SAN BERNARDINO COUNTY
MUSEUM
ASSOCIATION

Volume XXXVI Number 2 QUARTERLY Summer, 1989

NELSON LAKE: IMPORTANT EARLY SITES

C.N. WARREN & J.S. SCHNEIDER

ABSTRACTS OF PROCEEDINGS 1989 MOJAVE DESERT QUATERNARY RESEARCH SYMPOSIUM

SAN BERNARDINO COUNTY BOARD OF SUPERVISORS

Barbara Cram Riordan, Chairman, Third District

Marsha Turoci	First District
John Mikels	Second District
Larry Walker	Fourth District
Robert Hammock	Fifth District

COUNTY OF SAN BERNARDINO

Harry M. Mays, County Administrative Officer
Albert R. Reid, Administrator, General Services Agency
Dr. Allan D. Griesemer, Museums Director

SAN BERNARDINO COUNTY MUSEUM COMMISSION

Ralph Strane, Chairman, Rancho Cucamonga

Robert A. Robinson, Green Valley Lake
Dr. Paul F. Allen, Redlands
Roy K. Tate, Hesperia
Dr. Joseph E. Hearn, Redlands
Dr. Walter C. Schuiling, San Bernardino
Toddy Leuthold, Upland

SAN BERNARDINO COUNTY MUSEUM ASSOCIATION

Dr. Allan D. Griesemer, Executive Director
W. Kathryn Van Wormer, Administrative Assistant
Dr. Gerald A. Smith, Executive Director Emeritus

BOARD OF DIRECTORS

Dr. Walter C. Schuiling, President
Virginia Lapham, Vice-President
Linda Cremer, Secretary
William B. Adams, Vice-President
Dr. James Crum, Vice-President
Bill Cunningham, Treasurer

Dr. Paul F. Allen
Dr. Russell Barber
Randy Briggs
Arda Haenszel
Robert A. Robinson
Norwood Hazard
Dr. Joseph Hearn
Fern Jenkins
Jerrol Linkhart
Dorothy Grier
Gus Schmidt
Bee Walsh
Jerilynn Smith-Ritchie
Dr. Juanita Scott
Ruth Harris

PUBLICATIONS COMMITTEE

William B. Adams, Chairman
Dr. Allan D. Griesemer
Dr. R. Bruce Harley
Randy Briggs
Dr. Walter C. Schuiling
Dr. Russell Barber
W. Kathryn Van Wormer
Jennifer Reynolds, Editor

Nelson Lake, San Bernardino County, California: Museum Records and Collections from Important Early Sites

by

Claude N. Warren
Department of Anthropology, University of Nevada, Las Vegas

and

Joan S. Schneider
Department of Anthropology, University of California, Riverside

Abstracts of Proceedings
1989 Mojave Desert Quaternary Research Symposium
San Bernardino County Museum, Redlands, California

compiled by

Jennifer Reynolds
Mojave Desert Quaternary Research Center, San Bernardino County Museum

San Bernardino County Museum Association
2024 Orange Tree Lane
Redlands, California 92374

QUARTERLY Volume XXXVI Number 2
Summer, 1989

NELSON LAKE, SAN BERNARDINO COUNTY, CALIFORNIA: MUSEUM RECORDS AND COLLECTIONS FROM IMPORTANT EARLY SITES

Claude N. Warren
Department of Anthropology
University of Nevada, Las Vegas

Joan S. Schneider
Department of Anthropology
University of California, Riverside

INTRODUCTION

The evidence found on the present surface of important archaeological sites often does not reflect the significance of the surface manifestations at these sites as first recorded. This is especially true of Mojave Desert sites in which archaeological materials are limited to the surface. Many of these sites were intensively collected by early investigators between the 1920s and the 1940s. Most of this early fieldwork, conducted primarily under the leadership of Elizabeth Campbell and Malcolm Rogers, was extensive, ranging over much of the California deserts. Artifacts were often collected systematically from individual or perhaps dozens of sites within any one of many basins investigated (e.g., Soda and Silver playas). Many, if not most, of the data acquired during this 1920 - 1940 period have never been described or adequately analyzed, or published. These data, however, are to be found in the notes, maps and other written records, photographs, and the extensive collections housed in the museums with which these early archaeologists were associated.

Neither Rogers nor Campbell ever described specific artifact assemblages from individual sites. Both presented their findings as generalizations, presumably based on such data, and illustrated their conclusions with artifacts and artifact assemblages drawn from a variety of sites. Campbell and her collaborators on the Lake Mohave report (Campbell et al. 1937) treated the artifacts from about a dozen sites as if they were a single assemblage. This so confused some readers that these sites were interpreted as a single site (Roberts 1940; Warren 1970). Rogers' unpublished records indicate that he recorded approximately twice as many sites at Pleistocene Lake Mohave as did Campbell, but nowhere in his publications are these individual sites described nor their number reported. During this early period of California desert archaeology little attention was given to either the distribution of artifacts within sites, or their distribution among sites within a given basin. However, both Rogers and Campbell recorded and cataloged artifacts by individual site locations, and occasionally by loci within sites, even though they rarely, if ever, published these data. Consequently, bodies of data, like that from the shoreline of Pleistocene Lake Mohave, can be reanalyzed as a series of sites and provide new information on assemblage composition from individual sites and the variability of assemblage composition among sites.

This task, however, is more difficult than it first appears because of the manner in which collections were treated by museums in the past. For example, the Lake Mohave collection made by the Campbells is housed primarily at the Southwest Museum, but a portion of it is at Joshua Tree National Monument. There is also reason to believe that "samples" of this collection were sent to various museums as "type collections." The Rogers collection from Lake Mohave is housed at the San Diego Museum of Man, but a portion of it is curated separately as a part of the San Dieguito Type collection there. Clearly, there may be problems for researchers attempting to analyze whole collections, but that problem is outside the scope of this paper.

In this paper we present the Nelson Lake collection as an example of the kinds of data that are available. Nelson Lake is not an optimal example, in that the field notes from all early investigators are scanty and field maps and photographs are non-existent. There are, in fact, sites with more complete records and more extensive artifact collections. We present the Nelson Lake data here because it is a relatively small collection and we believe that it is an essentially complete record of all the available data collected during the early surveys of the Nelson Lake site.

Standing by itself as a descriptive report, the Nelson Lake data is significant for several reasons. 1) The site may be viewed as a single unit for analysis, comparable to many other such units from the California deserts. The Nelson Lake site report, perhaps not impressive by itself, is nonetheless a significant unit of comparison if all collections of similar sites made by Rogers and Campbell were available. That quantity of data would both allow and demand penetrating analyses; those analyses would contribute substantially to the understanding of the prehistoric record. 2) These data from Nelson Lake should be considered in further work at that site and in Nelson Basin. Since Nelson Basin is located in an area of Fort Irwin where extensive archaeological investigations are being conducted, it is important that these data be made readily available to archaeologists undertaking those investigations. 3) The primary purpose for publishing this report is to call attention to the untapped data in museum collections and files, and to encourage others to exploit these resources as a part of their research and in the decision-making process of assessing site significance.

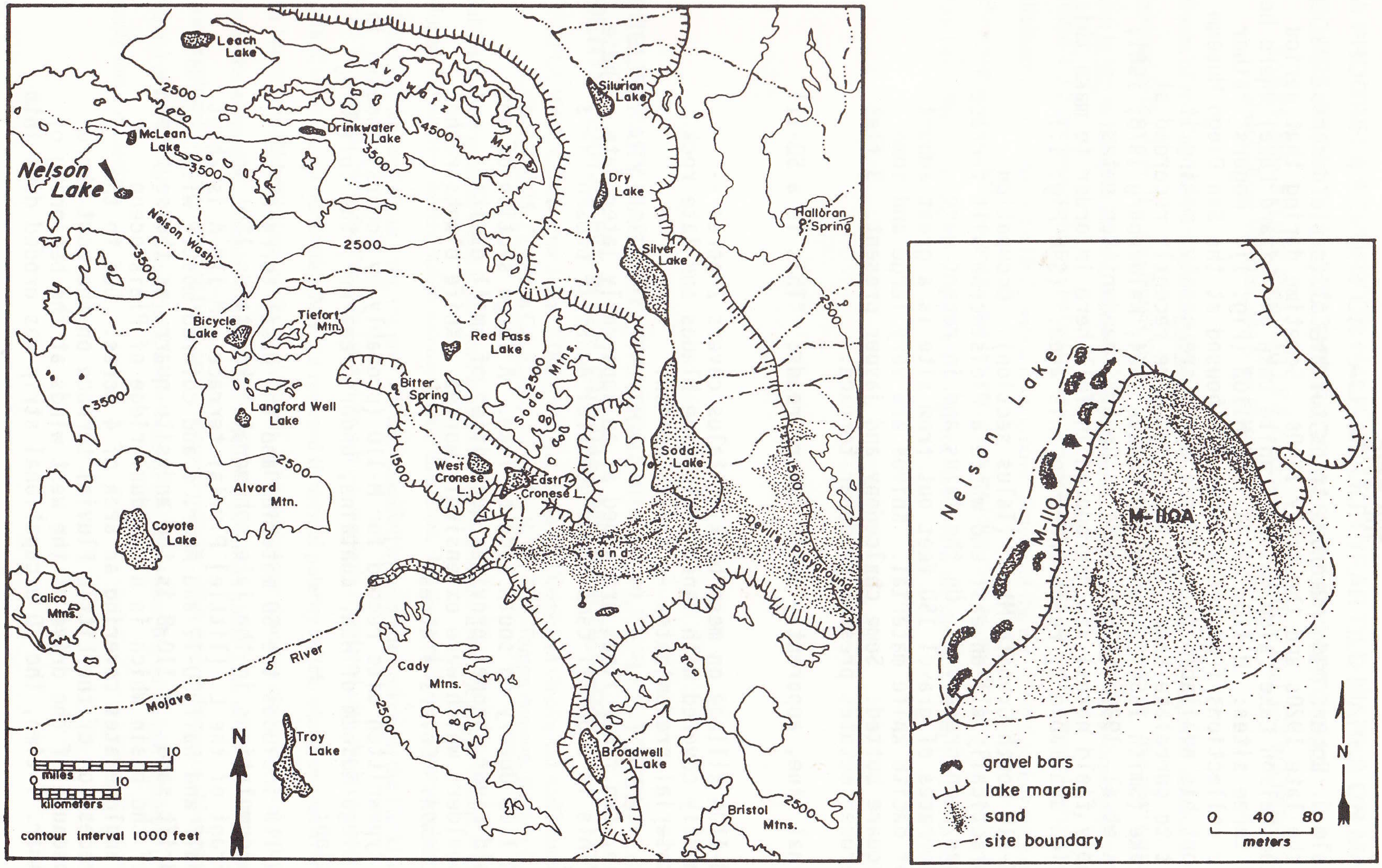

Fig. 1. Location of Nelson Lake and the Nelson Lake site.

THE SITE

Malcolm J. Rogers made numerous trips to the California deserts between the late 1920s and the early 1940s. Sometime during that period he visited Nelson Lake (also called Granite Lake and Lizard Lake) where he recorded three sites: M-110, M110A, and M110B (Fig. 1). Rogers' rather extensive collections from these sites are housed at the San Diego Museum of Man, but his available notes on the sites are scanty, making it difficult to correlate them with the sites more recently recorded at Nelson Lake (Smith 1964; Simpson and Demaye 1964; Kaldenburg 1978, 1981; Robarchek et al. 1982a, 1982b, 1984). Rogers' handwritten notes (presumably field notes) are reproduced in full here in order to make this information available to researchers in this area. (See Fig. 1.)

> M-110 South Granite Mts. (Talus section). Occupation practically all on east end where a Pleistocene silt terrace has been preserved. On the talus and in recent wave terraces of gravel 150 feet out from site is a great amount of dacite knife material. Knives are very large and some square butted. Some chalcedony and jasper present. 3 flat broken metates present on upper terrace.

A final line, apparently added later, reads: "This is a SD-II[1] level."

> M-110A Village on mesa back of talus covers 2 acres -- mostly covered with sand. Late type blades and late rock material predominates -- drills common.

Again, two final lines are added at an apparently later date. These read: "This is a SD-III camp. Some doubtful Amar. I[2] present -- 3 points."

> M-110B Quarry on south side of lake. A large section of an old river channel provides quantities of small dacite boulders which were extensively worked. Knife blanks rather common. Covers 4 acres.

The typewritten site record for M-110 (probably by Rogers), housed in the San Diego Museum of Man, contains, under "remarks", the following information:

> M-110 includes the SD material and the basal terrace accumulations in the late ephemeral lake stands 150' in front of the L. [little] Pluvial terrace. M-110-A is about half and half SD-II and Amar. I and covered mostly with drift sand. M-110-B is the andesite quarry at the south end of the basin which is a residual ridge of Pleistocene fanglomerates covering an area of 4 acres. Due to the recession of the Little Pluvial terrace on the east shore because of the drive of the west winds at the beginning of Amar. I time, the SD occupational strip was eroded down into

> the lake and concentrated in windrows in low, transient lake strands and spits. 1 mano and 3 flat broken metates are present on the upper terrace in with Amar. I material. These may be either of NY-I or Panamint origin.[3]

Rogers' site M-110 includes the San Dieguito material (Lake Mojave period) from on the talus along the east edge of the playa and in the gravel bars on the playa floor up to 150 feet out from the edge of the playa. Rogers interprets the location of this material as resulting from erosion of the shoreline by the action of wind and waves in a Little Pluvial lake. Rogers located M-110A in the sandy terrace (mesa) at the east end of the lake, where later material attributed to Amargosa I (Pinto) is found, apparently mixed with the earlier San Dieguito artifacts. The later material was presumably associated with the Little Pluvial lake. These two components were included within site CA-SBR-2356 as defined by Robarchek et al. (1984) and probably correspond to SBCM 763 (see below).

Site M-110B is listed as an andesite or dacite quarry by Rogers and is located on the south side of the playa. He describes it as "a large section of an old river channel" and as a "residual ridge of Pleistocene fanglomerates", covering about four acres. M-110B appears to correspond to another portion of site CA-SBR-2356 as described by Robarchek et al. (1984) and probably also corresponds to SBCM 764 (see below).

Site CA-SBR-2356 (recorded by Robarchek et al.) consists of a widespread discontinuous lithic scatter of cortical and noncortical flakes, cores, and tools, predominantly of basalt, but with some chalcedony, chert, and jasper. The heaviest concentration is along the north slope of a low hill (Rogers' "residual ridge of Pleistocene fanglomerates"), but the whole site covers an irregular area of about 22 acres. During the Robarchek survey, three small cleared circles and a possible hearth were recorded that are not mentioned in Rogers' notes. These features could be the result of more recent military activity, however.

The artifacts collected by Rogers from sites M-110, M-110A, and M-110B are housed at the San Diego Museum of Man. Four days were spent at the Museum describing the artifacts and reviewing Rogers' notes. Some artifacts from M-110 and M-110A are described and illustrated in <u>Ancient Hunters of the Far West</u> (Pourade 1966). Because Rogers did not assign individual catalog numbers to specimens, it is impossible to determine if the collection is complete.

In the interim between Rogers' description of the Nelson Lake sites (Rogers n.d.) and the Robarchek survey (Robarchek 1984), the sites that were originally described by Rogers have been recorded by others (Smith 1964; Simpson and De Maye 1964; Kaldenberg 1978, 1981). Collections were made at what was designated as San Bernardino County Museum site 763 (SCBM 763) at some time after 1930 by Gerald Smith and others, although no date(s) or collection information could be located in the San Bernardino County Museum records.

SBCM 763 was described by Smith (1964) as: "significant cultural resources weathering out of dunes at the edge of the dry lake ...1/4 mile by 200 yards along an old beach line ... early lithic assemblage ...scrapers, points, knives, flakes ...a very significant site ..." In the same year, a laconic site record form indicates SBCM 763 is a site "...in deflation hollows at the edge of the lake among dunes ..." (Simpson and De Maye 1964).

An analysis of Rogers' site descriptions, the locations of SBCM sites on the USGS Goldstone Lake 15' quadrangle (1984) and the site record forms on file at the San Bernardino County Archaeological Information Center have led us to the conclusion that the collections from M-110 and M-110A correspond to the collections from SBCM 763 and that the collections from M-110B probably correspond to the collections from SBCM 764. All previous designations are, at present, included in a large site known as CA-SBR-2356 (see above) under the California Archaeological Inventory system. CA-SBR-2356 extends from the east side of Nelson Lake, encompassing the southern margin of the lake to the north of an existing road. At least 15 other sites have now been recorded in the immediate vicinity of Nelson Lake (Robarchek et al. 1984).

The collections from SBCM 763 and SBCM 764 are housed at the San Bernardino County Museum. Data from the combined collections from M-110, M-110A (San Diego Museum of Man) and SBCM 763 (San Bernardino County Museum) will be presented in this paper. The archaeological site(s) at the east end of Nelson Lake have been described as significant by a series of investigators (Rogers N.D.; Smith 1964; Simpson and De Maye 1964; Kaldenberg 1981; Robarchek et al. 1984) yet, in spite of this, and a central location in what was an important occupational area during the early period, little investigative analysis has been carried out beyond the survey level. Other than Kaldenberg's (1981) published report, all other information on the early occupation around Nelson Lake has been, until recently, limited to the "grey literature" (Chartkoff 1987) and some information is privy to a few individuals who are familiar with the area. With this preliminary analysis of collections, we hope to call attention to the significance of the archaeological resources at Nelson Lake and to encourage further investigative work there before these resources are entirely obliterated.

ARTIFACT DESCRIPTIONS[4]

The major portion of the artifact collections are of flaked stone although a few specimens of ground stone were collected; a unifacial mano was collected by Rogers from M-110A and two slab metates, one slab metate fragment, two block metates and one mano were collected from SBCM 763 at a later date by Smith and/or others. A schematic chart was developed to facilitate the organizational sorting of the artifacts in the collection (Fig. 2). The flaked stone artifacts were first sorted into bifacially and unifacially-flaked categories. Each of these categories was then subdivided into smaller groups based on similarity of form, assumed function, and/or degree of reduction. The vast majority of the artifacts are broken and incomplete which limited the amount of variation that could be considered in establishing formal categories. When types were identified that had pre-existing designations, these designations were used (e.g. Lake Mojave projectile point).

BIFACIALLY FLAKED ARTIFACTS

Projectile Points (33 specimens; attributes, Table 1)
The 33 projectile points collected from the Nelson Lake site include those assigned to traditional types: Lake Mojave (N=7), Silver Lake (N=2), Pinto (N=1), Elko (N=2); and those assigned to descriptive types: basal-notched triangular (N=2), rectangular stemmed (N=2), leaf-shaped (N=15), and lanceolate (N=2).

1. Lake Mojave Points (Seven specimens; Fig. 3, a - g)
Four of the Lake Mojave points are complete enough to identify as classic types with relatively short blades, narrow, straight to sloping shoulders, and long stems tapering to a narrow, convex base. Two of the remaining specimens are fragments broken at the shoulders, and the remaining specimen is unique in having a much longer blade than classic Lake Mojave points generally have.

2. Silver Lake Points (Two specimens; Fig. 3, m,n)
One complete and one basal fragment are complete enough to identify as Silver Lake points. The complete point has a short blade, narow sloping shoulders, and a long, broad, straight-based stem. The basal fragment is fractured just above narrow sloping shoulders, and exhibits a relatively short, parallel-edged stem with a convex base.

3. Pinto Point (One specimen; Fig. 3, h)
One basal fragment is tentatively identified as a Pinto point. Broken just above the shoulders, it exhibits narrow, sloping shoulders, an expanding stem and a slightly concave base. The base is nearly as large as the shoulders.

4. Elko Series Points (Two specimens; Fig. 3, o,p)
Two specimens are identified as Elko points. One is nearly complete, exhibiting a wide, convex-edged blade with nearly straight shoulders, and a broad, straight stem with a deep basal notch. The second specimen has a broken stem that has been reworked, and exhibits the wide blade and wide shoulders of the Elko Series.

5. Basal-Notched Triangular Points (Two specimens; Fig. 3, k,l)
These are triangular in outline with convex edges. One of these points is marked by a wide deep basal notch and the other by a narrow and shallow notch in a convex base.

6. Rectangular Stemmed Points (Two specimens; Fig. 3, i,j)
One of these specimens has narrow sloping shoulders and a slightly expanding stem. The blade of this specimen is very short and appears to have been heavily reworked before being discarded. The second specimen

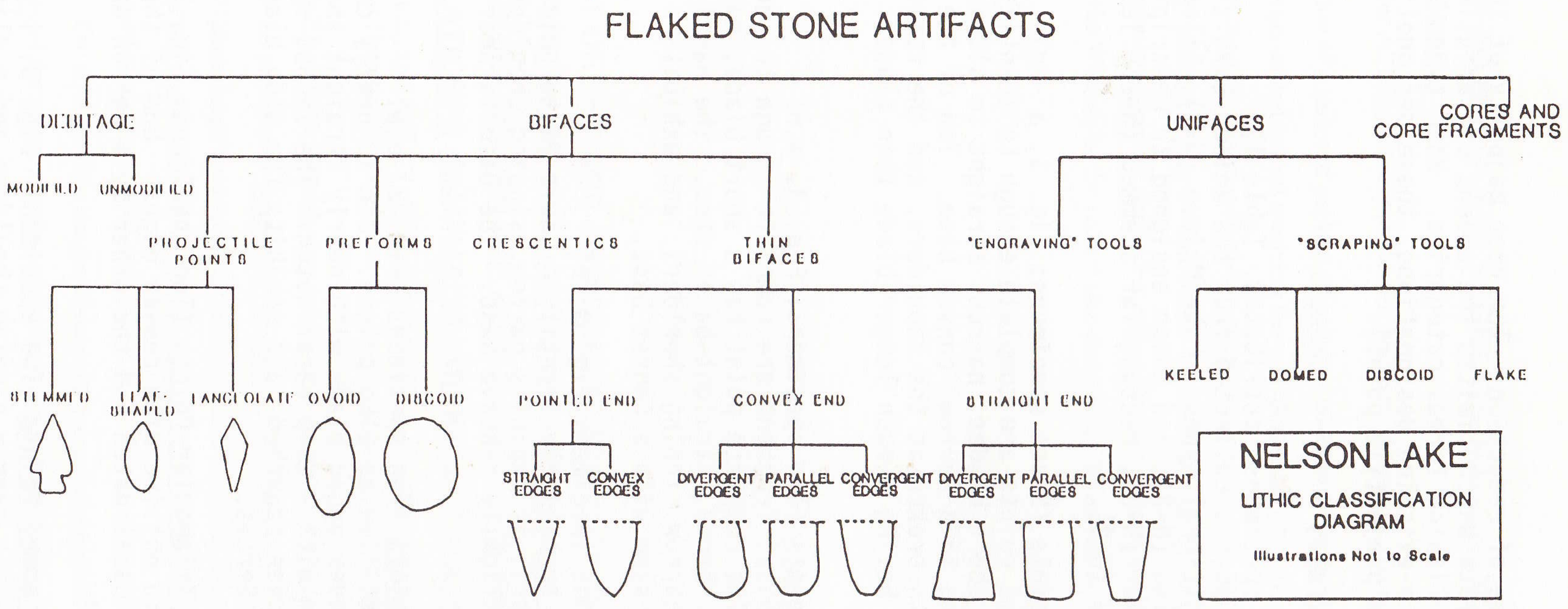

Fig. 2. Flaked stone artifact classification scheme for the Nelson Lake site.

also has narrow sloping shoulders and an expanding stem, but with a straight base. The blade has slightly convex edges and a fractured tip.

7. __Narrow Leaf-Shaped Points__ (13 specimens; Fig. 4, a - i) These are unstemmed leaf-shaped points with convex or pointed bases. The widest point of the blade is near the middle of the specimen or in the lower half. One specimen has been broken and reworked, producing a very short wide point (Fig. 4, h).

8. __Broad Leaf-Shaped Points__ (Two specimens; Fig. 4, j,k) These points are unstemmed, and leaf-shaped, with a convex base. The widest point of the blade is in the lower third of the specimen. These specimens may be exceptionally well made small bifaces rather than projectile tips.

9. __Lanceolate Points__ (Two specimens; Fig. 4, l,m) These specimens are stemless with the widest point near the middle of the specimen. From the wide point, the edges taper gently to a straight or slightly convex base with rounded basal corners.

__Crescentic__ (One specimen; Fig. 5a; attributes, Table 2)

A single fragment of a crescent, made of chalcedony and finely bifacially flaked, was collected from M110A. It is approximately one-half of a crescent, minus a portion of the convex edge. One edge is slightly concave, the end is a narrow blunt point and the remaining edge is convex. Because of the missing portion, it is impossible to determine if the crescent originally exhibited projections or had a simple convex edge.

__Thin Bifaces__ (161 specimens; attributes, Table 2)

Thin bifaces are distinguished from **preforms** by the stage of reduction and by the thickness of the artifact relative to its width. The **preform** represents the earliest stage of biface reduction considered here, characterized by a lack of any secondary flaking in edge preparation. The **thin biface** category includes bifaces in early, mid, and final stages of reduction.[5] **Thin bifaces** are further subdivided on the basis of the morphological attributes of the existing portion of the biface (Fig. 2). The fragmentary nature of most of the biface specimens makes it difficult, if not impossible, to consistently distinguish between distal and narrow/pointed proximal ends. Therefore, in these cases, we have described our categories based on form alone and eliminated the traditional assignment of each fragment to either the proximal or distal portion of a hypothetical biface form. The morphological attributes are described in standard English terms which have not been given specialized or restricted meanings. All attributes are presented in Table 2.

1. __Pointed Tip/Base Form__ (30 specimens; Fig. 6 shows representative range)

The edges of the biface fragment converge from the point of fracture to a pointed tip/base. The artifact is bifacially flaked with step and hinge fractures common. Identifiable edge retouch occurs rarely. Cross-sections are lenticular. These specimens appear to be the tips of biface tools. This class of artifact is divided into three sub-groups or types on the basis of the manner in which the edges converge toward the tip/base of the artifact:

(1a.) Straight edges converge toward a sharply pointed tip/base.

(1b.) One straight edge and one convex edge converge toward a pointed tip/base.

(1c.) Convex edges converge toward a bluntly-pointed tip/base.

2. <u>Convex (rounded) Tip/Base Form</u> (97 specimens; Figs. 7, 8, 9 show representative range)

These bifaces all exhibit convex (rounded) ends, are bifacially percussion flaked with step and hinge fractures occurring commonly. Cross-sections vary from lenticular to nearly plano-convex with cortex rarely exhibited on the planar surface. Edges vary from straight to sinuous; the straight edges exhibiting secondary light percussion flaking. This class of artifacts is divided into three distinctive subgroups or types based on the form of the artifact resulting from the manner in which the edges converge toward the convex (rounded) base/tip.

(2a.) The edges are straight or slightly convex and from the point of fracture, diverge or expand toward the tip/base, forming a broad-based leaf-shaped outline with the maximum width in the lower one-third (Fig. 7).

(2b.) The edges are straight or slightly convex, but are essentially parallel as they meet the convex base at rounded corners. No complete specimens were found in this collection, but it is assumed that the form of the distal may vary from pointed, to gently tapered, to a blunt and rounded form that would be indistinguishable from the base (Fig. 8).

(2c.) Convex edges converge toward the convex base to form a leaf-shaped outline with the maximum width near the center of the biface (Fig. 9).

3. <u>Straight-based Forms</u> (34 specimens; Figs. 10, 11, 12 show representative range)

These forms exhibit an essentially straight base of varying extent. These artifacts are percussion flaked with step and hinge fractures a common occurrence. Light percussion flaking occurs along the edges. Cross-sections vary from lenticular to plano-convex.

(3a.) Triangular with a straight base. Edges are straight or slightly convex and, from the point of fracture, diverge toward rounded basal corners of the straight base. The maximum width is in the basal portion of the artifact (Fig. 10).

(3b.) Square-based. The edges are parallel or converge very slightly toward the straight base. The basal corners are very slightly rounded and the edges are straight to very slightly convex (Fig. 11).

(3c.) Converging edges, straight base. The edges are straight or slightly convex and converge toward the base. The maximum width of the artifact occurs in or near the midportion of the artifact (Fig. 12).

Preforms (17 specimens; Figs. 13, 14; attributes, Table 2)
Biface preforms are relatively thick in relation to width, with coarse percussion flaking which apparently represents an early stage of biface reduction.

1. **Elongate ovoid** (14 specimens; Figs. 13, 14)
Elongate ovoid in outline, these artifacts are thick lenticular or biconvex in cross-section. Percussion flaking is present with retouching or modification of the edge absent.

2. **Discoid** (Three specimens; Fig. 14)
Disc-shaped in outline, these artifacts are lenticular in cross-section. These appear to be preforms, but may be reworked broken thin bifaces.

Biface Fragments (Attributes, Table 2)
These specimens are too fragmentary to assign to any category.
1. **Midsections** (23 specimens)
2. **Edge Fragments** (7 specimens)
3. **Unclassified** (33 specimens)

UNIFACIALLY FLAKED ARTIFACTS

1. **Keeled Unifaces** (18 specimens; Fig. 15 shows representative types; attributes, Table 3)
These are elongate (leaf-shaped, ovoid, or rectangular) in outline with a plano-convex to rhomoidal cross-section. Percussion flaking is exhibited around the entire periphery. Step and hinge fractures are common. This class of artifacts is subdivided on the basis of outline and thickness.

(1a.) Thin, Leaf-shaped Keeled Unifaces (Five specimens; Fig. 15, e,f)
These artifacts are leaf-shaped in outline with one rounded and one pointed end. Thickness is 1.1 to 1.5 cm.

(1b.) Thin, Parallel-edged Keeled Unifaces (Five specimens) These specimens have one convex end and parallel edges. Thickness is 1.0 to 1.2 cm. (not illustrated).

(1c.) Thick, Leaf-shaped or Rectangular Keeled Unifaces (Four specimens; Fig. 15, a,b,g)
These artifacts are leaf-shaped, rectangular, or long ovoid in outline. One specimen exhibits a striking platform at one end. Thickness is 1.8 to 1.9 cm.

(1d.) Large Ovoid Keeled Unifaces (Two specimens; Fig. 15, c,d)
These specimens are elongate oval in outline. Width is greater than 5.5 cm. Thickness is 2.2 to 2.5 cm.

(1e.) Center Sections of Keeled Unifaces (Two specimens)
These are plano-convex fragments with both edges intact.

2. **Domed Unifaces** (12 specimens; Fig. 16 shows representative types; attributes, Table 3)
These are ovoid in outline and plano-convex to rhomboidal in cross-

section. Steep unifacial percussion flaking is exhibited around 20% to 100% of the periphery. Light percussion retouch or usewear is found along most of the flaked edge.

3. <u>**Thick Flake Unifaces**</u> (Ten specimens; Fig. 17, a,b,c,e,f show representative types; attributes, Table 3)

These unifaces are made on a flake with the margin opposite the bulb of percussion unifacially percussion-flaked and pressure-retouched to form a convex edge. The remainder of the flake may or may not be modified, thus a great variety of form, ranging from ovoid to triangular, results.

4. <u>**Discoid Unifaces**</u> (Two specimens; Figs. 17, 18 show representative types; attributes, Table 3)

These artifacts are circular in outline and have a low, plano-convex cross-section.

(4a.) <u>Small Discoid Uniface</u> (One specimen; Fig. 17 d)

The planar surface is formed by several flake scars, and the convex surface by one large flake scar (weathered). This artifact is unifacially steeply flaked around the entire periphery. Step fractures are common.

(4b.) <u>Large Discoid Uniface</u> (One specimen; Fig. 18 a)

Formed on a large, primary flake of basalt, this artifact has a low plano-convex cross-section. Unifacial flaking is present on about one-half of the margin of the cortex face, and about one-half of the margin of the planar face. Flake removal from the two faces overlaps, forming bifacial working on about one-eighth of the periphery.

5. <u>**Flat End and Side Uniface**</u> (One specimen)

This uniface is made on a wide, end-struck flake with a rhomboidal cross-section and a rectangular outline. The striking platform and the bulb of percussion is located at one end. Both the long edges and the end opposite the bulb of percussion are unifacially flaked.

6. <u>**Backed Flake Unifaces**</u> (Two specimens; Fig. 5b)

This uniface has a long ovoid or triangular outline and a plano-convex or triangular cross-section. One long edge is the unifacially-flaked "working" edge. The backed edge, opposite the working edge, is formed by a flat surface perpendicular to the dorsal face on one specimen, and by a battered edge on the second specimen.

7. <u>**Irregular Thick Flake Unifaces**</u> (Two specimens)

These unifaces are made on a thick, irregular flake. Steep flaking on one edge produces a steep, strong working edge.

8. <u>**Triangular Uniface**</u> (One specimen; Fig. 18 c)

Made on a large basalt flake, this uniface is nearly circular in outline with the striking platform at one end. All edges except the striking platform are unifacially flaked. The cross-sectional configuration is low plano-convex to low rhomboidal. The straight edge has a steeper angle and more step-flaking than the convex edge. Flaking on all edges shows the removal of narrow flakes by either pressure or light percussion flaking.

9. Concave Flake Unifaces (Two specimens; Fig. 18 d,e)

These are unifacially-flaked on at least one concave edge. One is an end-struck jasper flake which is an elongate triangle in outline, and has unifacial flaking along a slightly concave edge adjacent to the striking platform, as the only modification. The second is an end-struck chalcedony flake with an irregular, plano-convex cross-section. The end opposite the bulb of percussion is squared, with concave adjacent edges expanding to a maximum width and then convex edges that taper to the flat striking platform. Unifacial flaking is exhibited along the squared end and one concave edge. The second concave edge is retouched along the one-third of its length adjacent to the squared end of the flake.

10. Spiked and Pointed Unifaces (Two specimens; Figs. 17, 18)

(10a.) Pointed Uniface ("Graver") (One specimen ;Fig. 17 g)

This is a thick, end-struck flake with a triangular cross-section. The end opposite the bulb of percussion and the platform has been unifacially and steeply pressure-flaked to form a sharp point. One lateral edge has also been unifacially-worked.

(10b.) Spiked Uniface (One specimen; Fig. 18 b)

This artifact is triangular in outline and flat rhomboidal in cross-section with steep unifacial pressure-flaking on the full length of two edges. The third edge is partially unifacially worked, producing a small "spike" near one corner. A second "spike" is formed on the adjacent corner. The striking platform and the bulb of percussion are located at one corner. Cortex covers one side of the specimen except where it has been removed on the worked edges.

CORES AND CORE FRAGMENTS (20 specimens; attributes, Table 4)

These are amorphous and thick lithic materials that exhibit scars of flake removal over most surfaces. All the cores in these collections are multifaced with the exception of one which is a split cobble core with unidirectional flake removal. It appears that the collection of cores and core fragments from this Nelson Lake site is probably not quantitatively representative of the core material present, and that only a small and selective sample is included in the collections.

MODIFIED AND RETOUCHED FLAKES (85 specimens; attributes, Table 4)

These include small and thin to large and thick (and often primary) reduction flakes which are irregular in shape and which have been modified by use or retouch.

UNMODIFIED FLAKES (403 specimens; attributes, Table 4)

These are flakes which have been removed in primary and secondary reduction and in the maintenance of tools an which have not been modified by subsequent use or retouch.

The flake sample in the collections is not random. Evidently, Rogers did not collect flakes from the site(s), for there are no unmodified flakes in the Museum of Man collections from M-110 and M-110A. By eliminating flakes from the sample, engraving tools and other tools made by simple modification of reduction flakes are probably not represented. The collection at the San Bernardino County Museum has a preponderance of large primary and secondary reduction flakes, and only a few small thinning flakes. Selective collecting is probably the reason why so few smaller flakes are present and does not represent an absence of "maintenance" type activity as well as tool production.

LITHIC MATERIALS USED IN FLAKED STONE ARTIFACTS

An overwhelming proportion (77%) of the flaked stone artifacts are made of locally available basalt. Twenty-one percent of the artifacts are made of cryptocrystalline materials, mostly chalcedony. Notable, however, is that in the uniface class, more than half (54%) of the artifacts are of cryptocrystalline materials. Obsidian material is very rare (<1 %). It is generally accepted that basalt and other fine-grained volcanics were preferred materials for the production of biface tools in the central Mojave during the early period (Lake Mojave and Pinto). The collections from Nelson Lake that are the subject of this paper certainly seem to be in accordance with this. The major source for basalt and other fine-grained volcanics, to the south of Nelson Lake, may have attracted early occupants.

GROUND STONE ARTIFACTS

Ground stone artifacts were reported at the Nelson Lake sites by several of the investigators (see above). Artifacts in the collections at the San Diego Museum of Man and at the San Bernardino County Museum are described below.

MANOS (Two specimens; Fig. 19)

One unifacial mano from M-110A is oval in shape and made of grey basalt. It is 11.5 cm. in length, 7.5 cm. in width, and 6.0 cm. thick. The flat, unifacial grinding surface is 5 cm. by 6 cm.

One multifacial mano from SBCM 763 is 9.8 cm. in length, 8 cm. in width, and 5.5 cm. thick. There are three grinding surfaces and one of these has dark discolorations on it. Two ends of the mano show evidence of battering.

METATES (Five specimens)

Five metates are in the SBCM 763 collection; there are none in the San Diego Museum of Man collections from M110 or M110A. Three are slab type (< 5 cm. thick) and two are block type (5 cm. thick or greater).

A slab metate with a shallow basin is of highly-weathered sedimentary material (probably sandstone). It is unifacial and while the grinding surface appears to cover the entire working side, a concavity 0.5 cm. deep occurs in the center. The length of the metate is 23.0 cm., its width 14 cm., and its thickness 4.8 cm. (Fig. 20).

Another complete, irregularly-shaped (elongated triangle) slab metate has rounded, well-worn edges and is composed of rhyolitic material. It is 39 cm. long, 23.5 cm. wide, and 4.5 cm. thick. The grinding area covers almost the entire top surface and there is a very shallow (<0.25 cm.) circular central area of concavity of about 10 cm. diameter.

A slab metate fragment of granitic material has a flat grinding surface which is stained with dark spots of a seemingly oily or tarry substance. There is no shaping, and the fracture intersects the grinding surface. The metate fragment is 22 cm. long, 171.3 cm. wide, and 4.2 cm. thick.

A block metate fragment in two segments is of grey rhyolitic material and has been shaped by pecking in several areas (edges and base side). It has a unifacial oval-shaped concave grinding surface which is slanted obliquely in vertical orientation and has a dark-colored stain on it. The grinding area is 22 cm. long, 12 cm. wide, and 2.6 cm. in depth. The fractures intersect the grinding surface. The entire block metate fragment is 34.2 cm. long, 19 cm. wide, and 12.4 cm. thick.

A second block metate of red rhyolitic material could not be relocated.

DISCUSSION

This discussion is concerned with three problems:

1) The age of the Nelson Lake site,
2) The relation of the site to other sites in the immediate vicinity,
3) The relation of the site to local natural resources which have been identified.

AGE

The age of the site is at present based on its relationship to certain topographic features and the known, or assumed ages of these features, and by time-sensitive artifacts that have been dated elsewhere. Two major features of the site are important in estimating its age: (1) a storm beach in and upon which are found cultural debris (Robarchek et al. 1984) and (2) a series of gravel bars (cusps), containing artifacts that have developed on the playa floor up to about 70 meters out from the storm beach. Symmetry is exhibited in individual bars, being up to 10 m. long with the points of their arc-shaped configuration oriented toward the shoreline (Bachhuber 1984:594-595). When describing these features, Rogers states:

> On the talus and in recent wave terraces of gravel 150 ft. out from the site is a great amount of dacite knife material. Knives are very large and some square butted. Some metates (are) present on the upper terrace (Rogers, n.d.)

These gravel bars were formed during a period when the lake held water that was two meters deep (Bachhuber 1984:595). In his concluding remarks regarding these bars, Bachhuber states:

> Geological data do not permit the establishment of an absolute chronology, but it is believed here that the Nelson

> Lake subpluvial phase occurred about 8000 - 9000 B.C. [10,000 - 11,000 B.P.]

Skinner and Ferraro, writing later (Skinner 1985:234) note:

> Artifacts were present in the cusps and this suggests that the lake filled to a high enough level to rework the beaches. The gravel bars, including the stone artifacts, are probably derived from the storm beach.

From our preliminary inspection, the artifact assemblages from the gravel bars and the storm beach, and the sand terraces are very similar. Lake Mojave points occur at both, suggesting considerable antiquity. The presence of a Pinto point and a large, stemmed (possible) Elko point may suggest final use of the site at perhaps 4000 B.P.

This late date raises another problem that is mentioned in passing. Nelson Lake is formed by water runoff in a basin of only about 225 square km. Any permanent body of water within the basin is dependent upon precipitation in that limited area and/or spring flow (not present now). This suggests that for the lake to fill on a permanent basis, it would be necessary to have wetter climatological conditions than at present in the central Mojave. Further support for an early date is the number of sites found along the margins of Nelson Lake, within the basin, and along Nelson Wash which drained the lake to the east (Robarchek et al. 1984; Skinner 1985).

RELATION TO OTHER SITES

Archaeological reconnaisance of the Nelson Basin has revealed a series of smaller sites on the lake margins that appear, on the basis of projectile point types, to date to the Lake Mojave and/or Pinto periods and appear to be small hunting camps or lithic reduction stations. CA-SBR-5042, -5043, -5255, -and -5262 contain one or more Lake Mojave and/or Silver Lake points, ovate and leaf-shaped bifaces, unifacial tools, and fire-cracked rock, suggesting that they were small hunting camps. Two sites appear to be primarily lithic reduction stations, but one (CA-SBR-5034) yielded a Lake Mojave point and the other (CA-SBR-5252) yielded one Silver Lake and two Pinto points. Two other sites are larger, but appear to have a similar range of tool types as the small camps. One Lake Mojave point and three leaf-shaped points were recovered from one of these sites (CA-SBR-2355) and the second site (CA-SBR-5047) yielded three Lake Mojave points, three Silver Lake points, and four generalized leaf-shaped bifaces.

In addition, there are a large number of lithic reduction stations scattered throughout the basin. This concentration is due to the availability of suitable lithic material in the Nelson Basin. Skinner (1985:290) has identified ten lithic procurement sites with basalt, chalcedony, and jasper to the east, west, and north of Nelson Lake. (One was a basalt source, one a basalt source with chalcedony, one a chalcedony source with some basalt, six were chalcedony sources, and one a jasper source.) All are within a short walk of the Nelson Lake site. To the south of the lake is a major Plio-Pleistocene detrital deposit containing fine-grained volcanics (basalts and other related materials), and cryptocrystalline quartz nodules. There are a large number of lithic procurement and reduction sites within this area (Robarchek et al. 1984; Skinner 1985).

RELATION OF THE SITE TO LOCAL NATURAL RESOURCES

Early occupants of the Nelson Lake Basin were apparently attracted by two major resource categories: suitable and abundant lithic materials for the production of flaked stone tools and the resources supported by and attracted to the fresh water.

Basalts and other fine-grained volcanics are generally recognized as being preferred materials for biface tools in the central Mojave during early times. Major sources of these materials, as well as lesser amounts of cryptocrystalline quartz are present within the Nelson Basin.

Fresh water resources probably consisted of plants and small animals that inhabited the lake margins as well as larger mammals and waterfowl attracted by the fresh water. Because of its position at the upper end of a minor stream system, fish and fresh water mussels were probably not present in Nelson Lake. With these exceptions, the fresh water resources of Nelson Lake and associated streams, e.g. Nelson Wash and Bicycle Wash, were probably much like the resources found along the margins of stream and lake systems that extended across the Mojave Desert during the early Holocene.

CONCLUSIONS

The Nelson Lake site appears to be the largest occupation site in Nelson Basin and to be the only one known to have cultural deposits of some depth (Robarchek et al. 1984:73). Other sites appear to be small camps or specialized lithic procurement and reduction sites. The present evidence from the Nelson Basin (Rogers n.d.; Smith 1964; Simpson and De Maye 1964; Kaldenberg 1981; Robarchek et al. 1985; Skinner 1985) strongly suggest that primary occupation was during the Lake Mojave period and that any occupation later than the Pinto period was extremely sporadic in nature. The known evidence for later use is limited to a few isolated projectile points (Robarchek et al. 1984; Skinner 1985) in addition to the few later specimens collected by Rogers from the Nelson Lake site (see above).

A number of hypotheses or problems can be posed on data now known from Nelson Basin, including those of chronological and climatological parameters as well as interrelationships between technology, settlement patterns, and production. Some hypotheses specifically related to Nelson Lake can be summarized as follows: (1) Nelson Basin sites were occupied primarily during the early Holocene (i.e. Lake Mojave and Pinto periods). (2) With increased aridity and the drying of the lake, occupation decreased markedly, with only rare occupation or periodic use of the area. Occupation of the known residential sites essentially came to an end. (3) The abandonment of the Nelson Basin corresponds to the time of the marked decrease in the use of basalt for production of flaked stone tools (Warren et al. 1986:3-22). There may be a causal relationship between the changes in settlement pattern and land use and the decrease in the "preference" for basalt.

The opportunity exists at the Nelson Lake site to test models of early Holocene subsistence strategy which have wide application in the Mojave Desert. Warren (n.d.) has suggested that during the Lake Mojave and early Pinto periods the early occupants followed a forager stategy (Binford 1980) in which man concentrated his procurement activities in the riparian, marsh, and lake shore zones, almost to the exclusion of other areas. The technology of this early Holocene population was appears to indicate a reliance on large game hunting in an increasingly arid environment. Larger and more mobile animals were hunted as they came to watering places. As animals became scarcer or stopped using watering places because of human presence, early human populations moved on to the next watering place. A foraging strategy of this kind would result in repetitive tool assemblages occurring at residental bases. Differences between sites would be limited to the specialized activities that might have taken place that were dependent on local resources, e.g. lithic reduction of basalt at residential bases in Nelson Basin.

The Nelson Lake site clearly has considerable significance for archaeological research in the Mojave Desert. It has cultural deposit at least 70 cm. deep containing faunal remains, features, artifacts, and abundant debris from the production and maintenance of tools (Robarchek et al. 1984). The location of the site adjacent to the lake bed makes the possibility of recovering pollen and macrofossils greater than at other sites in the region.

The removal of artifacts by early collectors has biased the sample of the remaining surface artifacts. Therefore the significance of the site could be under-rated if judged only by what is still present on the surface today. Access to the data in museum collections and field notes is imperative for the valid assessment of site significance, not only for this site, but for all sites in the Mojave Desert. The purpose of this paper is to bring the importance of museum collections to the attention of the archaeological community and to those in decision making positions in order to insure that proper action will be taken to mitigate the impacts that are threatening not only the Nelson Lake site[6], but many others threatened by modern day land use and development. This is especially important in areas such as this where a large proportion of the artifactual material occurs on the surface.

ACKNOWLEDGMENTS

We would like to thank Grace Johnson, Ken Hedges, and Rose Tyson of the San Diego Museum of Man and Carol Rector of the San Bernardino County Museum for their help in locating collections and manuscripts and for making work space available to us.

Information used in this paper was derived from the Fort Irwin Archaeological Project Reports which have been funded by the U.S. Army.

ENDNOTES

1. Rogers abbreviated San Dieguito with the letters **S. D.** and Amargosa with **Amar.** The designation **Amargosa I** has two different meanings. In 1939 (Rogers 1939) it referred to sites with a predominance of Elko series points (called Amargosa points by Rogers), but Rogers changed his terminology and sometime later **Amargosa I** is applied to Pinto material.

2. See endnote 1.

3. NY-I is Rogers' abbreviation for non-ceramic Yuman I. Panamint in his sentence refers to Panamint Shoshone.

4. After the completion of the artifact descriptions for SBCM 763, 14 artifacts, collected during a 1978-1979 survey by Russell Kaldenberg, were located in the museum. These are not included in our descriptions because they are not identified as to specific site number, but are attributed to SBCM 762 - 764. They include a fragment of a large biface of jasper, a small biface of basalt, a small and narrow keeled uniface of chalcedony, a long blade of chalcedony which shows modification along one edge, a small rhomboidal chalcedony core, an obsidian flake, two basalt flakes, one large chert flake, two jasper flakes, one pointed chert flake, a quartzite fragment, and a flake uniface of chert.

5. The following definitions of **thin biface** reduction stages, based loosely on a biface reduction sequence developed by Skinner (1985) will be used:

Early -- Some cortex remains (<5% of the surface); there are prepared platforms; edges are sinuous to somewhat straight; most prominent masses and ridges have been removed; approximates ovate shape, but cross-section may be rectangular or trapezoidal. The width - thickness ratio is <3:1.

Mid -- No cortex is present; overlapping flake scars; opposing lateral edges; cross-section is lenticular. The width - thickness ratio is about 4:1.

Late -- Regular flake removal; uniform lateral edges; cross-section is quite lenticular; pressure flaking may be used for shaping. The width - thickness ratio is 4:1 to 5:1.

6. After completion of this paper, Far West Anthropological Group began the investigation of this site under contract with the U. S. Army.

REFERENCES

Bachhuber, Fred

1984 Geologic Aspects of a Transect from Archaeological Site 4-SBr-4966 (KD-25) to Nelson Lake and A Discussion of the Ridge Quarry Site (4-SBr-4977), Fort Irwin National Training Center, California. In: An Archaeological Survey of the 1982 Gallant Eagle Exercise Area, Fort Irwin, San Bernardino County, California. Fort Irwin Archaeological Project Research Report 7, pp. 594-602. Salinas: Coyote Press.

Binford, Lewis

1980 Willow Smoke and Dog's Tails: Hunter Gatherer Settlement Systems and Archaeological Site Formation. American Antiquity 47:485-503.

Campbell, Elizabeth W. Crozer, William H. Campbell, Ernst Antevs, Charles Avery Amsden, Joseph A. Barbieri, and Francis D. Bode

1937 The Archaeology of Pleistocene Lake Mohave. Southwest Museum Papers No. 11.

Chartkoff, Joseph L.

1987 The Bleak and the Grey: Critical Issues of Publication and Scholarship in California Archaeology. Society for California Archaeology Newsletter 21(3).

Kaldenburg, Russell L.

1978 A Report on the Status of some Archaeological Resources at Fort Irwin, Mojave Desert, California. Manuscript on file at the Bureau of Land Management, Riverside.

1981 The Archaeology of Selected Springs and Playas on Fort Irwin and in portions of the Avawatz Mountains. San Bernardino County Museum Association Quarterly Vol. XXVIII, Nos. 3 and 4.

Pourade, Richard F., ed.

1966 Ancient Hunters of the Far West. Los Angeles: Copley Press.

Robarchek, E., W. H. Breece, K. A. Bergin, and C. N. Warren

1984 An Archaeological Survey of the 1982 Gallant Eagle Exercise Area, Fort Irwin, San Bernardino County, California. Fort Irwin Archaeological Project Research Report 7. Salinas: Coyote Press.

Robarchek, C., C. N. Warren, and V. Adair

1982 Intensive Cultural Resource Survey of Portions of the Live Fire Maneuver Range, Fort Irwin, California. Fort Irwin Archaeological Project Research Report 5. Salinas: Coyote Press.

Roberts, Frank H. H. Jr.
1940 Developments in the Problem of the North American Paleo-Indian. Miscellaneous Collections, Vol. 100:51-116. Washington: Smithsonian Institution.

Rogers, Malcolm J.
n.d. Notes on file at the San Diego Museum of Man

1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. San Diego Museum of Man Papers 3.

Simpson, Ruth D. and George De Maye
1964 Site Record Form for San Bernardino County Museum Site 763. On file at the California Archaeological Information Center, San Bernardino County Museum, Redlands.

Skinner, Elizabeth J.
1985 Bits and Pieces of Prehistory at Fort Irwin: Testing of KD-25, the Knoll Site, the Crossroads Site, Garlic Spring and Bitter Spring; and Survey of Areas 12A and 12H, Fort Irwin Archaeological Project Research Report 12. Salinas: Coyote Press.

Smith, Gerald
1964 Site Record Form for San Bernardino County Museum Site 763. On file at the California Archaeological Information Center, San Bernardino County Museum, Redlands.

Warren, Claude N.
n.d. The Subsistence Focus and Early Holocene Settlement Patterns in the Central Mojave Desert. In: Reconstructing Climatic Changes and Variations and Their Effects on Human Adaptations in the Western United States, Daniel O. Larson and Joel C. Michaelsen, Eds. London: Plenum Press.

1970 Time and Typology: Elizabeth W. C. Campbell's Approach to California Desert Prehistory. The Masterkey 44(1):5-14.

Warren, Claude N., Margaret M. Lyneis, Michael S. Kelly, F. W. Bachhuber.
1986 Research Overview. Volume 2, Fort Irwin Preservation Plan. San Francisco: National Park Service, Western Region.

Table 1
PROJECTILE POINTS
NELSON LAKE SITE

Type	Length (cm.)	Width (cm.)	Thickness (cm.)	MShW (cm.)	ShW (cm.)	NW (cm.)	BW (cm.)	SL (cm.)	Site	Material
Lake Mojave										
1	5.4	2.5	0.6	2.5	0.6	1.9	0.0	2.5	M110A	fngrn vol
2	inc	3.5	0.7	0.6	1.1	2.4	0.0	2.7	M110A	basalt
3	inc	3.5	0.7	3.5	1.1	2.4	0.0	3.4	M110	chal
4	inc	3.1	0.9	3.4	0.6	2.8	0.0	3.9	M110	basalt
5	inc	3.0	0.8	3.0	0.8	2.2	0.7	3.1	M110	basalt
6	6.1	2.7	0.8	2.7	0.5	2.2	inc	3.0	M110	rhyolite
7	8.0	2.5	0.7	2.4	0.6	1.8	0	1.7	M110A	rhyolite
Silver Lake										
1	4.5	2.6	0.8	2.6	0.5	2.1	1.5	2.0	M110A	felsite
2	inc	2.7	0.7	2.7	0.4	2.3	0	1.8	M110	basalt
Pinto										
1	inc	2.6	0.7	2.5	0.5	2.0	2.3	1.2	M110	basalt
Elko Series										
1	6.7	3.8	1.3	3.5	0.9	2.6	2.6	1.1	M110A	rhyolite
2	5.5	3.6	1.0	3.6	1.3	2.3	1.8	0.7	M110	basalt
Basal notched										
1	4.6	2.3	0.7						M110A	chal
2	3.3	2.0	0.8						M110	basalt
Rectangular stemmed										
1	2.8	2.3	0.6	2.2	0.3	1.9	2.0	1.1	M110A	obsidian
2	3.5	2.0	0.8	2.0	0.3	1.7	1.7	0.7	M110A	rhyolite
Narrow leaf-shaped										
1	6.7	2.3	0.8						M110A	chert
2	6.8	2.6	1.0						M110A	fngrn vol
3	5.0	2.3	0.8						M110A	basalt
4	5.6	2.5	0.8						M110A	basalt
5	6.4	2.4	0.9						M110A	basalt
6	4.9	2.5	0.8						M110	chal
7	5.1	2.1	1.1						M110A	rhyolite
8	5.1	2.5	0.7						M110A	rhyolite
9	inc	2.7	0.7						763	basalt
10	3.3	2.5	0.8						M110	obsidian
11	5.1	2.4	0.8						M110	basalt
12	inc	3.0	0.8						763	basalt
13	inc	(2.5)	0.6						763	basalt
Broad leaf-shaped										
1	inc	3.2	0.7						763	basalt
2	(4.4)	(2.3)	0.7						763	basalt
Lanceolate										
1	inc	2.2	1.0						M110	basalt
2	7.3	2.4	1.3						M110A	chert

MShW: maximum shoulder width
ShW: shoulder width
NW: neck width
BW: base width
SL: stem length
inc: specimen too incomplete for estimation
( ): estimated measurement
chal: chalcedony
fngrn vol: fine grained volcanic

Table 2
BIFACIALLY FLAKED SPECIMENS
NELSON LAKE SITE

	Length (cm.)	Width (cm.)	Thickness (cm.)	Site	Material	Reduction Stage
CRESCENTIC	--	--	0.7	M110A	chal	
THIN BIFACES						
1 Pointed Tip/Base						
1a Straight Edges	--	4.8	1.8	M110	chal	early
	--	4.4	1.2	M110	basalt	mid
N=12	--	2.7	1.0	M110	basalt	mid
	--	(3.5)	0.9	M110	basalt	mid*
	--	3.9	1.5	M110	basalt	mid
	--	2.2	0.7	M110A	basalt	final
	--	3.5	1.0	M110A	basalt	mid
	--	3.4	0.9	M110A	basalt	final
	--	3.2	0.9	763	basalt	mid
	--	2.0	0.7	763	basalt	final
	--	4.4	1.6	763	chal	mid
	--	2.8	0.8	763	chal	final
1b Straight/Convex Edge	--	3.4	1.0	M110	basalt	mid
	--	3.5	0.9	M110	basalt	mid*
N=8	--	2.7	1.1	M110	crypto	mid
	--	2.1	0.9	M110	basalt	mid*
	--	3.1	0.9	M110	basalt	mid*
	--	3.6	0.8	M110	basalt	mid*
	--	3.7	0.8	M110	basalt	final
	--	2.9	0.7	M110	basalt	final
1c Convex Edges	--	3.3	1.3	M110	basalt	mid
	--	2.9	1.0	M110	basalt	mid
N=10	--	3.2	0.9	M110	basalt	final
	--	2.6	0.9	M110	basalt	mid
	--	3.8	0.8	M110	basalt	final
	--	(3.3)	1.2	M110	basalt	mid
	--	3.8	1.0	M110	basalt	mid
	--	4.0	0.8	M110A	basalt	final
	--	3.5	1.0	M110A	basalt	mid
	--	5.3	1.6	M110A	basalt	early
2 Convex Base						
2a Divergent Edges	6.3	(3.5)	1.2	M110	basalt	final*
	5.8	(3.0)	0.8	M110	basalt	mid
N=19	6.4	3.8	1.2	M110	chert	mid
	5.9	4.0	1.0	M110	chert	final
	6.9	4.1	1.3	M110	basalt	mid
	4.5	2.8	0.9	M110	basalt	mid
	--	--	1.1	M110	basalt	early
	--	4.4	1.4	M110	basalt	early
	--	5.7	1.5	M110	basalt	mid
	--	3.5	1.5	M110	basalt	early
	--	5.2	1.2	M110	basalt	final
	--	4.3	1.3	M110	basalt	early
	--	3.8	0.8	763	basalt	***
	--	4.0	1.0	763	basalt	***
	--	3.4	0.9	763	basalt	***
	--	2.8	1.0	763	basalt	***
	--	4.3	1.2	763	basalt	***
	--	3.7	1.3	763	basalt	***
	--	4.0	0.9	763	basalt	***

Table 2 (continued)

	Length (cm.)	Width (cm.)	Thickness (cm.)	Site	Material	Reduction Stage
2b Parallel Edges	--	3.4	0.7	M110	basalt	final
	--	3.5	1.2	M110	basalt	mid
N=38	--	3.9	1.2	M110	basalt	mid
	--	4.6	1.5	M110	chal	mid
	--	4.4	1.5	M110	basalt	mid
	--	3.7	1.5	M110	basalt	early
	--	1.6	1.2	M110	basalt	mid
	--	3.3	1.1	M110	chal	final*
	--	2.6	1.0	M110	basalt	mid
	--	3.7	1.2	M110	basalt	early
	6.9	3.2	1.5	M110	basalt	early
	--	3.7	1.2	M110	basalt	mid
	--	3.8	1.2	M110	basalt	early
	--	2.6	1.1	M110	basalt	early
	--	2.8	0.7	M110	basalt	mid
	--	4.4	1.1	M110	basalt	early
	--	4.1	1.3	M110	chal	mid
	--	3.4	1.0	M110	basalt	early
	--	3.1	1.2	M110	basalt	early
	--	3.0	0.9	M110	basalt	early
	--	4.4	1.1	M110	basalt	final
	--	3.8	1.1	M110	basalt	mid
	--	2.7	1.1	M110	basalt	early
	--	4.1	1.1	M110	basalt	early
	--	4.2	1.5	M110	basalt	early
	--	3.6	1.0	M110	basalt	mid
	--	6.0	1.3	M110	basalt	mid*
	--	4.5	1.0	M110	basalt	mid
	(8.5)	3.8	1.5	M110	basalt	early
	--	2.8	1.7	M110	basalt	early
	--	3.3	0.8	M110	basalt	mid
	--	2.7	0.8	M110	basalt	mid
	6.1	3.5	1.3	M110	felsite	mid
	--	5.5	1.3	M110A	basalt	mid
	--	2.3	1.0	M110A	chal	final
	--	3.0	1.2	M110A	basalt	final
	--	4.3	1.5	M110A	chal	mid
	--	4.9	0.9	763	chal	***
2c Convergent Edges	--	6.2	1.6	M110	basalt	final
	--	6.5	1.2	M110	basalt	final
N=40	--	5.7	1.6	M110	basalt	mid
	--	5.7	1.5	M110	basalt	final
	--	5.5	1.0	M110	basalt	mid
	--	5.1	1.5	M110	basalt	mid
	--	5.2	1.1	M110	basalt	mid
	--	4.7	1.1	M110	basalt	mid
	--	4.8	1.3	M110	basalt	final
	--	4.7	0.8	M110	basalt	final
	--	4.9	1.1	M110	basalt	early
	--	4.6	1.1	M110	basalt	mid
	--	4.1	1.1	M110	basalt	mid*
	--	4.8	1.5	M110	basalt	mid
	--	4.2	1.1	M110	basalt	final
	--	3.8	1.2	M110	basalt	final
	--	4.3	1.5	M110	basalt	mid
	(8.1)	4.3	1.7	M110	rhyolite	final
	(7.3)	3.4	1.3	M110	basalt	final
	--	4.0	0.9	M110	basalt	mid
	--	4.3	1.1	M110	basalt	mid
	--	4.3	1.0	M110	basalt	final
	--	4.0	0.7	M110	basalt	early
	--	2.9	0.9	M110	basalt	early
	(6.1)	3.4	0.9	M110	basalt	final*
	--	3.0	1.2	M110	basalt	mid
	--	3.2	1.2	M110	basalt	mid
	--	4.0	0.6	M110	basalt	final
	--	4.3	1.0	M110	basalt	early
	--	4.0	1.1	M110	basalt	mid

Table 2 (continued)

	Length (cm.)	**Width** (cm.)	**Thickness** (cm.)	**Site**	**Material**	**Reduction Stage**
2c Convergent Edges (cont.)	--	3.0	0.9	M110	crypto	early*
N=40	--	3.1	1.1	M110	crypto	mid
	--	5.2	1.5	M110A	basalt	early
	--	5.1	1.6	M110A	chal	mid
	--	3.7	1.2	M110A	basalt	early
	--	2.6	0.7	M110A	basalt	final
	6.5	2.7	0.8	M110A	basalt	final
	--	5.7	2.2	763	basalt	***
	--	5.2	1.6	763	basalt	***
	--	7.1	1.7	763	basalt	***
3 Straight Base						
3a Divergent Edges (Triangular)	6.2	3.0	1.1	M110	basalt	mid
	--	4.6	1.2	M110	basalt	mid
	--	4.6	1.0	M110	basalt	mid
N=7	--	(6.1)	1.1	M110	basalt	mid
	--	(5.2)	1.2	M110	basalt	mid
	--	5.2	1.1	M110	basalt	final
	--	3.9	0.9	M110A	chal	final
3b Parallel Edges (Square Base)	--	4.9	1.6	M110	basalt	final
	--	5.2	1.2	M110	basalt	mid
	--	4.6	1.0	M110	basalt	mid**
N=15	--	4.1	1.1	M110	basalt	mid
	--	4.4	1.1	M110	basalt	mid
	--	3.6	1.0	M110	basalt	final
	--	4.0	1.6	M110	chal	mid
	--	4.1	1.8	M110	basalt	early
	6.6	3.6	1.8	M110	basalt	final*
	7.1	3.1	1.3	M110	chert	final
	5.2	3.1	1.5	M110	basalt	mid
	--	4.2	0.6	M110A	basalt	mid
	--	4.8	1.1	M110A	basalt	final
	4.8	3.8	1.2	763	basalt	***
	--	2.8	0.8	763	basalt	***
3c Convergent Edges	--	4.8	1.4	M110	basalt	final
	--	4.2	1.3	M110	basalt	mid
N=12	--	3.3	1.2	M110	basalt	final
	--	3.9	1.1	M110	basalt	early
	--	5.3	0.8	M110	basalt	final
	--	4.2	0.8	M110A	basalt	final
	--	3.1	1.1	M110A	basalt	early
	--	4.7	1.0	M110A	basalt	mid
	--	4.3	0.7	763	basalt	final
	--	3.4	0.8	763	basalt	***
	--	3.5	0.9	763	basalt	***
	--	4.0	1.0	763	chal	mid
4 Thin Biface Fragments						
4a Midsections N=23				M110 - 14 M110A - 2 763 - 7		
4b Edge Fragments N=7				M110 - 7		
4c Unclassified N=33				M110 - 11 M110A - 6 763 - 16		

Table 2 (continued)

	Length (cm.)	Width (cm.)	Thickness (cm.)	Site	Material	Reduction Stage
PREFORMS						
1 **Elongate Ovoid**	12.6	4.4	1.2	M110	basalt	
	11.7	4.8	2.1	M110	basalt	
	7.5	3.7	2.0	M110	basalt	
N=14	7.7	3.8	2.6	M110	chal	
	5.6	2.7	1.7	M110	jasper	
	5.6	3.4	1.4	M110	basalt	
	8.3	5.1	1.8	M110A	jasper	
	--	5.0	2.2	763	felsite	
	--	4.2	2.0	763	basalt	
	--	4.3	2.0	763	basalt	
	--	4.1	2.0	763	basalt	
	6.1	4.2	1.7	763	chal	
	6.7	5.1	2.5	763	chal	
	7.0	4.8	3.0	763	chal	
2 Discoid	6.2	5.1	1.5	M110	basalt	
	4.1	3.8	1.1	M110	basalt	
N=3	3.1	2.8	0.9	M110	basalt	

( ): estimated measurement
* : reworked specimen
**: unifacially worked specimen
***: reduction stage not noted
chal: chalcedony
crypto: cryptocrystalline material

Table 3
UNIFACIALLY FLAKED SPECIMENS
NELSON LAKE SITE

	Length (cm.)	Width (cm.)	Thickness (cm.)	Site	Material	Notes
UNIFACES						
1 Keeled Unifaces						
1a Thin, Leaf-shaped	6.3	3.5	1.3	M110	basalt	
N=5	6.7	3.5	1.1	M110	basalt	
	--	3.1	1.3	M110	basalt	
	--	3.3	1.3	M110	basalt	
	5.9	3.6	1.5	763	chal	
1b Thin, Parallel Edged	--	3.2	1.0	M110	basalt	
N=5	--	2.7	1.0	M110	basalt	
	--	2.9	1.0	M110	basalt	
	--	2.7	1.2	M110	basalt	
	--	2.8	1.2	763	chal	
1c Thick, Leaf-shaped/	(5.8)	4.6	1.8	M110	basalt	leaf-shaped
Rectangular	6.6	4.3	1.8	M110	basalt	rectangular
N=4	(6.9)	3.9	1.9	M110	basalt	rectangular
	6.9	2.9	1.9	M110	chal	rectangular*
1d Large Ovoid	(8.1)	5.9	2.2	M110	basalt	
N=2	9.2	7.7	2.6	M110	basalt	
1e Center Sections						
N=2	--	2.6	0.7	M110	basalt	
	--	3.0	1.3	M110	basalt	
2 Domed Unifaces						
2a Domed	6.3	4.8	2.5	M110	chal	
N=11	5.1	4.4	2.4	M110	chal	
	5.4	5.1	2.2	M110	chert	
	5.2	4.0	2.6	M110	chert	
	6.2	6.0	3.0	M110	basalt	
	5.3	3.7	1.8	M110	basalt	
	5.2	(3.1)	2.0	M110	chal	
	7.0	6.7	3.0	M110A	felsite	
	5.2	4.5	2.8	M110A	chal	
	6.5	5.1	3.5	763	jasper	
	4.1	3.4	3.2	763	chal	
2b Large Domed	--	7.0	3.9	763	basalt	
N=1						
3 Thick Flake Unifaces	6.7	5.2	1.6	M110	basalt	
N=10	5.7	4.6	1.5	M110	basalt	
	5.4	4.3	1.4	M110	chal	
	4.1	4.1	1.5	M110	chal	
	5.3	5.1	1.8	M110	chal	
	5.3	(3.5)	1.5	M110	chert	
	4.3	3.0	1.2	M110	jasper	
	7.4	5.1	1.7	M110	chert	
	5.5	4.5	1.8	M110A	chal	
	6.0	5.8	1.4	763	chal	
4 Discoidal Unifaces						
4a Small Discoid	4.0	3.8	1.2	M110	chert	
N=1						
4b Large Discoid	11.2	9.7	2.4	763	basalt	
N=1						
5 Flat End/Side Uniface	4.9	3.5	0.9	M110	chal	
N=1						

Table 3 (continued)

	Length (cm.)	**Width** (cm.)	**Thickness** (cm.)	**Site**	**Material**	**Notes**
6 Backed Flake Unifaces	7.6	3.3	1.5	M110	basalt	
N=2	6.7	3.7	1.4	M110	basalt**	
7 Irregular Thick Flake Uniface	5.2	3.4	1.5	M110	chal	
N=2	5.6	4.1	1.4	M110	chal	
8 Triangular/Pointed Uniface	7.0	5.7	1.3	763	basalt	
N=1						
9 Concave Flake Unifaces	4.3	2.9	0.6	763	jasper	
N=2	5.5	3.3	1.1	763	chal	
10 Engraving Unifaces						
10a Pointed	3.9	2.9	1.7	M110A	chal/chert	
N=1						
10b Spiked	3.3	3.8	0.7	763	chal	
N=1						

( ): estimated measurement
chal: chalcedony
*: triangular cross-section with striking platform at one end
**: base is cortex striking platform

Table 4
OTHER FLAKED STONE SPECIMENS
NELSON LAKE SITE

	Length (cm.)	Width (cm.)	Thickness (cm.)	Site	Material
Cores and Core Fragments					
1 Cores	5.4	4.4	2.8	M110	chal
N=8	6.9	4.1	2.1	M110	chal
	7.5	5.6	3.6	M110A	chal
	7.9	5.7	5.5	763	chal
	8.7	4.5	4.1	763	chal
	4.6	4.5	2.7	763	chal
	11.3	8.2	6.8	763	basalt
	11.2	8.7	5.7	763	basalt
2 Core Fragments				763	basalt N=11
N=12					chal N=1
Modified and Retouched Flakes					
N=85					
				M110	basalt N=7
				M110A	chal/chert N=5
				763	basalt N=60
					chal/chert N=12
					obsidian N=1

Measurements were not taken for the M110, M110A modified and retouched flakes at the San Diego Museum of Man

The range of sizes for modified and retouched flakes of both basalt and chalcedony/chert in the 763 collection from the San Bernardino County Museum are as follows:

	Length (cm.)	Width (cm.)	Thickness (cm.)
Basalt			
Largest	9.1	7.4	2.3
Smallest	3.4	2.4	0.4
Chal/chert			
Largest	7.6	3.7	1.3
Smallest	4.3	1.7	0.5

Unmodified Flakes			
N=403 (all from the San Bernardino County Museum)	763	basalt	N=324
		chalcedony	N=76
		rhyolite	N=2
		basalt nodule	N=1

Fig. 3. Projectile points: a - g, Lake Mojave points; h, Pinto point; i, j, rectangular stemmed points; k, l, basal-notched triangular points; m, n, Silver Lake points; o, p, Elko series points. Length of the upper left specimen, 5.4 cm.

Fig. 4. Projectile points: a - i, narrow leaf-shaped points; j, k, broad leaf-shaped points; l, m, lanceolate points. Length of the upper left specimen, 6.4 cm.

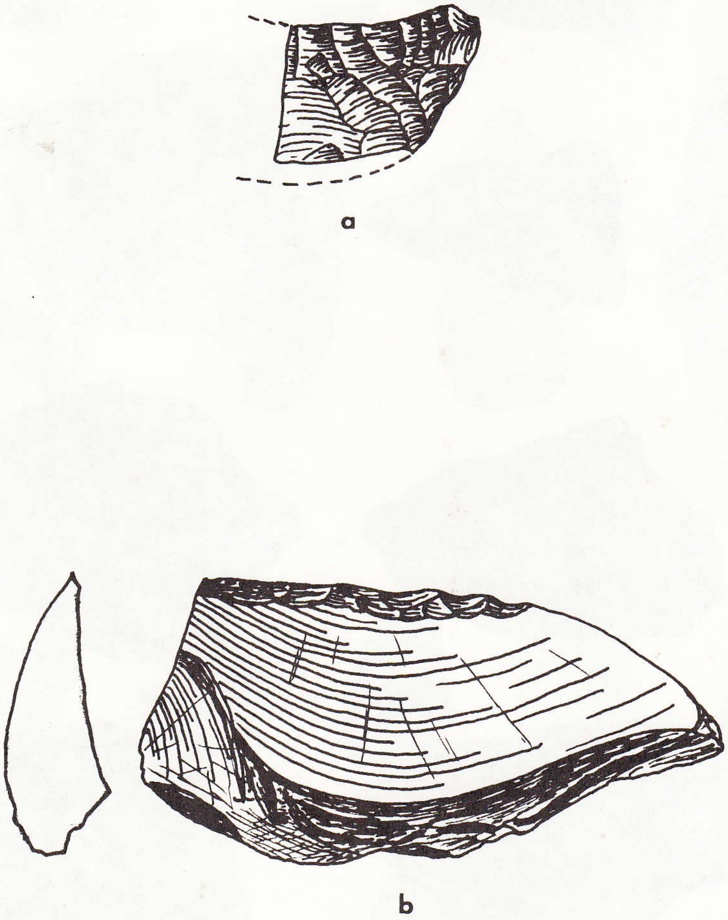

Fig. 5. Crescentic: a; Backed flake uniface: b. Length of b is 7.6 cm.

Fig. 6. Thin bifaces; pointed tip/base form: d, j, type 1a; c, e, f, i, type 1b; a, b, g, h, type 1c. Width of upper left specimen, 3.5 cm.

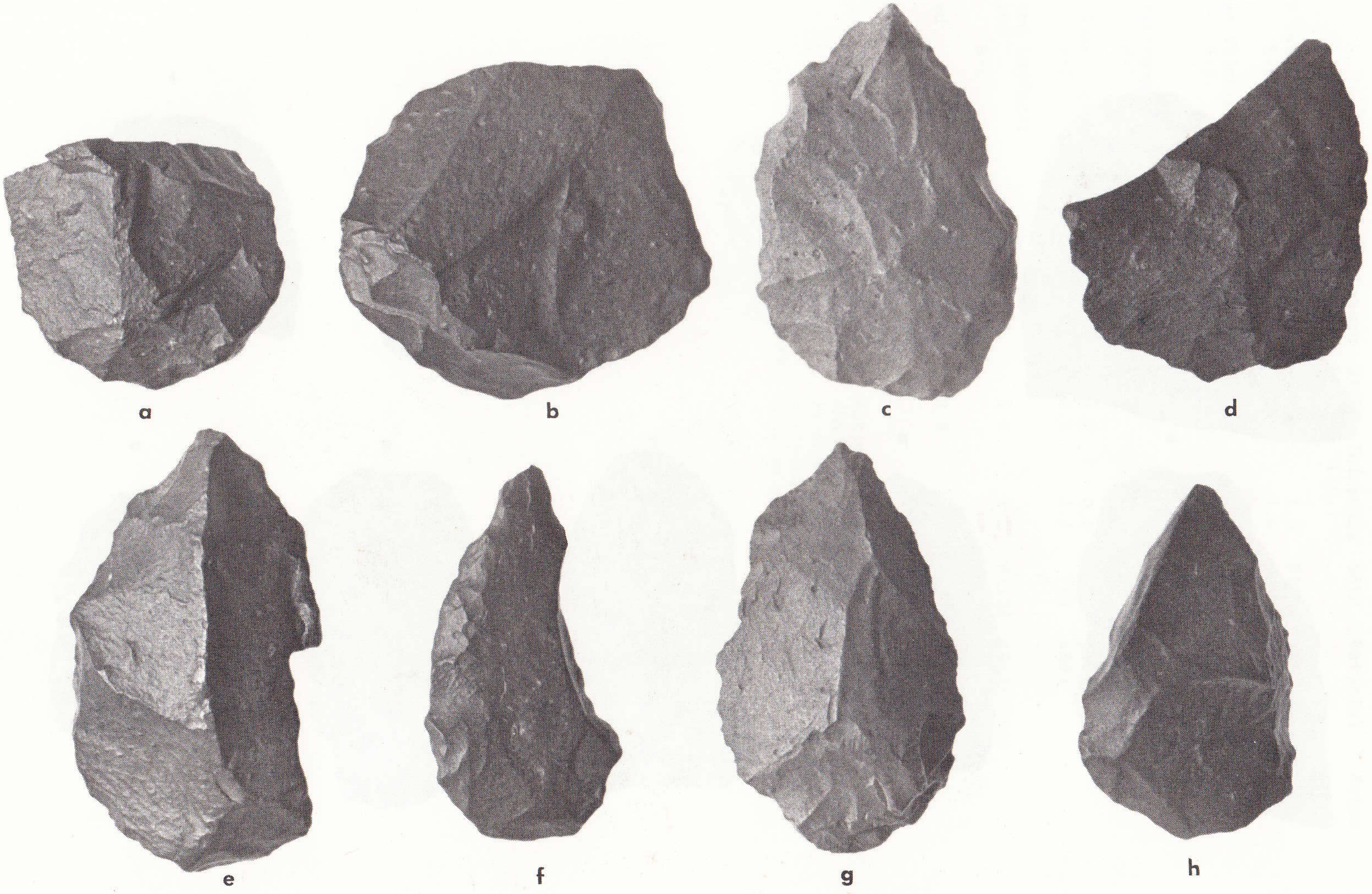

Fig. 7. Thin bifaces; convex (rounded) tip/base form: a - h, type 2a. Width of upper left specimen, 4.4 cm.

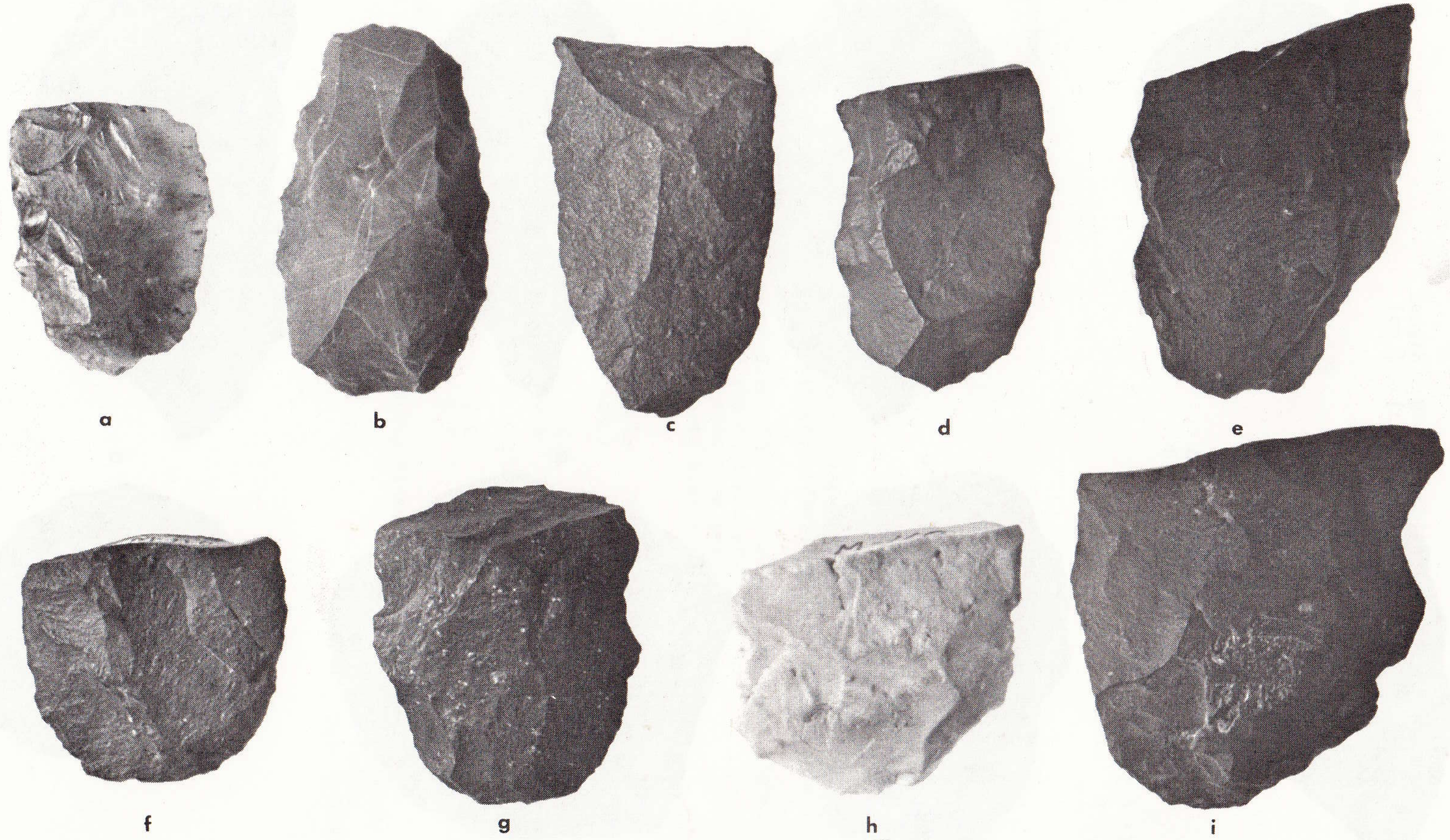

Fig. 8. Thin bifaces; convex (rounded) tip/base form: a - i, type 2b. Width of upper left specimen, 3.3 cm.

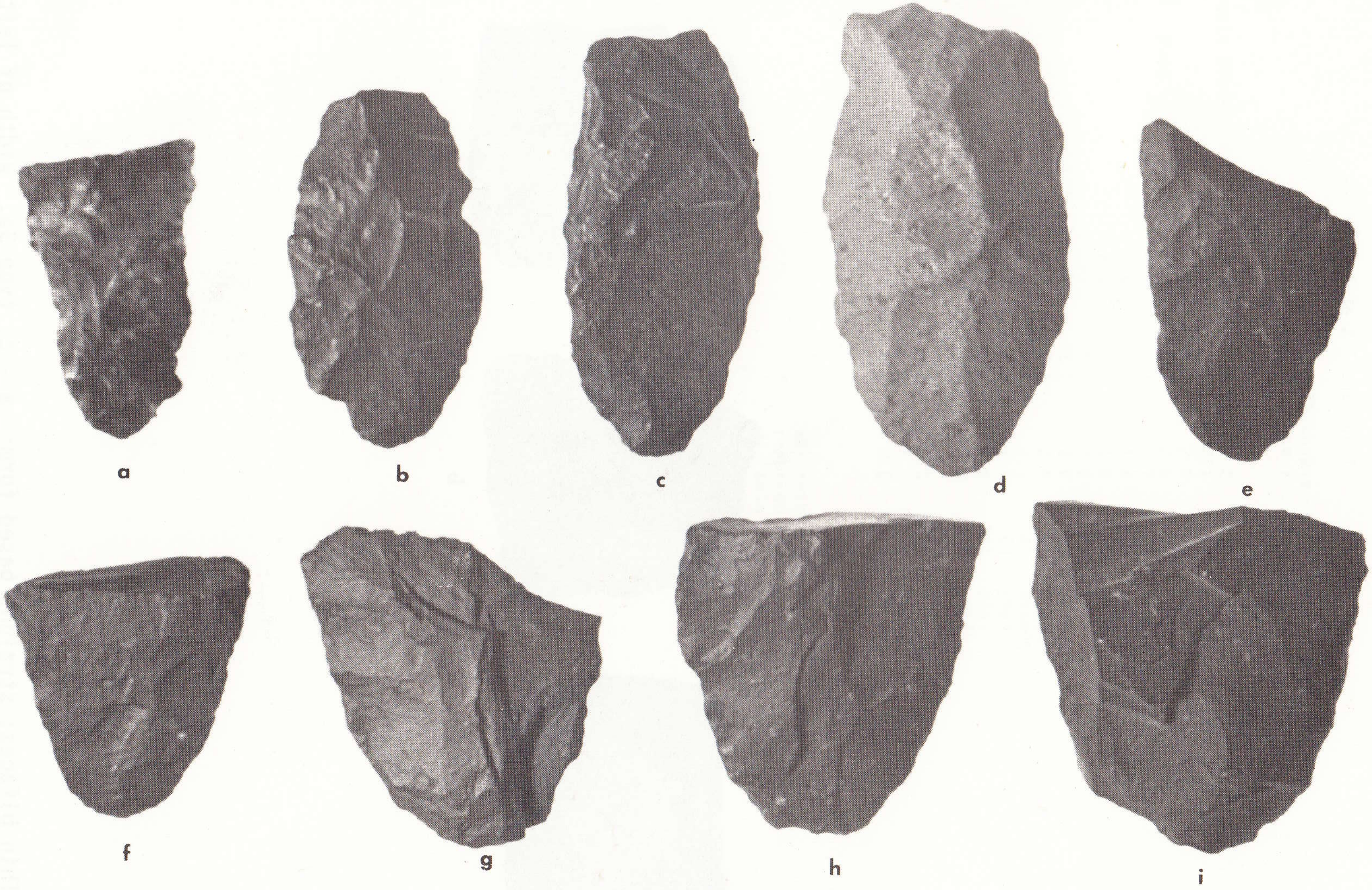

Fig. 9. Thin bifaces; convex (rounded) tip/base form: a - i, type 2c. Width of upper left specimen, 3.0 cm.

[redacted]

Fig. 12. Thin bifaces; straight-based form: a - i, type 3c. Width of upper left specimen, 3.6 cm.

Fig. 13. Preforms: a - c, elongate ovoid. Length of left specimen, 12.6 cm.

Fig. 14. Preforms: a - e, elongate ovoid; f - h, discoid. Length of upper right specimen, 7.7 cm.

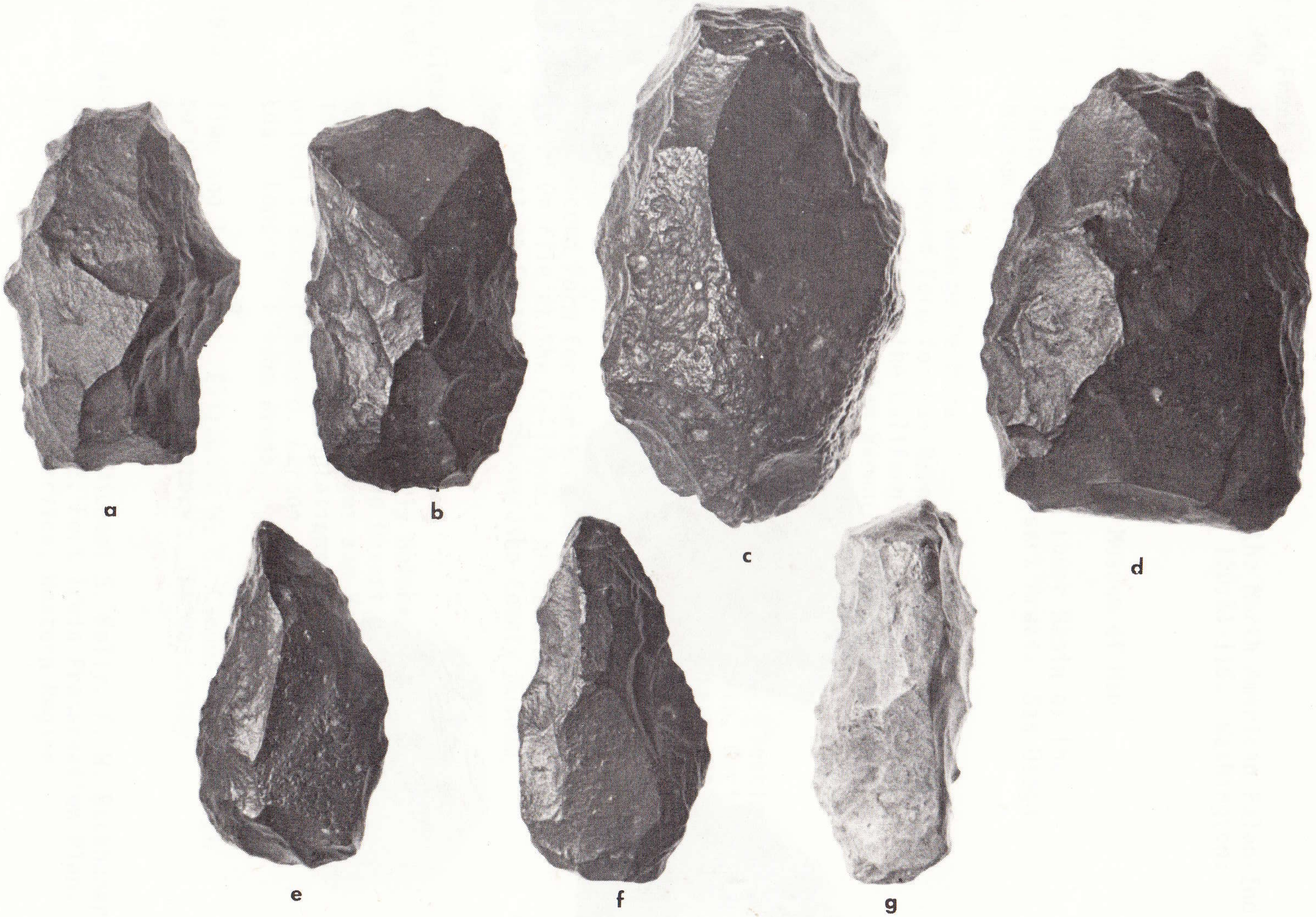

Fig. 15. Keeled unifaces: e, f, type 1a; a, b, g, type 1c; c, d, type 1d. Length of upper left specimen, 6.7 cm.

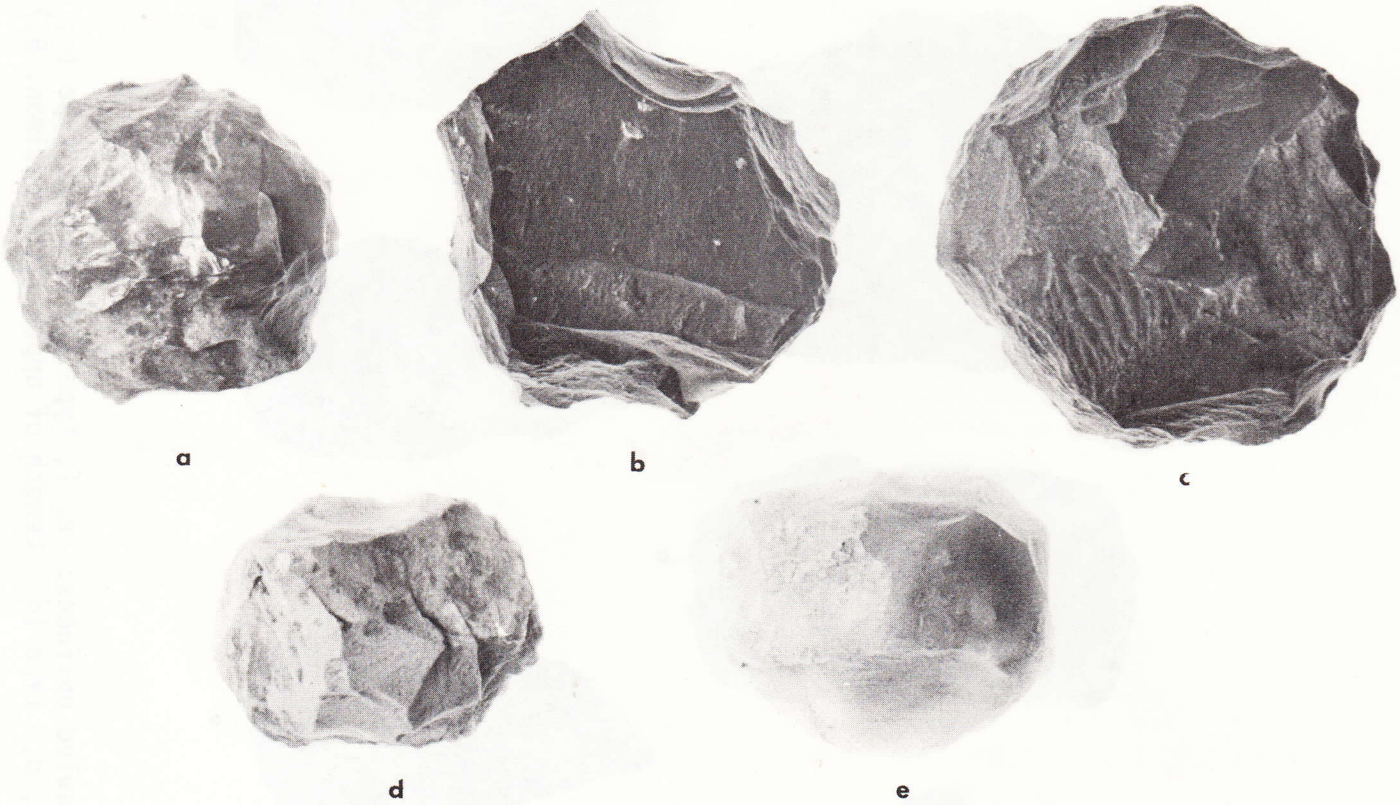

Fig. 16. Domed unifaces: a - e. Length of upper left specimen, 5.2 cm.

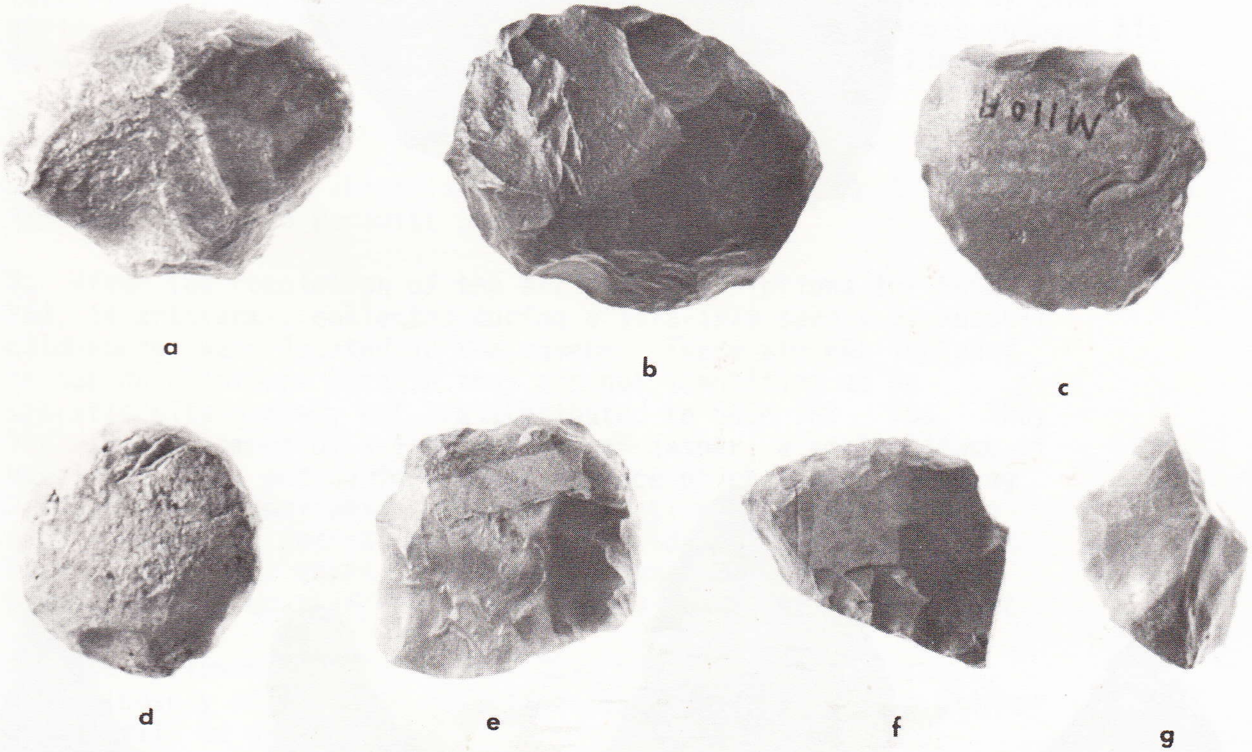

Fig. 17. Unifaces: a, b, c, e, f, type 3; d, type 4a; g, type 10a. Length of upper left specimen, 5.3 cm.

Fig. 18. Unifaces: a, type 4b; b, type 10b; c, type 8; d, e, type 9. Length of a, 11.2 cm.; length of b, 3.3 cm.; length of c, 7.0 cm.; length of d, 4.3 cm.

Fig. 19. Manos. Length of a, 11.5 cm.; length of b, 9.8 cm.

Fig. 20. Metate. Length, 23.0 cm.

Abstracts of Papers

presented at the

Mojave Desert Quaternary Research Center Third Annual Symposium

San Bernardino County Museum, Redlands, California

May 19 and 20, 1989

compiled by
Jennifer Reynolds
Mojave Desert Quaternary Research Center
Publications Editor, San Bernardino County Museum Association

GEOMORPHOLOGY AND LANDSLIDES OF THE BLACK HILLS, KERN COUNTY, CALIFORNIA

ADSIT, Randall J., Geology Department, California State University, 5151 State University Drive, Los Angeles CA 90032

The Black Hills are located on the north flank of the El Paso Mountains, in Kern County, California. They are about seven miles north of the Garlock Fault, in the southwesternmost Basin and Range Province.

The Black Hills are underlain by two Tertiary formations: the Paleocene and Eocene Goler Formation (Dibblee, 1952 and 1967; Cox and Diggles, 1986); and the Miocene Cudahy Camp Formation (Loomis and Burbank, 1988; formerly members 1 and 2 of Dibblee's Ricardo Formation (1952 and 1967)). The name "Black Hills" is due to the Black Mountain Basalt member of the Cudahy Camp Formation which overlies much of the area.

Extensive landsliding, both translational and rotational, has occurred in this area. Large translational slide sheets have moved to the north and west, sliding on zones of altered tuff within the Cudahy Camp Formation. Extensive rotational sliding has occurred on the flanks of the large translational slides, and also on the steep slopes of Black Mountain. Some of the most extensive rotational sliding has occurred on slopes facing away from the dip of the beds (the bedding dips into the slope, and the failure surface cuts it at a high angle).

These landslides vary in age from Late Pleistocene to perhaps only a few thousand years old. As of yet, none of these landslides has been dated.

The upper slopes of the Black Hills show sorted stripes, a type of patterned ground which forms on slopes of 6° to 30°. This indicates periglacial conditions (characterized by severe frost action) in the Black Hills during the last glacial maximum. However, sorted stripes do not necessarily indicate permafrost, which probably did not exist this far south.

GEOPHYSICAL EXPRESSION AND GEOLOGICAL INTERPRETATION OF BOTANICAL LINEAMENTS, EASTERN SODA LAKE, SAN BERNARDINO COUNTY, CALIFORNIA

BRADY, Roland H. III, Department of Geology, California State University, Fresno, 92740; NEGRINI, Robert M. and ROBIN, Bill, Department of Physics and Geology, California State College, Bakersfield, CA 93309

Soda Lake playa is situated approximately 5 km south of the town of Baker, filling the basin between the Soda Mountains to the west, and the Old Dad Mountains to the east. Active sand dunes separate the southern end of the playa from the Bristol Mountains 4 km south. Soda Lake is dry most of the year; its evaporite surface forms a thick crust of salts and soda minerals.

Two pronounced lineaments on the east-central part of Soda Lake playa were noted on aerial photographs by Dr. Steven Wells of the University of New Mexico-Albuquerque. Upon examination of NASA thematic mapper satellite imagery, we located five pronounced and three lesser lineaments along the eastern margin of Soda Lake; they trend northwest, range from 0.5 to nearly 3 km long, and are several meters wide. The lineaments lie along the southward projection of the Soda-Avawatz fault zone--a major, northwest-striking zone of closely-spaced faults within the eastern Soda Mountains, 12 km to the north.

In the field, the Soda Lake lineaments are formed by narrow rows of fresh-water phreatophyte plants, mainly mesquite. These plants have trapped aeolean sand, forming coppice dunes that accentuate the lineaments' relief. The growth of mesquite is conspicuous here because mesquite is salt-intolerant, yet the trees are growing in a highly soda-saline area of the playa and are surrounded by salt-tolerant and salt-loving plants including pickleweed and salt grass.

On the basis of published and unpublished hydrological data, it is known that the regional groundwater gradient slopes westward toward Soda Lake from the Cima area. Water from wells in the alluvial fans just east of Soda Lake is of potable quality while water from beneath Soda Lake is brine. The botanical lineaments appear to have formed above narrow, planer, vertical groundwater barriers that intercept the groundwater on the east side of the lake, and cause it to flow upward to the surface through the overlying salt- and soda-bearing playa deposits.

Gravity and seismic geophysical investigations were conducted across the lineaments and onto Soda Lake in order to study the subsurface. The data indicate that a subsurface zone (Layer 2) with significant velocity and density differences exists in the vicinity of the lineaments. This layer is located at a depth of 7 to 15 m beneath a homogeneous surficial layer (Layer 1). The boundary between Layer 1 and Layer 2 is irregular and is not at a constant depth below the surface. While the horizontal boundaries of the individual, geophysical "blocks" within Layer 2 do not align precisely with the individual lineaments, the overall boundary of Layer 2 correlates geometrically with the zone of lineaments. West of the lineaments, out in the lake bed, the subsurface is considerably more uniform geophysically than it is near the lineaments, and the Layer 1/Layer 2 interface is smoother. A notable gravity contrast in the subsurface corresponds to the eastern margin of the lineaments.

We conclude that the geological, hydrological and geophysical data are consistent with the interpretation that the Soda Lake lineaments are northwest-striking, high-angle faults, possibly the southern continuation of the Soda-Avawatz fault zone. Because the groundwater flow reaches the surface, the faults must also be close to the surface; therefore, if the lineaments represent faults, they have probably been active during Quaternary time.

A FLORAL AND FAUNAL ANALYSIS OF CLARK REGIONAL PARK (LA HABRA FORMATION: RANCHOLABREAN), ORANGE COUNTY, CALIFORNIA

CONKLING, Steven W. and EDWARDS, Samuel H., Jr., Clark Interpretive Center, 8800 Rosecrans, Buena Park CA 90621

Clark Regional Park, first collected as the Emery Borrow Pit, has produced a rich vertebrate and paleobotanical record. Temporally located between the Mojave Desert Camp Cady fauna (Jefferson, 1987) and Rancho La Brea Member C (Marcus and Berger, 1984), these deposits contain an extensive vertebrate assemblage which is not found elsewhere in Southern California. Current research efforts include microfaunal analysis, description of a new species of llama (Paleolama aff. mirifica), and renewed excavation at the abandoned Emery Borrow Pit Quarry (LACM 7053). Paleobotanical elements include a leaf quarry and many surficial lignite lacustrine deposits. Paleoecological studies indicate a mixed deciduous forest with open parklands and localized streams and lakes. Taphonomic characteristics of the large vertebrate fossils indicate aquatic transportation and accumulation.

THE DESERT FAN PALM--NOT A RELICT

CORNETT, James W., Palm Springs Desert Museum, P.O. Box 2288, Palm Springs CA 92263

The desert fan palm, Washingtonia filifera, was first suggested to be a "relict" species by Daniel Axelrod in 1950. The tropical affinities of its family (Arecaceae), relative scarcity, and disjunct distribution were cited as evidence of relict status. In addition, it was stated that Washingtonia fossils of Miocene and Pliocene age had been found in the present-day Mojave Desert, a region too cold for the genus today. Following Axelrod's paper, numerous authors, without any additional evaluation of the evidence, continued Axelrod's thesis stating that "the California fan palm is a relict species dating back to Miocene and Pliocene" (Vogl and McHargue, 1966); "a relict species now limited to sites with a permanent water supply" (Burk, 1977); "a semi-tropical plant, [that] was once more widespread than at present as attested by deposits of petrified palm roots" (Olin, 1977); and "a holdover from Miocene and Pliocene times" (Schwenkmeyer, 1986). Axelrod was explicit on this point when he wrote in 1977 that "the taxa are relicts of earlier times", referring to numerous genera including Washingtonia.

Relict species are those "which in the past were widely distributed, were affected by climatic changes and survive now only in a few islands of favorable climate" (Cox and others, 1976). The contention presented in this paper is that there is no direct evidence supporting the assertion that Washingtonia filifera is a relict species. On the contrary, all of the available evidence suggests that the status of the desert fan palm best fits the model of a recently evolved, invasive plant species and not a relict (Cornett, 1987a).

Recent evidence suggests that Washingtonia filifera has never been more widely distributed than it is at present. There does not, in fact, appear to be any fossil evidence indicating that this species was once widespread in the Mojave Desert. Axelrod (pers. comm.), with one exception, has retracted his earlier assertions that the fossils in question could be assigned to the genus Washingtonia. The one exception is a fossil collected near Wikieup, Arizona, and deposited in the collections of the Museum of Paleontology at the University of California at Berkeley. Axelrod believes it can be classified as Washingtonia. However, the specimen could not be located at the museum and thus could not be examined by the author. An examination of additional Axelrod palm fossils by the author failed to reveal any specimens that displayed spines on the petioles, an important characteristic of this genus, and therefore none could be classified as Washingtonia.

In addition to fossil evidence that might show a more widespread distribution, a relict species should be expected to have a declining number of individuals. However, at the present time, there are more wild desert fan palms than there were when the first census was taken. During the 1940s and 1950s, naturalist Randall Henderson counted approximately 17,700 wild palms (Henderson, 1961) compared with a 1987 count of 23,266 individuals, an increase of 31% (Cornett, unpublished data).

A relict species would also be expected to have a shrinking geographic range. Yet the distribution of W. filifera is presently expanding, particularly to the north. New palm oases have been recorded in Death Valley National Monument (Cornett, 1988a), southern Nevada (Cornett, 1988b), and Littlefield, Arizona (Cornett, 1989). Each of these locations is considerably north of Mopah Spring in the Turtle Mountains, previously the northernmost known location (Munz, 1959).

Finally, a relict species with a disjunct distribution should display genetic divergence between populations due to isolation. However, the desert fan palm does not appear to show genetic dissimilarity. Electrophoretic studies by McClenaghan and Beauchamp (1986) revealed a surprisingly low genetic differentiation between isolated populations of desert fan palms in Ana-Borrego Desert State Park, the reverse of what one would expect if the species was a relict.

These four lines of evidence: the absence of fossils; increase in total numbers; an expanding range; and a genetic similarity between populations, all point to a recently-evolved invasive species, not a relict.

It seems most likely that the genus Washingtonia first evolved in Baja California sometime after the peninsula broke away from mainland Mexico, approximately 4.5 million years ago. Today, the two species in the genus, W. filifera and W. robusta, occur together only in Baja California, suggesting this is the geographic origin. Had the genus been present before the peninsula broke away, one would expect it to be represented on the mainland--which it is not.

Washingtonia seems most closely related to the genus Brahea and is probably descended from it. The latter taxon is represented on both mainland Mexico (B. roezlii and others) and the Baja peninsula (B. armata, B. brandegeei, and B. edulis).

Just when Washingtonia filifera first appeared is conjecture. However, the study by McClenaghan and Beauchamp (1986) shows a surprising degree of genetic similarity between populations, and the lack of Washingtonia fossils argues for a very recent appearance of the taxon. Furthermore, it is tempting to speculate that the rise of this cold-tolerant palm (Cornett, 1987b) is associated with the glacial episodes of the Pleistocene. It is suggested that W. filifera first appeared within the present boundaries of the United States no earlier than the end of the Illinoian glacial episode.

Literature Cited

Axelrod, D.I., 1950. Evolution of desert vegetation in western North America. Studies in Lake Tertiary Paleobotany. Washington D.C., Carnegie Institution of Washington Publication 590.

____________, 1977. Outline history of California vegetation, IN Terrestrial vegetation of Califonia, M.G. Barbour and J. Major, eds. New York, John Wiley and Sons:139-193.

Burk, J.H., 1977. Sonoran desert vegetation, IN Terrestrial vegetation of California, M.G. Barbour and J. Major, eds). New York, John Wiley and Sons:869-889.

Cornett, J.W., 1987a. Status of desert fan palm populations in the Sonoran and Mojave deserts, IN Abstracts: symposium on the scientific value of the desert, Educational Bulletin 87-1Sp. Spring Valley, Desert Protective Council:10.

_____________, 1987b. Cold tolerance in the desert fan palm, Washingtonia filifera (Arecaceae). Madrono 34(1):57-62.

_____________, 1988a. Naturalized populations of the desert fan palm, Washingtonia filifera, in Death Valley National Monument, IN Plant biology of eastern California, C.A. Ha.., Jr. and V. Doyle-Jones, eds. University of California, Los Angeles, White Mountain Research Station:167-174.

_____________, 1988b. The occurrence of the desert fan palm, Washingtonia filifera in southern Nevada. Desert Plants 8(4):169-171.

_____________, 1989. A new locality for the desert fan palm in Arizona. Southwestern Naturalist (in press).

Cox, C.F., I.N. Healey and P.D. Moore, 1976. Biogeography: an ecological and evolutionary approach. Oxford, Blackwell Scientific Publications.

Henderson, R., 1961. On desert trails. Los Angeles, Westernlore Press.

McClenaghan, L.R. and A.C. Beauchamp, 1986. Low genic differentiation among isolated populations of the California fan palm. Evolution 40(2):315-322.

Munz, P.A., 1959. A California flora. Berkeley, University of California Press.

Olin, G., 1977. House in the sun. Tucson, Southwest Parks and Monuments Association: 236 p.

Schwenkmeyer, D., 1986. The palm oasis: our tropical vestige. Environment Southwest 514:18-23.

Vogl, R.J. and L.T. McHargue, 1966. Vegetation of California fan palm oases on the San Andreas Fault. Ecology 47(4):532-540.

COON CANYON LOCAL FAUNA (?HOLOCENE), FROM THE MOJAVE DESERT OF CALIFORNIA

FAY, Leslie P., Division of Earth Sciences, San Bernardino County Museum, Redlands CA 92374

On the south margin of the Mud Hills, San Bernardino County, California, a sediment-filled fault(?) crevice in Miocene deposits is yielding fossil reptiles, birds, and mammals. Excavation proceeds in a 50cm by 50cm grid pattern with arbitrary 10cm depth intervals. Depths of 110 cm below surface have been reached without exhausting fossiliferous sediments.

At least two lizard, three snake, two bird, and ten mammal species have been recovered in the first phase of excavation. Preliminary analysis of the mammalian sample has not divulged any species extirpated from the modern Mojave Desert community of the area; thus, a Holocene age is tentatively assigned.

LATE CENOZOIC STRIKE-SLIP AND NORMAL FAULTS REVEALED BY ENHANCED LANDSAT IMAGES, MOJAVE DESERT, CALIFORNIA

FORD, J.P., CRIPPEN, R.E., and BLOM, R.G., Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena CA 91109; DOKKA, R.K., Department of Geology and Geophysics, Louisiana State University, Baton Rouge LA 70803.

Previously undocumented strike-slip and normal faults that extend up to 25 km in the central and eastern Mojave Desert have been revealed on Landsat thematic mapper images enhanced by the four-component method of Crippen (in press). The faults are perceived on the images because of spectral contrasts primarily at wavelengths longer than the visible. The faults are not obvious on aerial photographs or on radar images but their presence has been confirmed by field investigations. These newly discovered faults are located in the Bristol Mountains-Lava Hills, Cady Mountains, Broadwell Lake, and Mesquite Valley.

The newly identified faults provide important insights to the late Cenozoic tectonics of the Mojave Desert Block. First, these structures are part of a complex regional network of right shear that connects faults of the Death Valley region with the San Andreas Fault System (Dokka and Travis, in press). Second, some of these newly identified faults bound blocks that have experienced different Neogene rotational histories. These faults have likely served to accommodate those motions. Third, timing relations revealed along the faults suggest two intervals of movement. Faults located east of Broadwell Lake are overlain by unconsolidated alluvial fan debris (Late Quaternary ?) and are probably inactive. In contrast, most faults lying to the west and south of the Cady Mountains cut all deposits and are currently active.

MID-WISCONSIN TO HOLOCENE VEGETATIONAL CHANGES FROM THE OWENS VALLEY, CALIFORNIA

KOEHLER, Peter A., Bilby Research Center, Northern Arizona University, Flagstaff AZ 86011

Preliminary investigation of a series of packrat (Neotoma) middens from the Alabama Hills near Lone Pine, California, reveals a vegetational record spanning the mid-Wisconsin (31,450 radiocarbon years BP) to recent interval. Vegetation at the site today is a shadscale scrub community, with Atriplex, Ephedra, and Eriogonum dominating, and Grayia and Lycium as co-dominates. Radiocarbon dates indicate that a Juniperus--Purshia--Yucca brevifolia community expanded during the mid and late Wisconsin period. This confirms the expansion of Joshua tree during the Wisconsin; the record also documents the arrival of modern plant communities.

REASSESSMENT OF THE AGE AND CORRELATION OF THE TYPE BARSTOW FORMATION IN THE RAINBOW BASIN AREA OF SOUTHERN CALIFORNIA, BASED ON CHANGES IN AVERAGE ADULT BODY SIZE THROUGH TIME IN BRACHYCRUS LATICEPS (MAMMALIA, ARTIODACTYLA, OREODONTIDAE)

LANDER, E. Bruce, and KELLY, Thomas S., Vertebrate Paleontology Section, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles CA 90007.

Changes in average adult body size through time have been documented in stratigraphic intervals containing superposed samples of the oreodontid Brachycrus laticeps. Similar paleontologic records in the Barstovian and Hemingfordian Land Mammal Age type areas of California and Nebraska, respectively, allow reassessment of previous correlations of the fossiliferous strata in these areas.

Three superposed faunas have been recognized in the Barstow Formation of the Rainbow Basin area in southern California. The stratigraphic ranges of these faunas are delineated relative to the Skyline Tuff, which occurs at the base of the upper member of the formation. From oldest to youngest, the faunas include the Red Division Quarry Local Fauna from near the top of the Owl Conglomerate (lower) Member, 700 m below the Skyline Tuff; the Green Hills Fauna from the upper part of the overlying Resistant Breccia (middle) Member, 55 to 300 m below the Skyline Tuff; and the type Barstovian Barstow Fauna from 6 m below the

Skyline Tuff in the uppermost part of the Resistant Breccia Member to about 250 m above the tuff in the lower part of the overlying Fossiliferous Tuff (upper) Member.

The Red Division Quarry Local Fauna, considered late Hemingfordian by most workers, precedes the first local occurrence of *B. laticeps* and is presumably middle Hemingfordian in age and a correlative of the Box Butte Fauna of Nebraska. The lowermost Green Hills Fauna from Steepside Quarry, 300 m below the Skyline Tuff, contains medium-sized *B. laticeps* (*B. l. buwaldi*) and is a correlative of the early late (type) Hemingfordian lower Sheep Creek Fauna from Greenside and Long Quarries in the lower member of the Sheep Creek Formation in Nebraska. The upper lower Green Hills Fauna from Sunset Quarry, 290 m below the Skyline Tuff, contains large *B. laticeps* (*B. l. laticeps*) and is a correlative of the latest (type) Hemingfordian upper Sheep Creek Fauna from Thomson and Hilltop Quarries in the middle member of the Sheep Creek Formation. However, some workers have considered the Green Hills Fauna early Barstovian in age. The middle Green Hills Fauna from Oreodont and Camp Quarries, 265 and 135 m, respectively, below the Skyline Tuff, contains small *B. laticeps* (*B. l. siouense*) and is a correlative of the lower Lower Snake Creek Fauna from Snake and Trojan Quarries in the lower member of the Olcott Formation (overlies Sheep Creek Formation) in Nebraska. These assemblages, considered late Hemingfordian and early Barstovian by various workers, represent a faunal interval not included in the original definitions of the Hemingfordian and Barstovian Land Mammal Ages. The slightly larger size of *B. l. siouense* from the type Barstovian middle Barstow Fauna at New Year Quarry, 10 m above the Skyline Tuff, suggests correlation with the middle and upper Lower Snake Creek Faunas from the middle and upper members, respectively, of the Olcott Formation at West Sand, Version, and Far Surface Quarries. Some workers have considered the Nebraska assemblages late Hemingfordian in age. The late (type) Barstovian upper Barstow Fauna from near the level of *Hemicyon* Quarry, 100 m above the Skyline Tuff, contains *Mediochoerus mohavensis*, which is larger and more derived than *M. blicki* from the upper Lower Snake Creek Fauna. The absence of *Merychyus* (= *Ustatochoerus*) *medius* in the Barstow Formation confirms radiometric evidence indicating the Valentine Formation (type Valentinian) faunas of Nebraska are younger than those from the Barstow Formation and should not be considered Barstovian in age.

RECONCILING THE LAKE MANIX AND LAKE MOJAVE HYDROLOGIC RECORDS

MEEK, Norman, Department of Geography, University of California, Los Angeles 90024

The published Lake Mojave hydrologic record as reported in detail by Warren and De Costa (1964) and Ore and Warren (1971), and modified by Wells et al. (1985, 1987), Brown et al. (1988) and Enzel et al. (1988), has been investigated to determine whether it precludes the rapid draining of Lake Manix approximately 14,000 yr B.P. Most radiocarbon dates reported by Ore and Warren also have supplementary details in Radiocarbon which permit a distinction to be made between lake levels reliably limited by radiocarbon data, and lake stages inferred from geomorphic relationships and/or core data.

The highest stand of Lake Mojave constrained reliably by radiocarbon data occurred between 15,350 +/- 240 and 13,620 +/- 160 yrs B.P. and is represented by the 287-288 m shoreline. Suggested higher lake levels prior to this period are based on sediments and geomorphic relationships open to interpretation, not radiocarbon dates from the uppermost strata on the highest shoreline.

The hydrologic records of the Lake Manix and Lake Mojave basins are remarkably consistent. The lake phase (wet) periods at 18.5-17 ka and 14.5-12 ka reported by Brown et al. are contemporaneous with two late Wisconsin lake stage maxima presently recognized in Lake Manix. This suggests that Lake Manix supplied water to Lake Mojave either by overflow or significant groundwater seepage during the first water influx without substantial alterations of the confining topography. However, less than 4,000 years later during the next major water influx the confining topography was not able to contain Lake Manix and Afton Canyon was cut.

Two noteworthy working hypotheses on the cause of the sudden basin failure are: 1) there was a very large and rapid influx of water approximately 14 ka; or 2) a major earthquake on the Manix Fault occurred during the final lake event. Available evidence in the Manix basin and other parts of the Great Basin tentatively supports the former hypothesis.

A PROGRESS REPORT ON HALF-MILLION YEAR OLD MARKS ON MAMMOTH BONES FROM THE ANZA-BORREGO DESERT IRVINGTONIAN

PARKS, Julia, STOUT, Betty, MILLER, George J., REMEIKA, Paul, and WATERS, Vern E., Imperial Valley College Museum, 442 Main Street, El Centro CA 92243

Bones of an adult male mammoth (Mammuthus sp.) closely related to the Imperial mammoth have been discovered in the Anza-Borrego Desert State Park, San Diego County, California. The nearly complete skeleton was in situ in Irvingtonian land mammal age sediments (Late Pleistocene). A rib bone with v-shaped cuts was found 251.5 centimeters below the top of the Pleistocene beds. Further study revealed several more ribs with distinctive cut marks and a fibula with a deep groove. Studies of the cuts show that they were made with a chopping motion. It is suggested that the cuts were made by early hominids using a primitive stone chopper or hand axe. Radiometric, faunal and paleomagnetic dates show the site to be from 300,000 to 500,000 years old.

PRELIMINARY MAGNETOSTRATIGRAPHY OF PLIO-PLEISTOCENE LAKE SEDIMENTS NEAR MANIX WASH, CENTRAL MOJAVE DESERT

PLUHAR, Christopher J. and KIRSHVINK, Joseph L., Division of Geological and Planetary Sciences, Caltech 170-25, Pasadena CA 91125; ADAMS, R.W., 7400 Tampa Avenue, Reseda CA 91335

Paleomagnetic samples taken from Plio-Pleistocene lake sediments in the vicinity of Manix Wash in the central Mojave Desert are yielding stable paleomagnetic directions. Most samples were located relative to a grey/white ash couplet dated at about 2 my; the grey ash was identified by previous workers as the Huckleberry Ridge Tuff from Yellowstone National Park, and the white ash was similarly correlated with Waucoba beds near Mammoth, California. In our section MRB, a reversed to normal polarity switch, which we tentatively correlate with the base of the Olduvai Normal Chron (1.87 my), is present about 6 meters above this grey ash (about 3 m above the white ash). Samples from our site MRC, which covers about 33 m of section and begins 60 m stratigraphically below these ash beds, are of reversed polarity. This reversed zone could either correlate with the top of the Gilbert Reversed Chron or the base of the Matuyama, but additional sampling is needed to clarify this correlation.

MID-PLEISTOCENE FAUNAS OF THE WEST-CENTRAL MOJAVE DESERT

REYNOLDS, Robert E., Division of Earth Sciences, San Bernardino County Museum, Redlands CA 92374

Certain fossil vertebrate assemblages from the West-Central Mojave Desert are referable to the Irvingtonian Land Mammal Age (> 450,000 ybp) based on incorporated taxa, or to a "mid-Pleistocene" age based on depositional relationships and soil development. These assemblages are from localities near Hesperia, Victorville, Adelanto, Helendale, Calico, Hawes, Kramer, Boron, and from multiple locations on Edwards Air Force Base. The faunas as a whole suggest a date prior to 450,000 ybp for the sediments in which they are found. Many of the localities are within or stratigraphically related to well-developed soil horizons and/or poorly-drained erosional surfaces. The geographic distribution of these fossiliferous sediments indicates structural stability and minimal tectonic-related erosion west and north of the Mojave River between Hesperia and Yermo since middle Pleistocene times.

NEW QUATERNARY AGE CONTROL FOR STRATA WITHIN THE INDIO HILLS, SOUTHERN CALIFORNIA

RYMER, Michael J., U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025

Recent geologic studies in the Indio Hills, Coachella Valley, reveal new age control for folded and faulted Quaternary deposits. Age control comes from fossil vertebrates, volcanic-ash deposits, and magnetostratigraphy. A referred fossil cotton rat (Sigmodon pre-hispidus) from the lower part of the Palm Spring Formation near the southeast end of the Indio Hills indicates an Irvingtonian (early Pleistocene) age. A horse skull (Equus sp.) found in the upper part of the Palm Spring Formation north of Edom Hill, near the northwest end of the Indio Hills, also indicates an Irvingtonian age but ranges in age from early to late Pleistocene. Four exposures of volcanic ash are in the Indio Hills; all four may be from the same eruption. These four exposures are near the top of the Palm Spring Formation in the central part of the Indio Hills (three exposures) and on Edom Hill. One exposure in the central part of the Indio Hills has a trace-element chemical identity of tephra from Long Valley caldera, east-central Sierra Nevada. This exposure was also paleomagnetically studied to show that the ash is the 0.74-Ma Bishop ash. Study of heavy minerals from the ash at Edom Hill suggests that this deposit also is the Bishop ash. Ash-bed thickness, internal layering, and stratigraphic relations further suggest that the third and fourth ash deposits also may be the Bishop. Magnetostratigraphy within the Palm Spring and Ocotillo Formations shows a thick, magnetically reversed section with a thick, magnetically normal section above. The magnetic reversal between these sections correlates with the Brunhes/Matuyama magnetostratigraphic boundary of about 0.75 Ma.

FRESH WATER BIVALVES AS PALEOENVIRONMENTAL INDICATORS

SCHNEIDER, Joan S., Department of Anthropology, University of California, Riverside CA 92521.

Fresh water mussel remains (Anodonta sp.) are often associated with archaeological sites in the Mojave Desert. Shells can provide a variety of cultural and environmental information that, combined with radiocarbon dates, can make a significant contribution of the knowledge of the prehistory of the Mojave Desert. Preliminary analysis of a small sample from East Cronese Lake can be used to document the minimum duration of at least one lakestand.

EVOLUTION OF GEOLOGIC UNDERSTANDING OF THE MOJAVE DESERT

STOUT, Dorothy L., Cypress College, Cypress, CA 90630.

Early explorations of the Mojave Desert were geographical in nature. The earliest geologic explorations were related to federal surveys which included John C. Fremont's explorations with the 1840s U.S. Explorers' Expedition, and U.S. War Department's Pacific Railroad Surveys and General Land Office Surveys in the 1850s. Local mining of borax at Searles Dry Lake in 1863; discovery of silver at Calico in 1881; and silver, gold, and tungsten from the Randsburg District, encouraged some of the geologic understanding of the Mojave Desert that evolved in the last half of the 19th century and early 20th century.

Mapping produced for the Los Angeles Metropolitan Water District aqueduct project from the Colorado River, starting in 1923; continued mapping by the U.S. Geological Survey for both civilian and military use during World War II, along with the discovery of borax, and the Mojave Project and its quest for boron for solid rocket fuel; and other mining projects in the 1920s through the 1950s swelled understanding of the Mojave region geology. Under D.F. Hewett's direction, Thomas W. Dibblee's almost single-handed mapping in the 1950s and 1960s made an impressive contribution to Mojave Desert geology.

Continued mining, mapping by students at different academic institutions, and increasing development of the desert with requisite land-use and environmental impact studies continue today to enhance our understanding of Mojave Desert geology.

LATE QUATERNARY GEOLOGY OF BLACKHAWK CANYON, SAN BERNARDINO MOUNTAINS, SOUTHERN CALIFORNIA

STOUT, Martin L., Department of Geology, California State University, Los Angeles CA 90032

Blackhawk Canyon, on the northeastern slope of the San Bernardino Mountains near Lucerne Valley in southern California, is best known as the source area for the Blackhawk landslide, a 17,000 year-old mass of marble debris which, as Shreve (1968, 1987) proposed, apparently rode on an air cushion for about 4.5 miles from the mountain front before coming to rest. However, the date of landsliding also provides data on geomorphic rates of erosion and deposition in desert environments, as well as late Quaternary climate.

The fresh water gastropod and pelecypod shells used for the date came from sediments deposited in a perennial lake about 20 feet deep developed on the landslide breccia. Thus, even without the benefit of any other data, a much wetter climate was indicated at the time of failure. Other data now available show that this time was the late Wisconsin maximum stillstand of sea level, with fresh water tied up in glacial ice, pluvial lakes, and extremely high groundwater levels, with very high rates of local precipitation. The nearest large pluvial lake, Lake Manix, was also filled during this interval of landslide movement (Meek, 1989). By 8-10,000 years B.P., water budgets were much closer to what they are at present, and maximum erosive and depositional events were controlled by intense periodic rainfall.

Following the landslide event in Blackhawk Canyon, stream erosion was successful in cutting a valley at least 90 feet deep into hard Cactus Quartz Monzonite, the most resistant rock controlling erosion rates in lower Blackhawk Canyon. A broad alluvial apron and fan, approximately 60 feet thick at the apex, was spread across the slide debris on the piedmont slope, and the landslide debris itself was entrenched by a stream valley about 25 feet deep and 70-100 feet across.

Because the upper reaches of Blackhawk Canyon are now blocked with talus and debris from road construction, the effect of future thunderstorm activity on rates of erosion and deposition in the area, as documentation for what has been occurring during the last 10,000 years, will be helpful.

A REVIEW OF CURRENT THEORY REGARDING FORCING AGENTS IN PLEISTOCENE CLIMATIC/ENVIRONMENTAL CHANGE

TAYLOR, Thomas T., Southern California Edison Company, Division of Environmental Affairs, Rosemead CA 91770

Concern regarding possible global warming due to increases in "greenhouse" gasses has added new interest in an understanding of causal factors contributing to climatic/environmental change. Most research in this area has emphasized the terminal Pleistocene and Holocene periods. Recent computerized modeling efforts identify several important factors, in particular solar insolation (the Milankovitch theory), which appear to be key forcing agents in climatic change. Data from earlier Pleistocene timeframes, however, do not seem to support the Milankovitch theory. This paper presents a review of these theories, and offers several observations from a historical perspective.

A LATE PLEISTOCENE RANCHOLABREAN ASSEMBLAGE FROM THE NORTHWESTERN MOJAVE DESERT.

WHISTLER, David P. and STEWART, J.D., Section of Vertebrate Paleontology, Natural History Museum of Los Angeles County, Los Angeles CA 90007.

A fossil assemblage, the Dove Spring Lignites local fauna, containing molluscs and diverse small vertebrates, has been recovered from unnamed stream and pond sediments outcropping in Dove Spring Wash on the eastern slope of the Sierra Nevada Mountains in the northwestern Mojave Desert, California. The unnamed sediments are in discontinuous exposures along Dove Spring Wash west of Red Rock Canyon and consist of interbedded sandy lignitic mudstones, pink, yellow and white arkosic sandstones, calcareous (caliche) sandstones and cross-bedded (aeolian) quartz sands. The most complete exposure contains over 8 m of sediments, including six distinct lignitic horizons in the lowest 3 m of exposed section. Charcoal from a conifer branch found within the lignite-rich portion of the sequence has yielded a radiocarbon date of 10,730 + 110 ybp (Beta-18449).

The fossil assemblage was obtained from approximately 1/2 ton of matrix from six different lignitic horizons processed using underwater screen sieving. The molluscs include Pisidium casertanum (Poli, 1791), Pyrgulopsis sp., Physella concolor (Haldeman, 1841), Fossaria cubensis (Pfeiffer, 1839), Fossaria parva (Lea, 1841) (all the preceding identified by R. Lamb, pers. comm.), Vallonia cyclophorella Sterki, 1892, Vertigo berryi Pilsbry, 1919, succineids, Discus crondhitei (Newcomb, 1865), and Deroceras laeve (Muller, 1774). All of these are extralocal taxa. Some of the aquatic taxa indicate permanent water, and several of the terrestrial species may be found living today at moderate to higher elevations in the San Bernardino Mountains or the Sierra Nevada. The vertebrates include 23 species of small birds, frogs and/or toads, lizards, snakes and small mammals, including a mix of xeric and more mesic adapted animals. At least 9 species are extralocal, existing today only in areas of permanent, running water or in more montane habitats: an unidentified anuran, Sceloporus occidentalis Baird and Gerard, 1985, Gerrhonotus sp., Lampropeltis zonata (Blainville, 1835), Sorex palustris (Richardson, 1828), Eutamias minimus (Bachman, 1839), Thomomys monicola J.A. Allen, 1839, Neotoma fuscipes Baird, 1858 or N. cinerea Ord, 1815, and Microtus californicus (Peale, 1848). The remainder of the species still occur in the high desert area today: Phrynosoma sp., Pituophis cantenifer Holbrook, 1842, Pipistrellus hesperus (Allen, 1864), Sylvilagus sp., Ammospermophilus sp., Perognathus longimembris (Coues, 1875), Chaetodipus penicillatus (Woodhouse, 1852), Dipodomys 2 spp., Reithrodontomys sp. and Peromyscus maniculatus (Wagner, 1845) or P. crinitus (Merriam, 1891). The combined assemblage demonstrates a Late Pleistocene habitat that has no modern analog in that many of these taxa are ecologically incompatible at present. A moister climate with warmer winters and cooler summers might accommodate such an assemblage. Local faunas composed of "ecologically incompatible" species are typical of Pleistocene deposits in the North American interior; in coastal sites, such as Rancho La Brea, however, this effect is not so pronounced.

SAN BERNARDINO COUNTY MUSEUM ASSOCIATION
INFORMATION FOR AUTHORS

The San Bernardino County Museum Association publishes articles and monographs on subjects pertaining to the cultural and natural history of San Bernardino County and surrounding regions. We welcome submissions of such manuscripts.

Subject matter: articles and monographs pertaining to San Bernardino County, inland Southern California, and surrounding regions, in history, anthropology, archaeology, paleontology, mineralogy, zoology, botany, ornithology, and related disciplines. Manuscripts considered for Quarterly publication should be written toward the well-educated non-specialist. Technical research will also be considered for publication. All manuscripts should reflect original work which furthers knowledge in their fields.

Format: Two clear copies of the manuscript must be submitted to the Editorial Board with a letter of transmittal requesting that the manuscript be considered for publication and that it is not presently under consideration elsewhere. Manuscripts should be typewritten, double-spaced, on one side only of 8.5 x 11 inch paper. Ample margins should be allowed for editing comments. The first page should contain the title and author(s) name, address, and telephone number. The author's last name and page number should appear at the top of each following page. Include copies of figures, tables, and photographs; do not send original photographs or figures with your initial submission. One copy of the manuscript and accompanying attachments will be returned to the author if not accepted for publication.

Style: Authors should follow the standards for footnotes, citations, headings, and other conventions as applicable to their discipline. The Editorial Board suggests the following:

Anthropology/Archaeology/History: Society of American Archaeology (American Antiquity)
History: American Historical Association (American Historical Review)
Geology: Geological Society of America (GSA Bulletin)
Paleontology: Society of Vertebrate Paleontology (Journal)
Biological Sciences: American institute of Biological Sciences (eg. Journal of Entomology)

Authors should be aware of and avoid inappropriate gender-biased language. The Editor is available for consultation on matters of style, format, and procedures.

Attachments: Original or equivalent photographs and figures will be required for publication. Photographs should be black-and-white, glossy finish, of good quality and contrast. Figures and drawings should be in India ink or equivalent on white paper or film; PMTs are acceptable. Captions should be submitted on separate pages, double-spaced, and referenced to their accompanying figures. Photographs should be marked lightly in pencil on the back border with the author's name and figure number. Do not include original photographs or figures with the initial submission.

Review: Manuscripts will be considered by the Editorial Board of the Association Publications Committee, and will be reviewed by outside experts. Manuscripts may be accepted, provisionally accepted, or be found unsuitable for publication by the Association. Provisional acceptance may include suggestions for revisions. Very lengthy or profusely-illustrated monographs that are otherwise acceptable for publication may require outside funding to help defray publishing costs. Manuscripts will be copy-edited after acceptance.

Responsibilities: The author has the primary responsibility for the correctness and reasonableness of his or her information, arguments, and presentation. In submitting a manuscript for consideration, the author assures the Editorial Board that the manuscript is an original work and does not infringe upon the rights of previous authors or publishers.

Address queries and manuscripts to:
The Editor
San Bernardino County Museum Association
2024 Orange Tree Lane, Redlands, California 92374