thick. The proximal and distal ends are missing from the holotype of *Antillovultur*.

Gymnogyps amplus is considered to be either the direct ancestor but specifically distinct from (Fisher, 1944), or a temporal subspecies (Brodkorb, 1964) of, *G. californianus*. The few specimens of *G. amplus* available indicate a closer relationship to *G. californianus* than to *G. howardae*.

Lönnerberg (1902) named *Vultur patruus* from a tarsometatarsus and femur from the Tarija Valley of Bolivia, listing primarily familial characters for identification of the material. The primary character used for the separation of *V. patruus* from *V. gryphus* was the small size of the fossil specimens in relation to one Recent specimen available to Lönnerberg. Although *V. patruus* is probably near the lower limit of the size range of *V. gryphus*, it is not significantly smaller than *V. gryphus*. In addition, the following characters of the tarsometatarsus of *V. patruus*, all taken from Lönnerberg's photograph of the specimen, are similar to those of *V. gryphus*, namely; (1) intercotylar prominence broad; (2) the bone appears symmetrical, with proximal and distal widening of shaft approximately equal; (3) presence of a prominent point of inflection near midpoint of internal side of shaft, distal to which a long curve leads to the edge of the internal condyle, positioning the narrowest point of the shaft distal to point of inflection; (4) middle trochlea short; (5) internal and external intertrochlear notches approximately equal.

That *V. patruus* does not represent *Geronogyps reliquus* is easily seen by two characters of the latter, i.e., (1) shaft widening much more externally than internally for proximal articular surfaces, giving an asymmetrical bone; (2) internal trochlea extending almost as far distad as middle trochlea (internal trochlea does not extend nearly so far distad in *Vultur*).

V. patruus superficially resembles *G. californianus* and *G. amplus* more than *G. howardae*, but *G. howardae* is easily distinguished by having (1) intercotylar prominence narrow; (2) shaft widening more gradually for proximal articular surfaces, more abruptly for distal articular surfaces; (3) no distinct point of inflection on internal side; (4) middle trochlea much longer; (5) trochlear surfaces asymmetrical.

Although the associated material was considered Pliocene by Lönnberg, later studies by Boule (1920) and Oppenheim (1943) have placed the age of the Tarija beds as Pleistocene. From the above information it appears that *V. patruus* is a specimen of *V. gryphus* and should be placed in synonymy with the latter. This belief was expressed earlier by Fisher (1944: 294).

The three species known from the subfamily Teratornithinae (L. Miller) are so distinctive they are readily seen to bear no resemblance to the *Talara* specimens.

Monotypic genera are perhaps undesirable from certain viewpoints, but the discovery of another species of *Gymnogyps* indicates again that the taxonomy of living species is at best incomplete without greater knowledge of the fossil record, which is often slow in coming. The "lumping" of *Vultur*, *Gymnogyps*, and *Pliogyps* into one genus, *Vultur*, as suggested by Mayr and Short (1970) appears to be an example of eliminating monotypic genera solely for the purpose of reducing the number of taxonomic names and not for valid systematic, or phylogenetic, reasons.

***Sarcoramphus* Dumeril**
***Sarcoramphus? fisheri* sp. nov.**

Fig. 22A, B, C

Holotype

Distal end of right tibiotarsus. ROM 12887.

Referred Material

Distal end of 1 right ulna, proximal end of 1 left radius. ROM 12888–12889. The 3 specimens, including holotype, represent a minimum of 1 individual.

Diagnosis

Compared with *Vultur*, *Gymnogyps*, *Coragyps*, and *Cathartes*, *Sarcoramphus* has tibiotarsus with (1) external condyle of greater depth than length (similar in *Cathartes*; more rounded in *Gymnogyps*, *Vultur*, and *Coragyps*); (2) tendinal groove passing under supratendinal bridge along straight line (similar in *Cathartes*; curving internally before reaching supratendinal bridge in *Gymnogyps*, *Vultur*, and *Coragyps*); (3) external condyle broad (similar in *Gymnogyps*, *Vultur*, and *Coragyps*; narrow in *Cathartes*).

Tibiotarsus differs from that of *Sarcoramphus papa* (Linnaeus) by having (1) shaft very flattened posteroproximally to internal condyle (less flattened in *S. papa*); (2) external condyle with rather even slope to medial surface (well-rounded in *S. papa*); (3) size larger, width and depth 40 mm proximal to base of intercondylar groove, 11.8 and 9.6, respectively (in *S. papa*, width, 10.2–10.3, mean, 10.2; depth, 7.7–8.1, mean, 7.9; n = 3).

Characters

Ulna with (1) external condylar surface passing medially into broad, shallow depression in shaft (passes onto shaft, but no depression in *S. papa*; does not pass onto shaft in *Gymnogyps*, *Vultur*, *Cathartes*, or *Coragyps*); (2) pneumaticity lacking in palmar surface (similar in *S. papa*, *Gymnogyps*, and *Vultur*; present in *Cathartes* and *Coragyps*). Distal width, 21.5 (in *S. papa*, 14.2–15.9; mean, 14.8; $n = 3$).

Radius with (1) ligamental attachment of internal side of capital tuberosity divided into two distinct sections (similar in *S. papa*; not divided into two distinct sections in *Gymnogyps*, *Vultur*, *Cathartes*, or *Coragyps*); (2) bicipital tubercle extending much farther distad than long attachment for M. biceps (similar in *S. papa*; does not extend as far distad in *Gymnogyps*, *Vultur*, *Cathartes*, or *Coragyps*, and attachment of M. biceps much shorter in all but *Gymnogyps*). Proximal width, 12.6 (in *S. papa*, 8.5–9.2; mean, 8.9; $n = 3$).

Etymology

This species is named for Dr. Harvy I. Fisher in recognition of his many contributions to our knowledge of New World vultures.

Remarks

Unfortunately, *Sarcoramphus? fisheri* is represented by such poor material that its true generic status must remain questionable until further collections of fossil material are made. That the material represents a large species of *Sarcoramphus* is reasonably certain, or at least it is much more similar to that genus than any other living genus of vulture. That the elements are intermediate in size between *S. papa* and *Vultur* indicates that they represent a new species as there is no living vulturid of comparable size.

One additional extinct species of *Sarcoramphus*, *S. kernense* (L. Miller) from the Middle Pliocene of California (L. Miller, 1931), has been described, and it is also larger than *S. papa*. Although the holotype of *S. kernense*, which is the distal third of a humerus, is not comparable with the specimens referred to *Sarcoramphus? fisheri*, the great difference in time and space between the occurrence of the two species makes it highly unlikely that the specimens of *Sarcoramphus? fisheri* actually represent *S. kernense*.

Coragyps Geoffrey *Coragyps* cf. *atratus* (Bechstein) Black Vulture

Material

Four premaxillaries, 2 left quadrates, 1 right articular, 4 right and 3 left scapulae, 4 complete right and 3 complete left coracoids, humeral ends of 2 right coracoids,

sternal end of 1 left coracoid, proximal ends of 3 right and 2 left humeri, distal ends of 4 right and 2 left humeri, 2 complete right and 1 complete left ulna, proximal ends of 2 right and 1 left ulna, distal ends of 2 right and 2 left ulnae, proximal ends of 2 right and 5 left radii, distal ends of 3 right and 2 left radii, proximal ends of 2 left carpometacarpi, 1 complete left femur, proximal end of 1 right femur, proximal ends of 1 right and 2 left tibiotarsi, distal ends of 5 right and 4 left tibiotarsi, 1 complete right and 1 complete left tarsometatarsus, proximal ends of 3 left tarsometatarsi, distal ends of 2 right and 2 left tarsometatarsi. ROM 16807–16878, 19536–19545. The 82 specimens represent a minimum of six individuals.

Characters

Coragyps atratus and *Cathartes aura* (Linnaeus) are easily separated by many characters.

Although the material listed above closely resembles *Coragyps atratus*, including *C. a. brasiliensis*, it differs in numerous small, but consistent, ways from that species. Measurements of the fossil material all fall within the range of living *C. atratus* and are much smaller than corresponding measurements for *C. occidentalis* (Howard, 1968).

Remarks

Despite strong resemblance to *C. atratus*, the fossil material is definitely distinctive, and may represent a new species, or at least a temporal subspecies. This being the case, earlier suggestions (Fisher, 1944; Howard, 1968) that *C. occidentalis* may be the direct ancestor to *C. atratus* must be re-examined.

Cathartes Illiger
Cathartes aura (Linnaeus)
Turkey Vulture

Material

One premaxillary, 2 left quadrates, 3 left scapulae, 2 complete right and 1 complete left coracoid, humeral end of 1 left coracoid, proximal end of 1 right humerus, distal ends of 2 left humeri, proximal ends of 2 left radii, distal end of 1 right radius, distal end of 1 left carpometacarpus, distal ends of 2 right and 3 left tibiotarsi, 1 complete right and 1 complete left tarsometatarsus, proximal ends of 1 right and 1 left tarsometatarsus. ROM 16879–16904. The 26 specimens represent a minimum of three individuals.

Remarks

Cathartes aura is generally distributed throughout South America.

Suborder Accipitres Vieillot
Family Accipitridae (Vieillot)
Subfamily Buteoninae (Vigor)

Miraquila gen. nov.

Diagnosis

Tarsometatarsus characterized by having (1) inner calcaneal ridge of hypotarsus projecting posteriad at 90° to vertical axis of shaft (projects posteriad at approximately 80° to vertical axis of shaft in *Heterospizias* Sharp and *Buteogallus* Lesson; approximately 60°–70° in *Buteo* Lacépède, *Geranoaetus* Kaup, *Harpyhaliaetus* Lafresnaye, *Spizaetus* Vieillot, and *Aquila* Brisson); (2) intercotylar area distinctive ridge (low elevated area in *Buteo*, *Geranoaetus*, *Harpyhaliaetus*, *Spizaetus*, and *Aquila*; moderate ridge in *Heterospizias* and *Buteogallus*); (3) edge of shaft external to outer calcaneal ridge of hypotarsus distinct long ridge flaring externally (long ridge but not as large in *Buteogallus*; short, protruding externally only slightly in *Buteo*, *Geranoaetus*, *Harpyhaliaetus*, *Heterospizias*, *Spizaetus*, and *Aquila*); (4) anterior metatarsal groove very deep (shallow in *Harpyhaliaetus*; moderately deep in *Heterospizias*, *Buteogallus*, *Geranoaetus* and *Buteo*; deep in *Spizaetus* and *Aquila*); (5) internal anterior metatarsal ridge well developed, extending distad for more than third of shaft (moderately developed in *Buteo*; slightly developed in *Geranoaetus* and *Buteogallus*; poorly developed in *Harpyhaliaetus*, *Heterospizias*, *Spizaetus* and *Aquila*); (6) attachment of tibialis anticus separated from external anterior metatarsal ridge by deep groove (groove slightly developed in *Buteo* and *Buteogallus*; groove not distinct in *Geranoaetus*, *Harpyhaliaetus*, *Heterospizias*, *Spizaetus*, or *Aquila*); (7) middle trochlea long anteriorly, turned only slightly externally in anterior view (long anteriorly, turned moderately externally in *Geranoaetus* and *Buteogallus*, and very strongly externally in *Aquila*; long anteriorly, turned slightly externally in *Heterospizias* and *Spizaetus*; short, turned significantly externally in *Buteo* and *Harpyhaliaetus*); (8) internal trochlea rotated posteriad such that posteromedial edge is at same level as posterolateral edge of middle trochlea (similar in *Buteo*, *Geranoaetus*, *Heterospizias*, *Buteogallus*, *Spizaetus*, and *Aquila*; not rotated posteriad in *Harpyhaliaetus*); (9) internal trochlea not projecting distad beyond middle trochlea and not rotated externally in anterior view (similar in *Harpyhaliaetus* and *Aquila*; projecting distad beyond middle trochlea and not rotated in *Heterospizias*, *Aquila*, and *Geranoaetus*; projecting or not projecting distad beyond middle trochlea and not rotated in *Buteogallus*; projecting distad beyond middle trochlea and rotated significantly externally in *Buteo*); (10) internal trochlea without distinct angular proximolateral projection (similar in *Harpyhaliaetus*, *Heterospizias*, *Aquila*, and *Spizaetus*; small projection in *Buteogallus*; prominent in *Buteo* and *Geranoaetus*).

Type Species

Miraquila terrestris sp. nov.

Etymology

From Latin, *mirus*, amazing or astonishing, and *aquila*, feminine, eagle.

Miraquila terrestris sp. nov.

Fig. 23A, 24C, 27C, D, E

Holotype

Proximal end of left tarsometatarsus. ROM 13025.

Paratypes

Proximal end of 1 right tarsometatarsus, distal ends of 2 right tarsometatarsi. ROM 13026–13028.

Referred Material

One complete left coracoid, 1 complete left carpometacarpus, proximal ends of 2 left tibiotarsi. ROM 13029–13032. The 8 specimens, including holotype and paratypes, represent a minimum of 2 individuals.

Diagnosis

As for genus. Tarsometatarsus agrees with that of *Geranoaetus melanoleucus* (Vieillot) and *Harpyhaliaetus (Urubitornis) solitaria* (Tschudi) in general form and proportions, and is similar in width but significantly longer than that of the latter. For measurements see Table 6. The only measurements available from the holotype is the proximal width, 20.8.

Characters

Coracoid with (1) coracohumeral surface twice as broad anteriorly as distal to bicipital tuberosity, sloping moderately externally (approximately same size throughout, sloping steeply externally in *Geranoaetus*, *Buteo*, *Heterospizias*, and *Buteogallus*; slightly broader anteriorly, sloping moderately steeply externally in *Harpyhaliaetus*, *Spizaetus*, and *Aquila*); (2) attachment of M. coracobrachialis anterior and Lig. humero-coracoideum antierius superius elevated (former not elevated and latter elevated only along posterior margin, if at all, in *Geranoaetus*, *Buteo*, *Heterospizias*, *Buteogallus*, *Harpyhaliaetus*, and *Aquila*; former not elevated but latter elevated in *Spizaetus*); (3) angle formed between internal side of shaft and anterior edge of glenoid facet approximately 155° (approximately 160° in *Geranoaetus* and *Buteo*; approximately 165° in *Heterospizias*, *Buteogallus*, *Harpyhaliaetus*, *Spizaetus*, and *Aquila*); (4) shaft very thick in distal view ventral to pneumatic foramen (slender in *Geranoaetus*, *Buteo*, *Heterospizias*, *Buteogallus*, *Harpyhaliaetus*, and *Spizaetus*; moderately thick in *Aquila*).

Carpometacarpus with (1) process of metacarpal I low (i.e., short anteroposteriorly) not turned proximad, and of approximately equal length (i.e., proximodistally) anteriorly and posteriorly (high, directed proximad, much longer anteriorly than posteriorly in *Geranoaetus*, *Harpyhaliaetus*, and *Aquila*; varying from high to low,

directed proximad, of equal length anteriorly and posteriorly in *Buteo*; high, directed slightly proximad, and of equal length anteriorly and posteriorly in *Heterospizias* and *Buteogallus*; low, directed proximad, and of equal length anteriorly and posteriorly in *Spizaetus*); (2) length of proximal fusion of metacarpal II and metacarpal III long (similar in *Harpyhaliaetus*, *Heterospizias*, and *Buteogallus*; of moderate length in *Buteo*, *Geranoaetus*, *Spizaetus*, and *Aquila*); (3) external edge of metacarpal III extending as slight ridge to base of external rim of carpal trochlea (similar in *Harpyhaliaetus*; extends external to midline of metacarpal II in *Heterospizias* and *Buteogallus*; extends to approximately midline of metacarpal II in *Buteo*, *Spizaetus*, and *Aquila*; lies directly in line with internal rim of carpal trochlea in *Geranoaetus*); (4) surface of carpal trochlea much wider anteriorly than posteriorly (similar in *Buteo*, *Geranoaetus*, *Heterospizias*, and *Buteogallus*; of approximately equal width throughout in *Harpyhaliaetus*, *Spizaetus*, and *Aquila*); (5) tendinal groove restricted to external side of metacarpal II (proximal half of groove lies on anterior face and distal half of groove on external side of metacarpal II in *Buteo*, *Geranoaetus*, *Harpyhaliaetus*, *Heterospizias*, *Buteogallus*, and *Aquila*; proximal half lies on corner of shaft in *Spizaetus*).

Tibiotarsus with (1) rotular crest low for length (internal end high, remainder low in *Geranoaetus* and *Buteo*; moderately high for length in *Heterospizias* and *Buteogallus*; high for length in *Harpyhaliaetus*, *Spizaetus*, and *Aquila*); (2) internal edge of proximal end sloping slightly posteriad in internal view (moderate slope in *Geranoaetus*, *Buteo*, *Buteogallus*, *Harpyhaliaetus*, and *Spizaetus*; steep slope in *Heterospizias* and *Aquila*).

Etymology

Latin, *terrestris*, of the earth.

Remarks

Miraquila is a very distinctive genus, and perhaps should be placed in a separate subfamily. In such characters as the sharp angle of the coracoid shaft, the tendinal groove of carpometacarpus restricted to external side of metacarpal II, and the middle trochlea of tarsometatarsus lying almost parallel to midline of shaft, this genus resembles no known living accipitrid genus.

Although *Oroaetus isidori* was not available for comparison its shorter tarsus and apparent relationship to the *Spizaetus* group (Brown and Amadon, 1968) would seem to indicate that *Miraquila* is different from that genus. *Harpia* is so distinctive that it is not necessary to draw a detailed comparison with that genus.

The tarsometatarsus of *M. terrestris* differs from that of *Titanohierax gloveralleni* Wetmore (1937) from the late Pleistocene of the Bahamas by having the middle trochlea turned externally only slightly. It differs from that of *Aquila borrasii* Arredondo (1970) from the late Pleistocene of Cuba by having the tubercle for tibialis anticus positioned farther distally and more externally. Both of these characters are readily seen in published illustrations of the types of these two large extinct eagles, and there are undoubtedly many other characters that cannot be detected from the illustrations.

The tarsometatarsus of *Wetmoregyps daggetti* (L. Miller) (1915) from the late Pleistocene of California and Nuevo León, Mexico, is much longer than that of *M.*

terrestris, and according to the original description has reduced trochleae which appear from the published photograph to lie parallel to the long axis of the shaft. In *M. terrestris* the trochleae are not reduced and the middle trochlea lies at a very slight angle to the long axis of the shaft.

The diagnostic character of *Calohierax quadratus* Wetmore (1937) from the late Pleistocene of the Bahamas is the quadrangular shape of the internal trochlea, resulting from the lack of a large posteromedially projecting wing. A large posteromedially projecting wing is present in *M. terrestris*.

Lagopterus minutus Moreno and Mercerat (1891) was described from the late Pleistocene of Argentina on the basis of a humerus. The large size difference between *L. minutus* and *M. terrestris* indicates that they are definitely not the same species. Although no humerus of *M. terrestris* is available for direct comparison with that of *L. minutus*, I do not believe the two species are congeneric because from the published illustration (Moreno and Mercerat, 1891) it appears that *Lagopterus* resembles *Buteo* very much, while the distinctive characters of the available specimens of *Miraquila* would lead me to expect a humerus with similarly distinctive characters.

Although there is still some question as to the generic position of *Harpyhaliaetus* (*Urubitornis*) *solitarius* (Brown and Amadon, 1968; Wetmore, 1965), the species is used here as representative of *Harpyhaliaetus* until an osteological comparison can be made between *H. solitarius* and *H. coronatus*. Skeletons available for comparison included four of *Geranoaetus*, seven of *Heterospizias*, one of *Harpyhaliaetus*, five of *Buteogallus*, two of *Aquila*, two of *Spizaetus*, and over 50 of *Buteo*.

Amplibuteo gen. nov.

Diagnosis

Tarsometatarsus is characterized by having (1) inner calcaneal ridge of hypotarsus projecting posteriad at approximately 60°–70° to vertical axis of shaft; (2) intercotylar area elevated slightly; (3) edge of shaft external to outer calcaneal ridge of hypotarsus without ridge; (4) anterior metatarsal groove moderately deep; (5) internal anterior metatarsal ridge only slightly developed; (6) attachment of tibialis anticus not separated from external anterior metatarsal ridge by groove; (7) middle trochlea short, turned significantly externally in anterior view; (8) internal trochlea rotated posteriad such that posteromedial edge is at same level as posterolateral edge of middle trochlea; (9) internal trochlea projecting distad beyond middle trochlea and rotated significantly externally in anterior view; (10) internal trochlea with distinct angular proximolateral projection. The numbers of the osteological characters correspond to those of the characters used in the diagnosis of *Miraquila*.

Type Species

Amplibuteo hibbardi sp. nov.

Etymology

From Latin, *amplus*, large, and *buteo*, masculine, buzzard

Table 6 Measurements of the scapula, coracoid, humerus, radius, ulna, carpometacarpus, femur, tibiotarsus, and tarsometatarsus of *Amplibuteo hibbardi* gen. et sp. nov., Recent *Geranoaetus melanoleucus*, *G. melanoleucus* from the Talara Tar Seeps (excluding scapula), *Harpyhaliaetus solitarius*; and of the coracoid, carpometacarpus, tibiotarsus, and tarsometatarsus of *Miraquila terrestris* gen. et sp. nov. (in mm).

		<i>Geranoaetus melanoleucus</i>		<i>Amplibuteo hibbardi</i>	<i>Harpyhaliaetus solitaria</i>	<i>Miraquila terrestris</i>
		Recent	Talara Tar Seeps	gen. et sp. nov.		gen. et sp. nov.
Scapula						
Proximal Height	OR	16.0–17.8		22.4–27.0	19.9	
	M	16.6		24.0	—	
	n	4		3	1	
Proximal Width	OR	6.8–8.1		11.8–14.7	9.6	
	M	7.4		13.1	—	
	n	4		3	1	
Coracoid						
Length	OR	48.3–55.7	51.1–52.3	78.8–81.8	60.5	68.0
	M	53.0	51.7	80.3	—	—
	n	4	2	2	1	1
Head to Scapular Facet	OR	21.2–24.7	22.4–22.7	35.4–37.8	26.8	32.0
	M	23.3	22.5	36.3	—	—
	n	4	2	3	1	1
Proximal Depth	OR	14.2–17.6	15.5–15.7	24.5–25.4	19.2	21.5
	M	16.1	15.6	24.8	—	—
	n	4	2	3	1	1
Least Depth of Shaft	OR	7.6–8.7	8.4	13.2–14.0	10.5	11.9
	M	8.2	—	13.6	—	—
	n	4	1	2	1	1
Length of Sternal Facet	OR	19.9–23.1		33.8	26.4	30.2
	M	22.0		—	—	—
	n	4		1	1	1

Humerus

Length	OR	129.7–150.7	195.0	163.4
	M	142.9	—	—
	n	4	1	1
Proximal Width	OR	25.1–29.4	39.3	33.7
	M	27.9	—	—
	n	4	1	1
Distal Width	OR	22.3–25.3	33.4–38.3	29.7
	M	24.2	35.9	—
	n	4	2	1
Least Width of Shaft	OR	9.1–10.2	14.1–14.5	12.0
	M	9.8	14.3	—
	n	4	2	1
Radius Length	OR	144.7–165.3	179.0	
	M	158.0	—	—
	n	4		1
Proximal Width	OR	5.7–6.1	7.1–8.5	7.2
	M	5.8	7.7	—
	n	4	4	1
Distal Width	OR	9.8–11.0	16.5	13.0
	M	10.6	—	—
	n	4	1	1
Ulna Length	OR	153.9–174.6	189.8	
	M	167.4	—	—
	n	4		1

Continued on page 80.

		<i>Geranoaetus melanoleucus</i>		<i>Amplibuteo</i>	<i>Harpyhaliaetus</i>	<i>Mirafquila</i>
		Recent	Talara Tar Seeps	<i>hibbardi</i>	<i>solitaria</i>	<i>terrestris</i>
				gen. et sp. nov.		gen. et sp. nov.
Proximal Width	OR	16.5-18.6		25.5	20.2	
	M	17.7		—	—	
	n	4		1	1	
Distal Depth	OR	13.1-14.6	12.5-13.9	17.6-19.1	15.3	
	M	14.0	13.5	18.4	—	
	n	4	4	4	1	
Least Width of Shaft	OR	6.6-7.8			8.4	
	M	7.5			—	
	n	4			1	
Carpometacarpus						
Length	OR	74.1-86.8		110.8	83.8	86.1
	M	80.8		—	—	—
	n	4		1	1	1
Height Through Metacarpal I	OR	18.6-21.4	18.3-20.5	28.2	21.9	21.0
	M	20.2	19.7	—	—	—
	n	4	3	1	1	1
Proximal Width	OR	7.0-8.2	8.3-9.7	12.0	9.1	10.0
	M	7.7	8.7	12.0	—	—
	n	4	3	2	1	1
Least Width of Shaft	OR	5.7-6.5	6.4	8.0-8.8	7.1	7.3
	M	6.2	—	8.4	—	—
	n	4	1	2	1	1
Length of Distal Fornix	OR	6.5-7.8		9.5	8.1	
	M	7.1		—	—	
	n	4		1	1	

Femur

Length	OR	93.7–102.9	90.3–105.1	127.4	106.4
	M	99.5	97.7	—	—
	n	4	2	1	1
Proximal Width	OR	18.0–20.6	17.5–20.9	27.4	23.7
	M	19.6	19.0	—	—
	n	4	4	1	1
Distal Width	OR	19.3–22.5	18.6–21.3	29.0	25.7
	M	21.3	19.7	—	—
	n	4	3	1	1
Least Width of Shaft	OR	8.7–9.4	8.2–9.3	12.9	11.3
	M	9.1	8.8	—	—
	n	4	2	1	1

Tibiotarsus

Length	OR	128.8–142.9			162.1
	M	137.1			—
	n	4			1
Proximal Width	OR	14.3–16.7	16.8	23.0	20.0
	M	15.9	—	—	—
	n	4	1	1	1
Distal Width	OR	15.3–17.9	16.7	21.8–22.6	20.2
	M	17.0	—	22.7	—
	n	4	1	7	1
Least Width of Shaft	OR	8.0–8.6			10.0
	M	8.2			—
	n	4			1
Depth of Internal Condyle	OR	10.0–11.2		13.9–14.8	13.1
	M	10.8		14.3	—
	n	4		5	1

Continued on page 82.

		<i>Geranoaetus melanoleucus</i>		<i>Amplibuteo</i> <i>hibbardi</i> gen. et sp. nov.	<i>Harpyhaliaetus</i> <i>solitaria</i>	<i>Miraquila</i> <i>terrestris</i> gen. et sp. nov.
		Recent	Talara Tar Seeps			
Tarsometatarsus						
Length	OR	98.1-107.7	100.3	132.3-136.5	124.8	145
	M	102.9	—	134.3	—	(Estimated)
	n	4	1	3	1	
Proximal Width	OR	16.2-18.8	16.3-19.6	22.2-25.0	20.7	20.8-20.9
	M	17.4	18.4	23.7	—	20.9
	n	4	5	3	1	2
Distal Width	OR	17.8-20.2	19.3-20.6	25.2-29.3	23.6	
	M	18.9	20.0	27.1	—	
	n	4	2	6	1	
Least Width of Shaft	OR	6.5-7.3	6.3-8.2	10.1-11.7	9.9	8.8
	M	6.8	7.5	10.9	—	—
	n	4	3	2	1	1
Width of Middle Trochlea	OR	4.9-5.6	5.3-5.7	6.9-8.1	6.2	6.3-6.5
	M	5.2	5.5	7.4	—	6.4
	n	4	3	8	1	2

***Amplibuteo hibbardi* sp. nov.**

Fig. 22D, 23B, 24A, B, D, E,
25A-E, 26A, 27A, B, 28A

Holotype

Complete left tarsometatarsus (inner calcaneal ridge and external trochlea broken). ROM 16905.

Paratypes

One complete right and 1 complete left tarsometatarsus, shaft of 1 left tarsometatarsus, proximal ends of 1 right and 1 left tarsometatarsus, distal ends of 6 right and 2 left tarsometatarsi. ROM 16906–16918.

Referred Material

Two rostra, 1 right ramus, 1 right and 2 left scapulae, 2 complete left coracoids, humeral end of 1 right coracoid, 1 complete right humerus, proximal end and shaft of 1 right humerus, proximal end of 1 left humerus, distal end of 1 left humerus, proximal end of 1 right ulna, distal ends of 2 right and 2 left ulnae, proximal ends of 2 right and 2 left radii, distal end of 1 left radius, 1 almost complete right carpometacarpus, proximal end of 1 right carpometacarpus, shaft of 1 right carpometacarpus, distal end of 1 right carpometacarpus, 1 complete right femur, proximal ends of 2 left tibiotarsi, distal ends of 2 right and 6 left tibiotarsi. ROM 16919–16956. The 52 elements, including holotype and paratypes, represent a minimum of 7 individuals.

Diagnosis

As for genus. For measurements see Table 6. Measurements of the holotype are as follows: length, 134.1; proximal width, 25.0; distal width, 27.1; least width of shaft, 11.7.

Characters

From the diagnosis of the tarsometatarsus it is apparent that *Amplibuteo* is very closely related to *Buteo* and *Geranoaetus*, and is quite distinct from other living South American accipitrid genera, *Miraquila*, *Titanohierax*, *Wetmoregyps*, *Calohierax*, and *Lagopterus*. Accordingly, the referred material is compared with *B. jamaicensis* and *G. melanoleucus* to facilitate future comparison. Because of the large size of *Amplibuteo*, in comparison with *B. jamaicensis* and *G. melanoleucus*, all comments as to size must be considered relative.

Amplibuteo hibbardi is characterized by having rostrum with (1) external nares long and narrow (shorter and wider in *B. jamaicensis* and *G. melanoleucus*).

Ramus with (1) very slight curvature in lateral view (much greater curvature in *B. jamaicensis* and *G. melanoleucus*); (2) post-articular process small (more prominent in *B. jamaicensis* and *G. melanoleucus*); (3) ventral corner of articular approximately 90° angle (less acute an angle in *B. jamaicensis* and *G. melanoleucus*); (4) medial third of internal articular process projecting anteriad (projects little, if any, anteriad in *B. jamaicensis*, and *G. melanoleucus*).

Scapula with (1) dorsointernal corner of acromion process well developed, giving straight dorsal edge (angular mediad projection present, giving sharp internal slope in *B. jamaicensis*; corner well rounded, giving moderate internal slope in *G. melanoleucus*); (2) dorsoexternal corner of acromion process prominent (similar in *B. jamaicensis*; less developed in *G. melanoleucus*); (3) glenoid facet wide anteriorly and short, with anteroventral corner well developed (similar in shape with moderately developed anteroventral corner in *B. jamaicensis*, more elliptical with poorly developed anteroventral corner in *G. melanoleucus*).

Coracoid with (1) coracohumeral surface twice as wide dorsal as ventral to bicipital tuberosity, short, with moderate external slope (narrow throughout, longer, with steep external slope in *B. jamaicensis* and *G. melanoleucus*); (2) attachments of M. coracobrachialis anterior and Lig. humero-coracoideum anterius superius prominently elevated (former not elevated, and latter elevated only at posterior edge, if at all, in *B. jamaicensis* and *G. melanoleucus*); (3) ventral extension of glenoid facet large (similar in *B. jamaicensis*, small in *G. melanoleucus*); (4) depression distal to intermuscular line and dorsal to external posterior sternal facet deep (slight to moderate depression in *B. jamaicensis*, slight to no depression in *G. melanoleucus*); (5) distal half of internal edge of sternal facet projecting significantly internally, giving deep sterno-coracoidal impression (similar in *B. jamaicensis*; projects internally only slightly, giving shallow or no sterno-coracoidal impression in *G. melanoleucus*); (6) prominent swelling dorsal to proximal end of internal sternal facet (slightly developed in *B. jamaicensis*; prominent in *G. melanoleucus*).

Humerus with (1) internal tuberosity moderately produced and rounded (similar in *B. jamaicensis*, more produced and less rounded in *G. melanoleucus*); (2) edge of bicipital crest merging gradually with shaft posteriorly (end of bicipital crest well marked in *B. jamaicensis* and *G. melanoleucus*); (3) base of deltoid crest very thick distally (thin in *B. jamaicensis* and *G. melanoleucus*); (4) area between shaft and distal edge of deltoid crest essentially flat (moderately concave in *B. jamaicensis*; very concave in *G. melanoleucus*); (5) impression of M. brachialis anticus deep, giving high narrow ridge leading proximad from attachment of anterior articular ligament (shallow, with only slight ridge in *B. jamaicensis*; moderately deep, with moderate ridge in *G. melanoleucus*); (6) entepicondyle well rounded in medial view, not projecting distad beyond internal condyle (rounded in medial view and projecting distad significantly beyond internal condyle in *B. jamaicensis*; subangular in medial view, not projecting distad beyond internal condyle in *G. melanoleucus*).

Ulna with (1) olecranon very rounded proximally on anconal side (not rounded in *B. jamaicensis* or *G. melanoleucus*); (2) internal cotyla sloping steeply externally (sloping moderately in *B. jamaicensis*, sloping slightly in *G. melanoleucus*); (3) external cotyla with moderate palmar projection (much larger projection in *B. jamaicensis* and *G. melanoleucus*); (4) external condyle short and well rounded (longer and less rounded in *B. jamaicensis* and *G. melanoleucus*); (5) carpal tuberosity short, projecting sharply internally (much longer and projecting less internally in *B. jamaicensis* and *G. melanoleucus*).

Radius with (1) ligamental papilla short, very prominent (long, not prominent in *B. jamaicensis*; very short, not prominent in *G. melanoleucus*); (2) carpal facet well rounded internally (only slightly rounded in *B. jamaicensis* and *G. melanoleucus*); (3) external corner not extending distad beyond carpal facet (extending significantly beyond carpal facet in *B. jamaicensis* and *G. melanoleucus*).

Carpometacarpus with (1) end of process of metacarpal I subangular to rounded in external view (almost straight in *B. jamaicensis* and *G. melanoleucus*); (2) internal ligamental fossa shallow (deep in *B. jamaicensis*, shallow to moderate depth in *G. melanoleucus*); (3) internal side of shaft of metacarpal II narrowing distally to form ridge leading to base of distal metacarpal symphysis (internal side of shaft narrowing slightly to form small ridge in *B. jamaicensis*, no narrowing of shaft and only slight indication of ridge in *G. melanoleucus*).

Femur with (1) abundant pneumaticity proximally (similar in *B. jamaicensis*, limited pneumaticity in *G. melanoleucus*); (2) proximal edge of trochanter moderately rounded in lateral view (similar in *B. jamaicensis*, less rounded in *G. melanoleucus*); (3) neck short and head projecting mediad in *B. jamaicensis*; neck long and head projecting dorsomedial in *G. melanoleucus*; (4) iliac facet with well developed posteroexternal corner (corner moderately developed in *B. jamaicensis*, area well rounded in *G. melanoleucus*); (5) attachment of M. gluteus profundus short (similar in *B. jamaicensis*, long in *G. melanoleucus*); (6) proximal end of lateral surface curving sharply internally in anterior view (curves moderately internally in *B. jamaicensis*, curves only slightly internally in *G. melanoleucus*); (7) proximal end of fibular condyle small, directed externally (larger and directed more proximad in *B. jamaicensis* and *G. melanoleucus*); (8) attachment of M. gastrocnemius, pars externa, shallow (of moderate depth in *B. jamaicensis*, deep in *G. melanoleucus*); (9) lateral surface of external condyle at large angle to vertical axis of shaft (at small angle to vertical axis of shaft in *B. jamaicensis* and *G. melanoleucus*); (10) shaft moderately convex anteriorly in lateral view (more convex in *B. jamaicensis* and *G. melanoleucus*).

Tibiotarsus with (1) rotular crest slightly elevated internally (elevated much more in *B. jamaicensis* and *G. melanoleucus*); (2) internal articular surface slightly convex and sloping slightly posteriad (quite convex and sloping steeply posteriad in *B. jamaicensis*, of moderate convexity and sloping steeply posteriad in *G. melanoleucus*); (3) anterior notch between internal articular surface and external articular surface well marked (only slight indentation in *B. jamaicensis* and *G. melanoleucus*); (4) external condyle short proximodistad and long anteroposteriad, with small anterior projection at anteroproximal end (more rounded with moderate projection in *B. jamaicensis*, rounded with very prominent projection in *G. melanoleucus*); (5) anterior portion of internal condyle long (similar in *B. jamaicensis*, short in *G. melanoleucus*); (6) opening in tendinal groove distal to supratendinal bridge does not extend distal to proximal edge of internal condyle (similar in *B. jamaicensis*, does extend distal to internal condyle in *G. melanoleucus*); (7) internal condyle only slightly undercut proximally (similar in *B. jamaicensis*, moderately undercut in *G. melanoleucus*).

Etymology

The species is named for the late Dr. Claude W. Hibbard in recognition of his many outstanding contributions to vertebrate palaeontology.

Position of *Morphnus woodwardi*

Through the courtesy of Dr. Hildegard Howard and the Natural History Museum of Los Angeles County, I have been able to compare a representative coracoid,

humerus, femur, and tarsometatarsus of *Morphnus woodwardi* L. Miller (1911) from Rancho la Brea with corresponding elements of *Amplibuteo hibbardi*. The two species are essentially identical in size, and *woodwardi* agrees with *A. hibbardi* in having those characters of *Amplibuteo* listed for the tarsometatarsus that serve to distinguish it from the tarsometatarsi of other accipitrid genera. A body skeleton of *Morphnus guianensis* has recently become available from the United States National Museum and a comparison of the coracoid, humerus, and femur of that specimen with *woodwardi* quickly reveals that *woodwardi* is not of that genus. From the specimen available it appears, osteologically, *Morphnus* is more similar to *Harpia* than any other genus. The very close resemblance of *woodwardi* to *A. hibbardi* in all elements examined indicates that the two species should be considered congeneric, and that *woodwardi* be removed from *Morphnus* and placed in *Amplibuteo*.

Amplibuteo hibbardi differs from *A. woodwardi* by having coracoid with (1) coracohumeral surface longer; (2) posterior edge of glenoid facet projecting much farther from shaft and more rounded; (3) attachment of M. coracobrachialis anterior and Lig. humero-coracoideum anterius superius more elevated and distinctly marked; (4) ventral end of furcular facet projecting more externally; (5) head more rounded; (6) anterior internal sternal facet longer, ending less abruptly; (7) area dorsal to distal external sternal facet more concave.

Humerus with (1) internal tuberosity more prominent; (2) concavity leading distad from base of median crest deep, not shallow; (3) capital shaft ridge more prominent, lying more internally; (4) external tuberosity more prominent, set off from head by slight groove; (5) bicipital crest longer; (6) attachment of Lig. humero-coracoideum anterius inferius larger and deeper; (6) shaft more curved in anconal view; (7) distal end flexed less palmarly; (8) ectepicondylar process slightly more produced; (9) intercondylar furrow deeper, particularly in palmar view.

Femur with (1) neck longer; (2) shaft less stout, more curved anteroposteriad; (3) internal condyle less rounded in medial view, and proximal ridge elevated more above shaft and joining shaft more abruptly; (4) rotular groove narrower and deeper; (5) proximal end of external condyle more rounded, and turned more externally; (6) fibular condyle much more prominent, projecting more sharply externally; (7) attachment of M. gastrocnemius, pars externa, larger in area, but shallower; (8) proximal end of fibular condyle larger.

Tarsometatarsus with (1) inner calcaneal ridge longer through base; (2) intercalcaneal furrow narrower; (3) tubercle for tibialis anticus larger, positioned more externally; (4) shaft curving externally less at level of metatarsal facet, giving larger external angle between line drawn along most distal point of trochlea and perpendicular axis of shaft; (5) internal trochlea narrower through base, thus having more distinct angular proximolateral projection; (6) external trochlea rotated less posteriad, extending farther distad.

Although only one specimen of each element of *A. woodwardi* was available I believe most of the characters will hold if a larger series is studied. It should be stressed that *A. woodwardi* differs from *B. jamaicensis* and *G. melanoleucus* as much as, if not more than, *A. hibbardi* in those characters listed in the diagnoses of *A. hibbardi*.

Although *Buteo* and *Geranoaetus* are closely related as revealed in the preceding diagnoses, I believe *Geranoaetus* is a valid genus and should be maintained (see also Amadon, 1963; Brown and Amadon, 1968).

***Geranoaetus* Kaup**
***Geranoaetus melanoleucus* (Vieillot)**
Black-chested Buzzard-Eagle

Material

Two complete right coracoids, proximal ends of 2 right and 2 left humeri, distal end of 1 right humerus, distal ends of 3 right and 1 left ulna, proximal end of 1 left radius, 1 complete right carpometacarpus, proximal ends of 1 right and 1 left carpometacarpus, 1 complete right and 1 complete left femur, proximal ends of 2 right and 1 left femur, distal end of 1 right femur, proximal end of 1 left tibiotarsus, distal ends of 1 right and 1 left tibiotarsus, 2 complete left tarsometatarsi, proximal ends of 1 right and 2 left tarsometatarsi, distal ends of 2 right tarsometatarsi, shaft of 1 right tarsometatarsus. ROM 16957–16987, 19548–19549. The 32 specimens represent a minimum of 4 individuals.

Remarks

Widely distributed in western South America, *G. melanoleucus* is common along coastal hills and western slopes of the Peruvian Andes.

***Buteo* Lacépède**
***Buteo polyosoma* (Quoy & Gaimard)**
Red-backed Hawk

Material

Two left articulators, 1 right scapula, 1 complete right and 4 complete left coracoids, humeral end of 1 right coracoid, proximal end of 1 right humerus, distal end of 1 right humerus, distal ends of 2 right ulnae, proximal end of 1 right radius, distal end of 1 left radius, proximal ends of 1 right and 1 left carpometacarpus, proximal ends of 2 left femora, proximal ends of 1 right and 1 left tibiotarsus, distal end of 1 right tibiotarsus, 2 complete right tarsometatarsi, proximal ends of 1 right and 1 left tarsometatarsus, distal ends of 2 right and 3 left tarsometatarsi. ROM 16988–17017, 19523. The 31 specimens represent a minimum of 4 individuals.

Remarks

Buteo polyosoma occurs all along the west coast of South America, and is very common in northwestern Peru.

***Buteo* sp. 1**

Material

Complete right ulna, proximal ends of 2 left ulnae, 1 complete left carpometacarpus. ROM 17018–17021. The 4 specimens represent a minimum of 2 individuals.

Characters

Size larger than *Buteo nitidus* (Latham) and overlapping that of small *B. polyosoma*. Agrees with *Buteo* and differs from related genera by having those characters of carpometacarpus listed for *Buteo* in description of *Miraquila terrestris*.

Carpometacarpus with (1) internal side of metacarpal II deeply excavated with ridge separating internal ligamental fossa from anterior portion (slightly excavated in *B. polyosoma*; moderately excavated in *B. swainsoni* Bonaparte; similar but lacking ridge in *B. platypterus* (Vieillot); excavated more anteriorly in *B. nitidus* and *Parabuteo unicinctus* (Temminck)); (2) external rim of carpal trochlea parallel with shaft and internal rim of carpal trochlea almost straight (external rim at angle to shaft and internal rim moderately to strongly curved in *B. polyosoma*; similar in *B. swainsoni*; external similar but internal at greater angle to shaft in *B. platypterus* and *P. unicinctus*; external rim similar, internal rim curved in *B. nitidus*); (3) process of metacarpal I very short, rounded on proximal corner (long, not rounded in *B. polyosoma*, *B. nitidus*, and *P. unicinctus*; moderately long, not rounded in *B. swainsoni*; slightly rounded in *B. platypterus*); (4) external edge of pollical facet long (short in *B. polyosoma*, *B. swainsoni*, *B. platypterus*, and *Parabuteo unicinctus*; moderately long in *B. nitidus*). Length, 51.4; proximal width, 5.9; height through metacarpal I, 13.5; least width of shaft, 4.4.

Ulna with (1) anconal side of olecranon continuing curve of shaft (reflected anconally, interrupting curve of shaft in *B. polyosoma*, *B. swainsoni*, *B. platypterus*, *B. nitidus*, and *P. unicinctus*); (2) olecranon long and broad in anconal view (long and narrow in *B. polyosoma*, *B. swainsoni*, *B. nitidus*, and *P. unicinctus*; short and broad in *B. platypterus*); (3) external cotyla greatly produced (similar in *B. polyosoma* and *B. nitidus*; less produced in *B. swainsoni* and *B. platypterus*; more produced in *P. unicinctus*); (4) carpal tuberosity short, well set off from shaft (long, not well set off from shaft in *B. polyosoma*, *B. platypterus*, *B. nitidus*; moderately long and moderately set off from shaft in *B. swainsoni* and *P. unicinctus*). Length, 110.1 (n = 1); proximal width, 11.5–12.4; mean, 11.9 (n = 3); distal depth, 9.7 (n = 1); least shaft width, 5.4 (n = 1).

Remarks

Although distinct from the species on hand, the material described above is referred only to genus because of the lack of comparative material of *B. brachyurus* and *B. leucorrhous*. Although the latter species is much smaller than the fossil material, *B. brachyurus* is in the right size range and until the fossil specimens can be compared with specimens of that species the question of whether the fossil material represents a living or extinct species must remain unanswered.

Buteo sp. 2

Material

Proximal end of 1 left ulna, distal end of 1 left ulna, proximal ends of 2 right carpometacarpi, distal ends of 4 right tibiotarsi, proximal end of 1 right tarsometatarsus, distal end of 1 left tarsometatarsus. ROM 17022–17031. The 10 specimens represent a minimum of 4 individuals.

Characters

Agrees with *Buteo* and differs from related genera by having those characters for carpometacarpus, tibiotarsus, and tarsometatarsus listed for *Buteo* in description of *Mirafquila terrestris*. *Buteo* sp. 2 is similar in size to *B. albicaudatus*, smaller than *B. peocilochrous*, and larger than *B. polyosoma*, *B. swainsoni*, and *B. nitidus*.

Buteo sp. 2 differs from *B. albicaudatus* by having ulna with (1) olecranon narrower, more rounded in internal view; (2) internal cotyla more concave; (3) protuberance between internal and external cotylae prominent (not present in *B. albicaudatus*); (4) external condyle smaller; (5) carpal tuberosity positioned farther proximad. Proximal width, 12.6 (n = 1); distal depth, 10.3 (n = 1).

Carpometacarpus with (1) process of metacarpal I higher, but shorter; (2) internal rim of carpal trochlea much shorter; (3) carpal trochlea narrowing distad more sharply, giving more curved external rim of carpal trochlea; (4) protuberance at distal end of external carpal trochlea much smaller; (5) external rim of carpal trochlea angular at point of attachment of M. flexor carpi ulnaris brevis, in external view (rounded in *B. albicaudatus*). Proximal width, 6.0 (n = 2); height through metacarpal I, 14.5–14.8 (n = 2); least width of shaft, 4.5 (n = 1).

Tibiotarsus with (1) tendinal groove passing under tendinal bridge more proximad; (2) internal condyle longer anteroposteriad, shorter proximodistad, with deeper depression at posteroproximal end; (3) external condyle much smaller; (4) shaft proximal to tendinal bridge and medial to tendinal groove depressed, and lateral to tendinal groove elevated. Distal width, 12.0–12.8 (n = 4); least width of shaft, 6.3–6.4 (n = 2); depth of internal condyle, 8.2–8.4; mean, 8.5 (n = 2).

Tarsometatarsus with (1) anteroproximal edge of shaft straighter; (2) proximal portion of anterior metatarsal groove narrower and shallower; (3) area between hypotarsi less excavated; (4) posterolateral corner of proximal end rounded, lacking protuberance; (5) external condyle projecting distad more than middle trochlea (projects distad less than middle trochlea in *B. albicaudatus*); (6) external trochlea projects less posteriad; (7) protuberance on posteroproximal corner of internal trochlea larger; (8) middle trochlea shorter, with shallower trochlear groove. Proximal width, 13.3 (n = 1); distal width, 14.5 (n = 1); depth of middle trochlea, 4.1 (n = 1).

Remarks

Buteo sp. 2 probably represents a new species, but until specimens of *B. ventralis*, *B. albonotatus*, and *B. brachyurus* are available for comparison its exact status must remain unknown.

Parabuteo Ridgway *Parabuteo unicinctus* (Temminck) Bay-winged Hawk

Material

Two right and 1 left scapula, humeral end of 1 right coracoid, distal ends of 1 right and 1 left humerus, distal ends of 1 right and 2 left ulnae, proximal ends of 2 right and

2 left radii, 1 complete right carpometacarpus, proximal end of 1 left carpometacarpus, proximal end of 1 left femur, distal ends of 1 right and 2 left femora, proximal ends of 3 right tibiotarsi, distal ends of 4 right and 1 left tibiotarsus, 2 complete left tarsometarsi, distal ends of 1 right and 1 left tarsometatarsus. ROM 17032–17062. The 31 specimens represents a minimum of 4 individuals.

Remarks

The proximal end of the left carpometacarpus differs from the other fossil carpometacarpus and the one Recent carpometacarpus available by having internal rim of carpal trochlea longer, extending to level of pollical facet. Without a greater series to determine variation of this character, the specimen is placed with *P. unicinctus*, as it is essentially identical otherwise. *P. unicinctus* occurs along the west coast of South America south to Aysen, Chile.

Family Falconidae Vigors

Subfamily Falconinae (Vigors)

***Falco* Linnaeus**

***Falco peregrinus* Tunstall**

Peregrine Falcon

Material

One left quadrate, 1 left articular, 3 mandibular symphyses, 2 right scapulae, 1 complete left coracoid, humeral ends of 2 right and 1 left coracoid, 1 complete right humerus, proximal ends of 2 right humeri, 1 complete left ulna, distal ends of 2 left radii, 1 complete right and 2 complete left femora, proximal ends of 1 right and 1 left femur, 1 complete right tibiotarsus, proximal ends of 2 right and 1 left tibiotarsus, distal ends of 2 right and 1 left tibiotarsus, 1 complete right and 3 complete left tarsometatarsi, proximal end of 1 right tarsometatarsus. ROM 17063–17093, 19533–19535. The 34 specimens represent a minimum of 3 individuals.

Remarks

Falco peregrinus occurs on the Peruvian coast as a migrant from both North and southern South America.

***Falco femoralis* Temminck**

Aplomado Falcon

Material

Two complete right and 1 complete left coracoid, 1 complete right ulna, distal end of 1 left ulna, distal end of 1 right radius, 1 complete right carpometacarpus. ROM 17094–17100. The 7 specimens represent a minimum of 2 individuals.

Remarks

Falco femoralis is generally distributed throughout Ecuador and Peru.

Falco sparverius Linnaeus American Kestrel

Material

One premaxillary, 1 right and 2 left scapulae, 2 complete left coracoids, sternal end of 1 left coracoid, 3 complete right and 1 complete left humerus, distal ends of 3 left humeri, 3 complete right and 4 complete left carpometacarpi, 1 proximal and 2 distal ends of left carpometacarpi, 1 complete right and 2 complete left ulnae, proximal ends of 2 right ulnae, distal ends of 2 right ulnae, 2 complete right and 1 complete left femur, distal ends of 1 right and 1 left femur, 1 complete right tibiotarsus, distal ends of 2 right and 3 left tibiotarsi, 3 complete right and 2 complete left tarsometatarsi, proximal ends of 2 right and 1 left tarsometatarsus, distal ends of 2 right and 3 left tarsometatarsi. ROM 17101–17147, 19550–19557. The 55 specimens represent a minimum of 6 individuals.

Remarks

Falco sparverius is generally and commonly distributed throughout Peru.

Falco sp.

Material

One complete right coracoid, humeral end of 1 left coracoid, distal end of 1 left humerus, proximal end of 1 right ulna, distal end of 1 right ulna, proximal end of 1 right femur, distal end of 1 right femur. ROM 17148–17153, 19524. The seven specimens represent a minimum of one individual.

Characters

Falco sp. is intermediate in size between *F. peregrinus* and *F. femoralis*, and differs from them by having coracoid with (1) head long, with slight curvature to dorsal edge in external view (long, well rounded in *F. peregrinus*; short, subrounded in *F. femoralis*); (2) attachment of Lig. humero-coracoideum anterius superius large, with depression lying posterior to it (large, no depression in *F. peregrinus*; small, no depression in *F. femoralis*); (3) attachment of M. coracobrachialis anterior small oval (elongated in *F. peregrinus*, small oval in *F. femoralis*); (4) coracohumeral surface moderately long (long in *F. peregrinus*, short in *F. femoralis*); (5) brachial tuberosity large, extending farther internally than head (small, flush with head in *F. peregrinus*; of moderate size, extending slightly farther internally than head in *F. femoralis*); (6) glenoid facet wide, widest near ventral end (wide, widest at dorsal end in *F. peregrinus*; narrow in *F. femoralis*). Length, 36.8 (n = 1); head to scapular facet, 13.5–13.9 (n = 2); proximal depth, 8.0–8.1 (n = 2); least depth of shaft, 4.1 (n = 1).

Humerus fragmentary, with (1) attachment of anterior articular ligament low, wider than long (high, longer than wide in *F. peregrinus*; high, width about equal to length in *F. femoralis*); (2) attachment of M. pronator brevis very deep pit (similar in *F. peregrinus*; not as deep, longer in *F. femoralis*); (3) attachment of M. extensor metacarpi radialis large and slightly elevated (large and very elevated in *F. peregrinus*, small and moderately elevated in *F. femoralis*). Distal width, 12.9; least width of shaft, 5.9.

Ulna with (1) external cotyla large (large in *F. peregrinus*, small in *F. femoralis*); (2) pronounced concavity between tricipital attachment and external cotyla (slight concavity in *F. peregrinus* and *F. femoralis*); (3) carpal tuberosity short and stout (long and more slender in *F. peregrinus* and *F. femoralis*). Proximal width, 10.0; distal depth, 8.4.

Femur with (1) attachment of M. gluteus profundus and M. obturator externus very deep (deep in *F. peregrinus*, moderately deep in *F. femoralis*); (2) protrusion between neck and trochanter broad (small in *F. peregrinus* and *F. femoralis*); (3) anterior intermuscular ridge prominent (similar in *F. peregrinus*, interrupted proximally in *F. femoralis*); (4) attachment of M. gastrocnemius, pars externa, large, very shallow (large, deep in *F. peregrinus*; small, shallow in *F. femoralis*); (5) ridge at base of internal condyle high with internal surface rotated to face distad (moderately high, not rotated in *F. peregrinus*; high, not rotated in *F. femoralis*); (6) internal condyle angular distally in internal view (rounded in *F. peregrinus*, subrounded in *F. femoralis*). Proximal width, 9.0; distal width, 8.8.

Remarks

The material listed above belongs without question in the genus *Falco*, and it probably represents a new species. It is not named at this time, however, on the slight chance that it represents *F. deiroleucus*, specimens of which were not available for comparison.

Subfamily Polyborinae Lafresnaye

Polyborus Vieillot
Polyborus plancus (Miller)
Crested Caracara

Material

One cranium, 4 right and 6 left quadrates, 4 left articulars, 6 mandibular symphyses, 2 premaxillaries, 4 right and 10 left scapulae, 9 complete right and 15 complete left coracoids, humeral ends of 6 right and 4 left coracoids, sternal ends of 4 right and 2 left coracoids, 1 complete right and 1 complete left humerus, proximal ends of 4 right and 3 left humeri, distal ends of 9 right and 2 left humeri, 5 complete right ulnae, proximal ends of 7 right and 2 left ulnae, distal ends of 15 right and 6 left ulnae, proximal ends of 3 right and 1 left radius, distal ends of 7 right and 6 left radii, 6 complete right and 6 complete left carpometacarpi, proximal ends of 6 right and 3 left carpometacarpi, distal ends of 4 right and 4 left carpometacarpi, 2 complete right and 3 complete left femora, proximal ends of 2 right and 4 left femora, distal ends of 3

right femora, 1 complete right tibiotarsus, proximal ends of 2 right and 3 left tibiotarsi, distal ends of 16 right and 14 left tibiotarsi, 8 complete right and 5 complete left tarsometatarsi, proximal ends of 12 right and 11 left tarsometatarsi, distal ends of 19 right and 11 left tarsometatarsi. ROM 17154–17446, 19525. The 294 specimens represent a minimum of 27 individuals.

Remarks

Although the subspecies of *P. plancus* living in northwestern Peru today, *P. p. cheriway*, is much larger than that represented by the fossil material, the latter is still larger than specimens of *P. p. plancus* from Bolivia. Despite numerous minor differences from living forms, I do not feel there is sufficient basis for placing the fossil material in a new species, especially when considering the great range of variation found in living forms. Instead, this material should be regarded as a temporal subspecies. As I do not believe there is any value in naming subspecies I have not put a separate name on this material.

Howard (1938) named the Rancho La Brea caracara as a new species and stated that she believed *P. prelutosus* represented an ancestral form of the living caracara. At the time she indicated disbelief in temporal subspecies. After examining specimens of “*P. prelutosus*” from Florida, and comparing her descriptions with the Peruvian material and Recent forms available I do not believe *P. prelutosus* is a valid species, but rather represents another temporal subspecies, if it is in fact separable from the highly variable living forms. Unfortunately Howard did not have available for comparison any representatives of the smallest members of *P. p. plancus* which are smaller than measurements given for *P. prelutosus*. Olson (1976: 363), in a discussion of the fossil species of *Polyborus* stated, “*P. prelutosus* in almost surely the temporal equivalent of, and on a direct genetic line with, *P. plancus*.” The problem of *P. prelutosus* may need additional study before it can be settled.

Milvago brodkorbi sp. nov.

Fig. 28B, C, 29A-G, 30A, B

Holotype

Complete left tarsometatarsus. ROM 17447.

Paratypes

One complete right and 4 complete left tarsometatarsi, proximal ends of 2 right and 3 left tarsometatarsi, distal ends of 7 right and 6 left tarsometatarsi. ROM 17448–17470.

Referred Material

One right and 1 left quadrate, 4 right and 4 left scapulae, 9 complete right and 6 complete left coracoids, humeral ends of 4 right coracoids, proximal ends of 3 right humeri, distal ends of 4 right and 2 left humeri, 3 complete right and 3 complete left ulnae, proximal ends of 7 right and 3 left ulnae, distal ends of 5 right and 2 left ulnae, 2 complete right radii, proximal ends of 4 right and 4 left radii, distal ends of 1 right and 3 left radii, 12 complete right and 5 complete left carpometacarpi, proximal ends

of 5 right and 1 left carpometacarpus, distal ends of 3 right and 1 left carpometacarpus, 1 complete right femur, proximal ends of 1 right and 1 left femur, distal ends of 1 right and 3 left femora, 2 complete right tibiotarsi, proximal ends of 4 right tibiotarsi, distal ends of 10 right and 13 left tibiotarsi. ROM 17471–17606, 19526, 19527. The 162 specimens, including holotype and paratypes, represent a minimum of 17 individuals.

Diagnosis

Tarsometatarsus agrees with that of *Milvago* and differs from that of all other South American falconid genera by having (1) internal calcaneal ridge short; (2) external calcaneal ridge directed proximad; (3) shaft with prominent ridges bordering both sides of anterior metatarsal groove; (4) trochleae compressed; (5) area internal to proximal end of internal calcaneal ridge depressed.

Compared with the tarsometatarsus of *M. chimachima* and *M. chimango*, the holotype is characterized by having (1) intercotylar prominence high and broad (low and broad in *M. chimachima*, high and narrow in *M. chimango*); (2) external calcaneal ridge large, with external side long (slender, external side short in *M. chimachima* and *M. chimango*); (3) tubercle for *M. tibialis anticus* very prominent (moderately prominent in *M. chimachima*, similar in *M. chimango*); (4) trochlear groove of middle trochlea very deep (moderately deep in *M. chimachima*, similar in *M. chimango*); (5) distal projection of internal trochlea long, broad, and only slightly depressed on internal surface (long, narrow, deeply notched on internal surface in *M. chimachima*; short, broad, deeply notched on internal surface in *M. chimango*); (6) internal intertrochlear notch deep and wide (moderately deep and narrow in *M. chimachima*, shallow and narrow in *M. chimango*); (7) external trochlea of moderate depth (lesser in *M. chimachima*, greater in *M. chimango*); (8) trochleae very slightly compressed in *M. chimachima* and *M. chimango*; (9) shaft large (small in *M. chimachima* and *M. chimango*).

For measurements see Table 7. Measurements of the holotype are as follows: length, 61.5; proximal width, 9.8; distal width, 10.4; least width of shaft, 4.1; width of middle trochlea, 4.0.

Characters

Scapula with (1) acromion broad and rounded proximally in distal view (narrow and straight in *M. chimachima* and *M. chimango*); (2) groove dorsal to proximal end of glenoid facet shallow to moderately deep (deep in *M. chimachima* and *M. chimango*); (3) glenoid facet broad (narrow in *M. chimachima* and *M. chimango*).

Coracoid with (1) external side with pronounced internal curvature at dorsal end (slight curvature in *M. chimachima* and *M. chimango*); (2) coracohumeral surface long (short in *M. chimachima* and *M. chimango*); (3) attachment of Lig. humero-coracoideum antierius superius greatly elevated anteriorly (slightly elevated in *M. chimachima*, moderately elevated in *M. chimango*); (4) external intermuscular line lying on pronounced ridge (slight ridge in *M. chimachima*, similar in *M. chimango*); (5) external face in distal view very concave (moderately concave in *M. chimachima*, similar in *M. chimango*); (6) concavity dorsal to sternal facet and anterior to external intermuscular line pronounced (slightly developed in *M. chimachima*, similar in *M. chimango*).

Humerus with (1) profile of head low in palmar view (high in *M. chimachima* and *M. chimango*); (2) anconal surface of shaft immediately distal to external tuberosity very concave (moderately concave in *M. chimachima* and *M. chimango*); (3) attachment of *M. proscapulohumeralis brevis* located midway between head and base of median crest (located near base of median crest in *M. chimachima*, similar in *M. chimango*); (4) internal tuberosity large (small in *M. chimachima*, moderate in *M. chimango*); (5) impression of *M. brachialis anticus* long and wide (moderately long and wide in *M. chimachima* and *M. chimango*); (6) attachment of anterior articular ligament rotated distad (rotated only slightly in *M. chimachima*, similar in *M. chimango*); (7) entepicondyle very produced internally (moderately produced in *M. chimachima* and *M. chimango*); (8) attachment of *M. pronator brevis* a large shelf (pit in *M. chimachima*, slight shelf in *M. chimango*).

Ulna with (1) internal cotyla with deep concavity (moderate in *M. chimachima*, similar in *M. chimango*); (2) external corner of external condyle projecting greatly palmarly (projecting only slightly in *M. chimachima*, projecting moderately in *M. chimango*); (3) impression of *M. brachialis anticus* shallow to moderately deep (very deep in *M. chimachima*, similar in *M. chimango*); (4) ligamental attachment at base of internal side of internal condyle a deep pit (shallow in *M. chimachima*, moderately deep in *M. chimango*).

Radius with (1) bicipital tubercle large (small in *M. chimachima* and *M. chimango*); (2) capital tuberosity large (small in *M. chimachima* and *M. chimango*); (3) tendinal groove deep (shallow in *M. chimachima*, moderate in *M. chimango*); (4) external end of carpal facet extending well onto ligamental prominence (extending only slightly onto prominence in *M. chimachima*, similar in *M. chimango*).

Carpometacarpus with (1) external rim of carpal trochlea moderately produced proximad, giving a moderate slope to carpal trochlea (greatly produced in *M. chimachima*, giving a steep slope to carpal trochlea; similar in *M. chimango*); (2) process of metacarpal I large, greatly produced internally (small, moderately produced in *M. chimachima*; small, slightly to moderately produced in *M. chimango*); (3) internal ligamental fossa deep (shallow in *M. chimachima*, moderate in *M. chimango*); (4) internal rim of carpal trochlea very large (small in *M. chimachima*, moderate in *M. chimango*); (5) depression distal to pisiform process deep (similar in *M. chimachima*, moderate in *M. chimango*); (6) attachment of *M. flexor digitalis III* greatly produced internally (moderately produced in *M. chimachima* and *M. chimango*).

Femur with (1) attachments of *M. gluteus profundus*, *M. flexor ischiofemoralis*, and *M. iliacus long* (all short in *M. chimachima* and *M. chimango*); (2) attachment of *M. flexor perforans et perforatus digiti II* large, but shallow (small and deep in *M. chimachima*, of moderate size and depth in *M. chimango*); (3) rotular groove broad (narrow in *M. chimachima* and *M. chimango*); (4) internal condyle angular in internal view (subangular in *M. chimachima* and *M. chimango*); (5) external condyle rounded, with moderate posterior projection (subrounded, with large posterior projection in *M. chimachima*; less rounded, with moderate posterior projection in *M. chimango*); (6) ridge dorsal to internal condyle long and very prominent (short and moderately prominent in *M. chimachima* and *M. chimango*); (7) shaft with strong curvature in external view (slight curvature in *M. chimachima* and *M. chimango*).

Tibiotarsus with (1) area distal to internal articular surface deeply excavated, giving a prominent lip to posterior side of head (moderately excavated, with small lip

Table 7 Measurements of the scapula, coracoid, humerus, radius, ulna, carpometacarpus, femur, tibiotarsus, and tarsometatarsus of *Milvago brodkorbi* sp. nov., *M. chimachima*, and *M. chimango* (in mm).

		<i>Milvago brodkorbi</i> sp. nov.	<i>Milvago chimachima</i>	<i>Milvago chimango</i>
Scapula				
Proximal	OR	9.9–10.7	9.0	9.8–10.1
Height	M	10.3	—	9.9
	n	8	1	2
Proximal	OR	4.0–4.9	4.2	3.9–4.5
Width	M	4.4	—	4.2
	n	8	1	2
Coracoid				
Length	OR	35.0–36.9	32.0	30.9–31.0
	M	36.0	—	30.9
	n	9	1	2
Head to	OR	12.3–13.7	11.3	11.5–15.1
Scapular	M	12.9	—	13.3
Facet	n	17	1	2
Proximal	OR	6.6–7.5	6.4	6.2–6.4
Depth	M	7.0	—	6.3
	n	19	1	2
Least	OR	5.3–6.6	5.3	4.5
Depth of	M	5.9	—	4.5
Shaft	n	9	1	2
Length of	OR	14.1–15.6	13.7	12.8–13.5
Sternal	M	14.9	—	13.2
Facet	n	3	1	2
Humerus				
Length	OR		71.2	67.9–69.3
	M		—	68.6
	n		1	2
Proximal	OR		14.4	15.1–15.3
Width	M		—	15.2
	n		1	2
Distal	OR	13.6–14.6	11.9	12.0–12.2
Width	M	14.0	—	12.1
	n	6	1	2
Least	OR	6.1–6.2	5.4	5.2–5.3
Width of	M	6.1	—	5.2
Shaft	n	2	1	2

		<i>Milvago brodkorbi</i> sp. nov.	<i>Milvago chimachima</i>	<i>Milvago chimango</i>
Radius				
Length	OR	74.7–75.5	70.4	69.4–72.8
	M	75.1	—	71.1
	n	2	1	2
Proximal Width	OR	3.1–3.7	3.1	3.1–3.2
	M	3.3	—	3.1
	n	10	1	2
Distal Width	OR	6.5–7.2	5.9	5.7–6.0
	M	6.8	—	5.9
	n	6	1	2
Ulna				
Length	OR	77.3–82.9	75.1	74.6–77.2
	M	80.6	—	75.9
	n	4	1	2
Proximal Width	OR	9.3–10.0	8.5	8.7–8.8
	M	9.6	—	8.8
	n	13	1	2
Distal Depth	OR	8.3–9.3	7.7	7.7–8.0
	M	8.8	—	7.8
	n	13	1	2
Least Width of Shaft	OR	4.3–4.7	4.2	3.9
	M	4.5	—	3.9
	n	6	1	2
Carpometacarpus				
Length	OR	41.7–46.7	39.6	40.7–42.2
	M	43.8	—	41.8
	n	15	1	2
Height Through Metacarpal I	OR	11.0–12.2	9.5	10.1–10.5
	M	11.5	—	10.3
	n	18	1	2
Proximal Width	OR	4.8–5.5	4.5	4.2–4.5
	M	5.1	—	4.4
	n	20	1	2
Least Width of Shaft	OR	4.1–4.6	3.7	3.7–3.9
	M	4.4	—	3.8
	n	23	1	2

Continued on page 98.

		<i>Milvago brodkorbi</i> sp. nov.	<i>Milvago chimachima</i>	<i>Milvago chimango</i>
Length of	OR	4.1–5.4	4.1	4.3–4.9
Distal	M	4.8	—	4.6
Fornix	n	16	1	2
Femur				
Length	OR	56.2	50.6	47.6–49.3
	M	—	—	48.4
	n	1	1	2
Proximal	OR	10.5–11.2	8.8	8.9
Width	M	10.8	—	8.9
	n	3	1	2
Distal	OR	10.1–10.8	9.3	8.7–8.9
Width	M	10.4	—	8.8
	n	5	1	2
Least	OR	5.3	4.9	4.1
Width of	M	—	—	4.1
Shaft	n	1	1	2
Tibiotarsus				
Length	OR	78.2–80.6	70.4	69.0–72.4
	M	79.4	—	70.7
	n	2	1	2
Proximal	OR	8.5–9.2	7.5	7.1–7.3
Width	M	8.9	—	7.2
	n	5	1	2
Distal	OR	8.2–9.9	8.2	7.9–8.0
Width	M	9.1	—	7.9
	n	23	1	2
Least	OR	4.3–5.1	4.3	3.9
Width of	M	4.7	—	3.9
Shaft	n	9	1	2
Depth of	OR	7.2–8.6	7.1	6.6–6.9
Internal	M	7.7	—	6.8
Condyle	n	22	1	2
Tarsometatarsus				
Length	OR	57.9–61.8	52.7	58.2–60.8
	M	59.8	—	59.5
	n	5	1	2

		<i>Milvago brodkorbi</i> sp. nov.	<i>Milvago chimachima</i>	<i>Milvago chimango</i>
Proximal	OR	9.4–10.9	8.9	8.6–8.9
Width	M	10.0	—	8.8
	n	9	1	2
Distal	OR	9.1–10.4	8.8	8.4–8.9
Width	M	9.7	—	8.7
	n	14	1	2
Least	OR	3.6–4.4	3.6	3.0–3.1
Width of	M	4.0	—	3.1
Shaft	n	15	1	2
Width of	OR	3.4–4.1	3.3	3.2–3.3
Middle	M	3.7	—	3.3
Trochlea	n	19	1	2

in *M. chimachima* and *M. chimango*); (2) external condyle with very deep concavity in side (deep in *M. chimachima*, moderate in *M. chimango*); (3) internal condyle with moderate concavity in side (deep in *M. chimachima*, shallow in *M. chimango*).

Etymology

This species is named for Dr. Pierce Brodkorb in recognition of his many outstanding contributions to avian palaeontology.

Remarks

It is apparent from the above comparisons that *M. brodkorbi*, although quite distinct from *M. chimango*, is more similar to that species than to *M. chimachima*. As *M. chimango* is found today west of the Andes in Chile, and *M. chimachima* only east of the Andes, a closer relationship between *M. chimango* and *M. brodkorbi* is perhaps to be expected.

Milvago brodkorbi is the second palaeospecies of *Milvago* to be described, the first being *M. alexandri* Olson (1976) from Pleistocene cave deposits in Haiti. The holotype of *M. alexandri* is a tarsometatarsus (length, 56.2; proximal width, 8.2; distal width, 9.1; least width of shaft, 3.4; width of middle trochlea, 3.4 (Olson, 1976: 358) which is significantly smaller than *M. brodkorbi*, and which is described as being morphologically more similar to *M. chimachima* than to *M. chimango*. In addition, from the published photograph of the type of *M. alexandri* it is possible to determine that the tarsometatarsus of *M. brodkorbi* differs from that of *M. alexandri* by having (1) intercotylar prominence higher and possibly narrower; (2) trochlear groove of middle trochlea deeper; (3) distal projection of internal trochlea larger; (4) anterior metatarsal groove not as deeply excavated.

The two living species of *Milvago* are residents of savannas and lightly wooded areas, and often feed as scavengers. If the fossil material represented a living species its presence in a currently unsuitable habitat could be attributed to its feeding habits and the long-distance attraction of the tar pits for scavengers, but as the material represents an extinct species a postdepositional change in the habitat at the site is implied.

Order Galliformes (Temminck)
Family Cracidae Vigors
Subfamily Penelopinae Bonaparte

Penelope Merrem
Penelope cf. *purpurascens* Wagler
Crested Guan

Material

One right scapula, proximal end of 1 left humerus, distal end of 1 right humerus, distal end of 1 right tibiotarsus. ROM 17607–17610. The 4 specimens represent a minimum of 1 individual.

Characters

The specimens listed above are readily recognizable as belonging to the genus *Penelope* by their size and many distinctive characters. They compare favorably with Recent *P. purpurascens* from Central America (none was available from South America), but are slightly smaller, corresponding to the current trend toward smaller size in South American forms.

The fossil material appears to resemble Central American *P. purpusascens* more than one available Bolivian *P. jacquacu* Spix, but the great intraspecific variation makes a definitive identification impossible without a larger series.

Remarks

The known range of *P. purpurascens* extends along the western slopes of the Andes only as far south as Naranjo (Naranjito), Ecuador, slightly over 125 km from the fossil site. However, suitable habitat does exist today south of its known range, and it may simply not have been found there yet. The presence in the fossil collection of a tropical forest bird such as *P. purpurascens* suggests that a heavy stand of forest, or at least a good riparian forest, was very near.

The fragmentary nature of the fossil material, a lack of comparative material from South America, and the availability of only one *P. jacquacu* prevents any comment on whether *P. purpurascens* and *P. jacquacu* are conspecific or distinct species (Vuilleumier, 1965; Hellmayr and Conover, 1942).

Order Ralliformes (Reichenbach)
Suborder Ralli (Reichenbach)
Family Rallidae Vigors
Subfamily Rallinae (Vigors)

Porzana Vieillot
Porzana carolina (Linnaeus)
Sora

Material

Distal end of 1 left humerus, distal end of 1 left tibiotarsus, distal end of 1 left tarsometatarsus. ROM 17611–17613. The 3 specimens represent a minimum of 1 individual.

Remarks

A North American migrant, *P. carolina* occurs as far south as central Peru.

Order Charadriiformes (Huxley)
Suborder Charadrii (Huxley)
Family Charadriidae (Vigors)

Coracoid with procoracoid perforated by coracoidal fenestra.

Subfamily Vanellinae Blyth

Viator gen. nov.

Diagnosis

Coracoid agrees with that of other genera of Vanellinae, and differs from those of genera of Charadriinae, by having (1) attachment of Lig. humero-coracoideum antierius superius long, lying close to internal side of head; (2) procoracoid long; (3) sterno-coracoidal impression deep.

Coracoid differs from that of *Belonopterus chilensis* (Molina), *Vanellus vanellus* (Linnaeus) and *Hoploxypterus cayanus* (Latham), by having (1) head turned approximately 85° from line drawn along scapular facet and procoracoid (turned approximately 65° in *B. chilensis*, 70° in *V. vanellus*, 55° in *H. cayanus*); (2) furcular facet with anterior portion without large dorsal and ventral projections (present in *B. chilensis*, *V. vanellus*, and *H. cayanus*); (3) head very deeply excavated internally (deeply excavated in *B. chilensis* and *H. cayanus*, moderately excavated in *V. vanellus*); (4) shaft with side between glenoid facet and head markedly concave (essentially flat in *B. chilensis* and *V. vanellus*, excavated so that large shelf is formed extending from distal end of glenoid facet to middle of head in *H. cayanus*); (5) attachment of M. coracobrachialis anterior large (smaller in *B. chilensis*, *V. vanellus*, and *H. cayanus*); (6) glenoid facet rotated internally (not rotated in *B. chilensis*, *V. vanellus*, and *H. cayanus*); (7) scapular facet large (smaller in *B. chilensis*, *V.*

vanellus, and *H. cayanus*); (8) depression immediately dorsal to sternal facet and anterior to external intermuscular line pronounced, with deeper internal pits (much less pronounced, without pits in *B. chilensis*, *V. vanellus*, and *H. cayanus*); (9) internal sternal shelf very large (smaller in *B. chilensis*, *V. vanellus*, and *H. cayanus*); (10) external sternal angle very long, projecting sharply ventrodistad so that attachment of *M. coracobrachialis posterior* does not reach sternal facet (of moderate length, not projecting sharply distad in *B. chilensis*, *V. vanellus*, and *H. cayanus*).

Coracoid differs from that of *Belonopterus (Ptiloscelys) resplendens* (Tschudi) in all ways that it differs from that of *B. chilensis*, and additionally by having (1) scapular facet positioned much lower on shaft; (2) glenoid facet much larger.

Type Species

Viator picis sp. nov.

Etymology

Latin, *viator*, masculine, wayfarer.

Viator picis sp. nov.

Fig. 30C

Holotype

Complete right coracoid, procoracoid broken. ROM 13021.

Diagnosis

As for genus. For measurements see Table 8.

Etymology

Latin, *picis*, genitive of *pix*, tar.

Remarks

An exhaustive comparative study of the osteology of the genera of lapwings is beyond the scope of this paper. However, osteological evidence cited above and in the following description of *Belonopterus* sp. nov., and examination of other skeletal elements, indicates that the inclusion of the genera *Belonopterus*, *Ptiloscelys*, and *Hoploxypterus* in the genus *Vanellus* as proposed by Bock (1958) is unwarranted and serves only to confuse relationships of the several species of lapwings rather than clarify them.

The suggestion by Bock (1958) that *B. chilensis* and *P. resplendens* be placed in a single genus is supported by their similar osteological characters as listed above, but these characters require that these two species be placed in the genus *Belonopterus*, not combined with *Vanellus*. The osteological differences between *Belonopterus* and *Vanellus* are more than sufficient to separate them at the generic level.

Viator picis and *Belonopterus* sp. nov. (described below) represent the second and third palaeospecies of lapwings to be described from the Pleistocene of the New World, *Dorypaltus prosphatus* Brodkorb (1959) being recorded from two localities in

Florida. The discovery of three palaeospecies of lapwings from the late Pleistocene suggests that perhaps even more palaeospecies will be found in earlier deposits. It also indicates the hazards of describing the origins of current worldwide distributions of the members of a group (Bock, 1958) without knowledge of their fossil record.

***Belonopterus* Reichenbach**
***Belonopterus edmundi* sp. nov.**
Fig. 31A, B

Holotype

Complete left humerus. ROM 13022.

Paratype

Distal end of one left humerus. ROM 13023.

Referred Material

One complete left femur. ROM 13024. The 3 specimens, including holotype and paratype, represent a minimum of 2 individuals.

Diagnosis

Humerus agrees with *Belonopterus* (including *Ptiloscelys*) and differs from *Vanellus* (sensu stricto) and *Hoploxypterus* by having (1) ectepicondyle reduced, not forming prominent spur (very prominent in *Vanellus*; moderately prominent in *Hoploxypterus*); (2) attachment of M. extensor metacarpi radialis, pars anconalis, with proximal end forming prominent projection equal to, or slightly lower than, proximal end of ectepicondylar prominence (not projecting, much lower than proximal end of ectepicondylar prominence in *Vanellus*; not projecting, but only slightly lower than proximal end of ectepicondylar prominence in *Hoploxypterus*); (3) olecranal fossa very poorly developed (moderate to deep, undercutting proximal end of internal condyle in *Vanellus* and *Hoploxypterus*); (4) brachial depression deep (shallow to moderately deep in *Vanellus* and *Hoploxypterus*).

Humerus is characterized by having (1) head more rounded anconally than palmarly in external view; (2) attachment of M. triceps, external head, very deep, excavated below attachment of M. proscapulothoracalis and undercutting head; (3) bicipital crest very wide; (4) entepicondyle with entire side very concave; (5) entepicondyle oblique, moderately produced; (6) olecranal fossa poorly developed; (7) concavity extending to internal side of external tricipital groove immediately proximal to ectepicondyle deep, giving ectepicondyle a very prominent external projection; (8) ectepicondylar prominence with external side concave; (9) attachment of M. flexor metacarpi radialis, pars anconalis, with proximal end very prominent, equal in height and separated by concavity from proximal end of ectepicondylar prominence; (10) external condyle wide, undercut externally and proximally by narrow groove, and flat internally; (11) brachial depression deep, extending less than 25 per cent of length proximal to proximal end of ectepicondylar prominence; (12)

Table 8 Measurements of the humerus, coracoid, and femur of *Belonopterus chilensis*, *B. resplendens*, and *Hoploxypterus cayanus*; of the humerus and femur of *Belonopterus edmundi* sp. nov.; and of the coracoid of *Viator picis* gen. et sp. nov. (in mm).

		<i>Belonopterus chilensis</i>	<i>Belonopterus resplendens</i>	<i>Belonopterus edmundi</i> sp. nov.	<i>Viator picis</i> gen. et sp. nov.	<i>Hoploxypterus cayanus</i>
Coracoid Length	OR	23.6-26.1	23.8-25.8		25.4	17.3
	M	24.7	25.3		—	—
	n	3	5		1	1
Head to Scapula Facet	OR	9.1-10.0	8.4-9.3		10.3	6.0
	M	9.6	9.0		—	—
	n	3	5		1	1
Proximal Depth	OR	6.6-6.9	5.6-7.1		7.1	4.0
	M	6.7	6.4		—	—
	n	3	5		1	1
Least Depth of Shaft	OR	3.1-3.4	2.8-3.3		3.4	2.2
	M	3.3	3.2		—	—
	n	3	5		1	1
Length of Sternal Facet	OR	8.4-9.0	8.4-9.2		9.1	5.4
	M	8.6	8.9		—	—
	n	3	5		1	1
Humerus Length	OR	67.0-71.1	59.8-65.5	43.5		40.1
	M	68.6	63.1	—		—
	n	3	5	1		1
Proximal Width	OR	12.6-14.1	12.4-13.5	9.5		9.0
	M	13.3	13.2	—		—
	n	3	5	1		1

Distal Width	OR M n	9.8-11.1 10.3 3	9.2-9.8 9.5 5	6.7-7.4 7.0 2	6.4 — 1
Least Width of Shaft	OR M n	4.1-4.8 4.4 3	3.8-4.3 4.0 5	2.8 — 1	2.4 — 1
Depth External Condyle	OR M n	5.7-6.2 5.9 3	5.5-6.0 5.8 5	4.2-4.3 4.2 2	3.7 — 1
Femur Length	OR M n	37.7-40.7 39.1 3	37.9-42.9 40.7 5	24.9 — 1	25.9 — 1
Proximal Width	OR M n	7.1-7.8 7.4 3	6.6-7.6 7.1 5	4.3 — 1	4.7 — 1
Distal Width	OR M n	7.9-8.5 8.1 3	7.2-7.9 7.6 5	4.9 — 1	5.1 — 1
Least Width of Shaft	OR M n	3.0-3.2 3.1 3	2.6-3.1 3.0 5	1.9 — 1	1.9 — 1
Least Depth of Shaft	OR M n	3.1-3.3 3.2 3	5.4-6.1 5.9 5	1.7 — 1	2.0 — 1

attachment of anterior articular ligament with proximal third rotated to face internal condyle; (13) shaft strongly sigmoid in external view.

Humerus resembles *B. chilensis* more than *B. (Ptiloscelys) resplendens*, but is less than two-thirds the size of either of those species. For measurements see Table 8. Measurements of the holotype are as follows: length, 43.5; proximal width, 9.5; distal width, 6.7; least width of shaft, 2.8; depth of external condyle, 4.2.

Characters

Femur with (1) head facing approximately equally dorsad and internally; (2) concavity distal to posterior edge of iliac facet very deep; (3) concavity undercutting anterior edge of iliac facet and proximal end of anterior intermuscular line, which remains parallel to edge of trochanter to its end; (4) shaft flattened, with deep depression on internal side of shaft at point of flexure distally; (5) internal condyle slightly rounded, with distalmost point centrally located; (6) external condyle moderately rounded; (7) attachment of *M. gastrocnemius*, pars externa, very large and elevated; (8) shaft relatively straight, with only slight anteroposteriad curvature. The femur agrees with the humerus in resembling *B. chilensis* more than *B. (Ptiloscelys) resplendens*.

Etymology

This species is named for Dr. A. Gordon Edmund, the individual most responsible for the palaeontological collections from the Talara Tar Seeps.

Remarks

Belonopterus edmundi is clearly related to *B. chilensis* and *B. (Ptiloscelys) resplendens*, and is quite distinct from *Vanellus* (sensu stricto) and *Hoploxypterus*, providing additional evidence for the congeneric status of *B. chilensis* and *B. (Ptiloscelys) resplendens*.

Subfamily Charadriinae (Vigors)

Pluvialis Brisson
Pluvialis dominica (Muller)
Golden Plover

Material

One left scapula, 4 complete left coracoids, 3 complete right humeri, shaft and distal ends of 2 right and 1 left humerus, proximal ends of 2 left humeri, distal ends of 3 right and 5 left humeri, 1 complete left carpometacarpus, distal ends of 1 right and 1 left tibiotarsus, 1 complete left tarsometatarsus, proximal ends of 2 right and 3 left tarsometatarsi, distal ends of 1 right and 1 left tarsometatarsus. ROM 17614–17645. The 32 specimens represent a minimum of 6 individuals.

Characters

The smaller size of *P. dominica* is generally sufficient to separate its elements from those of *P. squatarola* (Linnaeus). For those elements of the two species that are of similar length, *P. squatarola* is much stouter or broader. Additional characters of *P. dominica* separating the two species are coracoid with (1) angle between furcular facet and edge of triosseal canal approximately 135° (approximately 125° in *P. squatarola*).

Humerus with (1) base of median crest slightly nearer capital shaft ridge; (2) internal condyle narrow; (3) olecranal fossa narrow, and deepest on internal side.

Carpometacarpus with (1) process of metacarpal I lower; (2) carpal trochlea with internal rim projecting less distad.

Femur with (1) head much smaller; (2) greater trochanter much smaller; ridge at internal corner of internal condyle turned externally at greater angle.

Tibiotarsus with (1) external articular surface narrower; (2) posterior rim of internal condyle extending less proximad.

Tarsometatarsus with (1) intercotylar prominence more undercut externally; (2) proximal foramina situated more proximally; (3) middle trochlea extending distad less in relation to the internal and external trochleae.

Remarks

A North American migrant, *P. dominica* occurs on the west coast of South American as far south as Santiago, Chile.

Pluvialis squatarola (Linnaeus) Black-bellied Plover

Material

One complete left femur, distal end of 1 right tibiotarsus, distal end of 1 left tarsometatarsus. ROM 17646–17648. The 3 specimens represent a minimum of 1 individual.

Remarks

The differences between *P. dominica* and *P. squatarola* described above are not considered to be significant enough to place the two species in separate genera. This is in agreement with the recent allocation to congeneric status (A.O.U., 1973).

A North American migrant, *P. squatarola* occurs along the west coast of South America as far south as Concepción, Chile.

Charadrius Linnaeus *Charadrius vociferus* Linnaeus Killdeer

Material

Two complete left coracoids, 1 complete right humerus, distal end of 1 right

humerus, proximal end and shaft of 1 right femur, 1 complete right and 1 complete left tibiotarsus. ROM 17649–17655. The 7 specimens represent a minimum of 2 individuals.

Remarks

Charadrius vociferus is resident on the coast of Peru today.

Charadrius collaris Vieillot

Collared Plover

Material

Proximal end of 1 left humerus, shaft and distal end of 1 right humerus, 1 complete left tarsometatarsus. ROM 17656–17658. The 3 specimens represent a minimum of 1 individual.

Characters

Charadrius collaris is separated from *C. alexandrinus* Linnaeus, the only other plover of similar size, by having humerus with (1) proximal end narrow; (2) deltoid crest smaller; (3) head less undercut; (4) ectepicondyle and entepicondyle less produced; (5) external condyle wider and shorter.

Tarsometatarsus with (1) internal trochlea placed farther distally.

Remarks

Charadrius collaris occurs all along the west coast of South America.

Charadrius semipalmatus Bonaparte

Semipalmated Plover

Material

Complete left tarsometatarsus. ROM 17659.

Characters

Although the specimen represents an immature bird, the small, but stout, limb elements of *C. semipalmatus* are sufficient to distinguish it from all other species of the genus.

Remarks

A North American migrant, *C. semipalmatus* winters as far south as Llanquihue, Chile.

Family Scolopacidae Vigors

Coracoid with procoracoid not perforated by coracoidal fenestra.

Tringa Linnaeus
Tringa ameghini sp. nov.
Fig. 30E, F

Holotype

Complete left coracoid. ROM 12897.

Referred Material

Proximal end of 1 right tarsometatarsus. ROM 12898.

Diagnosis

Coracoid agrees with that of *Tringa* and differs from that of all other scolopacid genera, including *Totanus*, by having (1) head of moderate height, rectangular, with anterodorsal corner extending farthest anteriad; (2) external side of shaft between glenoid facet and attachment of Lig. humero-coracoideum antierius superius flat; (3) length of procoracoid through base short; (4) procoracoid set off sharply from shaft distally; (5) internal ridge of shaft leading dorsad from internal distal angle similarly developed and at similar angle as in *T. solitaria*; (6) sterno-coracoidal impression deep, extending more than halfway up shaft.

Coracoid differs from that of *T. solitaria* by having (1) shaft ventral to coracohumeral surface very flat, excavated from glenoid facet to base of attachment of Lig. humero-coracoideum antierius superius so that external edge of coracohumeral surface forms a lip and a large ridge extends from end of coracohumeral surface to attachment of Lig. humero-coracoideum antierius superius; (2) angle between line drawn along furcular facet and plane of procoracoid approximately 10°–15° less; (3) internal distal angle lying at greater angle to horizontal in internal view; (4) scapular facet directed more posteriad. For measurements see Table 9.

Characters

Tarsometatarsus differs from that of *T. solitaria* by having (1) proximal end narrower, with shaft flaring more gradually toward cotylae; (2) external cotyla positioned more distally; (3) proximal foramina and tubercle for tibialis anticus located more distally.

Etymology

This species is named for Florentino Ameghino, the great Argentine vertebrate paleontologist.

Remarks

Although there are not many differences between *T. ameghini* and *T. solitaria* (including fossil specimens) the few present are very good specific characters.

Tringa ameghini is the first recorded palaeospecies of the genus. While it cannot be proven, it is probable that *T. ameghini* was a northern migrant, as are all related species and genera today.

Table 9 Measurements of the coracoid and tarsometatarsus of *Tringa ameghini* sp. nov., Recent *T. solitaria*, and *T. solitaria* from the Talara Tar Seeps (in mm).

		<i>Tringa ameghini</i> sp. nov.	<i>Tringa solitaria</i> Talara Tar Seeps	Recent
Coracoid				
Length	OR	16.2	15.9–16.6	15.0–15.5
	M	—	16.3	15.2
	n	1	6	3
Head to	OR	5.8	5.8–6.2	5.1–5.5
Scapular	M	—	6.0	5.3
Facet	n	1	7	3
Proximal	OR	4.8	4.8–5.1	4.1–4.5
Depth	M	—	5.0	4.4
	n	1	5	3
Least	OR	1.9	1.9–2.2	1.7–1.8
Width of	M	—	2.0	1.8
	n	1	7	3
Length of	OR	5.1	5.3–5.7	4.3–5.1
Sternal	M	—	5.4	4.7
Facet	n	1	5	3
Tarsometatarsus				
Proximal	OR	3.6	4.0	3.8
Width	M	—	—	—
	n	1	1	1

Tringa solitaria Wilson
Solitary Sandpiper

Material

Two complete right and 5 complete left coracoids, 2 complete right and 3 complete left humeri, 1 complete right carpometacarpus, proximal end of 1 right carpometacarpus, proximal end of 1 right tibiotarsus, distal ends of 1 right and 2 left tibiotarsi, 1 complete right tarsometatarsus, distal ends of 1 right and 1 left tarsometatarsus. ROM 17660–17680. The 21 specimens represent a minimum of 5 individuals.

Characters

Tringa solitaria differs from other scolopacid species of similar size by having humerus with (1) proximal end small and bicipital surface small and narrow; (2) groove between capital shaft ridge and base of median crest very deep, deeply undercutting head; (3) line of M. latissimus dorsi anterioris prominent, lying near top

of capital shaft ridge; (4) impression of M. brachialis anticus elliptical, ending distally in deep pointed pit; (5) area between ectepicondylar process and ectepicondyle only slightly concave; (6) entepicondyle produced.

Carpometacarpus with (1) ligamental attachment of pisiform process well developed; (2) external side of metacarpal I sharply concave.

Tibiotarsus with (1) internal articular surface small; (2) external condyle joining shaft abruptly distally; (3) tendinal groove positioned near internal condyle.

Tarsometatarsus with (1) hypotarsus high and rectangular; (2) distal foramen long; (3) shaft long and narrow, and anterior face channeled for more than half its length; (4) shaft widening gradually to meet outer and inner trochleae; (5) trochleae compressed.

Remarks

For characters of the coracoid of *Tringa* that distinguish it from that of all other scolopacid genera see diagnosis of *T. ameghini*.

Although the sample is admittedly very small, the measurements given in Table 9 for *T. solitaria* suggest there has been a significant reduction in the body size of the species through time. A North American migrant, *T. solitaria* occurs all along the Peruvian coast.

Totanus Bechstein *Totanus flavipes* (Gmelin) Lesser Yellowlegs

Material

Seven complete right and 9 complete left coracoids, humeral end of 1 left coracoid, 6 complete right and 7 complete left humeri, proximal ends of 1 right and 7 left humeri, distal ends of 4 right and 3 left humeri, 6 complete right and 2 complete left carpometacarpi, proximal ends of 1 right and 2 left carpometacarpi, distal ends of 2 right and 6 left tibiotarsi, proximal ends of 2 right and 3 left tarsometatarsi, distal ends of 1 right and 1 left tarsometatarsus. ROM 17681–17749, 19528, 19529. The 71 specimens represent a minimum of 17 individuals.

Characters

Totanus flavipes differs from other species of scolopacids of similar size by having coracoid with (1) anterior furcular facet with large dorsal extension and small ventral extension; (2) protrusion distal to attachment of Lig. humero-coracoideum anterius superius.

Humerus with (1) external tuberosity facing anconally, forming a large shelf; (2) area between attachment of M. supracoracoideus and deltoid crest usually concave; (3) capital shaft ridge large, with anconal projection of head at its proximal end; (4) internal tuberosity prominent and slender; (5) ectepicondyle well developed; (6) attachment of M. anconeus, M. extensor digitorum communis, and M. flexor metacarpi radialis strongly developed; (7) brachial depression moderately deep, not extending to internal condyle.

Carpometacarpus with (1) metacarpal I long; (2) internal rim of carpal trochlea slanting externally only slightly; (3) lobe at end of external rim of carpal trochlea well developed; (4) concavity at distal end of tendinal groove deep.

Tibiotarsus with (1) distal end compressed; (2) condyles raised above shaft anteroproximally.

Tarsometatarsus with (1) hypotarsus distinctive; (2) trochleae long and compressed; (3) shaft widening gradually distad.

Remarks

On the basis of the large number of significant osteological differences between *Tringa* (*T. solitaria* and *T. ameghini*) and *Totanus* (*T. flavipes* and *T. melanoleucus*), I have refrained from accepting the recent lumping of the two genera into the genus *Tringa* (A.O.U., 1973). A North American migrant, *T. flavipes* occurs all along the Pacific coast of South America.

Totanus melanoleucus (Gmelin)

Greater Yellowlegs

Material

One complete right coracoid, humeral end of 1 left coracoid, 1 complete left humerus, proximal end of 1 right humerus, proximal end of 1 left carpometacarpus, distal end of 1 left tibiotarsus, proximal ends of 2 right and 1 left tarsometatarsus, distal ends of 1 right and 1 left tarsometatarsus. ROM 17750–17760. The 11 specimens represent a minimum of 2 individuals.

Remarks

A North American migrant, *T. melanoleucus* occurs all along the Pacific coast of South America.

Actitis Illiger

Actitis macularia (Linnaeus)

Spotted Sandpiper

Material

Distal end of 1 left humerus. ROM 17761.

Characters

Humerus with (1) attachment of *M. flexor carpi ulnaris* large and round; (2) attachment of anterior articular ligament short and high; (3) impression of *M. brachialis anticus* completely inset; (4) ectepicondylar process small.

Remarks

A North American migrant, *A. macularia* occurs all along the coast of Peru.

***Catoptrophorus* Bonaparte**
***Catoptrophorus semipalmatus* (Gmelin)**
Willet

Material

Humeral ends of 2 right coracoids, 1 complete right and 2 complete left humeri, proximal end of 1 left humerus, distal ends of 1 right and 2 left humeri, 2 complete right and 2 complete left carpometacarpi, distal ends of 2 left tibiotarsi, distal end of 1 left tarsometatarsus. ROM 17762–17777. The 16 specimens represent a minimum of 4 individuals.

Remarks

A North American migrant, *C. semipalmatus* occurs all along the coast of Peru.

***Erolia* Vieillot**
***Erolia minutilla* (Vieillot)**
Least Sandpiper

Material

One complete left coracoid, 9 complete right and 9 complete left humeri, proximal ends of 3 right humeri, distal ends of 2 right and 1 left humerus, 1 complete left femur, 1 complete right tarsometatarsus, distal end of 1 left tarsometatarsus. ROM 17778–17805. The 28 specimens represent a minimum of 12 individuals.

Characters

Erolia minutilla is the smallest species of the genus and is readily separated on size. As this species is approximately the same size as *Ereunetes mauri* and *E. pusillus*, the following characters were used to distinguish it from the genus *Ereunetes*.

Coracoid with (1) external rim of glenoid facet rotated more posteriad; (2) distal rim of scapular facet small. Additional characters listed by Brodkorb (1963a: 4–5) include (1) coracohumeral surface shorter, making head appear to rise at a lesser angle; (2) juncture of coraco-humeral surface and glenoid facet notched; (3) base of procoracoid process abruptly joining shaft; and (4) ligamental attachment at lower medial edge of shaft shortened.

Humerus with (1) internal condyle/external condyle ratio high (Brodkorb, 1955); (2) bicipital crest usually not extending as far distad; (3) internal condyle less produced; (4) attachment of anterior articular ligament lower; (5) impression of M. brachialis anticus long and moderately deep.

Carpometacarpus with (1) internal rim of carpal trochlea less rounded; (2) proximal area of fusion of metacarpal II and metacarpal III longer; (3) pisiform process deflected slightly more outward; (4) attachment of M. flexor carpi ulnaris brevis not positioned as far posteriorly.

Femur with (1) rotular groove wide, and internal condyle appearing to taper and run off shaft proximally (rather than curving with edge of shaft as in *Ereunetes*).

Tibiotarsus with (1) length short; (2) outer cnemial crest directed more toward fibular crest; (3) distal rim of internal condyle much more developed.

Tarsometatarsus with (1) length short; (2) trochleae less compressed; (3) external trochlea extending farther distad.

Remarks

In view of the numerous osteological differences between the genera *Erolia*, *Ereunetes*, and *Calidris*, I believe it is best to maintain each as a separate genus pending a detailed analysis of their osteological similarities and differences. This belief conflicts with the recent placement of *Erolia* and *Ereunetes* in the genus *Calidris* (A.O.U., 1973). A North American migrant, *E. minutilla* occurs all along the Peruvian coast.

Erolia melanotos (Vieillot)

Pectoral Sandpiper

Material

Five complete right and 8 complete left coracoids, humeral ends of 2 left coracoids, 19 complete right and 16 complete left humeri, proximal ends of 10 right and 6 left humeri, distal ends of 32 right and 41 left humeri, 22 complete right and 16 complete left carpometacarpi, proximal ends of 4 right and 2 left carpometacarpi, 3 complete left femora, distal end of 1 left femur, 1 complete right and 1 complete left tibiotarsus, distal ends of 6 right and 7 left tibiotarsi, 5 complete right and 2 complete left tarsometatarsi, proximal ends of 2 right and 2 left tarsometatarsi, distal ends of 4 right and 4 left tarsometatarsi. ROM 17806–18025, 19560. The 221 specimens represent a minimum of 57 individuals.

Characters

Erolia melanotos differs from other species of scolopacids by having coracoid with (1) brachial tuberosity large, and protrusion posterior to attachment of Lig. humero-coracoideum antierius superius large, combining to give very wide head; (2) coracohumeral surface short, wide, and sharply curved; (3) shaft large.

Humerus with (1) proximal end wide, capital shaft ridge dropping off sharply on either side; (2) attachment of M. supracoracoideus long; (3) area between ectepicondyle and ectepicondylar process usually quite concave; (4) impression of M. brachialis anticus deep distally, undercutting attachment of anterior articular ligament, and becoming gradually shallower proximad; (5) entepicondyle rectangular; (6) external condyle curving slightly toward anterior articular ligament.

Carpometacarpus with (1) internal rim of carpal trochlea rounded posteriorly; (2) lobe at end of external rim of trochlea long and well developed, tapering sharply to end; (3) ligamental attachment of pisiform process well developed; (4) ligamental attachment of ulnare deep, separated from ligamental attachment of pisiform process.

Femur with (1) trochanter high; (2) attachment of M. gluteus profundus wide; (3) attachment of M. obturator externus deep; (4) space between anterior intermuscular line and trochanteric ridge narrow; (5) internal condyle more oval than elliptical; (6)

external condyle quite produced; (7) attachment of M. gastrocnemius, pars externa, large, positioned near base of fibular condyle.

Tibiotarsus with (1) internal articular surface undercut distally; (2) outer cnemial crest directed away from fibular crest; (3) shaft convex externally and concave internally between fibular crest and articular surface in distal view; (4) tendinal groove directed toward inner condyle; (5) posterior intercondylar surface wide, but short.

Tarsometatarsus with (1) shaft moderately large, widening abruptly both proximad and distad; (2) intercotylar prominence produced; (3) hypotarsus roughly triangular, long on external side, very short on internal side; (4) trochleae not greatly compressed or widened.

Remarks

A North American migrant, *E. melanotos* occurs all along the Peruvian coast.

***Ereunetes* Illiger**
***Ereunetes mauri* (Cabanis)**
Western Sandpiper

Material

One complete right and 2 complete left coracoids, humeral end of 1 left coracoid, 1 complete right and 2 complete left humeri, shaft and distal end of 1 left humerus, 2 complete right and 2 complete left carpometacarpi, 1 complete right tibiotarsus, distal ends of 2 right and 1 left tibiotarsus, 1 complete left tarsometatarsus. ROM 18026–18041, 19531. The 17 specimens represent a minimum of 3 individuals.

Characters

Ereunetes mauri and *E. pusillus* are very similar osteologically, but some elements of the two species can be separated from one another. Of the material listed above I was not able to find any reliable characters for separating carpometacarpi and tibiotarsi of the two species. However, as all other elements were identifiable as *E. mauri* and not *E. pusillus*, I have assigned the carpometacarpi and tibiotarsi to *E. mauri*. *E. mauri* differs from *E. pusillus* by having coracoid with (1) coracohumeral surface rising at steeper angle; (2) brachial tuberosity larger: the combined effect of (1) and (2) being a larger, thicker head.

Humerus with (1) deltoid crest slightly larger; (2) attachment of anterior articular ligament slightly shorter and significantly higher; (3) impression of M. brachialis anticus much deeper.

Tarsometatarsus with (1) external rims of internal and external cotylae higher, the cotylae more produced anteriorly; (2) distal extension of internal trochlea more distinctly set off from rest of trochlea.

Remarks

A North American migrant, *E. mauri* occurs as far south as central Peru.

Micropalama Baird
Micropalama chapmani sp. nov.
Fig. 31G

Holotype

Complete right femur. ROM 13019.

Diagnosis

Femur agrees with that of *Micropalama* and differs from that of all other South American scolopacid genera by having (1) iliac facet slightly curved and extending over very short neck to head; (2) trochanter protruding moderately proximad; (3) iliac facet undercut posteriorly for entire width; (4) ridge leading to external rim of internal condyle from posterior intermuscular line; (5) attachment of *M. gastrocnemius*, pars externa, large, elevated, and extending distad in a long crescent to reach base of fibular condyle; (6) shaft with distal end turned sharply mediad posterior to anteroproximal termination of internal condyle, and very excavated on medial surface at that point.

Femur differs from that of *M. himantopus* (Bonaparte) by having (1) attachment of *M. iliacus* much shorter; (2) shaft much stouter; (3) attachment of *M. gastrocnemius*, pars externa, positioned much more proximad; (4) internal condyle with posterior articular surface extending farther proximad; (5) rotular groove much narrower and deeper; (6) shaft with less excavation at point of medial flexure of distal end; (7) internal and external condyles more rounded ridges at their anteroproximal terminations.

Measurements of the holotype are as follows, with those of the coracoids of six Recent *M. himantopus* and the one coracoid of *M. himantopus* from the Talara Tar Seeps in parentheses: length from iliac facet to external condyle, 22.2 (21.2–22.2, mean, 21.7; 21.2); width of proximal end, 4.0 (3.6–4.0, mean, 3.9; 4.1); depth of proximal end, 3.3 (2.7–3.0, mean, 2.9; 2.7 +); least width of shaft, 1.8 (1.7–1.8, mean, 1.8; 1.7); width of distal end, 4.3 (3.8–4.1, mean, 4.0; 4.1).

Etymology

This species is named for the late Dr. Frank M. Chapman in recognition of his many contributions to our knowledge of the ornithology of South America.

Remarks

Micropalama chapmani is the second fossil species of *Micropalama* described, *M. hesternus* Wetmore (1924) from the Upper Pliocene of Arizona being the first. Although based on different elements, the great difference in the ages of the two specimens would tend to preclude their being conspecific.

***Micropalama himantopus* (Bonaparte)**

Stilt Sandpiper

Material

One complete right femur. ROM 18042.

Remarks

A North American migrant, *M. himantopus* occurs all along the coast of Peru.

***Arenaria* Brisson**

***Arenaria interpres* (Linnaeus)**

Ruddy Turnstone

Material

Proximal end of 1 right humerus, 1 complete left carpometacarpus. ROM 18043–18044. The 2 specimens represent a minimum of 1 individual.

Characters

Humerus with (1) proximal end wide, and head large; (2) capital groove wide; (3) groove between capital shaft ridge and base of median crest moderately deep; (4) pneumatic fossa wide; (5) shaft widening considerably to meet bicipital crest.

Carpometacarpus with (1) trochlear surface wide, and internal rim of carpal trochlea very high; (2) pisiform process positioned near pollical facet; (3) shaft rather large.

Remarks

A North American migrant, *A. interpres* occurs all along the coast of Peru.

***Numenius* Brisson**

***Numenius cf. borealis* (Foster)**

Eskimo Curlew

Material

Complete right coracoid. ROM 18045.

Characters

Agrees with *Numenius* and differs from all other scolopacid genera by having (1) head extending only short distance anterior to shaft, and with dorsoventral length very large; (2) attachment of Lig. humero-coracoideum antierius superius very long, shallow, with only slight convexity distal to it; (3) internal edge of coracohumeral surface elevated; (4) internal excavation of head external to furcular facet shallow.

Differs from *N. phaeopus* (Linnaeus) by having (1) much smaller size; (2) head proportionately longer dorsoventrad, and extending less anteriad; (3) dorsal and anterior edge of head straight in external view.

Remarks

Although the specimen listed above probably represents *N. borealis*, it can be only tentatively referred to that species until a comparative specimen is examined. If the specimen does represent *N. borealis* it indicates a change in the distribution of this species in South America, as the winter range of this almost extinct species along the west coast of South America is from Arica, Chile, southward, and the migratory routes are poorly known.

Nuntius gen. nov.

Diagnosis

Coracoid agrees with that of all other genera of scolopacids by having (1) head elongated anteroposteriorly; (2) furcular facet long and wide, forming medial side of deep concavity underlying head; (3) procoracoid not perforated by coracoidal fenestra.

Coracoid differs from that of all other scolopacid genera by having (1) head approximately two-thirds as high as long in external view, with anterodorsal corner protruding farther anteriad than anteroventral corner, and dorsal edge essentially straight [length-height ratio similar or greater, with anteroventral corner protruding farther anteriad than anterodorsal corner, and dorsal edge convex in *Limnodromous griseus* (Gmelin)]; (2) head turned internally at anterior end (turned externally in *L. griseus*); (3) internal excavation of head deep (shallower in *L. griseus*); (4) coracohumeral surface short and narrow (longer and wider in *L. griseus*); (5) area between furcular facet and coracohumeral surface slightly convex, sloping slightly (moderately to strongly convex along dorsal half and essentially vertical in *L. griseus*); (6) angle between line drawn along glenoid facet and from ventral edge of glenoid facet to tip of external distal angle approximately 160° (approximately 170° in *L. griseus*); (7) glenoid facet narrow (wider in *L. griseus*); (8) procoracoid with short base, large anterior end and broad dorsal edge that does not dip below level of anterior corner of scapular facet (short base, small anterior end, and narrow dorsal end that dips below level of anterior corner of scapular facet in *L. griseus*); (9) sternocoracoidal impression very deep (moderately deep in *L. griseus*); (10) shaft moderately convex at anterior end of ridge leading along internal side of internal distal angle in internal view (slightly convex in *L. griseus*); (11) internal distal angle directed anteriad in internal view (directed more ventrad in *L. griseus*); (12) hyposternal process directed sharply internally (not turned as much internally in *L. griseus*); (13) sternal facet narrow, with tips of both internal and external distal angles projecting internally well beyond internal edge (wide, with both distal angles projecting only slightly, if at all, internally toward internal edge in *L. griseus*).

Type species

Nuntius solitarius sp. nov.

Etymology

Latin, *nuntius*, masculine, messenger.

Nuntius solitarius sp. nov.

Fig. 30D, G

Holotype

Complete right coracoid. ROM 13018.

Referred Material

One complete left tarsometatarsus. ROM 13020. The two specimens, including holotype, represent a minimum of one individual.

Diagnosis

As for genus. Measurements of the holotype are as follows: length, 16.7; head to scapular facet, 5.9; proximal depth, 4.6; least width of shaft, 2.1; sternal facet length, 5.6.

Characters

Tarsometatarsus with (1) intercondylar prominence of moderate width and very prominent (broad and moderately prominent in *L. griseus*); (2) hypotarsus long and broad, proximal end lying almost at level of internal cotyla (shorter and narrower, proximal end placed well distal to internal cotyla in *L. griseus*); (3) shaft narrows abruptly distal to condyles, widens slightly immediately distal to proximal foramina, and narrows markedly proximal to trochleae (narrows abruptly distal to condyles and then narrows gradually until it begins widening for trochleae in *L. griseus*); (4) trochleae spread (similar in *L. griseus*); (5) middle trochlea of moderate size (larger in *L. griseus* in specimen of same length); (6) anterior edge of internal trochlea lies anterior to midline of middle trochlea in internal view (lies posterior to midline in *L. griseus*); (7) trochlear grooves of middle and external trochlea narrow, with well-marked edges (broader and more rounded in *L. griseus*); (8) middle trochlea ends posteriorly elevated above shaft (merges with shaft in *L. griseus*); (9) trochlear surfaces of moderate length (longer in *L. griseus*); (10) metatarsal facet well marked (similar in *L. griseus*); (11) posterior projection of internal trochlea broad dorsoventrad and set off from rest of condyle by groove (narrower and not set off from rest of condyle in *L. griseus*); (12) distal third of shaft flattened anteroposteriad (not flattened in *L. griseus*). Length, 35.0; proximal width, 4.4; distal width, 4.3; least width of shaft, 1.6; width of middle trochlea, 1.4.

Etymology

Latin, *solitarius*, solitary.

Remarks

From the specimens on hand it is not possible to determine which genus within the

Scolopacidae is most closely related to *Nuntius*. *Nuntius* does not bear any close resemblance to any other scolopacid genus except *Limnodromus*, which it superficially resembles in size and general form. This superficial resemblance of *Nuntius* to *Limnodromus* is the reason why *L. griseus* was chosen to provide a reference point for the osteological characters of this new genus and species presented in the diagnosis. No close taxonomic or evolutionary relationship between *Nuntius* and *Limnodromus* is implied, and indeed, the two genera are quite different in numerous critical areas. For example, in the coracoid the shape and orientation of the head, the orientation of the glenoid facet, the shape of the procoracoid, and the size and position of the sternal articular facets are all quite different. These are the types of osteological differences that are to be expected between unrelated genera of different habits, and evolutionary history.

The tarsometatarsus is referred to *N. solitarius* because it also bears a close superficial resemblance to *L. griseus* and is of a similar size. It does not resemble *Tringa solitaria* sufficiently to warrant consideration as an element of *T. ameghini*.

Palnumenius victima L. Miller (1942) was described on the basis of a complete tarsometatarsus from the Upper Pleistocene of San Josecito Cave, Nuevo Leon, Mexico. *Palnumenius* was described as resembling *Numenius* more than any other scolopacid genus, and the tarsometatarsus of *P. victima* is slightly more than twice as large as the tarsometatarsus referred to *N. solitarius*. Additional characters of the tarsometatarsus referred to *N. solitarius* that distinguish it from that of *P. victima*, such as the more proximal position of the internal cotyla relative to the external cotyla, the presence of four hypotarsal ridges instead of three, and a smaller internal trochlea indicate that the two genera are quite different. If the tarsometatarsus referred to *N. solitarius* should prove to belong to another species, the large size of *Palnumenius* and its resemblance to *Numenius* would still indicate that *Palnumenius* and *Nuntius* are not congeneric.

Family Phalaropodidae Bonaparte

Femur with attachment of M. gastrocnemius, pars externa, elevated, lying on corner of shaft, and connected by ridge to base of fibular condyle.

Lobipes Cuvier *Lobipes lobatus* (Linnaeus) Northern Phalarope

Material

Two complete left humeri. ROM 18046–18047.

Characters

The humerus of *L. lobatus* is distinguished from humeri of other phalaropes by size, and from humeri of scolopacids of similar size by having (1) groove between capital shaft ridge and base of median crest very deep, undercutting head; (2) capital shaft ridge depressed, so that it curves anconally to meet base of head; (3) impression of M.

brachialis anticus deeply inset proximally and distally; (4) entepicondyle little produced.

Remarks

A North American migrant, *L. lobatus* occurs south on the Pacific coast of South America to Santiago, Chile.

Steganopus Vieillot
Steganopus tricolor (Vieillot)
Wilson's Phalarope

Material

Five complete right and 6 complete left coracoids, 8 complete right and 8 complete left humeri, proximal ends of 3 right and 2 left humeri, distal ends of 1 right and 3 left humeri, 3 complete right and 6 complete left carpometacarpi, proximal ends of 1 right and 2 left carpometacarpi, 1 complete left femur, distal ends of 6 right and 3 left tibiotarsi, 1 complete left tarsometatarsus, proximal ends of 3 right and 3 left tarsometatarsi, distal end of 1 left tarsometatarsus. ROM 18048–18112, 19559. The 66 specimens represent a minimum of 11 individuals.

Characters

Steganopus tricolor is the largest of the three species of phalaropes and can generally be easily separated on a size basis. In addition to size, *S. tricolor* is characterized by having coracoid with (1) shaft long and slender; (2) glenoid facet deeply concave; (3) anterior portion of head long and narrow; (4) coracohumeral surface long; (5) scapular facet elliptical.

Humerus with (1) proximal end narrow, and bicipital surface small; (2) attachment of *M. supracoracoideus* moderately long; (3) impression of *M. brachialis anticus* deeply inset on all sides and undercutting attachment of anterior articular ligament; (4) external condyle straight; (5) entepicondyle merging smoothly with shaft proximally, and curving slightly palmarly; (6) area between ectepicondyle and ectepicondylar prominence moderately to slightly concave.

Carpometacarpus with (1) external side of metacarpal I noticeably concave; (2) internal rim of carpal trochlea flattened posteriorly, distal end protruding farther posteriad than proximal end.

Femur with (1) head prominently elevated above shaft on all sides but dorsally, where it extends slightly above level of iliac facet; (2) shaft convex anteriorly; (3) attachment of *M. gastrocnemius*, pars externa, elevated, facing dorsad, and connected to base of fibular condyle by marked ridge; (4) pit at base of fibular condyle deep; (5) external condyle deep and short.

Tibiotarsus with (1) proximal end of external condyle joining shaft gradually; (2) tendinal groove curving slightly under internal condyle; (3) internal condyle of moderate size.

Tarsometatarsus with (1) shaft long and narrow; (2) proximal and distal ends laterally compressed; (3) hypotarsus high, narrow, and rectangular; (4) anterior face of shaft flat.

Remarks

A North American migrant, *S. tricolor* occurs all along the west coast of South America.

Steganopus graui sp. nov.

Fig. 31F

Holotype

Complete right femur. ROM 12896.

Diagnosis

Femur agrees with that of *Steganopus* and differs from that of *Lobipes* and *Phalaropus* Brisson by having (1) head small, with dorsal surface essentially flush with iliac facet (large, protruding well above iliac facet in *Lobipes* and *Phalaropus*); (2) shaft narrows rather abruptly distal to head in posterior view (narrows more gradually in *Lobipes* and *Phalaropus*); (3) trochanter narrow (slightly wider in *Lobipes* and *Phalaropus*); (4) shaft slender (slender in *Lobipes*, stout in *Phalaropus*); (5) attachment of M. gastrocnemius, pars externa, of moderate length, greatly elevated, with marked ridge leading to base of fibular condyle (long, moderately elevated, with moderate ridge, and located more on side of shaft in *Lobipes* and *Phalaropus*); (6) size large (small in *Lobipes* and *Phalaropus*).

Femur differs from that of *Steganopus tricolor* by having (1) head smaller, not extending as far proximad; (2) trochanter narrower, more concave on internal side; (3) shaft much more concave distal to anterior edge of iliac facet; (4) shaft more compressed laterally, less compressed anteroposteriad, with greater internal flexure at distal end; (5) internal and external condyles deep, with anterior end markedly elevated above shaft (of moderate depth, with anterior end slightly, if any, elevated above shaft in *S. tricolor*); (6) attachment of M. gastrocnemius, pars externa, more elevated, positioned more distally, with a larger ridge leading to base of fibular condyle. For measurements see Table 10.

Etymology

This species is named for Admiral Miguel Grau, Peruvian patriot and hero of the War of the Pacific with Chile.

Remarks

Steganopus graui is the first recorded palaeospecies of the family Phalaropodidae. The greater development of the attachment of M. gastrocnemius, pars externa, the greater lateral compression of the shaft, and the greater elevation of the condyles at their anteroproximal ends suggest that perhaps *S. graui* was a much stronger swimmer than *S. tricolor*.

Table 10 Measurements of the femur of *Steganopus graui* sp. nov., Recent *S. tricolor*, and *S. tricolor* from the Talara Tar Seeps (in mm).

		<i>Steganopus graui</i> sp. nov.	<i>Steganopus tricolor</i> Talara Tar Seeps	Recent
Femur				
Length	OR	21.6	23.4	20.7–23.5
	M	—	—	22.5
	n	1	1	3
Proximal Width	OR	3.5	4.1	3.2–3.9
	M	—	—	3.6
	n	1	1	3
Distal Width	OR	3.8	4.3	3.7–4.0
	M	—	—	3.8
	n	1	1	3
Least Width of Shaft	OR	1.3	1.9	1.4–1.5
	M	—	—	1.5
	n	1	1	3
Least Depth of Shaft	OR	1.7	2.0	1.5–1.6
	M	—	—	1.6
	n	1	1	3

Family Jacanidae (Stejneger)
Subfamily Jacaninae (Stejneger)

Jacana Brisson
Jacana spinosa (Linnaeus)
Jacana

Material

Distal end of 1 left humerus. ROM 18113.

Characters

Humerus with (1) ectepicondylar prominence well developed but small compared with other charadriiform species; (2) impression of M. brachialis anticus deep, undercutting attachment of anterior articular ligament; (3) entepicondyle produced.

Remarks

Jacana spinosa is resident in areas with abundant floating aquatic vegetation, and was recorded by Chapman (1926) as abundant along tropical lowlands of southern coastal Ecuador. Although the single specimen may represent a vagrant, it is probable that the range of the species previously extended farther south.

Family Burhinidae Mathews

Burhinus Illiger *Burhinus superciliaris* (Tschudi) Peruvian Thick-knee

Material

Three right and 2 left scapulae, 2 complete right and 2 complete left coracoids, humeral end of 1 left coracoid, proximal ends of 1 right and 4 left humeri, distal ends of 2 right humeri, distal ends of 1 right and 1 left radius, 2 complete right femora, distal ends of 3 right and 3 left tibiotarsi, proximal end of 1 right tarsometatarsus, distal end of 1 left tarsometatarsus. ROM 18114–18142. The 29 specimens represent a minimum of 4 individuals.

Remarks

Burhinus superciliaris is quite common all along the arid littoral of the Pacific coast of Peru, and it is also present on the Santa Elena Peninsula of Ecuador. A bird of dry areas with little ground cover, *B. superciliaris* is primarily nocturnal in habits, although I have seen them moving about during the day.

Family Thinocoridae (Gray)

Humerus with (1) attachment of external head of triceps very deep, undercutting head; (2) attachment of M. proscapulo humeralis brevis large, very prominent; (3) attachment of M. brachialis anticus extending under attachment of anterior articular ligament.

Thinocoridae gen. et sp. indet.

Material

Complete right coracoid. ROM 18143.

Characters

Coracoid with (1) procoracoid non-perforate (similar in *Thinocorus rumicivorus* Eschscholtz); (2) head long, anterodorsal corner rounded, and area ventral to attachment of Lig. humero-coracoideum antierius superius subangular, extending far ventrad (head longer, anterodorsal corner subangular, and ventral projection rectangular and longer anteroposteriad in *T. rumicivorus*); (3) head moderately high (very high and angular in *T. rumicivorus*); (4) internal excavation of head deep (moderate in *T. rumicivorus*); (5) external side of head concave ventral to dorsal end of coracohumeral surface (similar in *T. rumicivorus*); (6) internal edge of coracohumeral surface raised considerably above that surface (only slightly elevated in *T. rumicivorus*); (7) glenoid facet broad and rounded (broad and less rounded in *T. rumicivorus*); (8) posteroventral corner of scapular facet prominent (similar in *T.*

rumicivorus); (9) external surface of procoracoid markedly elevated above shaft (slightly elevated in *T. rumicivorus*); (10) sternal facet long and narrow (short and broad in *T. rumicivorus*); (11) external surface of shaft dorsal to external distal angle slightly concave (deeply concave in *T. rumicivorus*); (12) sterno-coracoidal impression moderately deep (deep in *T. rumicivorus*); (13) anterior edge of attachment of *M. supacoracoideus* marked by prominent ridge (small ridge in *T. rumicivorus*). Length, 21.4; head to scapular facet, 7.5; proximal depth, 5.6; least width of shaft, 2.4; length of sternal facet, 6.7.

Remarks

The specimen listed above resembles *Thinocorus* more than any other charadriiform genus available for comparison, particularly in the ventral projection of the anterior end of the head and the concavity on its external side. There are too many differences, however, between the fossil specimen and the humerus of *Thinocorus* for the two to be considered congeneric. No specimens of *Attagis* were available for comparison. Neither of the two living species of *Attagis* occurs on the coast of Peru today, although *A. gayi* Lesson occurs in the Andes from Ecuador southward. Until the specimen can be compared with *Attagis* its generic status must remain undetermined.

Thinocorus Eschscholtz
Thinocorus rumicivorus Eschscholtz
Least Seedsnipe

Material

One complete left humerus. ROM 18144

Characters

The single specimen of *T. rumicivorus* does not differ in any way from Recent specimens of the species examined, except for having a smaller size.

Remarks

Thinocorus rumicivorus is the smallest of the four living species of the family Thinoridae, and is the only one that occurs on the Pacific coast of South America today. *T. rumicivorus* is represented by five subspecies. The smallest, *T. r. pallidus*, which occurs on the Santa Elena Peninsula of southwestern Ecuador, was not available for comparison.

Thinocorus koepckeae sp. nov.
Fig. 31C

Holotype

Complete left humerus (internal tuberosity and bicipital crest broken). ROM 12893.

Diagnosis

Humerus agrees with that of *Thinocorus* by having (1) capital groove extremely deep, very deeply undercutting head.

Humerus differs from that of *T. rumicivorus* by having (1) head shorter but wider; (2) capital groove smaller; (3) attachment of *M. supracoracoideus* shorter, more shelflike; (4) capital shaft ridge straighter; (5) ligamental furrow more distinct, with deep, narrow distal extension; (6) concavity internal to attachment of *M. pectoralis superficialis* deeper; (7) attachment of *M. pectoralis superficialis* rotated less palmarly, located more on deltoid crest; (8) impression of *M. brachialis anticus* longer, extending proximad beyond proximal edge of ectepicondyle; (9) attachment of anterior articular ligament much smaller, as wide as long (much longer than wide in *T. rumicivorus*); (10) internal condyle narrower, extending farther distad than external condyle; (11) external condyle narrower, with proximal end not directed toward attachment of anterior articular ligament; (12) internal face of entepicondyle at very small angle to long axis of shaft (rotated approximately 45° to long axis of shaft in *T. rumicivorus*); (13) area proximal to entepicondylar prominence slightly concave (deeply concave in *T. rumicivorus*); (14) external side of ectepicondylar prominence slightly concave (deeply concave in *T. rumicivorus*); (15) posterior edge of ectepicondylar prominence straight, not bowing externally, and with slight palmar convexity (slightly concave in *T. rumicivorus*); (16) shaft much less sigmoid in external view; (17) shaft more slender. *Thinocorus koepckeae* is smaller than *T. rumicivorus* (see Table 11), and much smaller than *T. orbignyianus* (Lesson).

Table 11 Measurements of the humerus of *Thinocorus koepckeae* sp. nov., Recent *T. rumicivorus*, and *T. rumicivorus* from the Talara Tar Seeps (in mm).

		<i>Thinocorus koepckeae</i> sp. nov.	<i>Thinocorus rumicivorus</i> Talara Tar Seeps	Recent
Humerus				
Length	OR	23.6	24.5	28.8–34.1
	M	—	—	30.6
	n	1	1	3
Distal Width	OR	3.8	4.3	4.8–5.6
	M	—	—	5.1
	n	1	1	3
Least Depth of Shaft	OR	1.6	2.0	2.1–2.3
	M	—	—	2.2
	n	1	1	3
Depth of External Condyle	OR	2.5	2.8	3.1–3.5
	M	—	—	3.2
	n	1	1	3

Etymology

This species is named for the late Dr. Maria Koepcke, in recognition of her contributions to our knowledge of Peruvian ornithology.

Remarks

Although no specimens of *Attagis* were available for comparison, no differences between *T. koepckae* and *T. rumicivorus* were large enough to justify placing the two species in separate genera. *Thinocorus koepckae* is the first recorded palaeospecies of the family.

Suborder Lari Sharpe

Family Laridae Vigors

Subfamily Larinae (Vigors)

Larus Linnaeus
Larus atricilla Linnaeus
Laughing Gull

Material

Two premaxillaries, 1 right scapula, 2 complete right and 1 complete left coracoid, humeral end of 1 right coracoid, proximal ends of 2 right and 3 left humeri, distal ends of 6 right and 1 left humerus, 1 complete left carpometacarpus, proximal ends of 2 right and 1 left carpometacarpus, distal ends of 1 right and 1 left tibiotarsus, 2 complete left tarsometatarsi, proximal end of 1 right tarsometatarsus, distal ends of 3 left tarsometatarsi. ROM 18145–18175. The 31 specimens represent a minimum of 6 individuals.

Characters

Although considerable intraspecific size variation occurs in gulls, four of the nine species of gulls found in Peru are readily separated from the fossil specimens on a size basis, either because they are too large (*L. belcheri* Vigors, *L. dominicanus* Lichenstein, and *Creagrus furcatus* (Neboux)) or too small (*Xema sabini* Sabine). Of the remaining five species, *L. modestus* Tschudi, *L. cirrocephalus* Vieillot, and *L. serranus* Tschudi are rather distinctive and easily separated from the fossil material, but *L. atricilla* and *L. pipixcan* Wagler are very similar osteologically, and the usual intraspecific variation found in gulls makes their identification very difficult. *L. atricilla* tends to be larger than *L. pipixcan*, but the two species overlap broadly in size.

In comparison with *L. pipixcan*, *L. modestus*, *L. cirrocephalus*, and *L. serranus*, *L. atricilla* is characterized by having scapula with (1) coracoidal articulation of moderate size (similar in *L. modestus* and *L. cirrocephalus*; large in *L. serranus*; small in *L. pipixcan*); (2) glenoid facet long, narrow, and elliptical (short and triangular in *L. modestus*; long and triangular in *L. cirrocephalus*; long, notched, and elliptical in *L. serranus*; long, narrow, and elliptical, with very abrupt distal termination in *L. pipixcan*).

Coracoid with (1) anterior projection of head short (long in *L. modestus* and *L. cirrocephalus*; similar in *L. serranus*; short to long in *L. pipixcan*); (2) glenoid facet elliptical and of moderate width (wide and round in *L. modestus* and *L. serranus*; long, elliptical, and of moderate width in *L. cirrocephalus*; narrow elliptical to round in *L. pipixcan*); (3) concavity where M. biceps attaches moderate (deep in *L. modestus* and *L. serranus*; shallow in *L. cirrocephalus*, moderate in *L. pipixcan*); (4) anterior furcular facet elliptical and of moderate length (long and broad in *L. serranus*; of moderate length and rectangular in *L. pipixcan*); (5) attachment of Lig. humero-coracoideum anterius superius elliptical, deep, and narrow (large and round in *L. modestus* and *L. serranus*; short, deep, and narrow in *L. cirrocephalus*; small, round to long oval, and deep in *L. pipixcan*).

Humerus with (1) head large (large in *L. modestus*, *L. cirrocephalus*, and *L. serranus*; small in *L. pipixcan*); (2) capital groove wide and shallow (wide and deep in *L. modestus* and *L. cirrocephalus*; narrow in *L. serranus*; moderately wide and deep in *L. pipixcan*); (3) distal end laterally compressed with condyles of moderate size (broad, with side condyles in *L. modestus* and *L. cirrocephalus*; laterally compressed with large condyles in *L. serranus*; laterally compressed with small condyles in *L. pipixcan*); (4) intercondylar groove of moderate depth (very deep in *L. modestus*; deep in *L. cirrocephalus*, *L. serranus*, and *L. pipixcan*); (5) brachial depression deep (very deep in *L. modestus*, *L. cirrocephalus*, and *L. serranus*; of moderate depth in *L. pipixcan*); (6) ectepicondylar prominence large, projecting palmarly almost perpendicular to palmar surface (broader, but shorter, in *L. modestus*; larger in *L. cirrocephalus* and *L. serranus*; of moderate size and projecting palmarly at angle to palmar surface in *L. pipixcan*).

Carpometacarpus with (1) internal ligamental fossa deep (deep in *L. modestus*, *L. serranus*, and *L. pipixcan*; shallow in *L. cirrocephalus*); (2) metacarpal I long with moderately prominent process (short and thick, with prominent process in *L. modestus*; short, with moderately prominent process in *L. cirrocephalus* and *L. serranus*; moderate, with moderately prominent process in *L. pipixcan*); (3) groove in carpal trochlea moderately deep (deep in *L. modestus* and *L. serranus*; moderately deep in *L. cirrocephalus* and *L. pipixcan*); (4) external slant to internal carpal trochlea moderate (similar in *L. modestus*; less in *L. cirrocephalus*; greater in *L. serranus* and *L. pipixcan*); (5) shaft depth immediately posterior to pollical facet great (great in *L. modestus*; moderate in *L. cirrocephalus* and *L. serranus*; small in *L. pipixcan*).

Tibiotarsus with (1) condyles narrow and not well-rounded (wide external and narrow internal condyle in *L. modestus*; wide and rounded condyles in *L. cirrocephalus*; narrow external and wide internal condyle in *L. serranus*; narrow, well-rounded condyles in *L. pipixcan*); (2) anterior intercondylar fossa wide with internal condyle undercut internally (narrow in *L. modestus*; wide in *L. cirrocephalus*, *L. serranus*, and *L. pipixcan*); (3) external distal ligamental attachment shallow (deep, set in deep concavity in *L. modestus*; deep, not set in concavity in *L. cirrocephalus*; deep, set in poorly defined concavity in *L. serranus*; deep, set in moderate concavity in *L. pipixcan*); (4) notch in distal edge of internal condyle of moderate size (moderate size in *L. modestus*; deep in *L. cirrocephalus*, *L. serranus*, and *L. pipixcan*).

Tarsometatarsus with (1) cotylae very concave (similar in *L. modestus*; small degree of concavity in outer cotyla in *L. serranus* and *L. pipixcan*); (2) hypotarsus wide (similar in *L. modestus* and *L. serranus*; narrow in *L. pipixcan*); (3) trochleae

proportionately narrow, with pointed posterior termination of inner trochlea and shallow groove in external trochlea (inner trochlea narrow, and articular surface of outer trochlea with prominent dorsal projection in *L. modestus*; trochleae thick, with posterior projection of medial edge of inner trochlea small in *L. serranus*; middle trochlea large in *L. pipixcan*, with inner and outer trochleae not projecting posteriad as much as in *L. atricilla*, and a greater posteromedial slant to inner and outer trochleae than is found in *L. atricilla*). The tarsometatarsus of *L. cirrocephalus* is readily identified by incomplete fusion of middle and internal trochleae in the adult.

Remarks

A migrant to the coast of Peru, *L. atricilla* occasionally reaches as far south as Lima, but usually it does not go beyond the Gulf of Guayaquil. The presence of warm water apparently determines the southward range of this species along the west coast of South America (Murphy, 1936). In years when the warm northern current known as El Niño moves farther south than usual, the range of *L. atricilla* extends correspondingly. Primarily a coastal bird, *L. atricilla* occasionally occurs inland around bodies of water. Considering the current ranges and habitat preferences of *L. atricilla* and *L. pipixcan*, it appears that there are more specimens of *L. atricilla* in the fossil collection than would be expected under prevailing conditions, a possible indication of climatic changes.

Larus pipixcan Wagler Franklin's Gull

Material

One premaxillary, 3 right and 1 left quadrate, 3 right and 4 left scapulae, 3 complete right and 14 complete left coracoids, humeral ends of 4 right and 3 left coracoids, 1 complete right and 1 complete left humerus, proximal ends of 3 right and 4 left humeri, distal ends of 6 right and 4 left humeri, 4 complete right and 3 complete left carpometacarpi, proximal ends of 7 right and 2 left carpometacarpi, distal ends of 7 right and 6 left tibiotarsi, 1 complete right and 2 complete left tarsometatarsi, proximal ends of 2 right tarsometatarsi, distal ends of 6 right tarsometatarsi. ROM 18176–18270. The 95 specimens represent a minimum of 17 individuals.

Remarks

A North American migrant, *L. pipixcan* occurs in great numbers along the Peruvian coast, and also inland wherever there is sufficient food.

Order Columbiformes (Latham)
Suborder Columbidae Latham
Family Columbidae (Illiger)
Subfamily Columbinae (Illiger)

Zenaida Bonaparte
Zenaida auriculata (Des Murs)
Eared Dove

Material

Three left scapulae, 3 complete right and 7 complete left coracoids, humeral ends of 1 right and 1 left coracoid, 4 complete right and 2 complete left humeri, proximal end of 1 left humerus, distal ends of 2 right and 1 left humerus, 9 complete right and 3 complete left ulnae, proximal ends of 3 right and 1 left ulna, distal ends of 4 right and 2 left ulnae, 4 complete right and 2 complete left radii, 8 complete right and 8 complete left carpometacarpi, proximal ends of 1 right and 1 left carpometacarpus, distal end of 1 left carpometacarpus, 2 complete right and 2 complete left femora, proximal ends of 1 right and 1 left femur, distal end of 1 left femur, 5 complete left tibiotarsi, proximal end of 1 left tibiotarsus, distal ends of 1 right and 1 left tibiotarsus, 1 complete right and 5 complete left tarsometatarsi, proximal ends of 1 right and 2 left tarsometatarsi, distal ends of 2 right and 4 left tarsometatarsi. ROM 18271–18372. The 102 specimens represent a minimum of 13 individuals.

Characters

Zenaida auriculata differs considerably in numerous osteological characters from *Leptotila verreauxi* (Bonaparte), which is of similar size. Size is sufficient to distinguish it from all other species of doves from coastal Peru and southern Ecuador.

Remarks

Generally distributed throughout South America, *Z. auriculata* is very common in coastal Peru.

Zenaida asiatica (Linnaeus)
White-winged Dove

Material

One right scapula, 1 complete left coracoid, humeral end of 1 right coracoid, 1 complete right humerus, distal end of 1 right humerus, 1 complete left ulna, proximal end of 1 left carpometacarpus. ROM 18373–18379. The 7 specimens represent a minimum of 2 individuals.

Characters

Zenaida is readily distinguished from the genera *Columba* Linnaeus and *Geotrygon*

Gosse by many characters. *Z. asiatica* differs considerably from *Z. auriculata* in size, being a much larger and heavier-bodied bird.

Remarks

Zenaida asiatica is relatively common in South America from southwestern Ecuador down the coast to northern Chile.

***Columbina* Spix**
***Columbina talpacoti* (Temminck)**
Ruddy Gound Dove

Material

Two complete left coracoids, 1 complete right carpometacarpus. ROM 18380–18382. The 3 specimens represent a minimum of 2 individuals.

Remarks

The range of *C. talpacoti* in coastal northwestern Peru today is limited to those areas of the northernmost departments that have any amount of heavy vegetation. The habitat preferred by this species is apparently heavy brush, and the isolated specimens in the fossil material may indicate that heavy brush cover existed close to the fossil site. At the same time the small numbers may indicate that such cover was also not very close. The large number of specimens of *C. cruziana* (see below), which is the same size as *C. talpacoti*, would suggest that size was not a factor in preservation, but rather that the habitat in the vicinity of the site of deposition was not suitable to *C. talpacoti*.

***Columbina cruziana* (Knip & Pervost)**
Croaking Ground Dove

Material

Three left and 1 right scapula, 49 complete right and 39 complete left coracoids, humeral ends of 6 right and 4 left coracoids, 45 complete right and 56 complete left humeri, proximal ends of 12 right and 12 left humeri, distal ends of 10 right and 6 left humeri, 29 complete right and 23 complete left ulnae, proximal ends of 7 right and 6 left ulnae, distal ends of 6 right and 5 left ulnae, 8 complete right and 13 complete left radii, proximal ends of 4 right and 4 left radii, distal ends of 2 right and 3 left radii, 27 complete right and 29 complete left carpometacarpi, proximal ends of 3 right carpometacarpi, 16 complete right and 26 complete left femora, proximal ends of 8 right and 1 left femur, distal ends of 11 right and 4 left femora, 8 complete right and 10 complete left tibiotarsi, proximal ends of 7 right and 5 left tibiotarsi, distal ends of 14 right and 11 left tibiotarsi, 25 complete right and 26 complete left tarsometatarsi, proximal ends of 4 right and 2 left tarsometatarsi, distal ends of 4 right and 6 left tarsometatarsi. ROM 18383–18960, 19561–19574, 20676–20680. The 597 specimens represent a minimum of 68 individuals.

Characters

Columbina cruziana differs from *Claravis pretiosa* (Ferrari-Perez) (larger) and *Columbina minuta* (Linnaeus) (smaller) sufficiently in size so as to readily separate these three species. However, *C. cruziana* is essentially the same size as *C. talpacoti*, and they are very similar osteologically. No specimens of *C. t. buckleyi* were available, so the following comparisons with characters of *C. cruziana* are based on specimens of *C. t. rufipennis* from Panama.

Columbina cruziana differs from *C. talpacoti* by having scapula with (1) acromion smaller and more rounded; (2) glenoid facet smaller, with dorsal edge more set off from shaft; (3) anteromedial edge between glenoid facet and acromion straighter, less rounded.

Coracoid with (1) procoracoid much smaller.

Humerus with (1) head rotated more anconally and of less depth; (2) capital groove narrower, but deeper, cutting more into head; (3) impression of *M. brachialis anticus* deeper, undercutting a more elevated attachment of anterior articular ligament; (4) entepicondyle rotated slightly anconally.

Ulna with (1) olecranon smaller; (2) external cotyla smaller; (3) intercotylar area lacking a high ridge.

Radius with (1) bicipital tubercle larger; (2) capital tuberosity more pointed; (3) palmar surface of shaft at distal end more rounded.

Carpometacarpus with (1) groove separating metacarpal II and metacarpal III under carpal trochlea deep; (2) internal face proximal to pisiform process much more excavated.

Femur with (1) attachment of *M. gastrocnemius*, pars externa, large and elongated, positioned anteriorly (small, oval, situated on posterior side of shaft in *C. talpacoti*); (2) posterior end of external condyle extending less dorsad; (3) opening between base of internal condyle and ridge leading toward center of shaft posteriorly lacking.

Tibiotarsus with (1) rotular crest lower; (2) outer cnemial crest rotated less proximad; (3) external condyle of greater depth.

Tarsometatarsus with (1) external cotyla better developed; (2) proximal third of internal edge of shaft very angular, and middle third flat, the transition effected by passing of angular edge posteriad (in *C. talpacoti* the proximal third may not be as angular, and the edge does not pass posteriad, giving a more rounded edge to the middle third of shaft); (3) ridge leading from metatarsal facet to base of internal trochlea much larger.

Remarks

Columbina cruziana is very common from coastal Ecuador to the coast of northern Chile, often occurring in large flocks.

Order Psittaciformes (Wagler)
Family Psittacidae (Illiger)
Subfamily Psittacinae (Illiger)

Forpus Boie
Forpus coelestis (Lesson)
Pacific Parrotlet

Material

One complete left humerus. ROM 18961.

Remarks

The smallest parrotlet in northwestern Peru, *F. coelestis* is relatively common throughout its range. As an arboreal species that lives throughout the year in areas with little or no water, its occurrence in the fossil material must be regarded as a fortunate accident.

Order Strigiformes (Wagler)
Family Tytonidae Ridgway

Tyto Billberg
Tyto alba (Scopoli)
Barn Owl

Material

Five right and 8 left scapulae, 8 complete right and 1 complete left coracoid, distal end of 1 right humerus, 1 complete right ulna, proximal end of 1 left ulna, distal ends of 4 left ulnae, proximal ends of 2 right radii, distal ends of 2 right radii, 2 complete left carpometacarpi, proximal end of 1 right carpometacarpus, distal ends of 2 left carpometacarpi, 1 complete right and 1 complete left femur, proximal ends of 4 right and 2 left femora, proximal end of 1 right tibiotarsus, distal ends of 7 right and 8 left tibiotarsi, 2 complete right and 2 complete left tarsometatarsi, proximal ends of 5 right and 4 left tarsometatarsi, shaft of 1 left tarsometatarsus, distal ends of 4 right and 3 left tarsometatarsi. ROM 18962–19044. The 83 specimens represent a minimum of 8 individuals.

Remarks

Tyto alba is generally, but often locally, distributed throughout South America.

Family Strigidae (Vigors)
Subfamily Buboninae (Vigors)

Bubo Dumeril
***Bubo virginianus* (Gmelin)**
Great Horned Owl

Material

One premaxillary, 1 mandibular symphysis, 1 right articular, 3 right and 3 left scapulae, 2 complete left coracoids, humeral ends of 2 right and 2 left coracoids, sternal ends of 1 right and 1 left coracoid, distal ends of 4 right and 3 left humeri, proximal end of 1 right ulna, distal ends of 2 right and 3 left ulnae, proximal ends of 3 right and 3 left radii, distal ends of 1 right and 4 left radii, 3 complete right and 1 complete left carpometacarpus, proximal ends of 3 right and 1 left carpometacarpus, distal ends of 1 right and 1 left carpometacarpus, 3 complete right and 4 complete left femora, proximal ends of 2 right and 4 left femora, distal ends of 1 right and 1 left femur, proximal ends of 2 left tibiotarsi, distal ends of 5 right and 4 left tibiotarsi, 3 complete right and 6 complete left tarsometatarsi, proximal ends of 4 right and 4 left tarsometatarsi, distal ends of 3 right and 5 left tarsometatarsi, shaft of 1 tarsometatarsus. ROM 19045–19099, 19450–19495, 19546–19547. The 103 specimens represent a minimum of 11 individuals.

Remarks

Generally, although often locally, distributed throughout South America, *B. virginianus* is uncommon in coastal Peru. This species does, however, increase in numbers on the western slopes of the Andes in northern Peru.

Speotyto Gloger
***Speotyto cunicularia* (Molina)**
Burrowing Owl

Material

One complete right and 1 complete left coracoid, proximal end of 1 left carpometacarpus, 1 complete left femur, proximal end of 1 left tibiotarsus, distal end of 1 left tibiotarsus. ROM 19496–19501. The 6 specimens represent a minimum of 1 individual.

Remarks

Generally distributed throughout South America, *S. cunicularia* is very common in coastal Peru today.

Subfamily Striginae (Vigors)

Asio Brisson *Asio flammeus* (Pontoppidan) Short-eared Owl

Material

One mandibular symphysis, 1 right scapula, 2 complete right coracoids, 1 complete left femur, distal end of 1 right tibiotarsus, 2 complete left tarsometatarsi, proximal ends of 2 right tarsometatarsi, distal ends of 2 right tarsometatarsi. ROM 19502–19513. The 12 specimens represent a minimum of 2 individuals.

Remarks

Generally distributed in open areas throughout South America, *A. flammeus* occurs in northwestern Peru today, although not in large numbers.

Order Caprimulgiformes (Ridgway)

Suborder Caprimulgi Ridgway

Family Caprimulgidae Vigors

Chordeiles Swainson *Chordeiles acutipennis* (Hermann) Lesser Nighthawk

Material

One left scapula, 1 complete right and 1 complete left coracoid, distal end of 1 right humerus, 1 complete right and 1 complete left carpometacarpus. ROM 19514–19519. The 6 specimens represent a minimum of 1 individual.

Characters

In addition to its larger size, *C. acutipennis* differs from *C. minor* (Forster) by having scapula with (1) acromion smaller, projecting less anteriorly; (2) concavity between distal end of glenoid facet and ventral edge of shaft slightly deeper.

Coracoid with (1) head shorter, more rounded, and wider; (2) attachments for M. coracobrachialis anterior and Lig. humero-coracoideum anterior superior smaller and shallower.

Humerus with (1) attachment of anterior articular ligament less elevated; (2) curvature of shaft in region of attachment of M. gastrocnemius, pars externa, greater, resulting in ectepicondylar prominence appearing more produced; (3) concavity in proximal side of ectepicondyle greater.

Carpometacarpus with (1) process of metacarpal I shorter and slightly curved; (2) area immediately posterior to pisiform process more excavated; (3) external side of metacarpal I more concave; (4) internal ligamental fossa much deeper.

Remarks

Chordeiles acutipennis is common in river valleys of coastal Peru.

Caprimulgus Linnaeus *Caprimulgus piurensis* sp. nov.

Fig. 31D, E

Holotype

Complete left coracoid. ROM 12894.

Referred material

Proximal end and shaft of one right carpometacarpus. ROM 12895.

Diagnosis

Coracoid agrees with that of *Caprimulgus* and differs from that of *Chordeiles*, *Nyctidromus* Gould, *Nyctiphrynus* Bonaparte, and *Hydropsalis* Wagler by having (1) head projecting moderately beyond anterior edge of shaft; (2) brachial tuberosity small. The remaining six genera of South American caprimulgids were unavailable for comparison.

Coracoid differs from that of *Caprimulgus longirostris* Bonaparte and *C. parvulus* Gould, the only species of the genus occurring today in southwestern Ecuador and northwestern Peru, and from *C. cayennensis* Gmelin, the only other small South American species of the genus available, by having (1) head narrow, and anterior projection small (narrow with much larger anterior projection in *C. longirostris*, wide with much larger anterior projection in *C. cayennensis*, wide with larger anterior projection in *C. parvulus*); (2) angle between furcular facet and triosseal canal approximately 125° (approximately 125° in *C. longirostris*, 135° in *C. cayennensis*, and 115° in *C. parvulus*); (3) attachment of M. coracobrachialis of moderate depth, separated anteriorly from attachment of Lig. humero-coracoideum anterius superius by a high ridge (attachment shallow, ridge very small in *C. longirostris* and *C. parvulus*; attachment of moderate depth, ridge of moderate size in *C. cayennensis*); (4) attachment of Lig. humero-coracoideum anterius superius deep, consisting of deep dorsal and moderately deep ventral part separated from each other by high ridge (shallow and of one part in *C. longirostris*, deep and of one part in *C. cayennensis*, moderately deep and of one part in *C. parvulus*); (5) brachial tuberosity undercut by deep concavity (deep in *C. longirostris* and *C. cayennensis*, moderate in *C. parvulus*). For measurements see Table 12.

Characters

Carpometacarpus with (1) process of metacarpal I long through base (short in *C. longirostris*, *C. cayennensis*, and *C. parvulus*); (2) external side of metacarpal I deeply concave (similar in *C. cayennensis*, less concave in *C. longirostris* and *C. parvulus*); (3) external ligamental attachment long (short in *C. longirostris*, *C. cayennensis*, and *C. parvulus*); (4) fusion of metacarpal II and metacarpal III long and deeply excavated in internal view (similar in *C. cayennensis*, shorter and less

Table 12 Measurements of the coracoid and carpometacarpus of *Caprimulgus piurensis* sp. nov., *C. cayennensis*, *C. longirostris*, and *C. parvulus* (in mm).

		<i>Caprimulgus piurensis</i> sp. nov.	<i>Caprimulgus cayennensis</i>	<i>Caprimulgus longirostris</i>	<i>Caprimulgus parvulus</i>
Coracoid					
Length	OR	14.1	14.3–14.8	15.0	14.5–14.9
	M	—	14.6	—	14.6
	n	1	2	1	4
Head to	OR	4.3	4.7–5.0	4.6	4.8–5.1
Scapular	M	—	4.8	—	4.9
Facet	n	1	2	1	4
Proximal	OR	2.8	2.9–3.0	3.1	2.9–3.2
Depth	M	—	3.0	—	3.0
	n	1	2	1	4
Least	OR	1.4	1.3–1.4	1.4	1.3–1.5
Depth of	M	—	1.4	—	1.4
	n	1	2	1	4
Carpometacarpus					
Proximal	OR	2.7	2.3–2.5	2.4	2.3–2.6
Width	M	—	2.4	—	2.4
	n	1	2	1	4
Height	OR	5.3	5.0–5.4	5.1	5.2–5.4
Through	M	—	5.2	—	5.2
Metacarpal I	n	1	2	1	4

excavated in *C. longirostris* and *C. parvulus*); (5) proximal end of metacarpal III wide and flat (narrow and rounded in *C. longirostris* and *C. cayennensis*, narrow and flat in *C. parvulus*); (6) shaft very robust (slender in *C. longirostris*, *C. cayennensis*, and *C. parvulus*); (7) tendinal groove wide (similar in *C. cayennensis*, narrow in *C. longirostris* and *C. parvulus*).

Etymology

This species is named for the Departamento de Piura, within the borders of which lie the Talara Tar Seeps.

Remarks

Caprimulgus piurensis is the first recorded palaeospecies of the family Caprimulgidae. It appears more similar to *C. cayennensis* than to either *C. longirostris* or *C. parvulus*. Although five species of similar size (*C. maculicaudus*, *C. maculosus*, *C. nigrescens*, *C. whiteleyi*, and *C. hirundinaceus*) were not available for comparison, current distribution and habitat preferences of those five make it very unlikely that *C. piurensis* represents any of them.

Discussion and Conclusions

Ecology

From the northern limit of the Santa Elena Peninsula of southwestern Ecuador (approximately 2°S) to Coquimbo in central Chile (30°S) the western coast of South America is essentially an unbroken 3300-km strip of desert. The desert is delimited on the west by the Pacific Ocean and on the east by the Andes Mountains. The only interruption in the long desert between the two points mentioned above is the forested coastal area along the eastern side of the Gulf of Guayaquil.

Variation in local orographic conditions and distances from the coast permit slight variations in precipitation amounts and cloud cover, and a corresponding variation in vegetation. Following the Holdridge (1967) system of life zone ecology, Tosi (1960) divided the coastal desert into a western subtropical desert and an eastern tropical scrub desert, with local patches of differing vegetation found in both major zones. Zonation at the borders of the desert, both horizontally at the northern and southern ends and vertically up the western slopes of the Andes, is abrupt. For example, along the southern edge of the Gulf of Guayaquil mean annual rainfall at Zorritos is about 25 cm while only 100 km southwest at Lobitas it is less than 5 cm. The vegetation cover decreases correspondingly.

La Brea, Peru, the site of the Talara Tar Seeps, lies approximately two-thirds the distance from the nearest point on the coast to the mountains (see Fig. 1), and on Tosi's map (Tosi, 1960) it falls on the dividing line between the subtropical desert and the tropical scrub desert. While there is some vegetation present at the site it consists only of scattered thorn shrubs and epiphytes.

In northern coastal Peru during the local summer, which lasts from September 21 to March 23, the skies are clear with few clouds and little precipitation, except in years when a climatic phenomenon known as El Niño appears. Heavy rains may then fall and temporary streams and ponds or small lakes may form. Winds are usually strong, hot, and very dry during this season. During the local winter, which lasts from March 23 to September 21, there exists a heavy cloud cover, or *garúa*, near the coast and reaching variable distances inland, usually to the mountains when they are near the coast. At this time light mists may occasionally prevail near the coast, but inland no precipitation occurs except well up the western slopes of the mountains. Winds are strong, cooler than in summer, and have a higher relative humidity at this time.

Recent Avifauna

No thorough analysis of the avifauna of northwestern Peru has ever been done. The work of Marchant (1958, 1959, 1960) on the avifauna of the Santa Elena Peninsula of Ecuador gives the most comprehensive list of birds to be expected in northwestern Peru because the two areas show a very high correlation between their avifaunas. Although Chapman (1926) did not discuss this area of Peru, his comments on the avifauna of the arid region of Ecuador also pertain in part to the avifauna of northwestern Peru, particularly that area north of the Sechuran Desert.

Basically the modern avifauna consists of two groups of species, specific examples of which are listed in the following section on palaeoecology. One group comprises species adapted to the arid habitat, and most are representative of what Chapman

(1926) termed the Equatorial Arid Fauna, which is found in portions of both Ecuador and Peru.

The second group comprises opportunistic species that are able to live for short periods of time in the arid regions when there has been a sufficient amount of precipitation. Within this group are those species living in habitats adjoining the arid regions that extend their range, especially along river courses, during those summers when a short heavy rain may cause an increase in the desert vegetation. If the rains are sufficiently heavy and of sufficient duration these species may be able to breed in an area from which they are normally excluded. They are, however, forced to contract their ranges when the desert resumes its normal arid state.

Transient, or migrating, species and wandering individuals of wide-ranging species are also found in this second group. These species may temporarily stop to feed while the desert vegetation is abundant after rains, or to take advantage of temporary ponds or streams that may form. If the summer rains occur, they come during the northern hemisphere winter. North American migrant species are thus very likely to find and stay at these temporary bodies of water. Water being the powerful attractant that it is in a desert, most of the wandering individuals of local species will represent such groups as herons, ibises, ducks, shorebirds, cormorants and coots. Marchant (1958) listed numerous species attracted to the arid Santa Elena Peninsula after a man-made dam created a lake.

Palaeoecology

Earlier work on various faunal components of the Talara Tar Seeps (Churcher, 1959, 1962, 1965, 1966; Churcher and van Zyll de Jong, 1965; Lemon and Churcher, 1961) all indicate that at the time of deposition of the fossils the region was much more hospitable to a greater variety of animals than at present. Vertebrate remains other than of birds include those of a frog, crocodilians, tortoises, armadillos, ground sloths, bats, skunks, canids, felids, mastodonts, horses, deer, camelids, and rodents. The insect fauna contains several families of coleopterans, lepidopterans, and orthopterans, with aquatic forms a leading element. The molluscan fauna includes a freshwater pulmonate.

The palaeoavifauna can be broken into several component groups with each group analyzed for its role in the interpretation of the site. First, a few species are well adapted to arid conditions. These include *Burhinus superciliaris*, *Thinocorus rumicivorus*, *Columbina cruziana*, and *Forpus coelestis*. Although these species suggest the presence of nearby arid or semi-arid habitats, almost all may be found in cultivated areas and oases within arid zones today. This suggests that while these species may be arid-adapted forms, they are not bound to that habitat but do wander into savanna habitats. This might be particularly true during dry seasons when vegetation cover decreases. These species would not be expected to occur in heavily forested areas as they are all open ground species, with the exception of *F. coelestis*.

A second group consists of wide-ranging species that may colonize suitable habitats over long distances for short periods of time. Examples of such species would include all northern hemisphere migrants, *Jabiru mycteria*, *Anas bahamensis*, the condors and vultures, and *Polyborus plancus*. All of these species can cover large distances in short periods of time and could be expected in any suitable habitat, no matter how limited in size, anywhere they could range.

A third group consists of savanna or open woodland species that are also found in sparsely vegetated semi-arid habitats. Examples of these species include *Geranoaetus melanoleucus*, *Buteo polyosoma*, *Parabuteo unicinctus*, *Zenaida auriculata*, *Speotyto cunicularia*, and *Asio flammeus*. While individuals of these species may occasionally wander into arid zones, or even nest there, as does *S. cunicularia*, they prefer at least a small to moderate vegetation cover. Most of these species are quite common today in the transition zone that extends from the forested slopes of the Andes to the barren coastal desert that is without any vegetation.

A fourth group consists of those species found only in forested or heavy scrub habitats. Examples of these species would include *Crypturellus transfasciatus*, *Dendrocygna autumnalis*, *Cairina moschata*, and *Penelope purpurascens*. These species require at least a heavy scrub or riparian forest within their range. *D. autumnalis* and *C. moschata* also require the presence of suitable amounts of water.

A fifth group consists of those species that require substantial bodies of water, either as lakes, streams, or swamps. In addition to migrating or wide-ranging species that also fall into this group because of their attraction for water, there are included the grebes, a number of ardeids, and *Porzana carolina*.

Many species are not easily assigned to a specific category and some of those listed above as examples of one category may also be considered in another. Nevertheless, when all groups are considered together the overwhelming evidence is that northwestern Peru was considerably wetter during the period of entrapment of the fauna, and the habitat was probably that of a savanna woodland, or savanna with extensive riparian forests. This is also the conclusion reached by considering the fossil mammals and insects from the deposit. Archeological work (Richardson, 1973) also supports the idea that there has been a considerable change in the climate of the region.

Perhaps the best indicator that the habitat of northwestern Peru has changed considerably as a result of climatic change, rather than slightly or not at all, is the very high number of extinct species, comprising at least 23 per cent of the non-passerine portion of the avifauna. Some of the species probably became extinct, as did similar species at Rancho La Brea, California, because their primary food source of large land mammals also became extinct. Examples of such species are the condors and large eagles.

More important, however, are the supposedly non-migratory extinct ardeiform (3), anseriform (4), and charadriiform (3?) species that comprise at least half of the known extinct portion of the avifauna. What this suggests is that these species adapted to a specific habitat during the Wisconsin glaciation, and once this habitat began to disappear there was no alternative place for the species to survive. Being non-migratory these species could not have moved elsewhere to survive, and once their habitat had deteriorated past a certain point their fate was sealed. To the south there existed only the desert conditions found today; to the north the humid forests of Ecuador would not provide suitable habitat for savanna or aquatic species, and neither would the mountains to the east.

Although savanna or thorn scrub habitat does exist between the arid and humid habitats in this area today, the zonation is so abrupt that the total area is too small to support a varied avifauna, especially those species that require permanent or semipermanent bodies of water for feeding and breeding.

The causes of the present-day climate, as opposed to the wetter climate present during glacial periods, are the subject of another paper that is in preparation.

Dating Some Extinct Species

It was suggested earlier that a deteriorating habitat at the end of the Wisconsin brought about the extinction of certain species thought to be endemic to the area, i.e., the ducks, herons, ibises, and lapwings. If these species became extinct at the end of the Wisconsin when the climate changed, they could not have lived in the area prior to the onset of the glaciation and the formation of the savanna woodland habitat. During the Sangamon interglacial the area would have been desert, as it is now. The question then becomes whether or not the now extinct species came into the area as distinct species from another region, or whether they speciated *in situ*.

Speciation *in situ* means that the species would have evolved and become extinct within a period of less than 50,000 years, if one considers the onset of the Wisconsin glaciation to be 60,000 to 70,000 years ago and the age of the deposit to be 14,000 years B.P. (Churcher, 1966). Knowing what we do of the rate of divergence within certain species common to southwestern Ecuador and northwestern Peru since the end of the Wisconsin, a figure of 50,000 years is not inconceivable as sufficient time for the formation of a distinct species. Dunn (1974) makes a similar observation by citing the post-Pleistocene speciation patterns within the Irenidae. Selander (1971) suggests that speciation can occur even more rapidly than suggested above, particularly when new habitats appear, as would be the case here. Additionally, the work on rates of speciation of *Passer domesticus* in North America (Johnston and Selander, 1964, 1971; Selander and Johnston, 1967); the work of Häffer (1967, 1974) on speciation of neotropical birds; and the work of Müller (1973) on neotropical dispersal centers all present evidence of subspeciation occurring over very short periods of time.

Comparison of Avifaunas of Talara Tar Seeps and Rancho La Brea

Howard (1962) summarized the known avifauna from Rancho La Brea, and from her list the following comparison can be drawn. At least 98 non-passerine and 35 passerine species are known from Rancho La Brea, of which 19 species, or approximately 14 per cent (17 per cent of the non-passerines) are extinct. From the Talara Tar Seeps, 89 non-passerine species are known, of which at least 21, or approximately 23 per cent, are extinct. When the passerine component of the Talara avifauna is completely studied, and the identity of the few questionable non-passerine species is resolved, the final total of species from that locality may exceed that known from Rancho La Brea, and the percentage of extinct species should remain higher.

At least 16 species of non-passerines are common to the two faunas, most of which are wide-ranging accipitriform and ardeiform species, or northern hemisphere species that migrate to South America during the winter. The woodpeckers are the only group found in significant numbers at Rancho La Brea and not found at all in the Talara Tar Seeps. Whether this means there were no stands of forest in the immediate vicinity of the tar seeps, or that their remains simply have not been found yet is not known. Because remains of large tree limbs have been found in the matrix, the latter is probably the most likely explanation.

Correlation of Talara Tar Seeps with La Carolina, Ecuador

Lemon and Churcher (1961) argued that the Talaran faunas are younger than those of the Carolinian of Ecuador, and that the two faunas cannot be of equal age, nor can the Talaran faunas be older than the Carolinian faunas. Edmund (1965) stated that the Carolinian deposits are certainly very late Pleistocene.

Of the 89 non-passerine species recorded from the Talara Tar Seeps, 38 (43%) were also recorded from La Carolina; see Table 1 (Campbell, 1976). This includes seven extinct species described in this paper. In terms of specimens, the sample size of the La Carolina avifauna is approximately 25 per cent of that from the Talara Tar Seeps, and 44 per cent of the La Carolina avifauna is comprised of one species of parrot. If the sample size from La Carolina were greater it is probable that there would be an even greater correspondence between the two sites.

As I stated earlier (Campbell, 1976), the high degree of similarity between the two localities strongly suggests that there was a great deal of interchange between the two localities. It is not unreasonable to assume that the two local avifaunas were only portions of what would be considered today to be a single avifauna, occupying a unique, but continuous, widespread habitat. The mammalian faunas also demonstrate the same high degree of similarity between the two sites (Lemon and Churcher, 1961).

If the Carolinian is older than the Talaran, but still of approximately the same age as indicated by the similar faunas, it can be dated as late Sangamon or early Wisconsin. This would place it prior to the establishment of extensive forests in western Ecuador during the Wisconsin. However, the presence of three extinct species of ducks in the La Carolina avifauna that I believe speciated *in situ* would require me to argue that a late Sangamon or early Wisconsin age is too old for the site.

If the Carolinian is post-Wisconsin the deposits may have been formed early, prior to the establishment of desert conditions and the extinction of the large land mammals. I base this on the presence of the extinct species, and also on the large number of parrots in the La Carolina deposits. The similarity between the two faunas leads one to believe that deposition at the two sites was contemporaneous, although deposition at La Carolina possibly began later and lasted longer into the post-Wisconsin than did deposition at the Talara Tar Seeps. It is possible, of course, that some of the Carolina deposits are pre- or early-Wisconsin and others are late- or post-Wisconsin.

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- Fig. 6 A(i)–(iii) Holotype left coracoid of *Syrigma sanctimartini* sp. nov., in anterior, lateral, and posterior view, ROM 12892, $\times 1$.
B(i)–(iv) Holotype coracoid of *Theristicus wetmorei* sp. nov., in anterior, lateral, posterior, and posteromedial view, ROM 12890, $\times 1$.
C(i), (ii) Proximal end of right humerus of *Theristicus wetmorei* sp. nov., in anconal and palmar view, ROM 12891, $\times 1$.

A(i)

(ii)

(iii)

B(i)

(ii)

(iii)

(iv)

C(i)

(ii)

- Fig. 7 A(i), (ii) Right scapula of *Eudocimus peruvianus* sp. nov., in external and internal view, ROM 12919, $\times 1$.
- B(i), (ii) Proximal end of left radius of *Eudocimus peruvianus* sp. nov., in palmar and anconal view, ROM 12921, $\times 1$.
- C(i)–(iii) Left femur of *Eudocimus peruvianus* sp. nov., in anterior, external, and posterior view, ROM 12923, $\times 1$.
- D(i)–(iii) Holotype left tarsometatarsus of *Eudocimus peruvianus* sp. nov., in anterior, external, and posterior view, ROM 12917, $\times 1$.
- E(i), (ii) Distal end of left humerus of *Eudocimus peruvianus* sp. nov., in anconal and palmar view, ROM 12920, $\times 1$.
- F(i), (ii) Distal end of right tibiotarsus of *Eudocimus peruvianus* sp. nov., in anterior and posterior view, ROM 12926, $\times 1$.

A(i)

(ii)

B(i)

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C(i)

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E(i)

(ii)

D(i)

(ii)

(iii)

F(i)

(ii)

- Fig. 8 A(i), (ii) Holotype right humerus of *Nannonetta invisitata* gen. et sp. nov., in anconal and palmar view, ROM 13689, $\times 1$.
B(i), (ii) Holotype left humerus of *Anas amotape* sp. nov., in anconal and palmar view, ROM 12927, $\times 1$.
C(i), (ii) Holotype left humerus of *Anas talarae* sp. nov., in anconal and palmar view, ROM 12904, $\times 1$.
D(i), (ii) Holotype left humerus of *Anas sanctaehelenae* sp. nov., in anconal and palmar view, uncatalogued, $\times 1$.
E(i), (ii) Left scapula of *Nannonetta invisitata* gen. et sp. nov., in external and internal view, ROM 13717, $\times 1$.
F(i), (ii) Right scapula of *Anas talarae* sp. nov., in external and internal view, ROM 12905, $\times 1$.
G(i), (ii) Left scapula of *Anas amotape* sp. nov., in external and internal view, ROM 12935, $\times 1$.

A(i)

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B(i)

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C(i)

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D(i)

(ii)

E(i)

F(i)

G(i)

(ii)

(ii)

(ii)

- Fig. 9 A(i), (ii) Right coracoid of *Nannonetta invistata* gen. et sp. nov., in anterior and posterior view, ROM 13721, $\times 1$.
- B(i), (ii) Right coracoid of *Anas talarae* sp. nov., in anterior and posterior view, ROM 12906, $\times 1$.
- C(i), (ii) Left coracoid of *Anas amotape* sp. nov., in anterior and posterior view, ROM 12938, $\times 1$.
- D(i), (ii) Left coracoid of *Anas sanctaehelenae* sp. nov., in anterior and posterior view, ROM 12901, $\times 1$.
- E(i), (ii) Left radius of *Nannonetta invisitata* gen. et sp. nov., in palmar and anconal view, ROM 13762, $\times 1$.
- F(i), (ii) Proximal end of right radius of *Anas talarae* sp. nov., in palmar and anconal view, ROM 12911, $\times 1$.
- G(i), (ii) Distal end of right radius of *Anas talarae* sp. nov., in palmar and anconal view, ROM 12912, $\times 1$.
- H(i), (ii) Proximal end of left radius of *Anas amotape* sp. nov., in palmar and anconal view, ROM 12943, $\times 1$.

A(i)

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B(i)

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C(i)

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D(i)

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E(i)

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F(i)

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G(i)

(ii)

H(i)

(ii)

- Fig. 10 A(i), (ii) Right ulna of *Nannonetta invisitata* gen. et sp. nov., in palmar and anconal view, ROM 13739, $\times 1$.
B(i), (ii) Right ulna of *Anas talarae* sp. nov., in palmar and anconal view, ROM 12908, $\times 1$.
C(i), (ii) Right ulna of *Anas amotape* sp. nov., in palmar and anconal view, ROM 12942, $\times 1$.
D(i), (ii) Left carpometacarpus of *Nannonetta invisitata* gen. et sp. nov., in internal and external view, ROM 13771, $\times 1$.
E(i), (ii) Left carpometacarpus of *Anas amotape* sp. nov., in internal and external view, ROM 12945, $\times 1$.
F(i), (ii) Proximal end of right carpometacarpus of *Anas talarae* sp. nov., in internal and external view, ROM 12913, $\times 1$.
G(i)–(iii) Right femur of *Nannonetta invisitata* gen. et sp. nov., in anterior, external, and posterior view, ROM 13781, $\times 1$.
H(i)–(iii) Right femur of *Anas amotape* sp. nov., in anterior, external, and posterior view, ROM 12948, $\times 1$.

A(i)

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B(i)

(ii)

C(i)

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D(i)

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E(i)

(ii)

F(i)

(ii)

G(i)

(ii)

(iii)

H(i)

(ii)

(iii)

- Fig. 11 A(i), (ii) Left tibiotarsus of *Nannonetta invisitata* gen. et sp. nov., in anterior and posterior view, ROM 13786, $\times 1$.
B(i), (ii) Distal end of right tibiotarsus of *Anas amotape* sp. nov., in anterior and posterior view, ROM 12949, $\times 1$.
C(i), (ii) Distal end of right tibiotarsus of *Anas talarae* sp. nov., in anterior and posterior view, ROM 12914, $\times 1$.
D(i), (ii) Distal end of left tibiotarsus of *Anas sanctaehelenae* sp. nov., in anterior and posterior view, ROM 12902, $\times 1$.
E(i), (ii) Left tarsometatarsus of *Nannonetta invisitata* gen. et sp. nov., in anterior and posterior view, ROM 13795, $\times 1$.
F(i), (ii) Left tarsometatarsus of *Anas amotape* sp. nov., in anterior and posterior view, ROM 12955, $\times 1$.
G(i), (ii) Right tarsometatarsus of *Anas talarae* sp. nov., in anterior and posterior view, ROM 12916, $\times 1$.
H(i), (ii) Left tarsometatarsus of *Anas sanctaehelenae* sp. nov., in anterior and posterior view, ROM 12903, $\times 1$.

- Fig. 12 A(i), (ii) Proximal end of right humerus of *Geronogyps reliquus* gen. et sp. nov., in anconal and palmar view, ROM 12997, $\times 2/3$.
B(i), (ii) Distal end of right humerus of *Geronogyps reliquus* gen. et sp. nov., in anconal and palmar view, ROM 12998, $\times 2/3$.

A(i)

(ii)

B(i)

(ii)

Fig. 13 A(i), (ii) Left humerus of *Gymnogyps howardae* sp. nov., in anconal and palmar view, ROM 12972, $\times 2/3$.

A(i)

(ii)

- Fig. 14 A(i)–(iii) Left coracoid of *Geronogyps reliquus* gen. et sp. nov., in anterior, lateral, and posterior view, ROM 12891, $\times 1$.
B(i)–(iii) Right coracoid of *Gymnogyps howardae* sp. nov., in anterior, lateral, and posterior view, ROM 12969, $\times 1$.

A(i)

(ii)

(iii)

B(i)

(ii)

(iii)

- Fig. 15 A(i), (ii) Proximal end of left ulna of *Geronogyps reliquus* gen. et sp. nov., in palmar and anconal view, ROM 12999, $\times 1$.
B(i)–(iii) Distal end of left ulna of *Geronogyps reliquus* gen. et sp. nov., in external, anconal, and internal view, ROM 13000, $\times 1$.

A(i)

(ii)

B(i)

(ii)

(iii)

- Fig. 16 A(i), (ii) Proximal end of right ulna of *Gymnogyps howardae* sp. nov., in palmar and anconal view, ROM 12978, $\times 1$.
B(i)–(iii) Distal end of right ulna of *Gymnogyps howardae* sp. nov., in external, anconal, and internal view, ROM 12980, $\times 1$.

A(i)

(ii)

B(i)

(ii)

(iii)

- Fig. 17 A(i), (ii) Proximal end of left radius of *Geronogyps reliquus* gen. et sp. nov., in palmar and anconal view, ROM 13002, $\times 1$.
B(i), (ii) Left scapula of *Gymnogyps howardae* sp. nov., in external and internal view, ROM 12968, $\times 1$.
C(i), (ii) Distal end of right radius of *Geronogyps reliquus* gen. et sp. nov., in palmar and anconal view, ROM 13003, $\times 1$.
D(i), (ii) Distal end of right radius of *Gymnogyps howardae* sp. nov., in palmar and anconal view, ROM 12938, $\times 1$.
E(i), (ii) Proximal end of right carpometacarpus of *Geronogyps reliquus* gen. et sp. nov., in internal and external view, ROM 13006, $\times 1$.

A(i)

(ii)

B(i)

(ii)

C(i)

(ii)

D(i)

(ii)

E(i)

(ii)

- Fig. 18 A(i), (ii) Proximal portion of sternum of *Gymnogyps howardae* sp. nov., in lateral and anterior view, ROM 12967, $\times 1$.
B(i) Proximal portion of sternum of *Geronogyps reliquus* gen. et sp. nov., in anterior view, ROM 12990, $\times 1$.
C(i) Sternum of *Geronogyps reliquus* gen. sp. nov., in lateral view, ROM 12989, $\times 1$.

A(i)

B(i)

(ii)

C (i)

- Fig. 19 A(i), (ii) Proximal end of right femur of *Geronogyps reliquus* gen. et sp. nov., in anterior and posterior view, ROM 13008, $\times 1$.
B(i) Proximal end of right femur of *Geronogyps reliquus* gen. et sp. nov., in external view, ROM 13009, $\times 1$.
C(i), (ii) Distal end of right femur of *Geronogyps reliquus* gen. et sp. nov., in anterior and posterior view, ROM 13012, $\times 1$.
D(i), (ii) Distal end of left tibiotarsus of *Geronogyps reliquus* gen. et sp. nov., in anterior and posterior view, ROM 13007, $\times 1$.
E(i), (ii) Distal end of left tibiotarsus of *Gymnogyps howardae* sp. nov., in anterior and posterior view, ROM 12984, $\times 1$.

A(i)

(ii)

B(i)

C(i)

(ii)

D(i)

(ii)

E(i)

(ii)

Fig. 20 A(i)–(v) Holotype tarsometatarsus of *Geronogyps reliquus* gen. et sp. nov., in anterior, external, posterior, proximal, and distal view, ROM 12986, $\times 1$.

A(i)

(ii)

(iii)

(iv)

(v)

Fig. 21 A(i)–(v) Holotype right tarsometatarsus of *Gymnogyps howardae* sp. nov., in anterior, external, posterior, proximal, and distal view, ROM 12956, $\times 1$.

A(i)

(ii)

(iii)

(iv)

(v)

- Fig. 22 A(i)–(iii) Distal end of right ulna of *Sarcoramphus? fisheri* sp. nov., in external, anconal, and internal view, ROM 12888, $\times 1$.
- B(i), (ii) Distal end of holotype right tibiotarsus of *Sarcoramphus? fisheri* sp. nov., in anterior and posterior view, ROM 12887, $\times 1$.
- C(i), (ii) Proximal end of left radius of *Sarcoramphus? fisheri* sp. nov., in palmar and anconal view, ROM 12889, $\times 1$.
- D(i)–(iii) Left scapula of *Amplibuteo hibbardi* gen. et sp. nov., in external, internal, and proximal view, ROM 16923, $\times 1$.

- Fig. 23 A(i)–(iv) Left coracoid of *Miraquila terrestris* gen. et sp. nov., in anterior, lateral, posterior, and medial view, ROM 13030, $\times 1$.
B(i)–(iii) Left coracoid of *Amplibuteo hibbardi* gen. et sp. nov., in anterior, lateral, and posterior view, ROM 16925, $\times 1$.

A(i)

(ii)

(iii)

(iv)

B(i)

(ii)

(iii)

- Fig. 24 A(i), (ii) Right ramus of *Amplibuteo hibbardi* gen. et sp. nov., in dorsal and external view, ROM 16921, $\times 1$.
B(i) Rostrum of *Amplibuteo hibbardi* gen. et sp. nov., in external view, ROM 16919, $\times 1$.
C(i), (ii) Left carpometacarpus of *Miraquila terrestris* gen. et sp. nov., in internal and external view, ROM 13029, $\times 1$.
D(i), (ii) Proximal end of right carpometacarpus of *Amplibuteo hibbardi* gen. et sp. nov., in internal and external view, ROM 16943, $\times 1$.
E(i), (ii) Distal end of right carpometacarpus of *Amplibuteo hibbardi* gen. et sp. nov., in internal and external view, ROM 16945, $\times 1$.

A(i)

(ii)

B(i)

D(i)

(ii)

C(i)

(ii)

E(i)

(ii)

- Fig. 25 A(i), (ii) Right humerus of *Amplibuteo hibbardi* gen. et sp. nov., in anconal and palmar view, ROM 16927, $\times 2/3$.
- B(i), (ii) Proximal end of left radius of *Amplibuteo hibbardi* gen. et sp. nov., in palmar and anconal view, ROM 16939, $\times 1$.
- C(i), (ii) Distal end of left radius of *Amplibuteo hibbardi* gen. et sp. nov., in palmar and anconal view, ROM 16941, $\times 1$.
- D(i), (ii) Proximal end of right ulna of *Amplibuteo hibbardi* gen. et sp. nov., in palmar and anconal view, ROM 16932, $\times 1$.
- E(i)–(iii) Distal end of right ulna of *Amplibuteo hibbardi* gen. et sp. nov., in external, anconal, and internal view, ROM 16933, $\times 1$.

A(i)

(ii)

B(i)

(ii)

C(i)

(ii)

D(i)

(ii)

E(i)

(ii)

(iii)

Fig. 26 A(i)–(iii) Right femur of *Amplibuteo hibbardi* gen. et sp. nov., in anterior, external, and posterior view, ROM 16946, $\times 1$.

A(i)

(ii)

(iii)

- Fig. 27 A(i)–(iii) Proximal end of right tibiotarsus of *Amplibuteo hibbardi* gen. et sp. nov., in posterior, internal, and proximal view, ROM 16947, $\times 1$.
- B(i), (ii) Distal end of left tibiotarsus of *Amplibuteo hibbardi* gen. et sp. nov., in anterior and posterior view, ROM 16951, $\times 1$.
- C(i)–(iii) Proximal end of left tibiotarsus of *Miraquila terrestris* gen. et sp. nov., in posterior, internal, and proximal view, ROM 13031, $\times 1$.
- D(i)–(iii) Proximal end of holotype right tarsometatarsus of *Miraquila terrestris* gen. et sp. nov., in anterior, external, and posterior view, ROM 13025, $\times 1$.
- E(i), (ii) Distal end of right tarsometatarsus of *Miraquila terrestris* gen. et sp. nov., in anterior and posterior view, ROM 13028, $\times 1$.

A(i)

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B(i)

(ii)

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C(i)

(ii)

D(i)

(ii)

(iii)

(iii)

E(i)

(ii)

- Fig. 28 A(i)–(iii) Holotype left tarsometatarsus of *Amplibuteo hibbardi* gen. et sp. nov., in anterior, external, and posterior view, ROM 16905, $\times 1$.
- B(i), (ii) Right quadrate of *Milvago brodkorbi* sp. nov., in external and internal view, ROM 17471, $\times 1$.
- C(i), (ii) Right scapula of *Milvago brodkorbi* sp. nov., in external and internal view, ROM 17473, $\times 1$.

A(i)

(ii)

(iii)

B(i)

(ii)

C(i)

(ii)

- Fig. 29 A(i), (ii) Proximal end of right humerus of *Milvago brodkorbi* sp. nov., in anconal and palmar view, ROM 17500, $\times 1$.
B(i), (ii) Distal end of left humerus of *Milvago brodkorbi* sp. nov., in anconal and palmar view, ROM 17507, $\times 1$.
C(i), (ii) Left coracoid of *Milvago brodkorbi* sp. nov., in anterior and posterior view, ROM 17490, $\times 1$.
D(i), (ii) Left carpometacarpus of *Milvago brodkorbi* sp. nov., in internal and external view, ROM 17558, $\times 1$.
E(i), (ii) Right ulna of *Milvago brodkorbi* sp. nov., in palmar and anconal view, ROM 17509, $\times 1$.
F(i), (ii) Right radius of *Milvago brodkorbi* sp. nov., in palmar and anconal view, ROM 17532, $\times 1$.
G(i), (ii) Right tibiotarsus of *Milvago brodkorbi* sp. nov., in anterior and posterior view, ROM 17580, $\times 1$.

- Fig. 30 A(i), (ii) Holotype left tarsometatarsus of *Milvago brodkorbi* sp. nov., in anterior and posterior view, ROM 17447, $\times 1$.
B(i)–(iii) Right femur of *Milvago brodkorbi* sp. nov., in anterior, external, and posterior, view, ROM 17573, $\times 1$.
C(i)–(iii) Holotype left coracoid of *Viator picis* gen. et sp. nov., in anterior, lateral, and posterior view, ROM 13021, $\times 2$.
D(i), (ii) Holotype right coracoid of *Nuntius solitarius* gen. et sp. nov., in anterior and posterior view, ROM 13018, $\times 2$.
E(i), (ii) Holotype left coracoid of *Tringa ameghini* sp. nov., in anterior and posterior view, ROM 12897, $\times 2$.
F(i), (ii) Proximal end of right tarsometatarsus of *Tringa ameghini* sp. nov., in anterior and posterior view, ROM 12898, $\times 2$.
G(i), (ii) Left tarsometatarsus of *Nuntius solitarius* gen. et sp. nov., in anterior and posterior view, ROM 13020, $\times 2$.

- Fig. 31 A(i), (ii) Holotype left humerus of *Belonopterus edmundi* sp. nov., in anconal and palmar view, ROM 13022, $\times 1\frac{1}{2}$.
B(i)–(iii) Left femur of *Belonopterus edmundi* sp. nov., in anterior, external, and posterior view, ROM 13024, $\times 1\frac{1}{2}$.
C(i), (ii) Holotype left humerus of *Thinocorus koepckeae* sp. nov., in anconal and palmar view, ROM 12893, $\times 2$.
D(i), (ii) Holotype left coracoid of *Caprimulgus piurensis* sp. nov., in anterior and posterior view, ROM 12894, $\times 2$.
E(i), (ii) Proximal end of right carpometacarpus of *Caprimulgus piurensis* sp. nov., in internal and external view, ROM 12895, $\times 2$.
F(i)–(iii) Holotype right femur of *Steganopus graui* sp. nov., in anterior, external, and posterior view, ROM 12896, $\times 2$.
G(i)–(iii) Holotype right femur of *Micropalama chapmani* sp. nov., in anterior, external, and posterior view, ROM 13019, $\times 2$.