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Fossil Birds
in the
Marsh Collection
of
Yale University

BY
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FOSSIL BIRDS IN THE MARSH COLLECTION OF YALE UNIVERSITY

By R. W. Shufeldt.

INTRODUCTION.

On the twelfth of March, 1914, Professor Charles Schuchert, Curator of the Geological Department of the Peabody Museum, Yale University, sent me for revision nearly all the fossil birds (types) that had, in former years, been described, and in some few instances figured, by Professor O. C. Marsh. These did not include the species of the genera *Ichthyornis* and *Hesperornis*, and one or two others, as they were then receiving the attention of Professor R. S. Lull of the above institution. The material upon which Marsh based his *Grus proavus* could not, after long and careful search, be located, and up to the present writing I have never seen it.

Five of the types described by that distinguished palæontologist were in the collection of the Academy of Natural Sciences of Philadelphia, and for the loan of these I am under great obligations to Doctor Witmer Stone of that institution who, with unbounded kindness, sent them to me for study in the present connection. They are the types of Professor Marsh's *Uria affinis*, *Uria antiqua*, *Puffinis conradi*, *Grus haydeni* and *Palæotringa vetus*. In the following pages all of these have received my most careful study and consideration, while figures of them are given on the Plates.

In his letter transmitting the material, Professor Schuchert was good enough to say: "You are at liberty to rework this material and to photograph it as you think best." Later on, to still further place me in his debt, he sent me over one hundred more lots of fossil birds from the Peabody Museum to describe and figure, and which he suggested should appear in the same contribution—that is, in the present one, in which all this material is described. Not only am I to have the pleasure of thanking Professor Schuchert and Doctor Stone for these most unusual favors, but also Doctor Richard S. Lull and Aid, T. A. Bostwick of the Peabody Museum, for tabulated information taken from the Records regarding certain data that I needed in this work, which was not an easy task by any means, and thus my appre-

ciation of it is rendered all the keener and my gratitude the more profound.

My thanks are likewise extended to the United States National Museum for the loan of skeletons of existing birds from the collections of that institution, for the purpose of photography and comparison with the fossil material here presented, and for the additional loan of fossil types (*Diatryma*, etc.) for the same purpose. Especially am I indebted to Mr. Charles W. Gilmore, Curator of the Fossil Birds and Reptiles of the Division of Palæontology of that museum, for many courtesies in this connection, and for permitting me to study the museum material, as well as to Doctor Charles W. Richmond, Assistant Curator of the Division of Birds, for similar favors, and for his great kindness in affording me every facility within his power to obtain all the material I needed, to make the comparisons entailed in work of this character. His Aid, Mr. J. H. Riley, also has my thanks for assistance in the matter of carrying out Doctor Richmond's instructions as to the consignment of the specimens, and other details. Indeed, taken as a whole, I feel myself to be under lasting obligations to all those whom I have named; for without their aid the results I here offer would have been impossible of accomplishment. Moreover, I am fully sensible of the honor of which I am the recipient through the placing in my custody of material of such incalculable value, and selecting me to be the one to furnish its description for publication.

The descriptions of the species are arranged geologically, ranging from Cretaceous to Pleistocene. At the close of the article, however, a Summary appears, in which the results of the study are more systematically arranged, and set forth for the reader's convenience. No attempt has been made to submit an elaborate bibliography of the subject, as in initial work of this character it offers no especial value.

The most of Professor Marsh's descriptions appeared in the *American Journal of Science* and these will be quoted, as well as papers on the subject by other writers and my own. As a matter of fact, the literature on the fossil birds of North America is by no means extensive, and for the reason that, comparatively speaking, so very few of them have fallen into the hands of science.

After all the above-mentioned material was in my hands, Doctor Schuchert wrote me, on the eighteenth day of April, 1914, that he had sent me "a small registered package with a few ? bird bones from Como, Wyoming, that are from the Morrison = Lower Cretaceous

(some say Jurassic but as they mean Wealden the horizon must be Lower Cretaceous). If you make these bones out as those of birds they would be the oldest in America. However, they may be pterodactyl bones."

This specimen was received by me on the 21st of April, 1914, and I found it to be two small, very friable bits of bone. One piece, much crumbled, remained in the hard, gray matrix; the other was out of it. It is a long bone, and hollow, with *thin* walls to the cavity, and in some respects resembles a coracoid of a bird of the size of a Woodcock. It is altogether too fragmentary to serve the purpose of correct identification, and my impression is, it never belonged to a bird.

This Como material (Wyoming) is quite abundant in the palæontological collections of the United States National Museum, and through the kindness of Mr. C. W. Gilmore I was allowed to examine a large part of it. Most of the fossil bones are *black*, brittle, and still in the same hard, gray matrix, being there considered *Jurassic*. I failed to find anything that could be considered *bird*. Most of them were reptilian, as chelonians, small forms related to the Crocodilia, and so on. Mr. Gilmore had already described some new forms from it, and had others he intended to describe later on. So far as this examination carried me, it left the impression on my mind that we have yet to find the fossil remains of birds, *as* birds, from that horizon.

The specimen Doctor Schuchert sent me is Cat. No. 976, and marked "Birds ? Qar. 9. Como, Wy. W. H. Reed Col. 1880," and on the cork of the vial "Jurassic." In passing I may say that I examined the fossil remains of such pterodactyls as were to be found in the collection of the United States National Museum, and I am convinced that this specimen never belonged to one of those animals. There is a far greater likelihood that it belonged to some—not very large—reptilian form; further than this I would not care to say.

Beyond the "toothed forms," as seen in *Hesperornis* and *Ichthyornis*, Professor Marsh described in all not more than some twenty-seven or twenty-eight species, and the majority of these were referred to the same avian families and genera as those now found in the existing avifauna.

Most of the material I have here to describe was undoubtedly seen by him, as it was obtained by his staff of collectors. The museum collections in his day contained but few study skeletons of existing birds, thus rendering the proper comparison of bird fossils an unprofitable and uncertain task, and this may have influenced him to set aside what he had collected and suspected of being "bird."

It is left to the reader to judge of the correctness of such determinations as he did make, and of such species as he described, after a study and examination of the present contribution, including the plates and figures.

CRETACEOUS BIRDS.

FAMILY APATORNITHIDAE.

Genus APATORNIS Marsh.

Marsh, Amer. Journ. Sci., ser. 3, V, 1873, 162. Type, by monotypy, *Ichthyornis celer* Marsh.

APATORNIS CELER (Marsh).

Ichthyornis celer Marsh, Amer. Journ. Sci., ser. 3, V, 1873, 74.

Holotype. Cat. No. 1451, Peabody Museum, Yale University. Butte Creek, Kansas. Upper Cretaceous (Niobrara). O. C. Marsh, collector.

Fossil sacrum (without the pelvic bones) of a bird about the size of a medium-sized Tern (*Sterna*), and a thin sliver of fossil bone about a centimeter long and a millimeter in width.

Marsh first described this specimen as a sacrum of an *Ichthyornis* (*I. celer, antea*), but he subsequently made a new Family and genus for it, *i. e. Apatornis.* The specimen is very imperfect, and so much compressed for its anterior half, transversely, that the spinal canal has been *entirely obliterated.* This has given the bone in that locality the very *narrow* appearance, which, added to the fact that the ventral part has been chipped off on both sides for the entire length, led Marsh to believe that the sacrum was decidedly narrower and morphologically different from the bone as he found it in *Ichthyornis.* This specimen, palæontologically speaking, is not a kind upon which to base a *new genus* of extinct birds; and I am of the opinion that the bone in question belonged, in life, to a species of *Ichthyornis*, and that Professor Marsh was nearer the truth when he described it as *Ichthyornis celer.* Evidently it was in two pieces at one time (it is now glued together at the middle); and it is a significant fact that the hinder half or piece does not exhibit the transverse compression that the anterior half so markedly presents. Indeed, the last vertebra of this sacrum has its neural canal intact, the neural canal not being distorted in any way, while the first vertebra is so much compressed from side to side, that not only is the neural canal entirely obliterated, but the bone itself has lost all semblance to a bird's vertebra in that part of the spinal column.

BAPTORNIS ADVENUS Marsh.

(*Plate I, Figs. 1–6*; *Plate II, Fig. 12.*)

Marsh, Amer. Journ. Sci., ser. 3, XIV, 1877, 86.

Holotype. Cat. No. 1465, Peabody Museum, Yale University. Wallace Co., Kansas. Cretaceous (Niobrara). G. P. Cooper, collector.

The discovery of this fossil (two fragments) or fossils, of which there is no question about their having belonged to the skeleton of a new extinct bird, led Professor Marsh to believe that the species to which it belonged in life was "a small swimming bird cotemporary with *Hesperornis*," and that what he has before him was "a perfect tarso-metatarsus bone from the same geological horizon." He further maintained in his article that "This specimen, although pertaining to a bird not fully adult, is in excellent preservation, and so characteristic that it may be readily distinguished from any forms already described." This statement, in some particulars, is sustained by the figures I here present in Plates I and II (Figs. 1–6, 12), which are somewhat reduced in size and present the two fragments from three points of view. Now I am not informed as to the nature of the proof Professor Marsh may have had, going to show that these two pieces belonged to the same individual. The fracture surfaces, when approximated, do not indicate that they did, for they do not join in the way they would had the shaft of the bone been simply broken across. Possibly as much as the *middle* third is missing—that is, if the specimen is from the same individual, which I am inclined to doubt, inasmuch as the proximal fragment is from a subadult bird (Pl. I, Figs. 2, 5, 6), as Professor Marsh states, while the distal fragment presents no evidence of such having been the case.

"In general shape and proportions," continues Professor Marsh, "this bone most nearly resembles the corresponding part in *Hesperornis*, but differs from it decidedly in the outer metatarsal, which at its lower end scarcely equals the adjoining one in size and length.

"In *Hesperornis*, on the contrary, the outer metatarsal is more than double the size of the third.

"In the present specimen the three trochlear articulations of the distal ends are nearly equal.

"The existence of a hallux is indicated by a small elongated depression on the inner metatarsal, a short distance above the articulation.

"As in *Hesperornis*, there are no canals or grooves for tendons on the posterior face of the proximal end."

Professor Marsh nowhere in the article states whether this bone came from the right or the left pelvic limb. From the fact, however, that he speaks of the "outer metatarsal," he apparently recognized that the bone was from the *right side*, which is the case. This outer metatarsal is, however, not "double the size of the third," but is simply one centimeter *longer* than the third, or has exactly the same length as the middle metatarsal.

With respect to the proximal piece, which is evidently from a very young bird, ossification has not proceeded sufficiently far to have formed "canals or grooves for tendons" on the posterior aspect of the bone. As a matter of fact, when present, they are not found until complete development and ossification has culminated, as we find it in the fully matured individual. In *Gavia immer* the groove is narrow and sharply defined for the lower half of the posterior aspect of the shaft of the tarso-metatarsus in the adult bird, being shallower and broader above. These grooves, however, are always present in this locality on the tarso-metatarsi of all powerful swimming birds and divers.

To me, there is a lack of clarity in Professor Marsh's description of this material, and especially in what he says in regard to its agreement with the tarso-metatarsus of *Hesperornis*. Both these birds were powerful divers but utterly different forms. He states that "This specimen indicates a bird about a large as a loon and apparently of similar habits. The locality of the remains at present known is in Western Kansas, in the same cretaceous beds that contain the *Odontornithes* and *Pteronodontia*."

I have carefully compared these two fragments of Marsh's "*Baptornis advenus*" with the corresponding bone in both *Gavia immer* and *Hesperornis regalis*, and I am of the opinion that the specimen belonged to a diver related, on the one hand, to the *Hesperornithidæ*, and on the other to the existing *Pygopodes*, perhaps—though by no means certainly so—to a family group in which *Gavia* belongs, that is, so far as its affinities are concerned, it was no nearer the one than the other. Our Loons (*Gavia*) are descendants from hesperornithine stock, and this *Baptornis advenus* of Marsh, although from the Cretaceous of Kansas, may not have been so nearly related to *Hesperornis* as he inferred. It was doubtless larger, perhaps *when adult* considerably larger, than the present *Gavia immer*, as I believe it to have been; but whether it possessed teeth or not we have, as yet, no evidence.

As in other existing divers among the *Pygopodes*, there is very marked transverse compression of the shaft and distal extremity of

the *tarso-metatarsus*, a compression into which the proximal end or head of the bone does not enter. In fact, the entire tarsus and foot in life presents this lateral compression in such a form as *Gavia immer*, and, in swimming, it permits a rapid, unimpeded stroke of this part of the pelvic limb through the water, both forwards and backwards. This means increased speed in swimming and diving on the part of these modern pygopodines, a power which I believe they possess quite in excess of either *Hesperornis* or *Baptornis*, though in the last two genera the latter exhibits the character better than does the representative of the toothed birds. *As* a character, it has become emphasized during the evolvement of the tribe, and a comparative study of the skeleton of the foot in these several birds will convince one of the truth of this.

The name *Baptornis advenus* of Marsh should stand.

Genus CIMOLOPTERYX Marsh.

(*Plate VI, Figs. 38, 39.*)

Marsh, Amer. Journ. Sci., ser. 3, XXXVIII, 1889, 83, footnote. Type, by subsequent designation, *Cimolopteryx rara* Marsh (Hay, 1902).

CIMOLOPTERYX RARA Marsh.

(*Plate VI, Fig. 38.*)

Marsh, Amer. Journ. Sci., ser. 3, XXXVIII, 1889, 83, footnote; Ibid, XLIV, 1892, 175, Plate III, Fig. 2.

Holotype. Cat. No. 1805, Peabody Museum, Yale University. Converse Co., Wyoming. Cretaceous (Lance). J. B. Hatcher, collector.

Also: Cat. No. 868, Peabody Museum, Yale University. Converse Co., Wyoming. [Cretaceous (Lance). Lull.]

In his article cited above (Art. XI. "Discovery of Cretaceous Mammalia," p. 81), Professor Marsh briefly describes this material in a footnote, thus "Remains of a single bird were found at one locality in association with the mammals. It was about as large as a pigeon, and had strong powers of flight. It appears to be related to *Apatornis*, one of the toothed birds described by the writer. It may be called *Cimolopteryx rarus*."

In the places cited, Marsh gives figures and descriptions which quite fully describes the coracoids of these birds; but in the present species, so far as I have discovered, he did not mention that the process at the outer sternal angle had been broken off,—a process which is present in the coracoids of both *Ichthyornis* and *Apatornis*. The lower margin of the bone is likewise chipped.

I have compared this bone with the coracoids of many species, especially Grebes, *Limicolæ*, and other water birds, and I am convinced that it belongs to a genus of which there are now no living representatives. It possibly was a toothed form and related—but not closely related—to *Ichthyornis*.

Cat. No. 868 is likewise in this category; it is the anterior end of a fossil scapula of the left side, which belonged to some bird of medium size. As a rule, avian scapulæ are not often, when taken alone, of much value for identification, and this fragment is distinctly in this class.

CIMOLOPTERYX RETUSA Marsh.

(*Plate VI, Fig. 39.*)

Marsh, Amer. Journ. Sci., ser. 3, XLIV, 1892, 175, Pls. II–V (four views of the coracoid).

Holotype. Cat. No. 513, Peabody Museum, Yale University. Converse Co., Wyoming. Cretaceous ("Laramie"). J. B. Hatcher, collector.

The fragmentary head of a left coracoid (Fig. 33) is also briefly described by Marsh as cited above.

Imperfect as the piece is, and meagre in the matter of material, it is very evident that it belonged to a bird in an entirely different genus, if not different family, from *C. rara*.

The *heads* of these two coracoids are essentially very different; and the remarkable part of it is that Professor Marsh *noted* these differences and yet ignored them. In describing the present one, he says: "This bone lacks the strong inner process near the pit for the scapula, which is characteristic of the smaller form."

Their morphology as a whole is quite different, and the birds certainly belonged in different genera, to say the least. Why should they be arrayed with the PASSERES in the "Fossil Birds" of the A. O. U. Check List (1910, p. 392) is not clear to me, for passerine birds they surely are not.

If such a List, these forms, as a genus, might be made to follow after *Ichthyornis*, though with the understanding that *Cimolopteryx retusa* belongs in a very different group; and, as a matter of fact, the material upon which the species is made should be set aside as too fragmentary for reference until more of it is at hand.

CONIORNIS ALTUS Marsh.

(*Plate III, Figs. 22–24.*)

[*Hesperornis regalis.* Pl. IV, Figs. 25–27.]

Marsh, Amer. Journ. Sci., ser. 3, XIV, 1893, 81, Figs. 2–3*a*.

Holotype. Cat. No. 515, Peabody Museum, Yale University. Judith River, Montana. Cretaceous. J. B. Hatcher, collector.

As indicated by the fossil remains of the type, *Coniornis altus* was a bird of very considerable size. We find its description by Professor Marsh in *The American Journal of Science* for the year 1893, where he compares it with *Hesperornis regalis*, Marsh, and states that "The present type specimen [of *Coniornis altus*] indicates a bird about two-thirds the size of *Hesperornis regalis* Marsh or about four feet in length, from the point of the bill to the end of the toes. It was recently found by Mr. J. B. Hatcher, near the mouth of the Judith River, in Montana."

Inasmuch as we have but the lower part of the right tibio-tarsus of this bird in our possession, and as this fragment, as Marsh pointed out in his article,[1] would seem to indicate that it belonged to a species generically distinct from *Hesperornis regalis*, it would hardly seem that one would be justified in stating that it measured four feet from the tip of the mandible to the end of the toes. Indeed, no one would be justified in making such a statement, based upon only a part of one of the long bones of the skeleton.

Marsh's article on *Coniornis* is illustrated with five figures, giving the anterior (Fig. 1), lateral (Fig. 2) and posterior (Fig. 3) views of this fossil, together with a horizontal section of the shaft (Fig. 1 *a*) and a view of the condyles from below (Fig. 3 *a*). These "figures are one-half natural size," and to some extent restorations, as will be appreciated by any one who will compare them with my figures of the fossil remains of *Coniornis altus* in Plate III, Figures 22, 23 and 24 of this article.

At the present writing the *type* specimens representing *Coniornis altus* belong in the collections of the Peabody Museum of Yale University, and are at hand for examination (Cat. No. 515). It will be seen from the Plate that the specimens is in three pieces: a large distal portion of the right tibio-tarsus and two proximal fragments of the shaft which belong to it, and these, when brought together, are found to be in direct continuity with the aforesaid distal portion. (My figures are given about natural size.) This latter measures in total length

[1] Art. VIII.—*A New Cretaceous Bird allied to Hesperornis.*

11.5 centimeters, and was, at some time or other, broken into about twenty fragments, fairly good repair having been made through the use of glue and plaster-of-paris.

So far as I am aware, this is the only material in existence representing this extinct bird, and Professor Marsh's description of it is given in sufficient detail for all practical purposes of comparison. He believed the bird to be "distinct from *Hesperornis*, and of smaller size, but evidently belonging to the same general group of gigantic swimming birds." This may or may not have been the case, and he may have been influenced in his opinion by the fact that the specimen was found "associated with marine fossils of Fox Hills types, and certainly from a much higher horizon than that in which *Hesperornis* occurs" (loc. cit., p. 81).

Professor Marsh further believed that the distal portion of a bird's tibio-tarsus, including a fair part of the shaft, "is a most characteristic part of the skeleton," of which statement it may be said that it is not nearly as much so as is the distal portion of the tarso-metatarsus, or the proximal moiety of a humerus. We may make grave errors in relying too much on the characters presented on the part of the distal moiety of the tibio-tarsus, when we have in our possession for comparison only this portion of the skeleton. If we meet with marked differences in it, as compared with the corresponding ones in the bone of the species with which it is being compared, then we may be quite certain that the balance of the skeleton may be very different indeed, and may, in fact, not belong to the same group of birds at all.

This specimen evidently belonged to an "adult bird," as Marsh states, for the epiphyses are most firmly united to the distal end of the shaft. He further observes that this "tibia as a whole was very long and slender, with the shaft hollow throughout," in which surmise he was probably correct, although the statements are based purely upon indications. He found, too, that "In its general features, the specimen resembles most nearly the corresponding part in *Hesperornis*. The general proportions of the two are similar. The cavity in the shaft of each is equally extensive, and is bounded by smooth, well-defined walls. The ridge for the fibula is equally developed, indicating that this bone was proportionately of the same length in both, and probably of the same form.

"The differences between the present fossil and the corresponding part in *Hesperornis* are, however, strongly marked. In the latter, the distal end of the tibia is curved inward, and the smaller inner

condyle is especially prominent below. In the present specimen, the outer condyle is the lower, and the inner one is nearly on a line with the inner margin of the shaft." (See Pl. III.)

On the twenty-fourth of March, 1914, the United States National Museum loaned me the *cast* of the left tibio-tarsus of *Hesperornis regalis*, a privilege I am most grateful for, as I am to Mr. J. W. Gidley and to Mr. C. W. Gilmore of that institution for placing the specimen in my possession for the purposes of photography. This I accomplished the following day, Plate IV being a reproduction of the photographs made from my negatives. They present the lower half of the shaft on the three principal views, corresponding with those I present of *Coriornis altus* on Plate III.

The cast of this tibio-tarsus is of the same bone—with its imperfections restored—which Marsh figures in five views in the *Odontornithes* (Pl. XIV, Figs. 1, 2, 2*a*, 3 and 3*a*), it being from the left pelvic limb.

Marsh's figures are of natural size, and have been so drawn that the *compressed* parts in the original have been altered so as to restore their probable *normal* bulk and proportions, which anyone will appreciate by comparing them with my figures, which are, as I have stated, reproductions of photographs made direct from the specimen, they having been reduced rather more than one-fifteenth.

As examples of the aforesaid alterations, I may say that in Professor Marsh's *figures* (1 and 3) the transverse diameter of the distal end of the bone just above the condyles measures 3.4 centimeters, whereas, on the actual specimen, the same diameter measures but 3 centimeters. Posteriorly, the intercondylar valley or space in Marsh's Figure 3 measures transversely 2.1 centimeters, while in the specimen the same diameter is but 1.6 centimeters.

The caliber of the distal moiety of the shaft presents the same form, and all its diameters are the same in Marsh's figures of this bone as they are in the specimen; they also agree for the longest anteroposterior diameter of the external condyle.

We are not concerned here with the proximal moiety of this bone, for the reason that we have not that part for *Coniornis altus*.

I have carefully compared the characters of the distal end of the tibio-tarsus of the latter bird with the corresponding ones in the tibio-tarsus of *Hesperornis regalis*, and I do not find them to be so much at variance as Marsh made them out to be; indeed, they are no greater than would be presented on the part of *two good species* of *Hesperornis*, in so far as this part of the tibio-tarsus is concerned. In

some respects these differences are no greater than we would meet with in the case of two individuals of the *same species.*

The distal transverse diameter of the condyle is identically the same in both. In form and relative size the condyles agree in the two forms almost exactly. The characters of the anterior tendinal groove agree; while in both forms the antero-posterior flattening of this part of the shaft is the same. Where the condylar crests are more prominent in *Hesperornis*, they have been broken off in Marsh's *Coniornis altus*, and this likewise applies to the elevation for tendinal attachment on the anterior aspect of the shaft on the *outer side* of the tendinal groove, above the external condyle.

Why the specific name of *altus* should have been bestowed upon this fossil bird, it is not for me to say; the fragment of its skeleton does not offer a sufficient reason for it.

In my opinion, *Coniornis altus* of Marsh is but another species of *Hesperornis*, and one closely related to *H. regalis.* Furthermore, from such indications as we may legitimately consider, and which are presented on the part of the fragment at hand, it was a form nearly as large as *Hesperornis regalis*, and henceforth it should be relegated to that genus and bear the name of *Hesperornis altus.*

In instituting comparisons like the above, the fact must ever be borne in mind that in all birds their skeletons present certain individual variations, in addition to those which are due to sex and age. This is especially true with respect to Loons, Grebes, Divers and their allies, and it is fair to presume that, in the genus *Hesperornis*, the same variations were to be found; while in the case of fossils of great age, *distortion* due to pressure must always be taken into account.

Genus GRACULAVUS Marsh.

(*Plate VI, Figs. 33, 34; Plate VII, Figs. 49, 53; Plate XIII, Figs. 91–93; Plate XV, Figs. 125-127.*)

Marsh, Amer. Journ. Sci., ser. 3, III, 1872, 363.

In the collection of the Peabody Museum, Yale University, of fossil birds, I find the following *types* of the genus *Graculavus* of Marsh, and other material referable to it:

Graculavus velox.
Graculavus pumilus.
Graculavus anceps.
Graculavus agilis.
Graculavus lentus.
Graculavus, [sp.?]

GRACULAVUS VELOX Marsh.

(*Plate VI, Figs. 33; Plate VII, Fig. 49.*)

Marsh, Amer. Journ. Sci., ser. 3, III, 1872, 363.

Holotype. Cat. No. 855, Peabody Museum, Yale University. Hornerstown, New Jersey. Cretaceous. J. G. Meirs, collector.

This species is based upon a fossil fragment of the proximal end of a left humerus (not the proximal "half" as Marsh has it). It is chipped and otherwise imperfect, the color being a muddy, darkish green. Professor Marsh said of it that "In its general features this humerus [*sic*] resembles that of the common Cormorant (*Graculavus carbo* Linn.), although indicating a somewhat smaller species." (p. 363.)

As it was upon this fragment that the genus *Graculavus* was based, I have most carefully compared this type material with the proximal ends of the left humeri of a number of species of Cormorants, and in Plate VII, Figures 48-55, I illustrate these comparisons, not only with *Phalacrocorax* but with other birds.

It may be seen at a glance that the proximal end (anconal aspect) of the humerus of Marsh's *Graculavus* in hardly any particular agrees with the corresponding characters as they are found in the *Phalacrocoracidæ*.

In the first place, the *radial crest* of the humerus in a Cormorant has the appearance of having been shaved off, or in other words, it is *long* and unusually *low*. In *Graculavus* the *radial crest* is chipped off, but the indications are that it was rather *tall* and *short* as in an Oyster-catcher (*Hæmatopus*) (Fig. 50).

On the *ulnar aspect* of the head of the humerus in the *Phalacrocoracidæ*, the surface between the radial crest and the ulnar area over the pneumatic fossa, is *well defined* and markedly excavated; while in *Graculavus* it is relatively broader, very shallow, and not especially defined. This is as we find it in some other birds—strikingly so in such species as *Orthorhampus magnirostris*. This is not seen in Figure 51 for the reason that the anconal and not the palmar aspect of the bone is viewed there.

Again, comparing the anconal aspect of the head of the humerus of *Graculavus velox* with that of a Cormorant (*P. carbo*, *P. urile*), we find that the characters differ entirely.

1. On the radial side of the bone in *Graculavus*, distad to the *caput humeri*, there is a well-defined and somewhat circumscribed *depression*. This area is perfectly *flat* in *Phalacrocorax*.

2. The head of the bone in *Graculavus*, centrally, curls over a strongly marked excavation, which is extended back behind the ulnar projection. No such excavation occurs in *Phalacrocorax.*

3. In *Graculavus* the pneumatic fossa is *short*, defined from the mesial, elevated, longitudinal area of the shaft by a low, sharp crest, there being an interval between the two. In *Phalacrocorax* the formation is *entirely different:* the pneumatic fossa is broad and long, merging *everywhere* with the surface of the shaft, being as broad below as it is above, and the aforesaid crest is absent. As a matter of fact, *Graculavus* is in no way related to the *Phalacrocoracidæ*, and the *type* humeral head or proximal end is that part of the humerus which belonged to some apparently extinct species, which was not a steganopodine one at all.

As Professor Huxley long ago pointed out for us (P. Z. S., Apr. 11, 1867), such birds as Gulls, Plovers, Oyster-catchers, Curlews, and their allies, by him grouped as the *Schizognathous* birds, hold many osteological characters in common. He worked them out principally with respect to certain structures of the skull; while I may say here that similar resemblances are found throughout the skeletons of such genera, or the representatives of such genera, as I have just named.

For example, if we critically compare the *humerus* of a *Larus* with that of any Plover (*Vanellus*, *Charadrius*, etc.), and these again with the *humeri* of *Hæmatopus*, *Orthorhampus*, *Numenius*, *Philohela* and so on, we at once observe that a *general set* of characters are present in the humeri of them all. In some a certain character may be strong or pronounced, and in another it may be but feebly developed; while the *general facies* of the *humerus* cannot be mistaken. Now *Graculavus* had the *majority* of these schizognathine characters pronounced, in so far as the head of its humerus was concerned (see Figs. 50, 51 and 54); and so evident are these that, through an examination of *this* fragment, a well-informed avian osteologist could almost with certainty predict that Marsh's *Graculavus* was not only a schizognathous bird, but that it possessed more or less well-marked "supra-orbital glandular depressions," which Cormorants entirely lack, and so on for other skeletal characters.

Graculavus did not belong among the *Alcidæ;* and it was, judging from this fragment of its humerus, far less like any of the *Longipennes* (Gulls and their allies) than it was a number of *Limicolæ*. In other words, it was a limicoline species, and most nearly related to the *Charadriidæ* and the *Hæmotopodidæ*, that is, the Plovers and Oyster-catchers.

This being the case, the name bestowed upon it by Marsh is a particularly inappropriate and unfortunate one, and some such name as *Limosavis* would more correctly indicate its position in the system.

GRACULAVUS PUMILUS Marsh.

(*Plate VII, Fig. 53.*)

Marsh, Amer. Journ. Sci., ser. 3, III, 1872, 363.

Holotype. Cat. No. 1209, Peabody Museum, Yale University. Battle Creek, Kansas. Cretaceous. O. C. Marsh, collector.

Here we have a species of the genus *Graculavus* of Marsh, based upon the distal end of a right humerus (fossil); upon the distal moiety of the main shaft of the right carpo-metacarpus (fossil) and upon five slivers of bone, which probably belonged to the same individual, but which are, for the most part, too fragmentary for recognition.

As Marsh placed this extinct species in his genus *Graculavus*, it is fair to presume that he not only took it to be related to *Graculavus velox*, but likewise to *Phalacrocorax*. As a matter of fact, it was not related to a Cormorant in any way whatever, beyond the circumstance that both were birds. The head of this humerus, however,—that is, the one now being considered,—is distinctly from some limicoline species, and in that way related, within the same group, to *Graculavus velox* of Marsh. *Graculavus pumilus*, however, as these fragments clearly indicate, was a true scolopacine species, being a bird not far removed from either *Scolopax* or *Philohela*, and of a size about one-third (or a little more) larger than the latter (Pl. VII, Figs. 53, 54).

GRACULAVUS ANCEPS Marsh.

(*Plate XIII, Fig. 93.*)

Marsh, Amer. Journ. Sci., ser. 3, III, 1872, 364.

Holotype. Cat. No. 1208, Peabody Museum, Yale University. North Fork, Smoky Hill River, Kansas. Cretaceous. O. C. Marsh, collector.

In his description of the material upon which this species of *Graculavus* is based, it is given by Marsh as "the distal extremity of a left metacarpal." The *type* specimen is before me, with its number (1208) marked on it, and the determination of the bone (on a label with it) in Professor Marsh's own handwriting. I may say that it is probably the distal extremity of a left metacarpal, and if so, it belonged to some average-sized bird—a Curlew, for example; but it is so imper-

fect, *distorted*, and so meagre and characterless, that it is simply out of the question to determine what kind of a bird it originally belonged to in life. One thing is very sure, however: it never formed a part of a skeleton of a bird that had any special relation to the *Phalacrocoracidæ*.

As a specimen, it is valueless for the purpose of correct determination, even for the subordinal group.

GRACULAVUS AGILIS Marsh.

(*Plate XIII, Fig. 91.*)

Marsh, Amer. Journ. Sci., ser. 3, V, 1873, 230.

Holotype. Cat. No. 1209, Peabody Museum, Yale University. Battle Creek, Kansas. Cretaceous. O. C. Marsh, collector.

Two fragments of fossil bones, one of which is from a bird (Fig. 91); the other does not appear to be (Fig. 92). The fragment that can be determined is the upper or proximal end of the main shaft of the left carpo-metacarpus of some bird about the size of a Ptarmigan (*Lagopus*). It is extremely imperfect, chipped all over and very much abraded. Further, it is quite without characters, and from it alone it is entirely out of the question to judge as to what kind of a bird it belonged to in life. To say that it came from the skeleton of an extinct bird related to the Cormorants (*Phalacrocoracidæ*), is a statement that no reasonable avian palæontologist would entertain for a moment.

GRACULAVUS LENTUS Marsh.

(= *Pediœcetes phasianellus* (Linnæus). See page 25.)

GRACULAVUS [sp.?]

(*Plate XV, Figs. 125, 126.*)

Cat. Nos. 916, 917, Peabody Museum, Yale University. Hornerstown, New Jersey. Cretaceous. From Cream Ridge, Marl Co.

As will be seen by turning to Plate XV, Figures 125 and 126, the specimens representing a "new genus and species of *Graculavus*" are simply two pieces of the shafts of long bones which, whether they be birds, mammals, or reptiles, are worthless for the purposes of identification. If from birds (Nos. 916, 917), it would be simply impossible to say as to what kind of birds possessed them in their skeletons in life.

HESPERORNIS REGALIS Marsh.

(*Plate XV, Fig. 129.*)

Cat. No. 903, Peabody Museum, Yale University. Kansas. Upper Cretaceous (Niobrara). O. C. Marsh, collector.

This specimen has been compared by me—as well as I could do so through the glass case—with the mandible of the mounted specimen of *Hesperornis regalis* in the United States National Museum, the distal extremity of one side of which is original and perfect. I am satisfied that the present specimen is the proximal extremity of the *right* ramus of *Hesperornis regalis*, in which bird that portion of the lower jaw had a posterior supero-concaved extension which is here shown in Figure 128.

LAORNIS EDVARDSIANUS Marsh.

(*Plate II, Fig. 10.*)

Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1890, 206.

Holotype. Cat. No. 820, Peabody Museum, Yale University. Birmingham, New Jersey. Upper Cretaceous (Middle Marl Bed).

This is a most interesting specimen, and Professor Marsh gives a detailed account of it in the place above cited—so full, indeed, that it would be quite superfluous for me to add anything to it beyond a minor detail or two. However, it may be as well to point out that Professor Marsh referred the specimen to the "left" pelvic limb, which is an error, for it comes from the right. In other words, it is the distal portion of the *right* tibio-tarsus of some extinct bird larger than a Sandhill Crane (*Grus mexicana*).

He also seems to only have compared it with the corresponding bone in a Swan (*Cygnus americana*), a Goose (*Branta canadensis*), a Herring Gull (*Larus argentatus*), and then closed his article by saying that "A consideration of the characteristic points of this interesting fossil leads to the conclusion that it should be placed in the order *Natatores*, but additional remains will probably be required to determine its exact affinities. It shows a strong resemblance in several respects to the *Lamellirostres*, and also to the *Longipennes*, but differs essentially from the typical forms of both these groups."

The specimen is in very good condition, being but slightly chipped in some places, though nowhere to an extent to prevent one from clearly making out the characters. It is always an easy matter to distinguish the pelvic limb—right or left—to which any specimen of the lower half of the *tibio-tarsus*, presenting the characters that this

one does, belongs, even should the fibular ridge be absent. In this instance, if the specimen be held so that its *posterior* aspect is *towards* one, then the *outer tubercle* for the attachment of the *ligament* spanning the tendinal groove below is the *lower* of the two tubercles there found, while the *inner* one is considerably further up the shaft. So then, when the ligament is there (as in life), it is directed *obliquely* downwards from within to the outer side, being attached, of course, at both extremities. The *osseous bridge*, also spanning this tendinal groove, has a similar obliquity in the same direction, but it is, as a rule, never so well marked. That is the case here. So far as I am aware, this rule holds throughout *Aves*, and by its observance and application, the right or left tibio-tarsus can at once be made out correctly, if those characters are present and in clear view as they are in this specimen.

I went much further than Professor Marsh apparently did in comparing this specimen with the *tibio-tarsi* of existing birds; for I not only compared it, with the utmost care, with the corresponding bone in *Cygnus*, *Larus* and *Branta*, but added to the list *Meleagris*, *Grus*, *Ardea*, *Phœnicopterus*, *Mycteria*, *Nyctea*, *Aquila*, and not a few others with their numerous allies and affines.

As Professor Marsh seemed to suspect, this bone belonged to some *large*, generalized bird, from which a number of existing genera might be more or less closely related. In some particulars, it best agrees with *Meleagris*, and especially with respect to the *circularity* of the *outer* condyle. The *inner condyle*, however, is deeper in the Turkey than it is in *Laornis*, while in the former the *two* condyles are nearer together—that is, the valley between them is narrower in *Meleagris*. In general character, however, they are not far apart. Upon comparing it with the right tibio-tarsus of a specimen (adult) of *Grus canadensis* (No. 820, Coll. U. S. Nat. Mus.), a still greater number of characters are in agreement, though the circularity of the *external* condyle is not present in the Crane. On the *outer* side of the bone in *Laornis* there is a small, circumscribed little pit, between two short, sharp, longitudinal crests, just posterior to the tubercle where the oblique, tendinal ligament, attaches in life. This is present in *Grus*, though in the specimen at hand it is smaller.

In comparing the specimen with *Grus canadensis*, the principal difference to be noticed is that the shaft in the latter, on its anterior aspect, is flatter, and presents two pretty well marked grooves for the tendons, the inner groove being quite conspicuous below. The shaft, in consequence, is more cylindrical below, then, than it is in

the Crane, but otherwise the anterior *facies* are very similar. Judging from this fragment, it would appear that the bird was at least one of the generalized types of *Waders*, and not especially related to the "*Natatores*," as Marsh seemed to believe. It should be compared with the Horned Screamer (*Palamedea cornuta*), but I have not the skeleton of that species at hand. The circularity of the external condyle is seen in some *Anseres;* and, as a matter of fact, it would be extremely interesting to discover additional remains of this most remarkable type, which seems to have, judging from this piece of the tibio-tarsus, Turkey, Swan, Crane, and even other groups all combined in it.

PALÆOTRINGA LITTORALIS Marsh.

(*Plate VI, Fig. 35.*)

Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1870, 208.

Holotype. Cat. No. 830, Peabody Museum, Yale University. Hornerstown, New Jersey. Cretaceous. J. G. Meirs, collector.

As will be observed from the figures in my plate (VI), the material upon which this genus and species is erected now consists of the distal portion of a fossil left tibio-tarsus; three fragments which apparently belong to its shaft, and one piece which certainly does. These shaft-fragments help but very little in the matter of reference, while the chief part of the specimen lacks the entire internal condyle.

Some of the characters of this tibio-tarsus, however, are more or less distinctive; and such as they are, they do not point to the bird having been a *wader*, as Professor Marsh surmised. He compared it with the corresponding bone in the European Curlew (*Numenius arquatus* Linn.), and evidently had, strangely enough, the skeleton of the "Herring or Silvery Gull" before him at the time.

In my opinion, this tibio-tarsus belonged to the skeleton of a medium-sized Gull and not to any wader. Such characters as it presents in its imperfect condition, are distinctly *larine*, and *typically* larine at that. Were the internal condyle there to be examined and compared, one could be very certain as to this reference; but unfortunately it is, as I have pointed out above, broken entirely off.

Palæotringa vetus has been discussed by me on a later page of this contribution.

PALÆOTRINGA VAGANS Marsh.

(*Plate VI, Fig. 40.*)

Marsh, Amer. Journ. Sci., ser. 3, III, 1872, 365.

Holotype. Cat. No. 835, Peabody Museum, Yale University. Hornerstown, New Jersey. Cretaceous. J. G. Meirs, collector.

The material upon which Professor Marsh established this species consists of the distal end of a fossil tibio-tarsus, and of pieces of shaft which evidently belong to it; indeed, the one of the least caliber is the lower part in continuity.

All the characters of this bone have been practically destroyed through loss, chipping, or otherwise. The external condyle is entirely gone and the internal one very nearly so. The "tendinal bridge" alone remains intact, but that, as a part of the bone, in the majority of instances points to very little. It is surely not to be taken into account when all the other characters about it have been removed and lost. What there is to this specimen vaguely suggests a larine species, as to the kind of bird it may have belonged to in life; but the material is altogether too meagre and fragmentary for reference.

PALÆOTRINGA VETUS Marsh.

(*Plate VIII, Fig. 59.*)

Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1870, 209.

No Cat. Number. Academy of Natural Sciences, Philadelphia. Burlington Co., New Jersey.

This specimen consists of three very imperfect fragments of a left tibio-tarsus (lower third). Dating back to 1834, these have, as a whole, a very remarkable history, having been examined not only by Professor Marsh, but by Dr. Morton and Dr. Harlan, and several papers published on the subject.

Dr. Morton claimed that it was the fossil remains, as far as this went, of a species of bird belonging to the genus *Scolopax*, and in this he came nearer the truth, probably, than any of those scientists who subsequently examined it.[1] If it belonged to an extinct Woodcock (or Snipe?) (*Scolopax*), it was surely a big one; but it is just as likely to have been a very large Plover, or a Godwit, or some other limicoline form, though certainly no species of *Tringa*, like our existing sandpipers, whatever the ancient "tip-ups" and stints may have been like, —a point, I believe, upon which we have no literature.

[1] Synopsis of the Organic Remains of the Cretaceous of the U. S., 32, Philadelphia, 1834.

PEDIŒCETES PHASIANELLUS (Linn.).

(*Plate XV, Fig. 127.*)

Graculavus lentus Marsh, Amer. Journ. Sci., ser. 3, XIV, 1877, 253.
Ichthyornis lentus Marsh, Odontonithes, 1880, 198.
Holotype. Cat. No. 1796, Peabody Museum, Yale University. Near McKinney, Texas. Cretaceous. B. F. Mudge, collector.

There is but one fragment in this lot upon which the species is based; it is a fairly well-preserved fossil distal portion of a left tarso-metatarsus (Pl. XV, Fig. 127), and in life it belonged to some tetraonine species of average size. It is from a species of Grouse, and had nothing to do with a Cormorant, as Professor Marsh seemed to think.

I have carefully compared the fossil bone, or the specimen rather, with the corresponding distal end of the tarso-metatarsus of a number of our existing species of Grouse and their allies, as *Dendragapus*, *Lagopus*, *Pediœcetes*, *Canachites*, etc., and I find it comes so close to *Pediœcetes phasianellus* that truth and palæontology will best be served by referring it to that genus. (Compared with No. 17958, Coll. U. S. Nat. Mus. Ost. Birds.)

Dr. Lull sends me the following memorandum (taken from the Museum records) in regard to this specimen: "Ichthyornis lentus H. T. Cretaceous. Niobrara. (acc. Hay.)"

Should this mean that this specimen belonged to an *Ichthyornis*, I fail to entertain the same opinion. The tarso-metatarsus of an *Ichthyornis* is well known, and has been correctly described and figured by Marsh in his *Odontornithes* for *I. victor* (p. 175, Pl. XXXIII, Figs. 9-12). He says of it: "Of the three distal articular faces, the middle is the largest, and most advanced. The outer or fourth stands but little back of the middle, and is directed well outward, being more oblique than in the Tern." This obliquity is well shown in the figures and is characteristic. It is not at all present in the specimen at hand, which on the contrary presents all the characters of the distal extremity of the tarso-metatarsus in some small Pheasant or large Grouse.

Genus TELMATORNIS Marsh.

(*Plate VI, Figs. 36, 37.*)

Marsh, Amer. Journ, Sci., ser. 2, XLIX, 1870, 210. Type, by subsequent designation, *Telmatornis priscus* Marsh (Hay, 1902).

TELMATORNIS PRISCUS Marsh.

(*Plate VI, Fig. 37.*)

Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1870, 210.

Holotype. Cat. No. 840, Peabody Museum, Yale University. Hornerstown, New Jersey. Cretaceous. J. G. Meirs, collector.

Distal portion (perhaps a third) of a fossil humerus of a bird from the left pectoral extremity. As far as it goes it is quite perfect. It belonged to a form about one-fourth larger than a Green Heron (*Butorides virescens*), with which I have compared it. Taken the world over, it is an interesting fact that the distal part of the humerus of certain Herons and their allies are quite like the same part of that bone in many of the larger species of the *Limicolæ;* and either may, in some characters, resemble the distal ends of the humeri in certain paludicoline species. Professor Marsh, when he made his genus *Telmatornis,* was evidently confronted with this fact; for in his article on the subject, he clearly wavered in his decision on affinities, and mentions having humeri before him of *Rallus*, *Philohela* and *Butorides.* As a matter of fact, the distal portion of the humerus, even when perfect, is a very uncertain part of the skeleton, when used *alone,* to be employed in making a diagnosis, especially when the birds are from the above-mentioned groups.

Now the bird, to whose skeleton this fragment of a humerus belonged in life, was *not* a Heron, although it might easily be mistaken for that part of the skeleton of one, especially those belonging to species wherein the humerus is much compressed distally, transversely. With respect to *extinct* birds, there *may* have beeen some Rail (*Rallus*) that this bone, or rather fragment of a humerus, might have belonged to. There may have been some big Plover that this fragment belonged to; and I would not be surprised had either reference been made, and it was in our power to prove it to be the correct one.

In any event, it *may* have belonged to some rather large ralline species; but in the absence of any additional material there is no certainty about it.

TELMATORNIS AFFINIS Marsh.

(*Plate VI, Fig. 36.*)

Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1870, 211.

Holotype. Cat. No. 845, Peabody Museum, Yale University. Hornerstown, New Jersey. Cretaceous. J. G. Meirs, collector.

Here we have another distal end of a fossil humerus, with considerably less shaft preserved than in the case of *T. priscus*. It belonged to the skeleton of a bird of the same kind, the characters presented being essentially identical. Being but a trifle smaller than the other, this difference in size may have been due to either sex or age, or possibly to both, inasmuch as the two fragments are alike in all respects with the exception of size. Were this latter difference *constant* and *not* due to age or sex, then these fragments represent two good species of the same genus. This, however, is a matter not at all likely to ever be settled, as such fossil material is, at the best, extremely rare, and our knowledge of extinct birds of the New Jersey Cretaceous extremely limited.

TELMATORNIS REX sp. nov.

(*Plate XIII, Fig. 101.*)

Cotypes. Cat. Nos. 902, 948, Peabody Museum, Yale University. Hornerstown, New Jersey. Cretaceous. W. Ross, J. G. Meirs, collectors.

This species is established on a fossil right humerus which lacks the proximal end. Its distal end agrees with *Telmatornis priscus* Marsh, but belonged to a species considerably larger than this, and still larger than *T. affinis*. So perfect is the present specimen, however, that we gain from it the form of the humerus as a whole, and it would appear that we have no existing birds in this country possessing a humerus like it. Its distal end is very much expanded, or rather compressed transversely, with a general concavity in front of the articular tubercles, as we often see in the humeri of birds. On the whole, the bone is a short one, the shaft small and somewhat compressed transversely, and its sigmoid curve very pronounced.

It is most unfortunate that the proximal end of this bone was lost; for had the specimen been perfect it would have been possible to come much nearer the truth in making a reference.

I am inclined to think that the genus contained numerous species, and that these varied in size, much as the Rails now do in our avifauna; and, associated as they are with the Crakes, Gallinules and Coots, it is quite possible that, in Cretaceous time on the Atlantic

seaboard, there were numerous rail-like and other paludicoline forms of various sizes, which have long since become extinct.

In some respects, this humerus of *Telmatornis* resembles that of a Coot (*Fulica*, Pl. XIII, Fig. 104); but this extinct form—or association of forms—I am inclined to think had more ralline characters in their organizations, including the skeleton, than anything else, although we really have no certainty of this; and, with so little material at hand, I would not be surprised to know that, after all, the reference was quite wide of the mark.

The Yale Collection has in it a second specimen of *Telmatornis rex*—a *left humerus* (distal two-thirds) which, although presented by a different collector, has all the appearance of having belonged to the same individual bird to which the *type* specimen belonged. This specimen is in two pieces, and a phalanx of a crocodile was found with it.

EOCENE BIRDS.

Genus ALETORNIS Marsh.

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 256. Type, by subsequent designation, *Aletornis nobilis* Marsh (Hay, 1902).

Marsh described five species of his genus *Aletornis*, and the *types* of all of them are before me at the present writing. Reproductions of my photographs of them will be found in Plates II and VI of this article.

As described by Marsh, the species of *Aletornis* are as follows:

Aletornis bellus.
Aletornis gracilis.
Aletornis nobilis.
Aletornis pernix.
Aletornis venustus.

These specimens were described by Professor Marsh as given above in his article entitled "Notice of some new tertiary and post-tertiary birds" (pp. 256-258). They are now all considered as having been found in the Eocene (Bridger) of Wyoming.

ALETORNIS BELLUS Marsh.

(*Plate VI, Fig. 46.*)

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 258.

Holotype. Cat. No. 60, Peabody Museum, Yale University. Grizzly Buttes, Wyoming. Eocene (Bridger). O. C. Marsh, collector.

This species is based upon the distal end of a *left* tarso-metatarsal, with its inner trochlear process broken off and lost. Neither this fact, nor whether it belonged to the right or the left pelvic limb, are stated by Marsh, who says in his article that "The tarso-metatarsal is similar in its essential features to the same bone in the Killdeer Plover (*Ægialitis vociferus*, Cass.), and about the same size." This bone belonged to a bird not nearly as large as a Killdeer Plover, but to a form of about the size of the Purple Sandpiper (*Arquatella m. maritima*), with which I have compared it. (No. 17687, Coll. U. S. Nat. Mus. "Tringa maritima.") In fact, I believe it represents some Sandpiper of about that bulk. There is not enough of the specimen, however, to make even an approximate *guess* as to what kind of a small limicoline bird it may have belonged to in life. It is just as likely to have been a small Plover, or a Snipe of a similar size, and so on. There are not characters sufficient in *this* specimen to enable one to judge as to what *genus* it may have belonged to among existing birds, even if the corresponding part of the tarso-metatarsi of *all* the small limicoline species were at hand for comparison. It may have belonged to an extinct species, as Marsh claims; but there is absolutely no evidence at hand to prove that such is the case, and far less evidence that the genus Marsh created to contain it is likewise an utterly extinct one.

All that I can say about this imperfect fragment of the left tarso-metatarsus of a bird is, that it apparently belonged to some *small* limicoline species of about the proportions of a medium-sized Sandpiper, or Plover, or Knot, or an extinct diminutive Woodcock, or Snipe, and so on through the list. This is all that is necessary at present to state in regard to it; all that it will teach without additional material, and all, thus far, that palæontological science desires to know or to make record of; it is a positive detriment to that science to lumber up the list of the extinct birds described, and described with more or less certainty, with the names of genera and species, which have been based on altogether too little material, and of which we have so little knowledge.

ALETORNIS GRACILIS Marsh.

(*Plate VI, Fig. 45.*)

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 257.

Holotype. Cat. No. 61, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). H. D. Ziegler, collector.

Represented by the imperfect proximal end of a left humerus, which, as far as it goes, comes quite close to the corresponding part of the left humerus of an adult specimen of a *male* American Woodcock (*Philohela minor*). So imperfect is this fragment, however, and so little is there of it that it is quite impossible to state with certainty that it belonged to a *Philohela*, either a living or an extinct species; it is quite possible for it to have belonged to some kind of a *Snipe* of a like size. Furthermore, what valid reason is there, considering the material at hand, for placing this *Aletornis gracilis* of Marsh in the *same genus* with *Aletornis bellus* of that writer? It is very safe to say that the two fragments of fossil bones in question, although certainly from birds, did not, nevertheless, originally belong to species of the same genus. Had the corresponding pieces, *and no more*, been handed to me, and it was stated that they were from the skeletons of *existing* birds, I should have said that one belonged to some kind of Sandpiper (*Aletornis bellus*), and the other to a small Woodcock or a Snipe of close alliance thereto (*Aletornis gracilis*). I would have had nothing to say about the *genera*, unless more material was submitted for me to pass on in the connection.

ALETORNIS NOBILIS Marsh.

(*Plate II, Fig. 15; Plate VI, Fig. 43.*)

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 255.

Holotype. Cat. No. 63, Peabody Museum, Yale University. Grizzly Buttes, Wyoming. Eocene (Bridger). O. Harger, collector.

The material upon which Marsh named this species consists of a compressed, distorted, imperfect end of a *left* tarso-metatarsus, and two fragments of other bones, all belonging, as he states, to some bird of considerable size.

In his description, Marsh was quite right in stating that they represented—in so far as the tarso-metatarsus is concerned—some kind of a Crane. This is no reason, however, why he should have relegated the species to his genus *Aletornis*, in which he had already associated two other forms—one like a Woodcock and another like a Sandpiper.

This fragment of a tarso-metatarsus belonged to a *Grus*, about one-third smaller than *Grus canadensis*, and to that genus it should be relegated as *Grus nobilis* (Marsh.)

ALETORNIS PERNIX Marsh.

(*Plate VI, Fig. 47.*)

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 256.

Holotype. Cat. No. 64, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). O. C. Marsh, collector.

As will be observed by referring to Figure 47 of Plate VI, Marsh made this species of his genus *Aletornis* on *eighteen bits* of fossil bones, of which only one very imperfect fragment can be recognized as having belonged to a bird. It is the *external condyle* of a left tarso-metatarsus of some bird of medium size. The remaining seventeen bits are not recognizable. No one can tell from such material as this what kind of a bird it represents, and the characters Marsh enumerates for the end of the tarso-metatarsus are those to be found in a great many different kinds of birds, belonging to entirely different *families*.

Not only is it impossible to correctly determine what kind of a bird these little scraps of bone belonged to in life, but there is far less ground for announcing that it was a species belonging in his genus *Aletornis*—a genus already containing a Woodcock (?), a Sandpiper (?) and a Crane.

ALETORNIS VENUSTUS Marsh.

(*Plate VI, Fig. 41.*)

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 257.

Holotype. Cat. No. 206, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). G. M. Keasbey, collector.

Also: Cat. No. 1027, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). J. W. Chew, collector.

The determination of this species rests upon a perfect distal portion of a left tibio-tarsus. It is from a bird of about the size of a Coot or Gallinule (*Fulica gallinula*), and I believe it belonged to some paludicoline bird.

In "The Fossil Birds of North America" (The A. O. U. Check-List of North American Birds, 3d ed., p. 384), the genus *Aletornis* has been placed in the "Order PALUDICOLÆ." Now the bird to the skeleton of which this fossil bone belonged was a paludicoline species of some kind or another. The characters it presents are identical as

compared with the corresponding ones in the same bone in *Fulica*, only this specimen indicates a species about one-third smaller than *Fulica americana*, and was most likely either a true species of *Fulica*, or the representative of a genus having many osteological characters in common with *Fulica* and *Gallinula*, or even, perhaps, some *Rallus* in it.

So far as this fragment indicates, it would be a reasonable thing to refer the species to which it belonged to the genus *Fulica*, thus removing it from the Crane-Snipe group to one where it would at least be associated with its own kind.

I would suggest that it be called *Fulica venustus*.

Cat. No. 1027 consists of the distal part of the shaft of the left tibio-tarsus of a bird, which agrees in all particulars with *Aletornis venustus* of Marsh. The present specimen has but a little more of the shaft preserved, otherwise it is absolutely identical with the specimen shown in Plate VI, Figure 41, of the present article. The bones are both from *left* pelvic limbs, and are of the same size exactly; in other words, they are from the same species—a *Fulica*, smaller than the existing *Fulica americana*.

As a matter of fact, this polymorphic genus *Aletornis* should have the forms now in it redistributed to the groups wherein they either surely, or at least more likely, belong. If this be done, the redistribution would result in the following changes, to wit:

Aletornis bellus = A limicoline species.
Aletornis gracilis = A limicoline species.
Aleiornis nobilis = *Grus nobilis.*
Aletornis pernix is indeterminable.
Aletornis venustus = *Fulica venustus.*

If a more radical change were desirable, and Marsh's descriptions, as far as they go, and are correct, were used, the list would stand thus:

Aletornis bellus = *Tringa bellus.*
Aletornis gracilis = *Philohela gracilis.*
Aletornis nobilis = *Grus nobilis.*
Aletornis venustus = *Fulica venustus.*

and *Aletornis pernix* set aside awaiting additional material.

BOTAUROIDES PARVUS gen. et sp. nov.

(Not figured.)

Holotype. Cat. No. 1030, Peabody Museum, Yale University. Spanish John Meadow, Wyoming. Eocene (Bridger ?). L. LaMothe, collector.

A nearly perfect lower extremity of a left tarso-metatarsus of a fossil form of small size. It presents the main characters of this bone as it is found in the *Ardeidæ*, and more specifically among the Bitterns.

It evidently belonged to a species smaller than the Least Bittern (*Ixobrychus exilis*); and while a herodionine form, it was neither a true Heron nor a typical Bittern, but, judging from this fragment, apparently related to both, and, in any event, belonging squarely in that group.

Only the lower part of the shaft is preserved, and this is convex transversely, being correspondingly concave posteriorly. In the Bitterns, the shaft posteriorly is flat; the foramen for the anterior tibial artery is minute, and has a longitudinal groove leading into it anteriorly. As in most Herons and Bitterns, the inner and middle trochlear processes are of about the same length, while the outer one is markedly shorter. Across the three it measures 5 millimeters, the width of the shaft being somewhat less.[1]

BUBO LEPOSTEUS Marsh.

(*Plate II, Fig. 18.*)

Marsh, Amer. Journ. Sci., ser. 3, II, 1871, 126.

Holotype. Cat. No. 512, Peabody Museum, Yale University. Grizzly Buttes, Wyoming. Eocene (Bridger). O. C. Marsh, collector.

The specimen consists of the distal portion of a left tibio-tarsus, and two small slivers of bone that belong to the side of the shaft. It is fairly perfect, though somewhat worn on the condyles. Through a slip, Professor Marsh states that it is half of a tibia, which could not be so even in the case of an Owl. Probably not more than a fourth of the total length of the original bone is preserved.

This bone never came from the skeleton of an Owl, much less from such an Owl as a *Bubo*. It is a most interesting fossil, and the pity is that such a meagre part of the skeleton was discovered.

There is not enough of it to enable us to state correctly as to what kind of a bird it represents. It belonged to a species fully as large as a *Bubo virginianus*, but it presents but one strigine character and that

[1] Generic name = *Botaurus* + Gr. *ειδος* resemblance. Spec. name = Lat. *parvus*, small.

a *negative one, i.e.*, it lacks the osseous tendinal bridge on the lower anterior aspect of the shaft above the condyles. This is the case in all the Owls of this country known to me; but the fact that this bridge is absent in a tibio-tarsus by no means proves that the bone came from the skeleton of an Owl. I have compared this specimen with the tibio-tarsi of all of the large American Owls, including *Nyctea*, *Bubo*, *Strix*, etc. The distal extremity of a tibio-tarsus in any of the large strigine forms is very characteristic, and moreover, they are all very much alike. But, as I have remarked, beyond the absence of the osseous tendinal bridge, this specimen possesses none of them.

We may compare them thus:

"Bubo leptosteus."	*Bubo virginianus.*
1. Anterior aspect of the shaft, just above the condyles, *flat.*	1. Anterior aspect of the shaft, just above the condyles, deeply excavated, with two distinct pitlets at its base.
2. Inner condyle transversely thick, elongate antero-posteriorly, and reniform in contour.	2. Inner condyle transversely thick, almost *circular* in contour.
3. Outer condyle same form as inner one, and only half the thickness of it transversely. .	3. Outer condyle rather more reniform in contour, but fully as thick transversely as the inner one; subcircular.
4. Mesial surface of inner condyle flush with the border.	4. Border prominently raised as a surrounding rim.
5. Intercondylar valley of moderate width.	5. Intercondylar valley very narrow.
6. (Condyles worn away posteriorly.)	6. Condyles project conspicuously behind.
7. Shaft above the condyles, posteriorly, is *flat.*	7. Shaft above the condyles, posteriorly, is *concaved.*
8. No prominence on side of shaft above the internal condyle.	8. A marked elevation of the shaft on that locality.

It is clear from this comparison that the specimen never represented an Owl—that is, any *typical* Owl.

In my opinion it came from the skeleton of some long extinct generalized form, with strigine affinities. This is all that can be said for it; and it would be better to await the discovery of more material than to continue to list this as a *Bubo*, when it is so clear that it in no way represents an Owl, and very surely *not* a *Bubo*.

DIATRYMA GIGANTEA Cope.

(*Plate II, Fig. 16; Plate V, Fig. 30.*)

Cope, Proc. Acad. Sci. Phila., 1876, II; also Rept. U. S. Georg. Surv. West of the 100th Merid. (Wheeler's Survey), Vol. IV, Palæontology, 70, Plate XXXII, Figs. 23–25.

Shufeldt, Bull. Amer. Mus. Nat. Hist., XXXII, 1913, Art. XVI, 297, Plates LI–LIV.

Shufeldt, Aquila (Budapest), XX, 1913, 411–420, Tab. I–V.

Cat. No. 906, Peabody Museum, Yale University. S. side Island Point, N. Horseshoe, Gallina, New Mexico. Eocene. D. Baldwin, collector.

Slip inside of box containing specimen says: "Outer (*left*) condyl (distal) of metatarsus (see A. J. S., Vol. XII, 1876, p. 306. Wheeler's Vol., Plate XXXII)."

BARORNIS REGENS Marsh.

(*Plate I, Figs. 7-9; Plate V, Fig. 32.*)

Marsh, Amer. Journ. Sci., ser. 3, XLVIII, 1894, 344.

Holotype. Cat. No. 417, Peabody Museum, Yale University. Squankum, New Jersey. Eocene. O. C. Marsh, collector.

Professor Marsh was correct in his surmise that the specimen collected in New Mexico was a trochlea from a tarso-metatarsus of a specimen of Cope's *Diatryma gigantea;* but he was in error when he made the determination that it was the "Outer condyle from the tarso-metatarsus *left* side." (See description copied from the slip above.) On the contrary, it proves to be the *inner* trochlear process of the *right* side.

It was discovered in New Mexico, and it was in New Mexico that Cope found his specimen of *Diatryma gigantea.* Personally, I know nothing of the history of these discoveries, though what I do know points to the fact that Marsh's collector found his specimen *after* Professor Cope had discovered and *described* his find. As will be seen by the literature cited above, I have already given many figures of the *two trochleæ* belonging to the *type* of Cope's specimen, and now I find that this specimen found by Marsh completes in every way, as far as it goes, the *distal* extremity of the tarso-metatarsus of the specimen Cope discovered. I am of the opinion that these three trochleæ belonged to the *right* tarso-metatarsus of the same individual bird, and I shall entertain this opinion until history controverts it—that is, if the facts be known to anyone now living. Evidently one of Professor Marsh's collectors went to the exact locality where the Cope specimens were previously found and there discovered the missing trochlea. However, the two trochleæ of Cope's *type* of *Diatryma gigantea* belong to the collections of the United States National Museum, and are before me at the present writing, as is likewise the trochlea which is the property of Yale University. I present with this article several figures of it in the plates, and in Plate IX, Figure 68, there is a reproduction of a photograph I made which thoroughly sustains what I have set forth in the last few paragraphs.

As my figures on the plates are of *natural size*, and present this inner trochlear process of the right tarso-metatarsus of *Diatryma gigantea* from several points of view, it obviates the necessity of writing out any special description of it. Moreover, the description given under the aforesaid several figures is very full, rendering it still less necessary to enlarge upon it here. I may say, however, that in the tarso-metatarsus of the vast majority of birds there is, at the distal end, an oval foramen which transmits the anterior tibial artery, as it passes to the sole of the foot to become the plantar artery. This foramen is just above the valley between the *outer* and the *middle* trochlear processes, and consequently on the *outer* side of the bone. It does not form until complete ossification takes place in the adult, while in some birds it remains as a "notch" throughout life, merely deepening the valley between the middle and outer trochlear processes. It is entirely absent in the Moas and in the Ostriches, in which birds the anterior tibial artery apparently finds its way to the sole of the foot by simply passing between the aforesaid processes. It is well marked and thoroughly individualized in all true gallinaceous birds, and in Figures 69 and 70, Plate IX, I invite attention to it in the tarso-metatarsus of the Cock of the domesticated *Gallus*, there introduced to compare with my partial restoration of the distal extremity of the right tarso-metatarsus of *Diatryma gigantea* of Cope,—a much smaller species than *D. ajax*, elsewhere described by me.

Now, in the *outer* trochlea of *Diatryma gigantea* (Type U. S. Nat. Mus.), in the same locality where this *anterior tibial foramen* is found, I find a smooth, hemicylindrical, antero-posterior groove, which is, beyond all question, the distal half of the *interior surface* of the *outer side* of the foramen above described. It has an antero-posterior length of 1.5 centimeters, and a transverse diameter of 6 millimeters. There appears to be an indication of its opposite surface in the similar locality, on the outer aspect of the superior part of the middle trochlear projection; but the two trochleæ do not come accurately together there. In fact, while there is a shallow, antero-posterior groove in evidence, its margins have not the appearance of recent fracture, which leads me to believe that the trochleæ were long separated before their discovery—perhaps for many thousands of years. The interesting fact here is that a thoroughly differentiated anterior tibial foramen was present in the distal end of the tarso-metatarsus of *Diatryma gigantea* and probably in *D. ajax*, while it was entirely absent in *Struthio* and *Dinornis maximus*, and probably in other Moas.

BARORNIS REGENS Marsh. This specimen I take up in connection with *Diatryma gigantea* for the reason that Professor Marsh, who probably never saw Cope's types of that bird, described it, in consequence, as the representative of a different genus of giant birds. This pedal phalanx, although found in the Eocene of New Jersey, a long distance from where Cope found *Diatryma gigantea* (New Mexico), or where *D. ajax* was discovered (Wyoming), (they all having been found essentially in the same geologic formation), is from the skeleton of another species of *Diatryma*, and up to date this and other material represents, apparently, but several typical species of the genus *Diatryma* of Cope, of which *Diatryma gigantea* is the type.

In Plate I of the present article I give three views (Figs. 7–9) of this phalanx; and on Plate V (Fig. 32) I compare its lateral view with the larger phalanx of the two found which belonged to *Diatryma ajax* Shufeldt. The larger one of these I formerly described as the "basal one of the middle toe," while I am now, in the light of additional material, inclined to believe it to have been the *basal one* of the *outer toe* of *Diatryma ajax*, and the phalanx described by Professor Marsh as "a first phalange of the third digit of the right foot," to be correct in so far as the identification of the bone is concerned. It would have been nearer the truth, however, had he said the *outer toe* instead of the "third digit." The *hallux* or first toe was probably entirely aborted in *Diatryma*, so that only the anterior toes were present—that is, two, three, and four, with, counting the ungual phalanges, 3, 4, and 5 joints respectively.

Viewing this phalanx (*Barornis*) on its direct posterior aspect, there will be observed two articular, shallow facets, divided by a vertical, low, smooth elevation or ridge. In all the flightless birds I have examined, and in not a few others, especially the gallinaceous species of various genera, the larger of these two shallow concavities is next to the *middle toe*, when the toes are articulated as in life; and this is the case with the phalanx Professor Marsh described as that of *Barornis regens*, he doubtless having observed this point, and was led to say that the joint belonged to the *right* foot, in which determination he was correct. He further stated in his description[1] that this "extinct bird [was] about the size of an Ostrich, and apparently allied to that group," he having compared it with the corresponding phalanx of

[1] Marsh, O. C. "A Gigantic Bird from the Eocene of New Jersey." Amer. Jour. Sci., ser. 3, Vol. 48, 1894, 344, Figs. a–d. (4 views of the phalanx, half natural size.)

bird of that species. Further on in the article he says: "Its nearest allies will probably be found in *Diatryma* and *Gastornis*, from essentially the same geological horizon."

This phalanx, upon which Marsh attempted to establish his *Barornis regens*, in all probability belonged to the skeleton of a *Diatryma*. I have compared these several phalanges of *Diatryma ajax* from the Collections of the American Museum of Natural History of New York City and the Peabody Museum of Yale University, with the corresponding ones in the mounted specimen of a *Dinornis maximus* (No. 5501, U. S. Nat. Mus.), and with the pedal phalanges of various other ostrich birds of existing genera from all parts of the world; I am of the opinion that *Barornis regens* of Marsh should be relegated to the genus *Diatryma* of Cope as *Diatryma regens*, and this is what I here recommend.[1]

Judging from the several places of discovery; their *distances apart* and the *differences in time;* the *morphological differences* in the specimens themselves as shown in my various published figures of them; that Marsh went so far as to create a new genus for one of them (*Barornis*); and that, as in the case of existing ostrich birds where they occur in the avifaunæ in various parts of the world, the species may be more or less numerous, it would seem to be quite likely that there existed, between the borders now known as the Mexican and Canadian boundary lines, at least three species of these birds (and perhaps more) representing this genus *Diatryma*.

These were:

Diatryma gigantea Cope.
Diatryma regens (Marsh).
Diatryma ajax Shufeldt.

As indicated by their foot-bones (phalanges), *Diatryma ajax* was a stout and heavy form, corresponding to some of the Moas in their genus; *Diatryma regens* was of a more slender type; while in the case of *Diatryma gigantea* we have still to discover examples of its pedal phalanges. Indeed, through discovery of more material than we have up to date, we will gain a wider knowledge of these species than we have at the present time. I am still of the opinion that *D. ajax* was a much bigger and especially taller bird than even that ponderous avian giant, *Diatryma gigantea*, and I am inclined to think that the tarso-

[1] As pointed out in the literature above, Cope described *Diatryma gigantea* in 1876 and Marsh his *Barornis regens* in 1894; therefore *Barornis regens* simply becomes a synonym of *Diatryma regens*, Marsh having referred the species to the wrong genus.)

metatarsi of the forms found in this country were considerably longer than in the Moas of New Zealand, which I have just named.[1]

EOCEORNIS ARDETTA[2] gen. et sp. nov.

(*Plate XIII, Fig. 102.*)

Holotype. Cat. No. 891, Peabody Museum, Yale University. Henry's Fork Wyoming. Eocene (Bridger). A. B. Waring, collector.

This new genus and species is based on the fore part of a small sternum in the Yale University Collection that is sufficiently characteristic to make a reference for it. It came from some bird about the size of a small Heron, and is fairly well preserved, being thoroughly fossilized. It is of a pale, greenish-white color, and with scarcely any matrix adhering to it.

On the dorsal aspect there is developed a median, raised ridge, which separates two well defined concavities, antero-posteriorly elongated. The manubrium is very small, and its median anterior ridge is thin and fine and continued downwards only a very short distance, the fore part of the carina being elevated upon either side of it.

What is most characteristic about this sternum is that its coracoidal grooves decussate, the left one being above the right. This feature is present also in the sterna of *Apatornis* and *Ichthyornis*, and at first I was inclined to think that this bone belonged, in life, to some bird either in the latter genus or one affined to it. Closer examination, however, convinced me that this was not the case.

Among modern birds there are those in which the coracoids decussate in their sternal grooves, as for example the Herons and their allies and in some Hawks. This sternum, upon comparison with representatives of these birds, appears to be much nearer to the *Ardea* stock, and it is for this reason that the placing of it in that group was decided upon.

[1] Shufeldt, R. W. "The Biggest Bird That Ever Lived." Scientific American, Vol. CX, No. 12, New York, N. Y., March 21, 1914, 248 and 249. (Full-page outside cover design by Mr. Vincent Lynch, somewhat altered from my own drawing.) This contribution when submitted by me was entitled "The largest fossil bird known," and the title under which it appeared in the Scientific American was not authorized, the change having been made by the editor without consulting me; but this statement by no means implies that it is "the biggest bird that ever lived," as the magazine in question would have its readers believe.

[2] Gen. name: Eocene, = Gr. ἠώς, dawn + καινός, recent and Gr. a bird. Sp. name: ardetta, diminutive of *Ardea*.

FALCO FALCONELLA[1] sp. nov.

(*Plate XV, Figs. 139–143.*)

Holotype. Cat. No. 863, Peabody Museum, Yale University. Wyoming (Dry Creek?). Eocene (Bridger). LaMothe and Chew, collectors.

Consists of five (5) fossil bones or fragments of bones which, in life, evidently belonged to either a small Owl or a small Falcon or Hawk. I have compared it in all particulars with the corresponding bones or parts of bones in skeletons of *Cryptoglaux*, *Athene*, and the pygmy Owls, also in many of the smaller Falcons and Hawks, and I am convinced, on account of the form of the ungual phalanx and the upper extremity of the (left) *coracoid* which are here represented, that the bird was a small representative of the *Falconidæ*.

In addition to what has just been named as belonging to this lot, there is the distal part of the left humerus, the *radial* and *ulnar* tubercles of which are distinctly falconine, as is also the *pedal phalanx* belonging to the same individual. The remaining fragment is a condyle of one of the long bones, but broken in such a way as to render it difficult to say which one. It is interesting to find a falconine bird of this size in the Oligocene.

GALLINULOIDES WYOMINGENSIS Eastman.

Eastman, Geol. Mag., Feb. 1900, 54.

Cat. No. 961, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). J. W. Chew, collector.

Material consists of distal end of a fossil right tarso-metatarsus and the proximal moiety of a pedal phalange (mid-anterior toe?).

The characters of this specimen seem to point with great certainty to some form of extinct bird which possessed a skeleton having both ralline and galline characters in it. And inasmuch as it was found in the Eocene (Bridger) of Wyoming, and belonged to a bird about the size of *Gallinuloides wyomingensis* of Eastman, I propose to refer it to that form for the present until further material comes to light.

I have examined Dr. Eastman's plate and read his description of *Gallinuloides* in the *Geological Magazine*, and on some future occasion this specimen should be compared with the original of *G. wyomingensis*.

The fossil here being described has one very striking character: the presence on the mesial aspect of the inner trochlear process of a *circular* and quite conspicuous concavity, with a well defined bounding

[1] Gen. name = Lat. *falco*, a falcon. Sp. name = Latin for the diminutive of *falco*, *i. e.* a little or small falcon.

rim, the whole monopolizing the aforesaid location. This does not occur as a character in the tarso-metatarsi of any of the existing American Grouse I have examined; but it may be a ralline character heretofore not observed by me.

The *general facies* of this part of the skeleton of the foot and the phalange aforesaid appears to me to be quite tetraonine in character.[1]

GRUS MARSHI sp. nov.

(*Plate XV, Figs. 144–147.*)

Holotype. Cat. No. 888, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). L. LaMothe, collector.

This new species of an extinct crane I base upon the presence in the Yale collection of the distal end of a right tibio-tarsus (fossil, adult), which is nearly perfect as far as it goes.

As the type of *Grus proavus* Marsh has been lost, I have no means of comparing this specimen with it. I have, however, compared it with the type of *Grus haydeni* Marsh, and with the corresponding part of the tibio-tarsi of existing American *Gruidæ*, and I may say that, while it came from a *Grus*, it did not come from the skeleton of a *Grus americana* or *G. canadensis* or *G. mexicana*, as the comparisons I have made leave no doubt upon this point.

The specimen has the outer surface of the external condyle ground off, practically destroying its characters. On the other hand, the internal condyle, although it has been broken and repaired, presents all the usual characters of this part of the bone as they occur in any ordinary species of *Grus*. Both in form and in character this condyle agrees with the internal one in *Grus canadensis* (No. 820, Coll. U. S. Nat. Mus.), except that in *Grus marshi* it is smaller, the species itself having been a considerably smaller bird, than either *Grus canadensis*

[1] Since what I have said above in regard to *Gallinuloides wyomingensis* I have, thanks to the Museum of Comparative Zoölogy of Harvard University, had the opportunity of examining the slab containing this beautiful specimen of a fossil bird. It was in my possession for a fortnight or more, during which time I made two negatives of it, presenting the form nearly natural size, and reproducing in the photograph the minutest detail of its structure. During the time mentioned, I prepared an exhaustive paper on the subject, illustrating it with a number of plates and figures. This has been submitted to a scientific editor in Europe, and it will doubtless be published later on. In my opinion, this extinct bird had no ralline characters in its skeleton; while on the other hand, every osteological character it presents is distinctly tetraonine as I clearly point out in my paper. Further, I have suggested a new generic name for it, in that its place in the system may be better understood and appreciated.

or *haydeni*. Measurements will prove this fact, for the greatest transverse diameter (over all) for this end of the bone measures in *G. canadensis* 2.25 centimeters; in *Grus haydeni* 2.50 centimeters (approximate internal condyle broken off); in *Grus marshi* 1.9 centimeters.

The osseous tendinal bridge, spanning the tendinal groove in front, and the tubercule for tendinal insertion to its outer side, morphologically agree in all three of these species (compare Fig. 21, Pl. II; Figs. 66 and 67, Pl. VIII; and Fig. 144 of Pl. XV); and it will in all likelihood be found that they will be practically the same in all species of true cranes of the genus *Grus*.[1] This extinct species of the *Gruidæ* I name in honor of the late Professor Othniel Charles Marsh, formerly professor of palæontology at Yale University.

MINERVA ANTIQUA Shufeldt.

(*Plate XV, Figs. 131–136, 148–152 a–b, 154 a–i.*)

Aquila antiqua Shufeldt, Bull. Amer. Mus. Nat. Hist., XXXII, August 4, 1913, Art. XVI, 297, Pl. LV, Fig. 26.

At this writing I am satisfied that *Aquila antiqua*, described by me in the *Bulletin of the American Museum of Natural History* in 1913,

[1] Loomis, F. B. "A Fossil Bird from the Wasatch." Amer. Journ. Sci., ser. 4, 22, 1906, Art. XL, 481, 482, Figs. 1–3.

In this article Professor Loomis describes the remains of a fossil bird from the Wasatch Lake Basin (Lower Eocene), which he names *Gallinuloides prentici*, or, in other words, refers it to the genus *Gallinuloides* of Eastman (Geol. Mag., Lond., 1900, n. s. Decade IV, VII, Art. II, 54–57. Plate). As will be observed from a comparison of Fig. 1 of Professor Loomis' paper with Fig. 21, Pl. II, Figs. 66 and 67, Pl. VIII and Fig. 144 of Plate XV of the present article, that extinct species likewise belonged to the *Gruidae*, as the distal end of the *right* tibio-tarsus there figured was undoubtedly that of a *Grus*, and the form should have been referred to that genus as *Grus prentici*. That bird was a crane fully as tall and as big as *Grus canadensis*, and Professor Loomis himself says that "this bird was about half as big again as a turkey and of rather heavier build," or was, in other words, a *very large* species of *Grus*. Now it is not at all likely that a bird as big and as tall as *G. prentici* would belong in the same genus with a bird about "the size of a gallinule" (Eastman), which latter possessed all the main characters of a *grouse* in its skeleton. In other words, *Gallinuloides wyomingensis* Eastman and *Gallinuloides prentici* did not even belong in the same Order, as most present-day ornithologists define that group.

Some day I trust to examine the type of Dr. Eastman's *Gallinuloides wyomingensis*, and I am very much inclined to believe, from my examination of his excellent figure of it, that it had a far greater number of tetraonine characters in its

was not based upon sufficient material to make a correct generic diagnosis. The material in question consisted of a single osseous claw or ungual phalanx of peculiar formation, as will be observed by referring to the figure of it cited above.

In the material here being considered, I find a number of these claws, and in one or two instances associated with other bones of the skeleton belonging to the same individual.

These throw a very different light upon the subject, as is set forth below, and a study of them thoroughly convinces me of the fact that the extinct (fossil) Eagle I described as *Aquila antiqua* now proves to be a large Owl, and as an Owl it has no place in the genus *Aquila*.

The osseous ungual phalanges of this Owl are so distinctive that there can now be no question as to its having represented a very distinct genus of the *Strigidæ*. Its congeners are now all extinct in this country, and it is not possible, from the material at hand, to say what genus of Owls in the existing avifauna is most nearly related to it. Neither *Nyctea* nor *Bubo* possess such osseous talons, and surely none of the existing *Falconidæ* have them, as I have previously pointed out.

In removing the species from the genus *Aquila*, it becomes necessary to create a new genus to contain it, and I here propose for it the name of MINERVA, so that hereafter

AQUILA ANTIQUA Shuf. = MINERVA ANTIQUA gen. nov.[1]

established on the characters which are derived from the discovery of additional material, as follows:

Cat. No. 847 (Pl. XV, Fig. 151), Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). O. C. Marsh, collector.

Fossil claw or ungual joint of *hallux* of the extinct owl *Minerva antiqua*, showing the dorso-basal process of this phalanx, produced proximad, and its entire under side taking part in the articulation with the phalanx of hallux. This is the distinctive character to which attention was invited when I described "*Aquila antiqua*."

skeleton than it had ralline ones, several of which are plainly to be seen in the figure of the type. Moreover, *true gallinaceous birds* were by no means uncommon in this country during Eocene time. I have since examined this slab. (See footnote, p. 41).

[1] Generic name = L. the goddess Minerva of Roman mythology. The bird of Minerva was an owl. Sp. name = L. *antiquus*, old, ancient. In other words, an ancient bird of wisdom.

This specimen agrees in all particulars with the *type specimen* now in the collection of the American Museum of Natural History.

Cat. No. 833 (Pl. XV, Fig. 154, *a–i*), Peabody Museum, Yale University. Dry Creek, Wyoming. ? Eocene (Bridger). LaMothe and Chew, collectors.

Minerva antiqua is here represented by twenty-four (24) fragments of fossil bones; they are all from the same individual (adult), and constitute the collection through the means of which I was enabled to ascertain that they belonged to a huge owl and not to an eagle.

Nine of these fragments are shown on Plate XV (Fig. 154, *a–i*).

Fig. 154*g* presents a specimen of the characteristic claw or ungual joint of this owl, and it agrees in every detail with the type specimen and the one shown in Figure 151 of this Plate. Other specimens depart from it slightly, but only in the matter of size; but in this specimen it may readily be attributed to either the variations due to age or to sex. It will be remembered that in nearly all of our *Strigidæ* the females are larger than the males, frequently possessing larger talons and, as a consequence, larger osseous phalanges.

That this claw belonged to '*hallux*,' and that the ungual osseous claws of the three anterior toes were without the characteristic dorsal, backward-projecting process, is proven by the fact that, in the material now being examined, and all belonging to the same individual, there are *three* (3) other osseous ungual phalanges which, from their varying sizes, are, without the slightest doubt, those belonging to the three anterior toes. (Fig. 154, *a*, *c* and *f*.) The anterior portions of all these ungual phalanges are unfortunately broken off and were not recovered. However, more perfect specimens are seen in Figures 148 and 149 of this Plate.

The *basal phalanx* of *hallux* is here shown in *d*, the dorsal aspect being presented. Owing to distortion from pressure, it does not now perfectly articulate with the claw *g;* but further on specimens will be shown where it does do so (Figs. 133, 134).

There is also in this lot a nearly perfect proximal portion of the left carpo-metacarpus (Fig. 154, *b*, palmar aspect); and upon comparing the characters it presents with those of the corresponding bone in the skeleton of *Bubo virginianus* (No. 18753, Coll. U. S. Nat. Mus.), it becomes clear that not only did this fossil belong, in life, to a big owl, but to one having skeletal characters that were in some respects bubonine ones, or at least resembled them; *Minerva antiqua*, however, was by no means a *Bubo*.

I have also compared the fossil bones of this fossil owl with the corresponding ones in a skeleton of *Pseudoptynx blakistoni* (No. 18227, Coll. U. S. Nat. Mus.), and I find that they have a somewhat more general resemblance to them than to those of a typical *Bubo*, as *B. virginianus*. Moreover, the distinctive process on the claw of hallux, although not produced as in the extinct owl, is slightly more in evidence than it is in the bubonine owls. Doctor Sharpe placed *Pseudoptynx* in the genus *Bubo*, but on what grounds I do not remember. Unfortunately I have not at hand for comparison skeletons of either *Scotiapex nebulosa* nor some of the big owls of Africa.

After I had prepared and made Plate XV, I discovered that *both* the *condyles* of the *right tibio-tarsus* were among the fragments, and that they were simply broken apart. They were readily brought perfectly together and fastened with strong glue. In Figure 153*e* only the outer aspect of the *external condyle* is shown, but when the two were assembled, a very different appearance of things was presented. The two condyles were seen to be very prominent; the valley between them—the intercondylar space—was very narrow and deep, being entirely smooth, whereas, in all true eagles of the North American avifauna, this intercondylar valley is broad, shallow, and the condyles not particularly prominent.

In *Bubo* and *Nyctea* the condyles of the tibio-tarsus are very prominent, with the space between them narrow and smooth. In other words, in its general character the distal condylar portion of the tibio-tarsus of *Minerva antiqua* more closely resembled that of an owl than an eagle. But in *Bubo* and *Nyctea* the outline or contour of the *internal* condyle of these two is quite *circular*, the bounding rim being raised as a sharp ridge, and the included surface is smooth, all to a little minute tubercule near its center. Now the *internal* condyle of this bone in an eagle is distinctly reniform or kidney-shaped in outline, with the surrounding border rounded off, and the aforesaid tubercule *very* prominent. This distinctly and in all particulars agrees with what I find in *Minerva antiqua*. The form of the *external* condyle of the tibio-tarsus of this extinct owl is more like what we see in *Aquila chrysaëtos* than in either *Bubo* or *Nyctea*. Nevertheless, the general *facies* of the distal part of the tibio-tarsus of *Minerva antiqua* is very evidently more strigine than it is aquiline.

The rest of the fragments in this lot are so fragmentary (tarso-metatarsus, distal end of radius, etc.) that they throw no further light on the subject. Such as they are, however, it is very evident that they belonged to a large owl. I am inclined to believe that this big

owl had some aquiline affinity, judging from the characters presented on the part of this proximal end of the carpo-metacarpus. It was a form decidedly larger than *Bubo virginianus*, and were it living today, no systematist in ornithology would ever think of placing it in the same genus. In my own mind, I picture a large strigine form, which was, as I say, larger than *Bubo virginianus*, and perhaps a diurnal species exhibiting similar habits.

In this connection it will be well to remember that, while the owls are, in a way, related to the *Caprimulgidæ*, we have nevertheless a *Hawk Owl* (*Surnia*), as well as a remarkable Hawk—the Fish Hawk (*Pandion*)—that has some curious *strigine* characters in its skeleton.

Then again, as this extinct species was found in the Bridger Eocene (Dry Creek, Upper Crossing, Wyo.), it lived a great many thousands of years ago—perhaps over one hundred and fifty thousand—and during that time there may have existed, and probably did exist, raptorial species that brought the *Strigidæ* and the *Falconidæ* much nearer together than they appear to be at the present time. Were this so, *Minerva antiqua* may have been one of the intermediary affines, and one, were it in our present avifauna, would appear no more strange than any other "outlier" among birds, as, for example, a Hoatzin or a Kiwi.

Cat. No. 861 (Pl. XV, Figs. 131–136), Peabody Museum, Yale University Tule Spring, Wyoming. ? Eocene. J. W. Chew, collector.

Here we have additional fossil fragments of bone which belonged to a specimen of *Minerva antiqua*. The characteristic claw is well shown in Figure 134, and this articulates *perfectly* with the basal joint of *hallux* shown in Figure 133. This articulation is a very beautiful and unusually strong one, the approximation of the two articular surfaces being that of *complete contact* throughout, and a most extensive one. When powerfully *extended*, the proximal end of the process of the ungual joint fits snugly in a concavity intended for its reception on the dorsal distal end of the basal hallucial phalanx, an arrangement never noticed heretofore by me anywhere.

Unfortunately, the "accessory" or first metatarsals were not found with this material, or they may have been and since lost.

This *basal phalanx* of *hallux* in *Minerva antiqua* is double the size of the corresponding bone in *Nyctea*, and perceptibly larger than in *Bubo virginianus*. With respect to form, it appears to be more aquiline than strigine, while the *basal phalanx* of the second digit or

toe (Fig. 132) has much the form as we find it in some hawks (*Buteo*) as well as owls.

There is also a distal end of a left *femur* in this lot, with a perfect internal condyle and an imperfect external one, though the latter shows the "notch" for the head of the fibula to articulate in.

There is apparently more owl than eagle here (Fig. 136), and this is certainly the case with respect to the distal end of the left tibiotarsus (Fig. 131); for in the present instance, although the fragment is quite imperfect in some respects (chipped), it still shows, beyond all doubt, that the "tendinal osseous bridge," over the very shallow groove for the tendons in the anterior aspect below, is *absent*, as is the case in all owls known to me, while it is invariably present in the eagles. Instead of being markedly *concaved* in that locality (as well as to a lesser extent posteriorly), it is perfectly *flat* anteriorly, and only very slightly concaved behind. To some extent, this flatness may be due to pressure, as this, the lower end of the shaft, is much flattened antero-posteriorly. However, the form of the condyle present has not been materially altered.

The rest of the fossil fragments in this lot are pieces of other bones of the skeleton of *Minerva antiqua;* and while they are interesting and sustain what has been set forth above, they do not, however, demand detailed description.

Cat. No. 879 (Pl. XV, Fig. 152, *a* and *b*), Peabody Museum, Yale University. Upper White River, Wyoming. ? Oligocene. S. Smith, collector.

This lot contains, with other material, an ungual osseous (fossil) phalanx of *Minerva antiqua* that, although somewhat smaller than the one figured in Figure 154 *a*, evidently belonged to this species, and probably was the osseous claw of the middle anterior toe. Associated with it is a part of a phalanx of some mammal and a small fossil phalangeal joint from some bird, which it is quite impossible to determine.

Cat. No. 843 (Pl. XV, Fig. 149), Peabody Museum, Yale University. Dry Creek, Wyoming. Eocene (Bridger). LaMothe and Chew, collectors.

This is an almost perfect specimen of a fossil ungual phalanx of the extinct owl, *Minerva antiqua*, now being considered. Its extreme apex is broken off, and it is otherwise somewhat imperfect. There is no way of determining, so far as I can see, whether this claw belonged to the right or left foot. It is not as large as some of the other specimens of this bone, and so may have, in life, belonged to a male bird.

Cat. No. 1026 (Pl. XV, Fig. 148), Peabody Museum, Yale University. Sage Creek, Wyoming. Eocene (Bridger). Chew and Smith, collectors.

This hallucial fossil claw of *Minerva antiqua* is slightly above the average size, and may have belonged to a female individual of this species. It is nearly perfect, much worn, and has fossilized black like the majority of bird fossils from Fossil Lake, Oregon.

Cat. Nos. 858, 859, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). L. LaMothe, collector.

Imperfect fossil claw of hallux of *Minerva antiqua;* the process and apex broken off and lost. This claw, or what there is of it, agrees exactly in all particulars with the one figured in Plate XV, Figure 149. No. 859. Three pieces of fossil bones (bird? indeterminable).

Cat. No. 886, Peabody Museum, Yale University. Sage Creek, Wyoming. Eocene (Bridger). Chew and Smith, collectors.

Four fossil fragments of bones, one of which is a basal phalanx of the second pedal digit of *Minerva antiqua* from the *right* foot, which agrees, both in this respect and all others, with the specimen shown in Figure 132 of Plate XV (Adult.)

There are two other fragments of fossil bones in this lot that can not be determined. There is also the superior extremity of a small coracoid (left side) from a bird about the size of a Blue bird (*Sialia*). It is imperfect and too fragmentary for accurate determination. All the bones in this lot are of a coal black color.

Cat. No. 869, Peabody Museum, Yale University. Dry Creek, Wyoming. Eocene (Bridger). LaMothe and Chew, collectors.

Fossil osseous ungual phalanx from the outer or fourth pedal digit of a specimen of *Minerva antiqua* (adult). It is somewhat more perfect, and otherwise agrees with the one shown in Figure 154 *f*. There is also with this lot the distal end of another pedal phalanx, but it is not the one that in life articulated with this claw, though it appears to have belonged to a specimen of *Minerva antiqua.* Finally, with this lot we find an osseous fossil claw, which came from the foot of some Grouse or other, and which can not be determined with anything like accuracy.

Cat. No. 871, Peabody Museum, Yale University. Dry Creek, Wyoming. Eocene (Bridger). LaMothe and Chew, collectors.

Basal phalanx of second toe of *left* foot of *Minerva antiqua* (adult, fossil, perfect), which agrees with the one figured on Plate XV, Figure

132. It is of a pale clay color or drab. There is with it the distal end of another pedal phalanx (fossil), which would appear to be too small for a foot of this extinct owl.

Cat. No. 884, Peabody Museum, Yale University. Locality unrecorded. Eocene (Bridger). LaMothe and Chew, collectors.

Basal phalanx of hallux (fossil, black) of an adult individual of *Minerva antiqua*, from the opposite foot to the one shown in Figure 133 of Plate XV, with which it agrees exactly in all particulars.

In this lot there is also a very small cervical vertebra (fossil, adult) from some bird not larger than a Barn Swallow (*Hirundo erythrogastra*). It would be useless to endeavor to identify it.

Cat. No. 892, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). C. G. Knox, collector.

This appears to be an imperfect fossil basal hallucial phalanx of a specimen of *Minerva antiqua*, and I believe it is, as it agrees practically with Figure 154 *d* of Plate XV.

Cat. No. 857, Peabody Museum, Yale University. Black Fork, Wyoming. Eocene (Bridger). R. E. Son, collector.

Eleven fossil fragments of bones, some of which are mammalian or other vertebrates (caudal vertebræ); while there is with them in the lot a claw, which in life belonged to a specimen of *Minerva antiqua*. It is from the third toe and can be readily recognized, although the characteristic process is broken off, as is the distal moiety of the bone. Originally, it was of the same size as the specimen shown in Figure 149 of Plate XV.

Cat. No. 846, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). O. C. Marsh, collector.

Five fossil fragments of bones from an adult specimen of *Minerva antiqua*. (1) Basal portion of the ungual phalanx of one of the anterior digits of pes. (2) A basal hallucial phalanx of a foot (nearly perfect). (3) Two other imperfect phalanges, but interesting from the fact that each possesses a conspicuous mesial process, situated posteriorly on the plantar aspect of the articular facet of the bone. This process is present in the corresponding pedal phalanges of *Nyctea* and in probably other *Strigidæ*, while I do not find it in any eagles.

MINERVA ANTIQUA ?

Cat. No. 876, Peabody Museum, Yale University. Cattail Spring, Wyoming. Eocene (Bridger). LaMothe and Chew, collectors.

Two fossil ungual phalanges which may, and probably did, belong to an individual of this extinct owl; but they are a little too imperfect for the purpose of identification.

PALÆOPHASIANUS MELEAGROIDES Shufeldt.

(*Plate II, Fig. 20.*)

Shufeldt, Bull, Amer. Mus. Nat. Hist., XXXII, 1913, Art. XVI, 291–293, Pl. LVIII, Figs. 81–84, 86–88.

Cat. No. 896, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). J. W. Chew, collector.

This is the second example of this extinct pheasant which has come to hand for description. It is a very interesting specimen, and is far more perfect than the *type* specimen, as originally described. It consists of the distal end of the right tarso-metatarsus of an adult individual. The inner trochlea is broken off, and the remaining two are not entirely perfect.

This specimen might be mistaken for the corresponding part of the tarso-metatarsus of a Crane (*Grus*), but the characters attaching to the foramen for the anterior tibial artery; the narrower intervals between the trochleæ, and some minor points, all seem to point toward the gallinaceous rather than the paludicoline character of the bone.

UINTORNIS LUCARIS Marsh.

(*Plate VI, Fig. 42.*)

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 259.

Holotype. Cat. No. 617, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). O. C. Marsh, collector.

We have, representing this genus and species of Marsh, the distal portion of the right tarso-metatarsus (fossil) of some small bird the size of a Blue Jay (*Cyanocitta cristata*), and with it occurs six (6) other granules of fossilized bone, which it is claimed belonged to the skeletons of different individuals (Fig. 42).

Professor Marsh, in describing this specimen, says that he found it to be "A small bird evidently belonging to the Scansores, and probably related to the Woodpeckers, is represented by the distal end of a tarso-metatarsal in perfect condition, and by some other fragmentary remains of different individuals. These specimens indicate a bird

about as large as the Golden-winged woodpecker (*Colaptes auratus* Sw.)." He then completes his account by adding a technical description of the specimen and some measurements of it.

So far as his description of the specimen is concerned, it would appear to be quite correct, and I dare say his measurements are, too, although I have not verified them. When we come, however, to compare this fossil specimen with the right tarso-metatarsus of "*Colaptes auratus*," or any other true woodpecker like it, the fact will at once be recognized that Professor Marsh was not at all justified in referring his *Uintornis lucaris* to the *Pici*, and I am inclined to believe that it was a species in no way related to them.

On account of its being a zygodactyle foot, or a foot belonging to a "Scansorial" bird (as Marsh defined it), it has long been known that that type of foot presents some very interesting modifications over the foot in an ordinary passerine bird. In the woodpecker's foot, the *first toe* is the shortest, it being the *inner posterior* one; the *second* toe is the next longest and is the inner anterior one; the *third* toe, or outer anterior one, is still longer, and, finally, the *fourth* toe, or outer posterior one, is in nearly all woodpeckers the longest of all the toes. This unusual *scansorial* arrangement calls for a peculiar modification of the trochlear processes of the tarso-metatarsus, and this modification is recognizable on sight. Briefly, it may be said that the *fourth* or outer posterior toe, in so far as the basal phalanx of it is concerned, in the skeleton of the foot, has had a remarkable modification take place in the trochlear process of the tarso-metatarsus with which it articulated. This, as we would expect, has become bifid, twisted around posteriorly, in part, the posterior process having become *double* the size of any of the other prolongations.

Marsh's *Uintornis lucaris* presents no such feature or modification, and consequently the bone did not belong to a woodpecker.

It did not come from a typical passerine form of bird; for in the Passeriformes, as a rule, the trochlear projections are nearly parallel to each other, while in this specimen, as Marsh pointed out, they are "divergent." This cuts out a large group, and the probability is that it was not a passerine species.

All the zygodactyle birds exhibit some such modification of the trochlear processes of the tarso-metatarsi as do the woodpeckers; and this sets aside another formidable array of forms, no one of which it can be referred to, as the parrots, toucans, cuckoos, etc. We still have the *Cypseli*, the *Caprimulgidæ*, the Kingfishers, and numerous other non-passerine birds, with which it should be compared. This,

however, I have not done, as the skeletons of many of the existing species mentioned are not now at hand; moreover, there should be more of the material in order to make the determination certain and of any value.

In any event, it never came from the foot of a woodpecker (*Picidæ*), and the specimen should be set aside until such time as additional material will throw a better light on the subject.

BIRD (*Falconidæ* or *Strigidæ*).

(Indetermined).

(*Plate XV, Fig. 153, a* and *b.*)

Cat. No. 962, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). F. S. Wicks, collector.

Two very nearly perfect ungual phalanges of pes (fossil), from an adult individual of some raptorial species; but whether an owl or a hawk, it is hardly possible to say, and it will be as well to await the discovery of additional material before attempting to pass upon it.

BIRD (indetermined).

(*Plate XV, Fig. 130.*)

Cat. No. 959, Peabody Museum, Yale University. [Material mainly Wasatch (L. Eocene)—not sure of this." Lull.] L. S. Davis, collector.

Material consists of distal end of a fossil humerus of some mammal the size of a muskrat. The bird fossil is the superior part of a left *coracoid*, which belonged to a bird about the size of a Clapper Rail; but it is too imperfect and fragmentary for reference.

BIRD (indetermined).

(*Plate V, Fig. 29 c.*)

Cat. No. 863, Peabody Museum, Yale University. Millersville, Wyoming. Eocene (Bridger). R. E. Son, collector.

Distal portion of the right femur of some very large bird, which, unfortunately, is much distorted through pressure. It belonged to a bird fully of the dimensions of *Olor paloregonus* Cope, or of the California Vulture (*Gymnogyps californianus*). The external condyle is deeply grooved for the head of the fibula; but that is the case in a great many birds of all sizes. In my opinion, this fragment does not present a sufficient number of characteristic characters to admit of its being referred to any family of birds with certainty.

BIRDS ? (indetermined).

(*Plate V, Figs. 28, 29.*)

Cat. Nos. 952, 953, Peabody Museum, Yale University. Henry's Fork, Wyoming. Eocene (Bridger). H. G. Cheney and E. Lane, collectors.

These specimens, or in the case of No. 863 of Plate V, are excellent examples of fossil bones of birds—should they be birds—that are quite useless for the purposes of comparison with fossils of birds about which there can be no question; and, in my opinion, they are beyond the ability of any one to correctly determine.

In 952 we have the proximal portion of the left (?) tarso-metatarsus of some species, which, if it belonged to a bird, was a form about the size of an American Woodcock (*Philohela*), though it does not appear to be in any way related to that species. I say that this bone is from the left side, for the reason that the main part of the hypotarsus—a parallelogrammic plate—is on the mesial side of the shaft, with its inner surface flush with the latter. This is the rule in most birds wherein the hypotarsus consists of a single plate, as it does in this fossil bone.

There is a median, longitudinal groove also present in this specimen, its boundaries somewhat raised, forming the rest of the hypotarsus. The inferior part of the hypotarsial plate is broken off, while the superior end of it supports an articular facet, and the form of the facet on the summit of the shaft is, like the former, *convex*. All this so far departs from what we usually see in the summit of the tarso-metatarsus in birds, that I would not be surprised were I to find that this bone never belonged to a bird's skeleton, as I surmise to be the case in a former paragraph.

In 953 (Pl. V, Fig. 28 *a*, *b* and *c*,), the specimen is so compressed that it has been rendered useless for any purpose whatever. This bone is in three parts (*a*, *b* and *c*), and was compressed quite flat in the antero-posterior direction. It represents the right femur of some bird about the size of a small goose, and I have figured all three pieces on their posterior aspects, *a* being the distal half of the bone, *b* the proximal portion, and *c* a piece of the shaft from the middle section.

The "notch" for the head of the fibula is well shown, as is likewise a part of the internal condyle.

Passing to Figure 29 (Pl. V), *b* and *c* have already been described above; *a* invites attention to the specimen having the catalogue number of 895, and has likewise been described above.

OLIGOCENE BIRDS.

COLYMBUS OLIGOCEANUS (sp. nov. ?).

(*Not figured.*)

Holotype. Cat. No. 983, Peabody Museum, Yale University. Lower Willow Creek, Oregon. [? Oligocene (John Day). Lull.]

An extinct grebe based on the fossil left femur mentioned above. This specimen I have compared with a large series of femora belonging to existing and to fossil specimens of *Æchmophorus occidentalis*, to those of *Colymbus holbœlli*, and other grebes; but it does not represent a specimen of any of these, for it is too slender and small for an *Æchmophorus* or for a Holbœll's grebe, while it is too large for any of the smaller representatives of the American *Colymbidæ* of the genus *Colymbus*.

It has the form and general character of the femur in *Æchmophorus* or *Colymbus holbœlli* and the length (4.5 cms. approx.), while the shaft is notably *slenderer* than it is ever found to be in those birds.

The head of the bone has been broken off and lost, and the lower parts of the condyles are chipped; otherwise this femur is complete. Its basic color is black, which is extensively overlaid with a white deposit, giving it the appearance of many of the specimens from the Fossil and Silver Lake region of Oregon.[1] I name this species provisionally, as awaiting additional material to completely establish it. As it was probably discovered in the Oligocene (John Day) of Oregon, it may be known as *Colymbus oligoceanus*.

LARUS PRISTINUS[1] sp. nov.

(*Plate XIV, Fig. 112.*)

Holotype. Cat. No. 935, Peabody Museum, Yale University. Willow Creek, Oregon. [? Oligocene (John Day). Lull.]

Two fossil bones make up this lot, one being a vertebra—apparently a dorsal vertebra—which may or may not have belonged to the same skeleton as the second specimen did. This latter is the proximal part of a left tibio-tarsus from an adult individual. It is fairly perfect as far as it goes, though the cnemial processes are somewhat chipped off along their anterior free margins. Notwithstanding these defects, it is very clear that this fossil bone belonged to the leg of some longi-

[1] Shufeldt, R. W. "Review of the Fossil Fauna of the Desert Region of Oregon, with a Description of Additional Material collected there. Bull. Amer. Mus. Nat. Hist., Vol. XXXII, Art. VI, 123–178, Pl. XV, Fig. 130.

pennine species, most probably a gull. I have compared the specimen with the tibio-tarsi of numerous gulls, terns, jaegers, fulmars, etc., and I find it comes nearest to the *Laridæ*, especially to the Ivory Gull (*Pagophila alba*) ("*Larus eburneus*," No. 18593. Osteolog. Coll. U. S. Nat. Mus.), the latter being of about the same size. More material when discovered, will settle this point regarding the nearest relative of this extinct species of *Larus*, for which I propose the name of *Larus pristinus*. [1]

LIMICOLAVIS PLUVIANELLA gen et sp. nov.

(*Plate XV, Fig. 129.*)

Holotype. Cat. No. 957, Peabody Museum, Yale University. Lower Willow Creek, Oregon. ? Oligocene. L. S. Davis, collector.

Genus and species based on a fossil right *tibio-tarsus* (adult), the limicoline characters of which are abundantly evident, notwithstanding the fact that the proximal end of the bone has been broken off and lost. Originally, it probably had a length of about 5.8 centimeters. The shaft is straight and somewhat compressed antero-posteriorly, the fibular ridge or crest above being short, thin and sharp (Fig. 129). At the distal extremity the condylar portion is particularly limicoline in character, coming very near, in all particulars, the lower end of the tibio-tarsus of the large Chilean plover known as *Belonopterus chilensis*, with which I have compared it. Posteriorly, the condyles are nearly in the same vertical plane with the back of the shaft; their edges are low and sharp, the valley between them being shallow and wide. As the sharp condylar rims are carried forwards, they each become thicker and thicker and more rounded, until they each terminate on the front of the bone below. All this part of the extremity protrudes very much forward, and the intercondylar valley is here decidedly deeper and narrower than it is posteriorly. The "tendinal groove" is well marked and the "osseous bridge," which spans it, is so low down, and, owing to the forward protrusion of the condyles, it is nearly in the horizontal plane with reference to the long axis of the shaft. Viewed laterally, the external condyle is of a subcircular outline, with flat superficies and low bounding rim. At its center we note a small tubercle. Reniform in outline and with a somewhat raised border, the mesial surface of the internal condyle is likewise smooth, and anterior to its center there is a raised, ridge-like tubercle, the long axis of which is parallel to the shaft of the bone.

[1] Generic name = Lat., a gull; spec. name = Lat. *pristinus*, early, primitive.

For a limicoline bird, this tibio-tarsus is very *short, stout*, and with bulky distal extremity. It is proportionately shorter and heavier than is the tibio-tarsus in *Scolopax*, *Philohela* or *Gallinago*, while it has almost identically the same limicoline characters. It has nearly the same length as the tibio-tarsus of *Aphriza virgata*, but its condylar end is again comparatively much stouter.[1]

As a matter of fact, I have compared this fossil tibio-tarsus with the bone in many plovers, woodcock, snipe, stilts, avocets, godwits, willets, curlews, sandpipers, lapwings, and their various allies, and I am of the opinion that the form here noted is now extinct and its genus no longer in existence. The specimen should be compared with the tibio-tarsus from a skeleton of *Pluvianellus sociabilis* of South America, but I have no such material at hand.

As I say above, the distal part of the bone and lower shaft agrees very closely with the same bone in *Belonopterus chilensis*, but in the latter the tibio-tarsus has a length of 8.9 cms. (No. 18546. Coll. U. S. Nat. Mus.) This Chilean species is a big plover.

For this apparently extinct bird I propose the name of *Limicolavis pluvianella.* [2]

PHALACROCORAX MARINAVIS[3] sp. nov.

(*Plate XIV, Figs. 113–122.*)

Holotype. Cat. No. 936, Peabody Museum, Yale University. Willow Creek, Oregon. [? Oligocene (John Day). Lull.]

Cormorants of several species, now extinct, were residents of the Pacific Coast of North America, and probably were found far inland, extending from Oligocene time up to the present day. The species

[1] Shufeldt, R. W. On the Affinities of *Aphriza virgata.* Journ. Morphol., Vol. II, No. 2, Nov. 1888, 333, Pl. XXV, Fig. 9.

—— —— Observations upon the Osteology of *Podasocys montanus.* Journ. Anat. and Phys., Lond., Oct. 1883, Vol. 18, Pt. 1, 86–102, Fig. 10.

—— —— Osteology of *Numenius longirostris*, with notes upon the skeletons of. other American Limicolæ. Journ. Anat. and Phys., Lond., Oct. 1884, 57–82, Pls. 4–5

—— —— Osteology of the *Limicolæ.* Carnegie Mus. Mem., Pittsburgh, Pa., V. 3, Art. iii, 15–70. Plates and many text-figures.

[2] Generic name = Lat. *linus*, mud + *col re*, inhabit, + *avis*, bird. Sp. name = Lat. the diminutive of *Pluvianus*. Lat. *pluvia*, rain; *pluvialis*, pertaining to rain, hence plover or birds (*Pluvialiformes*) that were supposed to. be related in some way to the rainy season. The application here is: A limicoline bird of short stature related to the plovers.

[3] Gen. name = Latin, *phalacrocorax*, a cormorant. Sp. name = Latin, *marinus*, the sea + *avis*, a bird.

here to be described was one of that group, and the fossil bones representing it are ample to establish its presence in the above-named formation. They belonged to an adult individual; are thoroughly fossilized and in fairly perfect condition, after I had fastened *in situ* the several fragments representing the two humeri.

In addition to three small bits which I have not determined, there is in the lot what appears to be the head of a *femur*, so imbedded in a firm matrix as to be unrecognizable and useless. A vertebra, apparently one of the ultimate cervicals, is in a somewhat better condition, and it would appear, belonged to this individual. There is the proximal half of a right *ulna*, nearly perfect as far as it goes; the distal moieties of the two humeri, and an imperfect left tarso-metatarsus, which lacks the proximal portion of the bone as well as the internal trochlea.

These humeri, the ulna, and the tarso-metatarsus I have carefully compared with the corresponding bones of specimens in the collection of the United States National Museum of *Phalacrocorax urile*, *P. carbo* (No. 18851. See Pl. XV), *P. perspicillatus*, *P. dilophus*, *P. mexicanus*, and various other species; to none of these, however, did the present extinct species belong. It was a form larger than *P. urile*, and somewhat smaller than *P. carbo*, to which it appears it was most nearly allied.

The *humerus* in *Phalacrocorax marinavis*, in so far as its distal extremity is concerned, presents the usual characters of this bone in Cormorants. Both articular tubercules are very conspicuously elevated, and the proximal end of the radial one is drawn out as a *free* point, which is directed toward the middle of the shaft, pointing, as it were, toward the well marked and oblique depression for the *brachialis anticus* muscle. On the palmar aspect of this end of the humerus the several grooves for the tendons are unusually deep, and there is a pronounced concavity palmad to the ulnar tubercule, with another circular one to its outer side, on the projecting part of the bone there found. The shaft is smooth and somewhat compressed transversely.

In *P. marinavis* the proximal end of the *ulna* possessed in life the peculiar conspicuous process for articulation with the head of the radius; its apex has been broken off and lost. The tubercules for the quill-butts down the shaft are in a double row as in all *Phalacrocoracidæ*.

With respect to the tarso-metatarsus, it exhibits all the characters of birds of this group, as the large foramen for the anterior tibial

artery; the deep tendinal groove on the outer side of the bone, and this species has a distinctive pit anteriorly at the base of the middle trochlear process, the apex of which latter, posteriorly, is gradually turned toward the outer side. This character is especially well marked in *P. carbo*, anteriorly; the shaft is smooth and flat, while posteriorly it is much marked up by the tendinal grooves, and, on the whole, considerably compressed antero-posteriorly.

This Cormorant was very much smaller than *P. macropus* Cope, and, judging from the carpo-metacarpus of *P. idahensis* (Pl. VI, Fig. 44), it was smaller than that species.

PHALACROCORAX MEDITERRANEUS[1] sp. nov.

(*Plate XV, Fig. 138.*)

Holotype. Cat. No. 943, Peabody Museum, Yale University. Gerry's Ranch, North Colorado. Oligocene (White River). G. B. Grinnell, collector.

Established on the proximal part of a fossil carpo-metacarpus from the right pectoral limb.

This was a Cormorant of large size equal to *Phalacrocorax perspicillatus*.

Although we have but a part of the bone here, it proves to be a part which can not be mistaken as having belonged to any other kind of a bird, so distinctive is the proximal part of the carpo-metacarpus in a true Cormorant.

PHASIANUS AMERICANUS sp. nov.

(*Plate XII, Figs. 83, 84.*)

Holotype. Cat. No. 956, Peabody Museum, Yale University. Parilina Creek, Oregon. Six miles from its junction with Beaver Creek, and 40 miles S. W. from Camp Watson. Upper Oligocene (Middle John Day). L. S. Davis, collector.

There are two imperfect bones in this lot, namely the distal extremity of a left tarso-metatarsus, and a pedal phalange, which probably belonged to the same individual. The tarso-metatarsus evidently belonged to a pheasant, and to a species somewhat larger than *Phasianus alfhildæ*,[2] and I here propose the name for it of *Phasianus americanus*. It is an interesting fact that ages after the true pheasants of this country became extinct, the imported ones

[1] Generic name = Latin, *phalacrocorax*, a cormorant. Sp. name = Latin, *medius*, middle, and *terra*, land,—that is referring to this species having had its range in the central part of the North American Continent, in so far as at present known.

[2] See page 71.

from the Orient are now thriving in numbers in the same locality. This species was about one-third larger than *Phasianus colchius*, to which species, I take it, it was otherwise pretty closely related.

BIRD (Not sufficiently characteristic for exact determination).

(*Plate V, Fig. 29 b.*)

Cat. No. 912, Peabody Museum, Yale University. Colorado. [Probably Oligocene. Lull.]

Consists of the distal end and a good part of the shaft of the left tibio-tarsus, in a perfect state of preservation, and but very slightly chipped. It was from an adult individual, and belonged to some bird wherein the osseous bridge on the anterior aspect, spanning the tendinal groove below, is absent.

This is the case in a large number of avian species, belonging to entirely different groups, as, for example, Owls or the *Psittaci.* The bone here described belonged to some form about the size of a Barred Owl (*Strix v. varia*), or a somewhat smaller species, or to any of the larger Macaws (*Ara*); the condyles, however, are entirely different from what we find to be their form in existing Owls, while, on the other hand, it does not seem to be any nearer the *Psittaci.* To define what kind of a bird this belonged to, we should have additional material, and until this comes to hand, it is best to leave it as being an indetermined species.

BIRD (indetermined).

(*Plate XIII, Figs. 107–110.*)

Cat. No. 958, Peabody Museum, Yale University. John Day River, Oregon. [Probably Oligocene. Lull]. S. H. Snook, collector.

Lot consists of over thirty bits of fossilized bones, apparently all from one and the same individual. Many of them are covered for the most part with a greenish gray, flinty matrix; other pieces are free from it. There is a distal end of a left ulna (Fig. 107); the proximal end of a right carpo-metacarpus (Fig. 108), half embedded in the matrix; a fragment of the upper third of the indicial shaft of a right carpo-metacarpus, also embedded in its matrix (Fig. 109), and the middle and inner trochlea, with proximal ends of the basal phalanges (articulating with them) of the right tarso-metatarsus, embedded on the plantar aspect in the matrix (Fig. 116).

These bones belonged to some quite typical tetraonine of about the size of *Centrocercus urophasianus;* but they are altogether too frag-

mentary for the purposes of reference, especially in view of the fact that there is now quite a list of extinct birds of this group described; and if new species are to be established, beyond all manner of doubt, it must be done only upon ample material and exhaustive comparison with that already described and named.

BIRD (indetermined).

(*Plate XV, Fig. 137.*)

Cat. No. 944, Peabody Museum, Yale University. Cherry Creek, Nebraska. ? Oligocene. O. C. Marsh, collector.

Distal portion of a fossil right humerus of a bird. Imperfect. Adult. Species the size of a Sage Cock. Of but little use for reference.

MIOCENE BIRDS.

AQUILA DANANA Marsh.

(*Plate II, Fig. 13.*)

Marsh, Amer. Journ. Sci., ser. 3, II, 1871, 125.

Holotype. Cat. No. 293, Peabody Museum, Yale University. Loup Fork, Nebraska. [Miocene. Lull]. A. H. Ewing, collector.

Consists of the extreme distal end of the left tibio-tarsus of a fossil bird. It is fairly perfect anteriorly, but quite imperfect posteriorly. I have not Marsh's description before me at this writing, but I have compared this specimen with the corresponding part of the skeleton in several eagles. It doubtless belonged to a true eagle, but not essentially *Aquila*. In size it was but little more than half the bulk of the Bald Eagle (*Haliæetus l. leucocephalus*); but I am inclined to believe that it did not belong in either that genus or in *Aquila*. As a matter of fact, it was closer to some of the vulturine species than to any Eagle—something like a *small Gypaëtus barbatus* for instance. There is not enough of the material to really make a *positive* identification, in so far as its being an "Eagle" is concerned.

PHASIANUS MIOCEANUS sp. nov.

(*Plate XIII, Figs. 94–96, 98.*)

Cotypes. Cat. Nos. 908, 909, Peabody Museum, Yale University. Chimney Rock and Scott's Bluff, Nebraska. Miocene. Shelley and Clifford, H. Clifford, collectors.

The fossil material, upon which I base this new and true pheasant from the Miocene of Nebraska, consists of the proximal two-thirds

of a right humerus (Fig. 94), and the proximal end of a left femur (same individual?) Fig. 96). Accompanying it there is found a fossil imperfect fragment of bone of some other vertebrate which I have not made out (Fig. 97).

These fossil remains represent a pheasant closely related to *Phasianus colchius*, with which I have critically compared it (No. 19293. Coll. U. S. National Museum, ♂).

With respect to the *humerus*, the characters are almost identical, the opening of the pneumatic foramen in *P. mioceanus* being much smaller than in the existing species. This feature, however, is quite unimportant. A better marked difference is seen in the head of the bone, it being somewhat thicker, broader and larger in *P. colchius* than it is in the extinct species. In the latter, too, the shaft of the bone is a trifle stouter.

With respect to the proximal end of the femur (Fig. 96), I may say that it is imperfect to the extent of being chipped and worn in several places; otherwise it presents almost identically the same *form* as the corresponding part of the femur of *Phasianus colchius*. What is remarkable, however, in the fossil specimen is that there is not the slightest evidence of the presence of a pneumatic fossa, as there is in the existing species, where it is a very prominent feature, being a large, elongate fossa between the head of the bone and the great trochanter. Its base is perforated by some eight or ten pneumatic foramina, and the entire bone is permeated by air. The head of the fossil femur, or rather the entire end of the bone, was solid, and this, the upper part of the shaft, presents no evidence of ever having been hollow. Indeed, were it not for the fact that, in all other respects, this fossil agreed so closely, morphologically, with the existing species, I would have suspected this fossil proximal end of the femur to have belonged to some other animal—perhaps a mammal—and this suspicion would have been strengthened by the presence of the unidentified fragment of fossil bone shown in Figure 97, which has the appearance of the vertebral end of a mammalian rib of some sort or other. However, there is no question in the world about the humerus, as may be readily believed on comparing Figures 94 and 95 of Plate XIII; and if *this* specimen was associated with the proximal end of a femur which—apart from being completely non-pneumatic and the pneumatic fossa entirely absent—agreed morphologically in all other respects, it would, to say the least, constitute a most extraordinary coincidence.

Many birds in the present-day avifauna possess pneumatic humeri

when the femora are completely *non-pneumatic;* so it is just possible that the pheasants of this country of Miocene time possessed pneumatic humeri and non-pneumatic femora, and that the pneumaticity of the latter bones has been acquired since Miocene time; and for causes entirely unknown to us, the genus long ago became extinct in America.

PUFFINUS CONRADI Marsh.

(*Plate VIII, Figs. 63, 64.*)

Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1870, 212.

Holotype. No Cat. Number. Academy of Natural Sciences of Philadelphia. Maryland. Miocene.

Specimen consists of nearly the distal half of a left humerus (fossil) of a bird, and the distal third (or less) of the left ulna, apparently coming from the same individual.

I have compared this specimen most carefully with the humeri of many birds of many genera having the main characters which it presents; for, be it known, the Puffins are not the only sea-birds which possess a prominent ectocondyloid process on the radial side of the humerus, with a deep excavation proximad to the articular tubercules, as these characters exist in the humeri of auks, gulls, petrels and fulmars. (See Fig. 62, Pl. VIII.) However, the determination of Professor Marsh, with respect to *Puffinis conradi*, is probably as near the truth as we can hope to get; for, as a matter of fact, if *P. conradi* was not actually a Puffin, it certainly was as near the representatives of that genus as anything else. Personally, I am inclined to believe that it was a true Puffin.

SULA ATLANTICA sp. nov.

(*Plate XV, Fig. 123.*)

Holotype. Cat. No. 937, Peabody Museum, Yale University. New Jersey. Miocene. L. Leidy, collector.

Up to the present time, in so far as I am aware, but few fossil remains of *Sulidæ* have been described, and of these only one for North America.[1] For the new species here established, there exists in the collection of Yale University a fossil left coracoid of a

[1] Three extinct Gannets have been described from their fossil remains as having been discovered in France, one of these being from the Miocene and two from the Lower Miocene; all have been referred to the genus *Sula*.

The species that demands consideration here, however, is the *Sula loxostyla* of Cope (Tr. Amer. Phil. Soc., XIV, 236, Fig. 53, 1870), which he "found at the foot of the Miocene cliffs in Calvert Co., Maryland." In the place cited, Professor Cope

Gannet that, although somewhat imperfect, is so thoroughly characteristic as to leave no doubt whatever as to the kind of bird it belonged to in life. In comparing this bone with the coracoids of different species of Gannets, I find it to come nearer *Sula leucogaster* (No. 18023, Coll. U. S. Nat. Mus.) than to any other form. The extinct species, however, had the coracoidal shaft somewhat stouter, and the glenoidal facet for the humerus about one-third larger. With respect to the imperfections (Fig. 123), there is to be noted the loss in the fossil of the delicate osseous spur that springs from the lower margin of the glenoid cavity, to curve forwards and outwards in the direction of the summit of the bone, which is likewise broken off. Finally, the infero-external angle is also fractured off and lost.

Among the *Sulidæ*, the sternal facet is peculiar and unique. On the posterior aspect of the bone it is very broad, antero-posteriorly, the bone being thickened above in order to accommodate it. Its *internal angle* or termination is not carried to the mesial angle of the bone. This facet is narrow and elongate on the anterior aspect of the sternal extremity of this coracoid, all of which is strictly Gannet in character, and can in no way be confused with any other bird.

For this new and extinct species of the *Sulidæ* I propose the name of *Sula atlantica*—the Atlantic Gannet, now extinct.

URIA ANTIQUA Marsh.

(*Plate VIII, Fig. 56.*)

Catarractes antiquus Marsh, Amer. Journ. Sci., ser. 2, XLIX, 213.

Holotype. No Cat. Number. Academy Natural Sciences of Philadelphia. Tarboro, Edgecomb Co., North Carolina. Miocene.

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says that "this specimen is established on a single coracoid," which he admits was a very imperfect bone. He also admits that he had not a skeleton of *any species* of Gannet at hand, wherewith to make comparisons, but that he was obliged to rely upon a lithograph figure of the coracoid of a fossil *Sula*, published by A. Milne Edwards in his work on fossil birds. Cope's description is long and very elaborate, which is usually the case when the describer is required to make a special effort to convince his readers of the truth of his claims.

I am inclined to believe, judging from Cope's figure (which is published upside down) that the coracoid he discovered in Maryland never came from the skeleton of a Gannet of the genus *Sula*. As it is much broken and chipped, little can be said of its extremities; while it is quite evident that the shaft of his coracoid is much too slender for a bone as it exists in any species of *Sula*,—that is, taking the *length* of the bone into consideration. In any event, it is a very different coracoid from the one I here figure on Plate XV (Fig. 123), as any one will appreciate who will make the necessary comparisons. My figure is a reproduction of a photograph of the bone, and I compared the specimen with the coracoids of some six or seven different species of Boobies (*Sula*), including the Gannet (*Sula bassana*).

This humerus is a trifle larger than that of *Uria affinis*, but otherwise agrees with it in all of its characters. Both birds, in life, were true Murres of the genus *Uria*, and very likely distinct species.

This specimen is slightly chipped at its proximal end. There is not a particle of matrix adhering to it, and it is rather rough to the touch. Its color is of a rather dark earth-brown. The head of the bone has been broken off at some time, and very carefully glued on again.

BIRD (indetermined).

(*Plate XV, Fig. 124.*)

Cat. No. 940, Peabody Museum, Yale University. Virginia. Miocene.

Distal part (third?) of a right humerus of a bird. Adult. Fossil. (Extinct?). This belonged to some species about one-fifth smaller than a Night Heron (*Nycticorax*); but it is too much chipped and worn to be of any special use in the matter of reference (Fig. 124).

PLEISTOCENE BIRDS.

BRANTA CANADENSIS.

(*Plate XIII, Figs. 99, 100.*)

Cat. No. 910, Peabody Museum, Yale University. Alameda Co., California. Post-Pliocene. L. G. Yates, collector.

A right fossil carpo-metacarpus (adult) which agrees in all essential particulars with that bone as it is found to be in the existing Canada Goose (*Branta canadensis*), with which I have compared it. About the middle third of the shaft has been shattered into bits, while the terminal portions are quite perfect. The "bridge" referred to on the slip, as noted above, is a small, osseous span found on the palmar aspect near the distal end of the main shaft. It probably spans the tendon of the *flexor minimi digiti* muscle,[1] as the latter passes to its insertion. We have no assurance that it is a constant character, and even if it were, it is not of a kind to establish a new species upon, unless other more important features were associated with it.

On previous occasions, and in other places, I have touched upon fossil metacarpi of *Branta canadensis;* for instance, in my "Review of the Fossil Fauna of the Desert Region of Oregon, with a Description of Additional Material Collected There"; and in other contributions, fossil specimens are described which represent this species of

[1] Shufeldt, R. W. "The Myology of the Raven," p. 148. [87.]

goose. In the paper just named, on Plate XXV, Figures 304 and 305, a fossil carpo-metacarpus of *Branta canadensis* and the same bone from a skeleton of the existing species are compared. These I have also compared with the present material and with *B. c. occidentalis* (No. 18609. Coll. U. S. Nat. Mus.), and they all practically agree. I hardly think one would be justified in considering that this material now at hand represented a new species of the Canada Goose, much less that it came from a specimen of the subspecific form—that is, *C. c. occidentalis*.

Personally, I can only regard this fossil material as representing the remains of a specimen of *Branta canadensis*, especially as it came from the Post Pliocene of California, and we now know that the bird occurred in the avifauna of the Pleistocene formation of Oregon.

GRUS HAYDENI Marsh.

(*Plate VIII, Fig. 67; Plate II, Fig. 21.*)

Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1870, 214.

Holotype. Academy of Natural Sciences of Philadelphia. Niobrara River, Nebraska. ? Pleistocene. F. V. Hayden, collector.

Cat. No. 860, Peabody Museum, Yale University. Grizzly Buttes, Wyoming. ? Pleistocene. O. Harger, collector.

Professor Marsh gives a detailed description in his article of the distal end of a left tibia, which is broken and badly chipped, but which is, nevertheless, from the skeleton of an extinct Crane of the genus *Grus*, and very properly named *Grus haydeni* after its discoverer, Dr. F. V. Hayden.

In the collection of Yale University I find another distal end of a *left* tibio-tarsus, which is more or less perfect. It is in a better condition than the Philadelphia Academy type specimen in some respects, of which it is almost a counterpart, only being darker in color. This specimen likewise represents *Grus haydeni*.

The type of *Grus proavus* appears to have been lost, as it is not in the Yale Collection nor in that of the Academy of Natural Sciences of Philadelphia. (Marsh, *Amer. Journ. Sci.*, ser. 3, IV, 1872, 261.) Pleistocene, New Jersey.

Marsh said of it: "An extinct species of Crane, somewhat smaller than *Grus canadensis*, Temm., is indicated in the collections of the Yale Museum by a nearly perfect sternum, a femur, and a few other less important remains, which are probably all parts of the same skeleton."

This material I have never seen.

MELEAGRIS SUPERBA Cope.

(*Plate X, Figs. 71–73; Plate XI, Figs. 74–77.*)

(*Meleagris altus* Marsh is a synonym of *Meleagris superba*).[1]

Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 260.

Cotypes. Cat. No. 533–536, Peabody Museum, Yale University. Manalapan, near Freehold, New Jersey. Post-Pliocene. J. C. Thompson, collector.

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[1] Cope, E. D. *Meleagris superbus.* Trans. Amer. Phil. Soc., N. S. XIV, Pt. I. 1870, 239. Pleistocene of New Jersey.

Shufeldt, R. W. "On Fossil Bird-Bones Obtained by Expeditions of the University of Pennsylvania from the Bone Caves of Tennessee." Amer. Nat. Phil., July, 1897, 645–650. In this paper I dispute Professor Marsh in regard to his three extinct turkeys, as to their having been species distinct from the now existing *Meleagris gallopavo.* Among other things I remark: "In the case of *Meleagris altus*, Professor Marsh says that the length of the tarso-metatarsal is equal to 176.5 mm. (p. 261), and the present writer says that it is by no means uncommon to find the same bones in adult male specimens of *M. gallapavo* fully that length, if not longer. . . . . In other words, I am of the opinion, in so far as I am able to judge from his descriptions, that when Professor Marsh described his three extinct and new species of *Meleagris*, he had nothing more or less before him than the very meagre and fragmentary remains of *M. gallapavo.*"

For the first time in the history of this discussion, which took place years ago between Professor Marsh and myself, I am enabled to clear the matter up. The entire material upon which Professor Marsh based his *Meleagris altus* is now before me for the first time. While he lived he would never allow me to see this, and hence the present explanation. It will be noted above that Professor Marsh stated in his article that the tarso-metatarsus of *Meleagris altus* had a total length of 176.5 millimeters.

This measurement of Professor Marsh's is correct, as noted in the LIST below, where I offer the lengths of all these long bones. In these measurements the approximate lengths are very close to what the actual ones would have been. Had I *seen* and measured all these bones *before* I published my criticism of Marsh's *M. altus*, it is quite likely that it would never have appeared. As it is, in this new light, I am inclined to believe that the Professor was justified in naming at least *this* particular extinct turkey *Meleagris altus* (now *M. superba* Cope); and, judging from these fossil remains, it must have been, in life, a very *tall* turkey indeed.

This settles what I have to say in regard to this extinct form. As to *Meleagris celer* and *M. antiqua*, I have discussed them in another connection.

—— —— —— "Contributions to Avian Palæontology." The Auk, Vol. XXX, No. 1, Jan. 1913, 29–39, Pl. III, Figs. 1–5.

In this paper, the question of fossil *Meleagridae* is very fully discussed.

Marsh, O. C. Articles in Amer. Journ. Sci., II, 1871, 126; also *ibid*, 1872, 261; also Proc. Acad. Nat. Sci. Phila., 1870, 11; and Amer. Jour. Sci., 1872, IV, 260.

Shufeldt, R. W. (In MS.) "On the skeleton of the Ocellated Turkey (*Agriocharis ocellata*) with Notes of the Osteology of other *Meleagridae.*" Pls. I–XIV, Figs. 1–53. This paper is at present in the hands of the editor of *Aquila* for publication (Budapest, Hungary); it contains much which is pertinent to matters touched upon in the present connection. (Since published: *Aquila*, Vol. XXI. Budapest, 1914, pp. 1-52; Pls. I-XIII, Figs. 1-53; text in Magyar and English.)

This material is in very excellent condition and consists of twelve (12) long bones or parts of long bones. Some are very nearly perfect, others are less so. They are all of a uniform dark brown color and have the appearance of great age. The following LIST gives additional information about them.

LIST

Specimens	*Length in centimeters (of perfect bones)*
3 Humeri (one perfect) (all from right limbs)	147.0
1 Radius (perfect) left limb	138.0
1 Ulna (perfect) left limb	155.0
1 Coracoid (almost perfect) left side	123.0 (approx.)
1 Scapula (left: in two pieces)	152.0 (approx.)
2 Femora (somewhat chipped. Rights)	150.0
2 Tibio-tarsi (chipped)	
(1) (approx.)	244.5
(2) (approx.)	183.0
1 Tarso-metatarsus (right) broken in half	176.5

MELEAGRIS RICHMONDI sp. nov.

(*Plate II, Fig. 19.*)

Holotype. Cat. No. 905, Peabody Museum, Yale University. Alameda Co., California. Post-Pliocene. L. G. Yates, collector.

Specimen accompanied by the following letter:

CALIFORNIA STATE DENTAL ASSOCIATION,
Secretary's Office.

Centreville, Alameda Co., Cal., Feb. 14, 1876.

PROF. O. C. MARSH

Dear Sir: I send herewith a bone which I found a few days since in the P. Pliocene ? near Mission San Jose where I have found *Elephas, Mastodon Lama*, etc., it was imbedded in gravel about 30 feet below the surface. Please inform me what it is and oblige

Yours very truly
[SIGNED] LORENZO G. YATES.

The specimen consists of the sternum of some gallinaceous bird about the size of a male *Centrocercus urophasianus*. There are also a few small fragments with it, which apparently have been broken off from the larger specimen.

I have compared this fragment of a sternum with a large number of gallinaceous fowls of a more or less similar size, including *Argus*, Capercalzie, *Centrocercus*, etc.; but I am thoroughly convinced that it

belonged to a species of turkey considerably smaller than the existing *Meleagris gallopavo*.

I have compared it with the sterna of a great many turkeys, including a series of prehistoric ones from the burial mound adjoining the ruin of Puyé, New Mexico. These were collected by Mr. F. W. Hodge for the Bureau of Ethnology, and are now in the Collection of the Division of Birds of the United States National Museum. This material I have described in another connection (Ost. of *Agriocharis ocellata*, in MS. Apr. 29, 1914). See footnote, p. 66. (*antêa*).

They show many variations and sizes (for sex and age), but all have the typical meleagrine characters, and no one of the series is in any way as small as this fossil sternum found by Dr. Yates. Moreover, California is not now the range for a *Meleagris*, and they have long ago become extinct there.

This species was not more than half the size of the existing wild turkey (*M. g. merriami*).

Therefore I propose for it the name of *Meleagris richmondi*, naming it for Dr. Charles Wallace Richmond, Assistant Curator of Birds of the United States National Museum, in recognition of his work in ornithology, and especially his more recent labors in the bibliography of that science.

PHALACROCORAX IDAHENSIS (Marsh).

(*Plate VI, Fig. 44.*)

Graculavus idahensis Marsh, Amer. Journ. Sci., ser. 2, XLIX, 1870, 216.

Holotype. Cat. No. 527, Peabody Museum, Yale University. Castle Creek, Idaho. Pleistocene.

In the publication and place above cited, Professor Marsh has fully described this material, which consists of the proximal half of a left carpo-metacarpus of a bird (fossil: extinct), in a perfect condition as far as it goes. It is of a deep gamboge color, partially overlaid with whitish in some places, especially on the palmar aspect of the bone.

I have carefully compared this carpo-metacarpus with the corresponding bone as found in the skeletons of wings of our American species, and I am of the opinion that as a distinct species it is no longer in existence.

This form was slightly smaller than *Phalacrocorax perspicillatus* (Pall.) (extinct), and evidently more nearly affined to it than to any of the present existing species. It should be known as *Phalacrocorax idahensis*, and I see no reason for changing it to *P. idahoensis* (Sharpe's Hand-List of Birds, Vol. 1, p. 235), or for relegating it to *Pallasicarbo*,

a new extinct genus of Cormorants, suggested by Coues (MSS. 1898) to contain *Phalacrocorax perspicillatus;* for there are no good generic characters in the skeleton of the last-named species which would justify the creation of a genus. (Compared with No. 17041. Coll. U. S. Nat. Mus., *P. perspicillatus*.) (See Fig. 44.)

TYMPANUCHUS LULLI sp. nov.

(*Plate XII, Fig. 90.*)

Holotype. Cat. No. 911, Peabody Museum, Yale University. Hornerstown, New Jersey. Post-Pliocene. (Evidently a later deposit in the marl, which is Cretaceous.) J. G. Meirs, collector.

This is an imperfect left *humerus* of an adult species of Grouse. A large part of the head of the bone has been fractured off; otherwise it is in good state of preservation. I have carefully compared the specimen with the humeri of all of our larger species of existing grouse, and I find that it falls squarely in the genus *Tympanuchus*, having belonged to a bird apparently somewhat larger than *Tympanuchus americanus*. [1]

I take pleasure in naming this extinct species of Prairie Chicken for Doctor Richard Swann Lull, of the Department of Palæontology of Yale University (Peabody Museum), in recognition of his valuable contributions to the study of Extinct Reptilia and other vertebrates.

URIA AFFINIS (Marsh.)

(*Plate VIII, Fig. 60.*)

Catarractes affinis Marsh, Amer. Journ. Sci., ser. 3, IV, 1872, 259.

Holotype. No Cat. Number. Academy of Natural Sciences of Philadelphia. Bangor, Maine. Pleistocene. A. C. Hamlin, collector.

This type specimen is perfect in all particulars. It is smooth, shiny and free from any matrix. The color is of a deep ochre, with greenish white stainings at the extremities.

It is slightly longer than a humerus of *Uria lomvia* in the Collection of the United States National Museum (No. 18068), and in no other respects differs from it in its characters.

[1] Shufeldt, R. W. "Osteology of the North American Tetronidæ." Bull. U. S. Geol. and Geograph. Surv. of the Terr. (Hayden's) Dept. of the Interior. Vol. VI, Art. XIII, No. 2. Washington, Sept. 19, 1881, 309–350, Pls. V–XIII. The humerus of *Tympanuchus cupido* (*Cupidonia*) is figured on Plate X, Figs. 76, 77.

BIRDS OF UNCERTAIN GEOLOGIC POSITION.

COLINUS EATONI sp. nov.

(*Plate XIII, Fig. 103.*)

Holotype. Cat. No. 949, Peabody Museum, Yale University. Kansas (Shipped from Ft. Wallace). Geologic level unrecorded.

I find in this collection, as set forth above, a perfect left carpo-metacarpus, with the proximal phalanx of index digit. These bones are thoroughly fossilized and perfect in every way. They are nearly white, and show small, reddish spots of staining scattered here and there. Some little distortion from pressure is evident in the larger bone, but it is not very marked.

They represent a Bob-white, of a species somewhat larger than *Colinus v. virginianus* and present similar osteological characters.

I have pleasure in naming this new form for Dr. George Francis Eaton, of Yale University, in recognition of his palæontological work, and particularly for his valuable contribution "Osteology of Pteranodon," which has greatly furthered the accurate investigation and elucidation of the Pterodactyls of the North American Cretaceous Beds.

GAVIA PUSILLA[1] sp. nov.

(*Plate XIII, Fig. 106.*)

Holotype. Cat. No. 864, Peabody Museum, Yale University. ? Wyoming. Geologic level unrecorded. J. B. Hatcher and party, collectors.

Species based upon a fossil proximal extremity of a left carpo-metacarpus. It is in perfect condition, as far as it goes, and the remarkable part of it is that, in nearly every particular, it agrees with the part of the left carpo-metacarpus in *Gavia immer*—the common Loon. (Pl. XIII, Fig. 105.) In the new species, the head of the bone projects more posteriorly; the supero-external angle of the coössified metacarpal of pollex is more rounded off than in *Gavia immer*, and that part of the bone is comparatively broader.

This fossil carpo-metacarpus came from the skeleton of an extinct loonlet, about one-half the size of the existing Great Northern Diver or Loon (*G. immer*), and from all indications sufficiently like it osteologically to avoid the necessity of creating a new genus for it.

[1] Gen. name = L. *Gavia*, some kind of a bird. Spec. name = L. *pusillus*, puerile (*puer*, a boy, hence small).

PHASIANUS ALFHILDÆ sp. nov.

(*Plate XII, Figs. 79, 81, 85 and 86.*)

Holotype. Cat. No. 947, Peabody Museum, Yale University. Haystack Mt., Wyoming. Light colored clay, 100 feet below the horizon of Haystack Butte. J. Heisey, collector.

This lot, though in three parcels, was apparently all found in the same locality. Such matrix as is attached to the bones is rather hard and somewhat flinty, but may be easily dissolved, leaving the specimen in the clear and entire.

One lot contains fragments of some small bones (vertebrate) that cannot well be made out; it consists of several small pieces. Lot No. 2, similar to the last, has one small piece about an inch square, and a fragment of a bone in the clear. In the matrix there is the distal end of a left tarso-metatarsus of a bird, while the free piece is the proximal extremity of the same bone of the skeleton—also bird. It is probable that they are parts of the same bone with the middle portion of the shaft missing. They belonged apparently to some tetraonine form of a size about equal to that of the Ring-necked Pheasant.

Passing to the third and last lot, I find it to consist of some 34 pieces of shafts of long bones which all belonged, there is good reason to believe, to birds of perhaps several species. This opinion is sustained by the fact that, associated with these, I find some 36 more fragments of bones, which, with perhaps no more than two or three exceptions, certainly belonged to birds, ranging in size from that of the Passenger pigeon (*Ectopistes migratorius*) to that of an Eagle as big as our White-headed species (*Haliæetus l. leucocephalus*), the first being represented by a single cervical vertebra and the latter by a part of a toe-joint (Pl. XII, Fig. 89).

Finally, in this same lot there occurs the distal ends of two (right and left) tarso-metatarsi; the distal end of a right humerus, and the upper extremity of a left coracoid. These bones, I must believe, all belonged to the same individual (adult). I have most carefully compared them with the corresponding bones in a skeleton of *Phasianus colchius* (ad. ♂ Coll. U. S. Nat. Mus., No. 19293), and they are in very close agreement with them. So much is this the case that there is no question but that they belonged to a true Pheasant of a size about equal to the species just named and closely related to it. (Pl. XII, Figs. 78–81.)

This Pheasant is now extinct and heretofore undescribed, and I

here propose the name for it of *Phasianus alfhildæ*,[1] as a slight tribute to my wife, Alfhild, and in recognition of her faithful work in the matter of preparing fair copy of many of my original manuscripts during recent years, to the extent of many thousand pages. This she has invariably accomplished with promptness and accuracy, requiring on her part an extensive knowledge of a varied character, especially in punctuation, orthography and construction, in order to eliminate such slips as are usually made in first copy by writers in science, she thus placing the printers of scientific contributions in many parts of the world in her debt.

The discovery of this new and distinct form of Pheasant emphasizes the fact that at one time there must have been a number of large tetraonine species present in this country during the Eocene formation, and these have, for reasons unknown to us, died out in time. I have already invited attention to a much larger form than *Phasianus alfhildæ* in the likewise extinct *Palæophasianus meleagroides* Shuf., an account of which appears in the *Bulletin of the American Museum of Natural History* (Vol. XXXII, Art. XVI, pp. 291–293, Aug. 4, 1913).

BIRD (A large Eagle related to *Haliæetus leucocephalus?*).

(*Plate XII, Figs. 88, 89.*)

Cat. No. 982, Peabody Museum, Yale University. Haystack Mt., Wyoming Light colored clay, 100 feet below the horizon of Haystack Butte. J. Heisey collector.

This specimen, with others more or less imperfect, was found in the same lot with *Phasianus alfhildæ*. It is the distal end of the pre-basal phalange of the second toe of the right foot. I have compared it with the corresponding joint in several Eagles, and it comes nearer to *Haliæetus* than it does to any other species. On such meagre material, however, I would not care to bestow upon it a new name; moreover, inasmuch as some of its characters are at variance with those in *Haliæetus*, it may have belonged to some big vulterine form, which possessed toe-joints very much like those in large eagles—such a species of Old World Vulture, for example, as *Gypaëtus barbatus*. There should be more material at hand in cases of this kind, of the fossil as well as of the existing species, to be compared with it.

[1] Generic name = Gr. φασις *Phasis*, Pheasant, and Sp. name = Alfhild, Christian name of Alfhild Dagny Shufeldt, wife of the author.

Fragmentary Material

Included in the Yale material were many bones which were too fragmentary to permit of reference to any genus or species, and, in some cases, to determine whether they belonged to birds or not. These were all carefully studied, however, and a list of their catalogue numbers and their localities follows:

BIRDS.

Cretaceous (Niobrara)
Cat. No. 904. Butte Creek, Kansas.

?Cretaceous ("Lance")
Cat. No. 865. Wyoming.

Eocene (Bridger)
Cat. No. 831. Wyoming.
837-839. Wyoming.
841. Henry's Fork, Wyoming.
842. Dry Creek, Wyoming.
844. Dry Creek, Wyoming.
854. Black Fork, Wyoming.
862. Grizzly Buttes, Wyoming.
872. Dry Creek, Wyoming.
874. Henry's Fork, Wyoming.
883. Henry's Fork, Wyoming.
885. Sage Creek.
887. Henry's Fork, Wyoming.
890. Henry's Fork, Wyoming.
894. Millersville, Wyoming.
897. Henry's Fork, Wyoming.
901. Dry Creek, Wyoming.
919–920. Henry's Fork, Wyoming.
927. Henry's Fork, Wyoming.
928.
954–955.
964. Henry's Fork, Wyoming.
1032. Henry's Fork, Wyoming.

? Eocene (Bridger)
Cat. No. 834.
848. Wyoming.
849. Dry Creek, Wyoming.
851–852. Dry Creek, Wyoming.
856. Dry Creek, Wyoming.
875. Dry Creek, Wyoming.
880. Bitter Creek Station, Wyoming.
882.
895. Lane Meadow, Wyoming.

?Oligocene (John Day)
Cat. No. 878. Willow Creek, Baker Co., Oregon.
934. Willow Creek, Baker Co., Oregon.
1033. Willow Creek, Baker Co., Oregon.

?Oligocene (White River)
913. Gerry's Ranch, Colorado.
951. White River, Nebraska.
Miocene.
Cat. No. 941–942. Shiloh, New Jersey.
Age Unknown.
Cat. No. 893.
926. Grizzly Buttes, Wyoming.
1029. Henry's Fork, Wyoming.
1031. Wyoming.

BIRDS
Cat. No. 832. Wyoming.
918.
925. Wyoming.
929. Wyoming.
931.
1034. Cañon Largo, New Mexico.

SUMMARY

Apart from the five type specimens of extinct birds described by Professor Marsh, and which I borrowed from the Academy of Natural Sciences of Philadelphia for examination and comparison with new material, all the figures herein described and referred were, for the most part, collected either by Professor Marsh himself in the field or by some of his collectors. In a few instances, they were presented to him or to the collections of Yale University. At his death, the entire collection became the property of the Peabody Museum of Yale, where it is deposited at the present time.

Many of these specimens have remained in the Museum for years unworked and undescribed; some are still in their original receptacles, while several of them were collected as early as the 70's, and many of them only a few years thereafter.

When submitted to me for revision and description, as pointed out in the first part of this paper, there were 136 lots of these fossils, numbering, all told, some 400 specimens or more. Of these about 83 came from Wyoming, and are found to be principally Ft. Bridger Eocene forms; 16 from New Jersey; 2 from New Mexico; 7 from Kansas; 4 from Nebraska; 8 from Oregon; 2 from Texas; 3 from Colorado; California 2; Idaho 1; Virginia 1 and Montana 1, thus leaving *six* not definitely fixed.

As I have just stated, most of these fossils came from the Ft. Bridger Eocene formation, while some 24 are from the Cretaceous; 11 from the Oligocene formation; 6 from the Miocene; 9 from the Post Pliocene, and one from the "Post Tertiary."

There are no perfect fossil skulls in the entire collection, indeed, only a few very small and imperfect fragments of the same. This is likewise true of the *sternum*, the *pelvis*, the *vertebræ* and the *ribs*. On the other hand, the distal and proximal portions of long bones and the various phalanges of the feet are the parts of the skeleton most frequently met with, the *radius*, the *femur* and the *fibula* being the bones least often found.

A large part of the material is fragmentary and useless for thepurpose of reference. On the other hand, some of it is excellent, and this has been duly determined, described, figured and referred.

Occasionally the fossil bones of fish, reptiles, and mammals occurred with those of the birds, and were, in most instances, apparently dis covered with them. No attempt was made to do anything with such material beyond the parts representing birds.

In the matter of size, the species range all the way from a bird no bigger than a sparrow, to adult specimens of *Hesperornis regalis*, and the gigantic ostrich-like birds of the genus *Diatryma;* while in the matter of geologic time, the oldest forms are from the Lower Cretaceous of the Mesozoic, and the most recent from the Post Pliocene.

Taken as a whole, I find in this collection fifty-nine (59) lots which, although representing *bird* material, was found to be, for one reason or another, insufficient for the purpose of making accurate determinations or references.

Doubtless, in the future, a part of this will come to be available; but it should be used with the greatest possible caution, and only in cases where newly discovered material, in any particular instance, is found to supplement that at hand, in such a manner that it, beyond all doubt, furnishes the necessary distinctive characters which are required to make a diagnosis absolutely certain.

I find but little material in this collection representing birds which still exist in the North American avifauna; the principal ones are:

1. *Branta canadensis*
2. *Pediœcetes phasianellus*
3. *Haliœetus leucocephalus*

I also find a specimen which might be referred to *Gallinuloides wyomingensis* Eastman; but this bird had little or no Rail in it, and in any classification should be arrayed with the *Tetraonidæ*.

Among the large toothed divers of the Cretaceous there is a small amount of material representing

1. *Hesperornis regalis* Marsh.

Of species and genera previously described by me elsewhere, I find represented

1. *Palæophasianus meleagroides* Shuf. (extinct).

Of Marsh's types belonging to the collection of the Academy of Natural Sciences of Philadelphia, it may be said that:

1. *Uria affinus* = a good species.
2. *Uria antiqua* = a good species.
3. *Puffinus conradi* = a good species.
4. *Grus haydeni* = a good species.
5. *Palæotringa vetus* = a limicoline bird, but not a *Tringa* as now defined.

All five (5) of these species are extinct, and we only know them through their fossil remains, which, although sufficient, is in each case very meagre.

My study of Marsh's *types* in the Collection of the Peabody Museum of Yale University, convinces me, in the light of additional material, that they stand in need of the following revision and other changes:

1. *Apatornis celer* = *Ichthyornis celer*.
2. *Baptornis advenus* = A good genus and species.
3. *Coniornis altus* = *Hesperornis altus*.
4. *Barornis regens* = *Diatryma regens*.
5. *Phalacrocorax idahensis* = A good species.
6. *Phalacrocorax vagans* = Type material too fragmentary for reference.
7. *Graculavus velox* = *Limosavis velox*.
8. *Graculavus pumilis* = Some scolopacine species.
9. *Graculavus anceps* = Not determined from the type material.
10. *Graculavus agilis* = Not determined from the type material.
11. *Graculavus lentus* = Some tetraonine species.
12. *Graculavus* (sp.?)
13. *Cimolopteryx rara* = Some toothed species?
14. *Cimolopteryx retusus* = Not determined from the type material.
15. *Laornis edvardsianus* = A good genus and species.
16. *Aletornis bellus* = *Tringa bellus*.
17. *Aletornis gracilis* = *Philohela gracilis*.
18. *Aletornis nobilis* = *Grus nobilis*.
19. *Aletornis venustus* = *Fulica venustus*.

20. *Aletornis pernix* = Indeterminable from the type material.
21. *Telmatornis priscus* = A Rail?
22. *Telmatornis affinis* = A Rail?
23. *Telmatornis rex* = A Rail?
24. *Palæotringa littoralis* = A Gull?
25. *Palæotringa vagans* = Type material too fragmentary for a correct reference.
26. *Grus haydeni* = A good species.
27. *Grus proavus* = Not seen (lost?).
28. *Uintornis lucaris* = Awaiting additional material.
29. *Aquila dananus* = Good species (?) (provisional).
30. *Bubo leptosteus* = Not a *Bubo*. Awaiting additional material.

All of these birds are extinct.

Through the study of much additional material, the following change becomes necessary and is proposed:

1. *Aquila antiqua* Shuf. = *Minerva antiqua* Shuf.

I find the material in this Yale University Collection to establish the following new genera and species, each and all of which are now extinct:

1. *Colymbus oligoceanus.*
2. *Gavia pusilla.*
3. *Larus pristinus.*
4. *Sula atlantica.*
5. *Phalacrocorax mediterraneus.*
6. *Phalacrocorax marinavis.*
7. *Eoceornis ardetta.*
8. *Botauroides parvus.*
9. *Grus marshi.*
10. *Limicolavis pluvianella.*
11. *Colinus eatoni.*
12. *Tympanuchus lulli.*
13. *Phasianus mioceanus.*
14. *Phasianus alfhildæ.*
15. *Phasianus americanus.*
16. *Meleagris richmondi.*
17. *Falco falconella.*

From the list, and from what has been set forth on previous pages of the present article, it will be observed that, in so far as the new genera and species here described supplement those of previous works in the same field, and covering geologic ages between the middle Eocene (Bridger Beds) to include Post Pliocene time, the greatest number of

forms belong to the Gallinaceous group, as represented by quails (*Colinus*), grouse (*Tympanuchus*), pheasants (*Phasianus*) and turkeys (*Meleagris*); and, while there is but one new falcon represented (*Falco falconella*), there is considerable evidence that both the diurnal and nocturnal raptorial birds were more or less abundant. The remarkable feature is that both these and the fowls were so much like or actually typical representatives of existing genera.

For the rest, the list is made up of waders and water birds belonging to the genera shown; and a number of these—indeed, nearly all of these—likewise represent existing genera, and probably would not have been at all out of place in the North American avifauna of the present day.

EXPLANATION OF PLATES

[All the Figures on the Plates are reproductions of photographs made direct from the specimens they represent by the author.]

PLATE I

[Figures 1–6 on this Plate are reduced rather more than one-sixth.]

FIG. 1. Inner aspect of the distal portion of the right tarso-metatarsus of *Baptornis advenus* Marsh.

FIG. 2. Outer aspect of the proximal portion of the right (?) tarso-metatarsus of *Baptornis advenus* Marsh. Had this piece alone been discovered, it presents no character, as yet, by which it might, with certainty, be determined as to whether it belonged to the right or left pelvic limb. It came from a subadult individual.

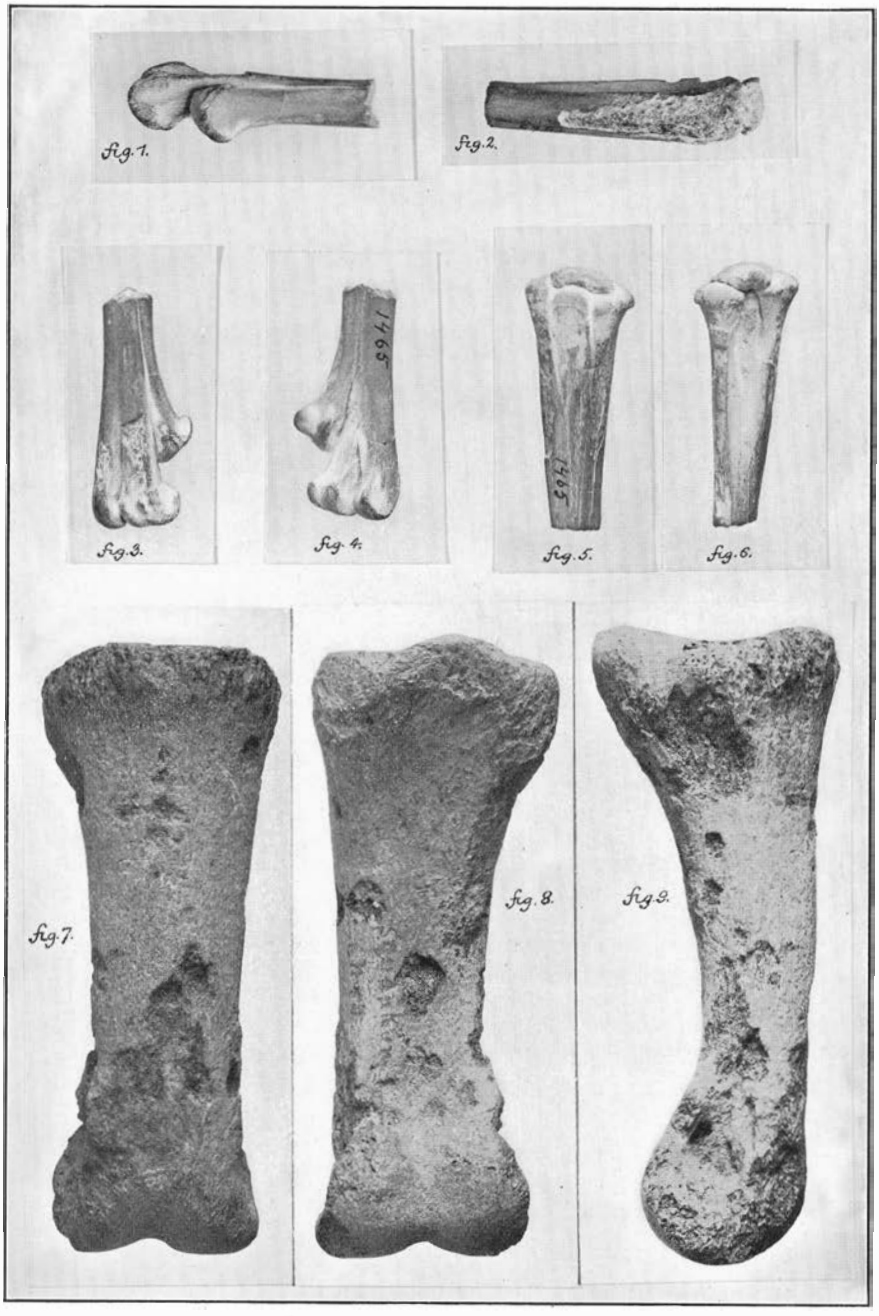
FIG. 3. Anterior aspect of the distal portion of the right tarso-metatarsus of *Baptornis advenus* Marsh.

FIG. 4. Posterior aspect of the distal portion of the right tarso-metatarsus of *Baptornis advenus* Marsh. Figs. 1–4 are all the same specimen.

FIG. 5. Anterior aspect of the proximal portion of the right tarso-metatarsus of *Baptornis advenus* Marsh. See note under Fig. 2.

FIG. 6. Posterior aspect of the proximal portion of the right tarso-metatarsus of *Baptornis advenus* Marsh. See note under Fig. 2. Figs. 2, 5 and 6 are all of the same specimen.

FIGS. 7–9. Dorsal, plantar, and outer aspect, respectively, of the first or basal phalanx of the outer pedal digit of *Barornis regens* Marsh. Slightly smaller than natural size. In the opinion of the present writer, this bone came from the skeleton of the foot of a specimen of *Diatryma*. (See Plate V, Fig. 32.)



SHUFELDT: FOSSIL BIRDS IN MARSH COLLECTION OF YALE UNIVERSITY

PLATE II

[All the Figures on this Plate are of natural size]

FIG. 10. Outer aspect of the distal portion of the right tibio-tarsus of *Laornis edvardsianus* Marsh. (Type.)

FIG. 11. Inner aspect of the right tarso-metatarsus of an adult Loon (*Gavia immer*). Coll. U. S. Nat. Mus. (Unnumbered.) Compare with Fig. 12.

FIG. 12. Inner aspect of the distal portion of the right tarso-metatarsus of *Baptornis advenus* Marsh. Compare with Fig. 11 and Figs. 1–4 of Plate I.

FIG. 13. Anterior view of distal end of the left tibio-tarsus of *Aquila dananus* Marsh (Type.)

FIG. 14. Postero-lateral aspect of the left tarso-metatarsus of an adult specimen of *Grus canadensis*. (No. 820, Coll. U. S. Nat. Mus.)

FIG. 15. Postero-lateral aspect of the left tarso-metatarsus of *Aletornis nobilis* Marsh (Type). See also Plate VI, Figure 43.

Fig. 16. Direct mesio-lateral view of the inner trochlear process of the right tarso-metatarsus of *Diatryma gigantea* Cope. This is the specimen collected by Marsh. In the Figure the plane of fracture is below. (See also Plate V, Figure 30.)

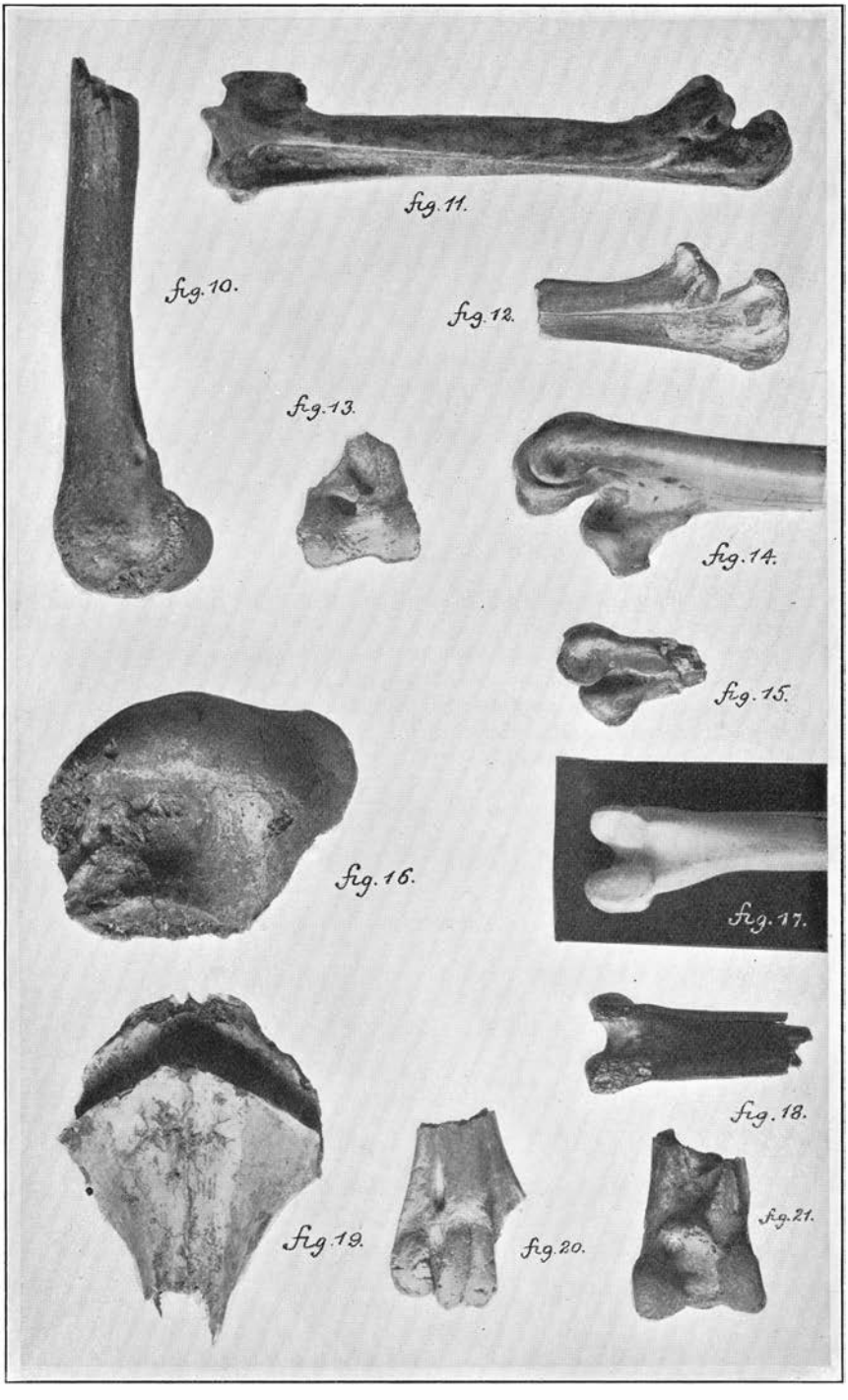
FIG. 17. Posterior aspect of the distal extremity of the left tibio-tarsus of a specimen of the Snowy Owl (*Nyctea nyctea*). Adult ♂. Author's private collection. Compare with Figure 18.

FIG. 18. Posterior aspect of the distal extremity of the left tibio-tarsus of *Bubo leptosteus* Marsh (Type). Compare with Figure 17, and see description in the text.

FIG. 19. Ventral view of the anterior portion of the sternum of *Meleagris richmondi*, sp. nov. (Type).

FIG. 20. Anterior view of the distal extremity of *Palæophasianus meleagroides* Shuf. Imperfect.

FIG. 21. Distal extremity of the left tibio-tarsus of a specimen of *Grus haydeni* Marsh. Adult and somewhat imperfect. Yale Coll. Cat. No. 860. Has been compared by the present writer with the *type* in Coll. Acad. Nat. Sci. of Phila.



SHUFELDT: FOSSIL BIRDS IN MARSH COLLECTION OF YALE UNIVERSITY

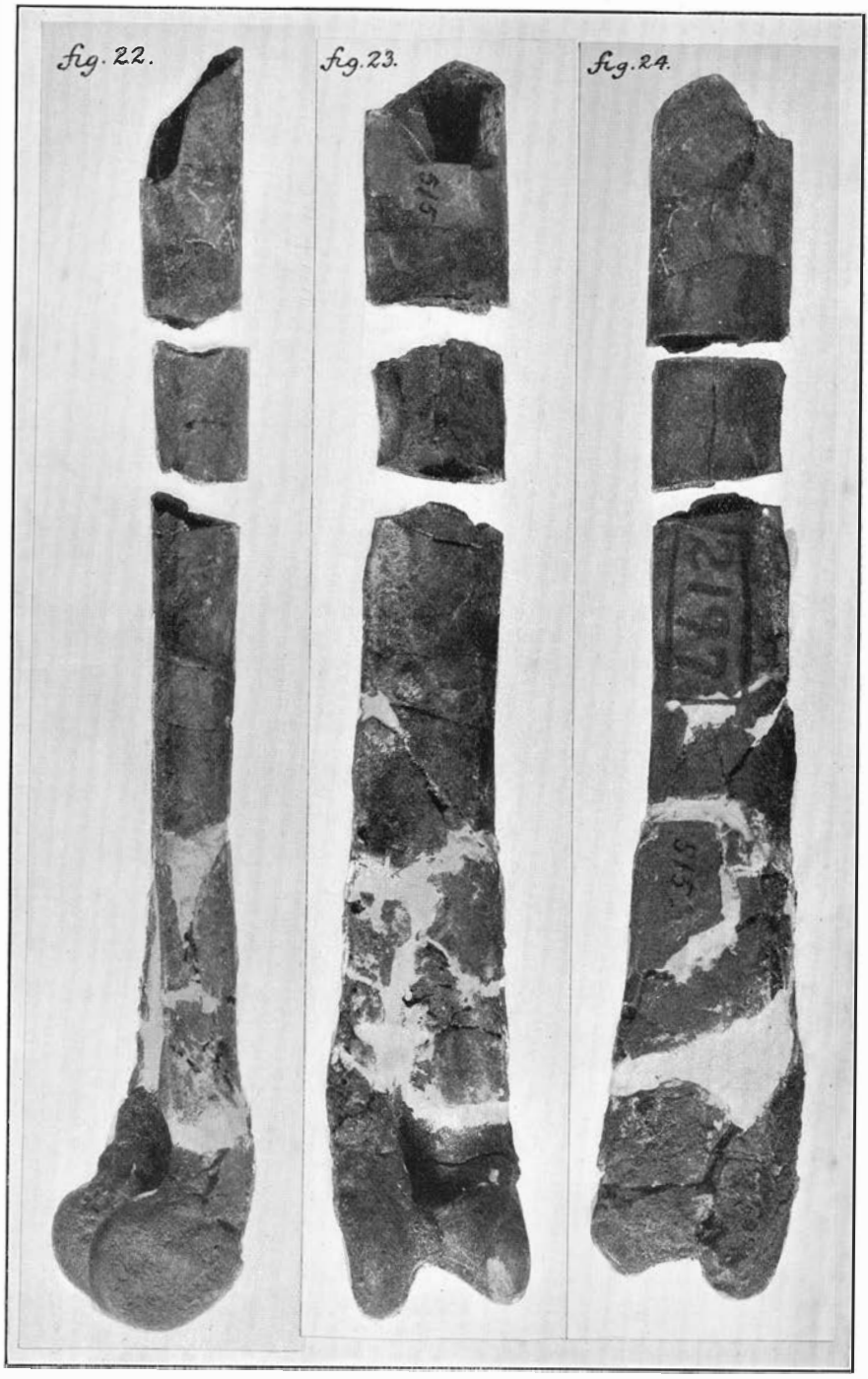
PLATE III

[All three Figures on this Plate are reduced rather less than one-eleventh. Cat. No. 515]

FIG. 22. Inner aspect of about the distal two-thirds of the right tibio-tarsus of *Coniornis altus* Marsh (Type). Compare with Plate IV, Figures 25–27. Adult. Imperfect. The bird to which this bone belonged was a *Hesperornis*, and the species should henceforth be known as *Hesperornis altus*. See text.

FIG. 23. Same bone as shown in Figure 22 and viewed upon its anterior aspect.

FIG. 24. Same bone as shown in Figures 22 and 23 of the Plate, and here viewed upon its posterior aspect.



SHUFELDT: FOSSIL BIRDS IN MARSH COLLECTION OF YALE UNIVERSITY

PLATE IV

[All three Figures on this Plate have been reduced rather more than one–fifteenth in size]

FIG. 25. Inner aspect of about the distal two-thirds of the right tibio-tarsus of *Hesperornis regalis* Marsh. (Plaster cast of the *type* bone.) Compare with Figures on Plate III. (No. 56 of the palæontological collection (Bird Division) of the U. S. Nat. Mus.)

FIG. 26. Same specimen as shown in Figure 25 and viewed upon its anterior aspect.

FIG. 27. Same specimen as shown in Figures 25 and 26 of this Plate and viewed upon its posterior aspect.

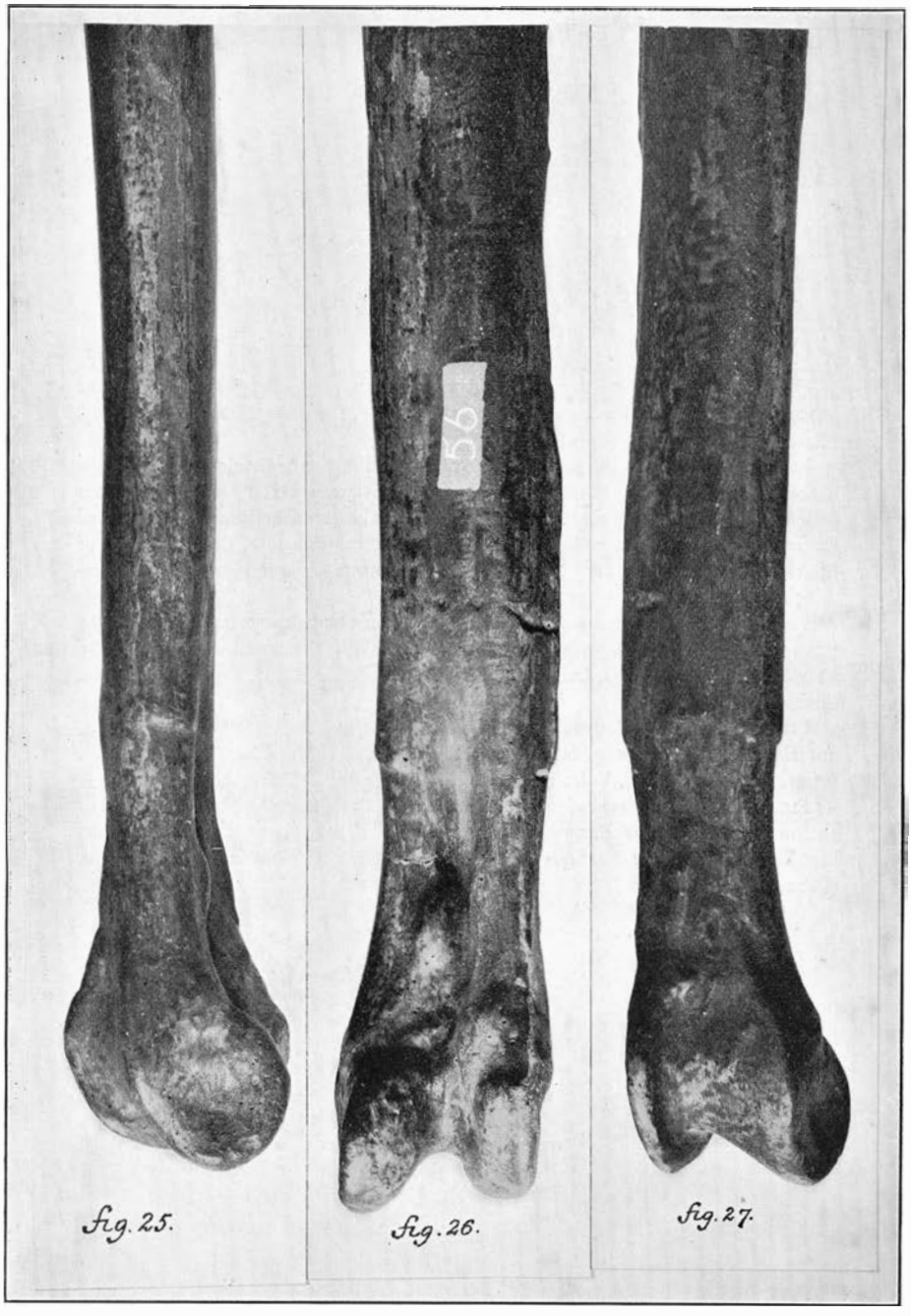


Fig. 25.
Fig. 26.
Fig. 27.

PLATE V

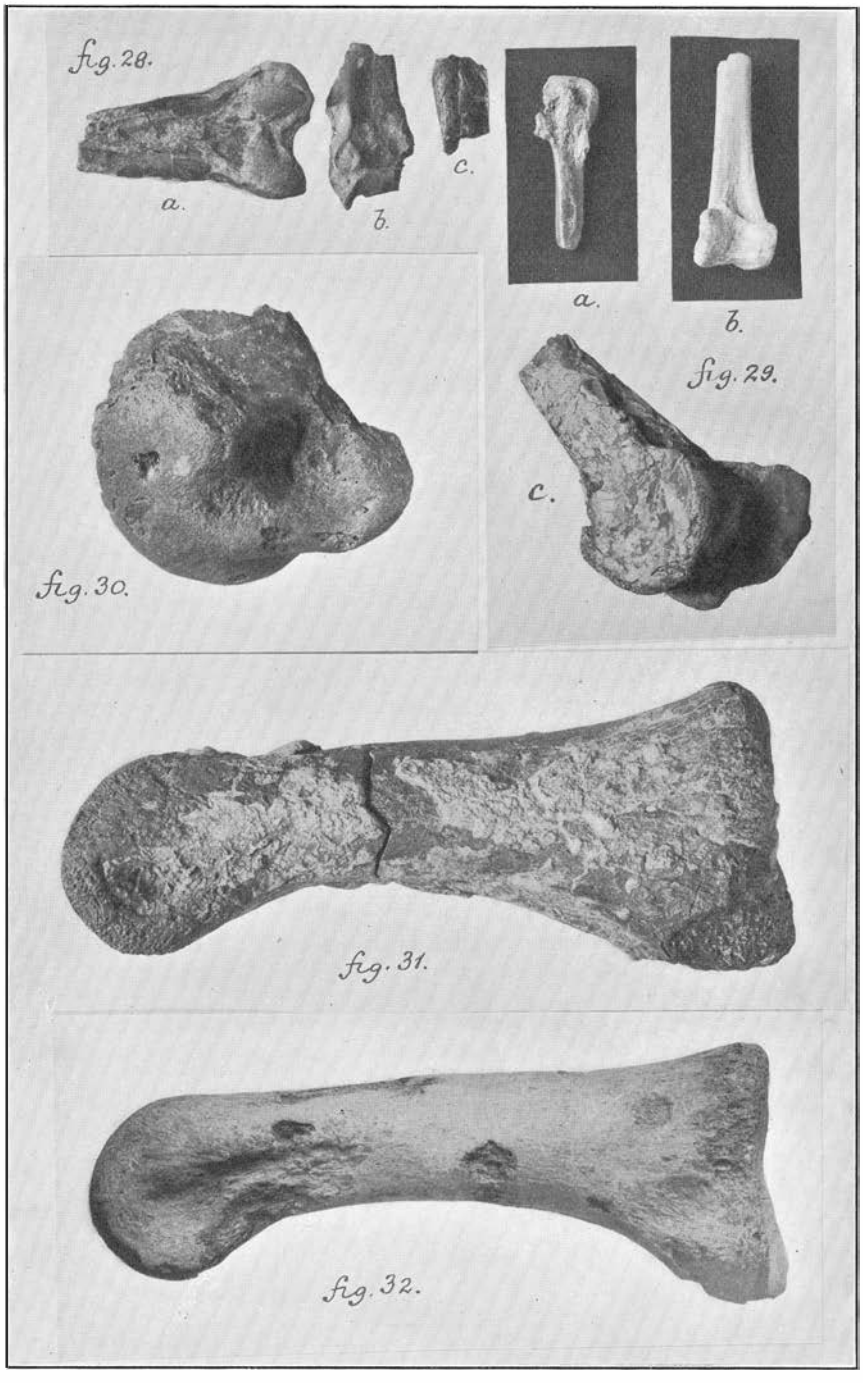
FIG. 28. (*a-c*). Right femur of a bird about the size of a small goose; posterior aspects; *a*, distal portion; *b*, proximal portion; and *c*, from the middle of the shaft. (Cat. No. 953.)

FIG. 29. (*a-c*). *a* is the proximal portion of a right carpo-metacarpus, palmar aspect. Cat. No. 895. Yale Coll. (See description in text.) *b*, distal portion of left tibio-tarsus, anterior aspect. Bird somewhat smaller than a Barred Owl (*Strix varia*). Cat. No. 912, Yale Coll. (See description.) *c*, distal portion of the right femur of some very large bird, seen on antero-oblique view. (Not determined; see description.) Cat. No. 863, Yale Coll.

FIG. 30. Direct externo-lateral view of the inner trochlear process of the right tarso-metatarsus of *Diatryma gigantea* Cope. This is the specimen collected by Marsh. In the figure the fracture is above. (See also Plate II, Figure 16.) Nat. size.

FIG. 31. Pedal phalangeal joint of *Diatryma ajax* Shuf. (Basal one of mid-anterior toe ?.) Nat. size, lateral aspect. (Type.) (Figure 13, Plate LIV, Bull. Amer. Mus. Nat. Hist., Vol. xxxii, Art. XVI. Aug. 4, 1913: Author's ed.)

FIG. 32. Direct lateral view of the inner aspect of the first or basal phalanx of the outer pedal digit of *Barornis regens* Marsh. Slightly larger than natural size. See Figure 9 of Plate I (above). This bone is from a specimen of a *Diatryma*. (See text description.)



SHUFELDT: FOSSIL BIRDS IN MARSH COLLECTION OF YALE UNIVERSITY

PLATE VI

FIG. 33. Proximal extremity, anconal aspect, left humerus of *Graculavus velox* Marsh (Type). Imperfect. Nat. size. Cat. No. 855. See description in text and Figure 49 of Plate VII.

FIG. 34. Fragments (7 in the group) representing *Graculavus pumilus* Marsh (Type). Nat. size. Above: distal end of right humerus; below it, to the left, distal half of the right carpo-metacarpus (indicial shaft). The remaining five (5) fragments not determined with certainty. Cat. No. 850.

FIG. 35. Distal portion of the left tibio-tarsus of *Palæotringa littoralis* Marsh (Type). Anterior aspect. Nat. size. Imperfect. Three fragments to the right belong with the same specimen. Cat. No. 830.

FIG. 36. Distal end, palmar aspect, of the right humerus of a bird. Imperfect. Nat. size. *Telmatornis affinis* Marsh (Type). Cat. No. 845, Y. U.

FIG. 37. Distal portion, palmar aspect, of the left humerus of a bird. Perfect as far as it goes. Nat. size. *Telmatornis priscus* Marsh (Type). Cat. No. 840.

FIG. 38. Posterior aspect, left coracoid of a bird. Nearly perfect. Nat. size. *Cimolopteryx rarus* Marsh (Type). Nat. size. Cat. No. 1805. Y. U.

FIG. 39. Superior extremity of the left coracoid of a bird. Imperfect. Nat. size. *Cimolopteryx retusus* Marsh (Type). Cat. No. 513. Y. U.

FIG. 40. *Five fragments* of the shaft of a long bone, from a bird (fossil). Very imperfect. Nat. size. *Palæotringa vagans* Marsh (Type). Cat. No. 835. Y. U.

FIG. 41. Distal portion of the left tibio-tarsus of a bird (fossil); anterior aspect. Nat. size. Perfect as far as it goes. *Aietornis venustus* Marsh (Type). Cat. No. 206. Y. U.

FIG. 42. Distal extremity of the right tarso-metatarsus of some small bird (fossil). Nat. size, anterior view. Six little bits of bone accompany the specimen. Nat. size. Imperfect. *Uintornis lucaris* Marsh (Type). Cat. No. 617. Y. U.

FIG. 43. Antero-inferior view of the left tarso-metatarsus of *Aletornis nobilis* Marsh (Type). Nat. size; fossil. The two other pieces of bone, each marked 63, accompany the specimen. Y. U.

FIG. 44. Proximal portion of the left carpo-metacarpus of *Graculus idahensis* Marsh (Type). Nat. size. Perfect as far as it goes. Cat. No. 527. Y. U.

FIG. 45. Proximal end of a humerus of some bird (fossil). Imperfect. Nat. size. *Aletornis gracilis* Marsh (Type). Cat. No. 61. Y. U.

FIG. 46. Distal end of a left tarso-metatarsus of some small bird (fossil). Nat. size. *Imperfect. Aletornis bellus* Marsh (Type). Cat. No. 60. Y. U.

FIG. 47. Very imperfect fragments, 18 in number, of what appears to be a left tibio-tarsus of some bird (fossil). Extremely imperfect. *Aletornis pernix* Marsh (Type). Cat. No. 64. Y. U.

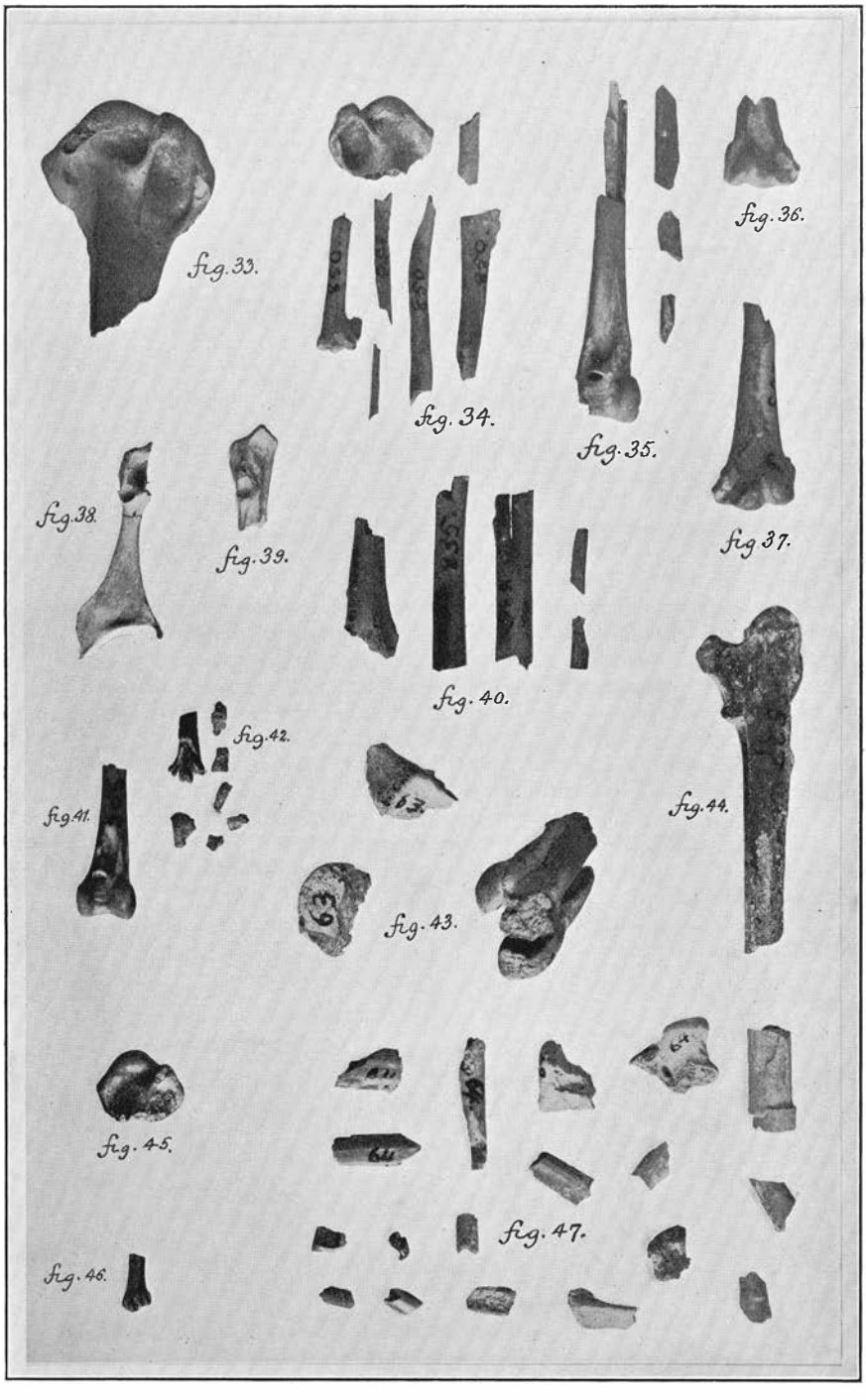


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PLATE VII

[All the Figures in this Plate are slightly enlarged; one-sixteenth (approx.)]

FIG. 48. Anconal aspect left humerus of *Phalacrocorax urile* adult. No. 18050. Coll. U. S. Nat. Mus.

FIG. 49. Anconal aspect of the proximal end of the left humerus (fossil) of *Graculavus velox* Marsh (Type). See Figure 33 of Plate VI above.

FIG. 50. Anconal aspect of the left humerus of *Hæmatopus* (*niger*) *backmani*. Adult. No. 13636. Coll. U. S. Nat. Mus.

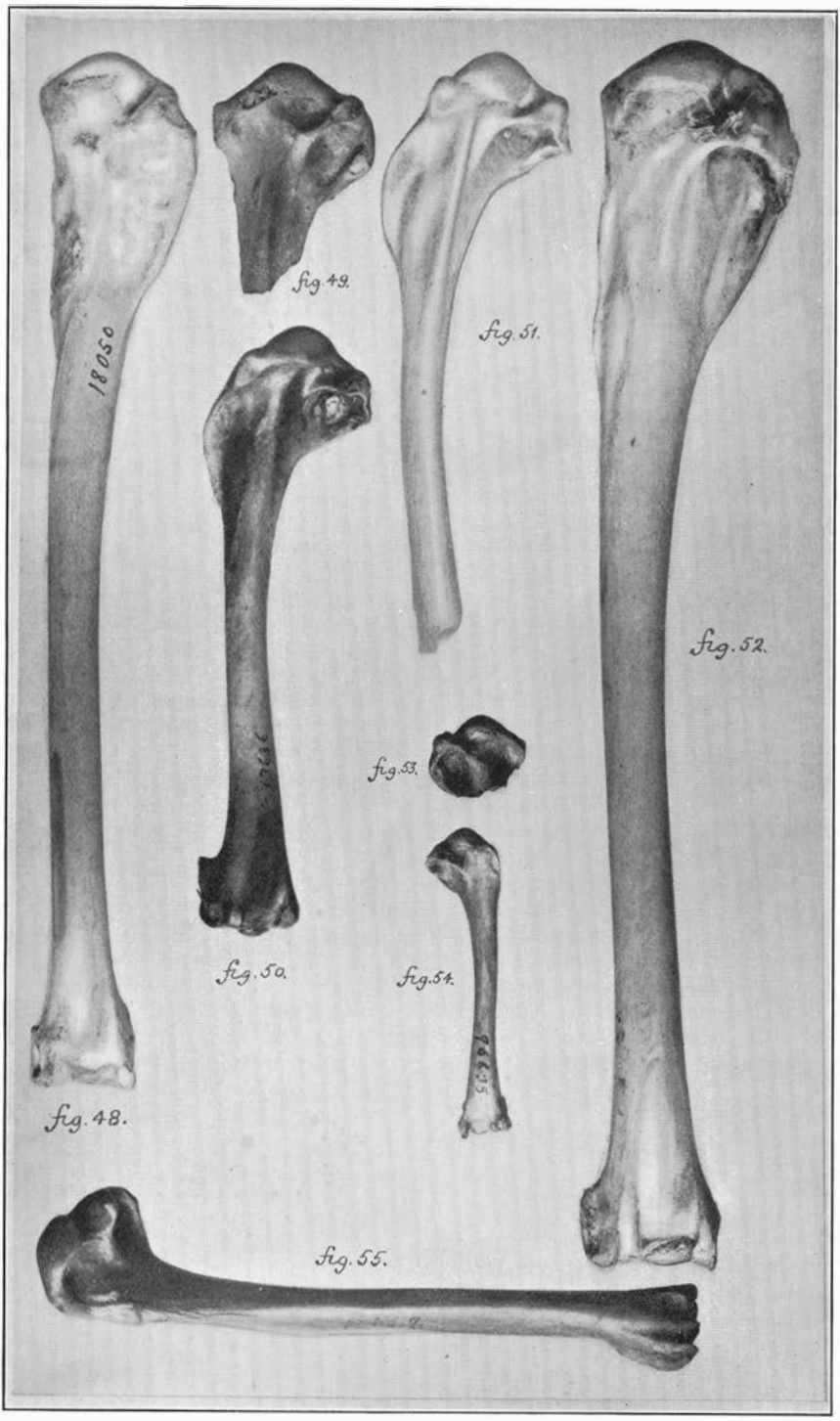
FIG. 51. Anconal aspect of the left humerus of a specimen of *Orthorhampus magnirostris*. Adult. Distal third broken off. Numbered 19649, Coll. U. S. Nat. Mus. (but it does not belong to the skeleton so numbered, as the latter has *two perfect humeri* without it; or else it does belong to it, and, having been broken by a shot, an *additional* bone (humerus, left side), was made to take its place, bearing the same number).

FIG. 52. Anconal aspect of the left humerus of *Phalacrocorax carbo*. Adult. No. 18851. Coll. U. S. Nat. Mus.

FIG. 53. Anconal aspect of proximal fragment of right humerus (fossil) of *Graculavus pumilus* Marsh (Type). (See Figure 34, Plate VI.)

FIG. 54. Anconal aspect of the right humerus of *Philohela minor*. Adult. No. 96635. Coll. U. S. Nat. Mus.

FIG. 55. Anconal aspect of the left humerus of *Uria lomvia*. Coll. U. S. Nat. Mus. Adult.



SHUFELDT: FOSSIL BIRDS IN MARSH COLLECTION OF YALE UNIVERSITY

PLATE VIII

[All the Figures in this Plate are slightly above natural size]

FIG. 56. Anconal aspect of the left fossil humerus. Adult. Nearly perfect. *Catarractes antiquus* Marsh (Type). Coll. Acad. Nat. Sci. Phila. No number. (Tarboro, Edgecomb Co., N. C.).

FIG. 57. Anconal aspect of the left humerus of *Uria lomvia*. Adult. Coll. U. S. Nat. Mus., No. 18061.

FIG. 58. Posterior aspect of the left tibio-tarsus and fibula of *Gallinago paraguayæ*. Adult. Coll. U. S. Nat. Mus., No. 18558.

FIG. 59. Three imperfect fossil fragments of a left tibio-tarsus of a bird. Adult. *Patæotringa vetus* Marsh (Type). Coll. Acad. Nat. Sci. Phila. (Marlbed. Burlington Co., N. J.)

FIG. 60. Anconal aspect of the right humerus (fossil) of *Catarractes affinis* Marsh (Type). Coll. Acad. Nat. Sci. Phila. (not numbered). Bangor, Maine.

FIG. 61. Anconal aspect of the right humerus of *Uria lomvia*. No. 18068. Coll. U. S. Nat. Mus. Adult.

FIG. 62. Palmar aspect of the right humerus of *Fulmaris glacialis*. No. 16781. Coll. U. S. Nat. Mus. Adult.

FIG. 63. Distal portion of the left humerus (fossil) of *Puffinis conradi* Marsh (Type). Coll. Acad. Nat. Sci. Phila.

FIG. 64. Distal portion of the fossil right ulna of *Puffinis conradi* Marsh (Type). Coll. Acad. Nat. Sci. Phila. Maryland.

FIG. 65. Anconal aspect of right humerus of *Puffinis creatopus*. No. 18773. Coll. U. S. Nat. Mus. Adult.

FIG. 66. Distal extremity of the left tibio-tarsus of *Grus canadensis*. Adult. No. 820. Coll. U. S. Nat. Mus. Compare with Figure 67.

FIG. 67. Distal end of the fossil left tibio-tarsus of *Grus haydeni* Marsh (Type). Coll. Acad. Nat. Sci. Phila. Compare with Figure 66. Pliocene, Niobara River.

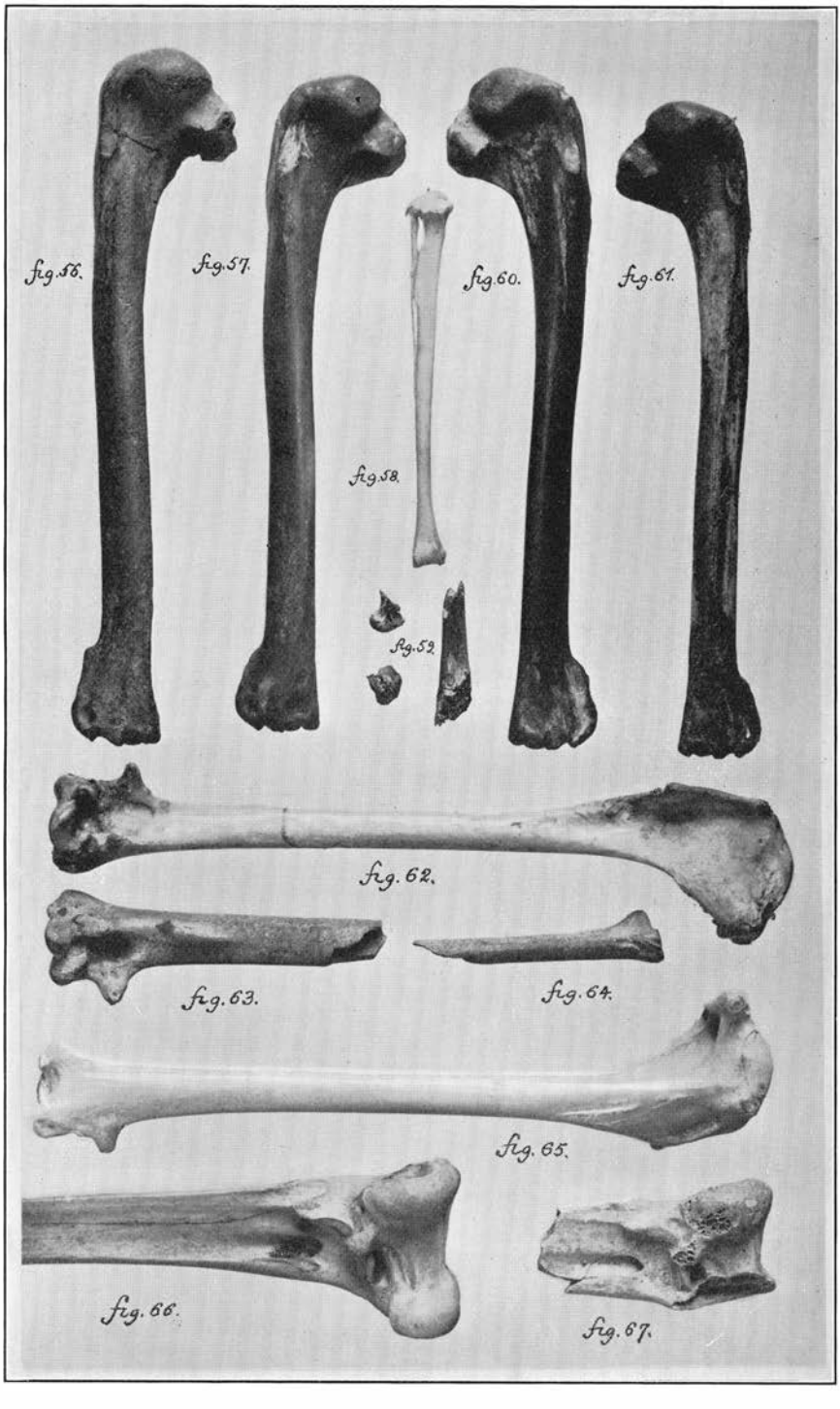


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PLATE IX

[All the Figures in this Plate are natural size]

FIG. 68. The three trochleæ of the tarso-metatarsus of *Diatryma gigante*, arranged *in situ*, or arranged in the corresponding position to those in the bone shown in Figure 69, *itp*, inner trochlear process. (This is the Marsh specimen.) (Plate II, Figure 16, and Plate V, Figure 30); *mtp*, middle trochlear process; *otp* outer trochlear process. The last two are the Cope types in the Collection of the U. S. National Museum. *atf*, anterior tibial foramen.

FIG. 69. Right tarso-metatarsus of a common domestic fowl (♂. ad.), anterior aspect. Author's collection. *atf*, anterior tibial foramen. This bone shows the relative size between *Gallus domesticus* and *Diatryma gigantea*, in so far as the trochleæ of the tarso-metatarsus is concerned.

FIG. 70. Skeleton of the *left* foot of a tame turkey, showing relative size and the presence of the anterior tibial foramen (*atf.*) on the opposite side, as compared with the corresponding foramen shown in Figure 69.

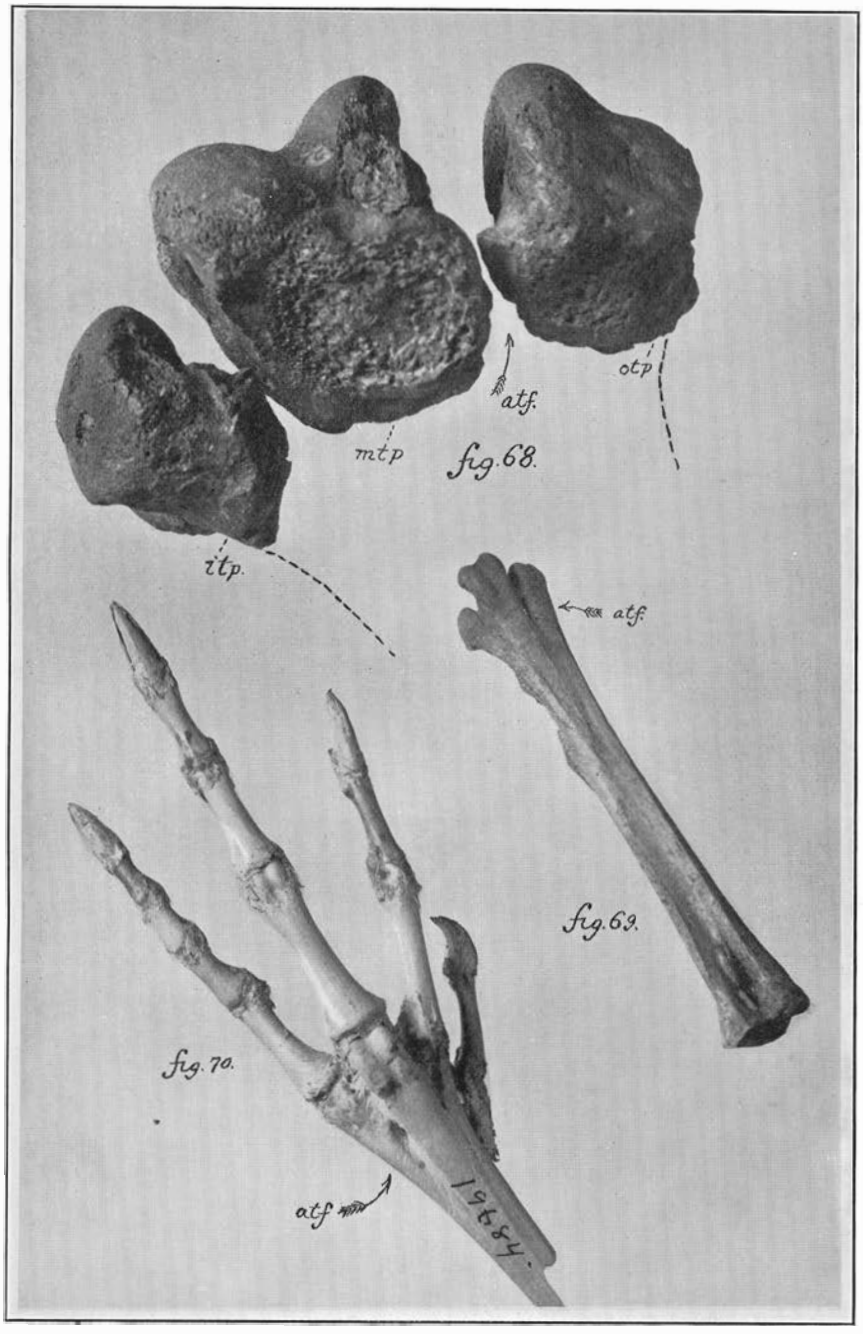

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PLATE X

[Figures all natural size]

FIG. 71. Right humerus, anconal aspect, of *Meleagris altus* Marsh (*M. superba* Cope). Fossil.

FIG. 72. Posterior aspect of the left coracoid of *Meleagris altus* Marsh.

FIG. 73. Posterior aspect of right femur of *Meleagris altus* Marsh, now a synonym of *M. superba* of Cope. These bones may have all belonged to the same individual, though there is no certainty of it, as the "lot represents four individuals." (See description.)

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PLATE XI

FIG. 74. Right tarso-metatarsus (ad.) of *Meleagris altus* Marsh. Anterior aspect, nat. size. Fractured through the center of the shaft. Calcar core is shown, but is of no great size. Trochleæ somewhat reduced in size by wear. Fossil.

FIG. 75. Left scapula, seen from above. (Ad.) *Meleagris altus* of Marsh. Distal end broken off, and complete transverse fracture of the blade at its middle; imperfect anterior extremity.

FIG. 76. Radial aspect of left ulna of *Meleagris altus* Marsh (synonym of *M. superba* Cope). (Ad.) Perfect specimen; nat. size.

FIG. 77. Ulnar aspect of left radius of *Meleagris altus* Marsh. (Ad.) Perfect specimen; nat. size. These bones, as are those in Plate X, are the TYPES of Marsh's *Meleagris altus*. (See description in text.)

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PLATE XII

FIG. 78. Left tarso-metatarsus of *Phasianus colchius*, ad. ♂; anterior view. (Coll. U. S. Nat. Mus., No. 19293); nat. size. Compare distal end with Figure 79.

FIG. 79. Distal end of tarso-metatarsus of *Phasianus alfhildæ* n. sp. (extinct). Anterior view; nat. size. Description in text. Fossil.

FIG. 80. Right tarso-metatarsus of *Phasianus colchius*, ad. ♂; anterior view. (Coll. U. S. Nat. Mus., No. 19293); nat. size. Compare distal end with Figure 81.

FIG. 81. Distal extremity of the right tarso-metatarsus of *Phasianus alfhildæ*, anterior view. See Figure 79. (n. sp. extinct); nat. size. Compare with distal end of Figure 80. Cat. No. of Figures 79 and 80 is 948. Yale Coll.

FIG. 82. Right humerus, palmar aspect, of *Phasianus colchius*, ad. ♂; nat. size. Compare distal end with Figure 85. Coll. U. S. Nat. Mus., No. 19293.

FIG. 83. Distal extremity, anterior aspect of left fossil tarso-metatarsus of *Phasianus americanus*, n. sp. Adult; nat. size. Type. No. 956, Coll. Yale University. Compare with distal end of bone shown in Figure 78. The pedal phalanx is shown in Figure 84.

FIG. 84. Pedal phalanx, dorsal aspect; from the foot of *Phasianus americanus*, n. sp. No. 956, Coll. Yale University. Ad. Nat. size. Type. Found with the specimen shown in Figure 83, and probably belonged to the same individual. Imperfect and distorted.

FIG. 85. Distal end of right humerus, palmar aspect, of *Phasianus alfhildæ*, n. sp. Ad. Nat. size. Type. Cat. No. 947. Yale University. Compare with the distal end of the humerus shown in Figure 82.

FIG. 86. Superior extremity of left coracoid of *Phasianus alfhildæ*, n. sp. Ad. Nat. size. Cat. No. 947. Yale University. Type. Compare with Figure 87. (*Phasianus colchius.*)

FIG. 87. Left coracoid and scapula of *Phasianus colchius;* lateral view. Ad. Nat. size. No. 19293. Coll. U. S. Nat. Mus. Compare superior end with Figure 86.

FIG. 88. Two phalanges (basal and second one) of the second toe of the right foot, dorsal aspect, of *Haliæetus leucocephalus*. No. 19384. Coll. U. S. Nat. Mus. Adult; nat. size. Compare its distal end with Figure 89.

FIG. 89. Distal end of the second phalanx of the second toe of a fossil eagle. (Cat. No. 947. Coll. Yale University). Nat. size, ad. Seen on dorsal aspect Compare with corresponding part shown in Figure 88.

FIG. 90. Left fossil humerus, palmar aspect, of ***Tympanuchus lulli***, n. sp., Adult; nat. size. Type. Cat. No. 911, Yale University Coll. Imperfect. Description in text.

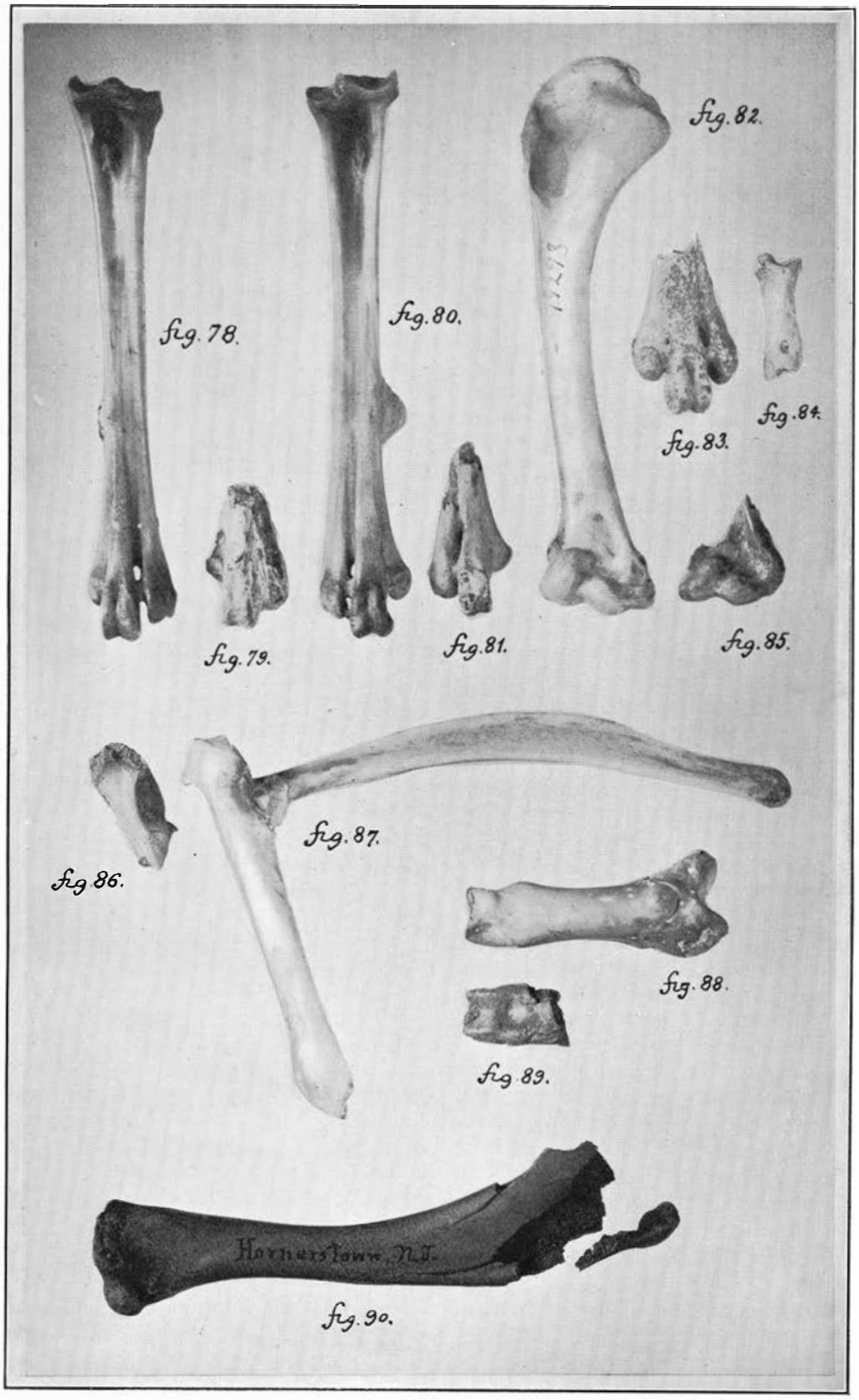

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PLATE XIII

[All the Figures in this Plate are somewhat above natural size, and made direct from the specimens by the author]

FIG. 91. Palmar aspect, proximal end, of main shaft of left carpo-metacarpus. (Fossil.) *Graculavus agilis* Marsh (Type).

FIG. 92. Fragment of fossil bone (bird?) accompanied the type specimen of *Graculavus agilis* Marsh. (See Figure 91.)

FIG. 93. Type of *Graculavus anceps* Marsh. (See description in text.)

FIG. 94. Anconal aspect, proximal two-thirds of right humerus of *Phasianus mioceanus*, sp. nov.

FIG. 95. Anconal aspect of right humerus of *Phasisanus colchius*. (No. 19293, Coll. U. S. Nat. Mus. ♂.) Introduced for comparison with Figure 94.

FIG. 96. Outer aspect, proximal extremity, of left femur of *Phasianus mioceanus*, sp. nov. (extinct).

FIG. 97. Small fossil bone (not bird) found with the fossil remains of *Phasianus mioceanus*. (See description in text.)

FIG. 98. Oblique posterior aspect of the left femur of *Phasianus colchius* ♂. No. 19293. Coll. U. S. Nat. Mus. Adult. Introduced to compare with Figure 96.

FIG. 99. Anconal aspect of a right carpo-metacarpus, proximal portion (fossil) of *Branta canadensis*. (See description in text.)

FIG. 100. Palmar aspect of distal part of indicial shaft of right carpo-metacarpus (fossil) of *Branta canadensis*. Belonged to the same bone shown in Figure 99.

FIG. 101. Palmar aspect of the distal two-thirds of the right humerus of *Telmatornis rex*, sp. nov. (fossil). Adult; extinct.

FIG. 102. Anterior aspect of the fore part of the sternum of *Eoceornis ardetta*, gen. et sp. nov. (fossil). Adult; extinct.

FIG. 103. Palmar aspect of the left carpo-metacarpus and proximal indicial digit of *Colinus eatoni*, sp. nov. (fossil; extinct). Adult.

FIG. 104. Palmar aspect of the right humerus of *Fulica americana*. (No. 19710, Coll. U. S. Nat. Mus). Adult. Introduced for comparison with Figure 101.

FIG. 105. Anconal aspect of the left carpo-metacarpus of the Loon (*Gavia immer*). No. 18496. Coll. U. S. Nat. Mus. Adult. Introduced for comparison with Figure 106.

FIG. 106. Anconal aspect of the proximal end of the left carpo-metacarpus of *Gavia pusilla*, sp. nov. Fossil. Adult (extinct).

FIGS. 107–110. Fossil fragments of some species (adult) of extinct bird, not determined. A large tetraonine form. Figure 107, distal end of left ulna; Figure 108, the proximal end of a right carpo-metacarpus; Figure 109, fragment of upper third of the indicial shaft of a right carpo-metacarpus; Figure 110, middle and inner trochleæ with proximal ends of basal phalanges (articulating with them) of the right tarso-metatarsus, embedded on the plantar aspect in the matrix.

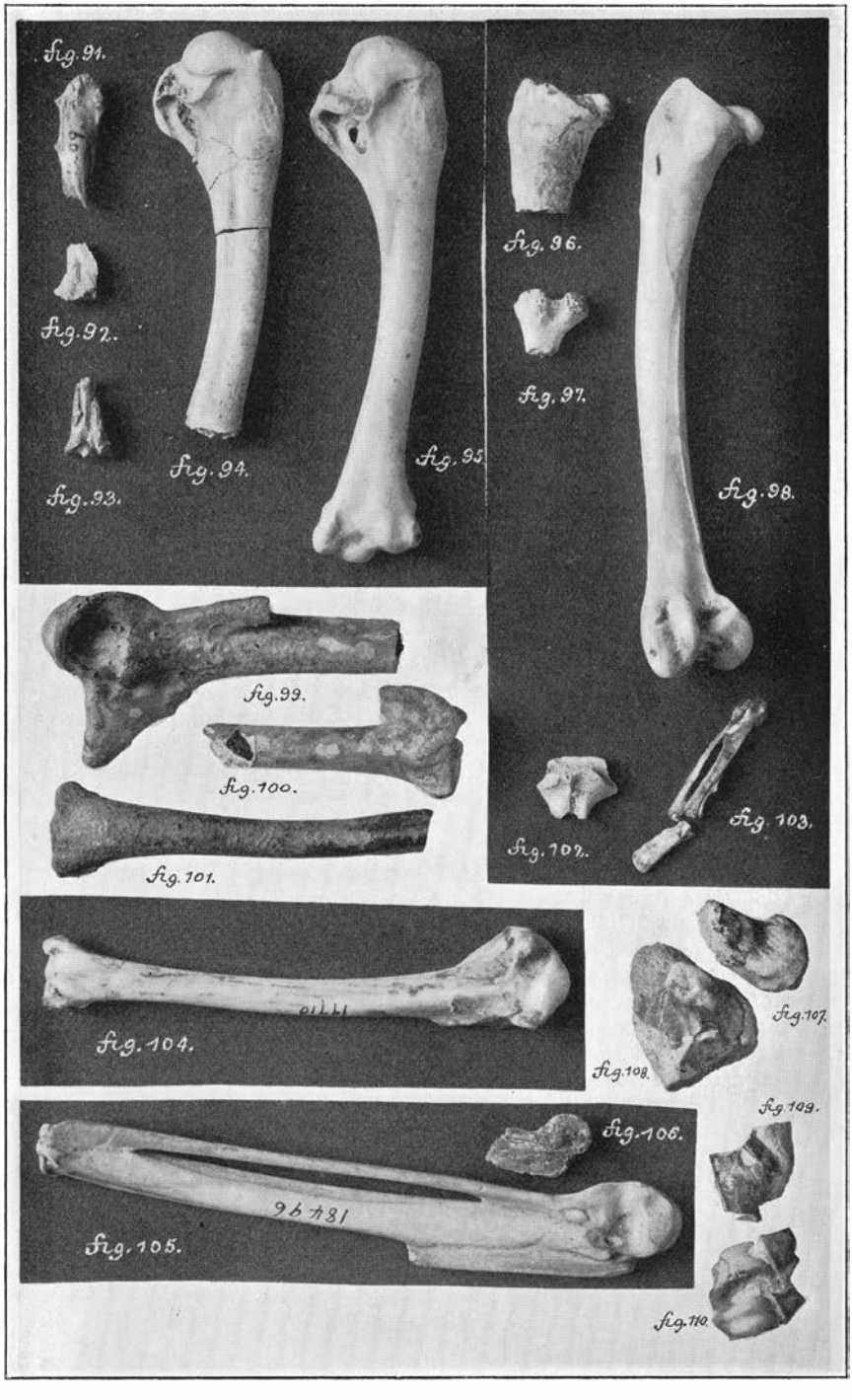

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PLATE XIV

[All the Figures on this Plate are of natural size, being reproductions of photographs made direct from the specimens by the author]

FIG. 111. Fossil vertebra of a bird ? (indetermined). This specimen was associated with the one shown in Figure 112 of this Plate, but it does not appear to have belonged to it. (John Day; Oligocene ??).

FIG. 112. Outer aspect of the left tibio-tarsus of *Larus pristinus*, sp. nov. (extinct). (Willow Creek, Oregon.) (John Day; Oligocene ? ?). See Figure 111.

FIG. 113. Palmar aspect of the right *humerus* of *Phalacrocorax carbo*. No. 18851, Coll. U. S. Nat. Mus., for comparison with the corresponding bone of *Phalacrocorax marinavis*, sp. nov. (Figure 114.)

FIG. 114. Palmar aspect of the distal half of the right *humerus* of *Phalacrocorax marinavis*, sp. nov.

FIG. 115. Anconal aspect of the left *humerus* of *Phalacrocorax carbo*. No. 18851, Coll. U. S. Nat. Mus., for comparison with the corresponding bone of *Phalacrocorax marinavis*, sp. nov. (Figure 116.)

FIG. 116. Anconal aspect of the distal half of the left *humerus* of *Phalacrocorax marinavis*, sp. nov.

FIG. 117. Ventral aspect of an ultimate *cervical vertebræ*, and one which probably belonged to *Phalacrocorax marinavis*, sp. nov., the individual to which the other bones of that extinct species belonged and which are figured on the Plate.

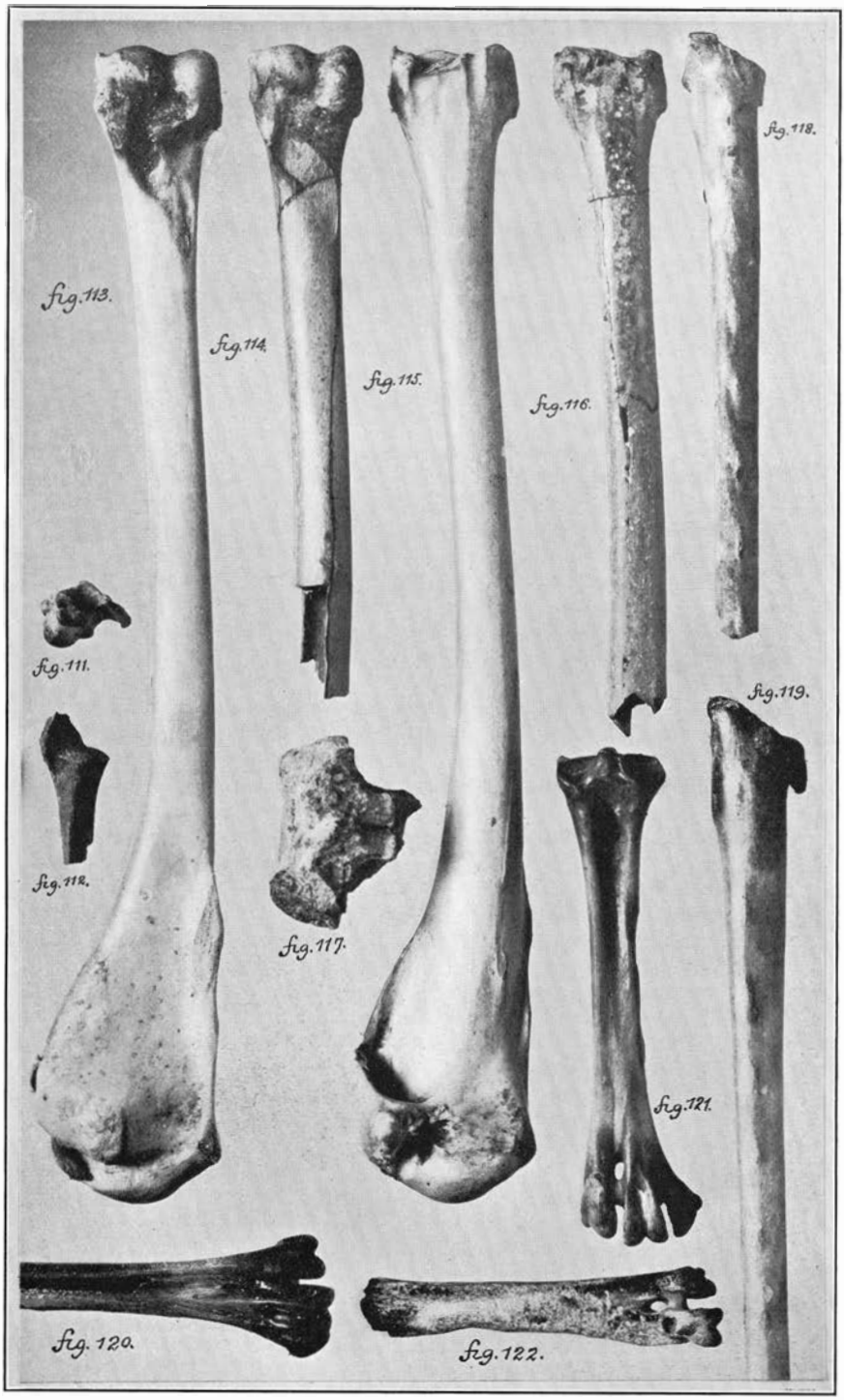
FIG. 118. Palmar aspect of the right *ulna* of *Phalacrocorax marinavis*, sp. nov.; radial process broken off. Compare with Figure 119.

FIG. 119. Palmar aspect of right *ulna* of *Phalacrocorax carbo;* proximal two-thirds, showing radial process. (No. 18851, Coll. U. S. Nat. Mus.)

FIG. 120. Anterior aspect of distal moiety of the left tarso-metatarsus of *Phalacrocorax carbo*. (No. 18851, Coll. U. S. Nat. Mus.)

FIG. 121. Anterior aspect of right tarso-metatarsus of *Phalacrocorax carbo* (No. 18851, Coll. U. S. Nat. Mus.)

FIG. 122. Anterior aspect, distal two-thirds of the left tarso-metatarsus (fossil) of *Phalacrocorax marinavis*, sp. nov. (extinct). Inner trochlea broken off and lost. Compare with Figures 120 and 121. (*P. carbo*.) All the bones of *Phalacrocorax carbo* on this Plate are from the skeleton of the same individual, and they represent a larger bird than *Phalacrocorax marinavis*, or the extinct species, with which they are compared.



SHUFELDT: FOSSIL BIRDS IN MARSH COLLECTION OF YALE UNIVERSITY

PLATE XV

[All Figures natural size. Reproductions of photographs made direct from the specimens by the author]

FIG. 123. Left coracoid, posterior aspect, of *Sula atlantica*, sp. nov. (extinct). Fossil. Adult. (See description in text.)

FIG. 124. Distal part (third?) of the right humerus of a fossil bird (indetermined). Adult. (Extinct?) Yale University Coll., Cat. No. 940. From a species about one-fifth smaller than a Night Heron (*Nycticorax*), to which, however, it does not appear to be related.

FIGS. 125, 126. Shafts of fossil long bones (*Graculavus*. New gen. and sp-Marsh). Birds? (See description in text.)

FIG. 127. Anterior aspect of distal portion of a fossil left tarso-metatarsus of a bird. Type of *Graculavus lentus* of Marsh. Cat. No. 1796, Yale University Coll. (See description in text.)

FIG. 128. Portion of a fossil bone (Bird; indetermined). (See description in text.) Cat. No. 903, Yale University Coll. Adult.

FIG. 129. Anterior aspect of the right tibio-tarsus of *Limicolavis pluvianella*, sp. nov. (Type.) Adult; fossil. Oligocene; John Day? Coll. Peabody Museum, Yale University.

FIG. 130. Anterior view of the superior end of a fossil left coracoid of a bird (extinct?). Adult; indetermined. Belonged to some species about the size of a Clapper Rail (L. Eocene?)

FIGS. 131–136. Various fossil bones representing *Minerva antiqua* Shuf. Figure 131, anterior view of the distal end of left tibio-tarsus; Figure 132, basal phalanx of the second digit, left foot, mesial aspect; Figure 133, basal joint of hallux; Figure 134, characteristic hallucial claw of the first digit or hind toe; distal portion broken off, otherwise perfect; Figure 136, distal end of a left femur with a perfect interna condyle and an imperfect external one.

FIG. 137. Anconal aspect of the distal portion of a right humerus of a bird (adult, fossil, indetermined). Size of a *Centrocercus urophasianus*.

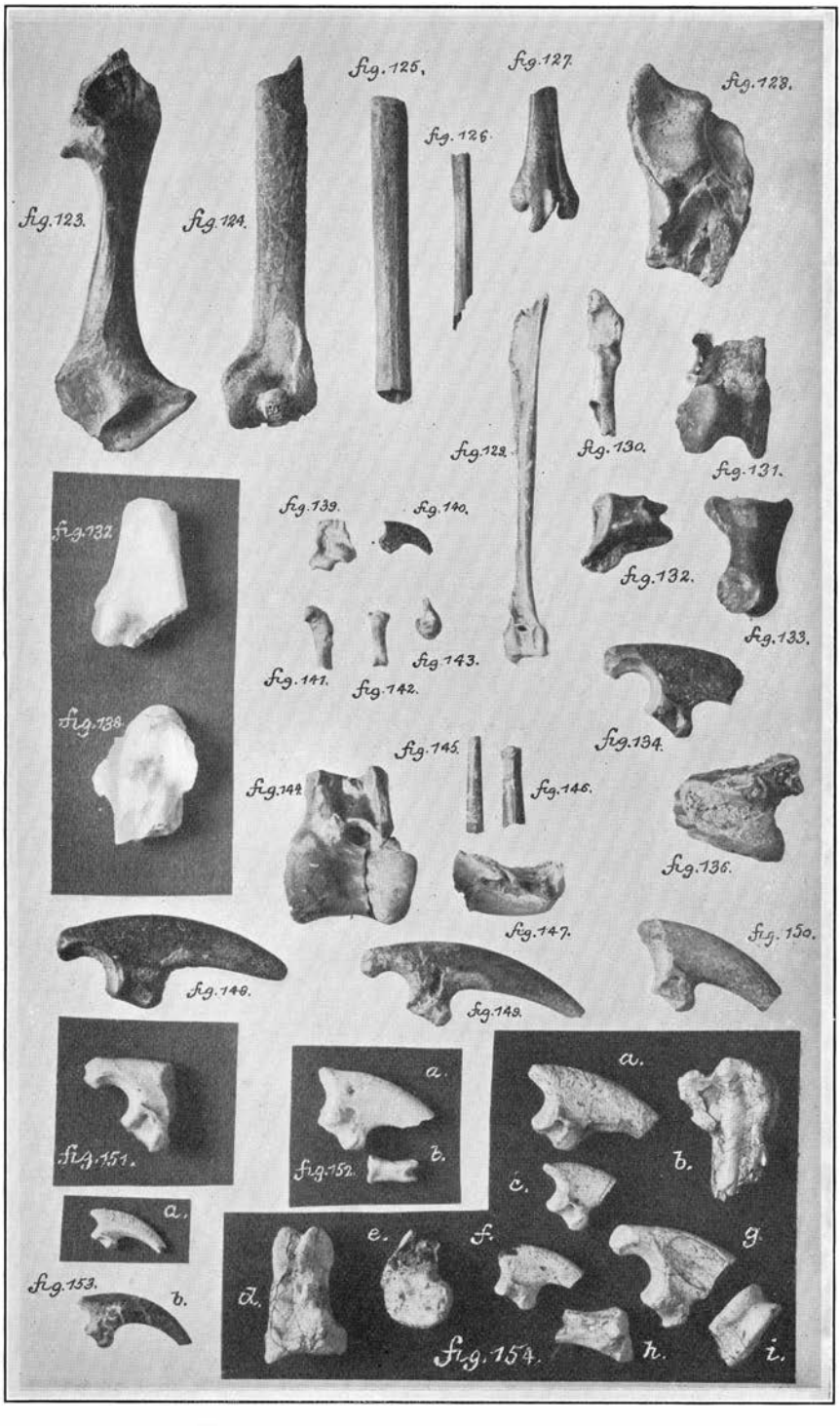
FIG. 138. Anconal aspect of the proximal part of the right carpo-metacarpus of *Phalacrocorax mediterraneus*, sp. nov. (extinct, fossil, adult).

FIGS. 139–143. Various fossil bones of *Falco falconella*, sp. nov. (extinct, adult). Eocene. Figure 139, anconal aspect of the distal end of the left humerus; Figure 140, ungual phalanx of one of the toes; Figure 141, anterior aspect of the superior extremity of the left coracoid; Figure 142, pedal phalanx of a toe; Figure 143, condyle of some long bone.

FIGS. 144–147. Figure 144, anterior aspect of the distal end of the right tibio-tarsus of *Grus marshi*, sp. nov. (extinct, fossil, adult). Bridger; Eocene. Figures 145–147, fragments (indetermined) which accompanied Figure 144.

FIG. 148. Hallucial fossil claw of *Minerva antiqua* Shuf.

FIG. 149. Fossil ungual phalanx of a specimen of *Minerva antiqua* Shuf. Nearly perfect (adult).



SHUFELDT: FOSSIL BIRDS IN MARSH COLLECTION OF YALE UNIVERSITY

PLATE XV—*Continued*

FIG. 150. Imperfect claw of hallux of *Minerva antiqua* Shuf.; the process and apex broken off.

FIG. 151. Ungual phalanx of *Minerva antiqua* Shuf.; anterior portion broken off. (Fossil, adult.) Shows the postero-superior process well.

FIG. 152. *a*, fossil osseous ungual phalanx of *Minerva antiqua* Shuf.; imperfect; adult. *b*, small fossil phalangeal joint from some bird, associated with *a*.

FIG. 153. *a* and *b*, nearly perfect ungual phalanges of pes (fossil) of some raptorial bird. Adult. (Not determined.)

FIG. 154. (*a-i*) Various fossil bones of a specimen of *Minerva antiqua* Shuf.; adult. More or less imperfect. *a*, *f* and *g* are ungual phalanges from the anterior toes; *d*, basal phalanx of hallux; *g*, the ungual claw that articulates with *d*; *b*, nearly perfect proximal portion of the left carpo-metacarpus; *e*, outer view of the external condyle of the tibio-tarsus; *h*, proximal portion of one of the smaller phalanges of the foot; *i*, distal part of one of the larger phalanges of the foot, and probably the mate to *d*, or the other basal phalanx of hallux.