# SOME PLIOCENE BIRDS FROM OREGON AND IDAHO

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The field activities of the California Institute of Technology in the Great Basin region of North America in the past two decades have added greatly to our knowledge of the Pliocene mammal fauna, but unfortunately the remains of birds have been but rarely encountered. A limited representation of the birds has, however, accumulated, and it has been made available for study through the kindness of Dr. Chester Stock. Comparative material has been loaned by Dr. Alden H. Miller, Dr. R. A. Stirton and Mr. A. J. van Rossem. Dr. Hildegarde Howard has been good enough to express tentative opinions on several of the specimens and to make helpful suggestions. Mr. E. L. Furlong, who has studied most of the deposits in the field, has also given much information. My indebtedness to these several parties is cheerfully acknowledged.

The collection contains some thirty bird bones or fragments which are determinable with some confidence and a number of others which are considered as better un-named at present. The specimens were taken in two areas, one in the Snake River valley of Idaho and one in Malheur County, Oregon. Practically all specimens were taken at or near the surface of the ground. Some had even accumulated bits of lichen and in no instance is there any surety of association as parts of a single individual. The bones are highly mineralized but the larger cavities in most of them are filled only with the friable silt-like matrix that has not been consolidated into hard mudstone. In some specimens a concreting of the matrix has taken place in a thin layer on the bone surface; presumably this was induced by the salts from the original bone. This layer is readily scaled off with a dental tool.

*Nature of the deposits.*—The physical nature of the matrix is suggestive of quiet waters. This impression is entirely supported by the vertebrate faunas thus far recovered. Beaver, otter, and mylogaulid rodents, terrapin and fish, swans, geese, stork, crane, pelican, and cormorant—all suggest an ancient lake or the marshy areas closely adjacent thereto. Only one bird bone has been determined as derived from a species not aquatic in its adaptations. That one bone is from a large eagle, but the avifaunas of most large bodies of water today include some species of eagle. Certainly there is no incongruity in adding this large raptorial species to the avifauna of a lacustrine deposit.

*Age of the deposits.*—For determination of the chronologic position of the several exposures, stratigraphy is of little use except for localities no. 61 and no. 62 (see beyond), where the stratum can be traced from one station to the other. Lithology and crustal movement are likewise of small value. One is thus left dependent largely upon the purely biologic criteria of correlation, and here the associated mammal faunas offer the greatest assistance. The chronology of equine evolution has become so completely known for western North America that the presence of horse remains and of slightly less diagnostic rhinoceros remains affords a fairly accurate geologic chronometer.

The stage of evolution of these mammals is definitely Pliocene. The pronghorn, *Sphenophalos*, also present, is almost strictly a Pliocene creature (Furlong, 1931). There seems therefore to be no question as to the Pliocene age of these bird remains. Wilson (1933, 1937) considers the beds to be slightly younger than the Hagerman Lake beds which are Upper Pliocene.

Mammalian species associated with the bird remains:

*Synaptomys vetus* Wilson
*Mimomys* (?) *parvus* Wilson
*Ondatra idahoensis* Wilson
*Lutravis* cf. *halli* Furlong
(?) *Ælurodon* sp.
*Mylogaulus* (?) *monodon* Cope

*Sphenophalos nevadensis* Merriam
*Pliohippus* near *spectans* (Cope)
*Teleoceras fossiger* (Cope)
*Lutra* sp.
*Plionictis* near *ogygia* (Mathew)
*Dipoides stirtoni* Wilson
*Goniodontomys disjuntus* Wilson
*Hypolagus vetus* (Kellogg)
*Castor* (?) sp.

*Relation to Pacific coast Pliocene.*—On the Pacific coast of California there are several Pliocene deposits that have produced bird remains (Miller and DeMay, 1942). The San Diego Pliocene at San Diego, the Third Street Tunnel in Los Angeles (Fernando Pliocene), Veronica Springs in Santa Barbara, and Sweetwater Canyon in eastern Monterey County are all salt water deposits. Kern River Divide and Kern County Oil Well, both in Kern County, are fresh water deposits. None of these California localities has yielded an avian species in common with the localities here discussed.

Other Pliocene deposits in the Great Basin area (Hagerman, Idaho) have yielded only *Phalacrocorax auritus* in common. So far as bird remains are concerned, the greatest coincidence is with Pleistocene deposits of coastal areas. This resemblance, however, is attributed to factors other than time, and greater weight in correlation is ascribed to the associated mammal faunas. For some reason, the Pliocene epoch has provided us with but little bird material. With such a limited fauna representing the group Aves, in which evolution during Tertiary time seems to have been slow as compared with mammals, geologic correlation by means of this group must be indulged in with much care.

*The localities.*—Bird remains in this particular collection have come from four localities. Field numbers of these quarries are as follows:

Locality 61, Owyhee Pliocene, Malheur County, Oregon. West side of Dry Creek (a tributary of Crooked Creek), and just east of the Crooked Creek Ranch. Exposures lie north of the road which crosses Dry Creek.

Locality 62, Owyhee Pliocene, Malheur County, Oregon. Along east side of Dry Creek. Same stratigraphic horizon as at locality 61.

Locality 118, Snake River, Idaho. Thirteen miles northwest of Grandview. The white beds underlie the rim rock to the north of the river where it enters a gorge.

Locality 122, on the Barbour Ranch on the south side of Snake River, Idaho, three and eight-tenths miles east of the Bruneau-Mountain Home Bridge.

All localities have the same physical character in general, the matrix is the same, the state of preservation of the specimens is likewise much the same. All are considered to represent the same stage of the Pliocene epoch.

TABULATION OF FAUNAS

| | | No. of bones |
|---|---|---|
| Locality 61 | Bird, indeterminate | 1 |
| Locality 62 | *Pelecanus erythrorhynchos* (?) | 3 |
| | *Phalacrocorax auritus* | 2 |
| | *Cygnus* sp. | 2 |
| | *Branta dickeyi* | 9 |
| | Goose, indeterminate | 6 |
| | Eagle, indeterminate | 1 |
| | Bird, indeterminate | 5 |
| Locality 118 | *Grus americana* | 1 |
| Locality 122 | *Ciconia maltha* | 5 |
| | Goose, indeterminate | 1 |
| | *Cygnus* sp. | 1 |
| | Bird, indeterminate | 2 |

SPECIES REPRESENTED

PELECANIFORMES

*Pelecanus erythrorhynchos* (?). White Pelican.—Specimen number $62^{2}/_{3238}$. The station at Dry Creek in Oregon (locality 62) yielded the poorly preserved fragments of three large femora that appear

to be of this species. The specific assignment is left with a question mark because of poor preservation of the specimens. The size and the grosser characters so far as preserved are those of the White Pelican. There seems to be no chance of confusion with *Pelecanus halieus* Wetmore (1933) from the Pliocene of Hagerman Lake since the describer of that species states that it is "slightly smaller than modern *Pelecanus occidentalis californicus*."

*Phalacrocorax auritus*. Double-crested Cormorant.—Specimens $^{62}/_{3241}$, $^{62}/_{3242}$. Two bones from Dry Creek, Oregon, are determined as of this species. They are the proximal end of a right humerus and the head of a left coracoid. Both fragments are remarkably well preserved despite the fact that they had been exposed on the surface of the ground sufficiently long for the accumulation of small bits of lichen. They are about average in size for the species as today represented on the Pacific coast by the subspecies *albociliatus*. The species has been reported previously from the Pliocene of Hagerman Lake, Idaho, and from the Pleistocene of California, Florida, and Nevada. *Phalacrocorax idahensis* (Marsh) from the Idaho Pliocene was an appreciably larger bird (Marsh, 1870; Wetmore, 1931, 1933).

CICONIIFORMES

*Ciconia maltha*. Asphalt Stork.—Specimens $^{122}/_{3239}$, $^{122}/_{3240}$. There are three fragmentary bones that were more or less associated in the formation at Barbour Ranch on the Snake River. No. $^{122}/_{3239}$ is a pair of coracoids and $^{122}/_{3240}$ is the distal end of a left tibia. A fragment of a furcula and the head of a humerus may belong to the same bird. They represent a large stork not distinguishable from *Ciconia maltha* first described from the Pleistocene asphalt of California (Miller, 1910). This individual is large, but the Pleistocene birds as recovered from several localities in California and in Florida show wide amplitude of variation (Howard, 1942). Within this variable species the Snake River form would easily be accommodated. The surfaces of critical areas have been broken away in such fashion as to make accurate measurements of no value, but specific assignment is made with confidence.

ANSERIFORMES

*Branta dickeyi*. Dickey Goose.—Specimens $^{62}/_{3232}$, $^{62}/_{3233}$, $^{62}/_{3234}$, $^{62}/_{3235}$, $^{62}/_{3236}$. This gigantic goose was first recognized in the Pleistocene asphalt fauna of McKittrick, California (Miller, 1924). The student interested in details of comparison with the almost equal-sized swan and with other extinct forms of *Branta* is referred to the original description of the McKittrick bird.

The species seems to have been extremely rare in the California Pleistocene, since a single bone, a perfect tibiotarsus, was the only specimen found among the many thousand bones of some seventy-six species from the type locality. The great collections from Rancho La Brea and Carpinteria afford nothing comparable to it. The Pleistocene collections from Fossil Lake, Oregon, have provided two large geese and two swans. Is it possible that *Branta dickeyi* is synonymous with any of these Fossil Lake birds?

There is no difficulty in distinguishing the swans on the basis of well marked osteological characters. Cope's *Branta hypsibata* (Cope, 1878) from Fossil Lake was based on a single tarsometatarsus which was very close to the living *B. canadensis* from which it differed in being longer and more slender. It also differed in certain osteologic characters. Cope surmises that the bird "had longer legs and probably larger dimensions" than any of the living geese of North America. *Branta dickeyi* is so definitely a giant that Cope would scarcely have used the term "probably larger" had he been describing the same bird.

*Anser condoni* Shufeldt of the Fossil Lake fauna was described from fragments of the furcula (Shufeldt, 1892). Unfortunately there is, in the original description, some confusion between text and figures as well as in orientation of parts and no type is designated. (There are three fragments allocated to the species.) Figures by Shufeldt indicate a bird larger than the living Trumpeter Swan and hence, presumably, it was much in excess of *B. dickeyi*. Just what the systematic position of *Anser condoni* would be if the bird were better known, is a matter of great uncertainty. I feel confident, however, that it is not to be confused with the Dickey Goose.

In the collection here discussed there were retrieved from the same locality a number of fragments that are assigned to this species. One of them fortunately is of the same element as the type, that is, the tibiotarsus. The specimen consists of the distal condyles with a short portion of the shaft. Other parts include an almost complete coracoid from the right side and a very small portion of its mate from the left, the manubrial portion of a sternum, the proximal end of a right carpometacarpus and the proximal end of a tarsometatarsus.

Three other bones of less distinctive character are a cervical vertebra, a toe bone and a fragment of a sternum. All these fragments are manifestly from anserine individ-

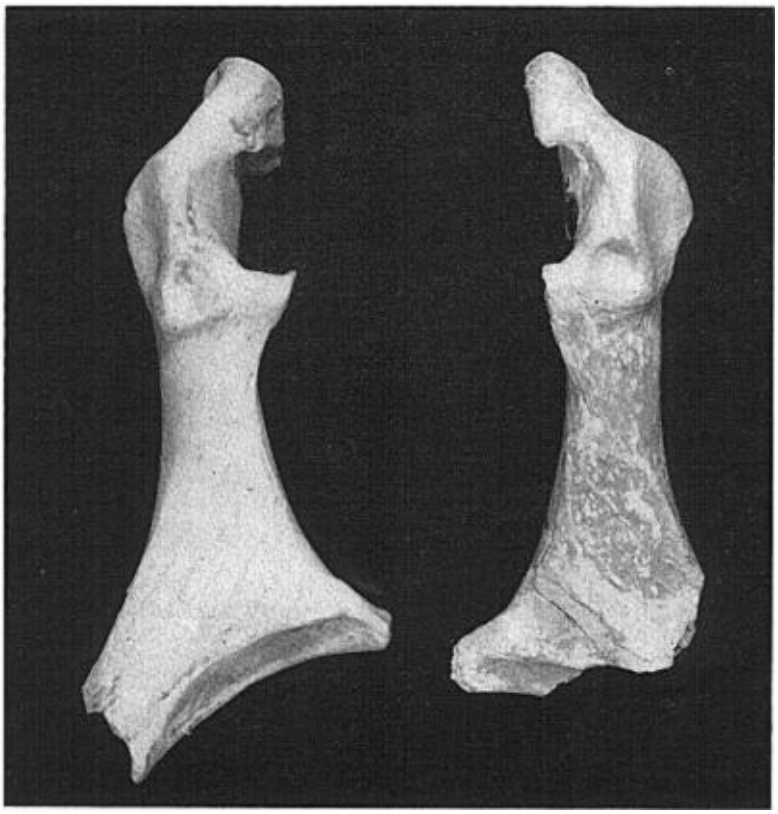

Fig. 6. Coracoids of *Cygnus columbiana* (left) and *Branta dickeyi* (right), x1. Photograph by Gretchen L. Burleson.

uals of about the same size as *Branta dickeyi* and all may have been from the same individual although there is no certainty of the latter point.

The coracoid referred to *B. dickeyi* is longer than that of an adult Whistling Swan (*Cygnus columbianus*) as measured from the manubrial facet to the summit of the head, although it is markedly less robust in the mid-region of the shaft. When viewed from the ventral side, the shaft rises almost at right angles to the general line of the sternal facet, whereas in the swan there is an effect of "leaning toward the median line" so that the shaft of the coracoid forms an angle that is less than ninety degrees on the axial side. The sternal facet is of different shape. Although the bone as a whole is longer, the distance from the center of the scapular facet to the crown of the head is less. This fact combined with a narrowness through the triosseal canal results in a definitely smaller head for the Pliocene bird. The scapular facet is markedly deeper despite possible postmortem corrosion. The furcular facet is more sharply marked. The coracoidal fenestra is unmarked in both species. Attachment of the coracobrachialis muscle and the sternocoracoidal muscle scars are much more pronounced in the fossil. As compared with the swan, then, we see the fossil coracoid as a longer, straighter, more slender, and smaller-headed bone.

The fragment of tarsometatarsus is so badly broken as to be of only slight service.

The corrosion of certain critical contours has rendered the micrometer useless in recording measurements; nevertheless, to the eye it is evident that we have a bone of swan size, with a resemblance to the geese.

Like the tarsal fragment last discussed, the fragmentary proximal end of a carpometacarpus is a bone of swan size with resemblance to the geese. The characters are, however, more strongly anserine and less cygnine.

The small fragment of the manubrial region of the sternum is definitely unlike that of living *Cygnus* of America in the form of the coracoidal facets and in the absence of a recess for reception of the tracheal convolution. Again we have a goose-like character.

As stated above there is no positive assurance that the specimens ascribed to *Branta dickeyi* are from the same individual. Furthermore it must be made clear that assignment to a single species is based purely on their size and their anserine characters. The proximal end of a scapula was also retrieved which is of proper size but it lacks the pneumatic foramen on the ventral side which occurs in all our living North American geese and is wanting in the swans. Another scapula the size of *Branta canadensis* has the foramen entirely lacking also. Was this foramen lacking in the Pliocene geese or are these specimens more properly to be considered as swans? Since there is a fragment of a sternum from locality 122 that is definitely assigned to the subfamily of the swans, it seems preferable to consider the two scapular fragments as swans also.

I had not seen the type specimen of *Branta dickeyi* since the initial study of it twenty years ago until it was borrowed for comparison with the Pliocene geese from Oregon. The characters set up at that time as compared with the Whistling Swan hold true in the main and to them may be added certain unmeasurable differences at the proximal end: the anteroposterior diameter is less in excess of the transverse diameter. The total length is less than in any of the swans at hand and the shaft is stouter than that of the shortest of them. On the posterior face of the bone just below the rim of the internal articular basin is an area of muscle attachment for the common extensor of the digits and the tibial head of the gastrocnemius muscle. The swans differ from the geese quite constantly in the pattern of this area. *Branta dickeyi* is distinctly allied with the geese in the nature of this attachment surface. The scar of the semimembranosus muscle is broader and slightly lower on the shaft.

Measurements of type of *Branta dickeyi* and *Cygnus columbianus*

| | *Cygnus*, 1243, U.C.L.A. | *Cygnus*, 1381, U.C.L.A. | *B. dickeyi* type |
|---|---|---|---|
| 1. Anteroposterior diameter of outer condyle of tibiotarsus | 19.4 mm. | 17.2 mm. | 19.0 mm. |
| 2. Anteroposterior diameter of inner condyle | 24.0 mm. | 20.8 mm. | 21.8 mm. |
| 3. Ratio of 1 to 2 in per cent | 80 | 82 | 87 |
| 4. Transverse diameter across the condyles taken on anterior side | 23.0 mm. | 21.0 mm. | 22.1 mm. |
| 5. Transverse diameter across the condyles taken on posterior side | 16.5 mm. | 14.4 mm. | 15.0 mm. |
| 6. Ratio of diameters 5 to 4 in per cent | 70 | 69 | 67 |

Indeterminate geese.—There are several fragments from the Dry Creek exposure that represent geese smaller than *Branta dickeyi*. They correspond fairly well in size to *Branta canadensis* and may have come from that species. On the other hand they may represent Cope's *Branta hypsibata* described originally from the Pleistocene of Fossil Lake, Oregon. A still smaller species is represented by a fragment of a humerus from Snake River, Idaho (locality 122) which might possibly represent Burt's *Branta esmeralda* (Burt, 1929) from the Pliocene of Fish Lake Valley, Nevada, but there is no way of making certain of the relationship. All these fragments are so incomplete as to make it seem unwise to make more specific assignments.

Indeterminate swans.—As stated above in the discussion of *Branta dickeyi*, there are two fragments of scapulae from locality 62 in Oregon which are considered to be the remains of swans. They are of different size. One of them is almost as small as *Branta canadensis* but both lack the pneumatic foramen found in the geese. The larger specimen approximates the size of *Cygnus columbianus*. From locality 122 on the Snake River there comes a fragment of a sternum that is suf-

ficient to show that there had been a recess in the carina for the reception of a tracheal loop such as appears in the living North American swans. These three fragments are the sole representatives of the subfamily Cygninae, but they indicate that no less than two species were present in the Pliocene.

FALCONIFORMES

Indeterminate eagle.—The present writer has come to feel of late years that any collection of bird bones from late Tertiary or Pleistocene strata that represents more than half a dozen species is almost certain to contain an eagle of some sort. The present collection seemed at first to be the exception but it was only the most superficial glance that failed to discover a distressingly meagre fragment of a large eagle tarsus. Both ends of the bone are missing. The distal foramen, the groove of the outer extensor tendon, the greater part of the metatarsal facet, and a small portion of the shaft are preserved.

The size is practically that of a large *Aquila chrysaëtos* and of a medium sized *Morphnus woodwardi*. From both these species, however, it differs in position of the distal foramen in relation to the metacarpal facet. Within the species *chrysaëtos* there is an appreciable variation of this character, but the range of such variation observed does not include the specimen at hand.

The size of this foramen also is surprisingly small—a phenomenon suggestive of a weak outer toe. Quite in contrast, the hind toe seems to have been a powerful talon, as is suggested by the long and deep metacarpal facet which strongly resembles that of *Morphnus woodwardi*. Dr. Hildegarde Howard was good enough to examine the specimen and suggest points in which it differs from *Spizaëtus willetti* of the subfossil fauna of Smith Creek Cave, Nevada (Howard, 1935). The metacarpal facet is directed less toward the inner side and the cross-section of the shaft through the tendinal groove is different. The outer margin of that groove is quite sharply defined.

*Titanohierax gloveralleni* Wetmore (1937), another subfossil raptor of gigantic size, was a different bird in several respects. The shaft was less tapering and the metatarsal facet was placed at a lower level. *Titanohierax* was a bird with a very long tarsus. Little more than surmise is permissible regarding shaft length in this Pliocene specimen. Such estimate on my own part would be that the tarsus was not unusually long since the foot as a whole was probably very powerful with greatly developed hind toe, although the outer toe may have been weak. Should more complete specimens of the bird become available at a later time, a new specific, if not a new generic, category would doubtless need to be set up.

GRUIFORMES

*Grus americana*. Whooping Crane. Specimen $^{118}/_{3231}$, Snake River Pliocene. It is perhaps excusable that no large series of skeletons of this rare bird was assembled but such as were available showed great variability, not only in size, but in osteological characters of certain parts. For example, there are at hand two specimens of the tibial condyles, both dissected from the skins of birds of unquestionable identity, yet the ratios of anteroposterior diameters to transverse diameters are markedly different. Likewise the inner condyle is relatively smaller in one specimen than in the other. Where a species approaches the orthogenetic stage we might consider as gigantism for the group, this variability is to be more or less expected. The Whooping Crane would seemingly fall within the "giant" category along with the condors and *Teratornis* of the scavenger group, the New World vultures.

The Pleistocene of Rancho La Brea (Miller, 1925) and McKittrick (DeMay, 1941) provided a very limited representation of a large crane ascribed with some reservation to the species *americana*. Wetmore (1931) reported the species from three Pleistocene localities in Florida, basing the determination upon size alone. Although a limited amount of unassociated material is available, yet all the fossil material comes from late geologic deposits representing a time lapse through which an avian species may be expected to have persisted. Assignment to a single specific category seems justified. Especially is this true of a species that shows a decline in numbers and in areal distribution such as we see in *Grus americana*. Here again one is perhaps justified in drawing a parallel with the California Condor and his kinsman *Teratornis* (Miller, 1942); the latter may have survived until early Recent time and the former seems headed for early extinction.

The Pliocene crane material in the collection here discussed consists of a well preserved tibial fragment including the distal condyles. The specimen is larger than the largest Recent specimen available, no. 1963 U.C.L.A., but is more closely like it than is the smaller Recent specimen, no. 68426 M.V.Z. There appears no good reason why they should not be considered conspecific.

A smaller tibial fragment from the Pleistocene of Rancho La Brea, F 569, preserved in the Los Angeles Museum, is intermediate in size between the Pliocene specimen and the larger Recent bird. The accompanying table records the measurable characters of the several specimens discussed.

Measurements in millimeters of tibiotarsi of *Grus americana*

| | 68426 | 1963 | F 569 | 118 |
|---|---|---|---|---|
| Transverse diameter through condyles | 22.4 | 23.6 | 25.2 | 25.5 |
| Anteroposterior diameter through condyles | 20.0 | 23.1 | 24.6 | 26.5 |
| Anteroposterior diameter through notch | 11.2 | 12.6 | 13.2 | 15.0 |
| Transverse diameter of shaft | 10.1 | 11.8 | 12.9 | ..... |

Species of the genus *Grus* are now known from North American deposits as follows:

1. *Grus* (*Aletornis*) *nobilis* (Marsh) from the Eocene of Wyoming, one-third smaller than *G. canadensis*.
2. *Grus nannodes* Wetmore and Martin, from the Pliocene of Kansas, smaller than *G. canadensis*.
3. *Grus proavus* Marsh from the Pleistocene of New Jersey, nearly the size of *G. canadensis*.
4. *Grus canadensis* (Linnaeus) from the Pleistocene of California. The Recent species is also recorded from the Pliocene of Nebraska and Pleistocene of Florida by Wetmore. *Grus minor* Miller is a synonym of *G. canadensis*.
5. *Grus conferta* Miller and Sibley from the Pliocene of California, size as in *G. americana*.

There is a possibility that the tibial fragment here discussed may be conspecific with Miller and Sibley's *G. conferta*, but those authors (1942) found marked osteologic characters of the tarsus which even suggest generic separation from the typical cranes. No such divergence is recognizable in the tibia in hand. It seems wiser therefore to record it as belonging with the genus and species of the living bird.

## SUMMARY AND CONCLUSIONS

A collection of about thirty bird bones from eastern Oregon and western Idaho was examined with the following results:

1. The age is considered to be Upper Pliocene and slightly younger than Hagerman Lake, Idaho.

2. There appears to be no correlation with other Pliocene avifaunas in the Great Basin or in coastal California.

3. The avifauna supplements the mammal fauna in that it indicates a lacustrine deposit.

4. Five species are identified with confidence, four others are discussed without specific allocation.

5. Three of the species are still living in North America.

6. *Grus americana*, *Branta dickeyi*, and *Ciconia maltha*, previously recorded from the Pleistocene are here made known from the Pliocene.

7. The coracoid of *Branta dickeyi* is described and the type (tibiotarsus) is reviewed.

8. The longevity of avian species as known from the skeleton is emphasized.

## LITERATURE CITED

Burt, W. H.
1929. A new goose (Branta) from the Lower Pliocene of Nevada. Univ. Calif. Publ., Bull. Dept. Geol. Sci., 18:221-224.

Cope, E. D.
1878. Discoveries of new extinct vertebrata from the Upper Tertiary and Dakota formations. Bull. Geol. and Geog. Surv. Terr., 4:279-396.

DeMay, I. S.
1941. Quaternary bird life of the McKittrick Asphalt, California. Carnegie Inst. Wash., publ. 530:35-60.

Furlong, E. L.
1931. Distribution and description of skull remains of the Pliocene antelope *Sphenophalos* from the Northern Great Basin Province. Carnegie Inst. Wash., publ. 418:27-36.

Howard, H.
1935. A new species of eagle from a Quaternary cave deposit in eastern Nevada. Condor, 37:206-209.
1942. A review of the fossil storks. Carnegie Inst. Wash., publ. 530:187-203.

Marsh, O. C.
1870. Notice of some new fossil birds from the Cretaceous and Tertiary formations of the United States. Amer. Jour. Sci., ser. 2, 49:216.

Miller, A. H., and Sibley, C. G.
1942. A new species of crane from the Pliocene of California. Condor, 44:126-127.

Miller, L.
1910. Wading birds from the Quaternary asphalt beds of Rancho La Brea. Univ. Calif. Publ. Dept. Geol., 5:439-448.
1924. *Branta dickeyi* from the McKittrick Pleistocene. Condor, 26:178-180.
1925. The Birds of Rancho La Brea. Carnegie Inst. Wash., publ. 349:63-106.
1942. Succession in the cathartine dynasty. Condor, 44:212-213.
Miller, L., and DeMay, I.
1941. The fossil birds of California. Univ. Calif. Publ. Zool., 47:47-142.
Shufeldt, R. W.
1892. A study of the fossil avifauna of the Equus beds of the Oregon desert. Jour. Acad. Nat. Sci. Phila., 11:389-425.
Wetmore, A.
1931. The avifauna of the Pleistocene of Florida. Smithsonian Misc. Coll., 85:1-41.
1933. Pliocene bird remains from Idaho. Smithsonian Misc. Coll., 87:1-12.
1937. Bird remains from cave deposits of Great Erume Island in the Bahamas. Bull. Mus. Comp. Zool., 80:427-441.
Wilson, R. W.
1933. A rodent fauna from the later Cenozoic beds of southeastern Idaho. Carnegie Inst. Wash., publ. 440:117-135.
1937. New Pliocene rodent and lagomorph faunas from Oregon and California. Carnegie Inst. Wash., publ. 487:1-19.

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