LATE PLEISTOCENE VERTEBRATES OF THE SILVER CREEK LOCAL FAUNA FROM NORTH CENTRAL UTAH

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ABSTRACT.— Presumed paludal and alluvial deposits in a small mountain basin in north central Utah have yielded the first terrestrial Pleistocene fauna from the state. Twenty-five mammalian and four nonmammalian species are present, most of which have not previously been reported as fossils from Utah. At 6,400 feet the elevation of this site is much too high to have been part of the Lake Bonneville deposition. Three mammals, *Ovis*, *Symbos*, and *Bootherium*, not existing in the present fauna, have been identified in the northern part of the state. They probably did not reach this area until later in the Pleistocene or else favored more rugged terrain. Previous reports of the Woolly Mammoth, *Mammuthus primigenius*, from Utah are considered to be in error. *M. columbi* is probably the represented species. A so-called giant bison, *Bison ? latifrons*, is represented in the fauna by relatively numerous specimens. The variation in size of these elements strongly suggests that the size range between the largest males and smallest females was much greater than previously assumed.

Most faunal constituents and current topography suggest that the Late Pleistocene habitat at the fossil site was a marsh encircled by a brush-interrupted grassland. The rare remaining faunal components were evidently part of a distant wooded community. A slightly moister but no colder climate than the present one is postulated on the basis of the fauna.

Radiocarbon dating establishes a time for the Silver Creek local fauna in excess of 40,000 YBP. The particular combination of extinct and extant species indicates a Late Sangamon to Early Wisconsin age.

With the exception of some small fish faunas from Lake Bonneville sediments (Smith et al. 1968), essentially only isolated vertebrates have previously been recorded from the Pleistocene of Utah. These include a few *Ovis* skulls that have been reported by Stokes and Condie (1961). This paper is the first report of a relatively extensive vertebrate assemblage of Pleistocene age from the state. Accordingly, many taxa here reported have not previously been identified as fossils in Utah. The name *Silver Creek local fauna* has been applied because the fossil assemblage was discovered at Silver Creek junction where Utah Highway 40 joins Interstate Highway 80.

The best known and most extensive Pleistocene deposits in Utah are those of Lake Bonneville. However, surprisingly few vertebrates have been found in them to date. As the present fauna was recovered at an altitude of 6,400 feet, the containing deposits are too high to belong to the Bonneville Group. According to Bissell (1968:3), the maximum elevation of Lake Bonneville was about 5,200 feet. At that time the present fossil site was 14 miles east of the eastern shoreline.

Numerous Pleistocene vertebrate faunas have been described from the Great Plains and West Coast, but relatively few have been described from the Rocky Mountains and Basin and Range. The present faunal assemblage is considered significant since it adds information about Late Pleistocene vertebrate distribution for 29 taxa in a Rocky Mountain location close to the Basin and Range.

It was due to the generous offer of Mr. James H. Madsen, Jr., of the University of Utah Department of Geology and Geophysics, that the Silver Creek local fauna and existing data were made available to me. Permission for its study was kindly granted by Dr. William L. Stokes, past chairman of that university's Department of Geology. Through the kindness of these

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two men a representative collection of the Silver Creek local fauna will be kept at Brigham Young University as well as at the University of Utah. Mr. Allan J. Lewis, owner of the property from which the Silver Creek local fauna was collected, is greatly appreciated for his wisdom and kindness in reporting the fossil deposit and donating all specimens subsequently recovered from it to a responsible institution. Mr. Lewis also donated the services of a backhoe and an operator to aid in fossil recovery. Federal aid salvage funds (Project Number I-80-[23]144) were administered through the Utah Department of Highways in support of fossil excavation.

Mr. James H. Madsen, Jr., directed the removal of fossils from the Silver Creek site and was assisted by Robert Bolland, Michael Stokes, Brent Lordes, and Megan Friedland, all students from the University of Utah. These and other students helped prepare the fossils. A. Dean Stock, graduate student in zoology from the University of Utah, made tentative identifications of some of the small mammals at the time of excavation. Additional preparation of the specimens was done by Mrs. Sharen Campbell of Brigham Young University. The index map was drawn by Mr. Artie Lee and the illustrations were made by Mr. Howard Brown, Miss Wendy Babel, and Miss Lorna Raty, all of Brigham Young University.

Gratitude is also expressed to Dr. David P. Whistler and Dr. Donald R. Patten of the Natural History Museum of Los Angeles County, Dr. John A. White of Idaho State University, Dr. Donald V. Hague of the Natural History Museum of Utah, and Dr. Wilmer W. Tanner of the Life Science Museum of Brigham Young University for making comparative specimens available.

Methods of Study

In general the mammalian classification used in this paper follows Simpson (1945). Unless otherwise indicated, information relating to animal habitats contained herein are from the following sources: Burt and Grossenheider (1964), Durrant (1952), Hall and Kelson (1959), Peterson (1951), Stebbins (1966), Walker (1964), and from personal observations. It is assumed that Late Pleistocene habitats

of most living mammalian species listed in this study were essentially the same as those that they currently occupy.

Points of measurement used for bison in the included tables are the same as those illustrated in Miller (1971:60-72). Measurements of *Bison antiquus* elements used in the present tables are from the largest males in the Rancho La Brea fauna from the Natural History Museum of Los Angeles County. Most of the comparative specimens of fossil species used were also from this fauna. Additional comparative material of extinct species used was from the collections at Idaho State University. Recent specimens from the collections at Brigham Young University, the University of Utah, and the Natural History Museum of Los Angeles County were used in comparison with the species found at Silver Creek that have living representatives.

Dental nomenclature applied in this report is generally from the following sources: Bryant (1945), Hibbard (1959), Peyer (1968), Skinner (1942), and Stirton (1959).

Abbreviations and Symbols Used

BYU—Brigham Young University

BYUO—Brigham Young University osteological collection

LACM—Natural History Museum of Los Angeles County

UUVP—University of Utah vertebrate paleontology collection

Y—Rancho La Brea specimens from the Natural History Museum of Los Angeles County

YBP—Years before present

cf.—Compares with (appears before a taxon when an identification was based on limited material)

( )—Approximate measurement

#—A taxon not previously reported as a fossil from Utah

+—An extinct genus

*—An extinct species

Description of Locality and Fauna

Location, Setting, and Discovery: The Silver Creek local fauna comes from a very restricted area immediately northwest of the junction of Utah Highway 40 and Interstate Highway 80 (Fig. 1). This site is approximately five miles north of Park City and 20 miles east of Salt Lake City in Summit County, Utah. It is situated in the north central part of a small basin located just east of the crest of the
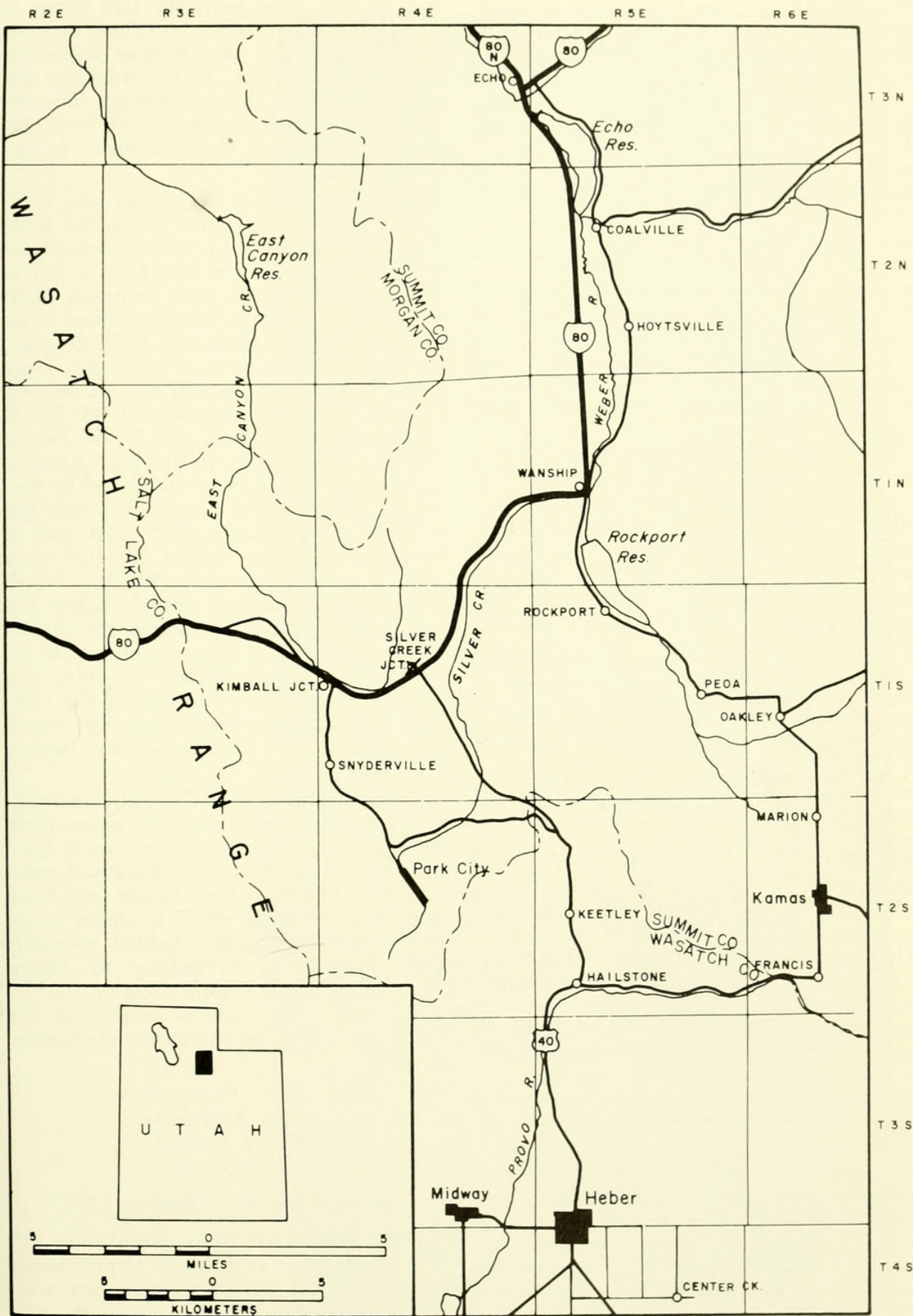
Fig. 1. Index map showing the location of the site from which the Silver Creek local fauna was obtained.

Wasatch Range. The basin itself is about seven miles long and five miles wide. The Silver Creek site is a small bowl-like depression within this basin.

Most of the basin is grass-covered, although some of it is broken by sagebrush and other shrubs (Fig. 2). Few trees are present. However, the flanks of the basin that merge into the surrounding mountains sustain stands of scrub oak and aspens. Occasional conifers are also present. With increasing elevations the bordering mountains become more densely forested. The highest elevations occur along the western border, with a maximum slightly in excess of 9,000 feet. The basin is currently used primarily for grazing livestock, but some homes and cabins are beginning to appear.

In the immediate area of the fossil site the water table is quite high; seasonally a very small marsh is often formed. Mr. Allan J. Lewis, owner of the property, had a ditch excavated in 1963 in an attempt to lower the water table. During that excavation a mammoth tooth was found, which led to the discovery of the Silver Creek local fauna.

GENERAL GEOLOGY: The Wasatch Range, in which the present fossil site is located, constitutes a portion of the Rocky Mountains. This range is mostly composed of Paleozoic and Mesozoic sedimentary rocks that were uplifted by block faulting from mid-Tertiary time to the present (Bissell 1964:26-28; Gilbert 1928:38-40; Hunt et al. 1953:38). Unfortunately, no detailed report has been published on the geology of the basinal area where the Silver Creek site is located. What information is available comes from a geologic map compiled by Bromfield and Crittenden (1971). They mapped most of the basin's surface as older Quaternary alluvium that was interpreted as mainly terrace deposits that formed adjacent to larger drainages. Along the eastern, southern, and western parts of the basin and adjoining flanks (the northern section has not been mapped), Tertiary volcanics are exposed. These are mapped as Early Oligocene Keetley volcanics and are said to be rhyodacitic to andesitic volcanic breccia. The poorly sorted sands and gravels and clay from which the fossils were taken (mapped as older Quaternary alluvium) were clearly derived from these volcanics. The sands

and gravels were probably laid down at the fossil site as intermittent flood deposits in a marshy area where finer sediments continually accrued. As the lithology did not appreciably change through a maximum excavative depth of 20 feet, the total thickness of these deposits is unknown.

METHOD OF FOSSIL RECOVERY AND CONDITION OF FOSSILS: After the initial fossil discovery a series of 18, 20-inch holes were drilled 75 to 175 feet apart by a truck-mounted auger. All were between eight and 15 feet in depth. This was done in an attempt to locate additional fossil deposits. Two other fossiliferous deposits were found, only one of which was excavated. The one excavated began about 400 feet to the east of the original site. It was by far the most productive of the two. Excavations were made both by hand and by machine (backhoe and dragline). Since the fossils were generally quite soft due to their wet condition, special care had to be taken in their removal. All the fossils came from sands and gravels below the water table. This necessitated the almost constant usage of a pump to eliminate accumulating water. Where feasible, this water was used in hydraulicing the sediments to facilitate fossil recovery. Small vertebrates were retrieved by screen washing.

Despite their originally soft condition, the bones did not show any appreciable distortion. After drying, they were hard and resistant and in a good state of preservation. Only a few fossils exhibited noticeable abrasion. No articulated bones were found, but some skeletal elements were associated. According to James Madsen (personal communication, 1975), an attempt was made to collect all the fossils present in the two adjacent deposits.

SYSTEMATIC PALEONTOLOGY
Class AMPHIBIA
Order ANURA
Family RANIDAE

Rana cf. *pipiens* Schreber, 1782

ABUNDANCE: Minimum number of 115 individuals based on humeri. Copius bones representing all skeletal elements are present in the fauna.

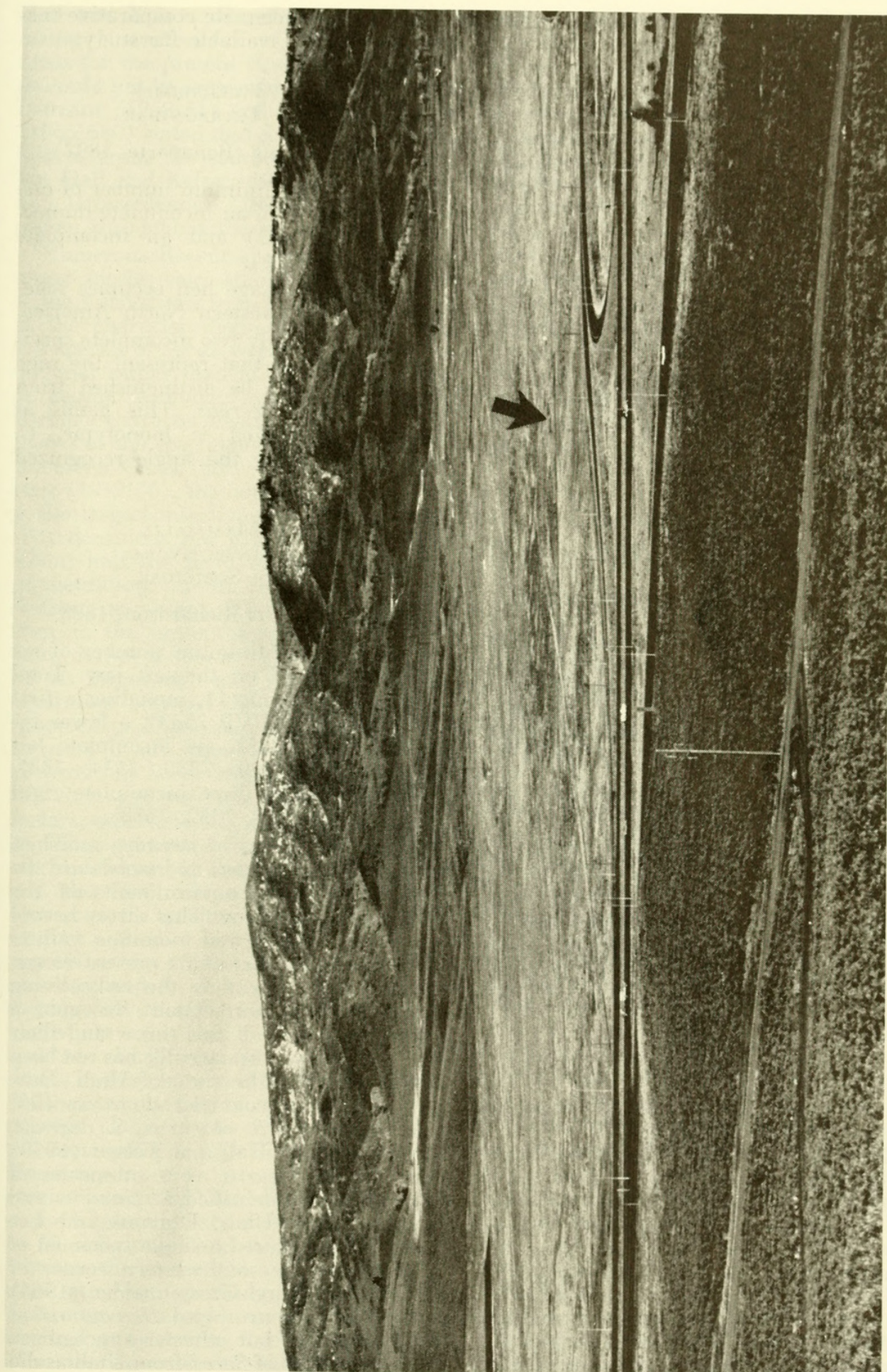HABITAT: The leopard frog is currently the most widely distributed amphibian

Fig. 2. Photograph of Silver Creek fossil site (arrow) and surrounding area. North is to the top of picture.

in North America, occupying almost any area where there is permanent fresh (or even brackish) water.

DISCUSSION: By far the most numerous vertebrate in the Silver Creek local fauna is the frog. In comparison with genera and species of frogs from western North America, the present form most closely resembles *Rana pipiens*. Unfortunately, only a limited. number of Recent skeletons were available for comparison. Considering the large number of frog bones in the fauna, a more detailed study of this taxon should be made when sufficient comparative material is at hand.

Only two species in the family Ranidae, *Rana clamitans* and *R. pipiens*, are currently recognized as being indigenous to Utah. To my knowledge, no fossil frogs have yet been reported from this state.

Class AVES
Order ANSERIFORMES
Family ANATIDAE

Anas platyrhynchos Linnaeus, 1758

ABUNDANCE: Minimum number of three individuals based on the left coracoid. Total number of elements five, including three coracoids (UUVP 7252, 7253, 7328) and a complete (UUVP 7254) and an incomplete (UUVP 7325) carpometacarpus.

HABITAT: Mallards usually frequent lakes, marshes, and ponds.

DISCUSSION: No differences were detected between any of the bones listed above and the corresponding elements of Recent *Anas platyrhynchos*. According to Kortright (1943:152), the mallard is probably the most abundant species of duck. It is very common in most parts of Utah today.

Anas ? carolinensis Gmelin, 1789

ABUNDANCE: One individual based on a right coracoid (UUVP 7327).

HABITAT: The green-winged teal has a habitat very similar to the mallard.

DISCUSSION: The adult coracoid identified as *Anas ? carolinensis* (=*Nettion carolinensis*) is considerably smaller than that of any observed *A. platyrhynchos*. Its size and conformation, though, are quite similar to the modern green-winged teal that presently inhabits Utah. This is the smallest of the North American ducks.

Unfortunately, adequate comparative materials were not available for study.

Order GALLIFORMES
Family TETRAONIDAE

cf. *Centrocercus* (Bonaparte, 1827)

ABUNDANCE: Minimum number of one individual based on an incomplete humerous (UUVP 7323) and an incomplete ulna (UUVP 7251).

HABITAT: The sage hen occupies sagebrush plains in western North America.

DISCUSSION: Only two incomplete specimens are present that represent the sage hen; they cannot be distinguished from the living *Centrocercus*. This genus as currently recognized is monotypic, *C. urophasianus* being the single recognized species.

Class MAMMALIA
Order INSECTIVORA
Family SORICIDAE

Sorex palustris Richardson, 1828

ABUNDANCE: Minimum number of six individuals based on the left jaw. Total number of elements 11, including a first upper incisor (UUVP 7333), a lower incisor (UUVP 7335), six incomplete left jaws (UUVP 7329, 7330, 7334, 7337, 7339, 7340), and three incomplete right jaws (UUVP 7331, 7332, 7338).

HABITAT: Borders of streams, marshes, and ponds in meadows and woods are the preferred physical environments of the northern water shrew. This shrew is confined to mountains and mountain valleys in the southern part of its present range.

DISCUSSION: *Sorex* is the only living insectivore known in Utah. Recognition of current species of this shrew and their geographic ranges apparently has not been agreed upon for the state of Utah. Durrant (1952) recognized four species: *Sorex merriami*, *S. obscurus*, *S. vagrans*, and *S. palustris*. Hall and Kelson (1959) regarded *S. obscurus* as a subspecies of *S. vagrans* but identified *S. cinereus* and *S. nanus* from Utah. Durrant and Lee (1955:560) captured a single specimen of *S. nanus* in the southwestern corner of the state. Burt and Grossenheider (1964) retained *S. obscurus* and *S. vagrans* as separate species but otherwise recognized the same species of *Sorex* from Utah as did

Hall and Kelson. Based on dentary and dental characteristics of available specimens for the present study, *Sorex obscurus* could not be separated from *S. vagrans*. Durrant (1952:31) and Durrant and Lee (1955:560) stated that *S. merriami* is only known from the southern part of Utah, but Hall and Kelson (1959:47) and Burt and Grossenheider (1964:7) indicated it occurs throughout the state.

Numerous Recent specimens of all the above species were studied and compared to the fossil shrew from Silver Creek. Most of the character distinctions observed in the species of *Sorex* were found to be gradational rather than to be simply present or absent. Although size is one of these variable character distinctions, only *S. palustris* of the specimens seen is as large as the Silver Creek shrew. According to Durrant (1952:36), the northern water shrew is the largest insectivore in Utah. All Recent dentitions are distinctly pigmented. About half the fossil teeth show marked pigmentation; in the remainder it is indistinct or absent. The only upper incisor in the present fossil deposit differs from that of all species except *S. palustris* by its larger size and relatively greater separation between the anterior and posterior cusp. This separation is not so pronounced in all specimens of *S. palustris*, however. In *Sorex cinereus*, *S. merriami*, and *S. nanus* the metaconid of the lower molars, especially M_1, is curved posteriorly. This curvature is either very slight or else is absent in *S. vagrans*, *S. palustris*, and the fossil shrew. The fossil shrew (based on six specimens) does not have as distinct a medial notch in the condyloid process as is present in *S. vagrans*, *S. cinereus*, and *S. nanus*. *S. merriami* and *S. palustris*, though, usually do not have as distinct a notch as do the above species and thus closely resemble the Silver Creek shrew in this character. McMullen (1975: 319) stated that the hypoconid joins the trigonid closer to the protoconid than to the metaconid in M_3s of *Sorex palustris*. However, in the 12 specimens of this species seen from Utah, the anterior ridge of the hypoconid extends to the metaconid in 10 individuals and to a point midway between the metaconid and protoconid in two. (In distinguishing the protoconid from the metaconid at their confluent bases, I projected a line straight down from the apex of the valley formed by

these cuspids.) In the M_1 of the above-mentioned 12 specimens, the hypoconid always joins the protoconid via the anterior ridge; in the M_2 the connection is to the protoconid in seven instances and to a point midway between the protoconid and metaconid in the remaining five. Of the *Sorex* species studied, only *S. palustris* and the Silver Creek shrew evinced an M_3 in which the hypoconid joins the metaconid rather than the protoconid. Also, this connection in M_2 was closer to the midpoint of the protoconid and metaconid in *S. palustris* and the fossil than in the other species seen.

Morphologically, the shrew from Silver Creek could not be distinguished from *Sorex palustris*, which presently inhabits the area.

<center>Order EDENTATA
Family MYLODONTIDAE</center>

Paramylodon cf. *harlani* (Owen, 1840)

ABUNDANCE: Minimum number of one individual. Total number of elements, three, including two lower cheek teeth (UUVP 7248, 7249) and a partial thoracic vertebra (UUVP 7250).

HABITAT: Stock (1925:27; 1963:51) and Hibbard and Taylor (1960:163) stated that *Paramylodon* occupied grassland areas throughout its range. It is probable, though, that significant amounts of brush grew in regions inhabited by this genus.

DISCUSSION: Although the partial thoracic vertebra cannot be ascribed to *Paramylodon* with certainty, the two lower cheek teeth can. The anterior moiety of the bilobed fourth tooth (?M_3) is missing but the second cheek tooth (?M_1) is complete. Both teeth are parallel-sided, thus indicative of an adult or nearly adult individual (Miller 1971:10). The size and configuration of these teeth fall within the variability of *P. harlani* from Rancho La Brea. (Previously, 1971:9-10, I commented on the extreme variability of this genus.)

Nothrotherium and *Megalonyx*, two genera of ground sloths that occur in Rancholabrean Age deposits of North America, differ in many respects from *Paramylodon*. Smaller size and rectangular rather than lobate cheek teeth are two characters that can be used to readily distinguish them from the Silver Creek

specimens. *Eremotherium*, which has not been reported in western North America, is distinctly larger than *Paramylodon*. It, too, has rectangular cheek teeth, which are strongly bilophed.

Because of the great variability in skeletal elements of *Paramylodon*, several genera have been named that are most likely synonymous with it (Stock 1925: 120). A number of species have also been introduced. However, I think that the pronounced variability and considerable overlap of skeletal characters warrants recognition of only a single genus and species, *Paramylodon harlani*. This view has also been advocated by others (e.g., Lull 1915; Lundelius 1972). Accordingly, the Silver Creek specimens are referred to *P. harlani*.

Order LAGOMORPHA
Family LEPORIDAE

Sylvilagus cf. *idahoensis* (Merriam, 1891)

ABUNDANCE: Minimum number of one individual. Total number of specimens five, including three upper molariform teeth (UUVP 7439, 7520, 7622), a proximal end of a femur (UUVP 7417), and the distal half of a tibia (UUVP 7412).

HABITAT: The pygmy rabbit is presently known only from areas where sagebrush, preferably tall, abounds.

DISCUSSION: *Sylvilagus idahoensis* is the smallest of living North American rabbits. According to Burt and Grossenheider (1964:223), it can be distinguished from all other extant rabbits by size alone. Ochotonids (pikas) are comparable in size but differ in a number of morphological respects. Their upper molariform teeth, for example, are rectangular rather than nearly ovate as seen in *S. idahoensis*. Ochotonids show much more pronounced enamel lophs on the occlusal surface of their molars and do not have nearly so extensive a medial reentrant as is found in *Sylvilagus*. Also, this reentrant lacks cement in pikas, whereas in cottontails it is filled with cement.

An extinct dwarf species of rabbit, comparable in size to *S. idahoensis*, was described by Cushing (1945:183) from San Josecito Cave in Nuevo Leon, Mexico. He stated that the species *S. leonensis* differed from *S. idahoensis* in several respects. The only difference that can be

applied to the Silver Creek teeth (other differences apply to the skull or lower teeth) is the enamel pattern of the external reentrant. According to Cushing it is crenulated in *S. leonensis*. No crenulations were observed here in the present fossils or in any of several Recent *S. idahoensis* specimens examined.

The Silver Creek teeth fit well within the size range noted for modern specimens of *S. idahoensis*. Their lingual reentrants extend labially about two-thirds the transverse width of each tooth and are cement-filled. The anterior edge of the internal enamel reentrant in each is slightly crenulated, while the posterior edge is not. These conditions were typical of observed Recent pygmy rabbits. Both the incomplete femur and tibia are adult in stage and conform well in size and configuration with *S. idahoensis* living in Utah today. In a map Durrant (1952:89) indicated the current range of *Sylvilagus idahoensis* falls outside the present fossil site. The closest proximity was shown as being about 50 to 60 miles to the west. Evidently this species had at least a slightly more eastern extent to its range in the past.

Lepus cf. *townsendii* Bachman, 1839

ABUNDANCE: Minimum number of one individual. Total number of specimens nine, including a P_3 (UUVP 7343), a lower molariform tooth (UUVP 7342), three upper molariform teeth (UUVP 7344-7346), the distal end of a humerus (UUVP 7414), a proximal femur fragment (UUVP 7416), a calcaneum (UUVP 7415), and a metatarsal (UUVP 7413).

HABITAT: The white-tailed jackrabbit is found in open grassy or sagebrush plains at elevations over 5,000 feet in Utah.

DISCUSSION: A second leporid, much larger than *Sylvilagus idahoensis*, is present in the Silver Creek local fauna. The configuration of its P_3 reentrant is similar to *Lepus* and different from *Sylvilagus*. Although there is an appreciable size overlap between some species of these two genera (*S. aquaticus*, for example, is larger than *L. americanus*), all the present fossils are larger than any specimens or illustrations seen of *Sylvilagus* species. Thus the Silver Creek *Lepus* is distinctly

larger than *L. americanus*. It does correspond in size, though, with both *L. californicus* and *L. townsendii*. All three of these *Lepus* species now inhabit Utah.

Hibbard (1952:11) said that the posterior labial reentrant of P_3 is crenulated in *L. californicus* but not in *L. townsendii*. I observed this to be true in most, but not all, instances, as two specimens of the black-tailed jackrabbit seen had no distinct crenulations. The P_3 in the present fauna has no crenulations on the posterior labial reeetrant. This tooth, as well as the other teeth in the fauna, could not be discriminated from *L. townsendii*. All the postcranial bones belonged to an individual (or individuals) that was very large. Hall and Kelson (1959) reported that *L. townsendii* slightly exceeds *L. californicus* in size. Currently the eastern geographic limit of the black-tailed jackrabbit is about 20 miles west of the Silver Creek site, while the white-tailed rabbit is common in this area.

Order RODENTIA
Family SCIURIDAE

Spermophilus cf. *armatus*
(Kennicott, 1863)

ABUNDANCE: Minimum number of four individuals based on the left upper third molar and left upper third premolar. Total number of elements 40, including an incomplete left jaw (UUVP 7350), nine incisors (UUVP 7514, 7891, 7929, 7931, 7938, 7956, 7967, 7982, 7986), 29 cheek teeth (UUVP 7459-7464, 7483-7486, 7488-7491, 7493-7495, 7498, 7499, 7503, 7530, 7650, 7670, 7761, 7877, 7892, 7895, 7896, 7908), and the distal end of a humerus (UUVP 7348).

HABITAT: The Uinta ground squirrel presently inhabits central and northern Utah in and adjacent to mountainous areas. This species is frequently found in pasture lands in high valleys and in mountain meadows up to the timber line. A moist location near a body of water seems to be preferred.

DISCUSSION: Several species of ground squirrels now live in Utah. The present fossils were compared with numerous specimens of each. Based primarily on the jaw, which has a complete dentition but lacks the ascending ramus and angle, the Silver Creek ground squirrel is discern-

ably larger than *Spermophilus leucurus* (=*Ammospermophilus leucurus*), *S. spilosoma*, *S. townsendii*, and *S. tridecemlineatus*. It is slightly larger than *S. lateralis*. The fossil M_3 is much longer anteroposteriorly than the M_2, while in *S. lateralis* M_3 exceeds M_2 but little in length, Also, the P_4 of the Silver Creek form is nearly quadrate; in *S. lateralis* it is trapezoidal, as the distance between the protoconid and metaconid is distinctly less than that between the hypoconid and entoconid.

Only one ground squirrel currently occurring in Utah, *Spermophilus variegatus*, is larger than the present fossil. This species further differs by possessing a narrower reentrant between the protoconid and hypoconid in the lower cheek teeth and an M_3 that is just a little longer anteroposteriorly than the M_2. *S. columbianus* is also larger than the Silver Creek ground squirrel, but its southern range terminates in southern Idaho.

The three remaining Utah ground squirrels are *Spermophilus armatus*, *S. beldingi*, and *S. richardsonii*. According to Durrant (1952), these three species superficially resemble each other. Based on my observations of their dentitions, these species are probably very closely related: Hall and Kelson (1959) placed them in the same subgenus. Although their sizes overlap considerably, the skull and jaws of *S. armatus* average larger than both *S. beldingi* and *S. richardsonii*. The average fossil size fits more closely with that of *S. armatus*. Of the dental characters, the greatest distinction seems to be a relatively larger M_3 talonid in *S. armatus* and the present fossil. The only other difference observed of possible significance is the configuration of the P_4 anterior to the protolophid. In *S. armatus* an anterior reentrant-like structure is in evidence, while in the Silver Creek specimen a distinct lake occurs. If the enamel ridge running anteromedially from the protoconid was higher, then a lake similar to that in the fossil P_4 would be formed (wear stages being equivalent). Unfortunately only one P_4 of the fossil ground squirrel is known.

At present *Spermophilus armatus* inhabits the area of the Silver Creek site. *S. richardsonii* is known in Utah only along the northeastern borders and *S. beldingi* from the northwestern corner.

Eutamias minimus (Bachman, 1839)

ABUNDANCE: One individual based on a right lower first molar (UUVP 7888).

HABITAT: *Eutamias minimus*, the least chipmunk, is known from diverse habitats ranging from low sagebrush deserts to high mountain forests.

DISCUSSION: Five species of chipmunks are currently known in Utah: *Eutamias dorsalis*, *E. quadrivittatus*, *E. umbrinus*, *E. amoenus*, and *E. minimus*. Only minor, albeit significant, differences were noted in the M_1s of these species. The first two named chipmunks averaged slightly larger than the latter three. However, none of the M_1s showed much size difference. The mesoconid is somewhat variable, but certain distinctions do occur among the species. It usually appears as an isolated structure of moderate size in *Eutamias dorsalis*. It is also of moderate size in *E. minimus* and the fossil tooth but in these it is part of an ectolophid. Based upon a limited number of specimens (eight), *E. amoenus* has a relatively large mesoconid that essentially fills the depression between the protoconid and hypoconid. There is a subdued ectolophid. Lower first molars of *E. quadrivittatus* and *E. umbrinus* commonly do not have a distinct mesoconid. This cuspid usually appears as part of a fairly distinct ectolophid. A small but distinct protolophid is visible on many M_1s of *E. minimus* and on the fossil M_1. Except for an incipient protolophid on one specimen of *E. dorsalis*, none of the other comparative teeth evinced this structure. The Silver Creek *Eutamias* compared favorably only to *E. minimus* in all of the above characters. This species occurs now throughout most of Utah.

Family GEOMYIDAE

Thomomys talpoides (Richardson, 1828)

ABUNDANCE: Minimum number of three individuals evidenced by the right lower first and second molars. Total number of elements 13, including an incomplete right jaw with dentition (UUVP 7448), three incisors (UUVP 7629, 7884, 7927), two lower premolars (UUVP 7579, 7673), an upper molar (UUVP 7910), and six lower molars (UUVP 7519, 7523, 7652, 7663, 7666, 7900).

HABITAT: The northern pocket gopher is typically found in montane meadows throughout its geographic range. It is also found, though, in grassy prairies, brushy areas, and open forests.

DISCUSSION: Only one genus and two species of gopher are known at this time from Utah: *Thomomys talpoides* and *T. bottae*. Typically *T. talpoides* inhabits the mountains and high valleys while *T. bottae* usually inhabits lower valleys and the lower mountains of the Basin and Range Province of Utah. *Thomomys talpoides* is presently common in the area of the Silver Creek site while *T. bottae* has an eastern limit in northern Utah about 20 miles to the west.

The size range of these two species of pocket gophers greatly overlaps, although *T. bottae* averages somewhat larger. In a comparison of many individuals of many subspecies of *T. talpoides* and *T. bottae*, it was found that two dental characters of the lower cheek teeth apparently serve to separate them. Almost always the P_4 trigonid of *T. bottae* is bilaterally symmetrical while that of *T. talpoides* is not. And M_1 and M_2 in *T. bottae* have pronounced labial sulci, while these molars in *T. talpoides* usually do not. The fossil gopher's size, asymmetrical P_4 trigonid, and lack of labial sulci in M_1 and M_2 fall well within the range of variation of *T. talpoides*.

One P_4 from the Silver Creek fauna (UUVP 7673) evidently represents a very young individual as indicated by an anterior embayment of the trigonid and very wide isthmus that joins the trigonid and talonid. It was observed that very young *T. talpoides* individuals evinced similar characters in the P_4, but juveniles of *T. bottae* did not. In the latter species one immature individual's P_4 had not yet reached the occlusal plane of the molars. Nevertheless, the isthmus was very narrow as in adult forms (adult specimens of both *T. bottae* and *T. talpoides* have a narrow isthmus connecting the P_4 trigonid to the talonid).

Family CRICETIDAE

Peromyscus maniculatus (Wagner, 1845)

ABUNDANCE: Minimum number of two individuals based on the left lower first molar. Total number of elements five,

including a left jaw (UUVP 7440), a left lower first and second molar (UUVP 7441, 7443), a right lower first molar (UUVP 7336), and a right upper first molar (UUVP 7442).

HABITAT: The deer mouse, which is ubiquitous in most of North America, occupies a wide variety of habitats. *Peromyscus maniculatus rufinis* is the subspecies that presently occurs in the Silver Creek area. It is the dominant form in Utah's mountainous regions.

DISCUSSION: Of the few species of *Peromyscus* that now inhabit Utah, only two, *P. boylii* and *P. maniculatus*, have geographic ranges that include the site of the present fossil fauna. Additional species from Utah that were used in comparison with the Silver Creek *Peromyscus* include *P. eremicus*, *P. crinitus*, and *P. truei*. Seventy-five specimens of *Peromyscus* were used in the identification of the Silver Creek deer mouse, with a minimum of 10 representing a species. The above five species are quite variable in most of their dental characters, and differences between them are slight. However, the dental characters of the fossil *Peromyscus* only completely coincide with those of *P. maniculatus*.

Just *P. crinitus* and *P. maniculatus* from Utah are as small as the fossil specimens, all other species being noticeably larger. The stage of M_3 reduction is about the same for these two species and for *P. eremicus*. In *P. boylii* and *P. truei*, this tooth is almost always relatively less reduced. The anterointernal reentrant is usually more pronounced and the anteroconid smaller in M_1s of *P. maniculatus* and the fossil than in the other species for a similar stage of wear. *P. maniculatus* and the present fossil are unique in possessing an anteroconule that is joined to the anterocone by a distinct loph (anteroloph) in M^1. This loph extends labially. Although an anteroconule occurs in all other observed species, it is never as frequent nor is there ever a distinct anteroloph (*P. boylii* has an indistinct anteroloph, though, that extends posteriorly from the labial margin of the anterocone to the anteroconule). *P. crinitus* specimens have the lowest frequency of anteroconules (4 of 16) and *P. maniculatus* the highest (25 of 25).

Considering the high degree of variation noted in species of *Peromyscus*, ex-

treme care should be exercised before naming new fossil species. Characters cited in the literature for recognition of new species from the Late Pleistocene were seen in extant taxa.

Ondatra sp. Link, 1795

ABUNDANCE: Minimum number of eight individuals based on the right lower first molar. Total number of elements 81, including 13 incomplete jaws and jaw fragments (UUVP 7355-7367), 46 isolated teeth and tooth fragments (UUVP 7353, 7368-7407, 7763, 7926, 7928, 7934, 7890, 7763), two vertebrae (UUVP 7418, 7434), four incomplete humeri (UUVP 7423, 7427, 7432, 7437), two incomplete ulnae (UUVP 7430, 7431), four metapodials (UUVP 7424, 7425, 7433, 7438), five incomplete femora (UUVP 7419, 7422, 7425, 7426, 7435), and five incomplete tibiofibulae (UUVP 7420, 7421, 7428, 7429, 7436).

HABITAT: The living muskrat, which is monotypic, occupies marshes, ponds, lakes, and streams throughout most of North America.

DISCUSSION: Although Semken (1966) and Nelson and Semken (1970) helped clarify some of the taxonomic problems relating to fossil muskrats, several problems regarding valid species apparently still exist. Hollister (1911) named two new species of *Ondatra*, *O. nebrascensis* and *O. oregonus*. His first-named species has been recognized in several local faunas but the second, *O. oregonus*, has not. The latter species has been briefly mentioned in several papers discussing fossil muskrats, but it has not been seriously considered in detailed comparisons. *O. hiatidens*, named by Hibbard (1947) to include the synonymous forms *Arvicola hiatidens*, *Anaptogonia hiatidens*, and *Sycium cloacinum*, and later elaborated upon (1955a), seems to have suffered a similar fate. In 1960, Stephens synonymized *Ondatra triradicatus* with the living species, *O. zibethicus*. Semken (1966:154) mentioned this synonymy, but by inference in his scatter diagram (Fig. 4, p. 154) listed *O. triradicatus* from the Berends local fauna of Oklahoma as *O. nebrascensis*. Stephens (1960:1695) and Semken (1966:153) both considered *O. kansasensis* a synonym of *O. annectens*.
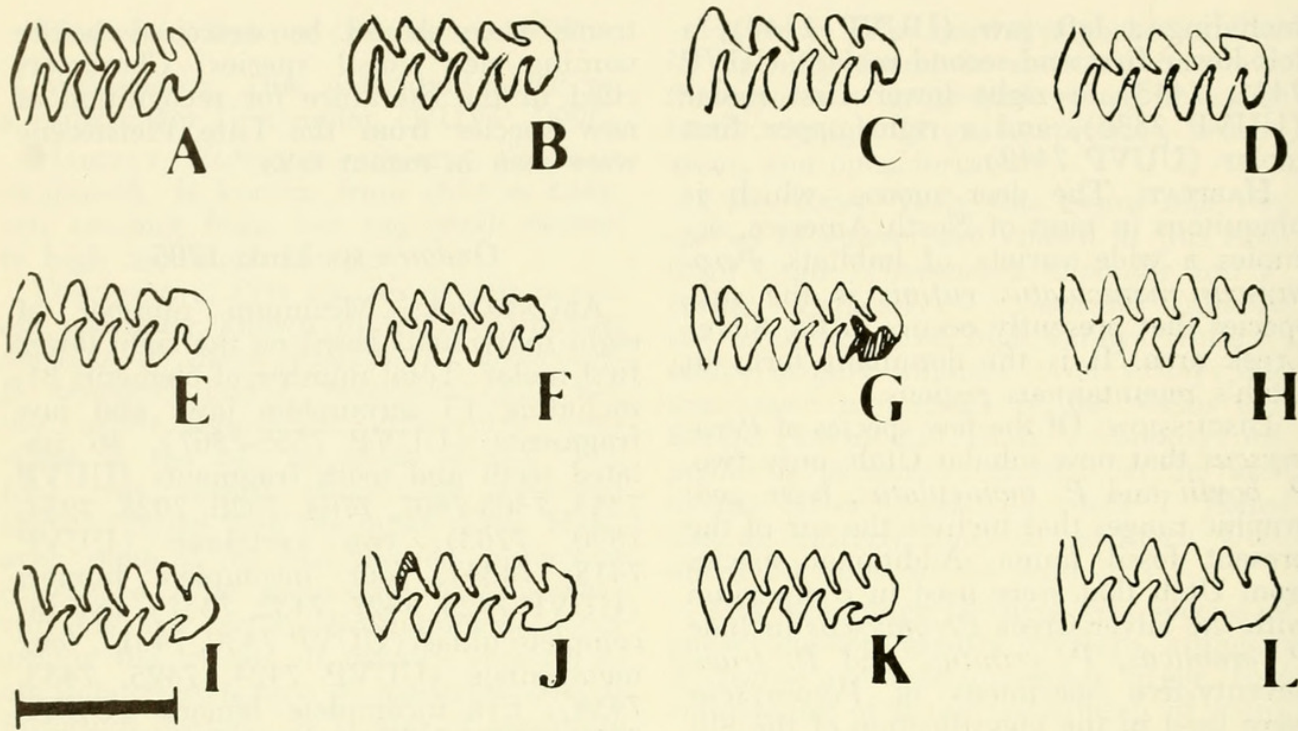
Fig. 3. *Ondatra* sp., left M_1s: A, UUVP 7360; B, UUVP 7356; C, UUVP 7358; D, UUVP 7363; E, UUVP 7364; F, UUVP 7385. Right M_1s, G, UUVP 7357; H, UUVP 7359; I, UUVP 7365; J, UUVP 7381; K, UUVP 7382; L, UUVP 7389. All occlusal views. Line in lower right-hand corner represents 5 mm.

However, not everyone recognizes this synonymy.

Based on measurements given in the literature, *Ondatra hiatidens, O. annectens* (=*O. kansasensis*), and *O. idahoensis* are much smaller than the present fossil muskrat. Also, *O. idahoensis* purportedly has but five alternating triangles on first lower molars; the present specimens have seven (Fig. 3). *O. oregonus*, according to Hollister (1911:33), is only a little larger than *O. annectens*, and therefore smaller than the Silver Creek *Ondatra*. The anteroposterior length of the M_1 from the type specimen is 6.0 mm and the combined length of M_1 and M_2 is 9.0 mm. The average length of M_1 for the Silver Creek muskrat (11 specimens) is 6.9 mm and the average combined length of six M_1s and M_2s included in jaws is 10.8 mm. Stephens (1960:1693) considered *O. nebrascensis* a synonym of *O. zibethicus*, but Semken (1966:153) recognized it as a distinct species, mainly due to its smaller size. According to Semken's (1966:154) and Hollister's (1911:32) measurements, *O. nebrascensis* averages smaller than the Silver Creek species although there is size overlap. Measurements of the upper and lower molars of the latter are shown in Table 1. All Re-

cent *O. zibethicus* skulls and jaws observed (25 specimens) show distinctly larger teeth than the present fossil muskrat. However, in Semken's figure (1966: 154) a few Recent and some fossil *O. zibethicus* do match it in size. Several characters in the Silver Creek specimens other than size seem to separate them from modern species (Fig. 4). In the few specimens where it is preserved, the angular process
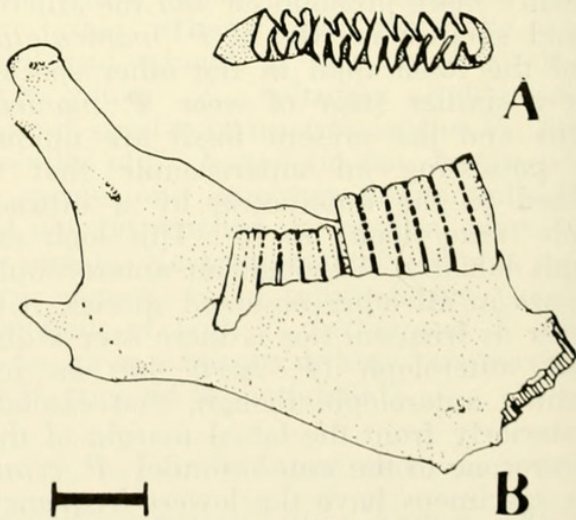

Fig. 4. *Ondatra* sp., left jaw with M_1-M_3, UUVP 7360: A, occlusal view of dentition; B, internal view of jaw. Line beneath figure represents 5 mm.
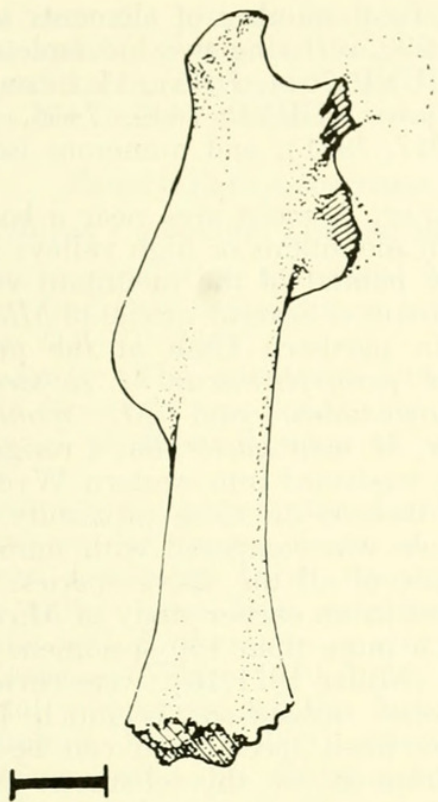
Fig. 5. *Ondatra* sp., anterior view of right femur, UUVP 7426. Line beneath figure represents 5 mm.

of the jaw is much smaller and less distinct than in Recent forms. The labial dentinal tracts on M_1 are quite high, but not as high as those observed on Recent *O. zibethicus* first molars. On one immature M_1 (UUVP 7385) the dentine tract is within 0.5 mm of the occlusal surface on the labial side of the posterior loop. Recent *O. zibethicus* specimens showing a similar wear stage already have the labial portion of the posterior loop interrupted.

Many postcranial skeletons of modern *O. zibethicus* were seen, and comparable elements from Silver Creek differ from them. The two ulnae, for example, have deeper medial sulci running dorsoventrally, posterior to the sigmoid notch. In the fossil femora (Fig. 5) the third trochanter is much more dorsoventrally elongate, broadly joining the greater trochanter rather than being distinct from it or narrowly joining it as in modern forms.

The tibiofibula (Fig. 6) in the two fossil specimens, where it is preserved distally, is of special interest. Although the two specimens represent adults, the tibia and fibula are not fused at their distalmost ends. No observed Recent adult specimens exhibited this degree of separation. In
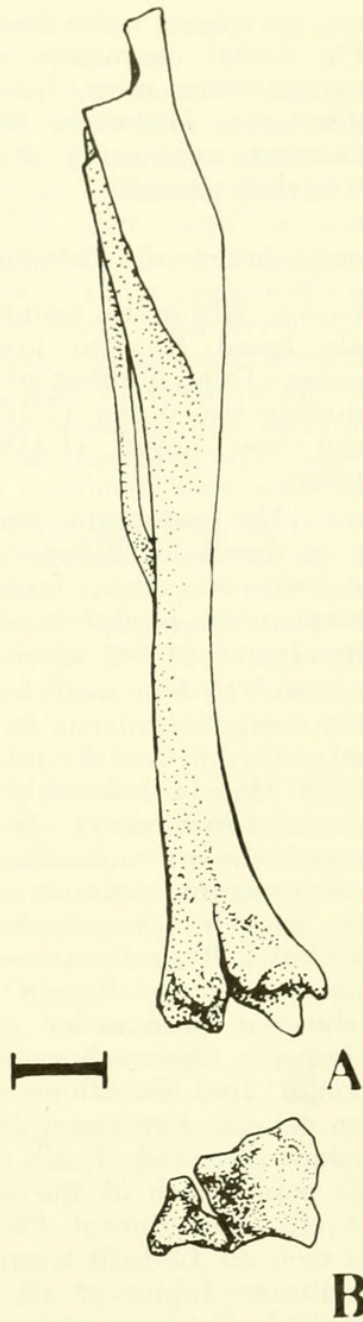
Fig. 6. *Ondatra* sp., right tibiofibula, UUVP 7420: A, anterior view; B, distal view. Line beneath figure represents 5 mm.

them, the two bones were usually well fused distally. Only one specimen, a subadult, showed a line of separation between these bones. It is possible that the Silver Creek muskrat had not reached the evolutionary stage of development of the modern muskrat in the distal fusion of the tibia and fibula.

A number of characters given as diagnostic for species of *Ondatra* were found significantly variable in the specimens from Silver Creek (e.g., amount of cement on molars, shape of M_1 anterior loop, constriction of dentine in alternating triangles of teeth, root development). For

this reason no species name has been assigned. On dental characters alone, the present species seems most closely related to *O. zibethicus.* However, some postcranial elements apparently preclude assignment to that species.

Phenacomys intermedius Merriam, 1889

ABUNDANCE: Minimum number of two individuals based on the lower right second molar. Total number of elements four, including two upper (UUVP 7525, 7658) and two lower (UUVP 7479, 7894) molars.

HABITAT: The mountain phenacomys is known to dwell in different habitats. These include evergreen forests, open grassy areas near mountain tops, and rocky slopes in wet or dry areas.

DISCUSSION: The four teeth from Silver Creek show a great similarity to *Microtus montanus* in size and dental configuration, suggesting a close relationship between *Microtus* and *Phenacomys.* Supposedly, *Phenacomys* is the only microtine in Utah with inner reentrant angles much deeper than outer ones in lower molars (Durrant 1952:360). Regardless, neither the fossil *Phenacomys* nor Recent ones examined show a pronounced difference in this respect. Other characters were noted, though, that do allow separation of the two genera. For example, no *Microtus* molars observed, fossil or living, have roots, while each of the four fossil teeth and all adult Recent *Phenocomys* specimens seen do. Cement is pronounced in the reentrant angles of all *Microtus* molars studied, but none is present in *Phenacomys* (fossil and Recent). The outer triangles in the M_2 of the latter genus are decidedly smaller than those of the former. Also, this tooth (M_2) is more strongly curved (labial concavity) in *Microtus.*

Phenacomys intermedius intermedius is the only mountain phenacomys that occurs in Utah. It is known just from the northern part of the state, which includes the Silver Creek site. No differences could be found between the fossil and living forms.

Microtus montanus (Peale, 1848)

ABUNDANCE: Minimum number of 26 individuals based on the right lower first molar. Total number of elements in excess of 200, includng two incomplete palates (UUVP 7644, 7645), 11 incomplete lower jaws (UUVP 7449, 7456, 7457, 7911-7917, 7921), and numerous isolated teeth.

HABITAT: A moist area near a body of water in mountains or high valleys is the primary habitat of the mountain vole.

DISCUSSION: Several species of *Microtus* occur in northern Utah at the present time, *M. pennsylvanicus, M. richardsoni, M. longicaudus,* and *M. montanus.* Another, *M. ochrogaster,* has a range that extends westward into western Wyoming and is thereby in close proximity. The fossil vole was compared with numerous specimens of all the above species. Also, data used in an earlier study of *Microtus,* in which more than 150 specimens were studied (Miller 1971:16), were reviewed.

Microtus richardsoni is much larger than the fossil species and can be separated from it by this character alone. All other species listed above are comparable in size' to the Silver Creek *Microtus.* *M. pennsylvanicus* has a variable number of closed alternating triangles in its M_1. The Recent Utah specimens observed (34 specimens) have 14 teeth with five closed triangles, 52 with six, and two with seven. Dalquest (1965:71) reported *M. pennsylvanicus* as an abundant taxon in a Pleistocene local fauna from Texas. Most of the first lower molars were said to have six closed triangles, with only a few containing five. All *M. ochrogaster* specimens seen have only three closed triangles. The ratio in *M. longicaudus* was noted as nine to one (36 specimens), five closed triangles as opposed to six. The Silver Creek *Microtus* has twice as many M_1s with five closed alternating triangles as six (22 to 11). This ratio occurred in only one of the comparative species, *M. montanus* (30 to 15). Of the Recent and fossil teeth studied, only *M. pennsylvanicus* has a fifth loop, posteriorly positioned, in the upper second molar. *M. montanus, M. richardsoni,* and the fossil *Microtus* were the only species which evinced a distinct posterior constriction of the incisive foramina.

Based on the above characters, the Silver Creek vole can be distinguished from all species except *M. montanus,* with which it is apparently identical. Two subspecies have current ranges which con-

verge near the present fossil site, *M. m. nexus* and *M. m. nanus*. The average size of fossil specimens more nearly approximates the former subspecies.

Family ERETHIZONTIDAE

Erethizon ? dorsatum (Linnaeus, 1758)

ABUNDANCE: One individual based on a jaw fragment containing a lower first molar (UUVP 7352).

HABITAT: The porcupine usually inhabits forests or woodlands, but may be marginal to them if there is sufficient cover.

DISCUSSION: Apparently *Erethizon* is monotypic for known fossil as well as modern specimens. Other named species have either since been considered conspecific with *E. dorsatum* or else referred to *Coendou* (White 1970:7, 12). In his skeletal comparison of the New World porcupines, White (1968) observed that *Erethizon* could be distinguished from *Coendou* on the basis of occlusal wear patterns. The scratches on the wear surfaces of both upper and lower cheek teeth of the latter species were reported as being oriented anteromediad and forming an angle greater than 35 degrees with the longitudinal axis of the tooth rows. In *Erethizon* this angle reportedly is less than 30 degrees. The M_1 of the Silver Creek porcupine was microscopically studied for masticatory striations on the occlusal surface. It was noted that the orientation of them was about 20-25 degrees anteromediad from the longitudinal axis of the tooth row. This angle falls well within the range of *Erethizon*. Morphologically, the cheek teeth of *Coendou* and *Erethizon* are very similar, although the living species of the former genus have noticeably smaller teeth. The M_1 of the Silver Creek specimen is within the size and configuration limits of that tooth as seen in numerous Recent individuals of *Erethizon*.

Porcupines are quite common throughout Utah today.

Order CARNIVORA
Family CANIDAE

Canis cf. *dirus* (Leidy, 1854)

ABUNDANCE: Minimum number of one individual. Total number of elements, three, including an atlas (UUVP 7317), a seventh cervical vertebra (UUVP 7318), and the shaft of a humerus (UUVP 7319).

HABITAT: Apparently the habitat of the dire wolf was diverse, as this animal has been found in association with faunas representing different physical environments. The dire wolf is numerically greater, though, in faunas representing grasslands or other open terrain, such as the one at Rancho La Brea.

DISCUSSION: The atlas, seventh cervical vertebra, and humerus shaft were compared with specimens of *Canis dirus* from the Rancho La Brea and Maricopa deposits in California and with corresponding elements described in the literature. All three elements are within the range of variation noted for this species. The Silver Creek specimens were also compared with the few Pleistocene and Recent ones available of *Canis lupus*. Each element from the present fauna is distinctly more robust than the same bone in the gray wolf. As Merriam (1912:238) noted, the humerus of the dire wolf is a massive bone compared with other canids. And although the size ranges of the two wolves overlap, *C. dirus* is discernably more massive in most of its skeletal elements. Other Late Pleistocene North American wolves have been synonymized by recent workers with either *Canis dirus* or *C. lupus*. Lundelius (1972:20) stated that there was no basis for considering *C. ayersi* a separate species from *C. dirus*. Martin (1974:76) considered *Canis armbrusteri, C. milleri,* and *C. occidentalis* as synonyms of *C. lupus*.

Since the type of *Canis dirus* consists of a maxillary with dentition, it is not possible to make a positive identification with the present material. However, as indicated above, the three postcranial bones resemble *C. dirus* more than *C. lupus*. The latter species has been reported from Utah in historic times. (Durrant 1952: 398; Hall and Kelson 1959:849), but has not been identified in the fossil records of this state. *C. dirus* has not previously been reported from Utah, although it is known from the west to the east coast of North America in numerous Late Pleistocene deposits.

Canis ? latrans Say. 1823

ABUNDANCE: One individual based on a proximal phalanx (UUVP 7321).

HABITAT: The ubiquitous coyote is

known to occupy habitats ranging from deserts to mountains throughout most of North America.

DISCUSSION: A proximal phalanx is the only evidence for coyote. It is much smaller than the smallest corresponding phalanx of either *Canis dirus* or *C. lupus.* In comparison with a number of proximal phalanges of Recent coyotes from Utah, it was found to be slightly longer and distinctly more robust than the largest male. However, its length and robustness were matched by a few of the larger coyote specimens from the Rancho La Brea, McKittrick, and Maricopa brea deposits in southern California. Based on cranial measurements by Merriam (1912:267) and Giles (1960:380), the Pleistocene coyote from Rancho La Brea was a little larger than the modern form. Probably, Late Pleistocene coyotes from Utah were also larger than their modern counterparts. The greatest length of the Silver Creek phalanx is 27.0 mm, least width of shaft is 5.5 mm, greatest mediolateral width at the proximal end is 8.8 mm, and greatest mediolateral width at the distal end is 7.5 mm.

Coyotes are currently known from all parts of Utah as well as from adjacent states.

Family MUSTELIDAE

Mustela cf. *erminea* Bonaparte, 1838

ABUNDANCE: One individual based on an incomplete lower left jaw with partial dentition (UUVP 7444).

HABITAT: Ermine prefer brushy or wooded areas in close proximity to water.

DISCUSSION: The Silver Creek specimen is a nearly complete horizontal ramus that includes P_2 - M_1; P_3 and M_1 show a moderate amount of wear. Alveoli for the canine and last molar are preserved. The size and configuration of the jaw and teeth closely resemble Recent specimens of ermine from Utah. It was noted, however, that the present specimen also closely resembles *Mustela rixosa,* the least weasel. Although this weasel is generally smaller than the ermine, a number of specimens of both species seen were similar in size. The Silver Creek jaw is equal in size to some *M. rixosa* jaws, but the P_2 and P_3 of the fossil are a little larger.

Mustela erminea is not presently common in Utah, but its range does include

the Silver Creek locality. *M. rixosa* does not currently inhabit Utah or adjacent states, nor is there a reported fossil record of this mustelid in Utah.

Mustela vison Schreber, 1777

ABUNDANCE: Minimum number of one individual. Total number of elements two, including a right upper first molar (UUVP 7445) and a right upper second premolar (UUVP 7446).

HABITAT: Mink are always found in close proximity to bodies of water.

DISCUSSION: The mink is the largest member of the genus *Mustela* in North America (the extinct sea mink, *M. macrodon,* was larger than *M. vison,* however). The M^1 from the present fossil site is as large as the largest Recent specimen from several localities in western North America, of which 20 were observed. Its maximum anteroposterior length is 4.0 mm and maximum transverse width is 6.8 mm. Morphologically, this tooth is indistinguishable from the modern form. Size and wear stage of the P^2 indicate it probably belonged to the same individual as the M^1. It, too, showed no differences from the same tooth of the living mink.

Mustela vison is currently present in the general area of the fossil site. However, it is not now abundant due to heavy trapping in the past. This species is rare in the fossil record of North America.

Taxidea taxus (Schreber, 1778)

ABUNDANCE: One individual based on a left, lower first molar (UUVP 7349).

HABITAT: The badger is known in habitats varying from mountains to deserts, being especially common in grassland areas.

DISCUSSION: Although not common, Pleistocene badgers are known from a number of localities, mostly in the western United States. Hall (1936:79) recognized only one species of badger, *Taxidea taxus,* for all living and Pleistocene forms. The Silver Creek specimen compares very favorably with the M_1 of Recent badgers. The only difference noted was the more pronounced twinning of the hypoconulid in the fossil tooth. However, only a few specimens were available for comparison. According to Kurtén and Anderson (1972:33), both living and Pleistocene

populations show considerable sexual and individual variation. Therefore, it is assumed that a larger comparative sample would include specimens that show comparable degrees of hypoconulid twinning. The above authors also recognize only one species, *T. taxus*, for all Late Pleistocene and Recent forms.

Badgers are currently widespread throughout Utah (Durrant 1952:427) and still occur in the area of the present fossil site.

Family FELIDAE

Smilodon cf. *floridanus* (Leidy, 1889)

ABUNDANCE: Minimum number of one individual. Total number of elements three, including an upper canine fragment (UUVP 7314), an atlas (UUVP 7316), and a humerus (UUVP 7315).

HABITAT: Based on known occurrences of this species, the saber-toothed cat probably occupied different habitats. The majority of fossils, though, have been associated with grassland faunas.

DISCUSSION: The saber-toothed cat has not previously been reported from the Pleistocene of Utah. Its presence is to be expected, however, as it has been identified in widely separated deposits throughout the Western Hemisphere. Its closest known occurrence to the present site is in southern Idaho (Hopkins et al. 1969: 4). All three elements from the Silver Creek fauna were compared with numerous similar ones from Rancho La Brea. They were found indistinguishable from them.

Apparently only two genera of saber-toothed cats, *Homotherium* and *Smilodon*, are currently recognized in the Late Pleistocene of North America by most workers (e.g., Churcher 1966:273; Waldrop 1974:156). The former genus is reported to be about the same size as the latter but much lighter in build. Thus, in this respect, *Homotherium* is more similar to the true felids (Churcher 1966: 268). Its upper canines are distinctly shorter and more mediolaterally compressed than those of *Smilodon*. Although the canine tooth fragment from the present fauna is only 30 mm in length, it is less compressed than a similar segment of a *Homotherium* canine. Its configuration is identical to *Smilodon*, though. This fragment is part of the upper root, prob-

ably just inside the alveolus. No enamel is present. It measures 36.6 mm in anteroposterior diameter, and its transverse diameter is 19.8 mm. The Silver Creek humerus is relatively massive for its length (Fig. 7) and thus it does not favorably compare with *Homotherium* or the true cats. Both wings of the atlas are missing but this bone, too, is identical to *Smilodon*.

Many species names have been included in the genus *Smilodon*. However, by current usage most of these names have been placed in synonymy (e.g., Slaughter 1963:75; Kurtén 1965:246; Webb 1974:150). Lammers (1962), in an unpublished dissertation, placed *Smilodon californicus* in synonymy with the previously named *S. floridanus*. Kurtén (1965: 246), though, concluded that *S. floridanus* should be synonymized with *S. fatalis*. On the basis of new material from Florida, Webb (1974:151) stated that *S. floridanus* is distinct from *S. fatalis* but that *S. californicus* is conspecific with *Smilodon floridanus*, as was previously contended by Lammers.

Smilodon floridanus seemingly replaced *S. fatalis* through the Late Pleistocene, possibly causing the latter species to become extinct well before the close of this epoch. According to Slaughter (1963: 78), *S. fatalis* is only definitely known from Middle Pleistocene to the earliest part of the Wisconsin. Since *Smilodon fatalis* has apparently only been distinguished from *S. floridanus* on the basis of dental characters, it is not prudent to assign the Silver Creek material to species with certainty. But since *S. floridanus* was evidently by far the most numerous Late Pleistocene saber-toothed cat, and since the present specimens are indistinguishable from it, they have been tentatively referred to that species.

Lynx cf. *canadensis* Kerr, 1792

ABUNDANCE: One individual based on a left upper third premolar (UUVP 7351).

HABITAT: The Canadian lynx currently dwells in forested areas at high elevations in northern North America.

DISCUSSION: The above specimen from the present fauna was compared to more than 60 specimens of *Lynx rufus* (the bobcat). It is larger than the correspond-
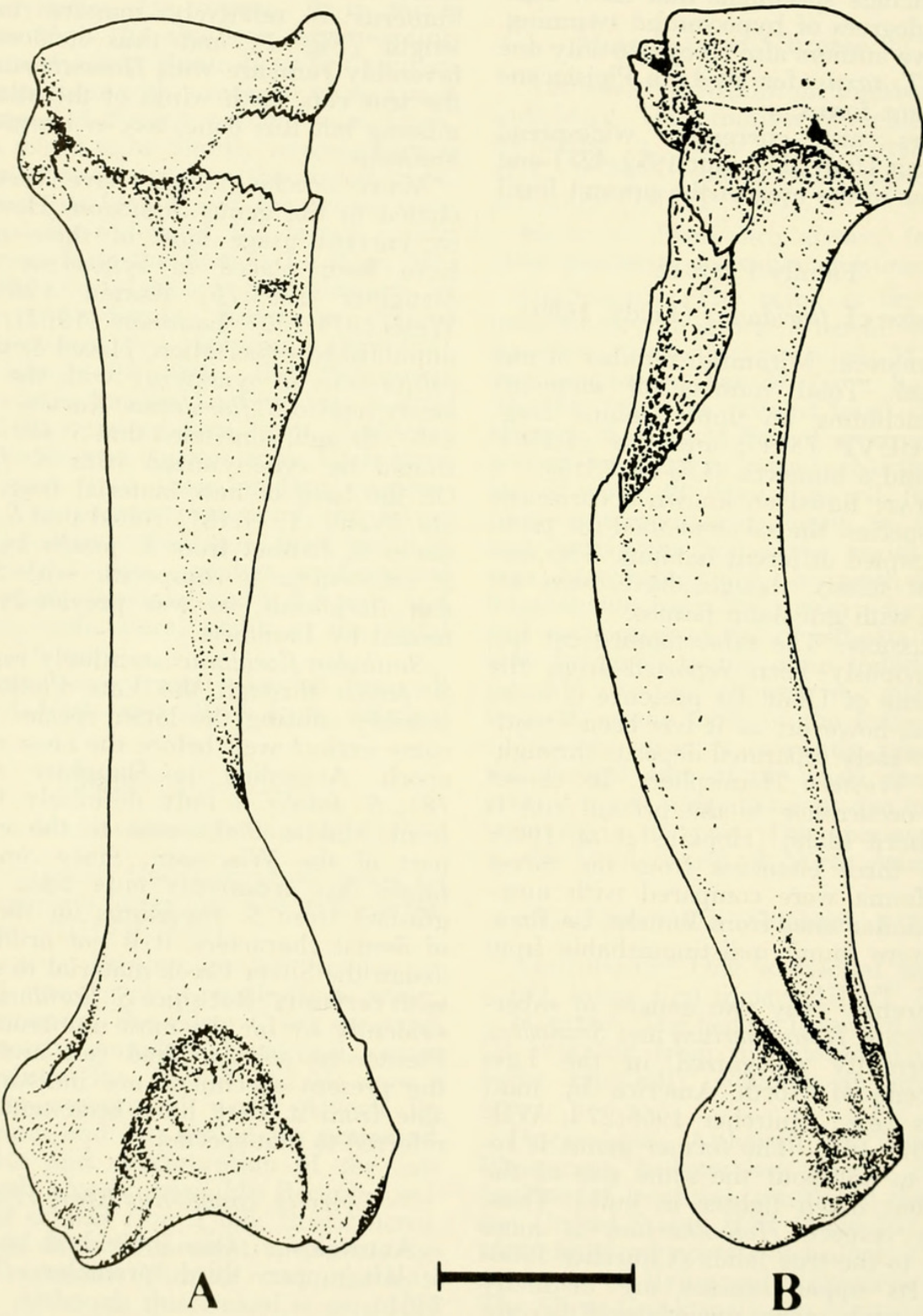
Fig. 7. *Smilodon* cf. *floridanus*, right humerus, UUVP 7315: A, posterior view; B, medial view. Line beneath figure represents 50 mm.

ing tooth in the largest individuals seen. Although only a few *L. canadensis* specimens were available for comparison, the Silver Creek premolar compared favorably in size and configuration with the largest individual.

The lynx is still present in Summit County, Utah, but is now very rare. Kurtén and Anderson (1972:23) reported a Canadian lynx from a Late Pleistocene cave deposit in Idaho and indicated that this felid is only rarely found in the fossil state.

Order PROBOSCIDEA
Family ELEPHANTIDAE

Mammuthus cf. *columbi*
(Falconer, 1857)

ABUNDANCE: Minimum number of four individuals based on deciduous and permanent dentitions and their attendant wear stages. Total number of elements 68, including two occipital condyles and an incomplete maxilla (UUVP 8026-8028), 13 complete and incomplete teeth (UUVP 7320, 8011, 8054-8064), tusk fragments (UUVP 7979), 19 vertebrae and vertebral fragments (UUVP 7284, 7285, 7287, 7290-7294, 7296, 7301-7304, 7311-7313), 13 incomplete ribs and rib fragments (UUVP 7268, 7270-7278, 7280, 7305, 8051), two femur heads (UUVP 7298, 7300), a patella (UUVP 7297), an incomplete fibula (UUVP 7263), 15 foot elements (UUVP 7261, 7262, 7264-7267, 7279, 7281, 7283, 7306-7310), and miscellaneous limb fragments (unnumbered).

HABITAT: Based on associated faunal types, this widespread species probably primarily occupied grasslands and savannas where significant amounts of perennial water existed.

DISCUSSION: As ascertained from the literature, the status of North American mammoth taxa is a very confused one. The recorded number of recognizable species is as high as 16 (Osborn 1942) and as low as two (Aquirre 1969); however, most current authors accept four or five as valid. Inadequate type specimens and diagnoses, and a relative abundance of mammoth teeth in the fossil record showing intergrading characters, has led to this confusion. One result has been that a number of authors are reluctant to identify North American mammoths to species, even when complete adult molars are

manifest (e.g., Anderson 1974; Lance 1959; Whitmore et al. 1967).

In 1857 Falconer described *Elephas columbi* on the basis of an incomplete lower third molar. A year later, Leidy (1858) identified another species, *E. imperator*. He used an incomplete upper third molar as his type. The subsequent history of these two species is very complex, with neotypes having been selected for each (Osborn 1922:2-3) and later having been rejected (Aquirre 1969: 1376). Generic names to which these species have been assigned have also changed. Originally described as species of *Elephas*, *E. columbi* was later placed by Osborn (1942) in the genus *Parelephas*, and *E. imperator* in the genus *Archidiskodon*. However, Osborn did consider both of them as species of *Elephas* in his 1922 paper. Although current usage is not unanimous, most authors do recognize "*columbi*" and "*imperator*" as species of *Mammuthus*. Because the complexities involved in the history of these two species is mostly beyond the scope of the present paper, the interested reader is referred to the following literature: Aquirre (1969), Falconer (1857, 1863), Harington et al. (1973), Leidy (1858, 1869), Maglio (1973), Miller (1971), Osborn (1922, 1942), Savage (1951), and Whitmore et al. (1967).

Many recent investigators have reported *M. imperator* in Late Pleistocene deposits (Churcher 1972:1562; Hopkins et al. 1969:4; Whitmore et al. 1967:1478-1479, and others). However, Aquirre (1969:1367), Maglio (1973:63), and others restricted *M. imperator* to the Middle Pleistocene (Aquirre:1367, Fig. 1, showed the chronologic range of this species extending back to the Early Pleistocene). He (1969:1374, Fig. 8) and Maglio (1973:77, Fig. 13) both regarded *M. imperator* as ancestral to *M. columbi*, the latter species being essentially a Late Pleistocene form. But Savage (1951:237) recognized *M. columbi* in the Middle Pleistocene desposits of Irvington, California, and cast doubt on the characters used by Osborn (1942) to separate *M. imperator* from *M. columbi*. Slaughter et al. (1962:20) questioned the distinctness of these species, as did Miller (1971:20). In order to determine whether the Columbian and Imperial mammoths are actually separate species, a comprehensive study
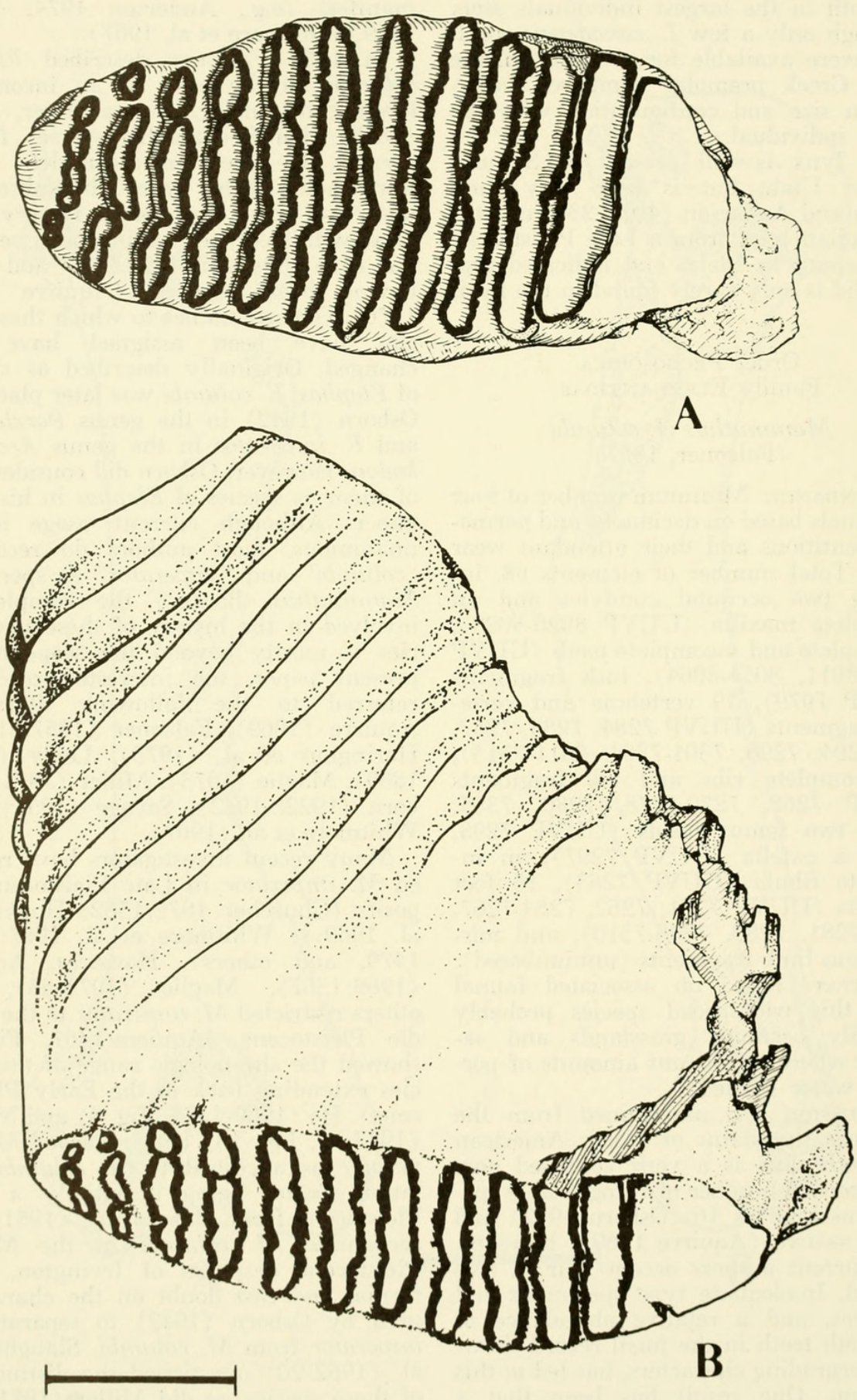
Fig. 8. *Mammuthus* cf. *columbi*, left M³, UUVP 8061: A, occlusal view; B, lingual view. Line beneath figure represents 50 mm.

of North American mammoth material from Middle and Late Pleistocene deposits, especially dentitions, should be made. Material from widely separated geographic areas must be taken into account. Maglio (1973:61) suggested that an extensive study of North American mammoths would be very desirable.

Most mammoth fossils from the Silver Creek local fauna represent immature animals. However, a complete upper third molar (UUVP 8061, Fig. 8), an incomplete lower third molar (UUVP 7320), and some postcranial bones are indicative of an adult (or adults). The lamellar frequency of these molars (number of tooth plates along a 100 mm anteroposterior line) was taken at the occlusal surface and base on both the linqual and labial side, then averaged as admonished by Maglio (1973:12), to make measurements more meaningful. Care was taken to obtain the true rather than the apparent enamel thickness on the tooth plates. (The thickness commonly appears greater on the occlusal surface due to the angle of wear.) An average of several enamel measurements on different tooth plates was obtained for each molar. The upper third molar from the present fauna has 19 plates, disregarding the anterior loop, and an average lamellar frequency of seven plates per 100 mm. (A difference of only one-half a plate resulted from the four points of measurement listed above.) The measurements of enamel thickness varied between 2.2 mm and 2.9 mm, for an average of 2.5 mm. Maximum tooth width, which was measured just below the occlusal surface, is 97 mm. This measurement was taken parallel to the fourth plate and included the cement. The greatest tooth height, measured parallel to the twelfth plate from the basal enamel salient to crest of the superior surface, is 208 mm. Plate 12 occurs at the posteriormost edge of the grinding surface and is essentially unworn. This plate's maximum width is 90 mm, with about 70 mm above its base. Although the lower third molar is incomplete, its lamellar frequency and enamel thickness have been determined. The former averages six-and-one-half per 100 mm and the latter averages 2.3 mm. Two nearly complete upper second molars (UUVP 8054, 8062), probably from the same individual, each have 16 plates and a lamellar frequency that ranges from

seven to eight-and-one-half, for an average of eight. The average enamel thickness is 2.1 mm. Except for the first five or six plates, cement does not cover the labial or lingual edges, and is only found in the grooves separating the plates. In specimen UUVP 8054, the highest plate is the fifth, measuring 175 mm. Its maximum width is 70 mm. Specimen UUVP 8062 is highest at plate six, 183 mm, which has a maximum width of 70 mm. The greatest overall width of the first M^2 is 80 mm, and that of the second is 78 mm. Only the first three to four plates on these teeth are worn.

Limits of lamellar frequencies and enamel thicknesses, as well as the other characters used in recognition of *Mammuthus columbi*, differ with investigators (e.g., Davis et al. 1973; Maglio 1973; Osborn 1942; Savage 1951). Even so, the Silver Creek mammoth apparently fits all these authors' concepts of *M. columbi*. The measurements for the Silver Creek mammoth given above do, however, correspond with lower lamellar frequencies and greater enamel thicknesses listed for *M. jeffersonii* (Osborn 1922). I am in agreement, though, with Aquirre (1969: 1374) and Maglio (1973:63), who regard this species as a variant of *M. columbi*. *Mammuthus primigenius* differs from the present mammoth by possessing a greater number of tooth plates on $M\frac{3}{3}$ and by having a higher lamellar frequency and thinner enamel plates.

Several reports have indicated mammoth fossils from northern Utah (Bissell 1968; Gilbert 1890; Hansen 1929; Knight 1903). The first two authors did not classify their fossils to species, but the other two did. Knight (1903:828) identified a tooth from the Bear Lake region as *Elephas primigenius*. But since the tooth was neither figured nor described, it is not possible to confirm or deny the identification. However, it probably represented a Columbian mammoth, not a Woolly mammoth. Hay (1927:46) stated that Knight's identification was doubtful. Hansen (1929:7) regarded an incomplete skeleton recovered from Lake Bonneville sediments near Springville, Utah, as belonging to *Elephas primigenius*. I have seen this partial skeleton, which includes two teeth, and consider it to be *M. columbi*. To my knowledge, no mammoth specimens from the contiguous 48 states have

been correctly identified as *Mammuthus primigenius.* According to Harrington et al. (1973:296-297), Columbian mammoths (including some previously recognized as Woolly mammoths) ranged into northern Canada and possibly Alaska. The northern limits of *M. columbi* and the southern limits of *M. primigenius* will be better understood after a comprehensive study .of North American mammoths is made.

Order PERISSODACTYLA
Family EQUIDAE

Equus sp. (large) Linnaeus, 1758

ABUNDANCE: Minimum number of four individuals based on upper cheek teeth. Total number of elements 76, including 51 teeth (UUVP 7003-7054, 7257, 7259, 7260), four vertebrae (UUVP 7001, 7056, 7058, 7059), a sacrum (UUVP 8013), two partial scapulae (UUVP 7235, 7236), an incomplete humerus (UUVP 7057), the distal end of a radius (UUVP 8030), three partial pelves (UUVP 7048, 7055, 8029), an associated scaphoid, unciform, magnum, trapezium-trapezoid, metacarpal, and two splint bones (UUVP 7000), a proximal sesamoid (UUVP 7002), and five phalanges (UUVP 7016, 7017, 7046, 7047, 7256).

HABITAT: Horses are known to inhabit grasslands throughout much of the world.

DISCUSSION: Of the larger vertebrates in the present fauna, the horse ranks second only to the bison in abundance. The abundance of these two taxa alone strongly suggests a predominantly grassland condition in the vicinity of the Silver Creek site.

Despite the numerous studies on Late Pleistocene horses (or perhaps because of them), the status of most species of *Equus* is still in a confused state. Since the number of Pleistocene horse fossils is so great, and the intergrading characters so many, it is very doubtful whether there will ever be even close agreement on valid species. Over 40 species have been proposed from North America alone. Several of these have very complicated nomenclatural histories. Unfortunately, many of them were originally designated on the basis of an isolated tooth or teeth. My observations have shown the variability is such that isolated teeth are usually not diagnostic at the species level.

Often, when more than one *Equus* species is reported from a fauna, postcranial elements are assigned to species on the basis of corresponding tooth size. While this could hold true in many instances, there are some in which it does not (Miller and Downs 1974:7).

Judging from the complete or nearly complete upper cheek teeth from the Silver Creek site, the premolars are noticeably larger than the molars. A moderately worn M^1 or M^2, UUVP 7035, measures 26.2 mm along the ectoloph and 26.3 mm in width, normal to a line joining the parastyle and mesostyle. A moderately worn P^3 or P^4, UUVP 7259, measures 30.1 mm along the ectoloph and 33.8 mm in width). The enamel pattern around the fossettes and the protocone is usually relatively simple, but is moderately crenulated in some specimens. Both the prefossette and postfossette show minimal folding (enlarged crenulations) on all cheek teeth. Pli caballins are present on a few of the molars and premolars, but are absent on most. The anteroposterior length of the protocone is generally great, varying from 18.7 mm to 12.5 mm on worn P^3s through M^2s. This length usually diminishes with wear. A protoconal heel is very distinct on all teeth (no complete P^2 is present, however). Although most protocones are flat along their lingual border, a few exhibit distinct concavity. Three slightly worn deciduous premolars, DP^2-DP^4 (UUVP 7019), all belonging to a single individual as evidenced by the perfect fit at the wear facets, provide information on the milk dentition. Even though the bases of the three teeth are broken, the height of the crown could not have been great. The unworn crown height was probably no more than 45 to 50 mm. The amount of cement covering the external borders of these teeth is much less than that of the permanent ones. In similar measurements previously given for the adult dentition, the anteroposterior length greatly exceeds the width (DP^2, 42.8 mm by 22.0 mm; DP^3, 34.5 mm by 23.9 mm; DP^4, 36.4 mm by 22.9 mm). No suggestion of a pli caballin is present, and the enamel pattern is even less crenulated or folded than that of the replacement teeth. Despite the relatively and absolutely greater anteroposterior length of the milk teeth, the length of the protocone is shorter. The

protoconal length decreases with wear and in this respect emulates the replacement teeth. Protocones on all three deciduous teeth show strong lingual convexities.

As in the upper cheek teeth, the lower molars (with the exception of M_3) are noticeably smaller than the lower premolars. This observation is, of course, based on a limited amount of material. The metaconid is a little larger and distinctly more rounded than the metastylid, which usually possesses a posterolingually directed angle. This angle is subdued in some specimens but distinct in most. The metaconid-metastylid groove (linguaflexid of Skinner and Hibbard 1972) varies from a wide V-shape to a broad U-shape. A pli caballinid is present on nine of 19 specimens, but is very prominent on only one. The ectoflexid is usually asymmetrical and extends lingually into the isthmus in M_3s only.

While most of the postcranial equid fossils are fragmental, a few foot bones are intact. A complete metacarpal (UUVP 7000) measures 248 mm in greatest length (trapezoid-magnum ridge to distal keel), 57 mm in greatest transverse width across the proximal articular surface, and 56 mm in greatest transverse width across the distal articular surface. A complete proximal phalanx (UUVP 7017) measures 94 mm in greatest length, 60 mm in greatest transverse width across the proximal articular surface, and 51 mm in greatest transverse width across the distal articular surface. A medial phalanx (UUVP 7047) measure 50 mm in greatest length, 53 mm in greatest transverse width across the proximal articular surface, and 52 mm in greatest transverse width across the distal articular surface. A distal phalanx (UUVP 7256) measures 22 mm in anteroposterior width along the proximal articular surface at the midline and 52 mm in greatest transverse width along the articular surface. (All the above dimensions were taken across articular surfaces only, even though processes or flanges would give a greater measurement.) The above foot bones articulate well and could represent the forefoot of a single horse.

Savage (1951:252) recognized only seven valid species of caballine *Equus* in the Late Cenozoic of North America. Although some later workers (e.g., Hibbard 1970; Hopkins et al. 1969; Lundelius

1972) acknowledged additional species, the type specimens on which most are based seem to to be diagnostic for reasons cited above. The species recognized by Savage are: *Equus tau, E. giganteus, E. pectinatus, E. bautistensis, E. scotti, E. caballus,* and the species from Rancho La Brea (usually regarded as *Equus occidentalis*). The large equid from Silver Creek cannot be referred to *E. conversidens* (=*E. tau*) because of its distinctly larger size, or to *E. giganteus* because it is considerably smaller than that species. *E. pectinatus* is recognized as a species largely on the basis of its relatively small protocone and complicated enamel plications. Neither of these characters are shown by the present horse teeth. One of the characters used by Frick (1921: 303) in his type description of *E. bautistensis* was the bilobed nature (lingual concavity) of the protocone. As noted above, the protocone of most upper cheek teeth from the present site are flat along their lingual border. Also, their average anteroposterior length significantly exceeds that of Frick's (1921) type and referred topotypal specimens. Although Frick (1921:303) stated that the protocone of *E. bautistensis* was anteroposteriorly longer than that of the Rancho La Brea horse, my observations indicate that just the opposite is true. Generally, the enamel border of the prefossette and postfossette of *E. bautistensis* are more folded and crenulated than the Silver Creek equid. In addition, the linguaflexid of *E. bautistensis* is described by Frick as being, on the average, sharp. This character, too, differs from that of the horse from the present study area. As previously stated it is wide V-shaped to broad U-shaped. *Equus scotti* was named by Gidley in 1900 (1900:111). The type specimen is a nearly complete skeleton; four additional skulls and parts of other skeletons were associated with it. According to the type description, the teeth of this species are markedly larger and the enamel pattern of the prefossette and postfossette much more complex on the average than the Silver Creek horse. The latter equid apparently has a linguaflexid that is usually more U-shaped, which further serves to distinguish the two species. The horse from Rancho La Brea has commonly been referred to as *E. occidentalis*. However, I have elsewhere (Miller 1971:

21-22) given a brief nomenclature history of this species and have considered it to be a *nomen dubium*. As Savage (1951: 252) has suggested, though, the Rancho La Brea horse is probably a distinct species; many Late Pleistocene horses from the western United States have been referred to it. The limited equid material from the Silver Creek local fauna appears to fall within the range of variability in all its noted characters with that of the horse from Rancho La Brea. However, most of these characters have also been noted on specimens of *E. caballus*. Skinner and Hibbard (1972:120-123) pointed out that the hemionid and asinid groups can be readily separated from the zebrid and caballine horses by the arrangement of the isthmuses on the lower molars. They said that the former two groups possess simple isthmuses in P_2-M_3, whereas the latter two groups have antero- and post-isthmuses due to the lingual extension of the ectoflexid on M_1 through M_3. Antero- and post-isthmuses do occur on the M_3s from the Silver Creek local fauna, but not on the other molars, which have a simple isthmus. However, the wide V-shape to broad U-shape of the linguaflexid on the specimens from the present area of study seems to warrant placing them in the caballine group of horses.

Equus ? conversidens Owen, 1869

ABUNDANCE: One individual based on a left lower first or second molar (UUVP 7061) and a proximal sesamoid (UUVP 7060).

HABITAT: Several species of small equid have been reported from the Pleistocene. Usually these small forms constitute a very small part of a fauna that generally reflects a grassland habitat. Possibly one or more of these small species of *Equus* are only marginally grassland inhabitants. Their major habitat may be savanna or brushy terrain.

DISCUSSION: Although usually rare, small equids have been reported in numerous faunas from Alaska to Mexico. Several names have been proposed for them, including *Equus conversidens, E. tau, E. francisci, E. littoralis, E. quinni, E. achates, E. barcenaei,* and *Onager zoyatalis*. As is true of larger species of *Equus*, much confusion exists regarding

valid names. *Equus conversidens* and *E. tau* were both named by Owen in 1869 on specimens collected in the "Valley of Mexico." The type of *E. conversidens* is a palate with dentition broken along the midline and restored. Gidley (1901:119) argued that this specimen represented two separate individuals, but stated that the species was valid. *E. tau* was named on a fragmental upper dentition (P^3-M^3) probably from one individual, though not so stated by Owen, and three contiguous premolars from the lower jaw. No statement was made indicating whether the lower teeth might correspond to the same individual as the uppers. In 1884, Cope synonymized *E. conversidens* with *E. tau* because he could not detect specific differences between them. (Actually, *E. conversidens* has page priority over *E. tau;* Owen 1869:563-565.) Gidley (1901), however, suspected that Cope never saw the actual type of *E. tau* and did not recognize the synonymy. Skinner (1942: 170) recognized both *Equus conversidens* and *E. tau* on limited material from the Late Pleistocene Papago Springs cave in Arizona. He stated that the former horse was medium-sized and the latter was a true dwarf. Hibbard (1955b:56), however, regarded *E. tau,* as well as *E. littoralis* and *E. barcenaei,* as synonyms of *E. conversidens*. In 1960, Hibbard and Taylor (1960:189) also synonymized *E. francisci* with *E. conversidens.* (*E. francisci* has been spelled *E. francisi* in several observed articles, including the one by Hibbard and Taylor, but in Hay's type description (1915:535) it is spelled *E. francisci.*) Dalquest and Hughes (1965: 417), in their paper on *Equus conversidens,* regarded five species, *E. tau, E. barcenaei, E. littoralis, E. francisci,* and *E. achates,* as being conspecific with it. In restudying the type of *E. francisci,* which is a partial skeleton including a skull and mandible, Lundelius and Stevens (1970) concluded that this species is distinct from *E. conversidens*. Their recognition of this equid as a separate species is based on both dental characters and exceptionally long metapodials. They also synonymized two other *Equus* species, *E. quinni* and *Onager zoyatalis,* with *E. francisci* (1970: 148).

The lower cheek tooth from the Silver Creek local fauna, probably an M_1 or M_2 (Fig. 9), shows a size and dental pattern

that fits within the variability noted for specimens identified as *Equus conversidens*. However, the metaconid-metastylid groove (linguaflexid) has a relatively sharp V-shape, which Lundelius and Stevens (1970:149) stated were characteristic of *E. francisci*. This tooth measures (22) mm in greatest anteroposterior length and 14.2 mm in greatest transverse width just below the occlusal surface. A proximal sesamoid, evidently of an adult, is also considered to represent *E. ? conversidens* based on its very small size.

Order ARTIODACTYLA
Family CAMELIDAE

Camelops cf. *hesternus* (Leidy, 1873)

ABUNDANCE: Minimum number of one individual. Total number of elements, eight, including a jaw symphysis (UUVP 8031), a right lower second and third molar (UUVP 7240, 7239), a lower canine (UUVP 7244), two lower incisors (UUVP 7243, 7245), the distal end of a metapodial (UUVP 7246), and an incomplete proximal phalanx (UUVP 7241).

HABITAT: According to Hibbard and Taylor (1960:186), *Camelops* inhabited open shrub and grasslands. This genus most always occurs with a fauna that also reflects these conditions.

DISCUSSION: The size and wear stage of the teeth indicate that just one individual is represented. When the M_2 and M_3 are held together, the wear facets match exactly. It is not possible to know whether the postcranial material belongs to the same individual as do the teeth, but the size of these elements and the maturity indicated are suggestive of this.

Webb (1965:44) recognized three genera of Pleistocene camels in North America: *Titanotylopus*, *Tanupolama*, and *Camelops*. (*Tanupolama* was regarded as a junior synonym of *Hemiauchenia* in a later paper [Webb, 1974:197].) In 1974 (1974:176) he acknowledged a fourth genus, *Paleolama*, from Pleistocene deposits of Florida and Texas. Langenwalter (personal communication, 1975) has also recognized *Paleolama* in Late Pleistocene deposits of southern California. The Silver Creek camelid is smaller than *Titanotylopus* and larger than *Hemiauchenia* and *Paleolama*. All present material was compared with available speci-
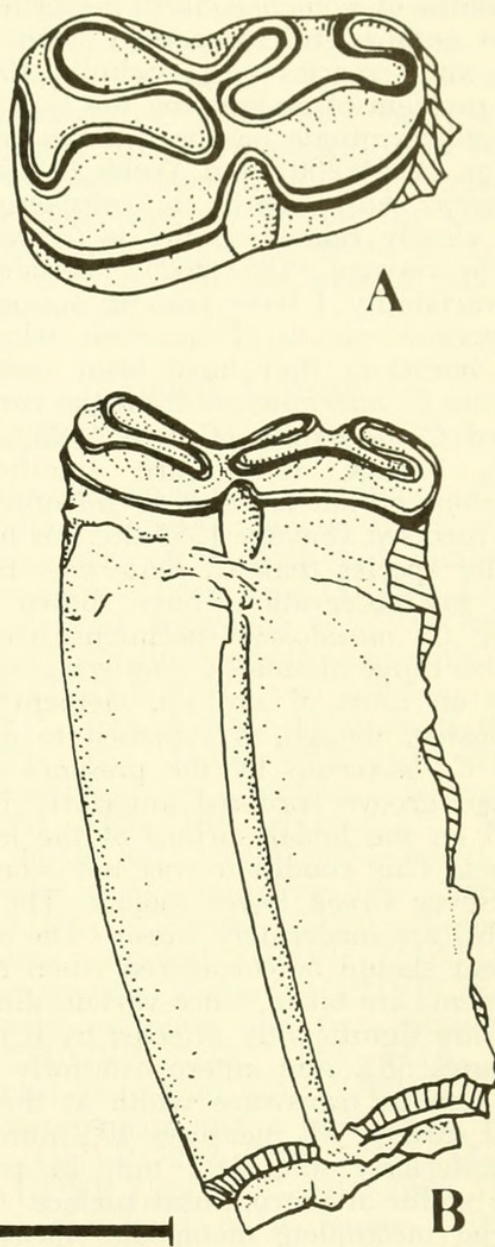
Fig. 9. *Equus ? conversidens*, left M_1 or M_2, UUVP 7061: A, occlusal view; B, labial view. Line beneath figure represents 10 mm.

mens of *Camelops hesternus* from Rancho La Brea at the Natural History Museum of Los Angeles County. Although the Silver Creek specimens were smaller than the average Rancho La Brea *C. hesternus*, they did compare very favorably in size and morphology with the smaller adults. According to Webb (1965:1), only one species of *Camelops*, *C. hesternus*, is present in the Rancho La Brea fauna.

Camelops kansanus (Leidy 1854) is the genotypic species. It was based on a premaxillary-maxillary fragment that was not considered specifically diagnostic by Savage (1951:260). He relegated it to

the status of *nomen vanum*. Nevertheless a few authors still recognize *C. kansanus* as a valid species (e.g., Schultz 1969). The problem of designating the type species indeterminate has been discussed by Savage (1951:260) and Webb (1965:3). *Camelops huerfanensis* is considered a very closely related species to *C. hesternus* by Savage (1951:262). Considering the variability I have seen in species of Pleistocene camels, I question whether the characters that have been used to separate *C. huerfanensis* from the earlier-named *C. hesternus* (Cragin 1892; Hay 1913; Savage 1951) are significant. *Camelops minidokae* and *C. sulcatus* are both reported (Savage 1951:263) as being smaller species than *C. hesternus*. However, my observations have shown that larger *C. minidokae* specimens overlap the size range of small *C. hesternus* specimens on most, if not all, elements. *C. minidokae*, though, is supposed to differ from *C. hesternus* by the presence of a median groove bordered anteriorly by a stylid on the labial surface of the lower molars. This condition was not seen on the Silver Creek lower molars. The M_3 and M_2 are moderately worn. (The stage of wear should be considered when measurements are taken, since various dimensions are significantly affected by it.) M_3 measures 58.2 mm anteroposteriorly and 20.2 mm in transverse width at the occlusal surface. M_2 measures 40.2 mm anteroposteriorly and 21.2 mm in transverse width at the occlusal surface.

The incomplete metapodial measures in excess of 92 mm in greatest transverse width and in excess of 40 mm anteroposteriorly at the distal end. Metacarpals and metatarsals of *Camelops* show little size difference distally. The distal-most end of the proximal phalanx is missing, but otherwise the bone is complete. It apparently belongs to a front foot. The greatest transverse width at the proximal end is 46.1 mm, and the greatest anteroposterior dimension is 36.2 mm.

Camelops is known from numerous Rancho-La-Brean-Age deposits in western North America. The closest locality to the present faunal site that yields significant numbers of *Camelops'* specimens is the American Falls Lake Beds in southern Idaho. Some of the many specimens from here have been reported by Gazin (1935: 300) and Hopkins et al. (1969:4-5). The

only reference to a Pleistocene camel from Utah, other than the present one, was made by Romer (1928; 1929). This specimen, a fragmentary skull, was found in a lava tunnel near Fillmore, Utah. Romer identified it as belonging to the genus *Camelops*, and stated that it probably should be referred to the species *C. hesternus*.

Family ANTILOCAPRIDAE

Antilocapra cf. *americana* (Ord, 1815)

ABUNDANCE: Minimum number of one individual. Total number of elements two, including a right lower fourth premolar (UUVP 7247) and a medial phalanx (UUVP 7218).

HABITAT: The living pronghorn species, *Antilocapra americana*, primarily occupies sagebrush plains and prairies in the western part of North America.

DISCUSSION: Presence of the antilocaprid is best represented by the P_4, as the medial phalanx is abraded and cannot be

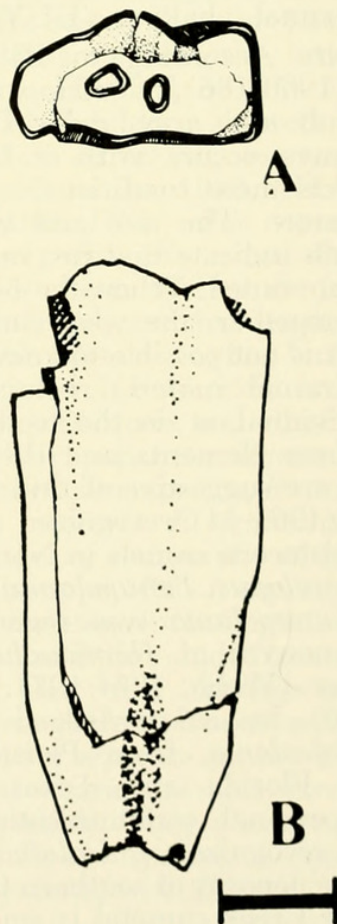Fig. 10. *Antilocapra* cf. *americana*, right P_4, UUVP 7247: A, occlusal view; B, lingual view. Line beneath figure represents 5 mm.

positively distinguished from a cervid. The premolar is missing a small antero-labial portion from the occlusal surface, but is otherwise complete (Fig. 10). In examination of the P$_4$ of Recent *Antilocapra americana* it was found that this tooth evinces an appreciable amount of variation. Most specimens showed a closed anterior and posterior lingual fold, with resulting fossettids. This is the condition of the fossil premolar. However, one Recent specimen, BYUO 121, has both the anterior and posterior lingual folds open such that fossettids would not have formed until the tooth was very well worn. Another specimen has three, rather than the usual two, fossettids. The Silver Creek P$_4$ was found to be within the variation of size and shape noted for *A. americana.*

Tetrameryx (and *Stockoceras,* if this taxon is recognized as a distinct genus as proposed by Skniner [1942:179]) approaches the modern antilocaprid in size. However, it does not have such hypsodont fourth premolars. It also shows a pronounced separation of the two roots, whereas they are essentially fused into one in *Antilocapra americana.* Although teeth are not generally considered diagnostic for antilocaprid distinction at the species and generic level (Colbert and Chaffee 1939:9; Savage 1951:275; Stirton 1932:49-51), the degree of hypsodonty and root fusion of the Silver Creek P$_4$ is apparently only matched in Pleistocene and Recent *Antilocapra.* The Pliocene species, *A. (Subantilocapra) garciae,* is smaller and evidently more primitive than *A. americana.* According to Webb (1973:215), there is a deep lingual inflection on the P$_4$ of *A. garciae,* which does not close to form a fossettid. However, since only one P$_4$ was reported, it is not possible to know the variability of this feature in the species. The degree of hysodonty and root separation of P$_4$ were not mentioned by Webb, but presumably the tooth was less hypsodont and the root separation more distinct in the Pliocene pronghorn.

The P$_4$ from the Silver Creek fauna is only modestly worn. It has two small fossettids, about 2 mm in greatest diameter, on either side of the tooth's midpoint. The greatest height, from occlusal surface to root base, is 25.1 mm. In greatest anteroposterior length it measures (10) mm,

and it measures 6.5 mm in greatest transverse width at the grinding surface.

As meager as the above evidence is for *Antilocapra,* it is apparently the first report of any fossil antilocaprid from Utah. The current distribution of pronghorns in the state does not include the present area of study. They do, however, occur about 75 miles east and west of this site (Durrant 1952:463).

Family BOVIDAE

Bison ? latifrons (Harlan, 1825)

ABUNDANCE: Minimum number of five individuals based on lower cheek teeth. Total number of elements 174, including an incomplete horn core (UUVP 7015), a basicranial fragment (UUVP 7063), a mandible including both jaws with dentitions (UUVP 7062), two jaw fragments (UUVP 7093, 8033), 43 isolated teeth (UUVP 7007, 7010, 7064-7103, 7219), 32 vertebrae and vertebral fragments (UUVP 7104-7121, 7125-7137, 7141, 7148, 8014, 8015, 8024, 8025, 8049), 31 complete and incomplete ribs (UUVP 7150-7169, 8038-8047, 8050), three incomplete scapulae (UUVP 7110-7112), an incomplete humerus (UUVP 7214), a nearly complete and two incomplete radii (UUVP 7118, 7113, 7114), the proximal end of an ulna (UUVP 7115), two metacarpals and a metacarpal fragment (UUVP 7212, 7213, 7216), 13 carpals (UUVP 7172, 7173, 7192-7200, 7203, 7242), the head of a femur (UUVP 7117), the distal end of a tibia (UUVP 7215), two astragali (UUVP 7170, 7171), an incomplete calcaneum (UUVP 8034), a navicular-cuboid (UUVP 8048), one incomplete and two complete metatarsals (UUVP 7122-7124), 16 phalanges (UUVP 7174-7189), and 10 sesamoid bones (UUVP 7201, 7202, 7204-7211).

HABITAT: Considering the habitat of the living bison and major faunal associates reported for extinct bison, *Bison latifrons* presumably occupied grassland areas.

DISCUSSION: Extinct species of *Bison* have been mostly established on the basis of horn cores, supposedly those of males. Difficulty in species identification arises when horn cores are incomplete or absent, or when just those of a presumed female are present. In most Late Pleistocene faunas where bison exist, elements

other than complete horn cores are the only basis for idenification. Consequently, the species is commonly tentatively referred, questioned, or left unnamed. Future finds of complete adult skeletons would do much to help alleviate present difficulties in identification.

Bison elements are relatively numerous in the Silver Creek local fauna, but only one horn core is present. Unfortunately, it is incomplete. At least one-third is missing from the distal end, as well as a posterodorsal segment .(Fig. 11). A portion of the frontal is attached to the horn core, including a part of the orbital protuberance. This allows a reasonably accurate orientation of the horn core to be made. When it was part of the skull, it would have projected posterolaterally away from it in a horizontal plane. Since there is very little curvature to the horn core, a juvenile is indicated. This is further attested to by the lack of grooves and ridges and possibly by the slightly developed burr. The specimen measures 134 mm along its ventral side from burr to broken end. Its estimated minimal total length is 420 mm. At the burr the circumference is approximately 320 mm.

Despite the immaturity represented by the Silver Creek horn core, its minimal projected length along the lower border (420 mm) is greater than the maximums listed for this measurement by Skinner and Kaisen (1947:170, 178) for male *Bison occidentalis* and *B. antiquus*. It is unknown whether the present specimen is referrable to a male or female. The full-grown size of the horn core would surely be within the limits of the so-called giant bison, *B. latifrons*, *B. crassicornis*, *B. alleni*, and *B. chaneyi*. *B. chaneyi* is removed from further consideration as it is presumed to be an invalid species. Dalquest (1957:350-351), Schultz and Frankforter (1946:6), and others have stated that there is little distinction between *B. chaneyi* and *B. alleni*. And elsewhere (Miller 1971:25) I suggested that these species are synonymous. Although the ultimate size and configuration that the present horn core would have attained is unknown, its shape is very slender. This is more suggestive of *B. latifrons* than the stouter ones of *B. alleni* and *B. crassicornis*. The latter species is very rarely known south of Alaska and northwestern Canada (Lillegraven 1967:299). The
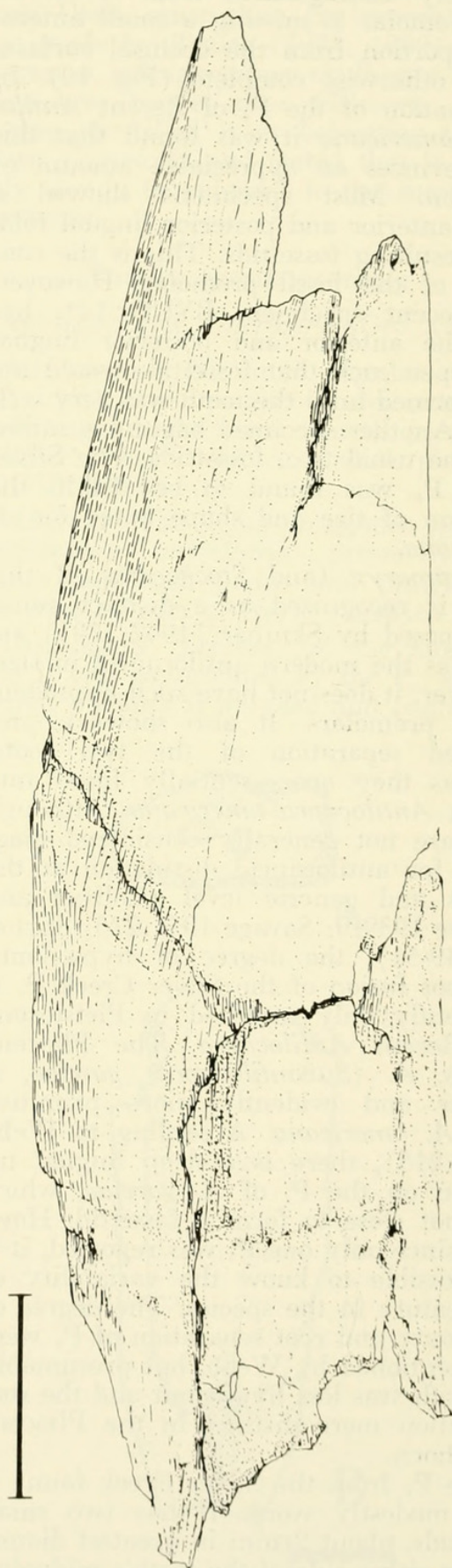

Fig. 11. *Bison ? latifrons*, anterior view of right horn core, UUVP 7015. Line beneath figure represents 50 mm.

TABLE 1. Measurements in millimeters of *Ondatra* first upper and lower molars from Silver Creek. (Teeth worn below greatest anteroposterior width were not used.)

Specimen Number		M¹	Maturity	Greatest Anteroposterior Length	Greatest Transverse Width
UUVP	7383		Mature	4.9	3.2
"	7384		Mature	5.0	3.3
"	7386		Mature	4.9	3.2
"	7387		Early Maturity	4.8	3.3
"	7388		Mature	4.7	3.2
"	7390		Mature	4.6	3.1
"	7396		Late Maturity	5.0	3.3
"	7389		Early Maturity	5.0	3.2
UUVP	7357	M₁	Early Maturity	(6.9)	2.9
"	7359		Mature	6.9	2.7
"	7363		Early Maturity	7.0	2.8
"	7365		Mature	(7.0)	2.9
"	7360		Mature	6.9	2.8
"	7381		? Mature	7.0	2.9
"	7356		Early Maturity	6.9	2.7
"	7382		Immature	7.2	2.8
"	7385		Immature	6.8	2.8
"	7389		Mature	6.9	2.9

distinctness between *B. crassicornis* and *B. alleni* has been questioned (Romer 1951: 230). Guthrie (1970:1) synonymized *B. crassicornis* with the northern holarctic species, *B. priscus,* while Wilson (1974: 93) considered *B. crassicornis* and *B. alleni* as northern and southern subspecies of *B. priscus. Bison alleni* (as it is generally understood) has been reported from southern Idaho (Gazin 1935:301; Hopkins 1951:192), which is its closest reported find to Utah. *B. latifrons* has also been identified from deposits in southern Idaho (Hopkins 1951:192, Stokes et al. 1966:37, and others) and from Lake Bonneville deposits in northern Utah (King 1878:494). The skull King assigned to *B. latifrons* was neither described nor figured, and its present disposition is apparently unknown; Stokes et al. (1966:37) said that the skull was evidently not collected. They further doubted its identity as *B. latifrons,* but did not give evidence for that doubt. However, they did admit that this giant species probably inhabited Utah at one time. In their discussion (1966:38) they also referred the bison from the present fauna (i.e., Silver Creek local fauna) and a partial skull from Lake Bonneville sediments as *Bison (Simobison) antiquus.* But, as stated above, the lone horn core in the Silver Creek fauna is larger than the maximum currently recognized for that species. Nevertheless, the presence of *B. antiquus* here cannot be entirely dis-

missed, since *B. antiquus* and *B. latifrons* could conceivably both be present on the basis of existing material. The joint occurrence of these two species has been previously reported (Miller 1968:4 and 1971:29).

North American bison, fossil and Recent, are generally placed in three groups based on size (Schultz and Frankforter 1946; Skinner and Kaisen 1947; Dalquest 1961; Robertson 1969, 1974; and others). These sizes are the large-horned types, the intermediate-horned types, and the small-horned types. The latter include all living bison. It is generally held by the above authors and others that the body sizes are fairly distinct in each of the three groups and that size overlap is minimal (e.g., Skinner and Kaisen 1947: 155). However, this may not necessarily be the case. Previously (Miller 1971) I indicated size overlap for some elements of *Bison latifrons* and *B. antiquus.* In the course of the present study it was found that a significant size overlap between similar elements of *B. antiquus* and *B. bison,* and possibly between these two species and *B. latifrons* (Tables 2-11), exists. Much more study of specimens other than horn cores is needed, especially with large samples, so that a better appreciation of size variations can be determined. Otherwise, species identifications based on size variations must be suspect.

One of the most interesting factors about the relatively abundant bison speci-

TABLE 2. Measurements in millimeters of adult *Bison* mandibles. (For figure showing points of measurement, see Miller 1971:60.)

Specimen Number	UUVP 7062	LACM 18807	LACM 18811	Y 6718	Y 6709	Y 6725	BYUO 228
Silver Creek *Bison*	X	......	......	......	......	......	......
Bison latifrons	......	X	X	......	......	......	......
Bison antiquus	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	X
1. Length of jaw, lateral border of C_1 alveolus to angle	475	(458)	......	423	430	425	396
2. Depth of jaw at anterointernal border of P_2 alveolus	53	......	......	48	47	47	44
3. Depth of jaw at posterointernal border of M_3 alveolus	90	......	95	83	83	85	76
4. Distance between anterior border of P_2 alveolus to posterior border of P_4 alveolus	68	(65)	......	62	60	62	49
5. Distance between anterior border of M_1 alveolus to posterior border of M_3 alveolus	126	110	125	110	111	113	70

TABLE 3. Measurements in millimeters of adult *Bison* atlases. (For figure showing points of measurement, see Miller 1971:60.)

Specimen Number	UUVP 7109	LACM 15218	LACM 18284	Y 5412	Y 5388	Y 5401	BYUO 228
Silver Creek *Bison*	X	......	......	......	......	......	......
Bison latifrons	......	X	X	......	......	......	......
Bison antiquus	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	X
1. Greatest transverse distance of atlas	(204)	261	......	191	195	193	213
2. Greatest transverse distance between articular facets for occipital condyles	132	153	148	132	137	121	126
3. Greatest dorsoventral width	105	123	118	100	108	100	101
4. Distance between anterior and posterior articulating surfaces	105	125	122	105	109	100	99

mens in the Silver Creek fauna is the great adult size variation. This can be seen in part in Tables 2-11. A seventh cervical vertebra (UUVP 7127, Table 4), in which no trace of epiphyseal lines can be detected, has most of the neural spine intact. In comparison with a very large Recent male bison (*Bison bison*, BYUO 228), it is evident that if the neural spine on the fossil was complete, it would be no longer than the one belonging to the Recent bison! This Recent bison is a very large (spread of horn cores, 635 mm) 12-year-old male obtained from the herd at Yellowstone National Park. Surprisingly, most of the measurements of postcranial bones from this animal are comparable in size to the larger male *Bison antiquus* from Rancho La Brea (see Tables 2-11). A fifth thoracic vertebra from Silver Creek (UUVP 7116) has a complete neural spine. De-

spite the fact that this vertebrae is much more massive than the comparable one of BYUO 228, its spine is only eight centimeters taller. The neural spine of the fossil, measured from the base of the posterior zygapophyses to the highest point on the spine, is 462 mm. Other measurements of this vertebra are: greatest anteroposterior length of centrum, 81 mm; greatest width of centrum (measured just beneath the facets for posterior rib articulations), 60 mm; height of centrum (measured at the midline along the anterior surface), 68 mm.

The mandible (both jaws) from the present fauna is much larger than that of BYUO 228 (see Table 2), as is the nearly complete dentition. However, some isolated teeth are only very slightly larger than similar ones from the above-mentioned Recent bison. This same situation applies to a number of postcranial ele-

TABLE 4. Measurements in millimeters of adult *Bison* seventh cervical vertebrae. (For figure showing points of measurement, see Miller 1971:64.)

Specimen Number	UUVP 7127	LACM 18375	LACM 18376	Y 6506	Y 6496	Y 6507	BYUO 228
Silver Creek *Bison*	X	......	......	......	......	......	......
Bison latifrons	......	X	X	......	......	......	......
Bison antiquus	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	X
1. Greatest anteroposterior length of centrum	82	86	82	76	76	75	79
2. Greatest width of centrum	(83)	88	98	79	77	77	77
3. Greatest height of centrum	62	68	69	55	54	52	56
4. Greatest width of head	44	52	50	40	39	37	39
5. Anteroposterior diameter at base of spine	52	58	59	54	49	54	52

TABLE 5. Measurements in millimeters of adult *Bison* fifth lumbar vertebrae. (For figure showing points of measurement, see Miller 1971:65.)

Specimen Number	UUVP 7125	LACM 18580	LACM 18581	Y 6739	Y 6744	Y 6752	BYUO 228
Silver Creek *Bison*	X	......	......	......	......	......	......
Bison latifrons	......	X	X	......	......	......	......
Bison antiquus	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	X
1. Greatest length of centrum	80	82	84	74	74	73	72
2. Greatest width of centrum	82	91	86	71	75	83	78
3. Greatest height of centrum	50	49	48	41	44	44	40
4. Width across center of posterior zygapophyses	73	82	76	77	72	82	63

TABLE 6. Measurements in millimeters of adult *Bison* scapulae. (For figure showing points of measurement, see Miller 1971:65.)

Specimen Number	UUVP 7110	UUVP 7112	LACM 18582	LACM 18583	Y 6764	Y 6754	Y 6759	BYUO 228
Silver Creek *Bison*	X	X	......	......	......	......	......	......
Bison latifrons	......	......	X	X	......	......	......	......
Bison antiquus	......	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	......	X
1. Anteroposterior diameter across center of glenoid cavity	99	96	96	93	81	83	82	79
2. Transverse diameter across center of glenoid cavity	83	77	72	73	64	64	54	54

ments (i.e., most specimens from the Silver Creek fauna are much larger than BYUO 228, but others are comparable in size). There appears to be no distinct size groupings of the Silver Creek bison elements; they are gradational from largest to smallest. Although it is possible that two species of *Bison* could jointly occur in a chronologically and areally restricted deposit such as the Silver Creek site, the probability is not great. If the bison specimens from this site do represent a single species of so-called giant bison, whether it is *B. latifrons* or another form, then the size variation between the largest adult males and smallest adult females must be much greater than previously supposed. A continual gradation, at least postcranially, would occur if the largest females were as least as large as the smallest adult males.

AGE AND CORRELATION OF FAUNA

AGE: Radiocarbon dates based on bone samples indicate that the age of the Silver

Creek local fauna is in excess of 40,000 YBP. The poorly known stratigraphy in the vicinity of the fossil site offers little assistance in an age assignment. At best the fossil-bearing sediments can be presumed to be Pleistocene. Although glacial deposits have been recognized elsewhere in the Wasatch Range, none were identified here.

Greatest chronologic precision is obtained by the fauna itself. *Bison*, which is prevalent from the present fossil site, is used as an index to the Late Pleistocene (Rancho-La-Brean) of North America. This was first proposed by Savage (1951:

277). Previously, the genus was thought to have been in the Great Plains as early as Kansan time (Schultz and Frankforter 1946, and Schultz and Stout 1948). Hibbard (1955c:221-223) asserted that there was no demonstrable evidence that supported the presence of *Bison* in North America earlier than Illinoian time. Most recent workers, including myself, have adopted Savage's and Hibbard's view if Alaskan and northwest Canadian faunas are not included. A good review of *Bison* evolution and distribution has been given by Guthrie (1970). However, the chronologic range of *B. latifrons* has not yet been

TABLE 7. Measurements in millimeters of adult *Bison radii*. (For figure showing points of measurement, see Miller 1971:68.)

Specimen Number	UUVP 7118	UUVP 7113	UUVP 7114	LACM 15221	LACM 18638	Y 6697	Y 6681	Y 6682	BYUO 228
Silver Creek Bison	X	X	X	......	......	......	......	......	......
Bison latifrons	......	......	......	X	X	......	......	......	......
Bison antiquus	......	......	......	......	......	X	X	X	......
Bison Bison	......	......	......	......	......	......	......	......	X
1. Greatest length	(375)	......	......	385	391	367	372	373	346
2. Greatest proximal transverse diameter	......	......	133	124	125	104	108	107	106
3. Least antero-posterior width of shaft	38	......	(42)	40	41	40	37	36	36
4. Least transverse width of shaft	53	......	72	67	67	56	55	57	56
5. Greatest distal transverse diameter	100	111	......	110	110	100	98	97	98

TABLE 8. Measurements in millimeters of adult *Bison* metacarpals. (For figure showing points of measurement, see Miller 1971:68.)

Specimen Number	UUVP 7212	UUVP 7213			Y 2445	Y 2404	Y 2429	BYUO 228
Silver Creek Bison	X	X	......	......	......	......	......	......
Bison latifrons	......	......	X	X	......	......	......	......
Bison antiquus	......	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	......	X
1. Greatest length	238	227	233	232	227	232	227	206
2. Least antero-posterior width of shaft	31	30	35	38	29	30	30	29
3. Least transverse width of shaft	49	54	61	61	49	50	50	49
4. Greatest distal transverse diameter	84	84	98	96	79	78	80	78

clearly defined as stated by Schultz and Lansdown (1972:398). The temporal duration of this species may have been from Illinoian through Late Wisconsin, although its population and distribution were probably very restricted by the latter date. Since the species of *Bison* from Silver Creek is questionably assigned (*Bison ? latifrons*), it offers no more temporal resolution than that of Late Pleistocene.

Of the 23 mammalian species reported from the Sliver Creek local fauna (including those tentatively assigned), 16 are extant. This ratio of living to nonliving species and the presence of *Antilocapra americana* is very suggestive of post-Illinoian time. Hibbard et al. (1965: 513) do not recognize *Antilocapra*, based on *A. americana*, prior to Wisconsin time. (This range zone, however, was not predicated on abundant specimens, and there is a likelihood that *A. americana* has existed since the Sangamon.) In 1966 (1966:154-155), Semken espoused that *Ondatra* was chronologically significant. He and Nelson (1970:3734-3735) showed that the length-width ratio of *Ondatra* M_1s changed with geologic time and climatic conditions. In their two diagrams utilizing this ratio (Figs. 1 and 3), it can be seen that the Silver Creek muskrat M_1, average value 2,462, falls between the averages given for Sangamon and Wisconsin forms.

The above evidence is suggestive of a Sangamon or Wisconsin age for the Silver Creek local fauna. Probably it is Late Sangamon or Early Wisconsin.

CORRELATION: Because of differences in the ecologies reflected by various local faunas, it is often difficult to determine precise correlations. Based on the general similarity of faunal constituents, the Silver Creek local fauna shows closest temporaneity to the faunas from American Falls (Hopkins et al. 1969) and Jaguar Cave (Kurtén and Anderson 1972) in

TABLE 9. Measurements in millimeters of adult *Bison* astragali. (For figure showing points of measurement, see Miller 1971:72.)

Specimen Number	UUVP 7170	UUVP 7171	....	Y 0815	Y 0983	Y 0973	BYUO 228
Silver Creek *Bison*	X	X	......	......	......	......	......
Bison latifrons	......	......	X	......	......	......	......
Bison antiquus	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	X
1. Greatest length	96	91	97	87	89	90	77
2. Greatest transverse width	66	63	65	59	59	56	56
3. Greatest anteroposterior width	58	54	59	50	52	52	45

TABLE. 10. Measurements in millimeters of adult *Bison* metatarsals. (For figure showing points of measurement, see Miller 1971:72.)

Specimen Number	UUVP 7122	UUVP 7123	UUVP 7124	....	Y 2317	Y 2319	Y 2289	BYUO 228
Silver Creek *Bison*	X	X	X	......	......	......	......	......
Bison latifrons	......	......	......	X	......	......	......	......
Bison antiquus	......	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	......	X
1. Greatest length of shaft	......	281	303	275	282	275	278	257
2. Greatest proximal transverse diameter	74	63	75	73	64	63	62	62
3. Greatest proximal anteroposterior diameter	......	64	71	65	61	60	59	58
4. Least transverse width of shaft	52	43	49	(50)	43	37	39	40
5. Least anteroposterior length of shaft	42	35	41	44	39	35	34	33
6. Greatest transverse width of condyles	......	76	83	(87)	78	74	73	70

TABLE 11. Measurements in millimeters of adult *Bison* anterior proximal phalanges.

Specimen Number	UUVP 7179	UUVP 7181	UUVP 7183	....	Y 4702	Y 4464	Y 4450	BYUO 228
Silver Creek *Bison*	X	X	X	......	......	......	......	......
Bison latifrons	......	......	......	X	......	......	......	......
Bison antiquus	......	......	......	......	X	X	X	......
Bison bison	......	......	......	......	......	......	......	X
1. Greatest length	77	76	77	78	77	76	76	73
2. Greatest proximal transverse width	43	44	43	41	40	46	45	41
3. Greatest distal transverse width	40	40	39	40	38	45	44	38

Idaho and Bell Cave in Wyoming (Zeimens and Walker 1944). The Costeau Pit local fauna from California (Miller 1971) and the fauna from Jinglebob in Kansas (Hibbard 1955c) also show temporal similarity to the present fauna, but it is not as great. This is probably due more to the greater distances and ecological settings involved. All the above faunas are Sangamon or Wisconsin in age.

ENVIRONMENTAL INTERPRETATIONS

The most common taxon of the Silver Creek fauna is the frog, with a minimum of 115 individuals represented. Two common small mammals are the water shrew and the muskrat. Each of these animals indicates the presence of perennial water at the Silver Creek site, and all three frequently live in marshes. With a modest increase in precipitation, the present topography would be conducive to marsh conditions. (Because of the existing high water table, depressions in the ground now often contain water during wet seasons). The water requirements of all the taxa constituting the fauna would, in fact, be met by a permanent marsh. The mallard, teal, ermine, mink, Uinta ground squirrel, and mountain vole often show a propensity toward this type of habitat.

A grassland area presumably encircled the postulated marsh. This assumption is favored by many grassland animals in the fauna such as the horse, bison, camel, ground squirrel, and possibly the mammoth, gopher, and others.

Since a significant number of taxa in the fauna are associated with brushy conditions, it is probable that the grassland was broken and/or bordered by brush. The sage hen, pronghorn, leporids

chipmunk, and possibly the ground sloth indicate this.

A few taxa are usually associated with wooded areas, such as the lynx, porcupine, and phenacomys. However, their representation is small, and the nearby mountain slopes were probably wooded as they are today.

No faunal element contradicts the above habitat complex. With the exception of a permanent marsh and the possibility of more abundant vegetation, the Late Pleistocene setting in the vicinity of the Silver Creek site ostensibly closely resembled the present one (see Text-fig. 2).

TABLE 12. Faunal list of the Silver Creek local fauna.

Class AMPHIBIA
  Order ANURA
    Family RANIDAE
      Rana cf. *pipiens*# Schreber
Class AVES
  Order ANSERIFORMES
    Family ANATIDAE
      Anas platyrhynchos# Linnaeus
      Anas ? *carolinensis*# Gmelin
  Order GALLIFORMES
    Family TETRAONIDAE
      cf. *Centrocercus*# (Bonaparte)
Class MAMMALIA
  Order INSECTIVORA
    Family SORICIDAE
      Sorex palustris# Richardson
  Order EDENTATA
    Family MYLODONTIDAE
      + *Paramylodon* cf. *harlani*# (Owen)
  Order LAGOMORPHA
    Family LEPORIDAE
      Sylvilagus cf. *idahoensis*# (Merriam)
      Lepus cf. *townsendii*# Bachman
  Order RODENTIA
    Family SCIURIDAE
      Spermophilus cf. *armatus*# (Kennicott)
      Eutamias minimus# (Bachman)
    Family GEOMYIDAE
      Thomomys talpoides# (Richardson)
    Family CRICETIDAE
      Peromyscus maniculatus# (Wagner)
      Ondatra sp.# Link

Phenacomys intermedius# Merriam
Microtus montanus# (Peale)
Family ERETHIZONTIDAE
Erethizon ? dorsatum# (Linnaeus)
Order CARNIVORA
Family CANIDAE
Canis cf. *dirus#* (Leidy)
Canis ? latrans# Say
Family MUSTELIDAE
Mustela ? erminea# Bonaparte
Mustela vison# Schreber
Taxidea taxus# (Schreber)
Family FELIDAE
+*Smilodon* cf. *floridanus#* (Leidy)
Lynx cf. *canadensis#* Kerr
Order PROBOSCIDEA
Family ELEPHANTIDAE
+*Mammuthus* cf. *columbi* (Falconer)
Order PERISSOCACTYLA
Family EQUIDAE
Equus sp. (large) Linnaeus
Equus ? conversidens# Owen
Order ARTIODACTYLA
Family CAMELIDAE
+*Camelops* cf. *hesternus* (Leidy)
Family ANTILOCAPRIDAE
Antilocapra cf. *americana#* (Ord)
Family BOVIDAE
Bison ? latifrons (Harlan)

Poorly sorted sands and gravels intercalated with clays at the fossil site manifest past depositional changes. The fine sediments laid down in the quiet marsh waters were probably interrupted periodically by flooding of a nearby stream that carried in coarse deposits from adjacent uplands. This would explain abrasional marks on some of the bones.

Since almost all small mammals in the Silver Creek local fauna can currently be found in the area today, existing temperatures were apparently little different than they are at present. All the larger animals in the fauna are usually indicative of temperate climatic conditions. No evidence, direct or indirect, suggests glacial conditions during Silver Creek time.

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