

only complaint is that he cannot get enough of it. What he most of all desires, and what his patient labour deserves, is that his work should be subjected to a searching examination. But until his conclusions are proved to be wrong, we may fairly claim a wide toleration for whatever views on the physics of the earth's crust seem to us most nearly in accordance with the nature of geological phenomena.

Some time or other, no doubt, Mr. Fisher's chief life-work will be weighed in the balance. Whether it be found wanting or not, no one will dispute that he has solved one problem with complete success. However bitterly he may have been attacked, his courtesy has never failed. He is one of the few men whose part in controversy has enriched, and never degraded, science. He can look back upon a long life of fruitful labour and of kindly service to his fellow-men. At the same time he can reflect that he has never written a harsh word that he could now wish to be withdrawn.

C. DAVISON.

II.—NEW FOSSIL BIRD AND FISH REMAINS FROM THE MIDDLE EOCENE OF WYOMING.

By CHARLES R. EASTMAN, Cambridge, Mass.

(PLATE IV.)

THE Green River Shales of Wyoming have long been noted for their numerous and beautifully preserved fossil fishes. Fragmentary traces of bird-remains have been met with in the same horizon from time to time since the year 1869, when the first fossil feather reported from North America was obtained by Dr. F. V. Hayden.¹

During the past summer the Museum of Comparative Zoology at Cambridge, Massachusetts, has come into possession of two remarkable specimens from the fish-bearing shales near Fossil, Wyoming. One of these is a gigantic Lepidosteid, of which only detached scales and vertebræ have hitherto been known; the other is a nearly perfect skeleton of a gallinaceous bird. It is the writer's intention to present a detailed description of both fossils at some future time, but meanwhile it is possible the following notes may be of interest.

Gallinuloides Wyomingensis, gen. et sp. nov. (Plate IV.)

Short-billed, stout-legged birds attaining the size of a gallinule, rail, or small coot; and resembling these forms in general characters. Coracoid straight and stout, without subclavicular process; furculum *V-shaped*, with well-developed hypocleidium. Wings short, bones of hind-limb of medium length. Femur one-fifth and tibia rather more than two-thirds longer than the tarso-metatarsus. The latter is flattened from back to front, has moderately expanded extremities, and a deep anterior channel occupying nearly the total length, which in the type measures 34 mm.; second trochlea slightly shorter than the fourth, and not produced towards the inner side. Lateral toes

¹ Amer. Journ. Sci. [3], vol. xi (1870), p. 272.



Gallinuloides Wyomingensis, gen. et sp. nov.

Middle Eocene : near Fossil, Wyoming.

subequal, about two-thirds as long as the middle one, and hallux one-third as long; middle digit and tarso-metatarsus of equal length. Plumage unknown.

The general appearance of this specimen is shown in the accompanying Plate, which is reproduced from a photograph without retouching. It will be seen that the body lies with its right side embedded in the matrix, the right hind-limb in advance of the left, the humeri elevated and overlying a bend in the neck. The right fore-wing is wanting, and the left is doubled over so as to expose the humerus from the palmar and the remaining wing-bones from the opposite or ventral aspect. The pelvis also is seen from the ventral side, the right hind-limb from in front, and the left partly from in front, partly from one side. Thus, one of the femora presents a lateral and the other an anterior view, but the coracoids and scapulæ are so turned as to exhibit mutually corresponding sides.

To speak of the imperfections first, the ribs are broken and confused, the caudal vertebræ are wanting, the dorsal displaced and in part scraped away by careless use of tools in the hands of a collector, and the cervicals in part concealed by the humeri. Between the scapulæ, and between the humeri and occiput, the vertebral column appears largely in section, owing to unfortunate mutilation. Most serious of all, however, is the damage done to the head, the bone-substance being so cut into or scraped away as to make it impossible to distinguish the separate elements. Depredations of this nature are wholly inexcusable, and cannot be too severely censured.

The *sternum* is well shown in lateral aspect, its body, however, being much compressed. The latter gives off a very long and slender intermediate xiphoid process, and a stouter and shorter external xiphoid, the distal extremities of both being expanded. The costal condyles for articulation with the sternal ribs are very small, and the costal process of only moderate proportions. There is a well-developed rostrum or manubrium, and the coracoid grooves are broad and deep. The coracoids themselves are relatively short and stout, without subclavicular processes and foramina; their sternal facets are considerably arched, and there is a faint hyosternal process. The clavicles form a narrow V-shaped arch, implying reduced powers of flight. The scapulæ are long and slender, with well-developed glenoidal and acromial processes, and are not distally expanded.

The bones of the *fore-limb* do not require special comment. The right humerus is seen in radial aspect, and shows a broad deltopectoral crest and prominent distal condyles. The latter are especially well displayed in the palmar view presented by the left humerus. Effects of pressure are apparent in the extreme width of the remaining wing-bones. It is possible, in addition, that the ulnæ of both wings are superimposed or are crushed contiguous to one another. Since the photograph was taken, all the limb-joints have been more fully exposed with the point of a needle.

The *pelvis* leaves much to be desired in the way of preservation. It presents the visceral aspect to view, the sacro-iliac roof being embedded in the rock; part of the sacrum is concealed by the overlying left femur. The anterior border of the ilium is convex; the post-acetabular portion is broader than the fore part, but of about equal length. The right acetabulum is distinctly shown, and measures 3·5 mm. in diameter. Just behind it lies the elongate-elliptical ischiadic foramen, and at the junction with the pubis is seen a very small obturator foramen. The pubes are long and delicate, slightly convex outward, and do not appear to have been attached to the ischia posteriorly. Only the first two caudal vertebræ are preserved. Concretionary structures are the cause of the discolorations in line with the distal extremities of the pubes, and adjacent to the left scapula.

The bones of the *hind-limb* are all more or less flattened by pressure. The femora are stout, nearly straight, and exhibit moderate-sized rotular channels and distal condyles. The left tibia is seen from the fibular side, with the fibula itself—together with the procnemial and ectocnemial processes—very much flattened. Of the distal condyles the inner is slightly the larger in fore-and-aft extent, the outer in transverse. An oblique bridge over the groove for the extensor tendons is faintly indicated close to the condyles. The tarso-metatarsus is flattened from front to back, traversed by a deep longitudinal groove along nearly the entire anterior face, has the external tibial facet on a lower level than the internal, and the second and fourth trochleæ of about equal size. The phalangeals of the first three toes are of about the same proportions as in the common pigeon, those of the fourth toe are longer. The proportions of principal parts are given in the subjoined table:—

TABLE OF MEASUREMENTS.

Length in mm.			Length in mm.		
Head	...	48	Manus	...	46
Scapula	...	48	Femur	...	42
Coracoid	...	27	Tibia	...	68
Furculum	...	33	Tarso-metatarsus	...	34
Crista sterni	...	68	I. Digit (7+4)	...	11
Humerus	...	47	II. " (11+8+6)	...	25
Ulna	...	49	III. " (12+10+8+6)	...	36
Radius	...	45	IV. " (7·5+5·5+4+4+2·4)	...	25
Height of knee-joint (estimated)			90 mm.		
Total height (estimated)			220 mm.		

Six cervical vertebræ are discernible in section between the occiput and distal portion of the left humerus, the length of the series being 4·5 mm. Possibly six or seven more lie concealed beneath the humeri and glenoidal end of the right scapula. Measuring along the loop indicated by the position of the vertebral column gives a length of 85 mm. for the entire series of cervicals; the length of the dorsal series cannot be precisely estimated.

Relationships.—The characters outlined in the above cannot be brought into strict agreement with any one modern ornithic family,

but appear to be transitional between true gallinaceous birds and the group typified by coots, rails, and gallinules. With the last-named the present skeleton exhibits a number of features in common, and there is also some resemblance to curassows. An annectant type or a generalized organization is exactly what we should expect to find, considering the antiquity of the remains. For palæontological purposes, the limits of modern bird-divisions must be considerably extended, and this becomes the more imperative the further we recede in geologic history. Hence, in the present instance, we shall not be very far wrong in assigning to the new form a position intermediate between the orders Paludicolæ and Gallinæ, as these are commonly understood.

From the late Tertiary of America a number of representatives of the two last-named orders have been described by Cope,¹ Marsh,² and Shufeldt,³ but so far as the writer is aware but one genus, and that a crane (*Aletornis*, Marsh), is known from the Eocene. The fragments described by Marsh as *Telmatornis priscus* and *T. affinis* from the Cretaceous marls of New Jersey are referred by him to the Rallidæ. *Rallus* itself and typical Gallinæ are first met with in the Upper Eocene of Europe.

Lepidosteus atrox, Leidy.

Only one of the eight 'species' of Lepidosteids described by Leidy, Cope, and Marsh, from the American Tertiary, is founded upon anything like a complete fish. This is *Lepidosteus cuneatus* (Cope), a small form about 30 cm. in length, from the Miocene of Central Utah. The remainder are established upon detached scales, jaw-fragments, and vertebræ, many of them too imperfect for generic determination. Our knowledge of European Lepidosteids is likewise confined to the same class of fragments. The fact is, fossil gars are very rare, and are known only from Eocene and Lower Miocene horizons.

Cope⁴ observed that in French examples the maxillary is much less segmented than in recent gars; also that two of the American species (*L. atrox*, Leidy, and *L. glaber*, Marsh) have the "mandibular ramus without or with reduced fissure of the dental foramen, and without the groove continuous with it in *Lepidosteus*." Upon such slight differences he erected the new genus *Clastes*, to which all the American species are commonly referred. The complete specimen obtained this summer from Fossil, Wyoming, proves that a generic separation from *Lepidosteus* is impossible; the name *Clastes* therefore becomes a synonym, and it is further probable that the so-called *Clastes anax* of Cope is identical with Leidy's *L. atrox*.

The new specimen is beautifully preserved as a whole, the only serious defect being that the cranial bones are more or less crushed.

¹ Bull. U.S. Geol. Surv. Terr., vol. iv (1878), No. 2.

² Amer. Journ. Sci. [3], vol. ii (1871), p. 126; *ibid.*, vol. iv (1872), pp. 256-8; Proc. Acad. Nat. Sci. Philad., 1870, p. 11.

³ Journ. Acad. Nat. Sci. Philad., vol. ix (1892), pp. 411-416.

⁴ "Tertiary Vertebrata," bk. i, p. 53 (Rept. U.S. Geol. Surv. Terr., vol. iii, 1884).

The tail and hinder part of the trunk present the right lateral aspect to view, but the remainder of the body lies squarely on the ventral surface and is flattened out symmetrically on both sides by pressure. The fins are superbly preserved, and with their bundles of finely articulated rays and fringe of biserial fulcra make a striking appearance. The total length of the fish is 1·7 m., of which the head forms about 0·5 m. In point of size, relative length of head, fin-structure, and squamation, there is a very close resemblance to the recent Alligator gar, or *L. viridis*, Günther; the dentition is much the same, and the number of longitudinal and transverse scale-series is the same in both. A detailed description of the new specimen will form the subject of a separate paper; it will be sufficient for the present to point out that the modern gar, and more particularly the Alligator gar, has existed from at least Eocene times essentially unchanged.

EXPLANATION OF PLATE IV.

Gallinuloides Wyomingensis, gen. et sp. nov. Middle Eocene: Fossil, Wyoming. *c*, coracoid; *cl*, furculum; *f*, right femur; *h*, *h'*, humeri of left and right wings respectively; *i*, ilium; *m*, manus; *p*, pubis; *r*, radius; *rb*, detached rib; *s*, scapula; *st*, sternum; *t*, tibia; *tm*, tarso-metatarsus; *u*, ulna; I-IV, toes.

III.—SOME SNOWDON TARNs.

By J. R. DAKYNS, Esq.

I HAVE from my boyhood been intimately acquainted with Snowdon and its neighbourhood, and for some years past I have been investigating the geology of the district in a systematic manner. In doing this I have paid particular attention to the lake basins, and shall in the following pages give an account of some of my investigations as far as they have gone. I say as far as they have gone, because I hope in the future to make by means of a level more accurate measurements than can be made with a pocket aneroid; and I also hope that next Summer the lakes and tarns will be sounded either by myself or by someone else; for at present we know nothing about the depth of Llyn dur Arddu, next to nothing above that of Glaslyn, and very little about Llydaw, though that little is of great importance.

I will now proceed with my account. Glaslyn at its outlet is bounded by rock on the north side and by drift on the south, but the shape of the ground shows that the drift is merely a mound of no great thickness, banked against the Gribbin, as the rocky spur is called which separates Glaslyn from Llydaw. At a distance of about twenty yards from the lake solid rock is seen in the bed of the outflowing stream at less than six feet below the level of the lake. This to my mind proves without any reasonable doubt that the lake lies in a rock basin; for, as I said above, the drift is apparently of but little thickness, and the lake is certainly more than six feet deep: I have myself dived into it to a greater depth than that. I will not, however, insist upon this; for at the old mill, seventy yards from the lake, solid rock extends right across the