the plant-beds occur appears, according to Mr. Warren's account, to be cut through by the buried channel, whereas the evidence at Barnwell is in favour of the view that the beds belong to the deposits filling a channel of that nature. Whether that be so or not, the significant feature is the similarity of the floras of the two districts. Mr. Reid permits us to state that in the case of the Barnwell beds "the assemblage is essentially that of the Lea Valley".

The occurrence of this flora in low-level gravels in the Lea and Cam Valleys encourages us to hope that it will be discovered elsewhere, and it is very desirable that the lowest Pleistocene gravels of other river-valleys should be examined for similar deposits.

III.—NEW EXTINCT BIRD FROM SOUTH CAROLINA.

By R. W. SHUFELDT.

(PLATE XV.)

EARLY in January, 1916, Dr. O. P. Hay, of Washington, D.C., referred to me for description the fossil bone of a large bird that had been discovered in the eastern part of South Carolina some time previously. This specimen I at once recognized as the lower extremity of the right femur of some bird belonging to a species much larger than any existing form in the United States. I find this specimen to be thoroughly fossilized and of a dull-black colour, the edges of both condyles being considerably chipped off. On the antero-internal aspect the shaft appears to be cut away as if by some shaving implement. This, and where the shaft is broken nearly squarely across above, exposes a filling of a dense, very hard, pale-grey matrix, with a grain as fine as clay. Judging from this there should be no doubt but that this femur was a thoroughly pneumatic one in the living bird, and that the thickness of the osseous wall of the shaft was by no means great, as may be appreciated by examining the figures on the accompanying Plate XV.

Upon measuring, I find the extreme length of this specimen to be 75 millimetres, and its greatest transverse width below (intercondylar), 40 millimetres. Antero-posteriorly, the external condyle measures 25 millimetres (the inner lip of the fibular cleft), and the corresponding diameter of the inner condyle is about the same. No especial effects of pressure or distortion from the same mark this fragment, which is, in every particular, quite typically ornithic in character. Superiorly, the shaft is nearly cylindrical; but, immediately below the point of fracture, begins to expand and to become, antero-posteriorly, flattened and much broadened, until it terminates in its condylar enlargements. In front, the intercondylar or "rotular channel" does not extend up the shaft beyond the condylar ridges, while posteriorly the popliteal area exhibits but little concavity, the whole being much in the same plane. There is, however, an independent excavation immediately above the internal condyle upon this aspect of the bone.

The external condyle is subcircular in outline upon its outer aspect, while the usual fibular cleft or notch is deeply impressed upon its posterior aspect (Fig. 4).

Passing to the internal condyle, we find that it too is, upon lateral aspect, subcircular in outline, its postero-superior termination being produced upwards in a more or less prominent way, behind the above described independent excavation (Fig. 1). The intercondylar valley averages about 7.5 mm. in width, being concave from side to side, and convex in the opposite direction. This fragment weighs $2\frac{1}{2}$ oz., and has been marked with a red capital letter S on its anterior aspect immediately above the intercondylar valley. From this I am assured by Dr. Charles Schuchert, Curator of the Geological Department of the Peabody Museum of Yale University, in his letter to me of February 25, 1916, that the specimen belongs to the "Scanlon Collection, and it has been loaned to Dr. Hay".

As to the formation from which this specimen came, I would say that Dr. Hay believed it to be Miocene, and this was also the opinion of Dr. Vaughan, of the U.S. Geological Survey, who likewise kindly examined it for me in February, 1916. It presents the general appearance of fossil bones of vertebrates from that horizon, and the question seems to be definitely settled by Dr. Earle Sloan, of Charleston, South Carolina, who says in his letter to Dr. Hay of February 29, 1916, in reference to these phosphatic fossils from the Stono River, South Carolina, near its source, whence the present specimen came, that "Nearly all of the vertebrate fossils (many of the cetacea and squalidae excepted) are junior in origin to the phosphate bed, the cavernous interstices of which they entered with their associate supernatant ooze (described as Salkehatchie Ooze), which purely from stratigraphic relations I regard as of late Miocene origin.

"In this connection I beg leave to refer you to my Mineral Catalogue, pages 330 to 336. Also to page 472, which relates to the phosphatic ooze designated the Salkehatchie Ooze.

"The Scanlon fossil collection was in the main taken from the rock dredged from the bed of the Stono River near its source, or about fifteen miles from the present coast line of the Atlantic, but coincident with the old shore line of the Middle Miocene.

"The Mastodon teeth presented by me to the Museum were dredged from the bed of the Coosaw River, which represents the former wide estuarine area of several minor streams, most of which was subsequently covered by the Salkehatchie Ooze and subsequent sediments, marshes, etc.

"The Mio-Pliocene beds enclose many reworked rounded fragments of the senior phosphate bed, but have nowhere been observed underlying Salkehatchie Ooze; therefore it is my opinion that the greater portion of the vertebrate remains in contact with the Old Miocene phosphate beds are late Miocene."

On February 6, 1916, at the U.S. National Museum, I compared this fragment of the lower end of the right femur with the corresponding part of that bone belonging to birds of many groups existing in North America, and also with a number in my own collection of avian skeletons, as well as with certain fossil femora figured by me in my "Review of the Fossil Fauna of the Desert Region of Oregon.

with a description of additional material collected there".¹ In that work I figure, on pl. xxxvi, fig. 431, the left femur of *Olor palaregonus*, Cope, natural size, anterior aspect, which is as big as an anserine fowl when it existed, but was very little more than half the size of the bird the femur of which I am now describing.² For example, I compared this fossil with the right femur of the Secretary Bird of Africa, with *Pandion*, with several eagles, with *Vultur monarchus*, and with various owls of large size, but very marked characters distinguished it from the lower end of the femora of any of these birds. In other words, this fossil femur did not belong to any genus, near or remote, of the *Striges*, nor to a diurnal representative of the Raptore. For similar reasons it could not be classed among the Cathartidæ, as a careful comparison with the femur of the Condor of South America and with the corresponding bone of the California Vulture (*Gymnogyps californianus*) showed very distinctive differences. Both the Condors and the Secretary Bird possess a marked excavation in the popliteal space above the condyles; while in *Vultur* the external lip of the fibular notch is, superiorly, drawn out into a somewhat conspicuous little process. This process is very well developed in several, if not in all, of the North American eagles.

Somewhat similar differential characters demonstrated the fact that this fossil femur never belonged to any bird at all related to *Sula*, or to any of the herons, or to *Pelecanus*, all of which have femora possessed of some characters, which, though not of wide difference, are quite sufficient to constitute discriminating ones, and to point to the fact that this great extinct fowl did not belong in any of those groups, as we now know them, osteologically.

This fossil end of a femur possesses no marked characters that point to any relationship with any large gallinaceous bird—still less to any struthious form, as an ostrich or the like. With negative results, I also compared it with the femur of various species of the Phalacrocoracidæ, the Phœnicopteridæ, and the Colymbidæ and their congeners. It belonged to a big bird, having no especial affinities with any of these, certainly not with any of the great toothed loons of the Cretaceous.³

Passing to the *Anseres* and to certain of their allies, near and remote, it at once appeared that certain characters in the specimen under consideration presented very evident points of agreement. In a specimen of *Olor buccinator* (No. 18509) at the National Museum, the femur appears to be non-pneumatic. This is a skeleton I prepared myself many years ago in New Mexico, where I had no facilities for thorough cleaning, and it is just possible that the femur may be, to some extent, pneumatic. There is a skeleton of *Branta canadensis* in the same collection that appears to be to a degree pneumatic. This would, apparently, be contrary to certain previous statements

¹ American Museum of Natural History Bulletin, vol. xxxii, art. vi, pp. 123-78, New York, July 9, 1913; see pl. xxxvi, fig. 431.

² E. D. Cope, Bull. U.S. Geol. and Geogr. Surv. Terr., iv, pp. 387-9, 1878.

³ O. C. Marsh, *Odontornithes*, pl. xiii, figs. 1-4.

of mine in some particulars, but not in all; in any event it would not invalidate the evident resemblance and certain actual agreements of this fossil specimen with the thigh-bone of several anserine genera and others remotely related to them.¹

In *Chauna torquata* the femur is very pneumatic, and this bird has long been suspected of having certain relationships with the *Anseres*, as have the Palamedeiformes generally.² The general facies of the femur of *Chauna* bear not a little resemblance to the specimen in hand, though in the first-named bird the rotular channel is relatively deeper. The external condyles in the two are very similar. This likewise applies to *Olor* and to other swans, but to *Branta* and other genera of geese to a somewhat lesser degree.

In other words, as far as this fossil fragment of a femur will carry us, I am of the opinion that it belonged to the skeleton of some very large, generalized, anserine bird, which existed, during late Miocene times, in the eastern section of this country and probably elsewhere. As far as the fragment carries, it confirms the affinity of the Screamers (Palamedeiformes) with the *Anseres*, but it throws no light upon the anserine affinities of the Flamingoes.

Inasmuch as we have already discovered the fossil remains in this country of such ponderous swan and goose species as *Anser condoni*, Shuf., and *Olor paloregonus* (Cope), it should not surprise us to find even bigger ones than these; in my opinion we have one here. Others of large size represent the extinct Gastornithiformes in other parts of the world.³

Confining ourselves to America—although it is doubtless also true of the extinct avifaunæ of all countries—I may say here that when we find fossil birds in a formation as early as late Miocene, and they are of comparatively large size, it is just possible—indeed, quite probable—that, in the case of some of them, they may represent an ancestral type, from which has descended several branches to be represented in the existing avifauna. Upon the extinction of the early ancestral stock, it is often very puzzling to conjecture what the true relations of the forms, genera, and families in existence may be that were derived from the aforesaid ancestor or ancestors. It is not at all unlikely that the fossil here described may be the ancestral type of several groups still in existence in this country or in the Americas. In this connexion it would be well to bear in mind the possible relationships of the *Anseres*, the Palamedeiformes, the Phœnicopteridæ, and others.

Finally, the fossil I have here described appears to be not unlike

¹ R. W. Shufeldt, "Osteology of Birds": New York State Education Department, State Museum Bull. 130, 1909, pp. 330-40. Attention is especially invited to what I say on p. 335 as to the femur in *Branta* agreeing with that bone in *Olor*. There are, of course, certain minor swan and goose characters of this bone, which can be both recognized and appreciated, and which would properly fall in the category of "general and special characters"; otherwise, the statement there made will hold good.

² R. W. Shufeldt, "An Arrangement of the Families and Higher Groups of Birds": *Amer. Nat.*, vol. xxxviii, Nos. 455-6, pp. 833-57, Nov.-Dec., 1904.

³ R. W. Shufeldt, *ibid.*, p. 337.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

DISTAL PART OF RIGHT FEMUR OF EXTINCT BIRD FROM
SOUTH CAROLINA.

the one I figure in another connexion, that is, fig. 74 of pl. lvii of my paper, "Further Studies of Fossil Birds, with Descriptions of New and Extinct Species": Amer. Mus. Nat. Hist. Bull., N.Y., vol. xxxii, art. xvi, p. 290, August 4, 1913.¹ The bone there figured is of a *left* femur, while the one described in the present article is from the *right* pelvic limb; and in so far as I am able to judge from the cited fig. 74 the two bones are wonderfully alike, both in the matter of form and proportions. Unfortunately, the femur shown in fig. 74 is so firmly fixed in its flinty matrix that the popliteal area cannot be examined properly. To all appearances, however, the femoral condyles were of the same size and form; and had I had these two specimens together at the time the bone in fig. 74 was described, it is quite possible that, by the aid of the greater number of exposed characters in the specimen described in the present article, I would have referred them both to the same species, or at least to the same genus. In fact, the Miocene types of both the gallinaceous birds and the anserine ones may have had not a few osteological characters in common.

For this extinct and probably largest anserine bird discovered in America up to the present time, I here propose the name of *Palæochenoides mioceanus*,² gen. et sp. nov.

In preparing this account I am indebted to Dr. O. P. Hay for various courtesies extended to me during the time the material was in my possession; to Dr. Earle Sloan, of Charleston, S.C., for information with respect to the discovery of the specimen and the formation to which it belongs; and to Mr. J. H. Riley, of the Division of Birds of the U.S. National Museum, for assistance in selecting bird skeletons in the collection of that institution for comparison with the material in hand.

EXPLANATION OF PLATE XV.

FIG. 1.—Direct outer aspect of the distal part of the right femur of *Palæochenoides mioceanus* (extinct). All the figures are natural size, and are reproductions of photographs of the specimen made by the author.

„ 2.—The same bone on direct inner side view. Here the specimen is slightly tipped toward the observer in order to show the matrix filling the thin, hollow shaft. This tipping causes Fig. 2 to be somewhat shorter than the other figures.

„ 3.—The same specimen viewed directly from in front.

„ 4. „ „ „ behind.

¹ I am not responsible for the title given pl. lvii of that paper; and on the page cited I say that it appears to have been a gallinaceous fowl, but that the material does not admit of a scientific reference.

² Generic name = Gr. παλαιός = ancient, + χήν, a goose, + οειδής, having a resemblance to, or, in other words, having the general characters of, some of the very early ancestors of the anserine birds. Sp. = Gr. μέλιον = less, + καινός, recent: a subdivision of the Tertiary named by Lyell.