

XIV. FOSSIL BIRDS FROM THE GREEN RIVER DEPOSITS OF EASTERN UTAH.

BY ALEXANDER WETMORE.

(PLATES XXXVI-XXXVII.)

During field-work for the Carnegie Museum in the season of 1923, Messrs. Earl Douglass and LeRoy Kay discovered on White River in Utah about two miles from the Colorado line a deposit, in which were a considerable number of bones of birds. These specimens, which were distributed over the surface of a large slab of hard sandstone, came from the lowest levels of the Green River Formation in the Eocene. Though a considerable number of individual bones are represented, the majority are fragments of ribs, radii, or similar bones, which offer no characters for identification. Among them there are a few bones from other parts of the body, all more or less crushed, but in condition to permit definite determination. From these I have described three species, which are characterized in the following pages.

The three species herein named seem to have no definite connection with birds which have been previously described from the Eocene, and distinctly add to our small fund of knowledge of the bird-life of that remote period. All three seem to have been adapted to life on or around water, and appear allied to two groups, the Auks and the Avocets, among modern birds. To enable proper understanding of their characters, study of these specimens has been prolonged over a period of months, during which the fossils have been compared with large series of modern forms in the collections of the United States National Museum. The specimens were all disassociated, so that correlation of different parts of the skeleton has come through a process of analogy.

For the privilege of examining this material I am indebted to Dr. Douglas Stewart, Director of the Carnegie Museum, and Mr. O. A. Peterson, Curator in Mammalian Paleontology of that institution. The illustrations of the species described, which appear upon Plates XXXVI-XXXVII, were drawn by Mr. Sidney Prentice.

Family ALCIDÆ.

NAUTILORNIS gen. nov.

Generic Characters: Humerus (Pl. XXXVI, figs. 1-4) somewhat similar to that of *Alca* Linnæus,¹ of the subfamily *Alcinæ*, but caput humeri considerably reduced; entire humeral head relatively larger and broader; shaft somewhat rounder, less flattened; depression for brachialis inferior large and well impressed; radial tubercle much larger and more rounded. *Type:* *Nautilornis avus* sp. nov.

1. *Nautilornis avus* sp. nov. (Pl. XXXVI, figs. 1-8.)

Type: C. M. Cat. Vert. Foss., No. 11,358, a right humerus, nearly complete.

Horizon: Eocene, bottom of Green River Formation. Collected on White River, Utah, two miles from the Colorado line, 1923, by Earl Douglass and LeRoy Kay.

Description: Head of humerus broad and relatively flattened, somewhat distorted by crushing; caput humeri long, narrow, smoothly rounded, with a deep excavation penetrating far back beneath its posterior margin, which forms a pronounced overhang above the cavity below; tuberculum internum low and poorly marked, apparently continuous at its proximal margin with caput humeri; crista superior long and pronounced, forming a thin curved plate, concave toward the posterior surface, which extends down in a gradual slope to merge with the blade-like margin of the shaft, somewhat crushed and distorted with part of margin broken away; crista inferior and surrounding area missing, with fossa subtrochanterica evident, but distorted; a low incisura capitis and a well marked tuberculum externum, which is partly broken away; a shallow coraco-humeral groove, partly obliterated by crushing; bicipital surface broad and rounded; bicipital groove very faint; deltoid groove rather broad and open; anterior end of shaft on posterior surface distinctly angular, on anterior face flattened; shaft throughout length much compressed, with the anterior face more or less plane, and the posterior surface rounded; shaft narrowed in transverse diameter below middle and then expanded again toward lower end; distal end of bone crushed and partly broken away; a broad concavity for the insertion of the brachialis inferior, quite different from the shallow impression in the Auks; a broken margin marking former presence of a distinct ectepicondylar process; radial tubercle distinctly rounded, with sharply

¹Syst. Nat., Ed. 10, Vol. I, 1758, p. 130. Type, by subsequent designation, *Alca torda* Linnæus.

angular impression on outer face, cut in under margin of tubercle and separating it from the plate which supports the ectepicondylar process; the tubercle in question supported on an extension of the shaft, which throws it well outward.

Measurements of type: Total length, 105.3 mm.; lateral diameter of shaft at narrowest point 6.5 mm.; diameter at right angles at same point 4.7 mm.

Remarks: There is in the collection a second humerus (Pl. XXXVI, fig. 4) attributed to *Nautilornis avus*, also from the right side of the body, which is somewhat more crushed and distorted than the specimen chosen as the type. Though in itself incomplete, this second example shows a few characters absent in the type. The head of the bone is more complete on the lower or inner side, showing that the bone was here extended outwardly as a broad shelf, which joined the shaft at an angle of nearly ninety degrees, as in *Alca torda*. The depression of the fossa subtrochanterica is evident, though its actual form has been lost through crushing. The shaft has much the form described in the type. The specimen as preserved is approximately 114.5 mm. long.

Comparison of the two humeri depicted on Pl. XXXVI, figs. 1 and 4 will at once reveal decided discrepancies in the conformation of the head. The differences indicated seem due to crushing and distortion and to the breaking away of bone in the type. The original condition was perhaps more or less between the two forms shown. It has seemed best in illustrating these specimens to show them more or less as they are, rather than to attempt an uncertain restoration.

Two fragmentary tibio-tarsi, much crushed, if they are properly allocated under this species, indicate that it had longer, more robust legs than are found in modern Auks. The more nearly perfect of these, the lower end of the bone, (Pl. XXXVI, figs. 5-7) has the condyles more flattened than is the case in *Alca torda*, and the channel between the two on the anterior face deeper and more pronounced. The depth of the condyles in this bone is as follows: outer 6.9 mm., inner 5.5 mm. The shaft in the second specimen is much crushed. If properly restored it indicates a relatively long leg, as the part preserved measures 83.0 mm. in length, and apparently terminates just below the peroneal ridge.

The proximal end of an ulna (Pl. XXXVI, fig. 8) attributed to this form has the usual hook-like inner projection found in other Auks.

It appears that *Nautilornis* was an Alcid with a wing adapted for

flight under water, though somewhat less specialized in this respect than modern forms. Both wing and leg appear to have been relatively longer than in modern species of Auks. The genus is considered as representative of a subfamily to be known as the *Nautilornithinæ*, distinct from existing subfamily groups in the characters which have been mentioned. It is possible, judging from its apparently longer wings and legs, that *Nautilornis* was less distinctly aquatic in habit, more an inhabitant of littoral playas, where it may have waded about on bars or in shallows in addition to disporting in deeper waters.

2. *Nautilornis proavitus* sp. nov. (Pl. XXXVI, fig. 9.)

Type: C. M. Cat. Vert. Foss., No. 11,359, a partly complete sternum.

Horizon: Eocene, bottom of Green River Formation. Collected on White River, Utah, two miles from the Colorado line, 1923, by Earl Douglass and LeRoy Kay.

Specific Characters: Size decidedly smaller than that of *Nautilornis avus*.

Description: Spina sternalis broken away, but indicated by roughened surfaces; groove for reception of coracoid extending in to base of spina sternalis, decidedly broadened inward from its center, rapidly constricted toward the base of the spina sternalis, narrowing slowly toward outer margin; anterior lateral process broken away; five articulations for ribs indicated, spaced with regard to one another about as in *Alca*, the margin to which they attach much broadened; carina long, but low, projected anteriorly, but with part of point broken away; free margin smoothly rounded in a long gradual curve.

Measurements of type: Height of keel at highest point 16.3 mm.; length of base of keel, as preserved (imperfect behind) 58.0 mm.; length of coracoidal articulation 12.8 mm. All measurements approximate.

Remarks: The specimen under discussion consists of a sternum, more or less crushed, in two halves of matrix, which have been broken apart at the center, leaving part of the keel in one side and a part in the other. On the right hand side is preserved the anterior margin of the body of the sternum, which, however, has been broken away from the keel and partly pushed out of place. This part comprises the anterior margin of about one-third of the left half and most of that from the right. The articular surface for the ribs is present on the right portion, where it has been pushed out to one side. Scattered fragments of the body are found on both sides but are incomplete.

The keel is quite perfect, though the anterior projection is partly missing. Posteriorly the keel is practically complete, but the xiphoid portion of the body is entirely gone, so that there is no indication of lateral processes, or of the broad apron which is developed in diving birds to protect the viscera from pressure. The drawing illustrating the type specimen is accurate, but is partly diagrammatic as the two upper fragments are drawn in place and not as they appear distorted in the specimen.

Among other bones in the present collection I find two coracoids, right and left, considerably broken and crushed, which are of a proper size to accompany this specimen. The more perfect of these two is somewhat similar to the same bone in *Alca torda*, so far as may be ascertained, but has the lower articulation relatively less broadened at its widest point. In addition to these there is a fragmentary lower end of a right tibio-tarsus much crushed and broken, which I also attribute to this species, as it resembles a similar fragment placed with *Nautilornis avus*, but is smaller. The allocation of the three fragments, which have been mentioned is not wholly positive.

The broken sternum taken as the type of the present species has been extremely puzzling and it was only after realization that parts of it have been pushed out of place that its proper position in classification was ascertained. It represents an auk-like bird of small size, but with characters somewhat less specialized than is the case in modern forms of this family. Its reference to the subfamily *Nautilornithinae* is assumptive, since no part of the sternum of *N. avus*, upon which species that subfamily is based, is available, so that it may possibly belong to another group. It has, however, seemed proper in this case to follow a conservative course, as it appears that the two birds in question are somewhat allied. Faint signs of missing characters of the two hint at possible greater divergence from modern Auks than the systematic rank allotted to them indicates, but in view of variations among existing species these are disregarded.

Nautilornis proavitus was apparently a bird of diving habit, as indicated by the thickening of the costal attachments to overcome water pressure, but from the form of the keel of the sternum may have used the wings to fly beneath the water to a less extent than modern Auks. In size it was apparently somewhere between the Ancient Murrelet and the Pigeon Guillemot.

Family PRESBYORNITHIDÆ fam. nov.

PRESBYORNIS gen. nov.

Generic Characters: Somewhat similar to *Recurvirostra* Linnæus, of the family *Recurvirostridæ*, but limb-bones, particularly the tarso-metatarsus, relatively much thicker and heavier, with the inner trochlea less elevated on the shaft, the outer trochlea more rounded, less elongated, and the shaft distinctly grooved in front for the greater part of its length. *Type:* *Presbyornis pervetus* sp. nov.

3. *Presbyornis pervetus* sp. nov. (Pl. XXXVII, figs. 10-20.)

Type: C. M. Cat. Vert. Foss., No. 11,360, nearly complete left tarso-metatarsus.

Horizon: Eocene, bottom of Green River Formation. Collected on White River, Utah, two miles from the Colorado line, 1923, by Earl Douglass and LeRoy Kay.

Description: Proximal face of head of bone somewhat broken, so that the inner glenoid facet is the only one distinctly indicated; this is deeply cupped and irregularly circular; intercondylar prominence strong and broad, in form an isosceles triangle with rounded outlines; anterior surface of bone excavated in a broad groove, that below the head is deep, while beyond it becomes shallow, in which condition it extends down for slightly more than three-fourths of length; tubercle for insertion of tibialis anticus tendon slight; talon somewhat broken away, but apparently with two slight crests, of which the one toward the inner side was longer and stronger; groove between the two apparently slight; posteriorly the talon, cut away to merge with the shaft a short distance below the head; inner face of bone with surface flattened but rounded, cut away posteriorly toward head to base of talon; shaft externally much flattened, with well defined angles, marking junctions with anterior and posterior faces; a raised line extending down center of posterior surface from base of talon to center of shaft, where it is obliterated, perhaps by crushing, as a similar line begins a short distance below and continues nearly to trochlea; shaft relatively strong and heavy; inner trochlea distinctly rounded, only slightly elongated; a posterior projection broken away so that it is indicated merely by a roughened spot on the bone; a shallow pit on outer face, bounded anteriorly by a rounded boss; lower margin extended down only to level of upper margin of middle trochlea; inner face hollowed out by a distinct concavity; middle trochlea larger, projecting well beyond the two lateral ones, strongly grooved around entire free surface; outer distal margin projecting beyond the inner; lateral outline elliptical, upper posterior margin

somewhat undercut, as the process here is projected backward; outer and inner faces strongly excavated; lower margin of outer trochlea elevated about 2.2 mm. above lower margin of middle trochlea; in lateral outline irregularly rounded, more or less elliptical with a well developed backward projecting flange, which projects posteriorly beyond the thicker central portion of the bone; outer face slightly excavated.

Measurements of type: total length 114.4 mm.; smallest transverse diameter of shaft 4.6 mm.; breadth of head (approximate) 9.8 mm.; breadth across trochlea 10.2 mm.

Remarks: The general contours of the tarso-metatarsus, selected as the type of the new species described above, are strikingly similar to those of *Recurvirostra*, the main distinction being in the proportions of the bone, which, though only slightly longer than in the Avocet, is much stronger and heavier. The antiquity of the specimen lends much weight to these readily apparent differences, so that it has seemed advisable to segregate the species in a separate family, the *Presbyornithidæ*, to stand as the lowest member of the suborder containing the shore-birds.

Among the many bones found more or less closely associated with the type of *Presbyornis* there are a few fragments, which are assumed to belong to the same species. These are all badly crushed and broken and offer few characters of value. For convenience they are compared with *Recurvirostra*.

The lower portion of a tibio-tarsus (Pl. XXXVII, figs. 13-17) including the condyles and possibly one-third of the shaft, bears out the characters of strength and robustness found in the tarso-metatarsus. The internal condyle in lateral view is long and narrow, with the upper anterior margin nearly straight, and a large raised tubercle on its outer face for tendinal attachment. The external condyle is broader and more rounded. The space between these two articular points, the intercondylar sulcus, is comparatively broad and is deep, with steeply sloping border walls. The shaft is robust. It differs from *Recurvirostra* in the straight upper margin and the strong outer tubercle of the internal condyle, broader intercondylar sulcus, and stronger general form. The transverse breadth across the condyles is 9.5 mm.; the depth of the external condyle 5.8 mm.; and the depth of the internal condyle 5.4 mm.

Broken bits of a right humerus appear to belong to this same species. The proximal end is represented by the caput humeri with

the tuberculum externum. The articular surface is long and narrow, swollen at the caput humeri, and restricted toward the external tubercle. Below the head on the posterior surface at the head of the shaft is an evenly rounded depression which is rounded and broad, not narrow and ridged, as in *Recurvirostra*. The lower end of the same bone (Pl. XXXVII, fig. 18) is represented by the trochlea with a fragment of the shaft, perfect only on the anterior face. A broken face represents the base of what was apparently a well-marked ectepicondylar process. The general conformation is similar to that of *Recurvirostra*, except that the ulnar trochlea is relatively longer. The greatest transverse breadth across the trochlea (not an accurate dimension because of distortion due to crushing) is 12.7 mm.

A right coracoid (Pl. XXXVII, fig. 19) allotted here lacks the precoracoid and outer angle at the lower end and is somewhat crushed. It is relatively strong and heavy, of flattened form, probably accentuated by crushing which has destroyed much of the original appearance of the lower articular surface. A notch appears to represent the presence of a subclavicular foramen. The total length of this bone as restored is 36.3 mm.

An ulna considerably crushed comes from a wing of large size, probably twice as large as that of an Avocet, as it measures 115.2 mm. It is too badly crushed to permit description.

A right metacarpal (Pl. XXXVII, fig. 20) partly embedded in matrix, is in general contour like that of *Recurvirostra*, but is longer and heavier. The pisiform process is at a lower point, and the first metacarpal is relatively longer. The fossil is also more excavated on the outer side at the base of the first metacarpal, and the carpal articulation is extended to a lower level. Otherwise no great differences are noted.

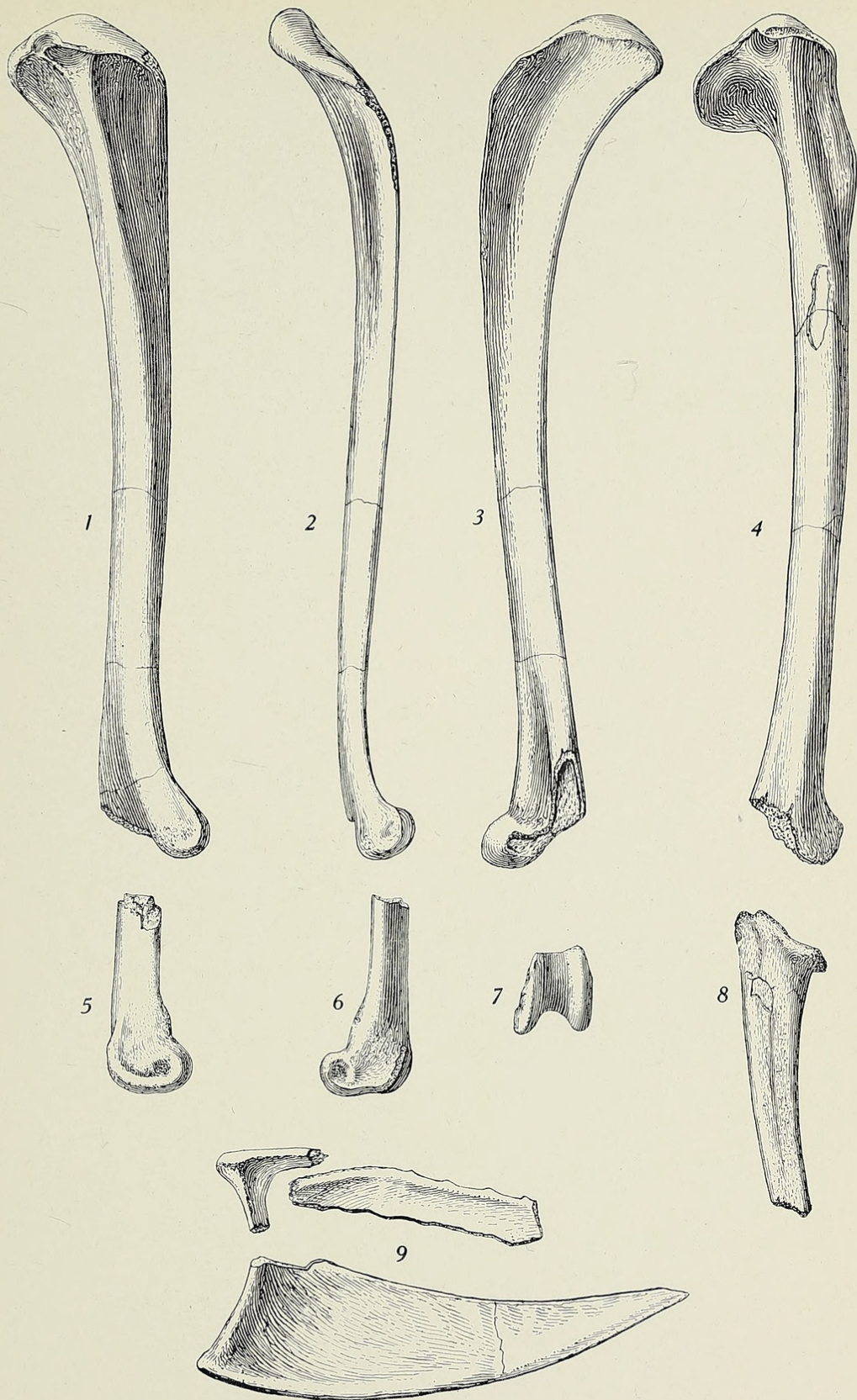
We may conceive that *Presbyornis pervetus* was an inhabitant of mudbanks at the borders of Eocene bays, streams, and lakes, where it waded freely and swam with equal ease. The suggestion is that it was heavier in the body and, therefore, more truly aquatic than the Avocets, which, though they swim readily, are content in the main to utilize their long stilt-like legs in wading. The family *Presbyornithidæ* may be considered typical of an ancestral stock, from which existing Avocets and Stilts have descended.

INCERTÆ SEDIS.

In addition to the bones which have been described, there are in the present collection a considerable number of crushed and broken fragments, which cannot be placed. These consist mainly of radii, ulnæ, and fragments of ribs, though among them are some bits of leg bones and one sacrum. Definite characters from which these may be successfully identified are missing; part of them undoubtedly belong to the three forms described above, while some probably come from another species. It is considered wholly inadvisable to give any of these specimens names. Such action will bring no actual increase in knowledge, since they can be placed in a systematic list only in the scrap-basket indicated by the heading of the present paragraph. They have been long buried, let them now rest in peace.

EXPLANATION OF PLATE XXXVI.

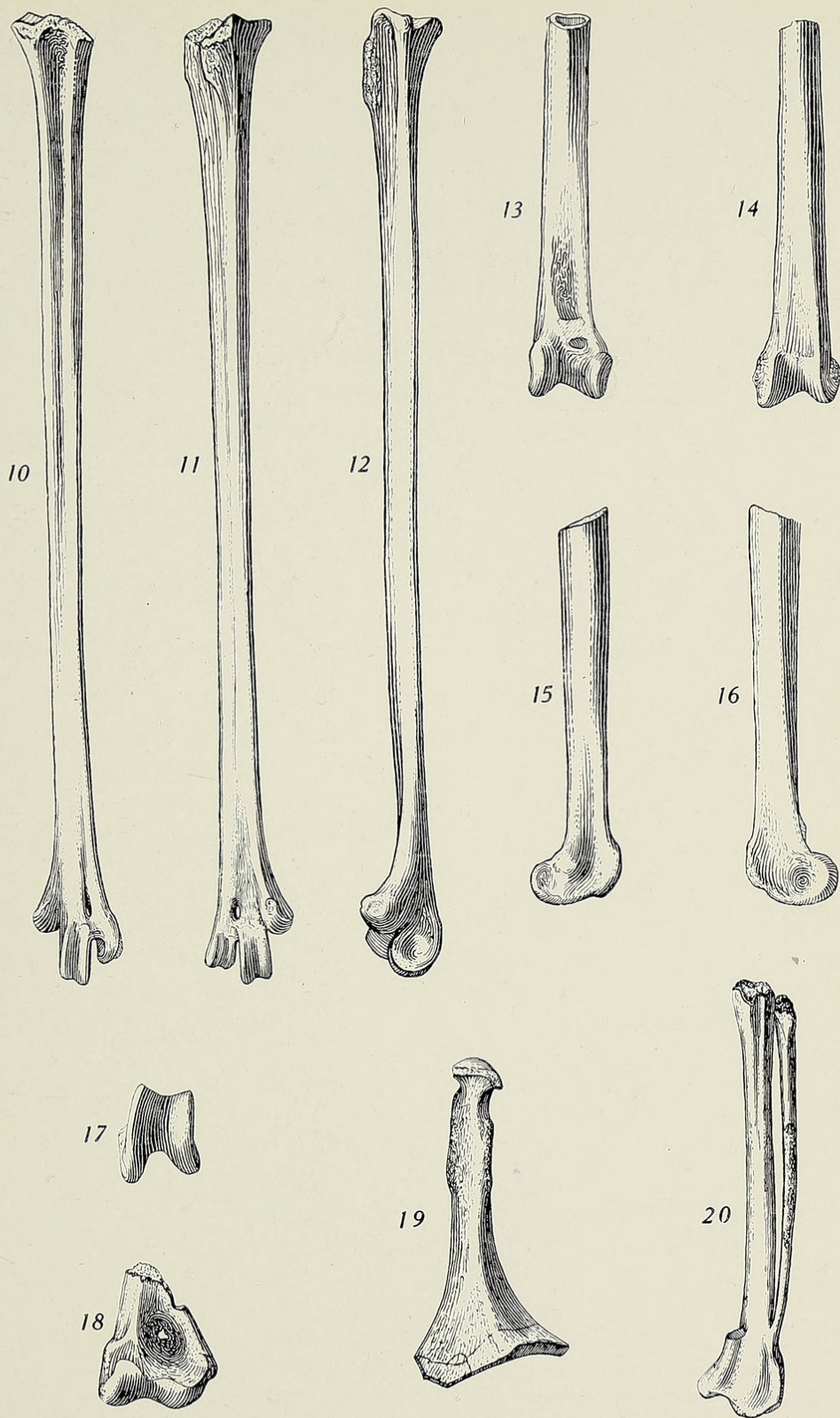
- FIG. 1. *Nautilornis avus* Wetmore, gen. et sp. nov. Type. Posterior view of right humerus. Slightly less than natural size.
- FIG. 2. *Nautilornis avus*. Type. Radial view of right humerus. Slightly less than natural size.
- FIG. 3. *Nautilornis avus*. Type. Anterior view of right humerus. Slightly less than natural size.
- FIG. 4. *Nautilornis avus*. Type. Posterior view of right humerus ascribed to this species. Slightly less than natural size.
- FIG. 5. *Nautilornis avus*. Outer face of fragmentary right tibio-tarsus allocated to this species. Slightly less than natural size.
- FIG. 6. *Nautilornis avus*. Inner face of tibio-tarsus shown in Fig. 5.
- FIG. 7. *Nautilornis avus*. Distal articulating surface of tibio-tarsus shown in Fig. 5.
- FIG. 8. *Nautilornis avus*. Proximal end of right ulna attributed to this species. Natural size.
- FIG. 9. *Nautilornis proavitus* Wetmore, sp. nov. Lateral view of sternum. Type. Somewhat restored, natural size.



Nautilornis Wetmore, gen. nov.

EXPLANATION OF PLATE XXXVII.

- FIG. 10. *Presbyornis pervetus* Wetmore, gen. et sp. nov. Anterior view of left tarso-metatarsus. Type. Somewhat less than natural size.
- FIG. 11. *Presbyornis pervetus* Posterior view of left tarso-metatarsus. Type. Somewhat less than natural size.
- FIG. 12. *Presbyornis pervetus*. Lateral view of left tarso-metatarsus. Type. Somewhat less than natural size.
- FIG. 13. *Presbyornis pervetus*. Anterior view of right tibio-tarsus, ascribed to this species. Somewhat less than natural size.
- FIG. 14. *Presbyornis pervetus*. Posterior view of tibio-tarsus shown in Fig. 13. Somewhat less than natural size.
- FIG. 15. *Presbyornis pervetus*. Inner surface of tibio-tarsus, shown in Fig. 13. Somewhat less than natural size.
- FIG. 16. *Presbyornis pervetus*. Outer surface of tibio-tarsus, shown in Fig. 13. Somewhat less than natural size.
- FIG. 17. *Presbyornis pervetus*. Lower articular surface of tibio-tarsus shown in Fig. 13. Somewhat less than natural size.
- FIG. 18. *Presbyornis pervetus*. Lower end of right humerus ascribed to this species. Natural size.
- FIG. 19. *Presbyornis pervetus*. Anterior aspect of right coracoid attributed to this species. Natural size.
- FIG. 20. *Presbyornis pervetus*. Inner face of right metacarpal identified as this species. Natural size.



Presbyornis Wetmore, gen. nov.



Wetmore, Alexander. 1926. "Fossil Birds from the Green River Deposits of eastern Utah." *Annals of the Carnegie Museum* 16(3-4), 391–402.

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