

Article XII.—AVIAN FOSSILS FROM THE MIOCENE AND PLIOCENE OF NEBRASKA

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INTRODUCTION

Field work in the fossil deposits of Sioux County, northwestern Nebraska, by parties sent out from The American Museum of Natural History has yielded small numbers of fossil bones of birds that until the present time have remained unstudied. Through the kind offices of Dr. W. D. Matthew, Curator of Vertebrate Palæontology, this material came into my hands for examination, while at the same time, through the courtesy of Dr. W. J. Sinclair, I was enabled to see specimens secured by the Princeton University Expedition of 1914 from the same deposits. Mr. Harold J. Cook, of Agate, Nebraska, in addition has allowed me to study bones that he has collected personally from the same area. It has thus been possible to assemble a small series of fossil bones of birds from the beds in question, in all seventeen from the American Museum, three from Princeton University Museum, and three from the private collection of Mr. Harold J. Cook; not a large number, but one that permits of some insight into the avifauna of the periods represented. The collection is especially valuable since it is accompanied by full data as to site and location. To the gentlemen mentioned I wish to acknowledge my indebtedness for information and material. My thanks are due especially to Dr. Matthew through whose suggestion this work was undertaken.

AGE OF DEPOSITS

The Snake Creek beds, from which come most of the specimens here studied, originally were considered as wholly Lower Pliocene but recently detailed study has led Dr. Matthew (to whom I am indebted for this information) to distinguish two phases in the fauna represented: first, a deposit that contains remains of *Hipparion* and *Pliohippus*, among other mammals, that is Lower Pliocene; and, second, a layer, apparently below the first, no less rich in fossils, that is thought to be Upper Miocene, as the species characteristic of the Pliocene are lacking.

Explorations in the summer of 1922 yielded a few more avian bones from the Lower Sheep Creek beds, in what Dr. Matthew considers as the earliest phase of the deposits containing *Merychippus*. This horizon is believed to be early Middle Miocene, older than Mascall.

A detailed description of the beds as a whole has been given by Matthew and Cook¹ from field work in 1908 when the desposits were first discovered. Additional information is included by Dr. Sinclair in a paper² drawn from work performed for the Princeton University Museum during the summer of 1914. The bird bones from these beds, though often broken, are well preserved; they vary from whitish to dark slate in color. Some show evidence of wear, while others are remarkable for the manner in which they have retained minute details of structure.

DISCUSSION OF THE AVIFAUNAS

The avifauna revealed in the fossils at hand is far from comprehensive, as it includes species from only three orders of birds, the Anseriformes, Galliformes, and Accipitriformes. Hawks, of moderate to large size, are most abundant (eight species) with two forms of gallinaceous birds and one goose, a total of eleven species in all. The lower Snake Creek beds, considered by Dr. Matthew to constitute an Upper Miocene horizon, contained more remains of birds than the Lower Pliocene levels. The Sheep Creek deposits have yielded two hawks. The following tabulation indicates the occurrence of species in the material studied, all of those listed, even where determination is not definite, belonging to forms that are now extinct.

LOWER PLIOCENE

Ortalis phengites, new species
Galliformes (indeterminate)
Geranoaëtus conterminus, new species

UPPER MIOCENE

Anserinæ (indeterminate)
Buteonidæ (indeterminate)
Buteonidæ³ (indeterminate)
Aquila species
Buteo typhoius, new species
Geranoaëtus contortus, new species

MIDDLE MIOCENE

Urubitinga enecta, new species

LOWER MIOCENE

Proictinia effera, new species

¹1909, 'A Pliocene Fauna from Western Nebraska,' Bull. Amer. Mus. Nat. Hist., XXVI, pp. 361-365.

²1915, 'Additions to the Fauna of the Lower Pliocene Snake Creek Beds,' Proc. Amer. Phil. Soc., LIV, pp. 73-78.

³Level of occurrence, according to Dr. W. J. Sinclair, somewhat in question, possibly Lower Pliocene (see p. 507).

The hawks, which comprise the bulk of the species listed, are from groups whose modern representatives are frequently attracted by carrion, a habit that, if supposed to exist in these ancient forms, perhaps may account for the extensive representation of these birds in deposits that contain abundant remains of other vertebrates. Though no asphalt was present here as at Rancho La Brea, in California, Dr. Matthew suggests that mammals may have been entrapped by other means, possibly by quicksands.

The golden eagle listed, so far as may be told, is closely allied to the modern species. The *Buteo* described is a species of large size. The presence of two species of long-shanked eagles of the genus *Geranoaëtus* is of interest since the modern representative of the group, *G. melano-leucus*, is known now only in South America, where it ranges from the Straits of Magellan north through the pampas of Argentina to Uruguay and Paraguay, and, avoiding the tropics, extends northward through the Andes into Venezuela.¹ In geologic history *Geranoaëtus* first appears in the species here described from the lower beds of the Snake Creek which are supposed to be Upper Miocene. It is continued by an allied form in the higher, Lower Pliocene, deposits of the same formation, and is found in the asphalt beds of Rancho La Brea, in California, from which L. H. Miller² has described *G. grinnelli* and *G. fragilis*, both based on several specimens. The first seems to have been quite closely allied to *G. melano-leucus*, while the second, of more slender form, may prove to be a *Urubitinga*. A humerus and a coracoid secured among Pleistocene deposits from Hawver Cave, Eldorado County, California, are said by Miller³ to be closely similar, if not indeed doubtfully distinct⁴ from the modern *Geranoaëtus melano-leucus*. Thus we have long-shanked eagles of this assemblage appearing first in North America in the Snake Creek beds of Nebraska and continuing at least well into the Pleistocene in California. Their extermination in the north perhaps may be attributed to severity of the climate that in the Pleistocene replaced the mild temperatures of the preceding age. The fact that the modern *G. melano-leucus* in South America appears little affected by cold has no bearing on this statement as it indicates merely a species now fitted to live under temperate rather than subtropical conditions.

Urubitinga enecta introduces another group of long-legged buteonids that today ranges from Argentina north to southern Arizona and the

¹It may be rare in its northern range as it is not mentioned in Chapman's, 1917, 'Distribution of Bird-Life in Colombia,' Bull. Amer. Mus. Nat. Hist., XXXVI.

²1911, Univ. California Publ. Geol., VI, pp. 314-315.

³1911, Univ. California Publ. Geol., VI, pp. 392-393.

⁴See Miller, L. H., 1912, Univ. California Publ. Geol., VII, p. 75.

lower Rio Grande Valley in Texas. *Morphnus daggetti* L. H. Miller¹ from the Pleistocene of Rancho La Brea is perhaps a near relative, as may be *Geranoaëtus fragilis* described by Miller from the same deposits. *Proictinia effera* is the first indication of the group of milvine hawks on this continent. It is remarkable that there is no representative of the Falconidæ among all of the species secured from these deposits.

The discovery of an extinct guan (*Ortalis*) in the typically Lower Pliocene levels of the Snake Creek beds is of considerable interest since the modern representatives of the group are Neotropical. In fact, the Penelopinae, the subfamily of the Cracidæ concerned, are confined largely to tropical and subtropical areas of South America, where they range southward to northern Argentina. A few are known in Central America and Mexico (*O. vetula* reaching to the lower Rio Grande Valley in Texas) while a *Pipile* is found on Trinidad and an *Ortalis* on Tobago, islands that, though they appear at the southern end of the Lesser Antillean chain, are South American rather than West Indian in their modern fauna. The presence of *Ortalis phengites* in northwestern Nebraska is indicative not only of the mild climate supposed to have prevailed during the Pliocene but, since this genus is arboreal, of heavy forest growth of fair extent at least along streams.

Several specimens in fragmentary condition in the collection have been referred simply to family. It is hoped that additional material from further exploration may yield bones from which these may be properly characterized.

Drawings to illustrate the new species described have been made by Miss L. Wieser.

Phasianidæ?

GALLIFORMES INDETERMINATE.—A right tibio-tarsus (Amer. Mus. Nat. Hist., Div. Pal. No. 1763), complete save for the head, from the Lower Pliocene level comes from a gallinaceous bird of uncertain affinity. In general form it is rather similar to *Canachites* but is much larger. Apparently it represents a bird with rather slender limb bones slightly taller than the modern sage grouse. The fossil is peculiar in having a very broad supra-tendinal bridge on the anterior lower end, a character in which it resembles the Cracidæ and differs from either the true pheasants, so far as they are represented in the collections of the National Museum, or the grouse of the New World. In other points, however, it seems near *Canachites*, *Dendragapus*, and *Centrocercus*. From the top

¹Condor, 1915, p. 179.

of the peroneal ridge to the distal end of the condyles this bone measures 104.0 mm. The greatest transverse breadth through the peroneal ridge is 8.2 mm., the least transverse breadth of the shaft 6.0 mm., and the greatest width across the condyles 12.0 mm.

At present the specimen may not be identified save to order.

Cracidae

Ortalis phengites,¹ new species

CHARACTERS.—Similar to *Ortalis vetula* (Wagler)² but slightly smaller; humerus (Figs. 1 and 2) with entepicondylar process relatively larger and longer; surface for attachment of pronator brevis muscle longer; shaft of bone somewhat more slender.

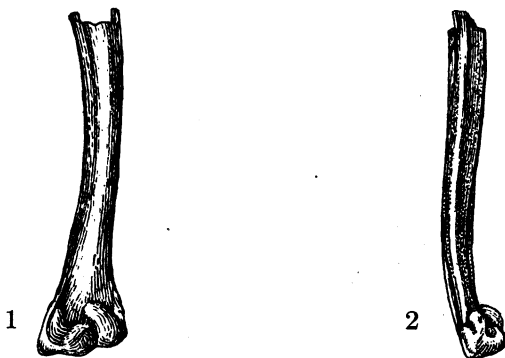


Fig. 1.—*Ortalis phengites*. Anterior view of left humerus (type), natural size.

Fig. 2.—*Ortalis phengites*. Internal view of left humerus (type), natural size.

DESCRIPTION.—Type, Cat. No. 426, collection of Harold J. Cook, left humerus with head missing, from the upper series of Snake Creek beds (Lower Pliocene) south of Agate, Sioux Co., Nebraska, collected by Harold Cook. Head of bone missing; shaft slender in middle expanding gradually toward either extremity, distinctly sigmoid, and flattened when viewed from front or back; curving toward front at lower end above support of trochlea, and slightly toward rear at upper end; nutrient foramen apparently closed; pit for attachment of brachialis anticus irregularly oval, small, but distinctly impressed; ectepicondylar process slight; shelf on anterior face external to base of radial trochlea narrow; radial trochlea moderately elongate and smoothly rounded, with upper base descending to meet shaft at a sharp angle, with a slight overhang on upper margin; inner margin slightly concave beyond level of ulnar trochlea, lower margin rounding smoothly into end of bone; ulnar trochlea globular on outer end, continued toward inner margin as a constricted ridge, projecting anteriorly to level of radial trochlea, rising at an oblique but marked angle above the shaft; attachment for pronator brevis elevated as a level plane above pit for brachialis

¹A transparent mineral substance known as *phengites* (*phryganea*) was used at times by the ancients to close window openings. We may look on the bone here described as a window through whose meager transparency we may secure, indistinctly, a glimpse of the past.

²*Penelope vetula* Wagler, 1830, Oken's Isis, p. 1112. (Mexico.)

anticus, rudely triangular in form, about as long as broad; entepicondylar process twice as high as broad, narrow and elongate, olecranal depressions sharply impressed at inner side where the margin is abrupt, gradually disappearing toward center; sulcus anconeus medius broad, plane, not definitely impressed; sulcus anconeus lateralis narrower, plane, also not distinctly impressed; intertrochlear sulcus a shallow groove; ulnar trochlea continued distally considerably beyond level of radial trochlea; outer portion of ulnar trochlea not projected to any marked degree beyond level of inner (medial) portion.

MEASUREMENTS.—Greatest breadth across trochlea, 11.5 mm.; transverse diameter of shaft at center, 4.5 mm.

The type and only known specimen of the present species, according to the collector, Mr. H. J. Cook, was found associated in position with numerous mammalian fossils, among them the type specimen of the primate *Hesperopithecus haroldcooki* Osborn, in deposits that included *Hipparion* remains. It represents the first known record for a member of the family Cracidae in a fossil state.

The only other fossil peristeropodous galliform that seems to have been described to date (unless some member of that group is hidden among the many poorly described fossils that have been placed in the phasianine group) is *Gallinuloides wyomingensis* Eastman¹ from the Green River shales (Eocene) of Wyoming. Dr. Lucas² considers this as representative of a peculiar family, the Gallinuloididae, related to the Cracidae but differing from that group in the absence of a recurved posterior mandibular process, in the form of the short, stout, U-shaped furculum with its large hypocleidium, and in the shape of the articular facet for the coracoid. Dr. Shufeldt³ in a later review has considered *G. wyomingensis* a true grouse related to *Lagopus* and *Bonasa*, evidently overlooking the fact that *wyomingensis* has the hallux on a level with the three anterior toes, and the inner notch on the posterior border of the sternum shallower than the outer one, both prominent characters that distinguish the peristeropodous from the alectoropodous section of the Galliformes.⁴

Ortalis phengites is distinctly smaller than *O. vetula*, a modern species that now extends from northern South America north barely within the confines of the United States in the lower Rio Grande Valley in Texas. It differs from the still larger *O. canicollis* of southern Brazil, Paraguay, and northern Argentina in more poorly developed ectepicondylar process, in relatively narrower, more elongate entepicondylar process

¹1900, Geog. Mag., February, pp. 54-58.

²1900, Bull. Mus. Comp. Zool., XXXVI, pp. 79-84, 1 pl., 1 text fig.

³1915, Journ. Geol., XXIII, pp. 619-634, 2 figs.

⁴The fossil described as *Gallinuloides prentissi* Loomis (1906, Amer. Journ. Sci., (4) XXII, pp. 481-482) is said by Shufeldt (1915, Trans. Connecticut Acad. Arts Sci., XIX, p. 42) to belong in the family Gruidae.

and relatively larger radial trochlea. In *O. vetula* (two specimens) the transverse diameter across the trochlea is 11.9 mm.; the diameter of the shaft at its center is 5.2 mm. The same measurements in *O. canicollis* are respectively 12.8 mm. and 6.3 mm. The slenderness of the shaft in *O. phengites* is especially to be noted. It may be observed that the humerus in the Meleagridæ and Phasianidæ (including the grouse and quails) has the globular portion of the ulnar trochlea projected beyond the level of the ridge that extends toward the entepicondylar process. This peculiarity is least noticeable in the turkeys and has its greatest development in the quails. The Cracidæ differ in that the trochlea in question has the two portions extended distally to practically the same level.

Ortalis phengites from the specimen seen is distinctly of the same type as our modern *chachalacas*, *charatas*, and *jacus*, tree-haunting forms of guans, with slender bodies and tails of long, broad feathers, that are noted for their harsh, raucous voices. Its presence in the Pliocene of Nebraska would seem to indicate heavy forests that at least must have bordered the streams. The Snake Creek beds mark the most northern record for its family, the Cracidæ, whose species in modern times are tropical and subtropical in occurrence.

Anatidæ

ANSERINÆ INDETERMINATE.—A right ulna (Amer. Mus. Nat. Hist., Div. Pal. No. 1764) from the Upper Miocene levels belongs to a gooselike bird apparently somewhat related to the modern genus *Branta*, particularly to *Branta canadensis*. From this species the fossil, a bird about as large as *Branta c. minima*, differs in particular in conformation of the proximal end of the bone while at the opposite end it has a somewhat lower carpal ridge. As characters found in the ulna of birds usually are generalized it is not deemed expedient to describe the bird from this bone. It may be noted that the extinct form does not appear to be generically identical with modern species.

Though anserine birds have been known from Middle and Upper Miocene deposits in France or even from supposed Oligocene beds, they have not been recorded previously in North America from below the Pleistocene (though the writer has identified a fragment of a *Branta* from what are supposed to be Pliocene deposits in Arizona).

Buteonidæ

Buteo typhoius, new species

CHARACTERS.—Metatarsus (Figs. 3 and 4) similar to that of *Buteo borealis* (Gmelin)¹ but considerably larger; lower end of metatarsus with a distinctly impressed anterior groove extending nearly to internal trochlea.

¹*Falco borealis* Gmelin, 1788, 'Syst. Nat.', I, pt. 1, p. 266. (Carolina.)

DESCRIPTION.—Type, Cat. No. 1754, Dept. Vert. Pal., American Museum of Natural History, distal two-thirds of right metatarsus, from Upper Miocene level of the Snake Creek beds, 23 miles south of Agate, Sioux Co., Nebraska, collected by Whitford and Stoll in 1916.

External face of metatarsus flattened, slightly concave at center and rounded toward anterior and posterior margins, forming an approximately plane surface that slopes from its outer margin behind toward the median line to form a sharp anterior median ridge, broad and expanded at upper part, where the upper end has been broken away and lost, continuing thus for half its length, and then contracted

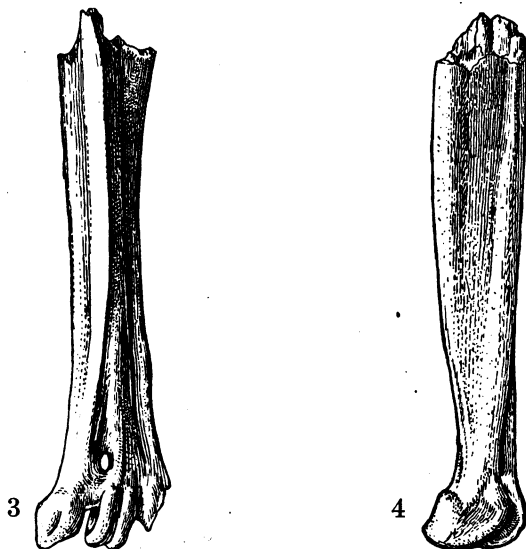


Fig. 3.—*Buteo typhoïus*. Anterior view of lower part of right tarso-metatarsus (type), natural size.

Fig. 4.—*Buteo typhoïus*. External face of right tarso-metatarsus (type), natural size.

gently to merge at the level of the distal foramen with a rounded surface that passes over to the base of the external trochlea; inner side of anterior face less regular in its contours; the anterior groove (proximal end missing) present as a shallow excavation in the sloping inner side of the anterior face; shaft constricted gradually with consequent restriction of the anterior groove, until the latter becomes a shallow impression of narrow width on the nearly plane surface of the inner face; the shaft, viewed from in front, appearing in horizontal profile near its center like an isosceles triangle; the shaft expanded once more below the center and flattened as the anterior ridge swings toward the outside; the anterior groove continued as a well-marked depression past the attachment of the hallux to disappear on the broadened space that supports the base of the outer trochlea; inferior foramen large, elongately elliptical, placed at the lower end of an impressed groove that begins on the inside of the central anterior ridge of the shaft, becomes better marked and deeper as the shaft

broadens distally, and then ends abruptly at the lower margin of the foramen; posterior surface broadly and regularly grooved to the level of the upper end of the attachment for the hallux where the bone expands, remaining very slightly concave; attachment for fourth metatarsal excavated as a shallow pit at upper end, below becoming less distinct, flattened and then slightly convexly rounded; viewed from in front the line of attachment is gently concave; the internal trochlea broken away; middle trochlea rather short, somewhat elongated posteriorly, distinctly inclined toward the outer one; its inner and outer faces concave, with a deep groove passing around it; posteriorly the raised outer margin prolonged to the base of the trochlea; the inner margin terminates below the attachment of the trochlea and is swung slightly inward; the groove is deeper on the posterior face than elsewhere; external trochlea narrow, the outer margin produced posteriorly as a thin flattened process that flares outward to a slight extent; outer face rounded gently, slightly excavated near center, inner face concave; the trochlea swung outward at a slight angle with the main axis of the bone; a canal leading upward through the bone from the center of the external intertrochlear sulcus to the lower, external margin of the inferior foramen; the middle trochlea projecting farther forward than the two lateral ones.

MEASUREMENTS (Of type).—Smallest transverse diameter of shaft, 9.2 mm.; transverse breadth at level of lower margin of inferior foramen, 14.0 mm.; greatest width of external face, 11.7 mm.; antero-postero diameter of external face of outer trochlea, 10.2 mm.

In addition to the broken metatarsus chosen as type *Buteo typhoius* is represented in the same collection by the distal third or more of a right ulna (No. 1757), and a nearly complete left coracoid (No. 1756). The fossil species is evidently similar to the modern red-tailed hawk (*Buteo borealis*) save that it is about one-half larger. The marked impression of the anterior groove on the shaft of the metatarsus as far as the digital facet for the first metatarsal is lacking in modern *Buteo* and is developed to an equal degree among related species only in *Heterospizias meridionalis* (Latham), a species of South American range with a long slender metatarsus of otherwise decidedly different proportions and appearance. Because of this marked anterior groove it is probable that, were *Buteo typhoius* a living bird, ornithologists would assign it to a distinct genus, but in its fragmentary condition it is deemed best to place it in the genus *Buteo*, which it resembles closely in other particulars.

The broken ulna secured has a conformation similar to that of *Buteo borealis* save that its tubercles and ridges are relatively less prominently developed. The bone is well fossilized but has the hollow of the shaft empty. The external face of the shaft is slightly flattened. The carpal ridge is broad, winglike, and produced below, but forms less of an angle with the line of the shaft and has the free proximal margin less angular than in *Buteo borealis*. The inferior radial depression begins slightly above the free upper margin of the carpal articulation and forms a broad elongated depression that terminates at the side of the carpal

tuberosity. It is marked by slight concavities at upper and lower end. The carpal tuberosity is strongly formed but any peculiarities that it possessed have been worn away so that it appears as a mere projection toward the inner side with the tip truncated and concave. The tendinal groove is deeply impressed. The bone exhibits the following measurements: diameter of shaft on external surface, 7.5 mm.; diameter on external surface through carpal ridge, 12.5 mm.; length of carpal ridge, 12.7 mm.

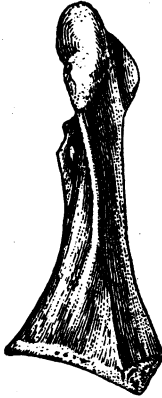


Fig. 5.—*Buteo typhoïus*. Outer view of left coracoid, natural size.

The coracoid (Fig. 5) associated with the other remains is nearly entire, as it lacks only the attenuated processes of the hyosternal apophysis, the subclavicular apophysis of the precoracoid, and the extremity of the brachial tuberosity. The bone differs from that of *Buteo borealis* in certain particulars. The opening that gives passage to the supracoracoidal nerve is placed relatively somewhat nearer the scapular facet. The clavicular facet is much broader and more nearly plane, and the lower portion of the intermuscular line on the shaft lower, and less angular. In addition the shaft is relatively broader and heavier. The sternal facet shows a broad articular surface that extends well outward. The glenoid facet is slightly longer than wide and is somewhat elliptical, with the inner margin flattened. This bone measures as follows: length, from acrocoracoid to base at center, 49.3 mm.; smallest transverse diameter of shaft, 8.1 mm.; distance from top of acrocoracoid to upper margin of subclavicular foramen, 22.0 mm.

Geranoaëtus contortus, new species

CHARACTERS.—Metatarsus (Figs. 6 to 9) similar to that of *Geranoaëtus melano-leucus* (Vieillot)¹ but larger, and relatively more robust; tubercle for tibialis anticus placed higher on shaft; anterior surface more deeply excavated below head; internal superior foramen opening, on posterior surface, inside of sloping base of talon.

DESCRIPTION.—Type, Cat. No. 1758, Dept. Vert. Pal., American Museum of Natural History, left tarso-metatarsus, from Lower Snake Creek beds (Upper Miocene), collected in a deposit near Sinclair Draw, Sioux County, 20 miles south of Agate, Nebraska, in 1916 by Whitford and Stoll.

Proximal face of head rudely rectangular, the external glenoid facet slightly concave, the internal one larger, considerably excavated; intercondylar tubercle broad and slightly elevated, the internal glenoid facet at a lower level than the outer

¹*Spizaëtus melano-leucus* Vieillot, 1819, Nouv. Dict. Hist. Nat., XXXII, p. 57. (Paraguay.)

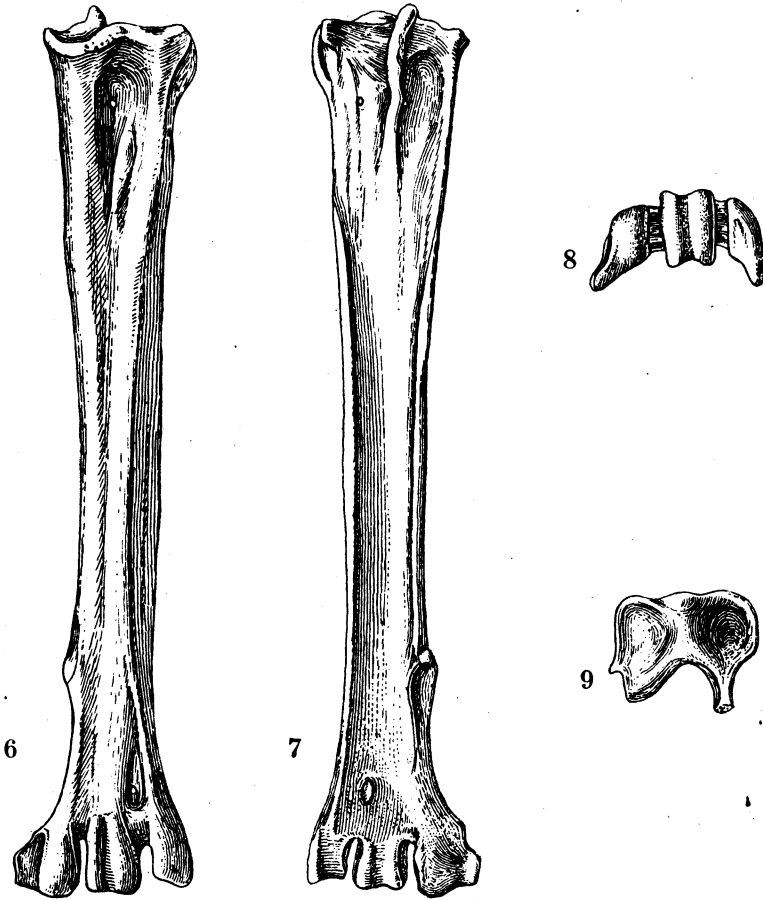


Fig. 6.—*Geranoaëtus contortus*. Outer view of left tarso-metatarsus (type), slightly more than natural size.

Fig. 7.—*Geranoaëtus contortus*. Inner view of left tarso-metatarsus (type), slightly more than natural size.

Fig. 8.—*Geranoaëtus contortus*. Distal outline of trochleæ of left tarso-metatarsus (type), natural size.

Fig. 9.—*Geranoaëtus contortus*. Proximal view of head of left tarso-metatarsus (type), natural size.

one; anterior semilunar groove nearly obsolete; posterior semilunar groove deep, the internal margin nearly at a right angle with the transverse plane of the shaft, the external margin sloping outward at a right angle to the same margin; external side of head square, the internal side rounded; a narrow, deeply excavated pit on the anterior face of shaft at upper end, the upper margin abrupt, with a sharp overhang of the head; the two superior foramina contained in this pit, below which the floor of the

depression slopes toward the front and then merges gradually with the anterior groove; external crest of transverse ligament (for tendon of extensor digitorum communis) very slightly indicated; internal crest of transverse ligament slightly stronger; space between only slightly flattened; tubercle for tibialis anticus strong, located slightly external to center of shaft; shaft moderately strong, only slightly expanded at upper end, contracting gradually to center, then continued to expand to support the trochlea, triangular in cross section in general, becoming flattened below, marked on anterior side by anterior sulcus which becomes shallow a short distance below tubercle of tibialis anticus and continues as a slightly impressed, rather narrow channel along inner side of median line to disappear at the level of the attachment for the first metatarsal; outer face of shaft almost plane, with a very gradual curve inward toward middle; external ligamentous ridge rather slight; below this point the anterior margin of shaft straight, meeting the anterior surface at a sharp angle; posterior margin of external face curving to form an expanded flat surface that gradually increases to middle and then contracts again at the level of the inferior foramen; inferior foramen moderately large, located at the bottom of a groove that begins shallowly and becomes much depressed as it continues downward; surface of shaft internal to this groove nearly flat; inner margin of shaft compressed to a thin plate that is straight at first, and then swings in a gradual posterior curve, that below the middle again returns toward the front until it is interrupted by the projecting crest that marks the proximal margin of the attachment of the first metatarsal, below which the line of the shafts wings outward to support the base of the outer trochlea; external head of talon somewhat rounded, knoblike, proximally slightly raised above level of external glenoid facet, with abrupt external margin cut by a slight notch, and internal and posterior margins sloping gradually into body of shaft; internal head of talon thin, bladelike, projecting, with free margin cut by two slight concave irregularities on inner side, posteriorly inclined slightly inward as an overhang; proximal margin raised above proximal articular surfaces, posteriorly, after forming a square, projecting blade, descending in an abrupt slope to level of shaft along which it continues as a raised line for a space of fifteen millimeters; internal superior foramen lying inside of elongated base line of external head of talon; external superior foramen, at same level, located below base of external head of talon; posterior face of shaft excavated to form a broad groove bounded laterally by crests formed by the posteriorly raised margins of the external and anterior surfaces, the groove terminating at the level of the upper end of the articulation of the first metatarsal; the shaft below this point plane to the level of the inferior foramen where there is a shallow excavation that extends across the center of the bone; articular facet for first metatarsal cut at an oblique angle into the inner side, the raised line of the internal margin of the anterior surface of the shaft terminating above the commencement of the articulation; the facet deeply excavated at first, bounded above by a raised ridge, and merging below into outline of side of shaft; external trochlea a flattened plate, swung slightly outward, compressed on posterior portion to a posterior projection one-half the width of the body of the trochlea; middle trochlea, somewhat broader, expanded slightly on external side, with lateral margins swollen and lateral faces concave, traversed by a strongly impressed groove that extends around entire articular surface, the external margin elevated slightly above the internal one, and the whole trochlea swung slightly toward the outside; internal trochlea with a broad, rounded base with a projecting, triangular winglike projection from the external posterior angle; a large, rather deep, excavation on the outer surface.

MEASUREMENTS (Of type).—Total length, 113.0 mm.; greatest breadth of head, 19.0 mm.; greatest breadth across trochlea, 23.0 mm.; smallest transverse diameter of shaft, 10.0 mm.; distance from center of tibialis anticus tubercle to upper end of shaft, 21.0 mm.

In the diagnosis of this species direct comparison has been made with *Geranoaëtus melanoleucus*, the only living member of the genus, confined at present to South America, where it ranges from Argentina and Brazil northward through the Andes into Venezuela. From *Geranoaëtus grinnelli* L. H. Miller¹ the species from Nebraska differs in slightly larger size, in greater elevation of the tibialis anticus tubercle, in reduced external crest of talon, and broader, more open, posterior semilunar groove. It is distinguished from *G. fragilis* L. H. Miller² by the same characters, and in addition has the shaft distinctly more robust. A third eagle of the long-shanked type, *Morphnus woodwardi* L. H. Miller,³ is distinguished from *contortus* by larger size, less excavation below the head on the anterior face of the shaft, and greater breadth of the transverse supratendinal bridge. In comparing the Nebraska fossil with these three species I have been dependent for details on Dr. Miller's figures and descriptions.

Aquila danana Marsh⁴ based on the condyles of a tibio-tarsus of doubtful Pliocene deposit seems to represent a hawk of questionable buteonid affinity. Marsh's type has been figured by Shufeldt.⁵ From this illustration, and from the original description, it appears that the bird described as *A. danana* was smaller than *Geranoaëtus melanoleucus*, as the measurement across the condyles, said by Marsh to be "8 lines," is equivalent to a little more than 16 millimeters. *G. contortus* is considerably larger, sufficiently so to determine that it is not identical with *A. danana* as the difference in size is beyond the range of individual variation.

The material upon which *Geranoaëtus contortus* is based has been more comprehensive than usual with avian fossils of like age. With the type tarso-metatarsus are associated a right metacarpus (A. M. N. H. No. 1759) that lacks the distal end and most of the third metacarpal, and the outer end of a left ulna (A. M. N. H. No. 1760), both collected in the season of 1916, and possibly from the same individual that furnished the type. Further material secured in 1921 includes a right metatarsus (A. M. N. H. No. 1762), entire save for the outer trochlea and the intercondylar tubercle on the head, a fragmentary metacarpus (A. M. N. H.

¹1911, Univ. Calif. Publ. Geol., VI, p. 314. (Pleistocene, Rancho La Brea.)

²*Loc. cit.*, p. 315. (Pleistocene, Rancho La Brea.)

³*Loc. cit.*, p. 312. (Pleistocene, Rancho La Brea.)

⁴*Aquila dananus* Marsh, 1871, Amer. Journ. Sci. Arts, (3) II, p. 125. (Pliocene (?) Loup Fork.)

⁵1915, Trans. Conn. Acad. Arts Sci., XIX, Pl. II, figs. 13.

No. 1766), comprising the distal part of the second metacarpal with the outer end of the third, and a left radius (A. M. N. H. No. 1765), that lacks the proximal end. The two last mentioned were secured from the same quarry.

In the collection of Mr. H. J. Cook is found the proximal fourth of another right metacarpal (No. 465), broken squarely across a short distance beyond the proximal union of second and third metacarpals. This specimen was secured by Mr. Cook in April, 1922 at the same locality that yielded the material from the American Museum listed as collected in 1921 (A. M. N. H. Nos. 1762, 1765 and 1766). It is marked as taken in the lowest phase of the Snake Creek beds in what have been called the "Sheep Creek" deposits. (Allocation under the present species somewhat tentative.)

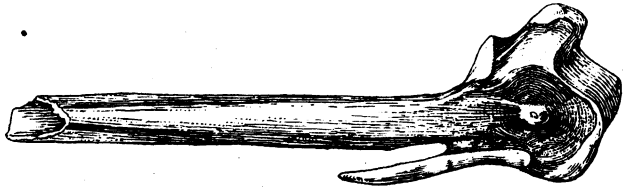


Fig. 10.—*Geranoaëtus contortus*. Inner face of broken left metacarpus, natural size.

The metacarpus (Fig. 10) of *G. contortus* as represented by three broken specimens, save for its larger size, is not notably different from that of *G. melanoleucus*. The articular facet for the pollex, on the first metacarpal, is relatively larger and has the surface more convexly rounded. The external groove (for the tendon of the extensor digitorum communis) in the fossil lies on the outer side of the second metacarpal, proximally approaching the upper margin, but not running along the upper surface as in *G. melanoleucus*. The pisiform process is strong and somewhat conical. Other differences from the modern bird are not noted. The greatest height of the head of the bone in the largest specimen is 23.3 mm.; the greatest transverse diameter of the second metacarpal, 8.8 mm.; of the third metacarpal, 7.8 mm.; the complete metacarpus was apparently about 100 mm. long. The metacarpus from the collection of Mr. Cook (No. 465) is smaller but is within the range of sexual variation in size in this group. It has a somewhat more porous texture on the ends of the projecting processes and may have come from an immature bird. The greatest height of the head in this specimen is 21.0 mm.; the greatest transverse diameter of the second metacarpal, 7.3

mm.; and of the third metacarpal, 7.5 mm. The bone is dark in color like the others.

The ulna, represented by a broken fragment (A. M. N. H. No. 1760), is closely similar to that of *G. melanoleucus* save that it is larger. The form in the fossil is so close to that in the modern bird that the slight differences perceptible are apparently such as occur in different individuals of the same species. The broken radius (A. M. N. H. No. 1765) assigned to this species is likewise almost identical with that of the modern bird save that it is of greater size. The angles of the lower end are slightly more rounded and the end of the bone is transversely more expanded. Otherwise the two are the same. The transverse diameter of the lower end in the fossil radius is 11.5 mm.; the transverse diameter of the shaft equals 4.7 mm.

The right tarso-metatarsus (A. M. N. H. No. 1762) collected in 1921 is somewhat distorted but is readily seen to be similar in form to the type. The bone is larger than the type as it has the following measurements: total length, 120.0 mm.; greatest breadth of head, 20.5 mm.; smallest transverse diameter of shaft, 10 mm.; distance from center of tibialis anticus tubercle to upper end of shaft, 23.0 mm. The general agreement in form in this bone to the type specimen is close. The tubercle for the tibialis anticus is slightly more prominent and is located nearer the outer margin. The internal head of the talon seems to have had a shorter base, but this is not certain as part of this crest has been broken away. Otherwise the two are closely similar save for the more massive proportions of the second fossil, a difference in size equal to that found as a sexual variation in an extended series of the modern *Buteo borealis*, a member of a genus allied to *Geranoaëtus*. There is nothing apparent to indicate that the two fossil bones may not be conspecific.

It appears that *Geranoaëtus contortus* was a long-shanked eagle of strong wing power, that may not have differed in any pronounced manner from the living *G. melanoleucus* save that it was of considerably greater bulk.

***Geranoaëtus conterminus*, new species**

CHARACTERS.—Metatarsus (Figs. 11 to 13) similar to that of *Geranoaëtus contortus* Wetmore, but with inner trochlea broader and more massive, especially at base.

DESCRIPTION.—Type, distal half of left tarso-metatarsus, Cat. No. 12156, Princeton University Geological Museum, collected from the upper level of the Snake Creek beds (Lower Pliocene) at locality 1000 A (T. 26 N., R. 55 W., Sec. 31, N. E. $\frac{1}{4}$) twenty miles south of Agate, Sioux County, Nebraska, in 1914, by Dr. W. J. Sinclair, A. C. Whitford and C. Barner:

External trochlea a flattened plate (with the posterior projection mainly broken away), swung slightly outward; articular portion narrow, laterally compressed, abrupt on inner margin, cut away on outer anterior angle, and faintly grooved on distal posterior part; excavated as a conical pit on outer face; sulcus between median and outer trochlea moderately deep, with an enclosed canal leading from the center of the sulcus to the lower margin of the inferior foramen; middle trochlea rather small, the free end swung slightly toward the external side, so that the projection appears to be set on the shaft at a slight angle; internal and external faces deeply excavated; trochlea strongly grooved; outer side of groove projecting slightly farther than

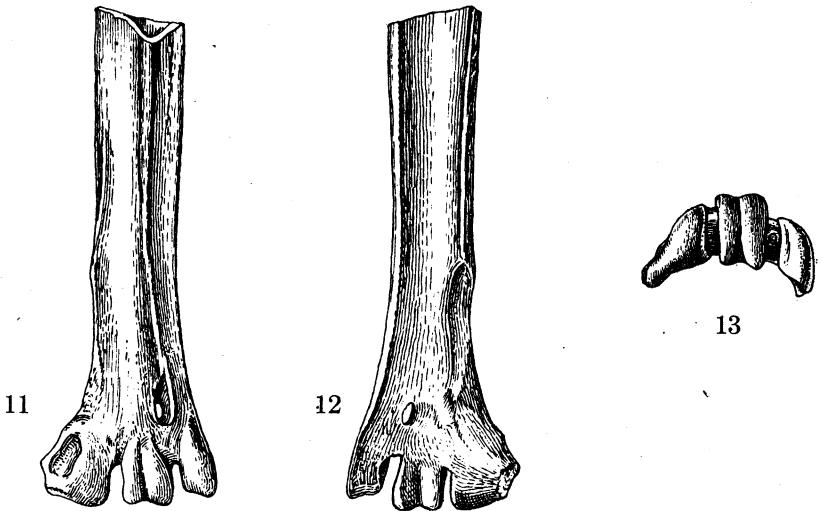


Fig. 11.—*Geranoaëtus conterminus*. Anterior face of broken left tarso-metatarsus (type), natural size.

Fig. 12.—*Geranoaëtus conterminus*. Posterior view of broken left tarso-metatarsus (type), natural size.

Fig. 13.—*Geranoaëtus conterminus*. Distal outline of trochleae of left tarso-metatarsus (type), natural size.

inner, especially on posterior face; proximal end of outer face inclined rather abruptly inward and continued upward on shaft for a shorter distance than inner face; inner face straight save for a slight indentation at lower anterior margin; the whole trochlea swollen on anterior side to form a prominent projection beyond the level of the lower end of the shaft and of the two lateral trochlea; the raised margins of the central groove merging posteriorly with shaft at line of intertrochlear sulci, the inner one cut off somewhat abruptly at an oblique angle; inner trochlea broad and strong, projecting distally slightly beyond level of middle trochlea; inner intertrochlear sulcus slightly shallower and narrower than outer one; trochlea projecting at a right angle with the transverse plane of shaft, extending outward beyond line of shaft; base

broadened externally; inner portion rounded, with inner face deeply excavated; winglike projection broad, flattened, in outline a truncated cone with a deep concavity excavated on outer face; lower posterior margin gently curved; posterior surface flattened, but with surface somewhat faintly and irregularly concave; facet for first metatarsal broad and prominently excavated for upper half, below narrowed and merged with compressed margin of shaft, bordered anteriorly by a faint rounded line; inferior foramen moderately large, oval in form, with a short, shallow, broad groove continuous with its upper margin; shaft triangular, strong; outer face plane on posterior portion, rounded on upper portion, meeting the anterior face at a sharp angle throughout; anterior surface somewhat irregularly rounded on lower portion, where it is perforated on the outer side by the inferior foramen, and grooved by the shallow canal leading into this foramen, while in addition a linea aspera extends in an irregular curve from the internal sulcus back to the groove; this surface posteriorly rotated outward and more flattened; a broad, shallow, poorly indicated furrow extended down past the articular facet for the first metatarsal; posterior surface of shaft with margins raised to delimit a deep, broad groove on upper portion, flattened and nearly plane at level of first metatarsal attachment, and shallowly concave below in region of inferior foramen; middle of shaft triangular in cross-section.

MEASUREMENTS (Of type).—Greatest breadth across trochlea, 22.5 mm.; smallest transverse diameter of shaft, 11.0 mm. (Other useful measurements not available because of broken condition of specimen.)

The present species appears similar to *Geranoaëtus contortus* of the Upper Miocene beds in the same vicinity but is distinguished by the broadening of the basal support of the external condyle. Like the species just mentioned, *G. conterminus* may not be confused with the species known as *Aquila danana* Marsh because of its larger size. It was apparently similar to *G. contortus* but perhaps of slightly more robust proportions.

With the description of the present form we find that the group of long-legged eagles, represented by our living *Geranoaëtus melanoleucus*, is present in the Upper Miocene as *Geranoaëtus contortus* Wetmore, in the Lower Pliocene as *G. conterminus* Wetmore, and in the Pleistocene (Rancho La Brea) as *G. grinnelli* Miller and *G. fragilis* Miller. This type of raptorial bird, to judge from the available material, was well developed during the later Miocene and, on the evidence offered by the metatarsal bone, seems to have continued to the present day with only slight modification of form, but with a reduction in size and strength, as the fossil species that have been mentioned are all larger than the living bird.

Urubitinga¹ enecta, new species

CHARACTERS.—Tibio-tarsus (Figs. 14 to 16) similar to that of *Urubitinga u. ridgwayi* Gurney² but considerably larger; anterior groove on lower face of shaft (above tendinal bridge) more extensive; space between this groove and outer face of bone narrower; lower margin of external condyle farther produced.

DESCRIPTION.—Type, Cat. No. 6300, Dept. Vert. Pal., American Museum of Natural History, left tibio-tarsus (somewhat crushed), from the lower Sheep Creek beds (early Middle Miocene) collected in quarry 20 miles south of Agate, Sioux County, Nebraska, in 1922, by A. Thomson. Shaft of bone flattened and slightly distorted, restored by the skill and meticulous care of Mr. Thomson nearly to original condition.

Outer face of external condyle rounded in outline, projecting farther in front than in rear, excavated centrally to form an oblong pit, bounded, save above, by the heavy rounded margin of the condyle, this margin being narrower on posterior side than below or in front; a low, elongate tubercle on lower side of shaft immediately above the depression mentioned; anterior face of external tubercle flattened, sloping inward to join at a sharp angle the perpendicular wall of the intercondylar fossa that bounds the inner side; lower face somewhat rounded, sloping gradually into intercondylar sulcus, merging gradually into the plane of the posterior surface with gentle inward slope; internal condyle not as high as external one, projecting anteriorly for nearly half of antero-posterior diameter, a considerably greater distance than in case of the external condyle, a circumstance due to the narrower form of the inner side of the shaft; outer face of inner condyle deeply excavated, with a large, rounded tubercle projecting at its center; this excavation bounded by a strongly raised ridge, save above, posterior to median tubercle where the depression passes as an open trough to side of lower posterior face of shaft; internal condyle projecting outward beyond line of shaft more than outer condyle; intercondylar sulcus broad, shallow with gently rounded bottom, the median point located slightly nearer the outer condyle; intercondylar fossa deeply incised to level of base of shaft, bounded on outer side by nearly perpendicular wall, on the inner margin by a slightly less abrupt line; broad, nearly plane at bottom, with slightly deeper excavation on outer side, divided into two depressions by a low transverse median ridge, tendinal bridge (for extensor digitorum communis tendon) strong, somewhat arched, a broad area separating the groove that passes beneath it from the external margin of the shaft; groove for the peroneus profundus short but distinctly marked; shaft somewhat crushed and distorted (skillfully repaired), but sufficiently perfect to indicate its slender, flattened form, with compressed outer and broader inner margins; peroneal ridge long, strong, blade-like, elevated distally, where it passes to the body of the shaft by an abrupt declivity, merging more gradually into shaft above, excavated along base on posterior side;

¹In the present paper the generic name *Urubitinga* is used as in the 'A. O. U. Check-List,' 3rd Ed., 1910, p. 160. According to Opinion 62 of the International Commission on Zoölogical Nomenclature (Smiths. Inst., Publ. 2256, March 1914, pp. 147-149) it would appear that *Urubitinga* Lesson should be replaced by *Morphnus*, since Gray in 1841 established *Falco urubitinga* Gmelin as the type of *Morphnus* Cuvier, 1817 (actual date December 7, 1816). Mathews (1915, Austr. Av. Rec., III, p. 10) has brought to attention the fact that *Morphnus* was first published (as of Cuvier) by Dumont in the continuation of the 'Dictionnaire des Sciences naturelles par plusieurs Professeurs du Jardin du Roi, etc.,' I, Suppl., October 12, 1816, p. 88. It seems doubtful that Gray's action with regard to type fixation of *Morphnus* Cuvier will hold for *Morphnus* Dumont of earlier date, so that *Urubitinga* may for the present be considered valid.

²1884, 'List Diurn. Birds of Prey,' p. 77. (Mexico and Guatemala.)

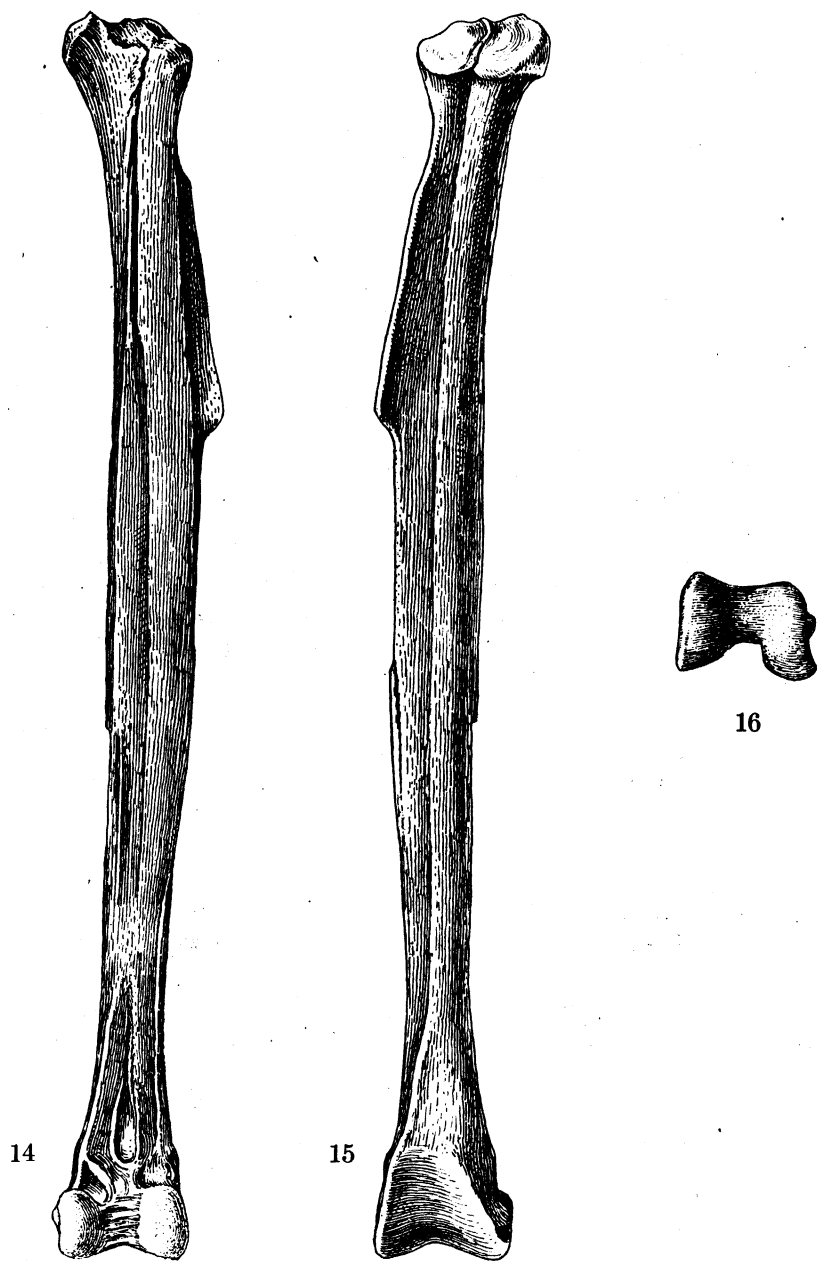


Fig. 14.—*Urubitinga enecta*. Anterior face of left tibio-tarsus (type), natural size.

Fig. 15.—*Urubitinga enecta*. Posterior surface of left tibio-tarsus (type), natural size.

Fig. 16.—*Urubitinga enecta*. Distal outline of condyles of tibio-tarsus (type), natural size.

posterior margin of head deeply notched in middle; a high central tubercle; remainder of head considerably damaged.

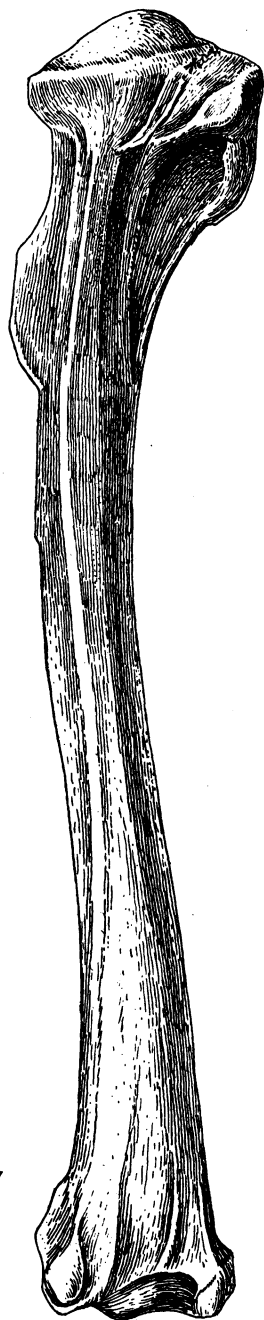
MEASUREMENTS.—Total length, 163.0 mm. (approximate); transverse breadth across condyles, 17.0 mm.; depth of internal condyle, 12.5 mm.; depth of external condyle, 12.5 mm.; length of articular portion of peroneal ridge, 32.0 mm.

In slender form and in the notching of the posterior margin of the head, characters found in the fossil here described, the tibio-tarsus in modern *Urubitinga* differs distinctly from other buteonids examined. In *Urubitinga* the transverse breadth of the lower condyles is equal to only about one-tenth of the total length, while in such species as *Geranoaëtus melanoleucus*, *G. contortus*, *Buteo borealis*, *B. galapagensis*, *Rupornis ridgwayi*, and *Heterospizias meridionalis* the lower end of this bone is distinctly broader. Though smaller buteos (notably *B. lineatus*) may be proportioned like *Urubitinga*, the larger forms have the tibio-tarsus distinctly stronger. The bone in *Heterospizias* is more slender than in other large hawks of similar size, but still is heavier than in *Urubitinga*.

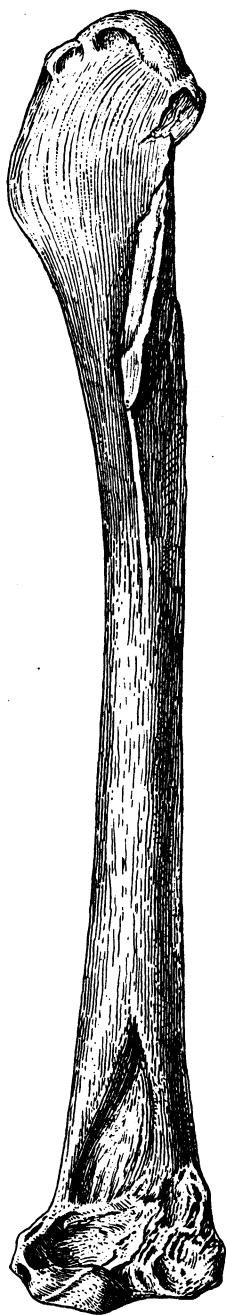
Associated in a small pocket with type of *U. enecta* was found a left humerus that, through careful restoration, is nearly perfect, parts of two radii, and a nearly complete right scapula, that perhaps came from one bird; part of another radius represents some other hawk.

The peculiarities of the humerus are shown in the accompanying drawings (Figs. 17 and 18). It must be remarked that the humerus in the larger buteonids is remarkably similar in general appearance in species otherwise very distinct. The humerus now under discussion, which is strong and heavy, has the depression for the brachialis anticus restricted, with a broad, comparatively smooth, space separating that depression from the base of the ectepicondylar process, as in *Urubitinga ridgwayi*, and not as in *Geranoaëtus* and *Buteo*. The size of the humerus is a certain indication of the bulk and weight of this ancient hawk, which was apparently as large a bird as the two species of *Geranoaëtus* of Miocene times, but one with longer, more slender legs. Careful comparison of the fossil specimens shows that the tarso-metatarsus that articulated with the tibio-tarsus of *Urubitinga enecta* was even more slender than that of the modern *Geranoaëtus melanoleucus*, and consequently much lighter in form than that of *G. contortus* or *G. conterminus*.

Though *Urubitinga* is here first reported as a prehistoric genus, it is not improbable that some of the fossil hawks previously described may transfer to this group on careful comparison. Thus, the slender form and high location of the tubercle for the tibialis anticus seen in the metatarsus of the bird known as *Geranoaëtus fragilis* L. H. Miller indicate an approach toward *Urubitinga* and may perhaps be sufficient to transfer



17



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Fig. 17.—*Urubitinga enecta*. Posterior face of left humerus, natural size.
 Fig. 18.—*Urubitinga enecta*. Anterior face of left humerus, natural size.

the species to that genus. The degree of relationship of *Aquila danana* Marsh to *U. enecta* is somewhat uncertain. The type of *A. danana*, the broken end of a left tibio-tarsus,¹ apparently has the dimensions found in *U. enecta*, but differs in the outline of the lower margin of the condyles, and in other details.

Aquila species

The distal end of a left radius secured by the Princeton University Expedition of 1914 (at locality 1000 C in T. 25 N., R. 55 W., S. E. $\frac{1}{4}$ to middle of Sec. 3) is rather closely similar in form to that of a golden eagle (*Aquila chrysaetos*). The bone in question is slightly smaller than the radius of the modern golden eagle, and, save that the protuberances are more swollen, is similar in general outline. It is probable that it represents a larger species than the fossil *Aquila danana* Marsh. The fragment measures 12.5 mm. in transverse diameter across the head. It was taken from the Upper Miocene levels of the Snake Creek beds.

Proictinia effera, new species

CHARACTERS.—Larger than *Proictinia gilmorei* Shufeldt.² Metatarsus (Figs. 19 and 20) somewhat similar to that of *Ictinia mississippiensis* (Wilson)³ but external crest of talon relatively lower, external ligamentous ridge more prominent, tubercle for tibialis anticus relatively higher on shaft; outer proximal margin produced posteriorly as distinct sharp-edged plate separated by a shallow groove from the external crest of the talon; much longer and slightly heavier.

DESCRIPTION.—Type, Cat. No. 6299, Dept. Vert. Pal., American Museum of Natural History, right tarso-metatarsus with inner side imperfect, from the Lower Harrison beds (Lower Miocene) collected in Agate Fossil quarry, Sioux County, Nebraska, by A. Thomson. Outer trochlea narrow, comparatively small and weak, with a slight platelike, posterior projection, and a slight depression on the outer and inner faces, separated by a narrow cleft from the middle trochlea; middle trochlea stronger, heavier, impressed with a shallow groove extending clear around, less perfect on inner side; inner and outer faces concave; inner trochlea broad with substantial base, separated by a narrow, straight-walled cleft from middle trochlea; outer wing broken away; inner trochlea produced distally slightly farther than middle one, middle trochlea extending slightly beyond level of outer one, the middle trochlea projected farther toward the front than the others; inferior foramen large, placed at the lower end of a long shallow groove; posterior face of lower end of shaft decidedly flattened, comparatively smooth; (articular surface for first toe missing); external face of shaft flattened, plane, bounded by sharply angular margins, widening in a gradual swell to near median line and then, as gradually, contracting toward head of

¹Figured by Shufeldt, 1915, Trans. Conn. Acad. Arts Sci., XIX, Pl. II, fig. 13.

²*Proictinia gilmorei* Shufeldt, R. W., 1913, Bull. Amer. Mus. Nat. Hist., XXXII, p. 301, Pl. LV, fig. 27. Type, imperfect right coracoid (U. S. Nat. Mus. Cat. No. 6852) from Loup Fork Formation, "Lower Pliocene," Long Island, Phillips Co., Kansas, collected by J. B. Hatcher in 1884.

³*Falco mississippiensis* Wilson, 1811 Amer. Orn., III, p. 80, Pl. xxv, fig. 1. (A few miles below Natchez, Mississippi.)

bone to the narrow line of the external ligamentous ridge, broadly cut away at upper end, behind the ligamentary ridge mentioned, in a smooth slope that passes to the posterior surface of the bone; the external surface broadened again beyond the ligamentary ridge, continuing thus to end abruptly at the upper margin of the bone; lower end of front of shaft flattened, the greater part of the remainder of this surface missing; tubercle for tibialis anticus attachment large, located far up toward head of bone; a cuplike depression with distinctly outlined upper and lateral margins on anterior face below head; internal tubercle developed but cut away below where it descends toward shaft; outer proximal margin immediately below head produced as a sharp-edged plate separated from the small but elevated external crest of the talon by a shallow groove, this crest thus entirely on posterior face of bone; external

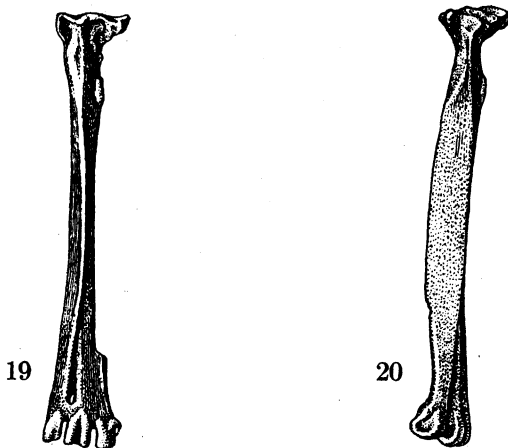


Fig. 19.—*Proictinia effera*. Anterior face of right tarso-metatarsus (type), natural size.

Fig. 20.—*Proictinia effera*. Outer surface of right tarso-metatarsus (type), natural size.

crest of talon perforated at tip by a small foramen; a broad shallow groove inward of this ridge; internal crest of talon broken away; glenoid facets on head shallow, the inner one deeper, with a raised outer margin; internal tubercle low and rounded; anterior semilunar groove faintly indicated; posterior semilunar groove distinct with rounded outline, rather narrow.

MEASUREMENTS.—Total length, 56.8 mm.; transverse breadth of head, 9.4 mm.; transverse breadth across trochlea, 9.4 mm.; distance from center of tubercle for tibialis anticus to upper end of bone, 9.6 mm.; width of external face at widest part, 5.3 mm.

The bird here under consideration needs comparison among other known fossil hawks only with *Proictinia gilmorei*, a genus and species named by Dr. Shufeldt from a broken coracoid, said to be from "Lower Pliocene, Loup Fork Formation, near Long Island, Phillips County, Kansas."

The type in question is apparently from a juvenile bird as it shows the porous, imperfectly ossified structure and lack of development of processes found in birds that have not yet attained adult stature. Immaturity is indicated too by the large size of the opening that leads from the inner side of the neural foramen to the cavity of the shaft. On careful comparison I find that the type of *Proictinia gilmorei* more nearly resembles the coracoid of the everglade kite, *Rostrhamus sociabilis* (Vieillot) than any other modern species, but is slightly shorter and a trifle more robust. It differs from *Rostrhamus* in the more central position of the tubercle on the dorsal face of the shaft, and in a slight thickening of the inner edge of the bone opposite this tubercle.

The metatarsus here described as *P. effera*, when compared with the metatarsus of *Rostrhamus*, is found to be decidedly longer and slightly heavier. By analogies derived from study of other kites I should expect *P. effera* to have a longer heavier coracoid than *Rostrhamus* or in other words it is my belief that *effera* represents a larger species than *P. gilmorei*. As *gilmorei* is known only from a coracoid and *effera* from a leg bone the difficulty of direct comparison between the two is obvious. The assumption that the Agate Quarry bird is congeneric with the species from the Loup Fork of Phillips County, Kansas, is arbitrary and is based solely upon the finding that both species concerned belong in the *Milvinæ*. Since the two come from horizons widely separated in time it is questionable whether the relationship between them was truly generic, but for convenience they may be so united for the present.

Three toe joints are mounted in place on the block that contains the metatarsus of this species. The fourth toe is represented by the basal phalanx only. This, shorter and heavier than in modern *Milvinæ*, is 5.5 mm. long. The basal phalanx of the middle toe measures 11 mm. and the second phalanx of the same digit 7.5 mm. These offer no peculiarities other than those noted.

BUTEONIDÆ INDETERMINATE

The proximal end of a right ulna (No. 466, collection of Harold J. Cook) taken in April, 1922 from Lower Miocene deposits at the same locality as that worked by the American Museum party in 1921 represents a hawk about as large as a caracara (*Polyborus*). The bone is considerably worn, but seems to have a very low carpal ridge. It is faintly suggestive of *Milvago chimango* but is much larger.

BUTEONIDÆ INDETERMINATE

The lower end of a right metatarsus (Princeton University Geological Museum Cat. No. 12157) collected by Dr. W. J. Sinclair at his locality 1000 D (in T. 25 N., R. 54 W., N. E. $\frac{1}{4}$ of Sec. 2) belongs to a hawk of the family Buteonidæ that may not at present be definitely determined. Dr. Sinclair informs me that this bone was secured with a few remains of a deer *Merycodus* (cf. *necatus*) from unconsolidated sand, apparently of the Upper Miocene level, though the fossils secured are too scanty to determine that point definitely. It is unfortunate that this specimen is not more complete since in many ways it is one of the most interesting in the entire collection studied in the present paper. The fragment consists of the lower part of a metatarsus with outer and inner trochleæ broken away and the middle trochlea considerably worn. It is peculiar in that the shaft on both anterior and posterior surfaces is flattened so that the support upon which the trochleæ rest is almost plane, instead of being depressed posteriorly at the base of the inner trochlea as is true in a vast majority of the genera of birds. In addition, the articular facet for the first metatarsal is placed very low on the shaft. Though broken, and somewhat worn the bone does not appear to have been flattened by crushing, nor does it seem to be deformed.

The fragment available is suggestive of the marsh hawks (*Circus*) and the bird hawks of the genera *Accipiter* and *Astur*, while in the low position of the facet for the first metatarsal it is similar to the carrion hawks (*Polyborus*, *Milvago* and *Ibycter*). The bone resembles that of the common marsh hawk (*Circus hudsonius*) in general sculpture, and in its broadened median trochlea with a distinct excavation at its base on the posterior surface, but is somewhat more robust, is more flattened at the distal end of the shaft, and has the first metatarsal articulation lower. *Astur* and *Accipiter* have the same flattened shaft and similar ridges to the fossil, but have the median trochlea narrower and the first metatarsal articulation higher. The fossil resembles these in the angular form of the internal intertrochlear sulcus, which is V-shaped, sloping outward to the base of the internal trochlea, rather than U-shaped as in *Circus*. The fossil is not near the group containing *Buteo* though placed there in preliminary examination (see 1915, Proc. Amer. Phil. Soc., LIV, p. 77).

The bone under discussion may be representative of a primitive stock ancestral to some of our modern forms; additional remains will be awaited with interest, as it is felt that the present specimen is too fragmentary to warrant a name.

