FOSSIL FEATHERS AND SOME HERETOFORE UNDESCRIBED FOSSIL BIRDS

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In addition to the photographs of the slabs of *Archaeopteryx* from the British Museum (*A. lithographica*) and from the Berlin Museum (*A. siemensii*), the material described in the present paper is based upon specimens sent me for the purpose by Mr. Theo. D. A. Cockerell, of the University of Colorado, Boulder, Colo.; by Professor Charles Schuchert, and Mr. C. W. Gilmore. The valuable lot from Professor Schuchert belongs to the Geological Collections of the Peabody Museum of Natural History of Yale University, and those loaned me by Mr. Gilmore belong to the Division of Paleontology of the United States National Museum, in which institution he has charge of the fossil birds and reptiles.

The most important part of this material was photographed by me, and the reproductions of those photographs appear throughout this article. All the figures in the illustrations are reproduced from photographs made by the author direct from the specimens figured.

With respect to the photographs of the two species of *Archaeopteryx*, the one of the British Museum slab was made for me, many years ago, for an illustration to a magazine article I was preparing at the time, and which has long since been published;[1] the other I obtained by copying it from the plate in Vogt's article by means of the camera, it being here reproduced as Fig. 2.[2]

[1] R. W. Shufeldt, "Feathered Forms of Other Days," *Century Magazine* (New York and London, January, 1886), XXXI, No. 3, pp. 352–65. It is Fig. 1 of this article on p. 353 (Fig. 1, below).

[2] Carl Vogt (professor in the University of Geneva), "*Archaeopteryx macrura*, an Intermediate Form between Birds and Reptiles," *The Ibis* (a quarterly journal of ornithology) (London, 1880), IV, 434–56. This is Plate XIII of the article, and is a reproduction of the photograph made direct from the original slab. Professor Vogt's article contains a great mass of valuable information in regard to *Archaeopteryx*, and is, indeed, a veritable classic on the subject, although his views are disputed by some paleontologists, the writer among the number.

FIG. 1.—*Archaeopteryx lithographica*. Considerably reduced. Reproduction of a photograph made for the author from the original slab in the British Museum.

In this article, and referring to the slab of *Archaeopteryx siemensii* (Berlin slab), Professor Vogt says:

There remain the feathers. Here, no doubt, these are birds' feathers, with a median shaft having barbs perfectly formed. The horny substance of

FIG. 2.—*Archaeopteryx siemensii*. By the author after Carl Vogt. Known as the "Berlin specimen." Considerably reduced.

the feathers has vanished, but the model in the fine paste of the lithographic stone is so perfect that the smallest details may be studied with the lens. The new slab shows all the feathers in their place.

The remiges of the wings are fixed to the ulnar edge of the arm and to the manus; they are covered for nearly half their length with a filiform down. None of them project beyond the others; the wing is rounded in its outline like that of a Fowl [p. 445].

What else Professor Vogt says in this article about the feathers of this famous fossil *bird* from the Upper Jurassic of Solenhofen, Bavaria, is not applicable here, where I desire to discuss only the character of fossil *contour* feathers, as well as "downy" ones.

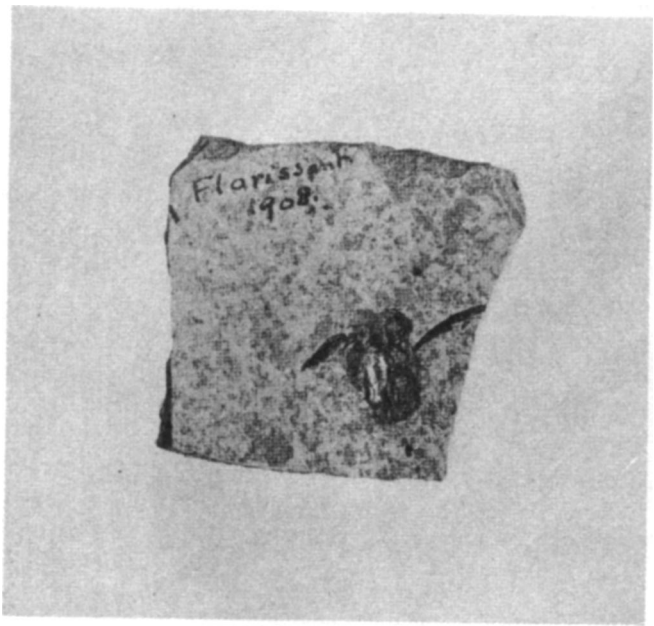

FIG. 3.—Fossil bird (?) from Florissant, Colo. (1908). Loaned by Theo. D. A. Cockerell, of the University of Colorado. Natural size. Reproduction of a photograph by the author.

Fossil feathers have puzzled paleontologists more than once; and not long ago, Dr. Knowlton, of the National Museum, showed me there, in the collections, some specimens that were originally described as "fossil feathers," but were subsequently pronounced, and proven to be, examples of fossil *ferns* of species since described.

Here in the United States nearly all the specimens we have in museums of the fossil feathers of birds—and they are, comparatively,

of great rarity—have been found in the Florissant formation at Florissant, Colo. Fossil bird feathers, however, have been found in various parts of Europe and elsewhere in the world.

After I had the conversation with Professor Frank H. Knowlton in regard to the mistaking of fossil ferns for birds' feathers, Mr.

FIG. 4.—Specimen shown in Fig. 3, enlarged three and one-half diameters (linear)

Gilmore kindly turned over to me the specimens shown in Figs. 5 and 6 of this article, they being the best of several others the National Museum had like them, and practically all they had. This is a single slab, fortunately cleft, that shows the impress (*V*) and fossil remains (*A*) of four primary feathers of a bird's

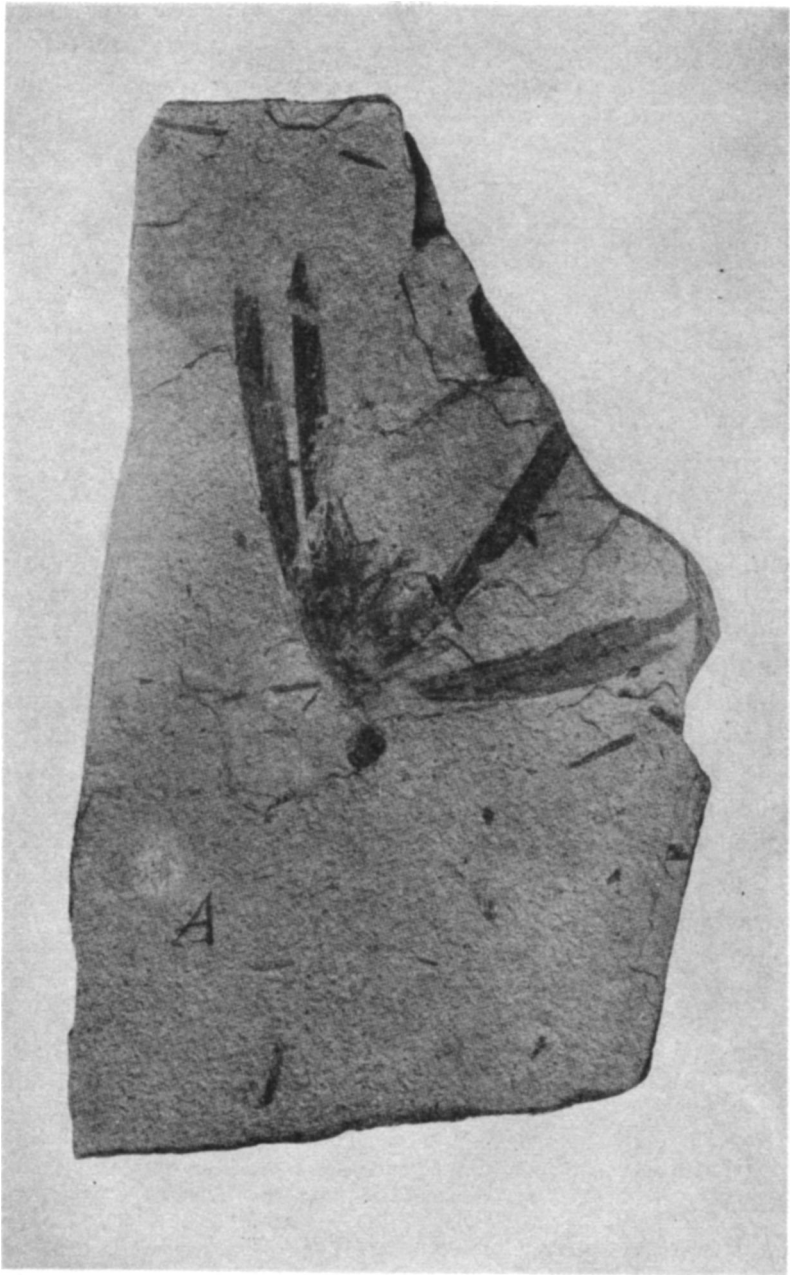

FIG. 5.—Bird feathers. Tertiary: (Oligocene), Florissant Beds, Florissant, Colo. Lacoe Coll. U.S. Nat. Mus. Reproduction of the photograph of the specimen made by the author. Natural size.

wing. They are long and rather narrow, but quite as well preserved, and in precisely the same way as those described for *Archaeopteryx* by Professor Vogt in a previous paragraph. In this specimen, too, there is evidence of some smaller feathers collected about a point from which the primaries diverge. It would appear that maceration had far progressed before these four feathers settled down at the place where they eventually fossilized, and that they had been held together by a single piece of integument at a point common to their attachment to the four apices of the calami. This might likewise have happened had some animal, in devouring this bird, torn off the four feathers, all clinging to a single piece of skin, and that have become separated from the rest of the bird. These feathers belonged to a bird about the same size as, or one perhaps somewhat smaller than, the *Palaeospiza bella* of Allen, and it is quite possible that they may have come from the wing of an individual of that species (cf. Figs. 5 and 6). Both are from the Florissant formation of Colorado.

As it appeared to be eminently desirable that I compare these feathers with those beautifully preserved ones of *Palaeospiza bella*, I made the attempt to borrow the original specimen of that bird, which I was given to understand was the property of the Boston Society of Natural History. In this I was disappointed; and it now appears that that famous slab and invaluable specimen has been *lost* for a number of years. Only recently, both Dr. J. A. Allen—its original describer—and Dr. Glover M. Allen, secretary of the aforesaid society, have written me that, after several most exhaustive searches, not a trace of the specimen can be found, and no clue has been discovered leading to its place of concealment, or in whose possession it was last.

Through the kindness of the librarian of the United States Geological Survey, I was enabled to borrow there a copy of Dr. Allen's description of his *Palaeospiza bella*, and this is now before me.[1] As but few ornithologists in this country and abroad know

[1] J. A. Allen, "Description of a Fossil Passerine Bird from the Insect-bearing Shales of Colorado," *Bull. U.S. Geol. and Geog. Surv.* (F. V. Hayden, U.S. Geol.-in-Charge), IV, No. 2, Washington, May 3, 1878, pp. 443–45; Plate I; Figs. 1 and 2. A most interesting brochure.

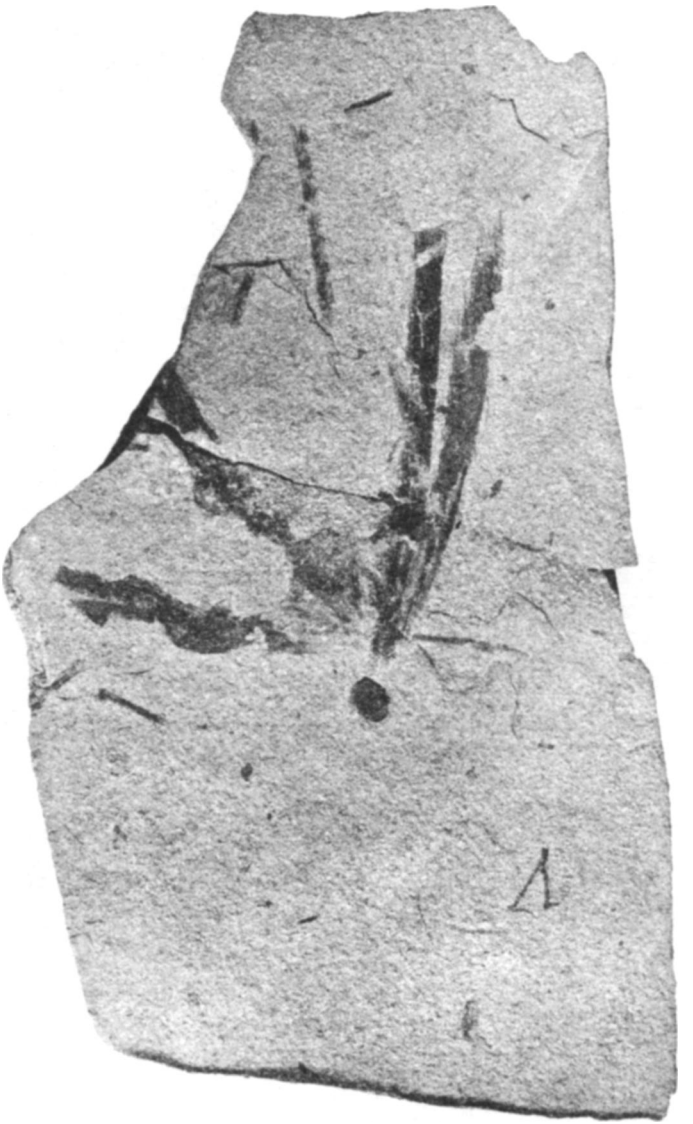

FIG. 6.—Bird feathers. Tertiary: (Oligocene), Florissant Beds, Florissant, Colo. Lacoe Coll. (V), 2 slabs. No. 4225, Coll. U.S. Nat. Mus. Reproduction of the photograph made by the author. Natural size.

of the appearance of this, "the first fossil passerine bird discovered in North America," although, as Dr. Allen remarks, "birds of this group have been known for many years from the Tertiary deposits

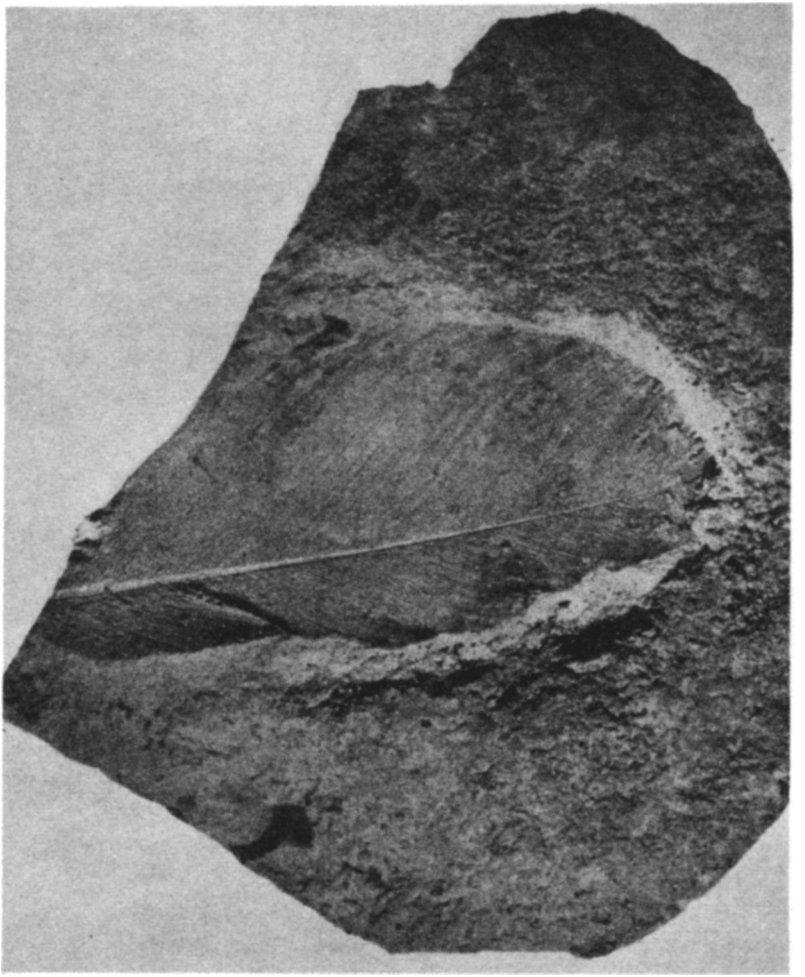

FIG. 7.—Bird's feather. Fresh-water chalk deposits. Gánócz. (Vogelfederabdruck in diluvialem Süsswasser-Kalkstein, Gánócz [Kom. Szepes].) Natural size. By the author after Koloman Lambrecht.

of Europe," I must believe that his figures of it, herewith reproduced, will be found to be useful.

Unfortunately, in this specimen everything anterior to the posterior margin of either orbit was not obtained by the collector; so it is quite impossible to state positively that this bird was a "Fringilline" bird. Indeed, Dr. Allen himself states in his paper that "the absence of the bill renders it impossible to assign the species to any particular family" (p. 443). By the aid of my camera I made a somewhat reduced copy of the plate illustrating this contribution, and it is here reproduced as Fig. 8, with the additional figure beside it as in the original.

With respect to the fossil feathers here shown, Dr. Allen further states:

> The specimen bears also remarkably distinct impressions of the wings and tail, indicating not only the general form of these parts, but even the shafts and barbs of the feathers. . . . . The most remarkable feature of the specimen is the definiteness of the feather impressions. Both the shafts and barbs are shown with great distinctness in the rectrices, and the tips of the primaries of one wing are also sharply defined, overlying the edge of the partly expanded tail. The tip of the opposite wing can also be seen beneath the tail.
>
> Another specimen from the same locality, and probably representing the same species, consists of the tip of the tail and about the apical third of a half-expanded wing [here shown in the smaller slab in Fig. 8]. In this example the tail is also pointed and graduated. About seven of the outer primaries of the wing are shown with great distinctness, and two others can be easily made out. The third primary is the longest; the second is slightly shorter; the first and fourth are about equal. There are also in the collection three detached contour feathers of small size, but whether pertaining to the same species as the other specimens cannot, of course, be determined.

From near the same locality, Dr. Allen, in 1871, obtained a few distinct impressions of feathers from the same Florissant shales; but he, in so far as I am aware, never published a specific description of them.

When visiting at my home in the spring of 1913, Mr. Cockerell informed me that it was not a rare event to meet with fossil feathers in those beds similar to the ones here shown in Figs. 5 and 6.

It was Dr. F. V. Hayden, in 1869 I believe, who discovered the first fossil feather of a bird in North America, it having been obtained in the fresh-water Tertiary deposits of Green River, Wyo.—a locality where so many fossils have been collected. Marsh described this specimen as "the distal portion of a large

FIG. 8.—*Palaeospiza bella* Allen. By the author after Dr. J. A. Allen's figure. Somewhat reduced. The additional slab to one side is of Fig. 2 from Allen's paper, which he suspected belonged to another specimen. (Fully referred to in the text of the present paper.)

feather, with the shaft and vane in excellent preservation."[1] This specimen I have never seen, and I am unable, at the present writing, to say where it is deposited.

Very fine, as well as large, fossil feathers of birds—and most perfectly preserved—are also found in various parts of Europe; one of these is here shown in Fig. 7, it having been photographically copied by me from Tab. I to a most valuable article on fossil birds, which appeared a year ago in the official publication of the Königlich Ungarische Ornith. Centrale, a copy of which was kindly sent me by its author.[2]

On the fourteenth of June, 1913, Dr. Charles Schuchert, curator of the Geological Department of the Peabody Museum of Natural History of Yale University, sent me for description a number of fossils, most of which were of birds and birds' feathers, and all of the last two are utilized in the present article.[3]

Fig. 9 shows a large fossil feather that evidently belonged to a bird of considerable size. It is one of those sent by Dr. Schuchert, and was probably found at Green River, Wyo. (Cat. No. 1227). It is the distal extremity of the feather—about 65 mm. of it—showing the shaft and the soft vanes on either side, the latter being somewhat disturbed proximally. This structure is of an extremely delicate character, and, if really a bird's feather, it was of the

[1] O. C. Marsh, *Amer. Jour. Sci. and Arts*, 2d ser., Vol. XLIV (1870), 272.

[2] Koloman Lambrecht, "Fossil Vögel des Borsoder Bükk-Gebirges und die Fossilen Vögel Ungarns," mit 4 Abbildungen und 4 Tafel-Beilagen. Separat abdruck aus dem XIX Bande der *Aquila*, 1912, pp. 270–320. This paper contains descriptions of a large number of fossil birds from the region in question, most of them, if not all, being species still to be found in the avifauna of the Continent.

[3] Dr. Schuchert remarked in his letter of transmittal:

We are sending you today by express, prepaid, a small box containing all of the fossil feathers that we have. On one of the slabs you will also notice two feet of a bird, and in another box there are quite a number of bird bones that were sent Professor Marsh many years ago by Professor Condon. You are at liberty to make use of these feathers in any way you see fit. Should you illustrate them or apply names to them, please place such information with the specimens, so that we may make the proper entries upon our records.

The two fine specimens of *Archaeopteryx* I saw some years ago in Europe, and of course these are by all means the finest cases of preservation of bird feathers. There is at least one other occurrence of a bird feather from the Solenhofen Upper Jurassic, and I rather anticipate there might be more if you would make extensive inquiries in Europe, particularly in Munich. I have looked through Professor Marsh's correspondence and find nothing there in the way of information concerning our specimens other than that given on the labels.

Hoping you are well, I am,

Yours truly,

[*Signed*] CHARLES SCHUCHERT

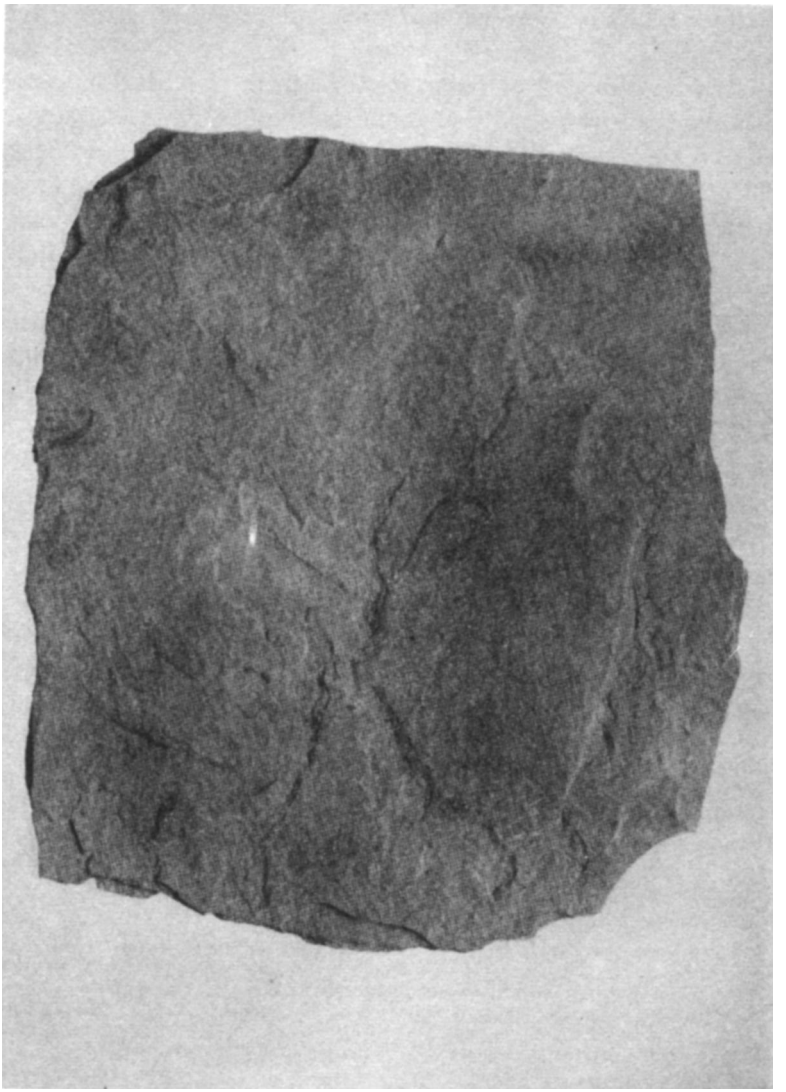

FIG. 9.—Large fossil bird feather. "Probably from Green River, Wyoming." No. 1227, Peabody Museum of Natural History, Yale University. Photograph of specimen by the author.

semi-plumulaceous kind. This specimen is upon a very thin slab, as may be observed in the figure. There is another faint indication of a small feather upon it, and a nondescript little fossil near the opposite border. It would be impossible to make a correct reference for this specimen or even to predict to what family the bird belonged that possessed it.

Many large birds, belonging to very diverse groups, probably flourished at the time, and it may have belonged to almost any one of them, as those I have in mind would all have feathers, in certain parts of their plumage, something after this order.

Among the material sent there is still another bird's feather of this character from the same locality (No. 1226, Peabody Mus. Nat. Hist.) that I have not figured in this article. No doubt can exist with respect to this being a fossil bird's feather, and one from a rather large bird of some species I am quite unable to determine—evidently one of the large wing-feathers; it shows the distal 70 mm. of it—the vane being, on an average, some 30 mm. transversely. This fossil, or perhaps its impression, is very faint and delicate, the surface of the matrix being almost smooth and flat. It will not be possible to state correctly to what kind of bird this feather belonged; but it may be said in passing that it resembles very closely the feather shown in Fig. 9.

Another slab (No. 1230) has a somewhat faint and feathery fossil upon it that may represent rather large plumulaceous feathers; but they may not be, and I would not care to undertake to decide the point. On the other side of this slab there is a partially broken-off skeleton of a medium-sized fossil fish (No. 861)—a fact mentioned merely to assist in the identification of the slab in the collection hereafter; it is from the same Green River beds of Wyoming, and the character of the thin slab is the same.

Other undeterminable feathers are shown in Figs. 11 and 12 of the present paper (*d*, *e*, and *f*, and *d'*, *e'*, and *f'*). Their museum numbers, the collectors, the beds and localities from whence they came, are, with other data, fully described in the figures throughout this article. In Fig. 12, I strengthened the fossils by pen and india-ink to give their outlines better. Nothing definite can be given about these as they are altogether too fragmentary and faint.

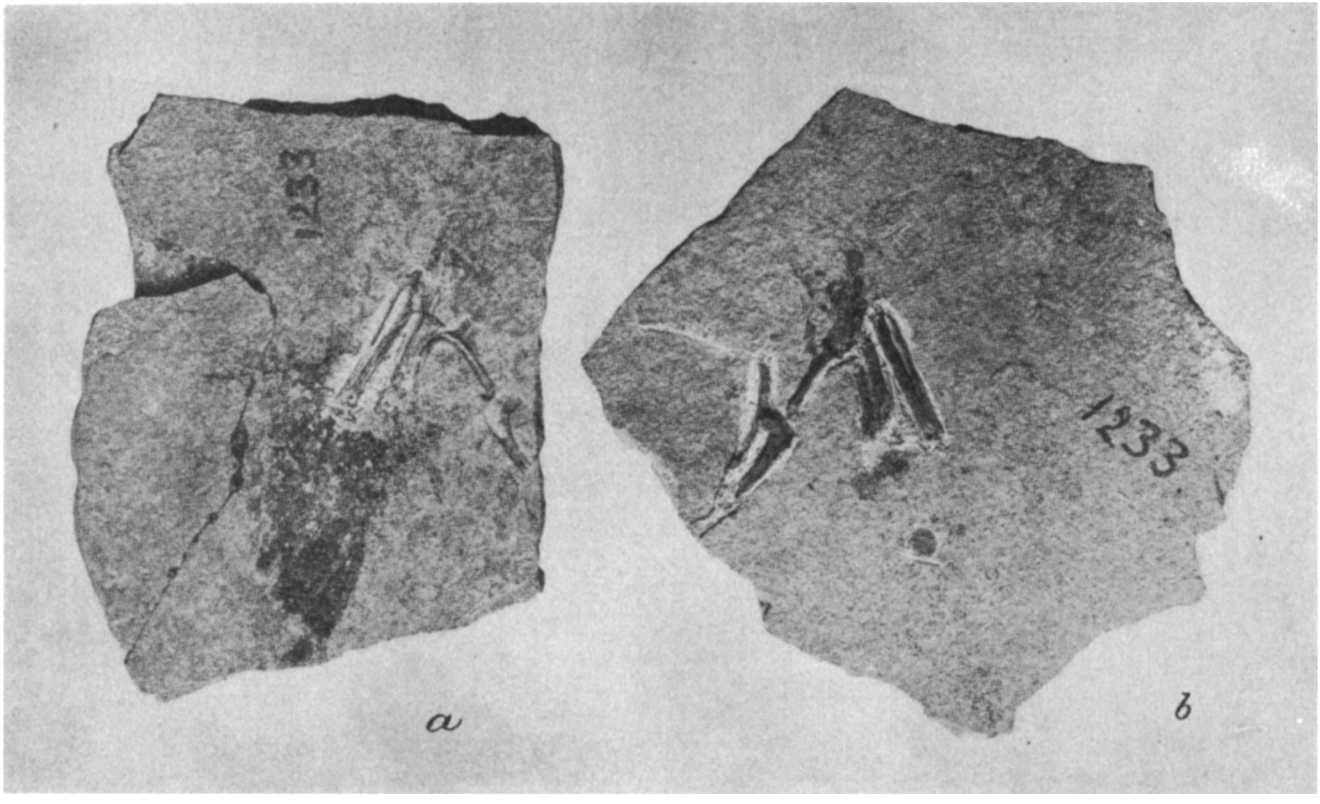

FIG. 10.—*Hebe schucherti*. Natural size. Reproductions of photographs direct from the specimens by the author. No. 1233, Peabody Museum of Natural History, Yale University. Found five miles west of Green River City, Wyo., in the fish cut of the railroad. Found by F. C. A. Richardson of Chicago (1874), with Powell Expedition. It was associated with insects described by Professor Scudder. *a*, slab showing the feathers and impressions of bones. *b*, slab containing fossil bones.

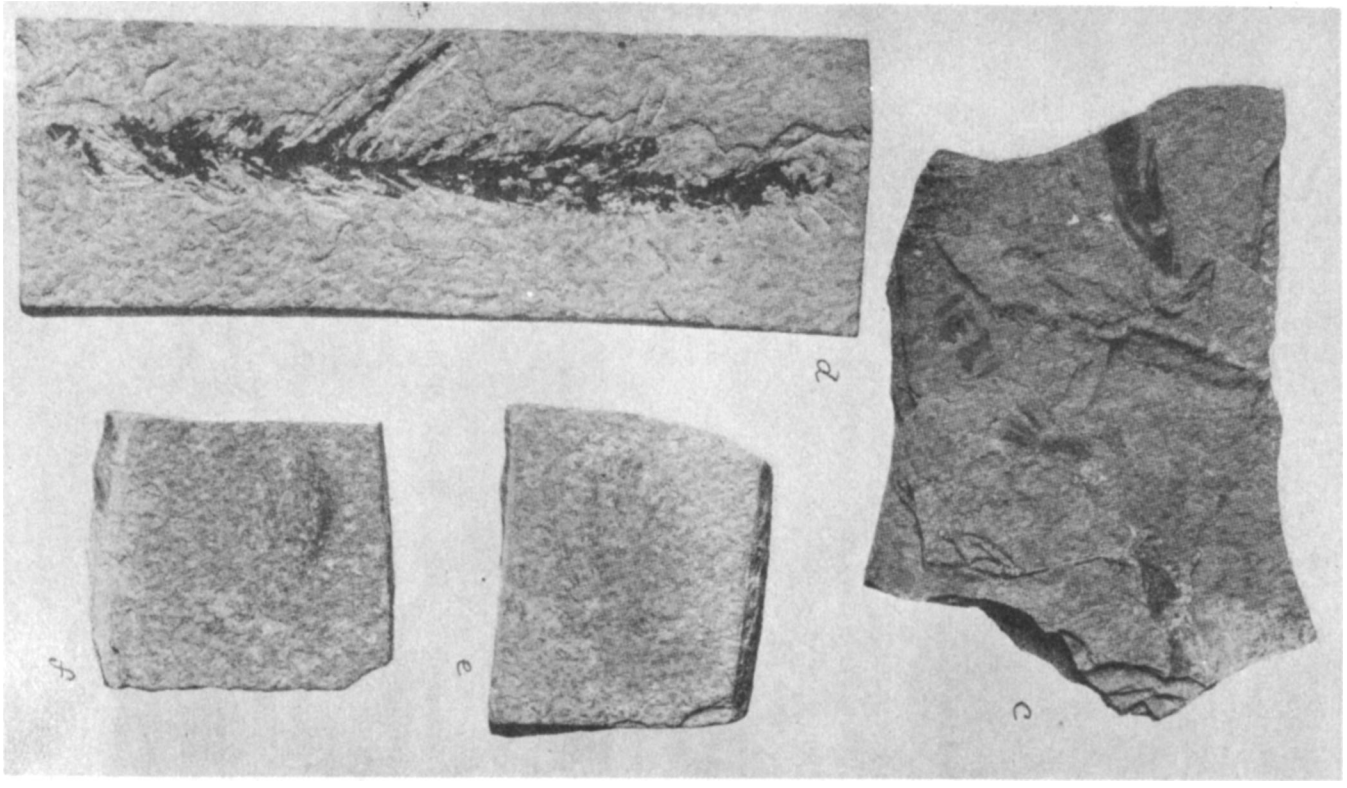

FIG. 11.—*Yalavis tenuipes*. *c*, No. 1231, Coll. Peabody Museum of Natural History, Yale University. (Marked "Bird" January, 1876, Professor O. C. Marsh.) No further history. Natural size. Photograph by the author. (See Fig. 12, *a*, *b*, *c*, and *d*.) *d*, fossil feather of . Orig. No. 988, Cat. No. 1235, Coll. Peabody Museum of Natural History, Yale University. From Green River beds (Eocene). Coll. Schoonmaker. Found near Evanston, Wyo. Received July 31, 1877 (see *d'* of Fig. 12). *e* and *f*, two slabs of same specimen. Fossil

The two feathers shown on the slab containing, at least, the pedal remains of the fossil bird described farther on in this paper in all probability belonged to the specimen. One of them is evidently a contour feather (Fig. 12, *c*), and the other from a wing (Fig. 12, *d*).

Similar feathers or feather impressions are also to be seen on other slabs at hand, such as those figured in Fig. 10 (*a*), in Figs. 3 and 4, and an unfigured one (No. 1232, Peabody Mus. Nat. Hist., Green River, Wyo. From F. V. Hayden) which I am very much in doubt about, as it so closely resembles some of the bits of fossil ferns shown me recently by Dr. Knowlton.

I now pass to the descriptions of the slabs belonging to the Peabody Museum, which contain the fossil remains of small birds heretofore undescribed. These are fully recorded in Figs. 10–12, where the required museum data are set forth. Two such birds are at hand, or rather fossil parts of them; these latter both belonged to small passerine species, and are more or less perfect, as far as they go. These parts, however, are not sufficient to admit of referring either of these birds to the genus to which it belonged. This being the case, I have thought it best simply to give them names by which they may hereafter be known, in order that avian paleontologists may be aware of their existence and of the museum to which they belong.

They may or may not have been from specimens representing genera still in existence in our avifauna; if they are, the generic names may be changed when future material is found, to which some paleontologist, in the years to come, can refer them with *absolute certainty*. As to the specific names, which I have given them below, they will stand for all time, as there is not enough of this material ever to decide upon that point with unqualified correctness. With these few words of explanation, I am sure it will be useful to future researchers in this field to have names attached to these specimens, in that they may be used and referred to in making other studies and comparisons.

HEBE SCHUCHERTI, gen. et sp. nov.

(Fig. 10, *a* and *b*)

The specimen is upon two slabs, one giving the actual bones found (*b*), and the other their impressions with some of the feathers of the wing—apparently the *right* wing.

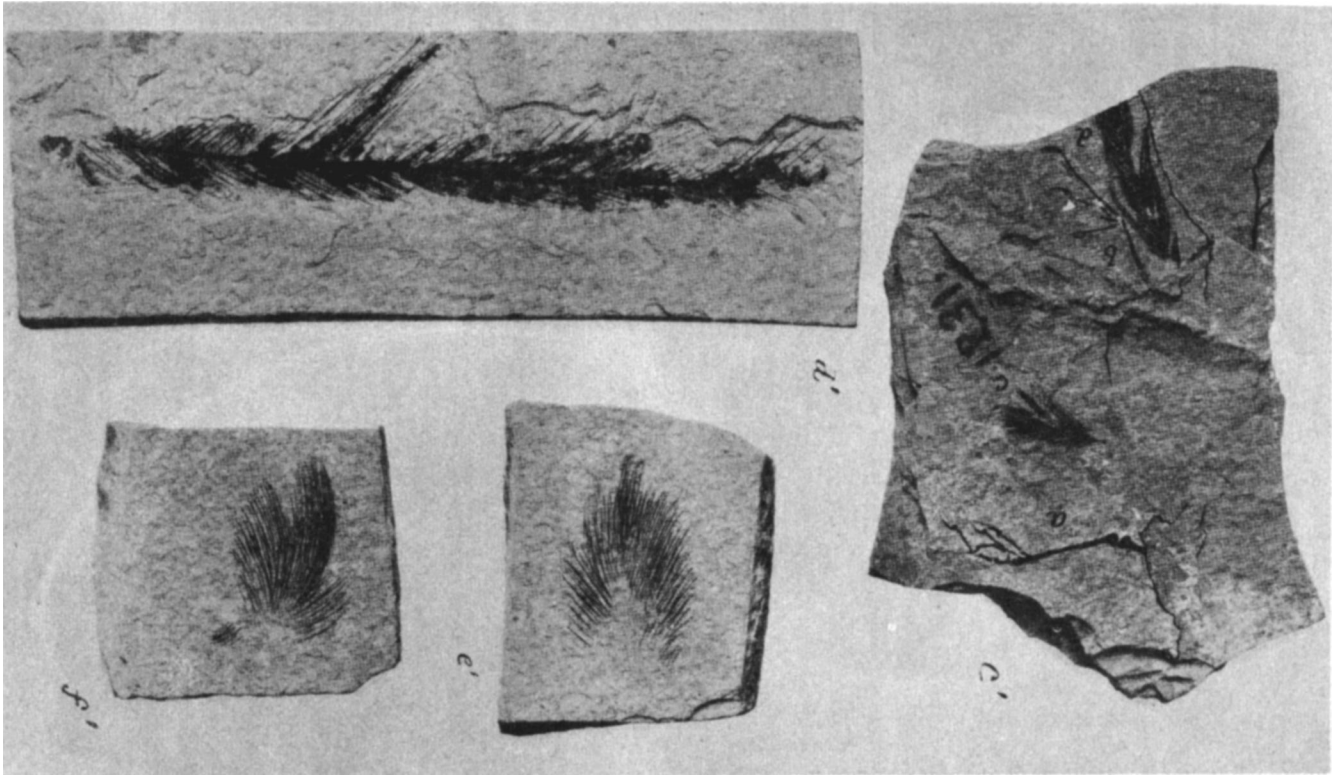

FIG. 12.—*Yalavis tenuipes*. Duplicate of Fig. 11 (see *antea*). Structures to be seen (Fossil) made black by the author, who also made the photographs direct from the specimens. $c'=c$ of Fig. 11, *a* and *b* (on the slab), fossil feet; *c* and *d* (on the slab), fossil feathers. $d'=d$ of Fig. 11; $e'=e$ and $f'=f$ of Fig. 11. Natural size. Same history as given under the previous figure (Fig. 11).

At this writing, the specimens are in the collection of the Geological Department of the Peabody Museum of Natural History, Yale University (Orig. No. 2831, Mus. No. 1233); found five miles west of Green River City, Wyo., in the fish cut of the railroad. Collector, F. A. C. Richardson (1874), Powell Exp. It was associated with insects described by Dr. Samuel H. Scudder.

On the other side of the label accompanying this material, apparently in the same handwriting, I find: "Compare *Pteroptochidae;* see *Ibis*, 1874, p. 19 (July), for sternum with 2 emarginations in *Sternum.*" This will be commented upon farther on.

The slabs are light colored and *thin*, and I have so arranged them in Fig. 10 that the fossil bones (*b*) and their impressions (*a*) bear the relation to each other that they would have had they been on the opposite pages of a book, and we had opened it to examine it.[1]

The bones on the slab *b* are as follows (and the *impressions* of all of them are seen on the slab *a*, which, with but one or two exceptions, are brought out with marked distinctness):

1. The *sternum* (in part: ventral aspect).
2. Both *coracoids*.
3. *Os furcula*.
4. A *scapula* (left).
5. *Humerus* (left: proximal moiety).
6. *Ulna* (right: nearly perfect).
7. *Radius* (right: nearly perfect).
8. Bones of *manus* (right: very faintly indicated, and some not exposed).

The feathers have already been referred to in a previous paragraph.

This skeleton belonged to an adult bird about the size of a cactus wren (*Heleodytes*).

The sternum.—Upon very close and careful examination with a high-power lens, we are enabled to observe the fact that the posterior margin of the sternum of this bird possessed two notches upon either side of the keel or carina; there is just enough of the bone

[1] On the opposite side of the slab (*b*) there is a small fossil fish, lacking three-fourths of the fore part of the skull; approximately, it had an extreme length of about 76 mm.

in sight to make certain of this.[1] It is the right side of the body of the bone that is exposed in the specimen; and, as its posterior border had *four* notches—that is, two on either side of the carina—the *sternum* of that bird differed in this particular from all *typical existing* passerines as they now occur in North America, at least north of Costa Rica.[2]

Many years ago, in speaking of the *Pteroptochidae*, Sclater pointed out that this assemblage "must remain, therefore, as an independent family of themselves, to be placed, according to my views, at the end of the Tracheophonine section of the Passeres, and at once distinguishable from all other Passeres by the posterior margin of the sternum being doubly emarginated as in the *Pici* and many *Coccyges*."[3]

That this bird was a passerine species with a four-notched sternum, and not a cuckoo or a woodpecker, is at once evident when we come to examine the remainder of that bone, and find that it possesses a large manubrium which is *bifurcated* anteriorly, thus producing two diverging apophyses, as is the case in the sternum of any true passerine form.[4] This sternum has a mesial length

[1] See note above (on original label) in regard to sternum of the *Pteroptochidae*.

[2] I have not examined the sternum in *Scytalopus argentifrons* of Costa Rica (see Ridgway, *Proc. U.S. Nat. Mus.*, XIV [1891], 475; Sharpe, *Hand-List*, III, No. 13, p. 5). Possibly it may have a four-notched sternum; but there is no material at my hand either to prove or disprove it.

[3] P. H. Sclater, "On the Neotropical Species of the Family *Pteroptochidae*," *The Ibis*, 3d Ser., No. XV, July, 1874, Art. XXIII, p. 191 (Plate VIII), of *Rhinocrypta fusca*. "The only other known Passerine form in which two emarginations are present on each side of the posterior margin of the sternum is the Australian genus *Atrichia*. Whether this form certainly belongs to the *Pteroptochidae* cannot be positively ascertained until the structure of its larynx is known; but I have little doubt that such is the case. There is a sternum of *Atrichia rufescens* in the Cambridge Museum."

To this I may add that on this date (July 1, 1913) there is not an alcoholic specimen, nor a vestige of a skeleton of any of the species of the *Pteroptochidae* in the collections of the U.S. National Museum for anatomical examination.

A. H. Garrod presented a sternum of *Hylactes megapodius* to the Museum of the Royal College of Surgeons of England; but I have never seen the specimen (S.S. 2660) (*Cat. Mus. R. Coll. of Surg. of Eng.*, 1891, p. 123).

[4] R. W. Shufeldt, Fig. 58 in *Key to North American Birds* (Vol. I, E. Coues, 5th ed., p. 151). This figure gives a ventral view of the "typical passerine sternum of the robin (*Planesticus migratorius*)," and in it the bifurcations of the manubrium of the bone are well shown.

of 15 mm., measured from the median anterior point of the posterior one on the carina.

A *coracoid* is 11 mm. long, being considerably expanded below, and developing a small process at its outer sternal angle. The bone is straight, and otherwise presents the usual passerine characters.

The *os furcula* is of uniform caliber with respect to the clavicular limbs, and not especially stout. It is of the broad U-shaped form, with the hypocleidium (if present) not exposed.

A *scapula* appears to be somewhat slender, though rather dilated and curved outward, distally. It has a length of about 11 mm.

Only a part of the left *humerus* is preserved in sight, and this exhibits some of the effects of pressure; it presents nothing worthy of especial note.

Passing to the *radius* and *ulna* of the right arm, we find them in a beautiful state of preservation, and in plain sight. They are quite straight bones, especially the *ulna*, which has a length of about 20 mm.

Bones of *manus* are not sufficiently exposed to admit of examination.

Whether the fossil bones of this bird belonged to a species of a genus in the *Pteroptochidae*, I am not at this time prepared to say; though as far as the evidence goes, there is every indication that it did—that is, barring the present range of those birds which, with one exception, is South American.[1] However, as I found a *flamingo* among Oregon fossil birds, it should not now be a source of surprise were we to meet with the fossil remains of a small South American passerine in the Green River deposits of Wyoming; the climate was entirely different at that age in North America.

It is not likely that this species belonged to any of the existing genera, and I have therefore created a new genus to contain it,

[1] "*Pteroptochidae:* A South American Family of formicarioid passerine birds, typified by the genus *Pteroptochus*, with tracheophonous mesomyodian syrinx, taxaspidean tarsi, operculate nostrils, and ten primaries; the rock wrens. They are small, wren-like birds of skulking habits, especially characteristic of Chile and Patagonia.

"There are about 24 species, leading genera of which, besides the type genus, are *Hylactes*, *Scytalopus*, and *Rhinocrypta*. Some of them are known as 'barking-birds'" (*Cent. Dict.*, p. 4826).

the same being provisional, or until such time when we have more material of both fossil and existing forms wherewith to critically compare it.

Hebe (new genus), the goddess of youth and spring of Greek mythology.

The specific name is in honor of the eminent paleontologist of Yale University, Dr. Charles Schuchert.

YALAVIS TENUIPES, gen. et sp. nov.

(Fig. 11, *c;* Fig. 12, *c'*)

From a study of the figures in the illustrations (fossil bones, etc.) it will be seen that in Fig. 12 (*a*) the specimen consisted of parts of the *left* pelvic limb, being the lower part of the tibio-tarsus; the tarso-metatarsus, and the toes complete. It is of the left limb for the reason that these are the actual bones, and the *inner toe* is to the outer side—that is, the first in order as we examine the foot.

It belonged to a small *passerine bird* of about the size of any one of the North American warblers, such, for example, as the pine warbler (*D. vigorsi*) or a somewhat larger species. The *tarso-metatarsus* has a length of 15 mm., and is, together with the toes, of notably *slender* proportions.

The toe-joints can be easily measured in the figures, as they are exactly of natural size.

The *right* foot of this specimen is doubtlessly to be seen at *b* on the same slab (Figs. 11, 12). Here the phalangeal joints occupy different positions.

These bones belonged to some small passerine bird that cannot as yet be referred to with certainty.

Birds of the same genus and species may or may not be still in existence; the probabilities are that they are not.

This specimen indicates that it belonged to a highly specialized *perching* bird, with very much *curved* claws, and the claw of hallux *not* lengthened as in the larks and their allies.

When we come to consider the vast number of small *passerine* birds that are in existence at the present time; and how many more there may have become extinct, representing such scores of

families, many species of which would possess the skeletal parts of the foot of a size and proportion quite like the one in this fossil, it will be appreciated how useless it would be to express an opinion as to the *family* this bird represented. No such attempt will be made here.

My reasons for creating a new genus for it are set forth on a foregoing page of this article.

Yalavis (Yale and *avis;* the University at New Haven, Conn., U.S.A.; and *avis*, a bird).

The specific name *tenuipes* refers to the slender bones in the foot of the specimen, as seen in its fossil remains.

Early in the summer of 1913, Mr. Theo. D. A. Cockerell, of the University of Colorado (Boulder, Colo.), when on a visit to Washington, handed me the specimen, here reproduced natural size in Fig. 3, for a description and, if possible, a diagnosis.

As the specimen is very small, I had it enlarged, and this latter is reproduced in Fig. 4.

It has no special history beyond having been collected in 1898 at Florissant, Colo.

At first glance, it has the appearance of being the fossil remains of some small bird, or even medium-sized bird, as it is associated with a few feathers. The latter consist of down (?), contour feathers, and one feather from a wing. The bones, whatever they may be, are in *pairs*, and evidently not materially disturbed.

By the aid of a two-inch objective on a powerful microscope, I brought these up to a large size for critical examination. To some extent they appear as though they might be a pair of *coracoids* and some part of the *sternum;* but as here exposed, I find that this suggestion cannot be verified.

It may be some part of a bird's skull; the smaller pair of bones, *pterygoids*, and the larger ones—partly exposed—*palatines;* but I doubt it. And were this so, the feathers would probably have belonged to the *head*—a fact militated against by the presence of what is undoubtedly a *wing-feather*.

These bones may have belonged to some other animal than a bird, or it may even have been some invertebrate form (crustacean), and the association with feathers entirely coincidental, as we would

find the fossil bones of some small mammal mixed up with, or in the same matrix associated with, those of some large raptorial species of bird that had eaten it just prior to its death. Such a case I have recently had good reason to suspect.

Pressure, fracture, and a number of other causes have caused fossil bones of animals of all sizes (vertebrates) to change their form and appearance. This must be borne in mind when making examinations of such material as we have here.

Then, when incased in a matrix and only *partially* exposed, bones have a very different *appearance* from what they have when seen in entirety. Every paleontologist of experience is aware of this fact.

Let us imagine that the fossil base of the superior mandible of a male surf scoter (*Oidemia perspicillata*) was the only part exposed in a dense matrix; would anyone suspect it of being a *duck?* When some bones are but partially exposed in the matrix, they often resemble others of the skeleton when the latter are more fully in view. For example, we may so far immerse the distal end of some avian *humeri* that the part left exposed may, in some instances, very much resemble the coracoid of some other kind of bird; and there can be no end to such instances.

This may easily be the case with the specimen here being discussed. The larger pair of bones seen in the enlargement in Fig. 4 may be the proximal extremities of a pair of humeri, palmar aspects, and only partly exposed, and the small pair (?) below them some part of a dorsal *vertebra.* It is quite possible.

In short, I am of the opinion that a reference—a correct reference—cannot be made for this specimen, beyond its being probably *bird*, and under the circumstances it would be useless to give it a name.

The fossil bird bones from Silver Lake, Ore., mentioned in Dr. Schuchert's letter on a previous page of this article, are, in all particulars, like those belonging in the Cope collection of the American Museum of Natural History of New York City. Very recently I have fully described that entire collection, and this description will appear as a bulletin of that institution with upward of 600 figures on plates.

The specimens now before me can be compared with those figures, thus rendering any description of them here superfluous.

It may be said, however, that in the lot now before me I find two *cervical vertebrae*, probably of an adult female of the western grebe (*A. occidentalis*); a portion of the right ramus of the mandible of some species of duck (?); bits of shafts of long bones (*humeri, ulnae, radii*, etc.), not determinable; a toe-joint, and the distal end of a *tibio-tarsus* (No. 1236), not determinable with certainty; a ray from the pectoral fin of a fish, proximal extremity—a bone also discussed in my forthcoming memoir.