The oldest remains of British fossil birds are recorded by Sir Charles Lyell as having been first found in 1858, in the Cambridge Upper Greensand*. This stratum still continues the only member of the British Secondary deposits in which the bones of birds have been identified by morphological characters; for though the Rev. Mr. Dennis had previously asserted the occurrence of birds in the Stonesfield Slate†, on the evidence of the microscopic structure of osseous tissue, it is safer, in the absence of recognizable bones, to believe that the ornithic structure he detected was found in an ornithosaurian rather than in a true bird. The discovery of bird-bones in the Cambridge Greensand was made by Mr. Lucas Barrett, F.G.S., then Assistant Naturalist to the late Professor Sedgwick in the Woodwardian Museum of the University of Cambridge; but I am not aware that Mr. Barrett ever published any account of his discovery. The bones are mentioned by Lyell as "the remains of a bird which was rather larger than the common Pigeon, and probably of the order Natatoridae, and which, like most of the Gull tribe, had well-developed wings. Portions of the metacarpus, metatarsus, tibia, and femur have been detected; and the determinations of Mr. Barrett have been confirmed by Professor Owen." What became of Mr. Barrett's specimens I was never able to find out. They were not in the Woodwardian Museum when I succeeded to Mr. Barrett's duties in 1859; and the whole of the remains to which I shall have to refer were collected subsequent to that date. Professor Owen, in his 'Paleontology,' remarks ‡:—"One of the evidences of birds from the Cambridge Greensand, transmitted to the writer by their discoverer, Mr. Barrett, is the lower half of the trifid metatarsal, showing the outer toe-joint much higher than the other two, and projecting backwards above the middle joint; it indicates a bird about the size of a Woodcock."

In the 'Annals Nat. Hist.' for August 1866 I mentioned, in a Note on new Genera of fossil Birds, that I had collected or seen from the Cambridge Greensand cervical, caudal, and dorsal vertebrae, proximal and distal ends of the tarsometatarsus, proximal ends of tibiae, proximal and distal ends of femora, humeri, metacarpal bones, &c., and suggested that the typical species should be called Pela-gornis Barretti. In my 'Index to Aves, Ornithosauria, and Reptilia,'

* Supplement, Elements of Geology, 1859, p. 40.
‡ Second edition, 1861, p. 327.
BRITISH FOSSIL CRETAEOUS BIRDS.

&c., 1869, I abandoned the generic name Pelagornis (which had been preoccupied by Lartet) for Enaliornis, and recognized a second species. In that catalogue forty-seven fragments of bird-bones are enumerated and briefly described. In 1870, in "Remarks on Dimorphodon" *, I drew attention to the fact (afterwards confirmed in American specimens by Prof. Marsh) that some dorsal vertebrae of Cretaceous birds have flat or slightly concave articular ends; and in other writings † I considered the affinities of the birds to be with Colymbus ‡ and the Penguins. Most of the Upper-Greensand bones were found in the neighbourhood of Coldham Common near Cambridge, or at Granchester. When I was residing at Cambridge, and endeavoured to add to the University collection every portion of the bird's skeleton which came under my notice, I was never so fortunate as to secure a perfect long bone; and the only specimen which I have seen with the shaft unbroken is a femur in the collection of Mr. Jesson, F.G.S. Many of the fragments are worn; but most are broken without being much abraded. And it is quite possible that the specimens may have been more perfect in the deposit than the state in which they are collected would imply; but allowance, in judging of this, must be made for the accidents of fossilization, and the carelessness and ignorance of the phosphatite diggers, whose interest in these remains is usually too small to ensure the preservation of inconspicuous bones which are only met with at long intervals of time; and thus portions of one skeleton, or even of one bone, sometimes get distributed to several collectors. In the remains of other animals I have seen several cases in which the fragments of fractured shafts of bones have lain in juxtaposition in the deposit, and oysters have grown on the fractured surfaces—showing, I think, that though the nodules may have been formed and mineralized in shallow water, they were rolled, with such of the bones as are unassociated, into a somewhat tranquil depth of sea before they were covered up by the Upper Greensand sediment.

There is no evidence of more than one bird-bone being found at a time; so that every fragment of bone may have belonged to a separate individual bird.

The Skull. (Pl. XXVI. figs. 1-4.)

A suspicion often occurred to me that the hinder part of the cranium (drawn in pl. 11. figs. 3-6 of my book on the Ornithosauria) might perhaps be the skull of a bird. In describing it seven years ago as Ornithosaurian I was influenced chiefly by probabilities and considerations such as these:—The specimen closely resembles the back part of the cranium in several Pterodactyles from Solenhofen; its Avian characters are in harmony with the characters of other

* Annals Nat. Hist., Aug. 1870, p. 129. † Ibid. Nov. 1871, p. 305. ‡ May 2, 1864, I communicated a note to the Cambridge Philosophical Society "On the Fossil Birds of the Upper Greensand (Palaeocolumbus Barretti and Pelagornis Sedgwicki);" but nothing beyond the title of the paper was printed.
parts of the skeleton of *Ornithocheirus* from the Cambridge Greensand, and it closely resembles the specimen figured on pl. 11. figs. 1 & 2, the Ornithosaurian nature of which I see no reason to doubt; while it seemed improbable that so many specimens (as were known to me) of birds' skulls should have been found, and so few of Pterodactyles—the bones of birds being so rare, and those of Ornithosaurs, especially jaws, being relatively abundant. Confessedly it is extremely difficult, if not impossible, to distinguish the hinder part of the cranium in some Natatorial birds from the corresponding region in some Ornithosaurs merely by the form of the head, the arrangement of its regions, or the proportions of its several osseous elements. When first describing the specimen referred to, I pointed out* the difficulties in the way of distinguishing the fossil from the cranium of a bird. The withdrawal of the specimen from the Ornithosaurian list would leave the question of the Avian nature of Ornithosaurs unaffected, as in most respects some of the admitted crania of Pterodactyles are almost as bird-like as this specimen.

I propose now to regard the skull as that of a true bird:—first, because, on careful reconsideration, I find no characters by which it can claim more than a generic distinction from living birds; secondly, it is more like a bird's skull than is the skull of any British Pterodactyle; thirdly, the cranial bones are comparatively thin and dense, instead of having the cellular structure characteristic of Ornithosaurs from the Cambridge Greensand, and in this character the skull agrees with the other portions of the bird's skeleton. It is about the size of the Red-throated Diver's cranium, and, in common with all the other bird-bones found, presents a marked resemblance to that Avian type.

I have already described elsewhere† the essential features of this specimen, and now offer a few measurements of its several regions, which were then omitted.

Transverse measurement over the lateral processes which form the articulation for the quadrate bones, 1 1/8 inch.

Transverse measurement of the constricted squamosal region of the skull just in advance of the preceding measurement, 3/4 inch.

Transverse measurement of anterior termination of the squamosal region 4/8 inch.

The parietal region rapidly rises as it extends forward from the occiput.

The parietal bones, which met in the median line in a slight ridge, are oblong, 1/6 inch long, though, owing to the anterior margin being concave, each becomes much wider (3/8 inch) where the parietal joins the squamosal bone in a nearly straight suture, 3/8 inch below the median cranial crest. There is a bend in the upper third of the parietal bone; the superior portion looks upward and outward; the lower portion is more inflated than in the Diver, but is similarly directed outward a little to meet the expanded frontal. The parietal bone (1/8 inch thick) had a smooth union with the

* Ornithosaurus, pp. 80-83.
† Ornithosaurus, p. 80, pl. 11. figs. 3-6.
The frontal, which it obliquely overlapped. The parietal appears to have been prolonged further forward in the line of the median crest than is evidenced by the preservation of the bones. The bones are transversely arched.

The squamosal bone differs from that element in the Divers, Cormorants, and Grebes (which in general form of cranium approximate to the fossil) in being folded so as to form a narrow inferior surface more than \( \frac{1}{2} \) inch wide and about \( \frac{3}{4} \) inch long; and a superior triangular, somewhat V-shaped area fully \( \frac{1}{4} \) inch deep and as wide. In this folded character there is some approximation to the condition of the squamosal bone in the Goose tribe.

The occipital crest seems to have been well elevated. It is sinuous and curves forward laterally, as in the Diver, but is more elevated inferiorly than in that type, and has the articulation for the quadrate bone placed entirely behind it, which is not the case in the Diver. The occipital aspect of the fossil is wonderfully like that of Colymbus, and differs chiefly in the fossil being somewhat broader, owing to the two sides of the occipital crest making a greater angle with each other. The basioccipital articular condyle in the fossil is probably removed by fracture. The Diver has the bone in front of the condyle vertically compressed; but in the fossil the basioccipital was compressed even more, since the fracture has left but a narrow rim to the base of the foramen magnum. The foramen magnum is vertically ovate, and relatively rather larger than in the Diver; it is \( \frac{3}{8} \) inch high, and \( \frac{5}{8} \) inch broad; its upper border considerably overhangs the base.

The tympanic area is large, internal to the articulation for the quadrate bone, and is best exposed in lateral view. It is limited by four irregular sides, and has an irregular surface in which are several perforations. The basi-temporal bones, which are missing, were shaped as in birds. The remarkable short-triangular form of the base of the sphenoid may result from abrasion. It is broader than in water-birds, but is essentially a modification of the sphenoid of the Diver. As preserved, it is \( \frac{1}{4} \) inch long and \( \frac{3}{8} \) inch wide at the base. This specimen I regard as the skull of Enaliornis Barretti.

Another specimen, in the collection of Mr. Reed, at York, probably belongs to another species.

A fragment which I regarded in 1871 as a premaxillary of a Toothless Pterodactyle has perhaps an equally good claim to be considered a portion of a premaxillary bone of a bird. It has already been figured by Prof. Owen as the proximal end of the metacarpal of the wing-finger of an Ornithosaur*. I have suggested for it (Ann. Nat. Hist. January 1871, p. 35) the name Ornithostoma; for, if a bird-bone, it has nothing in common with Enaliornis; and if an Ornithosaur, the name will be appropriate. It has the base flattened, concave from side to side, marked with blood-vessels, and terminating laterally in well-defined ridges gently rounded, which are concave in outline from front to back, so as to make the back wider than the front. If the specimen should hereafter prove to be a jaw, this

* Pal. Soc. 1859, pl. 4. figs. 4 5.
would be the palatal surface. It is 2\frac{1}{2} inches long, 2\frac{3}{4} inch wide in front, and 1\frac{3}{8} inch wide behind. The sides are smooth, finely wrinkled, concave in length, convex from above downward, with small oblique vascular foramina near the border, which may be alveolar; there are also foramina on the middle of the side. Superiorly the sides converge in a rounded ridge. It is 1\frac{4}{6} inch deep in front, and 1\frac{1}{2} inch deep behind. The great difficulty in the way of regarding it as an Avian premaxillary is that, although it widens behind somewhat rapidly, it shows no indication of a nasal groove or cavity, though the Diver has no lateral groove on the beak. And the recent discovery of Toothless Pterodactyles by Prof. Marsh in the Cretaceous beds of America lends some support to my original determination of the bone as Ornithosaurian.

I would suggest that since the birds from the American Greensand having teeth in their jaws show affinities with Colymbus, it is probable that Enaliornis, which has vertebrae resembling those of Ichthyornis in biconcave character, may also have had teeth in its jaws.

The Vertebral Column.

Cervical vertebrae have rarely been found. Some twelve years ago I detected what seemed to be a lower cervical in the collection of W. Reed, Esq., F.G.S., but have not noticed any other specimens. The vertebrae most commonly found, and best known, are dorsal. One in Mr. Reed’s collection has the visceral surface of the centrum terminated by a sharp ridge, while all the other specimens (including four in the Woodwardian Museum) have this surface convex. Mr. Reed’s two vertebrae probably belong to the two species of birds to which I refer the bulk of the remains, though this could only be definitively determined by a careful study of the somewhat abraded fossils. Of the sacrum, the Woodwardian Museum has three important specimens demonstrating the essential points of structure; another fragment of the postfemoral part of a sacrum has been obtained by James Carter, Esq., of Cambridge. These specimens are all from the anterior and middle regions of the sacrum, and are such as might all belong to one genus. The Woodwardian Museum also contains two other vertebrae, apparently precocious, which I am disposed to regard as bird-bones, and refer to the tail. As they have no transverse processes, they are probably elements which, in existing birds, are united in the ploughshare bone.

Lower Cervical Vertebra. (Pl. XXVI. figs. 5, 6.)

The centrum measures \frac{5}{6} inch in width over the anterior zygapophyses; the length of the centrum is \frac{1}{15} of an inch; the width of the centrum in front is nearly \frac{5}{17} inch, where the anterior articulation is concave from side to side, convex from above downward; it is more than \frac{4}{15} inch deep; and at its base a short tubercle is developed. The base is concave, long, narrow, flattened, and concave from side to side. It is margined by sharp concave borders.
The lateral areas are concave; the posterior articulation is slightly concave in depth, and more convex in breadth: it is nearly square, but broader above than below. The neurapophyses rise obliquely from above the upper part of the centrum behind, widening superiorly to above the neural canal in front. The depth in front of the centrum and neural arch is more than \( \frac{3}{2} \) inch. The upper surface is obscured, and the neural spine is not preserved; it does not rise from quite the front of the arch, which is nearly horizontal above. The facets for the zygapophyses look upward and inward.

This specimen, in the collection of W. Reed, Esq., is not unlikely to belong to *Enaliornis Barretti*.

*Dorsal Vertebrae.* (Pl. XXVI. figs. 7-13.)

The four dorsal vertebrae in the Woodwardian Museum, like all the other specimens which have come under my notice, except Mr. Reed's, agree in their characters, though they differ a little in size. They are small in proportion to the size of the head, and show no resemblance to any vertebrae of the Diver. Two of the centrums of *Enaliornis Sedgwicki* (fig. 12a) display to some extent indications of the peculiar Ichthyoid biconcave articular condition already referred to; but, as it is wanting from the largest specimen, it is possible that the smaller specimens though adult are imperfectly ossified; many natatorial birds have the lower dorsal centrums nearly flat, while very young birds have a small central notochordal depression on the articular face. The centrums are much less compressed from side to side than is usual in the dorsal vertebrae of water-birds.

The largest specimen, *Enaliornis Barretti*, has the centrum rather more than \( \frac{3}{2} \) inch long, expanded at both articular ends, somewhat flattened at the base and at the sides, which round into each other (fig. 9), and are each concave from back to front. The anterior articulation (fig. 11a) is \( \frac{3}{5} \) inch broad and \( \frac{1}{2} \) inch deep. It is remarkable for having the sides of the centrum prolonged forward for a considerable distance, so that the surface is markedly concave from side to side, while vertically the convexity, if it exists, is so slight as to be scarcely detected. Posteriorly the articulation (fig. 10b) is necessarily narrower; it is more than \( \frac{1}{2} \) inch wide and less than \( \frac{1}{4} \) inch deep. It is convex from side to side, flat from above downward, with a central concavity, is subquadrature, emarginate in the upper part of the side, with a slight impression dividing the basal margin. Laterally (fig. 7c), at the side of the anterior border of the neural arch is an oblique oval facet slightly elevated, \( \frac{1}{3} \) inch long and concave, which has exactly the form and position of the diapophysis in the vertebrae of existing birds like the Gannet. The whole centrum closely resembles that of the Solan Goose, differing chiefly in being much more depressed, and not much more than half the size. The form of the neural arch, however, much more closely resembles that of *Colymbus*. A narrow, compressed, horizontal, transverse platform is given off (fig. 8d). It is emarginate anteriorly and posteriorly, and directed outward and somewhat back-
ward; it is imperfectly preserved. Small zygapophysial facets (fig. 8q) are preserved or indicated both in front and behind. The neural spine (fig. 8e), as preserved, is thicker posteriorly than in front, does not extend quite to the anterior border of the neural canal, and posteriorly is cleft vertically. Specimens of *Eoalioformis Sedgwicki* (fig. 13) show the centrum to be considerably impressed laterally below the transverse process *, and that the neural canal is much wider than high; the neural spine is directed somewhat backward. The shortest centrum is more than \( \frac{1}{4} \) inch long. The amount of the concavity of the centrum varies.

### The Sacrum

(Pl. XXVI. figs. 14–19.)

There are three fragments of the sacrum in the Woodwardian Museum, and a fourth (from the posterior part of the sacrum) in the collection of James Carter, Esq., M.R.C.S. The Woodwardian specimens appear all to belong to the same genus, are in sequence to each other, and show the sacrum to have been constructed exactly after the water-bird pattern. The vertebrae, however, are more elongated, so that the sacrum is much longer in its several regions than are the corresponding parts of the sacrum of the Diver. The first fragment (fig. 14) comprises the first, second, and part of the third sacral vertebrae anchylosed, with the elevated margins of the confluent centra unusually well marked on the basal border. The first centrum is depressed, with the articular surface flattened in front, as in the Gulls and the Gannet, and somewhat concave centrally. The anterior articulation is nearly \( \frac{3}{4} \) inch broad. The centra increase a little in length from before backwards; the first is about \( \frac{1}{16} \) inch long, with a depressed form of centrum, broad and convex from side to side, and slightly concave from back to front. I am unable to detect any indication of the diapophysial articulation on the anterior border of this centrum usually to be seen in existing birds. A narrow transverse process, \( \frac{1}{3} \) inch wide, is given off from the anterior part of the side of the centrum and directed outward and somewhat upward; its outline is emarginate both anteriorly and posteriorly. In the succeeding vertebrae the centra become a little deeper, and rapidly more compressed from side to side, the third having the sides flattened, and base forming a narrow rounded ridge. The third vertebra shows the transverse processes, which, thick and strong, appear to have formed horizontal neural tables, the bases of which, as preserved, have a transverse measurement of \( \frac{3}{4} \) inch. From the neural platform to the base of the centrum is more than \( \frac{3}{8} \) inch. No indication of the neural spine is preserved.

The second specimen (figs. 15, 16), from the middle of the sacrum, is in a pale state of mineralization, and more free from matrix. It was collected by M. R. Pryor, Esq., late Fellow of Trinity College. It

* The impression is never as deep as in Gulls, or even as in the Wealden fossil *Ornithopsis*, a genus so named from the resemblance of its centrum to that of certain Gulls.
comprises portions of three vertebrae—one entire in the middle, and a
fractured vertebra at each end. In general form the vertebrae rather
recall the middle sacral region of Penguins. The centrum is rather
more than \( \frac{3}{8} \) inch long, while the least width at the intervertebral fora-
men is \( \frac{5}{8} \) inch. The sides, concave in length, are compressed so as to
converge inferiorly in a rounded median keel. The vertebral fora-
mina are large, rounded, and placed behind the transverse process
just at the hindermost part of the centrum (fig. 16). The neural plat-
form is wide, horizontal, and imperfectly preserved; it is traversed
in the median line by a low neural spine about \( \frac{1}{10} \) inch high and as wide.
The depth from the neural spine to the base of the centrum is fully
\( \frac{1}{8} \) inch. The substance of the centrum is largely excavated for the
neural canal, which is cylindrical and \( \frac{1}{4} \) inch in diameter. The
position of the transverse processes is above the middle of the neural
canal. Both the specimens described are from the part of the sacrum
anterior to the femoral articulation in the pelvis.

The third specimen (figs. 17, 18, 19) is postfemoral; it has almost
exactly the form of the region immediately postfemoral in the Diver.
It comprises portions of four vertebrae perfectly ankylosed together.
In transverse section the mass is triangular (fig. 17), having the base
flattened; and the flattened sides converge dorsally to a sharp ridge,
with which the iliac bones were in contact. The specimen is \( 1 \frac{5}{8} \) inch
long, \( \frac{3}{8} \) inch high as preserved anteriorly, and about \( \frac{1}{4} \) inch high
posteriorly. The base (fig. 18), which is channelled in length as in the
Diver, is margined on each side by a subangular ridge, external to which
is a narrow flattened lateral area which looks downward and outward.
The width of a centrum in front, where narrowest between the
transverse processes, is less than \( \frac{3}{8} \) inch; posteriorly the sacrum
becomes steadily narrower. On the lower portion of the lateral
aspect (fig. 19) is a row of four large rounded intervertebral foramina,
less than \( \frac{1}{8} \) inch in diameter, between which are the eminences forming
the bases of the short transverse processes. The flat side above
these foramina and processes, \( \frac{5}{16} \) inch deep, is divided into rhomboid
areas by impressed lines running upward and backward at unequak
distances from each other. Posteriorly at the fracture the sacrum
is becoming greatly compressed; but there is no means of estimating
the number of vertebrae in the posterior missing portion. In the
Diver there are six vertebrae posterior to the corresponding sacral
region; but if Enaliornis had a long tail, the sacrum may have in-
cluded fewer postfemoral elements.

Caudal Vertebrae. (Pl. XXVI. figs. 20, 21, 22.)

Two small vertebrae, apparently caudal and proceous, I am in-
clined to assign to the caudal region of Enaliornis; if so, they are
separate elements of the ploughshare bone, and would indicate a
peculiar condition of the termination of the tail. The centrum is
compressed from side to side; and the neural arch, which hangs for-
ward a good deal (fig. 20), shares in the compression. The centrum is
about \( \frac{1}{4} \) inch deep, and \( \frac{5}{16} \) inch in width superiorly, where it is widest;
and the base is rounded, with a narrow median furrow. The articulations of the centrum are oblique, looking downward and forward; the anterior one (fig. 22) is concave from above downwards, and shows a less concavity from side to side. The posterior articulation (fig. 21) is evenly convex, somewhat compressed from side to side, broader above than below; it is \( \frac{3}{4} \) inch deep, and \( \frac{3}{16} \) inch wide superiorly. On the middle of the side of the neural arch, on a line with the base of the neural canal, is a slight eminence indicative of a rudimentary transverse process. The zygapophyses are broken away, but extended far forward, and were elevated to the upper border of the neural canal. The neural arch in front is wider than the centrum; posteriorly it is compressed and narrower than the centrum. There appears to have been a slight neural spine; but it is broken away. As preserved the vertebra is \( \frac{7}{16} \) inch high. The neural canal is small, but is larger in front than behind.

The vertebral column, as a whole, is unlike that of any existing bird; but its affinities with members of the natatorial tribe admit of no question.

The Pelvis. (Pl. XXVI. fig. 23.)

Only one fragment has come under my notice; it is in the Museum of the Geological Survey, and had already been identified by Mr. E. T. Newton, F.G.S. I am indebted to Professor Huxley for the opportunity of studying this and other bird-bones in the Geological-Survey Museum. The ilium is large and deep, the acetabulum is perforated, and the small, but distinct, public and ischiac bones are directed backward.

The specimen is a fragment of the left ilium (fig. 23 a) with the ischium broken short, and an indication of the pubis. The acetabulum is \( \frac{9}{16} \) inch wide; it is subcircular, and is perforated as in living birds, the perforation being apparently nearly \( \frac{3}{4} \) inch wide. The external surface of the ilium is smooth; but the posterior margin of the acetabulum is elevated considerably, as in existing birds, the anterior margin being similarly depressed. The pubis (fig. 23 b) is seen on the internal side of the fragment not to be blended with the ilium, but to be separated by a short straight suture directed upward and backward. The pubis is directed backward, but forms the inferior anterior margin of the acetabulum; it is slender, \( \frac{1}{16} \) inch wide, subquadrate in section, with the external and internal anterior sides converging in a sharp anterior marginal ridge; consequently there are also posterior, external and internal ridges. As preserved, the pubis is \( \frac{9}{16} \) inch long; it has a large medullary cavity. The ischium (fig. 23 c) is more slender and more circular in section; it forms the inferior posterior part of the margin of the acetabulum; is flattened anteriorly, and directed backward at the same angle as the pubis, from which it appears to be entirely separated: as preserved, it is \( \frac{1}{2} \) inch long. The ilium is remarkably thin; it is compressed above and behind the posterior acetabular thickening, above which (as preserved) it extends for \( \frac{7}{16} \) inch. The length of the specimen is about 1 inch.
More specimens of femur have been found than of any other bone. The Woodwardian Museum contains twenty-four, of which eight are proximal ends. This is nearly half the total number of specimens of bird-bones in the Museum. In the collection of Mr. T. Jesson, F.G.S., in which there are seventeen bird-bones, six are fragments of femora—five of them distal ends, and one proximal. On the lowest computation these remains alone must have pertained to at least thirteen birds. The femora differ in size, form, and slenderness, but not to a marked degree; so that if the bones belonged to three different species, as is probable, they all may have been closely allied. The smallest femur is rather longer than that of the Red-throated Diver, but has the articular ends less expanded. One specimen in Mr. Jessou's collection (figs. 1, 2, 3) is 1 1/4 inch long, but has both articular ends worn and short of their true length. It is bowed superiorly, much as in the Diver, being concave in length inferiorly and convex superiorly. The shaft measures 3/4 inch from within outward in the middle, and widens proximally to 3/8 inch as preserved, and distally to 7/16 inch as preserved. The external surface is flattened, somewhat pitted with muscular attachments, rounded into the anterior and posterior surfaces, and is concave from the proximal to the distal end. The antero-posterior diameter of the shaft in the middle is more than 4 inch, but becomes somewhat less towards both ends. The internal surface is somewhat compressed on the posterior margin, but is well rounded in the shaft from back to front, though towards the extremities it becomes more compressed. The proximal end is subtriangular when seen from above, the superior antero-posterior external measurement being much more than in Colymbus, while the articular head of the bone is smaller; and the shaft is slightly compressed superiorly external to the articular head, the impression being greatest in front. The distal end is marked in front with a shallow broad channel, nearly the width of the anterior surface, margined on the inner side by a sharp ridge, which is the edge of a flattened, narrow, short inner surface that looks inward and backward. As usual in birds, the proximal and distal articulations are both in the same plane, and the outer distal articular surface is the larger of the two.

Another femur, imperfect proximally (fig. 8) (presented to the Woodwardian Museum by Rev. T. G. Bonney, F.G.S.), appears to have been shorter and stouter, approaching nearer to that of the Diver, and the muscular attachments very like those of the Diver. As preserved, the fragment is 1 1/4 inch long and 5/16 inch wide in the middle of the shaft; distally it is about 3/4 inch wide. At the distal end there is wide pit rather than a groove, resembling that in the Red-throated Diver, only not so deep.

A third femur, badly preserved distally, and showing no trace proximally of the articular end, is 1 3/4 inch long; distally it is 5/8 inch wide, while the larger condyle measures 3/8 inch from front to back. This indicates an animal somewhat larger; but it is difficult, with
such worn fragments, to estimate aright the differences of size and stoutness.

The isolated ends exhibit corresponding differences of size. The smallest measures $\frac{7}{16}$ inch from within outwards over the proximal articulation, while the largest specimens are $\frac{9}{16}$ inch in that measurement, and have a corresponding thickness in the shaft. In all, the external proximal surface terminates in a sharp margin on each side, is flattened and wide—$\frac{7}{15}$ inch wide in the larger specimens, and less than $\frac{3}{16}$ inch wide in the small bones. Usually this area is somewhat concave below the articulation. The articular surface itself extends over the whole of the proximal end.

A medium-sized distal end of a left femur (Pl. XXVII. figs. 9, 10, 11) I refer to *Enaliornis Sedgwicki*. The fragment is about an inch long, subovate where fractured proximally, being $\frac{5}{16}$ inch in the greatest oblique measurement from before backward, and less from side to side. The shaft becomes compressed on the inner and posterior side towards the distal articulation, above which its section would be subtriangular; for the inner margin of the anterior aspect is a somewhat sharp ridge more marked than in the Diver, which is prolonged into the inner distal condyle. The outer condyle is much the larger, and extends about $\frac{3}{16}$ inch further distally than the other. The intercondylar space in the fossil has not so great an antero-posterior compression as in the Diver; and the inner condyle is rather deeper than in that type. The width over the condyles is $\frac{9}{16}$ inch; the depth of the outer condyle is nearly $\frac{7}{16}$ inch.

A larger distal end of a right femur (Pl. XXVII. fig. 12), which I regard as that of *Enaliornis Barretti*, more than an inch long, is nearly $\frac{7}{8}$ inch wide over the articulation; and the whole bone is proportionately larger. The condyle is relatively larger and deeper than in the other species, and the anterior channel between the condyles is relatively deeper. Another specimen, in better preservation, I noticed in the collection of W. Reed, Esq. I shall be quite prepared to find that the femora which have passed through my hands belong to more species than I have indicated; but, in the absence of other evidence, I do not see my way to giving them any useful definition.

The Tibia. (Pl. XXVII. figs. 13-21; Pl. XXVI. figs. 24, 25.)

The remains of tibiae comprise two proximal ends of right tibiae in the Woodwardian Museum, and one in that of Mr. Reed, and a left one in the collection of Mr. Jesson, all of which have a moderate patelloid process, which is more developed than in the Gannet, but makes no approximation in length to that of the Diver. There are also in Mr. Jesson's collection two specimens of right and left proximal ends of the smaller of the two forms of tibiae, which are imperfectly ossified and have no trace of a patella, but terminate in rough cartilaginous surfaces. These bones seem to be young specimens of *Enaliornis Sedgwicki*, though the remains are not inferior in size to
those in which ossification is complete. In the Woodwardian Museum is a similar larger proximal end of a tibia without a patella, which I take to be that of *Enaliornis Barretti* (figs. 20, 21). There are also distal ends of tibia: the Woodwardian Museum is fortunate in possessing an example of each species.

The large proximal ends of the bone in *Enaliornis Barretti* are four in number. Mr. Reed's specimen is the finest. Twelve years since I noticed that it was 1\(\frac{1}{4}\) inch long, with a subquadrate shaft and strong compressed semiovate patelloid process fully \(\frac{3}{8}\) inch high, with flattened subparallel surfaces. Both lateral margins of the patella develop ridges which are directed outwards. The ridge on the fibular side of the bone is the stronger. The shaft terminates upward internal to the patella in a flattened horizontal slightly convex surface wider than deep, though the depth is increased by projecting backward over the posterior face of the shaft. This articulation for the femur is nearly \(\frac{1}{2}\) inch wide, but is not so deep on the inner side and is rather narrower towards the fibula; the surface is slightly oblique, sloping from the front backward. In front the shaft is channelled; and posteriorly it is somewhat concave from side to side. It is compressed externally and develops a fibular ridge on the posterior external margin at \(\frac{5}{8}\) inch below the femoral articulation. The internal surface of the shaft is flat. The proximal end figured Pl. XXVII. fig. 20 is in the collection of T. Jesson, Esq., F.G.S.

The distal articular end of the right tibia of *Enaliornis Barretti* in the Woodwardian Museum (Pl. XXVI. figs. 24, 25) has the shaft much compressed from back to front, and sharp along the fibular margin. The articulation is \(\frac{5}{8}\) inch broad. The (?) tarsal element is as completely ankylosed to the tibia as in most Ornithosaurs and existing birds. The condyles are broad and rounded, the internal one being the larger of the two. The depression between the condyles appears to be less deep than usual. There is a deep channel in front on the fibular side; but it does not appear to have been arched over by a bridge, but was defended by a strong process directed outward from above the inner condyle. This is one of the most distinctive parts of the skeleton of *Enaliornis*.

The tibia of *Enaliornis Sedgwicki*, like all the other bones, is smaller than the tibia of the species just described. The Woodwardian fragment of a right proximal end (figs. 13, 14, 15) is about 1\(\frac{1}{2}\) inch long. The shaft, where fractured at the commencement of the fibular ridge, is triangular in section, less than \(\frac{3}{8}\) inch wide, and more than \(\frac{3}{8}\) inch deep on the slightly convex internal aspect. The other surfaces of the shaft appear to be more flattened than in *E. Barretti*, the vertical channel on the anterior surface being conspicuously shallower. The proximal articulation for the femur is subquadrate, more than \(\frac{3}{8}\) inch wide, and not quite so deep. The articular surface consists of a flattened internal surface for the condyle, and a mamillate process rising above that level, which extends to the outer margin of the bone, showing that the external condyle of the femur was supported entirely on the fibula. The patelloid process is shaped much as in the other
species, and is \(\frac{1}{2}\) inch wide. It is ovately rounded proximally, strong, compressed from front to back, and extends a little outward and forward beyond the shaft, where it terminates in a sharp ridge, which is directed forward and continued a short distance distally down the shaft. On the inner side there is no ridge on the patella; but a sharp angle extends from its base down the shaft.

The distal end of a right tibia of this species in the Woodwardian Museum is well preserved (figs. 16, 17, 18). The shaft is much compressed from front to back, and set on to the small distal articulation so as to be flush with it behind. The shaft measures \(\frac{3}{16}\) inch from side to side at about \(\frac{5}{8}\) inch from the distal end, and is nearly \(\frac{3}{16}\) thick. The distal articulation widens to \(\frac{7}{8}\) inch; posteriorly it extends up the shaft for \(\frac{3}{8}\) inch, forming a broad shallow channel margined laterally by two strong ridges which are continued round into the condyles (fig. 18), forming their external margins, and defining the lateral regions of the lower part of the shaft. The convex base of the inner side of the shaft is more than \(\frac{1}{4}\) inch wide, while the base of the inner side, which is rounded superiorly, is \(\frac{3}{16}\) inch wide. The anterior surface (fig. 16) of the shaft consists of an external half, which is deeply excavated, and an internal part which is somewhat thickened, and at its base, just above the middle of the articulation, gave off a slight process which appears to have been directed over the channel. The margins of the articulation are elevated; but the space between them is concave from side to side. The internal condyle is rather the larger of the two.

_Fibula._ (Pl. XXVI. figs. 26, 27.)

This identification is less evident than are the others. But as no bone of the fore limb, or scapular arch, or sternum, has hitherto been recognized among the bird-remains from the Cambridge Greensand, the only bone left to be identified which could unite to a slender shaft a moderately expanded proximal end, is the fibula. The bone is, relatively to the tibia, much larger than in existing birds; but since Professor Marsh finds this to be a characteristic of the fibula in fossil birds from the American Cretaceous deposits, it is probable that _Enaliornis_ had a community of structure with the transatlantic genera in this particular as well as in general affinities. Two specimens have been preserved in the Woodwardian Museum, both probably from the left side. The longest is more than an inch long, is compressed from side to side so as to be four-sided at the distal fracture, where it is \(\frac{3}{8}\) inch wide and less than \(\frac{3}{16}\) inch thick. Proximally the shaft becomes wider on one of the narrow sides, and compressed on the opposite side, so that in section it is triangular, and wider in both dimensions than lower down. On what I take to be the inner posterior margin is a slight sharp ridge, which may be an indication of the ridge by which, lower down, the fibula united with the tibia. The proximal end is expanded and articular, sub-triangular, inclined a little inward, and somewhat rounded superiorly from side to side. It measures \(\frac{7}{16}\) inch from back to front, and
3/8 inch from within outward on the posterior side, and less on the anterior side.

**Proximal end of Metatarsus.** (Pl. XXVII. figs. 22, 23.)

Although many examples of the distal end of this bone have been found, I have seen but one specimen of the proximal end. It has been for many years in the Museum of Practical Geology; and I would express my thanks to Professor Huxley for permission to study its characters.

The bone is trifid, having lost the proximal ossifications which are at present usually reckoned as the distal tarsal row. The fragment is 3/4 inch long, and measures 1/2 inch in width over the articulation, but is only two thirds as deep. At the fracture distally the diameter of the almond-shaped section is 3/8 inch.

The middle bone is entirely ankylosed with the other two. All are of equal length. In front the grooves between the bones are not very deep, and seem at the fracture to be disappearing. The bone which is probably external has the outer side flattened and the proximal end twice as long as wide. The middle bone is flattened in front; its proximal end is rather shorter. The third is half a cylinder, compressed a little behind. Its proximal end is put a little behind the other bones; and it extends a little above them.

**Distal end of Metatarsus.** (Pl. XXVII. figs. 24, 25.)

The distal ends are usually much broken, and rarely show the articulations perfect. Occasionally the want of definition on their articular surfaces may be the result of imperfect ossification. The specimens show some variation in size, probably a specific character; the large one figured is from the collection of T. Jesson, Esq., F.G.S., and may be referred to *Enaliornis Barretti*; while the smaller and less perfect examples at Cambridge seem to have belonged chiefly to *Enaliornis Sedgwicki*. The bone presents a very close resemblance to the metatarsus of the Red-throated Diver, but is larger. The several metatarsal elements in both types occupy the same positions and terminate in similarly grooved pulley-like ends, rounded from front to back.

The fragment is 1 3/8 inch long, and is deeply channelled in front between the middle and outer metacarpal elements, as in *Columbus*; but I have not been able to determine whether the groove in *Enaliornis* is similarly prolonged so as to perforate the metatarsus, or whether a deep cleft renders the perforation unnecessary. The external lateral surface is rather more inflated than in *Columbus*, rather more enlarged at the distal articular end, and is thrown a little further backward. The two outer bones measure from side to side 3/8 inch; they are nearly of the same length; but the outer one is slightly the longer: at the fracture proximally the diameter of these elements is less than 1/4 inch. The middle articulation mea-
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sures \( \frac{3}{4} \) inch from front to back; and the outer one is nearly as long. The inner articulation is placed about this height above the middle one, and is more compressed from side to side than the others, but measures as much from front to back; it terminates posteriorly in a sharp ridge, which is prolonged up the bone. The inner element of the metatarsus is thrown behind the middle bone, so as to be very imperfectly seen from the front.

So far as I have seen, no digital bones have been collected.

These remains offer evidence of many parts of the skeleton in at least two species of birds, distinguished from each other by size and minor osteological characters: the larger, here named *Enaliornis Barretti*, is indicated by skull, vertebral column, pelvis, and all the larger bones of the hind limb; the smaller species, *Enaliornis Sedgwicki*, is at present only known by its dorsal vertebrae, femur, tibia, and metatarsus.

Although some of the bones and parts of the vertebral column in both these species sometimes show evidence of remarkable persistence of cartilaginous conditions of the articulations, especially in the region of the dorsal vertebrae, I do not find this character to suggest that the animals should not, in classification, be placed along with existing Natatorial birds, with which all their other osteological characters closely associate them. Even if these Greensand fossil birds should hereafter prove to have had teeth like *Ichthyornis* and *Hesperornis*, I should be inclined to remember the variableness of dental and other characters in the existing orders of Mammals and Reptiles as a reason for more than hesitation before contemplating the removal of these Cretaceous fossils from the Natatorial section of the class Aves. When the affinities of the fossil type to Colymbus are so persistent, both in the English and American genera, the biconcave condition of certain vertebrae seems to be of no more value than the opisthocoelous condition of dorsal vertebrae in the Penguins; and the toothed condition of jaws I should estimate in classification by our knowledge of dental variation observed in the jaws of Monotremata and Edentata, and conclude that the character is only generic.

Besides thanking the gentlemen whose assistance has been already mentioned, I would express my thanks to Professor T. M'Kenny Hughes, F.G.S., for the kindness with which he has permitted me to make use of the resources of the Woodwardian Museum, and figure the specimens referred to in this and other papers.

**EXPLANATION OF THE PLATES.**

**PLATE XXVI.**

Fig. 1. Right side of occipital and parietal regions of the cranium of *Enaliornis Barretti* in the Woodwardian Museum.

2. Anterior view of the same specimen, showing a section of the cerebral cavity.

3. Posterior view, showing the foramen magnum and occipital bones.
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Fig. 4. Inferior aspect of occipital and sphenoid bones, showing the anterior divergence of the squamosal bones: a, suture between parietal and frontal bones; b, brain-cavity; c, foramen magnum; d, area from which the basiangular bones have come away; e, articulation for the quadrate bone; f, basisphenoid.

5. Basal aspect of a cervical vertebra of *Enaliornis Barretti* in the collection of W. Reed, Esq., F.G.S.

6. Anterior aspect of the same specimen: a, anterior articulation; b, posterior articulation.

7. Left side of dorsal vertebra of *Enaliornis Barretti* in the Woodwardian Museum.

8. Neural aspect of the same specimen.


11. Anterior aspect: a, anterior articular surface; b, posterior articular surface; c, tubercle for rib; d, transverse process; e, neural spine; f, neural canal; g, anterior zygapophysis.


13. Lateral aspect of the same specimen. Lettering as in previous figure. a, the concave anterior face of the centrum.

14. Visceral aspect of anterior portion of the sacrum of *Enaliornis Barretti* in the Woodwardian Museum, showing the nearly flat anterior articulation of the first vertebra.

15. Visceral aspect of middle portion of sacrum of *Enaliornis Barretti* in the Woodwardian Museum.

16. Lateral aspect of the same specimen.

17. Anterior end of postfemoral portion of sacrum of *Enaliornis Barretti* in the Woodwardian Museum.

18. Visceral aspect of the same specimen.

19. Lateral aspect of the same specimen.


22. Anterior aspect of same specimen.

23. Portion of pelvis around the acetabulum of *Enaliornis Barretti* in the Museum of Practical Geology: a, ilium; b, pubis; c, ischium.

24. Distal end of right tibia of *Enaliornis Barretti* in the Woodwardian Museum.

25. Distal view of the articulation of the same specimen.

26. Proximal view of the articulation of a fibula of *Enaliornis Barretti* in the Woodwardian Museum.

27. Lateral view of proximal portion of another specimen of the same species in the Woodwardian Museum.

**Plate XXVII.**

Fig. 1. Anterior aspect of a left femur in the collection of T. Jesson, Esq., F.G.S.

2. Inner view of the same specimen.

3. Outer view of the same specimen.


5. Proximal articulation of the same specimen.


7. Proximal articulation of same specimen.

8. Anterior view of distal end of left femur of another species of bird in the Woodwardian Museum.


10. Anterior aspect of same specimen.

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Fig. 11. Distal articulation of same specimen.
12. Distal end of right femur of *Enaliornis Barretti* in the Woodwardian Museum.
14. Posterior aspect of same specimen.
15. Fractured distal end of same specimen.
17. Fibular aspect of same specimen.
18. Distal articulation of same specimen.
19. Internal aspect of proximal end of left tibia of *Enaliornis Barretti*.
   (Distal end, figs. 24 & 25 in previous Plate.)
20. Proximal end of right tibia of *Enaliornis Barretti*, in which the articular surface has remained cartilaginous, and has not been ankylosed to the patella.
21. Proximal cartilaginous surface of same specimen.
22. Proximal end of metatarsus of *Enaliornis Barretti*, seen from above, showing imperfect ossification. In the Museum of Practical Geology.
23. Anterior aspect of same specimen.
25. Distal articulation of same specimen, showing the backward position of the articulation for the inner digit.