CONTRIBUTIONS TO PALEONTOLOGY

III

QUATERNARY BIRD LIFE OF THE McKITTRICK ASPHALT, CALIFORNIA

IDA S. DeMAY

With four text figures

[Preprinted from Carnegie Institution of Washington Publication 590, pages 35 to 60. July 1, 1941.]

Balch Graduate School of the Geological Sciences
California Institute of Technology
Pasadena, California

Contribution No. 316
QUATERNARY BIRD LIFE OF THE McKITTRICK ASPHALT, CALIFORNIA

IDA S. DeMAY

With four text figures

[Issued July 1, 1941]
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>37</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>37</td>
</tr>
<tr>
<td>Occurrence and Nature of Avifauna</td>
<td>38</td>
</tr>
<tr>
<td>Discussion of Species</td>
<td>40</td>
</tr>
<tr>
<td>Colymbiformes</td>
<td>40</td>
</tr>
<tr>
<td>Ciconiiformes</td>
<td>40</td>
</tr>
<tr>
<td>Anseriformes</td>
<td>41</td>
</tr>
<tr>
<td>Falconiformes</td>
<td>43</td>
</tr>
<tr>
<td>Galliformes</td>
<td>47</td>
</tr>
<tr>
<td>Gruiformes</td>
<td>47</td>
</tr>
<tr>
<td>Charadriiformes</td>
<td>48</td>
</tr>
<tr>
<td>Columbiformes</td>
<td>49</td>
</tr>
<tr>
<td>Cuculiformes</td>
<td>49</td>
</tr>
<tr>
<td>Strigiformes</td>
<td>49</td>
</tr>
<tr>
<td>Caprimulgiformes</td>
<td>50</td>
</tr>
<tr>
<td>Piciformes</td>
<td>51</td>
</tr>
<tr>
<td>Passeriformes</td>
<td>51</td>
</tr>
<tr>
<td>Species Not Recorded</td>
<td>52</td>
</tr>
<tr>
<td>Ecologic Relationships of Avifauna</td>
<td>53</td>
</tr>
<tr>
<td>Features of Avifauna Due to Time of Accumulation</td>
<td>56</td>
</tr>
<tr>
<td>Conclusions</td>
<td>57</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>59</td>
</tr>
</tbody>
</table>
INTRODUCTION

Fossil bird remains from the Quaternary asphaltic lenses near McKittrick, California have been discussed in a number of papers during the past twenty years. Two avifaunas in the collection of the University of California were described in detail by L. H. Miller (1925, 1935). The first of these included a large number of aquatic or semiaquatic species, and therefore presented a definite contrast with the Pleistocene avifauna of Rancho La Brea. The second consisted predominantly of birds of nonaquatic habitat, and showed greater similarity to that of the asphalt deposits in Los Angeles. In addition to a general account of the McKittrick avifaunas, special studies have appeared which relate to new species identified in the collections of the University of California (L. H. Miller, 1924, 1927).

Thus far no comprehensive study has been made of the McKittrick avifauna based on the collections of the California Institute of Technology, although certain species among the fossil birds have in the past received individual attention. For example, L. H. Miller described some stork material in 1932 and 1938. A new genus and species of pygmy goose was described by Ross in 1935, and the species was later reassigned by Howard (1936). In 1938, Howard also identified remains of the caracara. L. H. Miller (1935) states that his account of the avifauna from McKittrick is based on the remains in the collection of the University of California, but notes that an examination was likewise made of some of the bird bones in the collection of the California Institute of Technology.

Since the fossil materials in the collections of the latter institution represent the largest number of specimens thus far obtained at McKittrick, it seems desirable to survey this important Quaternary bird assemblage in order to determine additional facts regarding its constitution, and to establish its ecologic and age relationships. Fortunately, recent studies make available more information regarding the avifaunas of Rancho La Brea and Carpinteria, and thus furnish a basis for closer comparison between these and the McKittrick assemblage than has been possible heretofore.

ACKNOWLEDGMENTS

It is a pleasure to acknowledge my indebtedness to Dr. Loye Holmes Miller, of the University of California at Los Angeles, for guidance and constant encouragement in the course of this study. Access to his comparative collections of Recent and fossil bird skeletons and free use of his documented materials have made this work possible.

The fossil bird bones from McKittrick in the collections of the California Institute of Technology were made available by Dr. Chester Stock, whose continued interest and valuable advice are deeply appreciated. Dr. Hildegarde Howard very kindly permitted access to the comparative material in the Rancho
La Brea and Recent collections of the Los Angeles Museum. I should also like to extend thanks to Dr. Howard for suggestions and for aid in the identification of some of the more difficult species. The text figures were prepared by David P. Willoughby. Other acknowledgments are made in the text.

OCCURRENCE AND NATURE OF AVIFAUNA

The fossiliferous asphalt beds of McKittrick, located about a mile south of the village of that name, were discovered during construction work on the Taft-McKittrick highway through the oil fields southwest of Bakersfield, in western Kern County (Merriam and Stock, 1921). The Pleistocene vertebrate remains were uncovered on either side of the highway, and it is evident that the fossil-bearing deposits extend beneath the paved road. The original cut on the southeast side is Univ. Calif. locality 4096, and has been designated by L. H. Miller (1935) as McKittrick locality 1. McKittrick locality 2, on the northwest side of the road, is Univ. Calif. locality 7139, and corresponds to Calif. Inst. Tech. Coll. locality 138 (Schultz, 1938). The collection of fossil birds considered in this paper was taken from C.I.T. locality 138.

The asphalt deposits at McKittrick comprise a series of thin sheets of asphalt and fine-grained silt, resting unconformably upon the Santa Margarita and McKittrick formations. The Pleistocene lenses are exposed to a depth of about 10 feet, and are overlaid by a stratum containing bones of Recent mammals and birds (Schultz, 1938). A number of the latter seem to be included in the present collection.

A comparison of the two McKittrick assemblages of fossil birds described by Miller (1922, 1925, 1935) shows a marked contrast in the percentage of aquatic species present. In fauna 1, aquatic and semiaquatic species constitute two-thirds of the total. Half of these are anserines and the rest are shore birds and waders, all of which are usually found on mud flats or along the marshy edges of lakes and estuaries. The gulls and divers, however, are represented by only one bone, the femur of a pied-billed grebe. Unlike the anserines, these birds prefer the open water of bays and lakes, and are not generally found on small ponds and streams. Approximately one-third of the species are nonaquatic predators and other nonaquatic forms. It seems probable, therefore, that the oil seeps were located near the edge of a lake or pond. The fauna from locality 2 is more terrestrial in character, and, like that of Rancho La Brea, shows a preponderance of flesh-eaters. Nearly two-thirds of the species are nonaquatic predators, and about one-fourth are aquatic or semiaquatic birds (Miller, 1935).

The combined evidence of the mammals, birds, and plants indicates that the physical environment of the region in late Pleistocene time resembled that of today, except for slight changes in topography. The McKittrick region was probably an arid valley in the Lower Sonoran faunal zone, with an adjacent Upper Sonoran zone in the near-by hills. The saltbush (Atriplex
polycarpa), characteristic of the western parts of the San Joaquin Valley today, is found in the McKittrick asphalt. Associated today with the salt-bush formation is the sage sparrow (*Amphispiza belli*), which is known also from the Pleistocene deposit. The presence of California jays and of a few piñon pines indicates that the Upper Sonoran piñon forest, which now extends in the Coast Ranges to the vicinity of Mount Pinos in southern Kern County, was distributed farther north and east and to lower elevations in Pleistocene time. The lacustrine body that provided a habitat for the aquatic species found at McKittrick was probably much like the lakes which are found today in the arid parts of the San Joaquin Valley (A. H. Miller, 1937).

At Rancho La Brea the fauna and flora are largely characteristic of the Upper Sonoran-San Diegan region. Meadowlarks are more abundant than at McKittrick, and horned larks are less so. The pine forest association is almost absent, but live oaks and Lewis woodpeckers are present. Carpinteria was much more humid during the Pleistocene than it is at present. The asphalt deposits at this locality occurred in a coastal Transition forest such as is now found in the California fog belt. Monterey and Bishop pines and pygmy nuthatches are typical of the Carpinteria assemblage (A. H. Miller, 1937).

Many species of birds found at McKittrick have little value in determining the presence of particular life zones because of their wide distribution. Among these one may list the large raptors, which have only recently retreated southward, and the crows and ravens. A. H. Miller (1937) states that crows are entirely absent from the McKittrick collection described by him, although they occur in Rancho La Brea collections and are now found in the river bottom on the arid western side of the San Joaquin Valley. The extinct California turkey (*Parapauo californicus)*, so numerous at Rancho La Brea, does not occur in the McKittrick collections. Presumably not enough ground cover was available to furnish an adequate habitat for these large gallinaceous birds, although the occurrence of a body of water might well have brought them into the immediate region of the tar had they been present. Perhaps the mountain barrier which today exists between McKittrick and Rancho La Brea was even more formidable during Pleistocene time, preventing a migration of *Parapauo* from the Los Angeles coastal area into the San Joaquin Valley. A similar reason may account for the absence of *Ueomoregyps daggettii*, *Spizaëtus grinnelli*, and perhaps *Norphus woodwardi* (L. H. Miller, 1935).

---

1 Throughout this paper, the asterisk (*) indicates that the genus or species following it is extinct.
DISCUSSION OF SPECIES

Since most of the birds found at McKittrick belong to Recent species, and the extinct species have been previously described in detail, no descriptions are included in this paper. The arrangement of species follows that of the Check-list of the fossil birds of North America (Wetmore, 1940).

The method used in determining the number of individuals in each species is that described by Howard (1930). In making a census based upon the wing or leg bones, the left or right element occurring in greatest number in each species was taken, as a rule, to represent the minimum number of individuals present. Parts of broken bones were matched whenever possible, and counted as one bone; additional ends were counted as whole bones. It should be remembered, however, that many more individuals are probably represented in some species than the figures would indicate. For this reason, the total number of bones and bone fragments for each group is also given.

At least 2150 individual birds, including the unidentified anserines, shore birds, and small passerines, are recorded in the present census. Approximately 16,000 bones and bone fragments in the McKittrick collection of the California Institute are now identified. In addition, there remain an estimated total of 4600 unidentified bones, of which number perhaps 4000 belong to small passerines. The total number of identified bird bones in all the McKittrick collections is approximately 20,000.

COLUMBIFORMES (Grebes)

These diving birds prefer the open water of bays, estuaries, tule-bordered inland ponds, and sloughs (Hoffmann, 1927), but are sometimes found in small, shallow ponds or even in irrigation ditches. Miller (1925) suggests that the scarcity of grebe remains at McKittrick indicates that only shallow pools of water were present in the immediate vicinity of the tar seeps.

*Podilymbus podiceps* (Linnaeus). Pied-billed grebe

1 individual; 1 bone (tarsometatarsus).

This species is an abundant breeder at Buena Vista Lake today, but is represented in fauna 1 by a single bone (Miller, 1925). It is not recorded in fauna 2, and was probably a straggler in the region.

CICONIIFORMES (Storklike Birds)

Minimum number of individuals, 45.

Total number of bones and fragments, 485.

The herons and storks are inhabitants of marshes, reedy pools and ditches, mud flats, and the beaches of bays and estuaries (Hoffmann, 1927). Some of them are known to seek insects and small rodents in dry fields, and are therefore not to be regarded as strictly aquatic birds (Miller, 1935).
Ardea herodias Linnaeus. Great blue heron
8 individuals; 66 bones.
This heron is well represented in fauna 1, but only 15 bones of the species are found in fauna 2 (Miller, 1925, 1935). It is found at Buena Vista Lake today, and must have nested near the Pleistocene lake at McKittrick. This is indicated by the presence of incompletely ossified bones of young individuals in the collection.

Casmerodius albus (Gmelin). American egret
3 individuals; 7 bones.
The American egret has not been previously recorded from the McKittrick asphalt. Its rarity in this collection indicates that the birds were probably not very abundant in the region in Pleistocene time, but some of them apparently nested there.

Florida caerulea (Linnaeus) (?). Little blue heron
3 individuals; 8 bones.

Butorides virescens (Linnaeus) (?). Green heron
1 individual; 4 bones.

Nycticorax nycticorax (Linnaeus). Black-crowned night heron
1 individual; 5 bones.
Neither the little blue heron nor the green heron has been previously found in the McKittrick asphalt, and the night heron was previously known by a single bone. The little blue heron is identified tentatively because of the scarcity of the fossil material and because of a possible confusion with Hydranassa tricolor. Identification of the green heron is made tentatively since the bones show slight differences when compared with available Recent material. Two of these herons are found at Buena Vista Lake today.

Ciconia *maltha* Miller. Asphalt stork
29 individuals; 395 bones.
One hundred and seven bones of this extinct stork occur in fauna 2. This species shows considerable variation in size, as noted by Miller in 1932. He states that the size range extends beyond that of *Jabiru* and *Euxenura* at either end of the series, and that *Ciconia *maltha* differs from these species in many details of structure (Miller, 1910, 1932). Young individuals occur in the present collection.

ANSERIFORMES (Gooselike Birds)
Minimum number of individuals, 183.
Total identified bones and fragments, 1628.
Ducks and geese commonly feed along the marshy edges of lakes, ponds, shallow bays, and estuaries. Geese may also feed in grain fields near by, but some of the ducks prefer to dive for food in open water.
Branta canadensis (Linnaeus). Canada goose
3 individuals; 26 bones.

Five bones of this species, all stouter than those of the Recent goose, were found at locality 2. In the avifauna from locality 138, only one bone, the proximal end of a tibiotarsus, is stouter than the comparable element in Recent species.

*Anabernicula minuscula* (Wetmore). Brea pygmy goose
11 individuals; 99 bones.

This small goose was described from McKittrick by Ross (1935), who named it *Anabernicula gracilenta*. He states that it shows characters of both the ducks and the geese, but is more slender than any living goose. In 1936, Howard referred to this genus a humerus described by Wetmore from the Pleistocene of Arizona, and a number of bones from Rancho La Brea. The species *gracilenta* is now regarded as synonymous with Wetmore's *minuscula.*

Anas platyrhynchos Linnaeus. Mallard
36 individuals; 527 bones.

Ninety-two specimens of this very adaptable species are identified in fauna 2.

Chaulelasmus streperus (Linnaeus). Gadwall
7 individuals; 31 bones.

* Mareca americana* (Gmelin). Baldpate
8 individuals; 56 bones.

Dafila acuta (Linnaeus). Pintail
6 individuals; 24 bones.

The gadwall is represented in fauna 2 by 5 bones, and the baldpate by 7 bones. Only one perfect tibiotarsus of the baldpate and several bones referable to the pintail occur in fauna 1.

Nettion carolinense (Gmelin). Green-winged teal.
42 individuals; 355 bones.

Next to the golden eagle, this species is represented by the largest number of bones in the collection of fauna 1. In fauna 2, however, the green-winged teal is known by only 34 bones. These teals are very adaptable, and frequent small puddles as well as large bodies of water.

Querquedula cyanoptera (Vieillot). Cinnamon teal
31 individuals; 403 bones.

Spatula clypeata (Linnaeus). Shoveler
6 individuals; 33 bones.

The cinnamon teal is abundant in fauna 1, and 81 bones are known in fauna 2. The shoveler duck, on the other hand, is represented by only two or three bones.
BIRD LIFE OF THE McKITTRICK ASPHALT, CALIFORNIA

in the two collections. These ducks feed by dabbling in shallow water near
the edges of sloughs and marshes.

*Nyroca americana* (Eyeton). Redhead
7 individuals; 33 bones.

*Nyroca affinis* (Eyeton). Lesser scaup duck
3 individuals; 10 bones.

*Charitonetta albeola* (Linnaeus). Bufflehead
3 individuals; 31 bones.

The last three species are poorly represented in the McKittrick collec­
tions. This is due perhaps to the fact that these ducks prefer the open
waters of lakes or bays, where they dive for food.

Unidentified Anseriformes

More than 140 bones of ducks and geese are not identified as to genus and
species. These represent at least 20 individuals.

FALCONIFORMES (Falconlike Birds)

Minimum number of individuals, 675.
Total identified bones and fragments, 7806.

This order includes the vultures and condors, which are carrion feeders of
such widely diverse habitats as to have little value as life-zone indicators.
Their habit of alighting on the ground and approaching their food on foot may
account for the scarcity of these birds in the McKittrick deposits. Some of
the hawks, such as the sharp-shinned and Cooper's hawks and the falcons, are
hunters of open country. The bald eagle is seldom found far from the ocean or
from large lakes. This may be one reason for its scarcity at McKittrick. The
golden eagle is often seen soaring above the foothills and mountains inland as
well as along the coast. These birds may have become entangled in the tar when
they dropped down upon a partly submerged carcass and by accident permitted
their wings or feet to come in contact with the sticky tar in their struggles
with the prey (Hoffmann, 1927; Miller, 1935).

*Cathartes aura* (Linnaeus). Turkey vulture
7 individuals; 67 bones.

*Coragyps *occidentalis* (Miller). Western black vulture
4 individuals; 32 bones.

*Cathartes aura*, the only small vulture now living in southern California,
outnumbered the extinct *Coragyps* by more than five to one in fauna 2, but the
reverse is the case at Rancho La Brea (Howard, 1930; Miller, 1935). Only 4
bones of the western black vulture have been previously found at McKittrick,
and Miller has suggested that latitude may have been a factor in accounting
for their scarcity. In the present collection *Cathartes* outnumbers *Coragyps*
by approximately two to one. *Coragyps *occidentalis* is a somewhat larger
and stouter bird than the living black vulture (C. atratus), according to
the original description by Miller in 1909. The femur is longer and heavier,
the tibiotarsus is shorter and stouter, the foot is wider, and the humerus
is longer.

*Gymnogyps californianus* (Shaw). California condor
2 individuals; 11 bones.

These are the first condor bones to be recorded from the McKittrick
Pleistocene. The specimens are slightly larger than comparable Recent bones
of California condors in Dr. Miller's collection and differ from them in sev-
eral details. When, however, comparisons are made with the large series of
specimens of condors from the Rancho La Brea Pleistocene, the McKittrick
bones are seen to fall within the range of variability of the species. Miller
(1935) has commented on the absence of condors in previous McKittrick collec-
tions. These birds were widely distributed in Pleistocene time, and their
range even today includes the southwestern San Joaquin Valley region. Why,
then, are their remains so scarce in the McKittrick asphalt?

*Teratornis merriami* Miller. Merriam's teratorn
8 individuals; 124 bones.

This gigantic bird shows a combination of eagle- and vulturelike characters,
having a skull much larger than that of the condor, and a bill higher and more
like that of the eagle. With a wingspread of possibly 16 to 18 feet, *Terator-
nis* was one of the largest birds of flight known (Miller, 1909; Stock, 1930).
Three bones of this species occur in fauna 1, and 178 in fauna 2. It should be
noted that remains of *Teratornis* are less abundant in the present assemblage
than in fauna 2, even though the former collection is four or five times larger
than the latter. A comparable decrease is also found in the number of large
vultures and eagles. Possibly this change reflects a decrease in number of
these birds toward the end of Pleistocene and the beginning of Recent time.

*Neogyxps errans* Miller. Errant eagle
17 individuals; 173 bones.

*Neophronontops americanus* Miller. American neophron
36 individuals; 549 bones.

These two extinct eaglelike vultures are fairly abundant in the present col-
lection. *Neogyxps*, in contrast with the true eagles, is not particularly abun-
dant in fauna 2, and *Neophronontops* is represented by only 46 bones. *Neogyxps
is large and stockily built, and resembles Haliaeetus. *Neophronontops* is dis-
distinctly smaller and resembles Neophron, particularly in the weakness of the
tarsometatarsus (Miller, 1916; Howard, 1932). *Neophronontops* must have nested
in the vicinity of the asphalt deposits, since bones of immature individuals
are present in the C.I.T. collection.
Accipiter striatus velox (Wilson). Sharp-shinned hawk
2 individuals; 14 bones.

Accipiter cooperii (Bonaparte). Cooper's hawk
14 individuals; 108 bones.

The sharp-shinned hawk has not been previously found at McKittrick, and
the Cooper's hawk is represented by only two bones. These birds usually hunt
in thickets or forested regions, and they were probably present only in small
numbers in the open country near the tar seeps.

Buteo jamaicensis (Gmelin). Red-tailed hawk
32 individuals; 391 bones.

Buteo swainsoni Bonaparte. Swainson's hawk
31 individuals; 297 bones.

Buteo regalis (Gray). Ferruginous roughleg
25 individuals; 277 bones.

The collection from McKittrick locality 2 contains 80 bones of the red­
tailed hawk, 53 bones of Swainson's hawk, and 26 bones which were not assigned
to species. The bones of these hawks are generally distinguishable only by
size and proportion of parts. Since there is an overlapping in size among the
three species, it is quite probable that specific identification based on the
dissociated bones of these birds has been confused to some extent.

Hypomorphnus fragilis (Miller). Fragile eagle
52 individuals; 596 bones.

This small, slender-limbed eagle resembles the buteonid hawks. The tarso­
metatarsus is of about the same length as that in Geranoaetus melanoleucus, but
the width is much less (Miller, 1911; Howard, 1932).

Spizaëtus grinnelli (Miller). Grinnell's eagle
4 individuals; 6 bones.

Spizaëtus has not been previously reported from the McKittrick asphalt.
According to the original description, it "resembles Geranoaëtus melanoleucus
in general, but is slightly more robust and shows superior strength by greater
production of the hypotarsal ridge and lower position of the papilla of the
tibialis anticus" (Miller, 1911).

Aquila chrysaëtos (Linnaeus). Golden eagle
126 individuals; 1810 bones.

This is by far the most abundant species in the fossil collections pre­
viously described from McKittrick and Rancho La Brea. In the present col­
lection, it is the most abundant in total number of bones and fragments, but
not in the minimum number of individuals. In this respect it is surpassed by
the burrowing owl and the sparrow hawk.
Haliaeetus leucocephalus (Linnaeus). Bald eagle
14 individuals; 128 bones.

Bones of this eagle are not very numerous in the collection, probably because the bird prefers to live near the coast. The species was not listed in the two collections described by Miller (1925, 1935). It was first recorded from this locality by Howard in 1932.

Circus hudsonius (Linnaeus). Marsh hawk
53 individuals; 607 bones.

This marsh-dwelling hawk was represented in fauna 1 by half a dozen specimens of characteristic parts, and in fauna 2 by 63 bones. In the present collection there is a wide variation in size of the bones, probably due to a difference in sex.

Polyborus "prelutosus" prelutosus Howard. Rancho La Brea caracara
16 individuals; 158 bones.

Four specimens of this aberrant hawk (listed originally as Polyborus cheri-way) were found in fauna 1, and 30 in fauna 2. In 1938 Dr. Howard assigned the caracara bones from Rancho La Brea to the new species P. "prelutosus", and referred the material from McKittrick to this type. With the description of a new subspecies of caracara from Mexico (Howard, 1940), the California bird becomes P. "p. prelutosus.

Falco mexicanus Schlegel. Prairie falcon
70 individuals; 839 bones.

Falco "swarthi" Miller. Swarth's falcon
2 individuals; 9 bones.

Falco peregrinus Tunstall. Duck hawk
17 individuals; 132 bones.

Falco columbarius Linnaeus. Pigeon hawk
12 individuals; 81 bones.

Falco sparverius Linnaeus. Sparrow hawk.
131 individuals; 1397 bones.

Many of the falcons inhabit open fields and deserts, where they hunt for small vertebrates and insects. They probably were attracted to the tar seeps by the presence of these small animals. The prairie falcon is represented in fauna 2 by 65 bones, Swarth's falcon by 4, the duck hawk by 15, the pigeon hawk by 10, and the sparrow hawk by 102 specimens. The last species was second in number only to the golden eagle in McKittrick fauna 1, and is second also in the California Institute collection. Bones of a few immature sparrow hawks are included in the fossil accumulation. Certain elements of the skeletons of Falco mexicanus and F. peregrinus are not readily distinguishable except by size, and as there is no break in the series where one may draw the line, some of these bones may not be correctly classified. Falco "swarthi
resembles *F. mexicanus* closely, but exceeds it in size and differs from it in a few other characters (Miller, 1927).

Unidentified Falconiformes

More than 170 bones of hawks and eagles are not identified as to genus and species. Most of these probably belong to species identified on the basis of more diagnostic skeletal elements.

**GALLIFORMES** (Fowl-like Birds)

The California quail is apparently the only species of gallinaceous bird occurring in this deposit. The extinct turkey, *Parapavo californicus*, so abundant at Rancho La Brea, is still not recorded from the McKittrick region.

*Loophortyx californica* (Shaw). California quail

88 individuals; 762 bones.

Only 3 bones of the California quail occur in fauna 1, and 92 in fauna 2. No other galliform is present. In the present collection, the quail bones vary widely, grading up in size from that of a small California quail to that of the plumed quail (*Oreortyx picta*). The specimens are here grouped together, however, as one variable species. These birds are gregarious ground dwellers on the chaparral-covered hillsides of the Upper Sonoran zone (Hoffmann, 1927).

**GRUIFORMES** (Crane-like Birds)

Minimum number of individuals, 17.

Total number of bones and fragments, 224.

Cranes are often found near small ponds on sagebrush-covered plains, and now winter in the flat country in the vicinity of McKittrick (Hoffmann, 1927; Miller, 1935).

*Grus americana* (Linnaeus) (?). Whooping crane

1 individual; 1 bone.

*Grus canadensis* (Linnaeus). Little brown crane

11 individuals; 158 bones.

*Grus*, sp. (?). Crane

5 individuals; 65 bones.

The whooping crane has not been previously listed from McKittrick, and is here recorded tentatively because of lack of comparative material. The little brown crane was present in previous collections, 86 bones occurring in fauna 2. In 1925, Miller stated that the bones of this crane are intermediate in size between those of the living *Grus canadensis* and *G. mexicanus*. This is true also of the material in the California Institute collection. The bones which are unidentified specifically are variable in size, but are generally larger than the comparable elements of *G. mexicanus* available in the osteological col-
lection of Dr. Miller. It does not seem advisable to make definite specific
determination until more comparative material is available. One gruine skull,
almost complete, is of particular interest. It is about as long as that of
*G. canadensis*, but the bill is much heavier. The cranium is worn away on one
side, but is noticeably smaller than in the modern birds with which it was
compared.

**CHARADRIIFORMES** (Ploverlike Birds)

Minimum number of individuals, 270.
Total identified bones and fragments, 995.
These birds are usually found on the muddy borders of sloughs, marshes,
and bays, or on the beach. The killdeer and mountain plover, however, also
frequent flat open country and broad valleys (Hoffmann, 1927).

*Eupoda montana* (Townsend). Mountain plover
31 individuals; 132 bones.

*Oxyechus vociferus* (Linnaeus). Killdeer
88 individuals; 462 bones.

Unidentified plover
3 individuals; 7 bones.

The mountain plover is represented in fauna 2 by 74 bones. The killdeer
was not listed by Miller in 1935, and is but poorly represented in fauna 1.
Both birds are fairly abundant in the present collection, and probably nested
in the region, as is indicated by the presence of bones of young individuals.

*Totanus melanoleucus* (Gmelin). Greater yellowlegs
40 individuals; 191 bones.

*Numenius americanus* Bechstein. Long-billed curlew
1 individual; 2 bones.

*Phaeopus hudsonicus* (Latham). Hudsonian curlew
3 individuals; 8 bones.

*Pelidna alpina* (Linnaeus) (?). Red-backed sandpiper
3 individuals; 4 bones.

*Limnodromus griseus* (Gmelin). Dowitcher
17 individuals; 102 bones.

The greater yellowlegs is represented in fauna 2 by 37 bones, and the
long-billed curlew by 2 bones. The Hudsonian curlew has not been found at
McKittrick before, and the red-backed sandpiper and dowitcher do not occur
in fauna 2. The greater yellowlegs and the dowitcher apparently nested in
the region.

*Recurvirostra americana* Gmelin. Avocet
10 individuals; 94 bones.

This was the most abundant shore bird in fauna 1, and is represented by
37 bones in fauna 2.
Unidentified Charadriiformes

More than 275 bones of shore birds still remain to be identified. They represent at least 74 individuals.

COLUMBIFORMES (Pigeonlike Birds)

This order is represented in the asphalt only by the mourning dove, a species which lives in open fields and ranges, but roosts in trees at night. It rarely alights in marshy places, and was probably attracted to the small pools of drinking water found in the vicinity (Hoffmann, 1927; Miller, 1925, 1935).

Zenaidura macroura (Linnaeus). Mourning dove
44 individuals; 172 bones.
Sixteen bones of this species are found in fauna 2. Bones of immature doves occur in the present collection.

CUCULIFORMES (Cuckoolike Birds)

The road runner is the only cuculine present in the collection. Like the quail and doves, this bird is an indicator of low brush in the near vicinity of the tar seeps, and, like them, it probably came to the region to drink even though the marshy ground was not to its liking.

Geococcyx californianus (Lesson). Road runner
31 individuals; 229 bones.
Only one specimen of this species occurs in McKittrick fauna 1, but it is well represented in fauna 2. Numerous incompletely ossified bones of immature road runners are found in the present collection.

STRIGIFORMES (Owls)

Minimum number of individuals, 282.
Total number of bones and fragments, 3019.
Most of these nocturnal predators live in or near wooded regions, but the short-eared owl prefers marshy or open country in the lowlands, and the very abundant burrowing owl lives in burrows in barren fields. The latter species seems to be independent of a natural water supply, but was probably attracted to the area by insects and small vertebrates caught in the asphalt.

Tyto alba (Scopoli). Barn owl
30 individuals; 273 bones.
The barn owl has not been previously recorded from McKittrick, but is fairly abundant in the C.I.T. collection. These birds live in valleys and foothills, but are not common in heavily wooded regions.
**Bubo virginianus** (Gmelin). Great horned owl
9 individuals; 81 bones.

**Speotyto cunicularia** (Molina). Burrowing owl
166 individuals; 1738 bones.

**Asio wilsonianus** (Lesson). Long-eared owl
31 individuals; 339 bones.

**Asio flammeus** (Pontoppidan). Short-eared owl
46 individuals; 588 bones.

Twelve bones of the versatile great horned owl were found at locality 2. In the present collection, many of the bones of this species are large, falling just within the range of variability of the owls at Rancho La Brea ( Husband, 1924). The burrowing owl, represented by only 26 bones in fauna 2, is the most abundant species in the C.I.T. collection, in number of individuals present. It apparently nested in the region, for bones of young birds occur in the assemblage. The long-eared owl prefers to live in wooded regions but also occurs in the desert. Twenty-one bones of this species occur in fauna 2. The short-eared owl, a dweller in marshy country, has not been previously found in the McKittrick asphalt, but is rather abundant in the present collection. There is an intergradation in the size of some elements of the skeleton between this species and the long-eared owl. It is possible, therefore, that some of the bones have not been correctly assigned as to species.

**CAPRIMULGIFORMES** (Goatsuckers, Nighthawks, etc.)

Minimum number of individuals, 4.
Total number of bones and fragments, 10.

The bones referred to this order represent at least two species and furnish the basis for an addition to the list of birds from the Pleistocene or early Recent. These birds are found today on dry, brushy hillsides and open deserts in southern California. It is therefore not surprising to find them living in the San Joaquin Valley region during Pleistocene or early Recent time. According to Lönnberg (1927), birds of this order appear to have originated in South America, and to have entered North America after the southern and northern continental areas were connected in post-Miocene time. It is interesting to note that the cathartiform vultures and the caracara are also presumably of Neotropical origin.

**Phalaenoptilus nuttalli** (Audubon) (?). Poorwill
2 individuals; 4 bones.

**Chordeiles acutipennis** Lawrence (?). Texas nighthawk
1 individual; 3 bones.

**Chordeiles, sp. (?)**. Nighthawk
1 individual; 3 bones.

The bones of these birds appear to differ slightly from comparable ele-
ments in Recent skeletons in the collections of the University of California at Los Angeles and of the Los Angeles Museum. It does not seem advisable, therefore, to give them positive specific identification until additional comparative material becomes available.

**PICIFORMES (Woodpeckers, etc.)**

The woodpeckers are represented by the aberrant flicker and a smaller species which has not yet been identified. In previous McKittrick collections, the flicker is the only woodpecker recorded.

*Colaptes cafer* (Gmelin). Red-shafted flicker
5 individuals; 19 bones.

Eight bones of this species are found in fauna 2. It is rather surprising that relatively few individuals are known, since this ground-dwelling bird might be expected to occur in larger numbers.

Unidentified Piciformes

Five pelves are assigned to this order, but have not been identified as to species. They are not included in the census.

**PASSERIFORMES (Sparrowlike Birds)**

Minimum number of individuals, 505.

Estimated total number of bones, about 4000.

Although hundreds of bones of small passerines occur in the collection, most of these still need to be classified. Bones of the raven, however, are more readily identified, and their number is included here. A. H. Miller (1937) states that the crow is absent from the McKittrick passerine materials available to him for study. In the present collection, however, there are several passerine bones which fall within the size range of modern crows.

Passerines recorded from McKittrick by A. H. Miller (1937) include the Bendire thrasher (*Toxostoma bendirei*), cliff swallow (*Petrochelidon albifrons*), house finch (*Carpodacus mexicanus*), cactus wren (*Haeleodytes sp.*), and sage sparrow (*Amphisitta belli*). These are not found at Rancho La Brea or at Carpinteria. In addition, Dr. A. H. Miller has found the following species in the McKittrick fauna: horned lark (*Otocoris alpestris*), sage thrasher (*Oreoscoptes montanus*), loggerhead shrike (*Lanius ludovicianus*), California jay (*Aphelocoma californica*), magpie (*Pica*), raven (*Corvus corax*), white-necked raven (*Corvus cryptoleucus*), and meadowlark (*Sturnella neglecta*).

*Petrochelidon albifrons* (Rafinesque). Cliff swallow

No attempt is made to identify all the skeletal parts of this swallow. The humerus, which has a characteristic shape, does occur in the collection, however. These mud-gatherers are represented in the earlier McKittrick collection.
Corvus corax Linnaeus. Raven
46 individuals; 582 bones.

Very few bones of ravens were found in fauna 1, but 110 bones of the genus Corvus are reported from fauna 2. Young individuals of this variable passerine occur in the present collection.

Unidentified passerines
458 individuals.

At the suggestion of Dr. A. H. Miller, a count was made of all humeri of passerines in the present collection, and the total for the side most numerous­ly represented (right or left) was taken to indicate the minimum number of individuals present. In making this count, the humerus was chosen because it is one of the most characteristic elements, and is sufficiently well preserved in the fossil avifauna to make possible a fairly accurate estimate of the number of birds present. The exact number of bones has not been determined, but an estimate based on the number of individuals places the total at about 4000.

SPECIES NOT RECORDED

Species previously found at McKittrick which do not appear in the avifauna from locality 138 are as follows: whistling swan (Cygnus columbianus), one bone from fauna 2; Dickey's goose (Branta "dickey"), one bone from fauna 1; snow goose (Chen hyperborea), two bones, fauna 1; ruddy duck (Erismatura jama­icensis), two or three bones, both faunas; and Virginia rail (Rallus limicola), two bones, fauna 1 (L. H. Miller, 1924, 1925, 1935). It is suggested that the great scarcity of the anserines listed above may be due to the shallowness of the water in the vicinity of the asphalt seeps when the McKittrick fauna accu­mulated.
Previous investigations of the McKittrick avifauna in the collections of the University of California have demonstrated that two-thirds of the species from fauna 1 are aquatic or semiaquatic in habit, and that only one-fourth of the species from fauna 2 belong to this ecologic group. In the present collection also, one-fourth of the individuals are aquatic or semiaquatic and three-fourths are terrestrial. The accompanying diagram (fig. 1) shows the relative significance of the several ecologic niches occupied by the birds that occur in the asphalt. The sectors representing the relative importance of open country and chaparral in and about the McKittrick tar seeps during their active period are based upon the number of nonaquatic species.
that in large measure inhabit these environments. The size of these segments in the diagram will doubtless increase greatly when all the small passerines in the collection are identified.

The Falconiformes in the C.I.T. collection do not form proportionately so large a group as at Rancho La Brea (see fig. 2), but the percentage of owls in the McKittrick collection is about twice as great as that at Rancho La Brea. The number of Galliformes at the Los Angeles locality is striking because of the great numerical representation of the extinct turkey, *Parapavo. This species has not been found at McKittrick, and the gallinaceous birds occupy only a small place in the fauna (see fig. 2).

The number of individuals for each species of which 10 or more individuals are present in the avifauna from locality 138 is recorded in figure 3. The
Burrowing owl, with at least 166 individuals present, is the most abundant species in the collection. The sparrow hawk is second with 131, and the golden eagle third with 126. It is interesting to note that bones of the golden eagle are most abundant in McKittrick fauna 2, with the fragile eagle second and Teratornis third. The sparrow hawk is fairly abundant in the latter collection, but the burrowing owl is represented by only 26 bones. According to the census of Rancho La Brea birds made by Howard in 1930, the golden eagle is by far the most abundant species; Parapavo is second, and the caracara third. In the Rancho La Brea avifauna, the sparrow hawk is represented by only 12 individuals.
Species new to the McKittrick collections include the following: American egret, some small herons, California condor, sharp-shinned hawk, Grinnell's eagle, a large crane, Hudsonian curlew, barn owl, short-eared owl, a poorwill, and a nighthawk. This is the first fossil record of the Caprimulgiformes.

On the basis of incompletely ossified bones of young individuals occurring in the collection, it is assumed that the following species nested in the McKittrick region: great blue heron, American egret, asphalt stork, sparrow hawk, California quail, mourning dove, road runner, and nighthawk.

FEATURES OF AVIFAUNA DUE TO TIME OF ACCUMULATION

Peculiarities in the mode of accumulation and the type of collecting done at McKittrick make it impossible now to distinguish between the Pleistocene and Recent birds recovered from these deposits. As a matter of fact, the lateness in Pleistocene time of the older fauna and the continuous geologic activity that has occurred in the region, permitting outpours of tar of greater or less size down to the present, increase the difficulty of recognizing faunal differences due to time.

Examination of the skeletal remains of birds leads to the conclusion that the type of preservation of this material was not always the same. As observed in the field, some bones were preserved in clay or sand, others in an almost pure tar. As a consequence there is a difference in the appearance of the specimens. Some are jet black, others brown, and a third group are of still lighter hue. It is not always clear, however, whether a lighter color necessarily results from a shorter period of contact of the bone with petrolierous substances, and it is thus unsafe to use this criterion in distinguishing between Recent and Pleistocene specimens. As a matter of fact, bones of extinct types of birds may on occasion have a very light color, apparently due to oxidation and bleaching of the material since its entombment. This is especially true of some of the *Parapavo bones from the Carpinteria asphalt.

Aside from these differences in color, many elements taken from the McKittrick deposits show a toughness and a resistance to stress not seen in others. These qualities may have some geologic age significance and may ultimately be found useful in distinguishing the bones of more recent age from those of the typical Pleistocene. It is significant to note at this point that in the present collection a few bones of small passerines are still attached to each other by ligaments. This type of preservation would seem to indicate that these particular specimens, at least, are Recent in age.

In view of these observations, it is important to keep the factor of time in mind when considering the ecology of the avifauna obtained at locality 138. Thus the smaller percentage of aquatic species in this avifauna, as compared with those previously noted from McKittrick, may indicate that the present collection was made in deposits laid down farther back from the edge of the lake,
or on slightly higher ground. This view seems unlikely, however, since C.I.T. locality 138 and the U.C. locality whence fauna 2 came are in essentially the same area. It is probably more logical to assume that decrease in the number of aquatic birds reflects a change in the environment about the tar seeps as the lake receded in time, with a concomitant increase in representation of Recent forms (see figs. 1, 3).

A number of additional changes should be noted in the composition of the avifauna. In the Institute collection the small predators are very abundant, a marked contrast with Rancho La Brea and McKittrick fauna 2. Burrowing owls and sparrow hawks are present in great numbers, exceeding even the golden eagle in abundance. The large eagles and eaglelike vultures, so characteristic of the typical Pleistocene fauna of Rancho La Brea and McKittrick 2, are not well represented in this collection. It seems probable that much of the avifauna was trapped in the asphalt after most of these large predators became extinct. The fact that the traps were still capable of attracting and mirroring the large flesh-eaters that existed in the region is shown by the presence of great numbers of bones of the golden eagle and smaller numbers of bones of the fragile eagle, marsh hawk, and prairie falcon. It does not seem likely that an environmental barrier was responsible for the scarcity of the larger falconiforms. Several species, as for example the California condor and *Teratornis, were widely distributed in Pleistocene time, and the eagles and vultures living today are generally not restricted to any one faunal zone.

A comparison of the Recent fauna from pit 10 at Rancho La Brea with that from typical Pleistocene pits of the same locality demonstrates that there has been not only a decrease in the percentage of individuals of extinct species, but also a marked decrease in number of large predators and an increase in number of small ones. In this regard a definite resemblance exists between McKittrick 138 and pit 10 (see fig. 4, p. 58). Judged from its composition, the avifauna from locality 138 falls in time between the Recent and Pleistocene avifaunas of Rancho La Brea. It appears to be definitely younger than the typical Pleistocene fauna of Rancho La Brea and McKittrick 2, but somewhat older than the avifauna from pit 10, Rancho La Brea. Probably the fauna was entombed in successive asphalt flows over a period of several hundred years, beginning in Pleistocene time and continuing into the Recent.

**CONCLUSIONS**

The great abundance of falcons, buteonid hawks, and small owls in the California Institute collection from McKittrick strongly suggests that there was considerable open country in the region about the tar seeps in late Pleistocene time. The presence of nesting quail, doves, and road runners indicates particularly the presence of chaparral-covered hillsides in the vicinity. The larger owls and the sharp-shinned and Cooper's hawks probably lived in
sparsely wooded areas not far from the asphalt traps. The presence of water, mud flats, and marshes near by is certainly indicated by the occurrence of herons, ducks, cranes, shore birds, the marsh hawk, the short-eared owl, and a grebe in the collection.

The absence of the extinct California turkey (*Parapavo californicus) from McKittrick may be due to lack of sufficient brushy cover in the vicinity or to the presence of a mountain barrier between the Los Angeles area and the San Joaquin Valley, as suggested by L. H. Miller. Unlike the vultures and eagles, these large gallinaceous birds may have been restricted in habitat. That their absence at McKittrick was controlled by an ecologic rather than by a time factor is suggested by the fact that the species is recorded in the Recent avifauna of pit 10, Rancho La Brea. Also, *Parapavo is the most abundant species in the Carpinteria avifauna, which appears to be about the same age as McKittrick faunas 1 and 2.

Decrease in number of the larger Falconiformes with noticeable increase in representation of the smaller predatory birds at McKittrick contrasts with the relative abundance of the larger types in the Rancho La Brea Pleistocene,
and is taken to indicate a later stage for the former assemblage. There is, however, reason for believing that some of this lack of antiquity is due to an admixture of a later (Recent, but not present-day) assemblage with a fauna dating from the Pleistocene.

Analysis of the composition of the avifauna from locality 138 leads to the conclusion that the ecologic requisites of most of the birds found in the McKittrick asphalt are satisfied by an environment in which sparsely timbered mountain slopes give way to brush-covered hills and arid or semi-arid plains lying adjacent to a desert lake.

LITERATURE CITED


