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AVIFAUNA OF THE PLEISTOCENE CAVE DEPOSITS OF CALIFORNIA

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LOYE HOLMES MILLER

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Introduction

There is assembled in the collections of the Department of Palaeontology at the University of California an extensive and highly interesting collection of vertebrate remains from the Pleistocene cave deposits thus far known to the state. The material was secured during the exploration of the caves by the immediate efforts of Dr. Wm. J. Sinclair and Mr. E. L. Furlong, working under the direction of Professor John C. Merriam. General accounts have been published by both Sinclair[1] and Furlong[2], giving the location of the caves, nature of the deposits and lists of determined species. The bird material from these collections forms the subject of the present paper.

Occurrence

The caverns yielding bird remains are three in number. Potter Creek and Samwel caves are in the lower region of the McCloud River in Shasta County, California. Both are limestone caverns of considerable extent. Hawver Cave is in Eldorado County and is likewise of limestone origin. All three localities have present elevations between 1300 and 1500 feet above sea level and lie in the same faunal zone as determined by the distribution of Recent vertebrates. The Pleistocene age of the deposits is indicated by the fact that about thirty per cent of the mammalian species represented are at present extinct. *Elephas, Mastodon, Euceratherium, Megalonyx, Equus, Camelus,* and *Arctotherium* appear among the genera which are either extinct or are no longer represented in this region. Students of the mammalian fauna consider that the indications point to the greater age of the Potter Creek deposits although, as noted below, the evidence furnished by the avian remains is somewhat to the contrary.

The specimens obtained were in many cases badly fractured

[1] Sinclair, W. J., Univ. Calif. Publ. Am. Arch. Ethn., vol. 2, pp. 1–27, 1904.

[2] Furlong, E. L., Am. Jour. Sci., vol. 22, pp. 235–247, 1906; and Science, n.s., vol. 25, pp. 392–394, March 8, 1907.

or were gnawed by rodents before being unearthed, otherwise the preservation is generally good, since the factor of weathering is reduced to a minimum. As suggested by Sinclair, the method of introduction of the bones is not easy in all cases to determine. The great preponderance of birds belonging to ground-dwelling species is at once noticeable. None of these bones occur in their proper anatomical relations in the deposits. This condition suggests that their bodies were either brought in as the prey of predatory forms or else swept in by currents of surface drainage. A number of owls and vultures also occur, both of which groups commonly resort to caverns as places of abode. Their remains, deposited in the outer chambers of the caverns, would readily be swept on into more remote recesses by currents of water. The anserine remains doubtless represent prey carried into the cavern mouth by predatory forms such as the duck hawk (*Falco peregrinus*) which in turn left its bones in a similar position.

RECORD OF SPECIES

CATHARTES AURA (Linnaeus)

The remains representing this species are somewhat fragmentary, yet are in each case perfectly determinable. An ulna, a radius and a metacarpal are practically perfect and agree absolutely with the corresponding parts of the Recent specimens at hand. The single specimen of the species from Samwel Cave is represented by the distal end of a radius only; this part is however markedly different from the same portion of the skeleton in *Catharista*. The fragment is certainly of the genus *Cathartes*, and there appears no reason for considering the species as different from the existing *C. aura*. The manubrial part of a sternum and the distal end of a humerus represent the species in Hawver Cave.

The reason for the greater abundance of the species in Potter Creek Cave is hard to determine. Some local condition must have been the determining factor and not a scarcity of the species in the region of Samwel Cave. The mammalian remains suggest that the Potter Creek deposits represent an earlier time than those of Samwel Cave. *Cathartes* was evidently abundant during

the formation of the former deposits and it likewise is one of the abundant forms of to-day. Its scarcity in the Samwel Cave deposits was due probably to some one of the factors which brought about the entombment of the Samwel Cave remains.

CATHARISTA SHASTENSIS, n. sp.

Type specimen no. 8603, Univ. Calif. Col. Vert. Palae., tarsometatarsus from Potter Creek Cave, California. General characters of *Catharista occidentalis* Miller, but more robust; foot rotated inward upon the shaft. Comparison is here made with an average specimen of *C. occidentalis* from Rancho La Brea.

Fig. 1. *Catharista shastensis,* n. sp. Tarsometatarsus no. 8603, Pleistocene of Potter Creek Cave, Shasta County, California. Anterior face, approximately natural size.

The two specimens of the tarsometatarsus of *C. occidentalis* and *C. shastensis* are much the same in osteological characters. In total length the cave form is but five-tenths millimeters the shorter, a fact which greatly facilitates the comparison of proportions. Seen from in front, the most striking character afforded by the new form is the greater degree of robustness. In the head region, greater width increases the bluntness of the intercotylar tuberosity and the roundness of the dome-shaped cavity into which the proximal foramina open, as well as the width of the septum between these two foramina.

The shaft is much wider at its middle portion, so much so that the graceful taper toward a narrowest point slightly below the middle, that is seen in *C. occidentalis* is entirely lost. As noted in a study of the condors,[3] the tarsometatarsus of the young cathartid seems to differ from that of the adult individual by its greater slenderness of shaft in proportion to the width of the articular surfaces. The natural objection that the type specimen of the proposed new form might merely represent a more mature individual is controverted by the fact that its proximal foramina are less completely closed than in the specimen of *C. occidentalis* with which it is compared, a condition indicative of youth rather than of age in the individual.

The elevated inner border of the anterior face of the bone in *C. shastensis* drops backward as it passes down the shaft, thus giving the appearance of an inward rotation of the foot upon the shaft. This condition is more marked in the form under discussion than it is in *C. occidentalis.* Other differences are

[3] Miller, L. H., Univ. Calif. Publ. Bull. Dept. Geol., vol. 6, p. 1, 1910.

those of proportion and are best noted by a comparison of the dimensions recorded in the table below.

It is interesting here to note that the two extinct vultures from the cave region display a greater breadth of shank and foot than do their nearest relatives from the asphalt or from the Recent North American fauna, and although large series of specimens have been employed for comparison in each case, there is no intergradation in this character. In the case of the genus *Catharista*, the asphalt form is differentiated from the Recent *C. urubu* in the same respect, thus the three species, *shastensis*, *occidentalis* and *urubu*, form a series successively less robust of tarsometatarsus.

The material assembled indicates at least eight and possibly fifteen individuals of the species. With the exception of some of the Gallinae, no other form is so abundantly represented in the cave collections. Thus the occurrence is such as to indicate the comparative abundance of the species in the Shasta region during the period of deposition of the cave deposits.

Like the last named species, *Catharista* is less abundant in the Samwel Cave than in the Potter Creek Cave. There are but three specimens referable to the genus in the Samwel Cave, and their specific identity is not absolutely certain. In so far as they are known they correspond with the specimens of similar parts of true *C. shastensis* from Potter Creek Cave. Two fragmentary specimens from Hawver Cave are likewise ascribed with some reserve to this species.

TABLE OF MEASUREMENTS OF *Catharista shastensis* AND *C. occidentalis*

	C. occidentalis	*C. shastensis*
Tarsometatarsus—		
Total length	83.5 mm.	83.0
Greatest transverse diameter through head	16.0	17.4
Least transverse diameter of shaft	7.2	8.7
Greatest transverse diameter through trochleae	17.0	17.9
Greatest sagittal diameter through head	11.8	13.3
Sagittal diameter of shaft at middle point	5.9	6.9
Sagittal diameter of middle trochlea	10.8	10.6
Transverse diameter of middle trochlea	7.3	7.3
Humerus—		
Length from distal tubercle of pectoral crest to depression for brachialis anticus	56.4	59.5
Anteroposterior diameter of shaft at middle	11.6	12.4
Dorsiventral diameter of shaft at middle	9.7	9.8

GYMNOGYPS AMPLUS, n. sp.

Type specimen no. 9834, Univ. Calif. Col. Vert. Palae. Right tarsometatarsus from Samwel Cave. Tarsometatarsus very broad as compared with *Gymnogyps californianus* (Shaw); foot set inward on the shaft so that the median line of the shaft falls outside the center of the foot.

The establishment of this new form of condor is based on its comparison with a single Recent specimen in addition to a series of fourteen tarsometatarsi from the Pleistocene of Rancho La Brea, in which beds the bird occurs abundantly in a phase considered to be identical with the Recent species.[4] In this splendid series there is no individual which approaches in breadth of shank the dimensions displayed by the specimen here described. It is to be expected that a bird of the large size to which the condor grows would vary to a considerable degree. However, the extremes of variation exhibited by the series referred to above fail by a wide margin to include the cave form within its limits. As mentioned also in the previous discussion of that series, the difference between *Sarcorhamphus* and *Gymnogyps* as displayed by the tarsus is almost entirely one of relative width. *Cathartes, Gymnogyps, Sarcorhamphus,* and *Catharista* form a graduated series in this respect, passing from broader to narrower tarsus. The species here proposed displays a degree of flattening equal to or in excess of that seen in *Cathartes.*

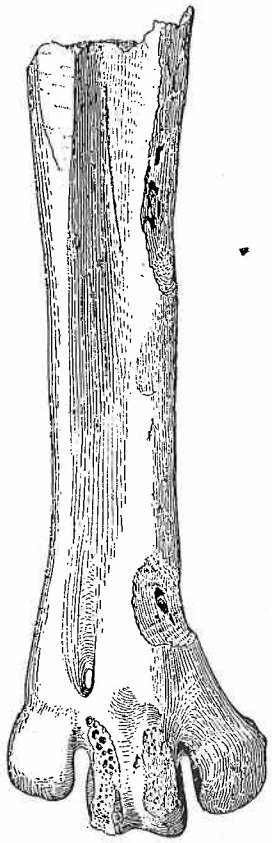

Fig. 2. *Gymnogyps amplus,* n. sp. Tarsometatarsus, no. 9834, Pleistocene of Samwel Cave, Shasta County, California. Anterior face, approximately natural size.

Unfortunately the proximal end of the tarsometatarsus is not preserved,

[4] Miller, L. H., Univ. Calif. Publ. Bull. Dept. Geol., vol. 6, pp. 1–19, 1910.

hence the characters of the hypotarsus, the intercotylar tuberosity and the tibial articulations remain undeterminable.

There appear in the Potter Creek Cave collection the remains of a condor the exact identity of which is not determinable. These bones, ten in number, are all fragmentary. The size of the form, as judged from the coracoid and humerus, is in excess of *Gymnogyps californianus*. Since the suggestion conveyed by the robust tarsus of *G. amplus* is that of a large species, the remains from Potter Creek are tentatively assigned to the latter species.

MEASUREMENTS

	G. californianus fossil No. 12161	*G. californianus* Recent No. 201	*G. amplus* No. 9384
Tarsometatarsus—			
Least transverse diameter of shaft	13.7 mm.	14.0	16.0
Anteroposterior diameter of shaft at middle point	10.0	8.6	11.0
Transverse diameter through trochleae	32.2	29.6	32.8
Transverse diameter of inner trochlea	9.0	8.0	9.3
Transverse diameter of outer trochlea	7.6	6.8	7.9

BUTEO BOREALIS (Gmelin)

The red-tailed hawk is represented in the Potter Creek collections only. The major part of a right humerus, a complete femur and an imperfect tibiotarsus, parts which, judging from their positions in the deposit, represent at least two different individuals, prove beyond question the identity of the remains. They compare perfectly with Recent specimens from California ascribed to the variety *Buteo borealis calurus*.

BUTEO SWAINSONI Bonaparte (?)

A fragmentary tarsometatarsus in the Samwel Cave collection is ascribed to this species. It is a typical buteonine shank, but appreciably slender as compared with *Buteo borealis*.

ARCHIBUTEO FERRUGINEUS (Lichtenstein)

The species is represented by one specimen only, a right humerus from Hawver Cave. The bone is broken away across the deltoid crest, the shaft and distal portion are perfectly preserved with the exception of the external portion of the radial

condyle. The characteristic region of the brachialis anticus is perfect, thus the identification becomes positive. The size is that of a large female specimen at hand.

ACCIPITER VELOX (Wilson)

Represented in the Samwel Cave collection by a single tarso-metatarsus which is perfect except for the extreme head. In size it is slightly stouter than a Recent juvenal at hand.

FALCO SPARVERIUS Linnaeus

A perfect tarsus and humerus in the Samwel collections and a humerus in the Potter Creek collection prove the presence of the species in a form osteologically identical with the existing phase.

FALCO PEREGRINUS Tunstall

Four specimens from Potter Creek Cave represent the species. The distribution of the material was such as to indicate at least three individuals.

GERANOAËTUS, sp.

In the collection from Hawver Cave there appears the humerus of a slightly built eagle almost identical in size with a specimen of the existing *Geranoaëtus*. The osteological characters of the genus are, as regards the humerus, more closely like those of *Haliaëtus*. The size is however too small to be included within the latter genus. In the asphalt of Rancho La Brea there appear several species of the smaller long-shanked eagles. The form under discussion may prove to belong to one of these Rancho La Brea species, but the characters obtainable from the distal end of the humerus are insufficient to differentiate it from the existing *G. melanoleucus* from South America. The bone from Hawver Cave is slightly larger than the single specimen of the South American form at hand, and the type tarsus of *Geranoaëtus grinnelli* from Rancho La Brea is likewise larger than the existing form. The Hawver Cave specimen does not however display any osteological characters which would distinguish it from the existing species.

There also appears in the same collection a coracoid of a size

slightly smaller than the Recent specimen of *G. melanoleucus* at hand which displays also a slight difference in the disposition of the pneumatic foramina. The two specimens probably belonged to birds of the same species.

Additional material of the Recent species of long-shanked eagles from South America may later make it possible to define the cave form as to species. It does not seem wise at present, however, to do so.

BUBO VIRGINIANUS (Gmelin)

This owl is represented in a phase perfectly similar to the existing form in so far as osteological characters and size are concerned. A lower jaw, perfect except for the left angular and articular region, corresponds in every particular with a specimen of the western subspecies, *B. v. pacificus*. A humerus and two femora, though fractured at the ends, display characters sufficient to place them in this species. The species is represented only in the Samwel Cave collections.

BUBO SINCLAIRI, n. sp.[5]

Type specimen no. 7092, Univ. Calif. Col. Vert. Palae. Right tarsometatarsus, Potter Creek Cave; cotype no. 8952, a tibiotarsus from Samwel Cave. The species is characterized by its very large size. The great gray owl, *Scotiaptex nebulosa*, is generally conceded to be the largest of the American owls, and perhaps equals in size the largest known member of the group. The cave form was compared with a large female specimen of this species in the University of California Museum of Vertebrate Zoology and was found to be quite appreciably larger. The snowy owl, *Nyctea*, was also inferior in size to the fossil specimen.

On comparing the tarsi of *Bubo* and *Scotiaptex*, there are several points of difference which appear at once, though the size is almost exactly the same. In *Bubo* the shaft is much more curved, the axis being concave from without where that of *Scotiaptex* is almost perfectly straight. The outer border of the external articular face is raised higher, the supratendinal bridge is narrower, the gorge under it much broader, the papilla

[5] This species is named in honor of Dr. Wm. J. Sinclair, who was actively connected with the early exploration of the Shasta caves.

of the tibialis anticus is higher up the shaft, and the outer toe much higher above the middle toe. In all these respects the cave form resembles the genus *Bubo* except that the characters of the foot are not determinable. The depressed region of the proximal end is very broad and open in its excavation, the papilla of the tibialis anticus is lower, but is not drawn out into a ridge as in *Scotiaptex*. The somewhat accentuated angle on the exterior border just opposite the osseous bridge seems due in part to a slight scar on the bone.

On the whole, the relationships of the form seem to be decidedly with *Bubo* rather than with *Scotiaptex*.

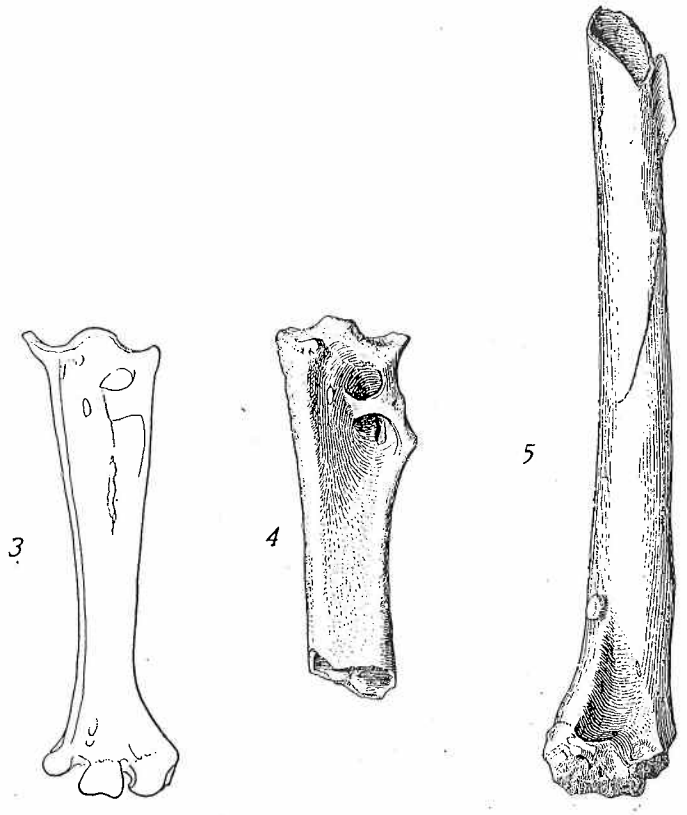

Fig. 3. *Scotiaptex nebulosa* (Forster). Recent. Tarsometatarsus, anterior face, approximately natural size.

Fig. 4. *Bubo sinclairi*, n. sp. Tarsometatarsus, no. 7092, Pleistocene of Potter Creek Cave, Shasta County, California. Anterior face, approximately natural size.

Fig. 5. *Bubo sinclairi*, n. sp. Tibiotarsus, no. 9852, Pleistocene of Samwel Cave, Shasta County, California. Anterior face, approximately natural size.

MEASUREMENTS

	B. sinclairi	*B. virginianus*	*Scotiaptex nebulosa*
Tarsometatarsus—			
Total length		60.0	58.0
Transverse diameter of head	16.0 mm.	14.4	15.0
Least transverse diameter of shaft	10.5	7.8	8.1
Least anteroposterior diameter of shaft	6.1	5.1	4.7
Diameter through trochleae		17.6	17.0

OTUS ASIO (Linnaeus)

Known only by the shaft of a tarsometatarsus and the distal ends of two humeri occurring in the material from Potter Creek Cave.

ASIO WILSONIANUS (Lesson)

Two tarsometatarsi of this owl occur in the Samwel Cave collection. One lacks the trochleae and the other the extreme head, otherwise they are perfectly preserved and permit of exact determination. The two may have belonged to the same individual, as they were closely associated in the deposit and they correspond perfectly in size. The specimens are slightly less in size than a female of the Recent phase at hand, but the difference is no greater than is readily ascribable to difference in sex.

GLAUCIDIUM GNOMA Wagler

A perfect tarsometatarsus of this species occurs in the Samwel Cave material. Mr. Swarth of the University of California Museum of Vertebrate Zoology kindly dissected out the tarsometatarsus of a male specimen in the museum collection so that this rare material might be available for comparison. The cave form is identical in every respect with the Recent specimen except that it is slightly larger. Since the Recent specimen is a male and the difference in length is but one and one-half millimeters, the fossil form may be safely considered as a female of the same species.

MICROPALLAS WHITNEYI (Cooper)

A single perfect tarsometatarsus from Samwel Cave represents this species, which is now confined to the arid regions

farther southward. To find it here associated with the remains of *Dendragapus, Bonasa,* and *Branta* is certainly an interesting addition to our knowledge of the distribution of birds. The specimen is a typical strigine tarsometatarsus, the length of which corresponds perfectly with the recorded tarsal length of the Recent phase. Shufeldt figures the ligamentous skeleton of a specimen from the region of Tucson, Arizona,[6] which shows the general proportions of the tarsometatarsus though the details are obscure.

[6] Shufeldt, R. W., Am. Phil. Soc. Proc., vol. 39, p. 665, 1900.

BRANTA CANADENSIS (Linnaeus)

A single nearly perfect carpometacarpus occurs in the Potter Creek collection. The size is that of the Recent *B. c. canadensis.*

INDETERMINATE ANSERINES

Four imperfect specimens representing three anserine species of different sizes were found in the Samwel Cave deposits. The characters of the bones are not sufficiently well shown to warrant their assignment to any particular genus.

MELEAGRIS, sp.

There appear in the Potter Creek deposits, eight specimens of a meleagrine form, the species of which is not determinable from the material obtained. An almost perfect humerus and the major part of a coracoid are the only specimens at all well preserved. These show the bird to be *Meleagris* and not *Pavo.* The size is that of a female *Meleagris ocellatus* from Guatemala. The characters of the humerus are intermediate between those of *M. ocellatus* and *M. gallopavo* (domestic). In the absence of a larger amount of material both of the fossil and the Recent species, the specific designation of the cave form is left in question.

DENDRAGAPUS OBSCURUS (Say)

No less than one hundred and fourteen specimens from the Samwel and Potter Creek caves are ascribed to this species. With the exception of seven coracoids, all are limb bones, some in a perfect state of preservation. For comparison a specimen

of an adult female was loaned by the University of California Museum of Vertebrate Zoology. The uniformity of the material in regard to size is quite sufficient to include all under the one species *D. obscurus,* which is found in the locality at the present time.

DENDRAGAPUS, sp.

There appear among the grouse remains in the collection a large number of specimens of unusual size. The closest relationship seems to be with *Dendragapus,* from which the form differs in its great robustness and in the slight detail of the head of the tarsometatarsus. The Recent material at hand includes only a female of *Dendragapus,* hence the range of variation due to sex and age is unknown to the writer. Until further Recent material is obtained the identity of these larger specimens remains in doubt.

BONASA UMBELLUS (Linnaeus)

This species is at present distributed along the humid coast region of the continent as far south as the latitude of the Shasta region. It is however not recorded from localities so far inland in Recent time. It is of interest, then, to find in the Potter Creek Cave two very perfect specimens referable to this species.

OREORTYX PICTA (Douglas)

This quail is represented by eighteen specimens, all but four of which are from Hawver Cave. Comparison was made with a specimen from the University of California Museum of Vertebrate Zoology and the identity found to be unquestionable.

LOPHORTYX CALIFORNICA (Shaw)

This species is represented in the Hawver Cave deposits only, but here it is the most abundant of avian species, seventeen specimens of wing and leg bones making the identification complete.

In number of individuals, the group Gallinae far surpasses all of the others combined. There are in the cave collections some two hundred and seventy individual bird bones that are determinable. Of these one hundred and sixty-eight are assigned

to the Gallinae. The number of species is however limited to six, and of these one contains one hundred and fourteen specimens. Of the six species, three are grouse, two are quail, and one a large meleagrine form.

One very noticeable fact is that the genus *Lophortyx,* embracing the varieties of the California quail, is entirely wanting in the collections from Potter Creek and Samwel caves, while *Oreortyx* is represented by only four specimens from Potter Creek Cave. It seems hardly probable that this lack of quail remains can be due to the conditions of interment, but rather to a scarcity of the species in the immediate vicinity during the time of deposition. A predatory species which would carry the remains of grouse into the cave would prey also upon the quail, which are slightly smaller and of similar habit. The greater fragility of the bones of the smaller form seems an inadequate explanation in the presence of the remains of such forms as *Colaptes, Cyanocitta, Glaucidium, Micropallas,* and *Falco sparverius.*

The accidental introduction by washing from the surface or through blundering of the animal causing its death by falling into an open fissure would be more effective in the introduction of quail remains than in the case of the non-terrestial forms *Colaptes* and *Corvus,* both of which are forms represented in a well-balanced fauna by fewer individuals as a rule than is the case with the quail.

The great abundance of quail remains in Hawver Cave would suggest a later time of deposition for these deposits.

COLAPTES CAFER (Gmelin)

This species is represented in all three caves by the very characteristic ulna with its pronounced olecranon process and prominent papillae for the attachment of the secondaries.

CORVUS CORAX Linnaeus

The species is found in Hawver Cave only, where it is represented by twelve specimens, the remains of several individuals if the character of the specimen may serve as an indication.

CORVUS BRACHYRHYNCHOS Brehm

There occur in the Potter Creek collection a nearly perfect humerus and the distal end of a tibiotarsus which correspond perfectly with the existing phase of this species. The position in the deposit indicates their origin from two different individuals.

CYANOCITTA STELLERI (Gmelin)

A single perfect tarsometatarsus represents this species of jay in Samwel Cave. In comparing with a specimen of the subspecies *C. s. carbonacea,* the only noticeable difference lies in the slenderness of the fossil. The length is exactly the same, the degree of slenderness is so slight as to seem negligible in the determination of the species. In Hawver Cave there occur four specimens which show the same slenderness of build.

EUPHAGUS CYANOCEPHALUS (Wagler)

Seven specimens of this species occur in the collections from Hawver Cave. Several limb bones and a coracoid serve to establish the specific identity. This bird is entirely wanting in the deposits of the other caves.

TABULAR VIEW OF THE CAVE FAUNAS

Illustrating number of specimens of each species found in the different caves.

	Potter Creek Cave	Samwel Cave	Hawver Cave
Cathartes aura (Linnaeus)	9	1	2
Catharista shastensis, n. sp.	26	3	7
Gymnogyps amplus, n. sp.	10	2	....
Buteo borealis (Gmelin)	3	....	....
Buteo swainsoni Bonaparte(?)	....	1	....
Archibuteo ferrugineus (Lichtenstein)	....	....	1
Geranoaëtus, sp.	....	....	2
Accipiter velox (Wilson)	....	1	....
Falco peregrinus Tunstall	4	....	....
Falco sparverius (Linn.)	1	2	....
Bubo virginianus (Gmelin)	....	4	....
Bubo sinclairi, n. sp.	2	3	....
Otus asio (Linnaeus)	3	....	....
Asio wilsonianus (Lesson)	....	2	....

	Potter Creek Cave	Samwel Cave	Hawver Cave
Glaucidium gnoma Wagler	....	1	....
Micropallas whitneyi (J. G. Cooper)	....	1	....
Branta canadensis (Linnaeus)	1	....	....
Anserine indeterminate, no. 1	....	1	....
Anserine indeterminate, no. 2	....	1	....
Anserine indeterminate, no. 3	....	2	....
Meleagris, sp.	8	....	....
Dendragapus obscurus (Say)	22	92	....
Bonasa umbellus (Linnaeus)	2	....	....
Oreortyx picta (Douglas)	2	....	14
Lophortyx californica (Shaw)	....	....	17
Colaptes cafer (Gmelin)	1	2	3
Corvus brachyrhynchos Brehm	2	....	....
Corvus corax Linnaeus	....	....	12
Cyanocitta stelleri (Gmelin)	....	2	4
Euphagus cyanocephalus (Wagler)	....	....	7

Transmitted July 8, 1911.