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AN ARCHAEOLOGICAL STUDY OF THE BEDROCK MORTAR-PETROGLYPH AT AMA 14, NEAR VOLCANO, CALIFORNIA

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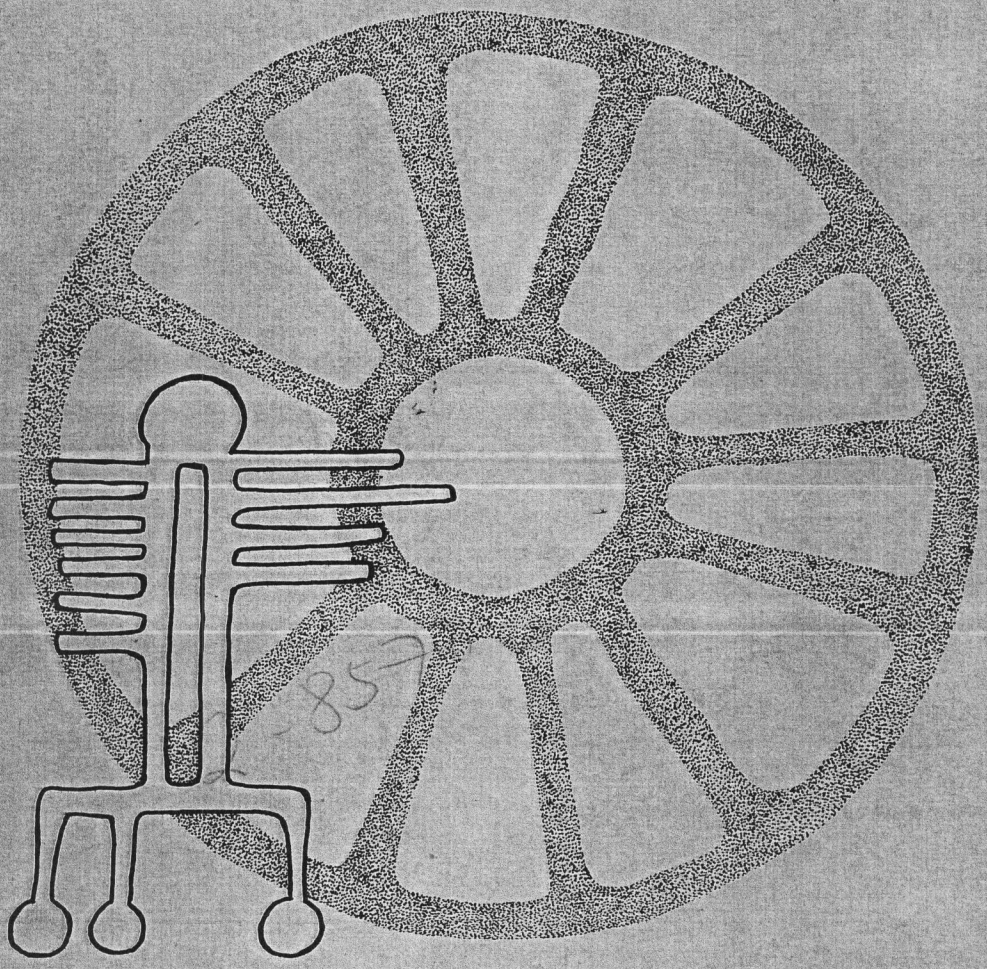

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF PARKS AND RECREATION
DIVISION OF BEACHES AND PARKS
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AN ARCHAEOLOGICAL STUDY OF THE BEDROCK MORTAR-PETROGLYPH AT AMA-14, NEAR VOLCANO, CALIFORNIA

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Louis A. Payen and David S. Boloyan

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TABLE OF CONTENTS

FOREWORD

This report is based on Archaeological Field Investigations executed at the "Indian Grinding Rock" between March 21 and 31, 1961. This project was carried out under the provisions of a contract between the Central California Archaeological Foundation and the California State Division of Beaches and Parks.

The project was initiated by Mr. Francis A. Riddell, State Archeologist, to provide information for a proposed state park. This field work is the first comprehensive study of its kind at the site, Ama-14. The field work was carried out by the authors with assistance from Mr. G. Thiry, and Dr. L. J. Payen. Thanks is due to Mr. L. A. Readdy for his services in drafting the final map for this report.

In addition, further appreciation is extended to Mr. Scapuccino, owner of the site, for his cooperation in expediting the work in a number of ways and in providing valuable information concerning the site. A special acknowledgment is due to Mr. Scapuccino and his late brother for care and preservation of this particularly outstanding bedrock mortar site. Undoubtedly it is the most outstanding example of its kind in the western United States and is certainly a monument to the hunting and gathering cultures of aboriginal Californians.

INTRODUCTION

Approximately two and one-quarter miles southwest of the town of Volcano, at an elevation of 2,340 feet above sea level, lies a small valley which has a prominent limestone outcropping (see Map #1). This outcropping, a part of the Calaveras Formation (Carlson and Clark 1954), measures 175 feet in overall length and 82 feet wide and has an approximate surface area of 7,700 square feet. Scattered on this outcrop are 1,185 bedrock mortars and a total of 363 petroglyph designs. This archeological feature will be the main subject of the following study.

In addition to the bedrock mortar feature within the valley, there are three areas of intensive occupation indicated by midden accumulations and scattered artifacts. A surface collection made by us and Mr. Scapuccino included manos, bowl mortars, metate fragments, cobble pestles, acorn crackers (hammer stones), and cooking stones of soapstone (see Barrett and Gifford 1933 for description and uses of such artifacts in this region). At the lower end of the valley, in a gully, occurs a year around spring of sufficient size to maintain a reasonably large aboriginal population. Coupled with floral and faunal assemblage, this water supply played an important role in consideration of the selection of the site by the aboriginal people. The location of Ama-14* is within an area which affords a large variety of seed bearing plants. Such plants were utilized by hunting and gathering cultures inhabiting this section of the west slope of the Sierra Nevada.

The historic population of the area was the Northern Miwok, who, along with the central and southern groups, have been the subject of an intensive ethnological study by S. A. Barrett and E. W. Gifford (1933). A check of this work reveals that a number of seed bearing plants used by these people were prepared into a palatable food by pulverization. The bedrock mortar was the primary tool used for this grinding (Barrett and Gifford 1933: 208-209, 272). The bowl or portable mortar was found in the possession of the Miwok, but they claim to have never manufactured such objects as they were created by Coyote, thus of supernatural origin. Barrett and Gifford (1933: 272), present the hypothesis that the portable mortar preceded the bedrock type. The transportation of the heavy portable grinding stones was difficult in the seasonal movements from higher and lower elevations. The invention, they believe, of the bedrock form was from a temporary convenience which came gradually into use, replacing the older form almost entirely. Evidence is toward a late use and possibly late development of the artifact in the Yosemite area (Bennyhoff 1956: 49, 53-58). It is interesting that the mano and metate, bowl mortar and bedrock mortar grinding tools are all found in association, at least in occurrence at Ama-14. Excavation of the midden areas possibly could shed evidence on the sequence of use and development of these tools in this area.

The following list, taken from Barrett and Gifford, of plant foods, has been presented to give the reader some idea of the types of plants processed in the bedrock mortar by the Miwok. This list is not complete and does not necessarily represent all varieties or indicate those growing in the site area. (The nomenclature was checked by State Park Naturalist

*University of California Archaeological Survey record number for this site.

B. W. Heacox using A California Flora, by Philip A. Munz and David D. Keck, 1959. The specimens were not examined--only the list was checked. The fungi were not checked as no ready reference is available.)

California Black Oak, Quercus kelloggii
Valley Oak, Quercus lobata
Interior Live Oak, Quercus wizlizenii
Scrub Oak and others, Quercus dumosa var.
Blue Oak, Quercus douglasii
Slender Wild Oat, Avena barbata
Balsam Root, Balsamorhiza sagittata
Boisduvalia, Bosduvalia densiflora or var.
Boisduvalia, Bosduvalia stricta
Ripgut Grass, Bromus rigidus
Red Maids, Calandrinia ciliata var. menziesii
Paint-Brush, Castilleja sp.
Clarkia, Clarkia unguiclata
Farewell-to-Spring or Summer's Darling, Godetia amoena
Lobed Godetia, Godetia biloba
Gunweed, Madia gracilis
Common Madia or Tarweed, Madia elegans
Blazing-Star, Mentzelia sp.
Skunkweed, Navarretia sp.
Valley Tassels, Mentzelia sp.
California Buttercup, Ranunculus californicus

The following bulbs and corms were pulverized in the bedrock mortar:

Bolander's Yampah, Perideridia bolanderi (formerly Eulophus b.)
St. John's Wort, Hypericum formosum var. Scouleri

The following "greens" were pulverized in a bedrock mortar:

Horseweed, Erigeron canadensis
Sheep Sorrel, Rumex asetosella

The following fungi were pulverized in a bedrock mortar:

Sierra Puffball, Lycoperdon sculptum
White Mushroom, Helli
Giant Mushroom, Atita

It should be noted that the Black Oak (Quercus kelloggii) acorn was most highly favored by the Miwok. We find that the acorn of this oak best fits the depression in an acorn anvil recovered at the site. Coupled with this is the fact that within the surrounding hills the Black Oak is the predominant species. This leads the authors to believe that this species was probably most utilized at the site.

BEDROCK MORTARS

As has been discussed in the preceding, the bedrock mortar appears to have been the primary method of pulverizing various plant foods among the historic Miwok. These mortars are commonly associated with occupation sites

in this part as well as the rest of the Sierras. A check of 101 recorded sites in Amador and Calaveras Counties, where numbers of mortar pits have been noted, indicates a range of 1 to 38 holes at a given site (Figure 1). Information was lacking for larger sites (150 or more pits), but their number seems to be few. At Yosemite National Park (Bennyhoff 1956: 13) only 3 had significantly greater numbers, Mrp-177, 85 cups; Tuo-236, 156 cups; and Mrp-3, 473 cups out of 140 sites.

The present site, Ama-14, has a total of 1,158 mortar holes. The cups occur for the most part on the level areas of the main rock outcropping, although a few occur on nearby boulders. The mortar pits are round in horizontal cross section. Only several occurrences of eliptical-shaped mortars were noted. Another feature was the occurrence of a small number of mortar holes which occurred in natural basin-shaped solution cavities.

The size range of the mortar pits has been determined from measurement of a sample of 250 or approximately one-quarter of the holes at the site. Diameter of the pits ranges from under 3 inches (smaller examples may be petroglyph elements or acorn hulling depressions) to a maximum of 11 inches (Figure 2). The average diameter is around 6 1/2 inches, with the majority of the pits falling within a 5 to 8 inch diameter range. The depth range is from a very slight depression of 1/4 inch up to a maximum depth of 10 inches (Figure 3). The average depth reached is 4 3/4 inches. According to Barrett and Gifford the Miwok frequently abandoned mortar holes at a depth of 5 inches; although deeper holes were used to crack the shells of certain seeds and manzanita berries. An examination of Figure 2 indicates that 46% of the pits are over 5 inches deep. Bennyhoff (1956) attributes deeper holes at some of the Yosemite sites as being due to limited rock surface for use, advantages of comfort of a particular spot and possible ownership of certain holes. At three sites where sufficient numbers of holes were over 5 inches, there was indication of limited unused space for new holes. Ama-14 in some respects has limited space for new pits, but not all the surface has been used by any means. It is hard to believe that the space for new holes was rationed for later use. Emphasis on seed processing may have been one factor for the development of the deeper mortars, rather than limited space for any longer use of an individual pit.

The amount of stone removed from the grinding process is believed to be of importance. Ultimately such data may be of some value in approaching the problem of population size and/or duration of occupation of the site. If volume change rate per unit of meal ground in the mortars in limestone could be found, an insight into the amount of time and food consumed might be obtained. Since at the present time we do not know this factor, this aspect will not be pursued beyond a discussion on determination of the total volume of stone removed at the site. Such a resulting figure would also be an interesting point in the interpretive material as the area is developed into a park.

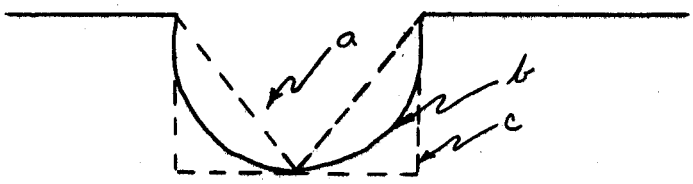
Time was allowed in our field work for the measuring of 22 pits for their volume. In order to arrive at a reasonable figure several approaches were used in the calculation of the average amount of stone removed from the feature. The measurement of the volume was obtained by filling a selected group of pits with water from a calibrated cylinder (Figure 4). The average volume of a pit arrived at from this sample was 1,607cc. This gives the figure of 10,850 pounds as the average amount of rock removed as computed below:

22 measured by filling with water:
Average+1600cc
extending to all 1,185 pits:

$$1600cc \text{ hole} \times 1{,}185 \text{ hole} \times 2.6 \frac{qm}{cc} \times 0022 \frac{lb}{qm} + 10{,}850 \text{ lbs}$$

If the 250-hole sample (Figures 2 & 3) is approached by making an attempt to arrive at an estimate of volume from the dimensions, we have the problem of the true nature of the configuration of the hole. The obtainable answers with the present data (diameter and depth) gives two extremes in the possible volume of rock removed. First, if we calculate the volume, assuming the mortar pit to be a cylinder (Shape"c"),we get 157.5 cubic inches for the average pit.

A second approach would be to assume that of a mortar being in the shape of a cone (Shape "a"). The average hole would then contain 52.5 cubic inches. Shapes "b" and "a" are clearly the extremes, the approximate value lies between them. Something like shape "b", which is a cylinder with a hemisphere at the end would give a figure between the two extremes. We arrive at a volume of 121.4 cubic inches for the average pit, giving us a figure of 13,500 pounds as the amount of stone removed from the whole feature.



250 hole sample:
Average diameter=6.5 inches
Average depth=4.75 inches

Shape "c" $(3.14^2)\ 4.75 = 157.5\ in^3$

Shape "a" $\frac{(3.25)^2\ 4.75}{3} = 52.5\ in^3$

Shape "b" $(3.14^2)\ 1.5 + (3.14^2)\ 3.25.2/3$
$49.7 + 71.7 = 121.4\ in^3$

Wt.of limestone removed: $121.4\ in^3 \times 1185$ holes, $\times .0938 \frac{lb}{in^3} + 13{,}500$ lbs.

Examination of the mortar pits indicates that they are not a true cylinder-hemisphere in configuration, but more on the order of a hyperbola in cross-section. A more reasonable estimate would be between the 10,850 and 13,500 lbs. figure, probably 12,000 lbs. of limestone* ground away. At least part of this amount was consumed in the diet of the site's occupants. If one assumes that only a small fraction of the rock was removed in comparison to the meal ground, one gets some idea of the amount of food prepared during the use of the feature.

*Limestone is taken here to have a specific gravity of 2.60

PETROGLYPHS

Second interest to the bedrock mortars, the petroglyph aspects of Ama-14, make up an outstanding feature both from an archaeological and layman's point of view. To the latter there is always some air of mystery involved as to the meaning of petroglyph symbols, and in many instances they are erroneously referred to as "hieroglyphics". Before going any further into the discussion of the petroglyphs themselves, a brief review of the field methods employed in recording is presented at this point.

A total of ten days was allotted to the primary field recording of the mortar rock area. During this time adverse weather conditions limited the actual time in the field to six days. Due to these limitations, it must be pointed out here that in some cases a certain amount of accuracy had to be sacrificed and some details left out. Heavy rains required that the rock area be cleaned of debris such as leaves, twigs, and other residue. Standing water had to be removed from the mortars and low areas on the surface to enable recording and photography.

Examination of the surface of the outcropping indicated that petroglyphs were present, but in most cases were too faint to be adequately recorded. Attempts were made earlier in the year to employ the "surface printing" method (Hedden:1958). This method was found to be unsatisfactory due to the uneven texture of the stone surface and faintness of the glyphs. The only feasible method found to obtain proper completeness in recording was to employ "night lighting" in recording (Payen 1959: 67).

Using an artificial light source, such as a gasoline lantern, at night produces lighting conditions which show contrasts between surfaces. Varying the intensity of the light by moving toward or away from the area being studied is useful. For sketches to be made the following day, the glyphs were chalked; however, photographs can be taken at night with time exposures for a more accurate recording.

The rock area exhibited few designs in natural light, these accounting for less than a third of the total petroglyphs finally recorded. The faintness and obscure nature of the majority of the glyphs can be attributed to the relatively fast rate of weathering and lack of contrast on the surface of the stone.

Mapping of the distribution of the petroglyphs, mortar holes and rock outlines was accomplished by establishing a five by five-foot grid over the entire surface of the outcropping. A datum was established on the southeast corner of the mortar area. Datum A, an iron rod, was driven into the ground 14 feet from the west end of the outcropping. From this point stakes were placed at five-foot intervals around the perimeter of the outcrop in magnetic north-south and east-west directions. Twine was strung across the area from each stake to form a grid of five-foot squares over the entire area (see Plate 1). For drawing of more detailed areas within a unit, a wooden frame divided by string into one-foot squares was employed (for detail see Heizer 1958: 59). Unit designation was accomplished by lettering the units A through P on the east-west axis and numbering 1 through 37 on the north-south axis from Datum A. Each unit has a specific designation for reference, such as unit H-22, B-22, etc.

Photography presented a problem in reproducing areas of the surface due to extreme foreshortening. This limitation was overcome by use of a 24-foot portable aluminum tower. (Plate 1,a)

The results of the "night lighting" enabled the recording of 363 individual petroglyph designs. The primary area of decoration seems to be a band running across the length of the outcropping. This band is primarily limited to the sloping area less favored for the placement of mortars but which was ideal for the placement and viewing of the glyphs (Map 2 and sections).

The other areas of designs are found in the spaces between the mortar pits in the areas on the southwest corner and on the east end of the outcrop. Examination of the glyphs indicate that the more elaborate designs occur in the band; the present study does not attempt any comparison of designs between areas on the outcropping, but such an analysis might show some differences. Thirty-seven occurrences were noted where mortar pits are a part of petroglyphs. A unique occurrence to the authors' knowledge.

Description of the various designs* will be handled in a somewhat different manner than has appeared in previous works on petroglyphs in the western United States. To date, design types or petroglyph elements have been described in popular descriptive terms such as spoked wheel, target and snake (Cressman 1937: Steward 1929: Payen 1959). These categories have generally covered a rather wide variation of design types being described. An example could be best taken from the senior author's work (Payen 1959) where concentric circles are lumped as one design type. Designs included under this heading may vary from a set of 2 to 12 circles making up a design.

In this work each circle (element) combination would represent a different design; in previous works all circle combinations were grouped together. The usefulness of this classification for showing relationships and differences areally will not be attempted here but will appear at a later date, perhaps in a somewhat modified form. The main contribution of the present study is the description and analysis of data within the bounds of the site.

The classification here applied to the petroglyph complex at Ama-14 has resulted in the isolation of 14 different figures that were selected as basic components or elements: Dots (Type A), Box (Type B), Circle (Type C), Grooves (Type D), Lines (Type E), Tracks (Type F), Curved converging lines (Type H), Wavy lines (Type I), Zigzag line (Type J), Natural feature (Type K), Grid or ladder (Type L), Triangle (Type M), Animal (Type N), Mortar with petroglyph (Type O). The elements, and combinations thereof, produce 85 different design types on the basis of this classification. The relationship, occurrence, element combinations, and associations will be described and illustrated on the following pages and charts.

Design Classification and Description:

Type A: A design formed by a shallow depression or cup varying from 1/4 to 3 inches in diameter. The depth range of these

*Design being a unit separate from other such units both in construction and space, can be single element or combination of elements.

depressions varies from under 1/16 inch to a maximum of 1 inch. Dots occurring at random may in some instances represent depressions used as acorn cracking anvils (Barrett and Gifford 1933: 210), rather than a petroglyph element; although such elements do occur as a definite design in the Valley-Sierran series (Payen 1959). There are 22 occurrences at the mortar site where dots are placed in series to form a more complex design. The dot element is used in combination with other elements to create a complex design. These will be described under the description of the particular design.

Type A: Single dot occurring at random.

Sub-type A_1: Dots occurring in a cluster. This may vary from two to a dozen or more dots.

Sub-type A_2: Dots occurring in a series or straight line.

Sub-type A_3: Dots in parallel series to form a rectangular pattern.

Sub-type A_4: Dots placed in a circle.

Sub-type A_5E: Two dots connected by a straight line.

Sub-type A_5I: Two dots connected by a curved line.

Type B: Rectangular "box-like" element formed by four straight lines, small in size, and occurring only five times at the site. Such elements are common in connection with dot elements at sites along the Mokelumne River to the south (Payen, n.d.).

Type B: Rectangular element with no modifying elements.

Sub-type B_1A: Rectangular element with dot in center.

Type C: The circle is used as a design or combined as an element to form a different design. One modification is where the circles are placed within each other to form a concentric circle design. Dots are sometimes used at the center of a circle or circles to form what are known as "target" designs.

Type C: Simple circle design.

Sub-type C_2: Concentric circle design formed by two circle elements.

Sub-type C_3: Concentric circles formed by three circles.

Sub-type C_4: Concentric circles formed by four circles.

Sub-type C_2A_4: Concentric circle of two circles with outer ring of dots.

Sub-type C_1A: Simple circle element with a dot at the center to form a nucleated circle.

Sub-type C_3A: Concentric circles formed by three elements with a dot at the nucleus forming a "target" like design.

Sub-type C_4A: Concentric circle formed by four circles with a dot element at the nucleus.

Sub-type C_1A (A_4): Nucleated circle with outer ring of dots.

Sub-type C_1E_3: Circle element with radiating lines included within the central area. The design may in some cases represent incomplete (C_2E and C_1EA) designs partly obliterated by weathering.

Sub-type C_1EA: Circle design with central dot. Several radiating lines connect both the outer and inner elements. This type has also been classed as "spoked wheel" designs in previous works (Cressman 1937).

Sub-type C_5: Circle design resembling a "spoked wheel" but is formed in a somewhat different manner. Circle is modified by loops on perimeter to form a flower like effect.

Type D: Design formed by a series of short grooves or bars. The element is set off from short lines (Type E) due to their width, which is one-half the length, and do not form a true line in essence. The design may represent a counterpart to groove type elements at sites of "Baby Rock type" such as found in the Sacramento area (Payen 1959). The groove elements in a design may vary from three to eight elements.

Type E: The "E" type designs consist of combinations of straight line elements which are often combined into more complex groups. The designs formed by this linear element show less regularity of line placement in relation to each other. This results in a wide range of designs where no two are identical. Complex figures include dot elements, but other element types are rarely used.

Sub-type E_1: Parallel short lines, varying from two to twelve or more elements.

Sub-type E_2: Two groups of parallel lines being grouped next to each other.

Sub-type E_1A: Parallel lines with dot elements terminating one or more of the lines.

Sub-type E3: Three intersecting straight lines forming an asterisk-like element.

Sub-type E4: Design formed by a main line with an evenly spaced series of short parallel lines extending at right angles from it. The design is often referred to as a "rake".

Sub-type E_4A: Design type E_4 with a dot element terminating one of the short lines.

Sub-type E_5: Several short lines intersecting, connecting, etc., to form a linear design. Designs E_5 through E_7 are classed by their degree of complexity, but the separation may not be entirely valid.

Sub-type E_5A_2: Linear design type E_5 combined with dot elements.

Sub-type E_5A_3: Linear design with combination of dot series.

Sub-type E_6A_1: Long complex rectangular design with scattered dots. The design may cover an area over six feet in length.

Sub-type E_6AF: Rectilinear design with dot elements and animal tracks in association.

Sub-type E_7A: Complex linear designs of various forms usually with numerous dots, sometimes in a series. Set off from type E_5A due to complexity.

Sub-type E_7AI: Complex linear designs where curved lines are combined with straight line elements.

Sub-type E_8A: Specialized linear design set off due to its uniqueness in form but closely resembles Sub-type E_5A.

Type F: Type F includes a set of designs that clearly represent tracks of animals and possibly humans. The element is formed by pecking down the whole area to give a track-like depression. The designs show the greatest control and skill in their execution, being life-like in proportion and size in most instances. Several animals such as rabbit, deer, bear, and human are apparently represented by the designs. The tracks appear both as a single element or in pairs.

Sub-type F_1: Element or design resembling a human hand having four fingers and a thumb set apart from the fingers.

Sub-type F_2: Design resembling a human foot, the toes occur separate from the pad.

Sub-type F_3a: Human-like track design with toes attached to pad.

Sub-type F_3b: Paired human-like tracks with toes attached to pad.

Sub-type F_4: Track design formed by two lines forming the pad area and with dots representing the toes.

Sub-type F_5: Design of what may be classed as a bear track. The element is wider than the human track.

Sub-type F_6a: Track design with two round areas making up the pad, toes attached.

Sub-type F_6b: Track design with double pad as in Type F_6 but with toes detached from pad.

Sub-type F_7a: Track design with two separate toes from short pad.

Sub-type F_7b: Similar to sub-type F_7a; but with toes attached.

Sub-type F_8: Design resembling deer tracks in shape and size. Formed by two crescent shaped areas resembling hoof prints of a deer.

Sub-type F_9: Design formed by paried elements made of a dot and short line resembling the foot print of a rabbit.

Type H: Design formed by converging curved lines, the basic design forms a "U" shaped figure; more lines are added to form more complex designs.

Type H: Simple "U" design.

Sub-type H_1: Basic "U" figure with the addition of a curved line in the central area.

Sub-type H_2: Design formed by a number of converging curved lines.

Type I; Designs included in the "I" group are those using the wavy line element. The wavy line occurs as an unmodified element, or can be modified by dots and circles. Type ICA represents complex curvilinear meander rather than a true wavy line design and may not belong in this group, but is included here for lack of a better grouping.

Wavy line designs have often been called in the past by such terms as "tadpole" and "snake" designs. The design element when terminated by a dot or circle may have represented a snake.

Type I: Simple wavy line, may vary from three to eight or more loops.

Sub-type I_1: Wavy lines placed in parallel series.

Sub-type IA: Wavy line terminated by a dot element.

Sub-type IC_1 (a): Wavy line element terminated by a circle.

Sub-type IC_1 (b): Wavy line terminated at both ends by a circle element.

Sub-type IA_5C_1: Wavy line terminated by a circle and two dots connected by a curved line at the other extremity.

Sub-type I_3: Complex wavy line meander.

Sub-type I_4C and I_4CA: Group of curvilinear designs that only group on the basis of sharing of curved lines. The circle is used freely in most examples. The wavy line is not truly represented in the strict sense in design type. Dots may or may not be associated with the elements.

Type J: Basic design element is that of a zigzag line. The element is set off from wavy lines due to the angular and linear nature of the element.

Type J: Zigzag line element occurring without any modification.

Sub-type J A: Two or more zigzag lines parallel to each other with a dot or dots terminating the element.

Type K (Sub-type KEAN): Design formed around a natural feature of the surface of the decorated rock. The technique is found at sites in the higher Sierra (Nev-5, Pla-26) where natural inclusions in the granite surface are modified by petroglyphs such as circles, etc. The example at Ama-14 elaborates a natural solution hole in the limestone surface. This elongate cavity is one of five found on the rocks surface, but all others appear to have had no modification. The one example makes up one of the more interesting designs at the site. The basic construction is straight lines drawn on three sides of the cavity, and a triangular alement at one end. Other modifying elements are dots in clusters, an unidentifiable zoomorphic form which appears as if it were entering the hole (See Map 2, Unit H-24 and 25).

Type L: Design formed by straight lines to create grids and/or ladder-like meanders by placing the lines at right angles to each other. The designs can be classed as rectilinear in nature.

Sub-type L_1: Designs resembling a ladder, formed by two parallel straight lines with three or four lines connecting the two lines at right angles.

Sub-type L_2 and L_2A: Complex form of the ladder-like designs, the two outer lines tend somewhat to curve, dot may or may not be found in association.

Sub-type L_3: Numbers of straight lines cross-hatching each other at right angles to form a design resembling a grid.

Type M: Two designs formed by an overall triangular element, several with modifying lines in the center.

Sub-type M_1: A simple triangular design occurring twice at the site.

Sub-type M_2: Triangular design where the two longer sides tend to be curved and the base line is straight. Lines in the enclosed area connect with the base line and converge at the intersection of the two longer lines.

Sub-type M_3: Triangular design with interior area decorated with lines running both vertically and horizontally to form a quite complex meander.

Type N: Several designs occur that resemble animal forms. In each case the design is unique in its occurrence. Each of the three designs in this grouping is quite different in basic construction and represents a different animal in each case.

Sub-type N1: A figure formed by a number of straight lines radiating from an elongate area to form a design resembling perhaps some sort of arthropod such as a centipede. The basic construction of the design would be similar to Type H elements in many respects.

Sub-type N_2: A zoomorphic design executed in a "stick figure" manner forming a quadruped creature.

Sub-type N_3: Unmistakably a symbol representing a rattle-nake. Wavy lines form the body, and rattles re represented by a triangular figure with crosslines. The head is triangular with dot eyes.

Type O: Petroglyph designs are found in direct association with 42 mortar cups. Designs found in this combination are classified under a separate heading though in most examples incorporate petroglyph

elements such as dots, circles and line combinations. The nature and placement of the design around the mortar indicates the glyph was intentionally executed to elaborate the mortar cup.

Sub-type O_1A: A mortar cup where a short series of dots are placed along the edge.

Sub-type $O_2A_3A_6$: A design where two mortar cups are decorated by a circle of dots and connected by a series of dots.

Sub-type O_3C_1: Mortar cup encircled by a simple circle element.

Sub-type O_4C_1E: A mortar cup with a circle which has radiating lines or rays.

Sub-type O_5EC_1: "Spoked wheel" element with mortar cup at the center forming the "hub".

Sub-type O_6E_1: Mortars with straight lines radiating out from the cup.

Sub-type O_7I: Mortar cup with a wavy line running from one edge.

Sub-type O_8J: Mortar cup with a zigzag element running from the edge. The mortar in this and the above design may represent the terminating dot or circle head on such elements.

Sub-type O_9: Design in unique association to mortars at this site. Consisting of lines often several in number, connecting two mortar cups.

Sub-type O_{10}: Rectangular designs radiating out from a mortar cup; this type is unique to mortar cups.

Sub-type O_{11}: Pointed rays around mortar cups; a variation of the above (O_{10}) design.

Sub-type $O_{12}IC$: Mortar cup decorated by a complex curvilinear meander. Including concentric circles or other curved line elements connected to a mortar cup. This subtype has some unattached elements.

The foregoing classification of designs on the basis of construction by basic components or elements can be utilized in a scheme for comparison and analysis. A chart (**Figure** 6) has been prepared in an attempt to illustrate this quantitative and inter-relationship approach to the petroglyph data. The chart gives five levels of abstraction which show various aspects of the

material on each level; these levels can also be utilized for comparisons with other sites (Levels 1, 2, 3, and 5 mainly). We will not attempt any comparison at this time with this classification, but we believe it has definite promise. The bars on the chart represent percent of occurrence of a particular item involved, enabling easy visual comparison.

The first level, design types, classifies designs on the basis of the elements in them. This level of abstraction describes, by letter and number designations, the type of design depicted. The occurrence of the total complex of types can be visualized in respect to the total complex of material. The percent refers to the total number of designs (363).

The second level illustrates the percent of the total number of designs in which various element combinations occur; in other words, how frequently do element combinations occur in the designs. For example, the combination of dot and line elements (AE and EA) occurs in 46 or 13% of the designs. Within the data studied here, there is evidence that certain element combinations are favored, such as A (dot) with E (line) element. Other combinations may be of less favor or do not occur at all, such as F (track) with E and A, or we find that certain types occur essentially alone such as the D type element. The chart indicates that no more than three different graphic* elements are combined in any one design, and that the more complex combinations (three elements) such as ICA, EAF, EAI and CEA are less common than the single and double element occurrences.

The third level illustrates the percentage of the various associations of elements with each other. To illustrate, element C is found in combinations (level two) with elements A, I, E, and O, but not with elements J, L, or F. Some elements occur singly, such as the F type, which has a 45:1 ratio of single occurrence to combination with a second type of element. In contrast, element A (dot) is found in a much greater combination with other types, 82:27 ratio in favor of associations. Thus from the body of data being studied here, we can conclude that the most frequent combination is that of element E (lines), A (dots), and C (circle) in forming designs. The I (wavy line) element also seems quite popular in some sets of combinations. E (line) elements are most frequently included or combined with dot (A) elements. The dot elements occur in greater association with other elements (A_5I) than in combination with its own type (A_2, A_3, A_4), not considering random dots (not included as we believe many are of a different function than petroglyphs; i.e., acorn crackers). Therefore, designs made up wholly of dots are rather uncommon at Ama-14.

The fourth level attempts to illustrate some stylistic groupings within the total complex of designs. No areas were noted where super imposition was present to indicate one style followed another. Weathering is believed not to be of importance as an age indicator. The rate of surface alteration over the outcrop does not appear to be uniform due to varying exposures and textures of the stone. The grouping of proposed styles is subjective, based on results of this study, element similarities, and on previously isolated styles (Steward 1929).

The major grouping proposed is a group of elements, associated, and of similar graphic construction; these being, for the most part, geometric in

*Mortar O as an element, natural hole k, excluded.

nature. This geometric style includes line (E), dot (A), circle (C), mortar (O), wavy line (I), curved line (H), ladder (L), zigzag (J), and triangle (M) design elements occurring in that frequency. Track (F) and zoomorphic designs may not belong here, and are considered as a separate style. The geometric style accounts for 82.8% of the petroglyphs found at the site. The linear element is most prominent, with dots and circles important.

Track designs are the second proposed style, isolated mainly on the basis of their complete difference in concept (naturalistic) from the geometric figures. Tracks appear to depict with careful and realistic accuracy the food print of certain animals such as bear, deer, rabbit, and man. The style accounts for 12.8% of the petroglyph designs.

The third style is that of groove-pit. Here we have three designs, B, BA, and D (grooves), that are generally disassociated from the other elements and are similar to designs of this type common at petroglyph sites along the Mokelumne River (Payen, n.d.). Variation of this style is found in the Valley-Sierran area to the north (Payen 1959). In both areas designs consisting of dots (A, A_2, A_3 and two dots connected by a line (A_5E) are common suggesting that at least some of these designs at Ama-14 may be also associated with this style. The groove-pit style accounts for 3.6% of the designs and may be somewhat higher in reality.

A fourth and minor grouping of designs may express an additional style, that of representations of animals. The four designs listed under this heading apparently represent four different animals; a rattlesnake, a lizard (?) and two insects (?). This grouping accounts for a little more than one percent of the designs at the site. Only one case of association is noted where an insect-like figure is combined with a line and dot element around a small solution cavity (Map 1, H-24 and H-25).

Level five illustrates the total complex of elements at the site. The most important thing illustrated here, for our study, is the percent of occurrence of various types of elements. One can easily see that some forms are more abundant than others, playing a more important role in the makeup of the petroglyphs of Ama-14.

The relationship of Ama-14 petroglyphs to those previously defined style areas (Steward 1929) is an interesting problem. From a superficial inspection in 1958, the senior writer placed the site with the Valley-Sierran petroglyphs to the north (**Payen** 1959), which are very closely allied with the Great Basin style area (Steward 1929: Area A). The present analysis indicates that Ama-14 glyphs tend to be dominated by linear type elements, with the dot and circle elements of lesser importance. The Valley-Sierran geometric group is definitely curvilinear with the circle dominant and with lesser use of linear elements; thus indicating the original assumption was not altogether correct. In fact, if the two petroglyph complexes were compared on lower levels in the scheme, we would most probably find even greater differences. One can say that there are some designs that seem similar to the Valley-Sierran geometric, but occur in different proportions. There is probably influence from this area at least in the curvilinear elements. The design types, both geometric and track are found in the Great Basin style area (Steward 1929: Baumhoff, Heizer and Elsasser 1958); however, the degree of frequency and association was not investigated.

A sub-type of the Great Basin area is that of rectilinear designs on the western edge of the Basin area, mainly in Owens Valley, Mono Lake area (Steward 1929: 220). There remains the possibility that the Ama-14 glyphs may be related to or influenced from this area. Also, the petroglyphs within the geographic region of the site should also be considered. Sites recorded by the writers along the Mokelumne River to the west of the Volcano area have revealed a series of pictographs of a predominently simple linear type (Payen, n.d.). These are made up of various simple line drawings, wavy lines, stick figures, and simple circles which are also found at pictograph sites in Yosemite National Park (Bennyhoff 1956). These seem to make up a style distinct in itself, extending in area from the Mokelumne River in the north toward the south to where the elaborate Tulare Pictographs would represent a different style. This would suggest that this style is restricted to areas occupied by the Miwok. The relationship of the Ama-14 geometric elements to this style is suggested by the sharing of dominant linear elements, but contrasting greatly in degree of complexity and variety of designs.

The groove-pit type of petroglyphs of Ama-14 presents a clear relationship of a more direct nature to elements found at several sites along the Mokelumne River that seem to represent a second style in that area (Payen, n.d.). The box element around a dot is common in this area and is set off from the groove-pit "Baby Rock" sites in the Valley-Sierran group (Payen 1958: 80). Such groove-pit glyphs have been attributed to the control of weather in the north-western section of California (Heizer 1953) and were used by the Pomo to enable women to bear children (Barrett 1952). The function of these figures in the Miwok area has not been recorded in ethnographic studies.

MIDDEN SITES

Several surface indications of occupation areas immediately to the north and west of the grinding rock were recorded. What appears to be the main occupation site lies immediately to the west of the rock and occupies the surface area of a low lying knoll. The soil of the site is a characteristic dark midden, with scattered artifacts, chippage, and an abundance of fire fractured rock.

Few artifacts were recovered from this site because of its proximity to the heavily visited mortar area, cultivation, and selection and limited development of this knoll for a homesite several years ago. This site is apparently the major village area and would therefore be worthy of excavation.

A second and smaller midden area occurs approximately 50 yards to the north across a small natural drainage. Surface artifacts were recovered from this site and on the lower north and west end of the valley (See Map 1). Utilization of the valley by the Indians was not likely restricted to the midden areas alone. Evidence for this assumption is indicated by the abundance of surface artifacts over the entire northern and western half of the valley.

According to the owner, Mr. Scapuccino, a historic site is located on or near the top of a brush covered ridge to the northeast of the sites.

Glass trade beads are described as having been recovered in this area; although after some searching for this site in heavy chaparral, we were unable to locate it. However, a more intensive survey in this area is recommended.

A better understanding of the bedrock mortars could best be obtained through intensive excavation of the occupation middens. Some questions as to the duration of occupation, population size, and other important ecological factors may be answered through an approach of this type.

RECOMMENDATIONS FOR PROTECTION

The bedrock mortar-petroglyph area is the most outstanding archeological feature of Ama-14, and would be the primary attraction of the area if developed for visitor use. To preserve this feature, it must be protected from both natural erosion and vandalism. The nature of the rock in which the mortar cups were ground must be taken into consideration in the planning and developing of such a protective program. The rock, a soft limestone, is highly susceptible to weathering, as compared to granite or basalt. This weathering is of two types: chemical and mechanical. The former type, (i.e., chemical weathering in limestone) can be expressed in the following chemical action: Water running over and collecting on the surface of the rock collects CO_2 to form a weak acid H_2CO_3 which reacts with the limestone to form the solvable $Ca(HCO_3)_2$. This process is slowly eating away the surface of stone. Areas where this has worked to an extreme can be pointed out as large solution cavities in the rock on the northwest edge of the outcropping.

The limestone making up the outcrop has small crystals in its composition, the chemical weathering causes spaces between these crystals. This sets up conditions which enable mechanical weathering to occur.

Mechanical weathering is caused by water collecting in spaces and cracks on the surface of the stone. Freezing expands the water causing widening of the cracks and spaces which in turn causes scaling of the surface. Large areas of the rock show indications that this action has, in the past, removed large areas of the surface. Large aggregations of crystal grains in the bottom of mortar cups and in depressions on the rock clearly indicate that the weathering has effectively removed the surface in recent times, thus obliterating the petroglyphs.

A great degree of alteration of the surface is also caused by intentional vandalism and by a process of abrasion. This abrasion is caused by walking over the surface of the comparatively soft rock with hard soled shoes. The defacement has been in the form of initials and dates scratched on the areas which contain petroglyphs. This vandalism was at a minimum up to the time of announcement for development, since then uncontrolled visitation has caused an increase in defacement. Visitations by Scout troops are credited with having done at least some of this damage in the past several years. This points out need for education of such groups along lines of archeological conservation; archeological sites are as much a part of the natural resource and heritage as are the forests of California and the United States.

A program for protection will have to take into account the foregoing factors. The authors realize the conflict involved in such matters, where means of protection would conflict with the natural setting desirable in

interpretive development. To stop the most marked defacement (walking over the surface of the feature and willful vandalism) will require fencing off the mortar rock. The less severe, but ever present natural weathering could be prevented or at least slowed by construction of a roof over the feature.

It is the writers' opinion that the construction of such protections are a must; the natural setting of the stone in the valley will have to be changed in these respects. Here one must keep in mind that an archeological site is made by man of an extinct culture; a site often is a fragile sign, which is susceptible to eradication. If it is to be saved, the site must be protected from the destructive forces inherent in the environment. Archeological remains are unlike a forest or wildlife, which can be replenished; they must be protected at the start if they are to be kept for future generations.

SUMMARY

The bedrock mortar feature of Ama-14 can be cited as probably the largest single aggregation of mortars at one site within California. The total of 1,185 mortar cups is far greater than the average bedrock mortar site in the Central Sierra. Questions still remain as to population of the site area; the great number of mortars may be the result of a moderate-to-large population. But the number of mortars alone cannot be taken as an indicator of population size at this site as has been done in the Yosemite area (Bennyhoff 1956). Limestone, being relatively soft, wears down at a much faster rate than does granite. But even with this factor, that of limestone being a softer stone, other bedrock mortar sites in limestone and even softer rock in connection with large midden sites do not reach the proportions of the Amador feature. The rate of wear could be determined through controlled experimental tests. Excavation of the accompanying midden deposits would probably give some clue as to the duration of occupation and size of the site, and a clue to the population density at a given time.

About 3% of the mortars are parts of petroglyphs. Such an association seems to be unique. The main body of the petroglyphs are scattered in the space between mortars and in a "band" running the length of the outcrop. In the case of the mortars, the petroglyphs may represent a purely decorative art. Similar designs occur on baskets and other objects of daily use. The majority of the petroglyphs recorded at the site, however, may have served a function other than decoration. The representation of tracks of various game animals may have had something to do with hunting magic, or totemism, inasmuch as the Miwok were zoologically oriented with respect to kinship terminologies, cults, and myths (Gifford 1916, 1926; Merriam 1910).

Stylistic relationships of the petroglyphs seem to be to the Great Basin. The glyphs, however, do show some ties with the petroglyph and pictograph traditions of the Valley-Sierran and Mokelumne River areas. One may surmise that Ama-14 is in a receptive situation where at least in historic times the Miwok had contact with and were influenced by several neighboring ethnic groups such as the Maidu, Washo, Mono and Yokuts. This may, in part, account for the strong ties with several of these areas in petroglyph style rather than the rest of the Miwok area. The petroglyph

style represented is largely that of a geometric type with a heavy use of linear, dot, and circle elements. Naturalistic track designs may represent a separate style as well as groove-pit types. More survey in this region may reveal additional petroglyph sites of this type, but at the present time the complex of petroglyphs at Ama-14 appears to be apart in style from other known sites in the area.

The probable abandonment of the site may have occurred around the 1850's when the pressure of the Gold Rush converged on the rich gravels in the immediate vicinity of the site (Crosley 1957). Periodic use of this site apparently has occurred after this date as suggested in information contributed by Mr. Scapuccino. He was told by "old timers" that Indians came to the grinding rock area for dances and "picnics", staying for a week or so. He believes this to have been during the 1870's and 1880's. Limited interviews during a days' trip to local Indians at West Point and Sheep Ranch produced little information, primarily due to a lack of knowledge of old ways on the part of the younger informants, and to the limited number of older informants. However, this sourve of information should be further investigated as soon as possible while the few remaining informants are still living. One informant at West Point claimed knowledge of the site, and stated that cups or mortars were called Chō-se or tco-se. This corresponds to the name of mortar cups given by (Barrett and Gifford 1933), but we were unable to secure an aboriginal place name for the site from the informant. He insisted that the aboriginal name was Volcano.

The site, as well as the adjoining terrain, offers an excellent opportunity for an interpretive program if the area is developed for visitor use. Village sites and large oak trees within the valley additionally present a situation in which the objects to be displayed are in a suitable environment. There are few places where such an opportunity is now present and yet within easy reach of large population centers. Here exists an opportunity to provide the visitor with an understanding and insight of the daily life processes and ecological adaptation of the Indians of California.

Thought should be given to the utilization of the purely petroglyph aspects of the site. The "mystery" of the meaning of the glyphs would be of substantial interest to the average visitor. The use of light effects over the surface of the outcrop at night to bring out the obscure symbols would be of major interest in a "campfire-type" program.

In California, at the present time, Ama-14 is probably the most outstanding monument to illustrate a past way of life which saw the acorn, and other seed plants, as dominant items in the economy of a hunting and gathering society. The opportunity for the preservation of such a monument will never again be given the people of California. Without immediate protection from vandalism, this great work of native industry will not long endure.

APPENDIX A

A NOTE ON CAVES OF THE VOLCANO, CALIFORNIA, AREA WITH RESPECT TO ARCHEOLOGY

by
Leigh A. Readdy
Sacramento Speleological Society

Caves and cave deposits have often been linked with man. Because of this history of association, Louis Payen suggested that the author present this small addendum concerning various caves in the area of Volcano, California, to be considered as part of his report.

Masonic Cave. This cave is located in a small hill of limestone just across Sutter Creek from Volcano. It is of historic interest, in that it was used for the first five meetings of the local lodge of Masons in 1854. The Indians used this same hill of limestone as a grinding place, and many mortar holes are to be seen near the cave entrances. It seems not too improbable that the Indians made use of the cave from time to time, although no definite study has been made from the archeological standpoint.

Ive's Hill Cave. Another small cave near the town is reported to consist of one main room 15 feet high and about 30 feet in diameter. The cave entrance is a vertical fissure which could have acted as a death trap to animal and man alike. Also, it is not uncommon for vertical caves of the Mother Lode region to be used as places of easy burial (Heizer 1952). Thus caves such as Ive's Hill cave should be kept in mind as likely archeological sites.

Black Chasm. This cave has been described as one of California's most dangerous caves; in this writer's opinion this is quite true. Two small entrances lead to a steep mud slope which terminates in a vertical drop of over 100 feet to a lake. Any animal or object falling in the entrances would eventually find itself at the bottom of the lake. It is quite possible that Black Chasm could prove to be an archeological site. This cave is under study by the San Francisco Bay chapter of the National Speleological Society. The cave is under lease by the Nature Conservancy and entry is by permit only.

From the foregoing it is apparent that the caves of this area could quite conceivably be of interest to the archeologist. In the near future a rapid reconnaissance of these caves will be made, with respect to their possible archeological significance.

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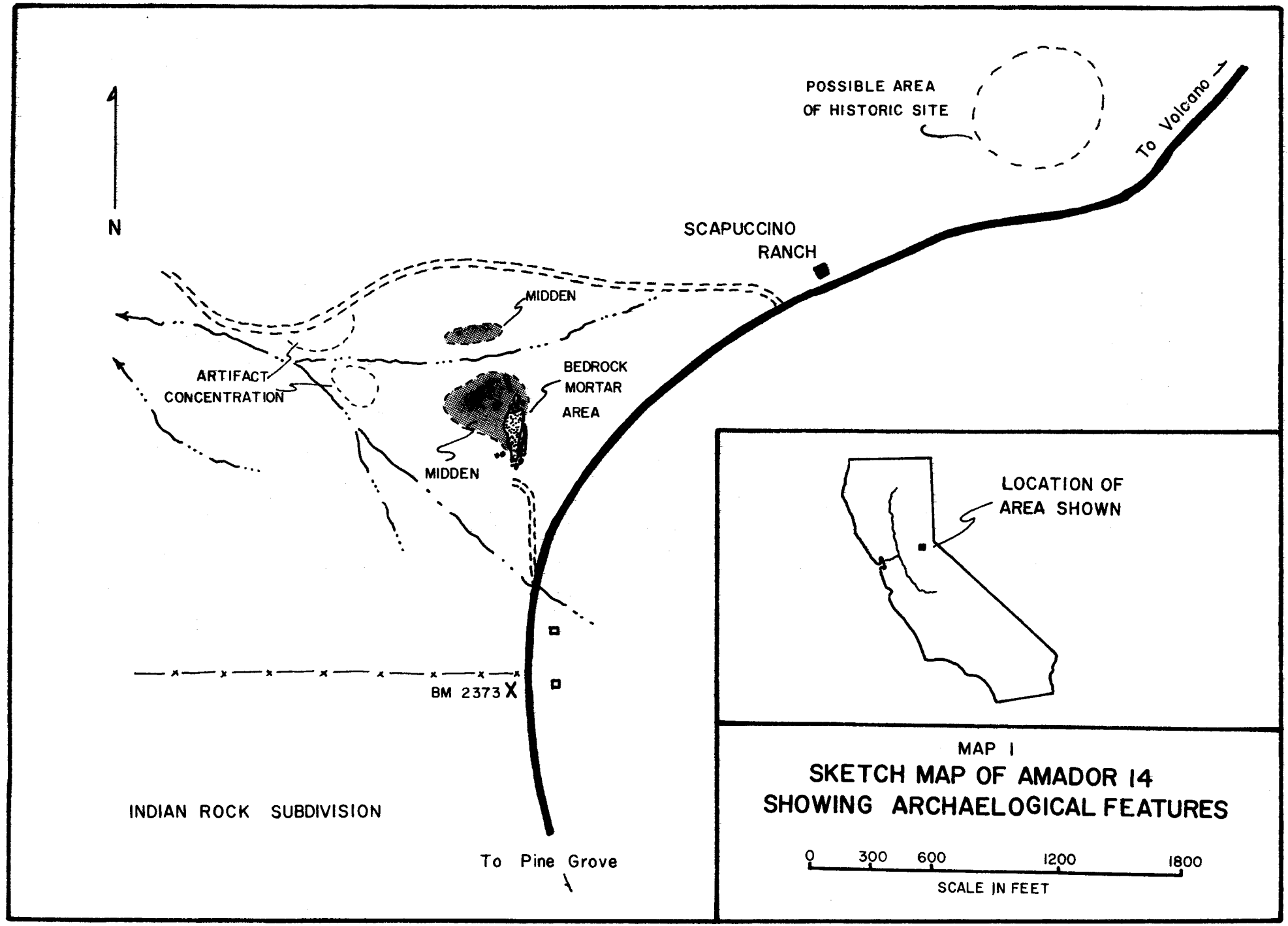
EXPLANATION OF MAPS

Map 1.	Sketch Map of Amador 14 Showing Archaeological Features.
Map 2.	Archaeological Base Map of the Bedrock Mortar Area, Amador 14.

EXPLANATION OF ILLUSTRATIONS

Plate 1.	Views of Bedrock Mortar-Petroglyph.
Figure 1.	Number of Mortar Pits at Sites in Amador and Calaveras Counties.
Figure 2.	Distribution of Depth of Mortars.
Figure 3.	Distribution of Diameter of Mortars.
Figure 4.	Random Sample of 22 Mortar Pits Showing Measured Volume.
Figure 5.	Cross-sections Through Bedrock Mortar Area.
Figure 6.	A Quantitative and Inter-relationship Approach to Petroglyph Data.
Figure 7.	Diagrammatic Relationship with Adjacent Petroglyph Styles.
Figures 8-14.	Design Elements and Their Location on the Rock Outcrop at Amador 14.


N
POSSIBLE AREA
OF HISTORIC SITE
To Volcano
SCAPUCCINO
RANCH
MIDDEN
ARTIFACT
CONCENTRATION
BEDROCK
MORTAR
AREA
MIDDEN
BM 2373
INDIAN ROCK SUBDIVISION
To Pine Grove
LOCATION OF
AREA SHOWN
MAP 1
SKETCH MAP OF AMADOR 14
SHOWING ARCHAELOGICAL FEATURES
0 300 600 1200 1800
SCALE IN FEET

OAK TREE

N

ARCHAEOLOGICAL BASE MAP
OF THE
BEDROCK MORTAR AREA, AMADOR 14

0 2.5 5 10 15 20 feet
SCALE

LEGEND

- MORTAR PITS
- MORTAR PITS DECORATED WITH PETROGLYPH
- PETROGLYPH DESIGNS (As recorded by artificial lighting)
- N — NATURAL SOLUTION CAVITY

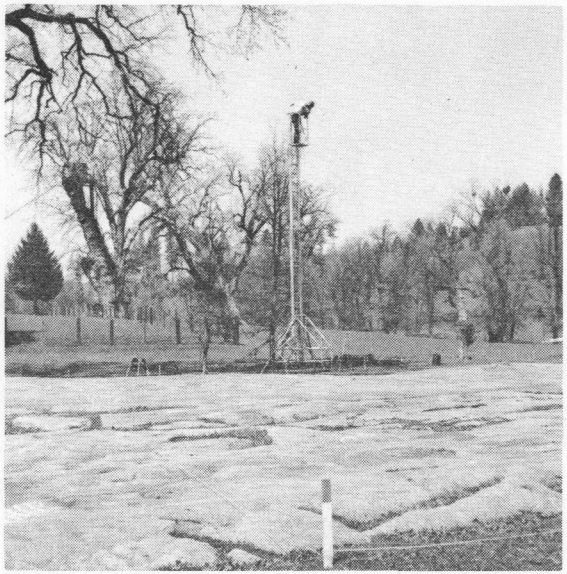
MAP 2

POINSETTIA

A B C D E F

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

Datum



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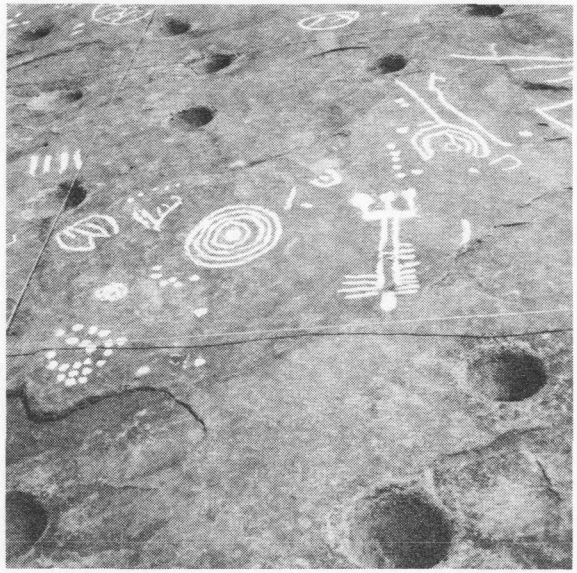

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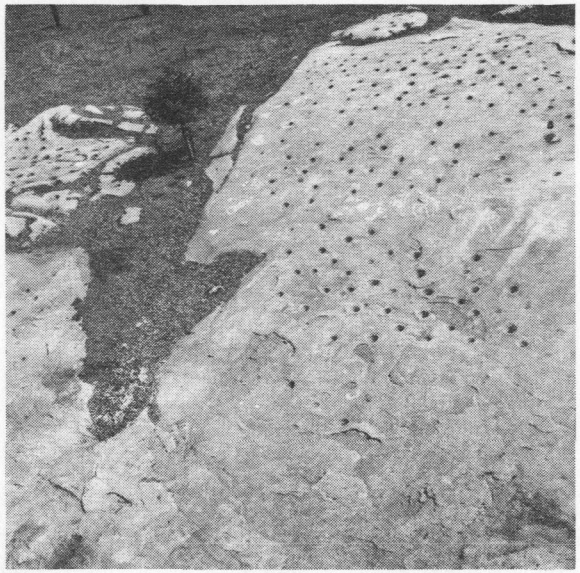

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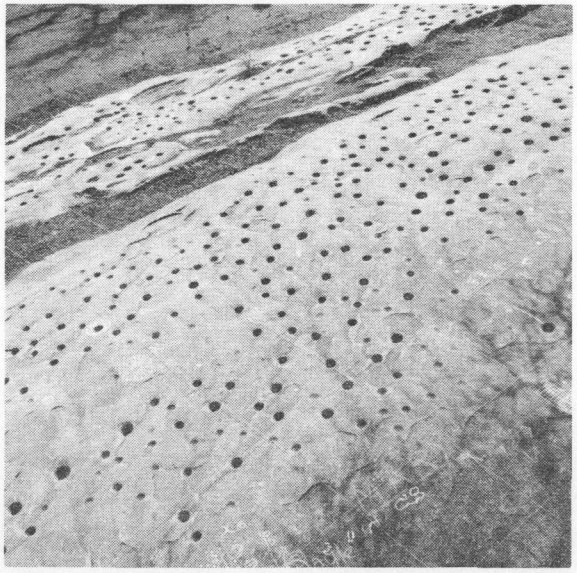

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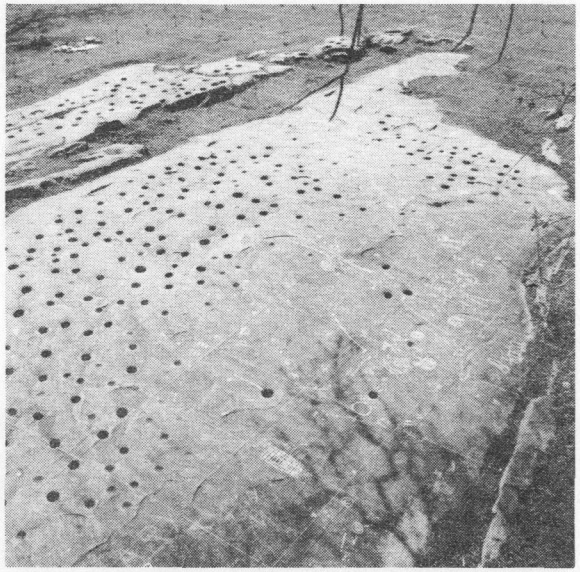

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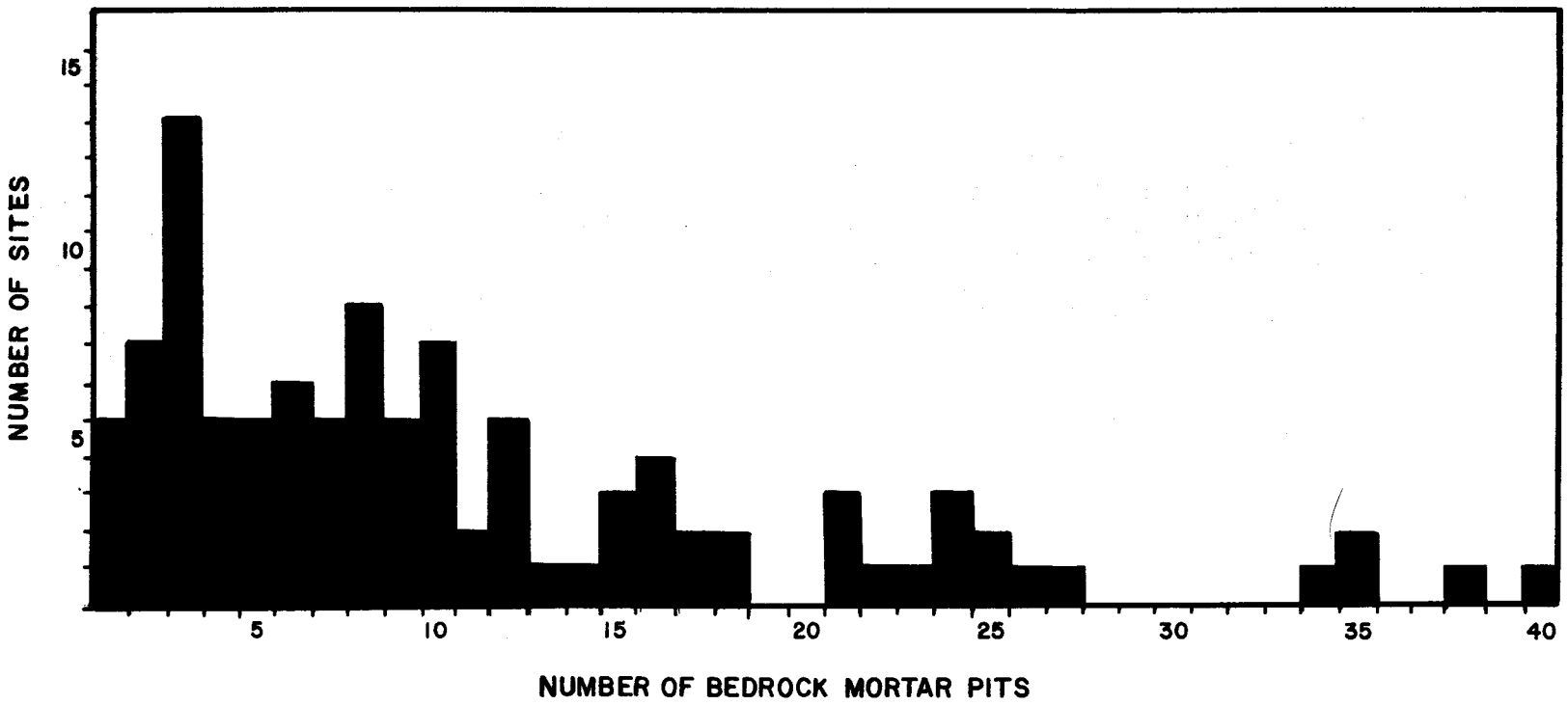
PLATE I



NUMBER OF MORTAR PITS AT SITES IN AMADOR AND CALAVERAS COUNTIES

FIGURE 1

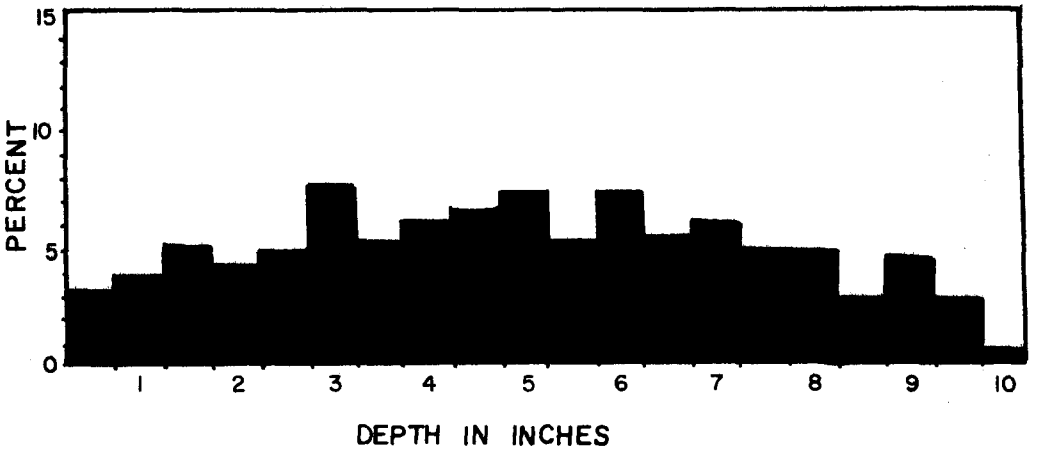


FIGURE 2

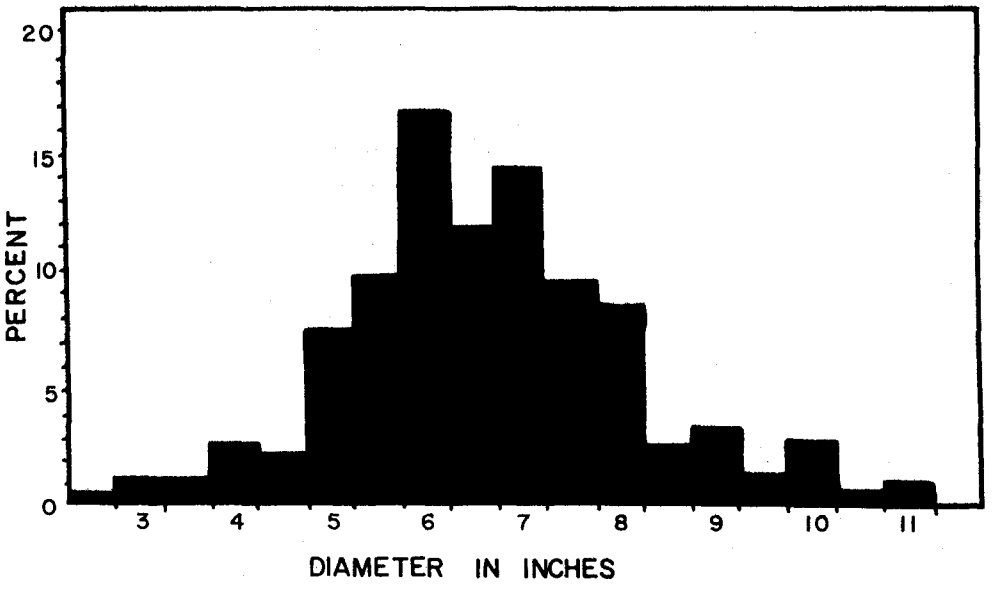
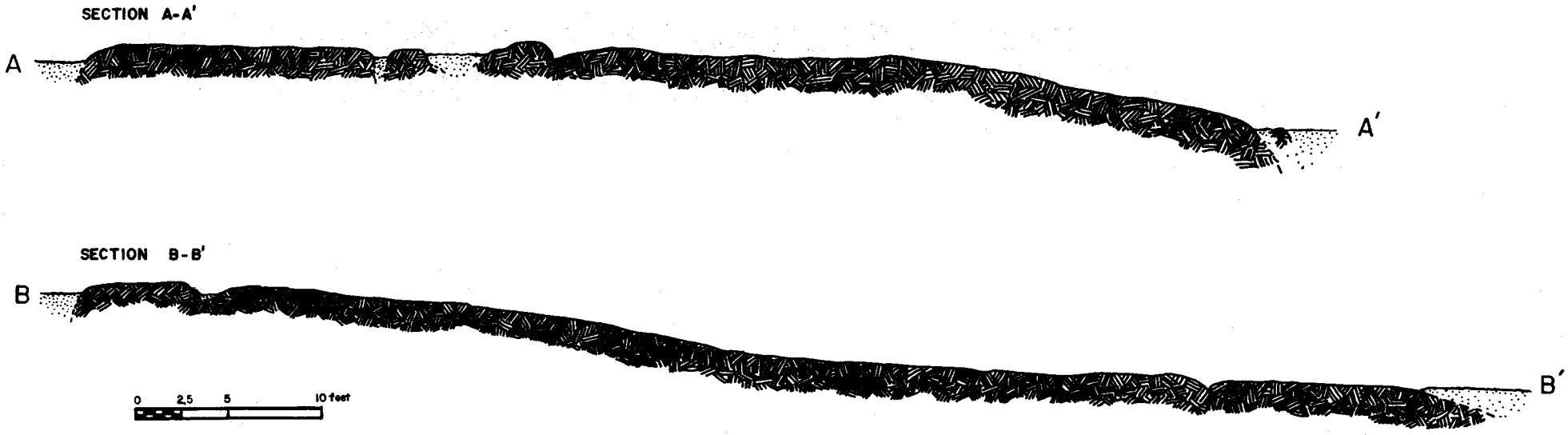


FIGURE 3

DISTRIBUTION OF DEPTH AND DIAMETER OF MORTARS

Diameter	Depth	Volume in cc	Diameter	Depth	Volume in cc
4.5	1.0	40	6.5	5.0	1210
5.0	2.0	220	6.5	6.0	1540
5.0	2.5	310	7.0	6.5	2120
6.0	2.5	340	7.75	6.5	2120
5.5	3.0	510	7.5	8.0	2510
5.0	3.0	520	8.0	8.5	3310
6.0	3.5	700	9.0	10.0	4000
5.5	4.0	710	8.5	9.5	4200
6.0	3.5	740	10.0	9.0	4700
6.5	4.0	800			
6.0	4.5	920			
6.0	4.0	930			
6.5	4.0	1110			

Figure 4. Random sample of 22 mortar pits showing measured volume.



CROSS SECTION THROUGH BEDROCK MORTAR AREA

FIGURE 5

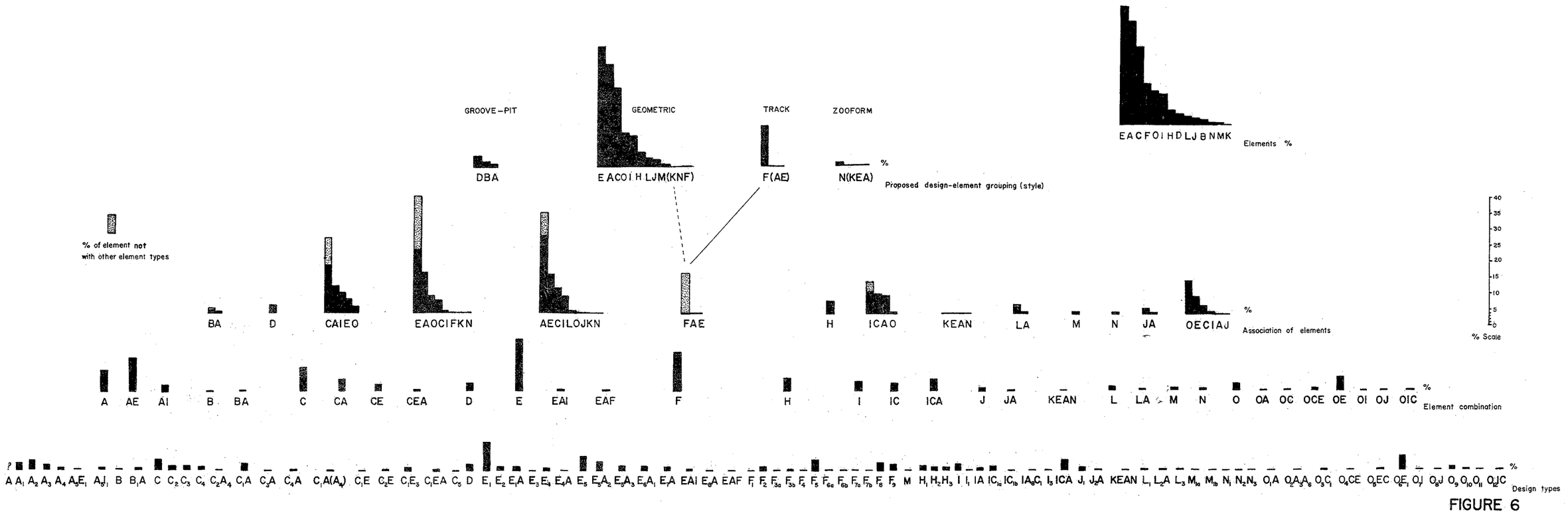
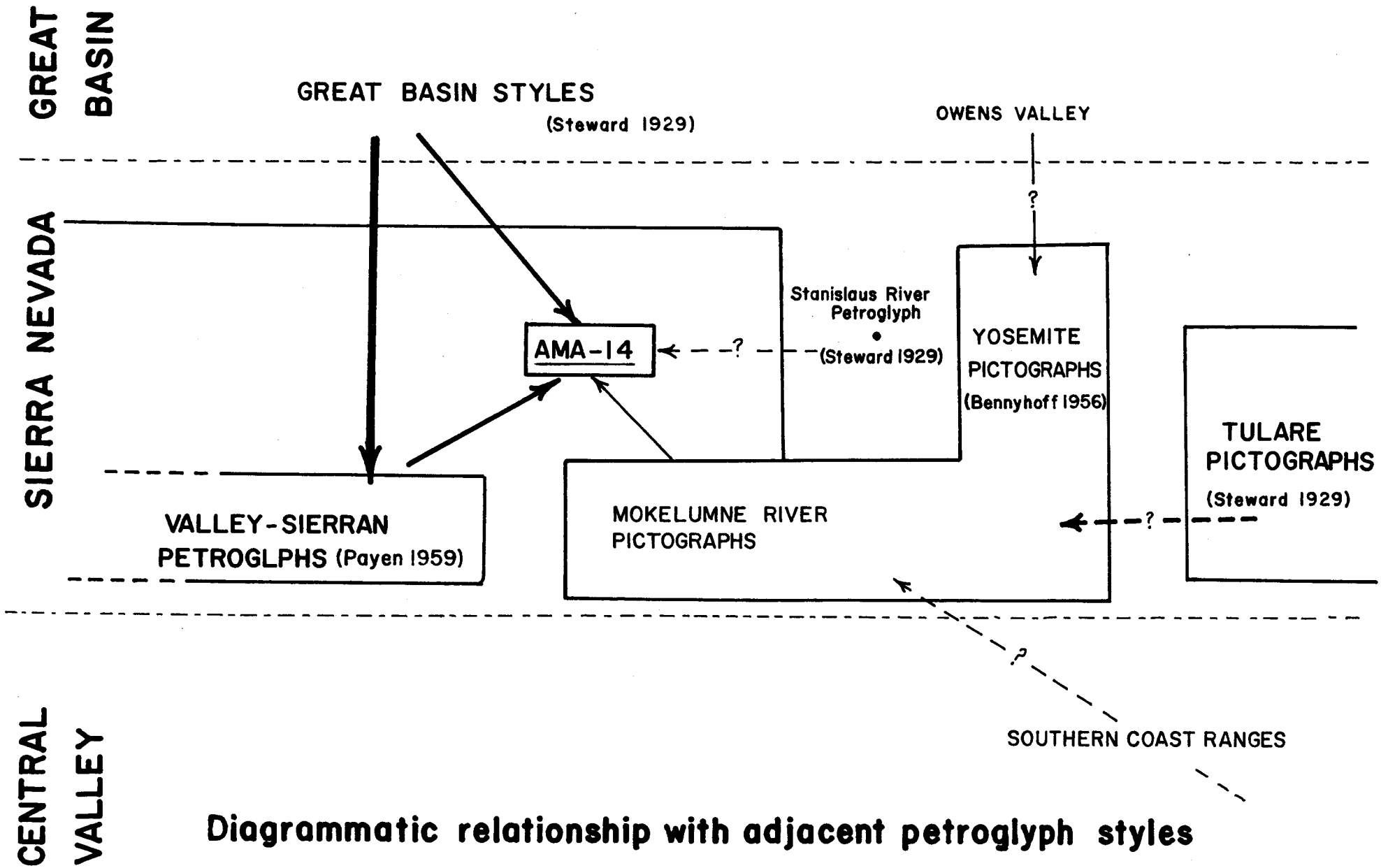

GROOVE–PIT
GEOMETRIC
TRACK
ZOOFORM
EACFOIHDLJBNMK
Elements %
DBA
EACOIHLJM(KNF)
F(AE)
N(KEA)
%
Proposed design-element grouping (style)
% of element not with other element types
BA
D
CAIEO
EAOCIFKN
AECILOJKN
FAE
H
ICAO
KEAN
LA
M
N
JA
OECIAJ
%
Association of elements
40
35
30
25
20
15
10
5
0
% Scale
A AE AI B BA C CA CE CEA D E EAI EAF F H I IC ICA J JA KEAN L LA M N O OA OC OCE OE OI OJ OIC
Element combination
? A A1 A2 A3 A4 A5E1 A6I1 B B1A C C2 C3 C4 C2A4 C1A C3A C4A C1A(A4) C1E C2E C1E3 C1EA C6 D E1 E2 E1A E3E4 E4A E5 E5A2 E5A3 E6A1 E7A EAI E8A EAF F1 F2 F3a F3b F4 F5 F6a F6b F7a F7b F8 F9 M H1H2H3 I I1 IA IC1a IC1b IA6C1 I5 ICA J1 J2A KEAN L1 L2A L3 M1a M1b N1 N2N3 O1A O2A5 A6 O3C1 O4CE O5EC O6E7 O7 O8J O9 O10O11 O12IC
Design types
%

FIGURE 6



Diagrammatic relationship with adjacent petroglyph styles

FIGURE 7

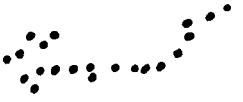
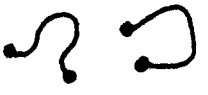
TYPE	DESIGN	No.	%	LOCATION ON OUTCROP (See Map #2)
A				
A_1		8	2.216	C36, D11, E16, E12, H20, I25, J27, L18
A_2		11	3.047	B19, C8, C18, E3, H22, I15, L12, L15, M16, M28, O10
A_3		5	1.375	F3, I21, J28, K19, H28
A_4		3	.831	D10, F35, K19
A_5E		1	.277	C35
A_5I		3	.831	G35, I21, K19
B		2	.554	G28, N29
B_1A		3	.831	E7, K8, L14
C		12	3.470	D8, D8, D9, D13, F2, F35, G5, H21, K11, L14, L15, M14
C_2		6	1.662	H19, H23, J29, K10, K12, M15
C_3		6	1.662	D36, E8, G29, I23, L13, M16
C_4		5	1.375	H17, I20, K12, L13, L25
C_2A_4		1	.277	L14

FIGURE 8

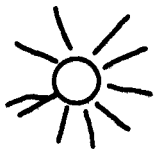
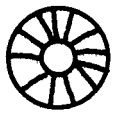
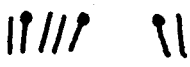
TYPE	DESIGN	No.	%	LOCATION ON OUTCROP (See Map #2)
C_1A		8	2.216	C7, C8, D36, I27, K10, L11, L14, O10
C_3A		1	.277	D15
C_4A		2	.554	G13, I27
$C_1A(A_4)$		1	.277	L14
C_1E		1	.277	C16
C_2E		3	.831	I17, I17, K10
C_1E_3		4	1.108	G6, H27, H28, I26
C_1EA		3	.831	B32, E16, F29
C_5		1	.277	E16
D		8	2.216	C16, D6, H29, H31, H35, K14, K14, K14
E_1		33	9.141	B7, B36, C8, C10, C13, C15, D8, D12, D14, D33, E10, E16, G5, G6, G23, G30, H3, H8, H21, H24, H25, I20, J28, K11, K12, K15, L19, L20, L11, L15, M14, O9
E_2		5	1.375	C8, G7, I20, K26, L11
E_1A		5	1.375	E13, G6, G6, H21, I20

FIGURE 9

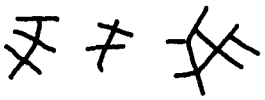
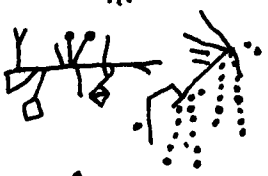
TYPE	DESIGN	No.	%	LOCATION ON OUTCROP (See Map #2)
E_3		1	.277	G32
E_4		4	1.108	D30, H24, H30, M15
E_4A		1	.277	K12
E_5		18	4.986	D8, D11, D17, E4, E8, E11, F28, I22, I26, H26, L12, L15, L16, L16, L17, M14, M16, O10
E_5A_2		11	3.047	D10, G7, G28, G29, H30, J10, K13, L11, L12, L14, L18
E_5A_3		7	1.911	G28, H26, H28, I27, I29, J10, K12
E_6A_1		7	1.911	H22, I16, J12, J21, J21, L12, L13
E_6AF		1	.277	H23, I24
E_7A		5	1.375	G8, G8, H31, I26, L12
E_7AI		3	.831	H8, J20, K18
E_8A		1	.277	I27
F_1		1	.277	J11

FIGURE 10

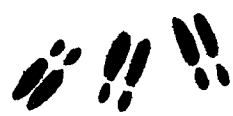
TYPE	DESIGN	No.	%	LOCATION ON OUTCROP (See Map #2)
F_2		4	1.108	C8, C9, E15, H15
F_{3a}		1	.277	D11
F_{3b}		2	.554	C9, D10
F_4		1	.277	I26
F_5		14	3.878	C7, D8, D9, D10, D36, E10, G29, H21, H30, I24
F_{6a}		2	.554	D11, G27
F_{6b}		1	.277	J15
F_{7a}		1	.277	H35
F_{7b}		1	.277	L18
F_8		9	2.493	B14, C10, D9, H27, I28, K14, K14, L14, M16
F_9		8	2.216	C10, D8, D12, K14, K14, L13, L18, M14
H_1		7	1.911	F28, H21, I27, J14, L11, L14, M14

FIGURE 11

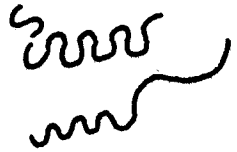
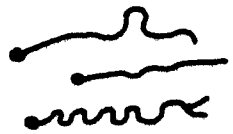
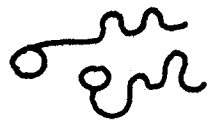
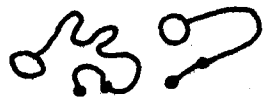
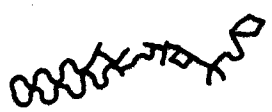
TYPE	DESIGN	No.	%	LOCATION ON OUTCROP (See Map #2)
H_2		4	1.108	D17, H28, K18, M14
H_3		4	1.108	H4, H25, I22, K29
I		8	2.216	D35, H22, J11, K11, K18, L5, L12
I_1		2	.554	D36, I30
IA		5	1.375	D23, H21, J21, L14
IC_{1a}		7	1.911	D16, D36, H9, I22, J10, K12, K18
IC_{1b}		1	.277	I20
IA_5C_1		2	.554	I21, L17
I_3		1	.277	H7
I_4CA		13	3.747	D9, H7, H8, H27, I16, I17, I27, I28, J12, K6, K11, K18, M6, M13
J_1		5	1.374	C8, H29, K12, I20, I22
J_2A		2	.554	D9, E11

FIGURE 12

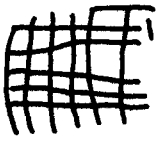
TYPE	DESIGN	No.	%	LOCATION ON OUTCROP (See Map #2)
KEAN		1	.277	H24, H25
L_1		3	.831	G10, I11, J21
L_2A		3	.831	G3, H23, J29
L_3		3	.831	B14, I20, L15
M_1		2	.554	C8, D8
M_2		1	.277	H5
M_3		1	.277	I26
N_1		1	.277	H25
N_2		1	.277	K15
N_3		1	.277	I10

FIGURE 13

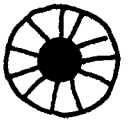
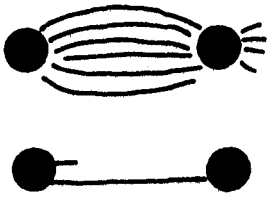
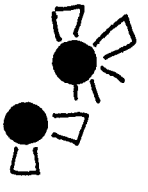
TYPE	DESIGN	No.	%	LOCATION ON OUTCROP (See Map #2)
O_1A		1	.277	C8
$O_2A_3A_6$		1	.277	D10
O_3C_1		3	.831	B33, D6, I11
O_4C_1E		1	.277	E4
O_5EC_1		3	.831	G27, H16, H18
O_6E_1		16	4.415	C8, C9, C16, D9, D9, D10, D35, E9, E9, F28, H15, H30, I28, K15, L14, L15
O_7I		1	.277	D35
O_8J		1	.277	D8
O_9		5	1.375	F28, F29, F29, G29, G30
O_{10}		3	.831	G27, G28, F28
O_{11}		1	.277	I14
$O_{12}IC$		2	.554	G30, L13

FIGURE 14