Plate 17. Scraper planes. Type II-A. Plate 17a: 19-454-1, banded chert; b: 16-307, fine-grained igneous. (Photographed items coated with ammonium chloride powder.)

TABLE 18
DISTRIBUTION OF FLAKED STONE ARTIFACTS
OTHER THAN PROJECTILE POINTS BY SITE

Category	Total	4-Riv-202	4-Riv-463	4-Riv-452	4-Riv-331	4-Riv-464	Survey (all unexcavated sites)
Scraper Planes							
Type IIA	4	3	--	--	--	--	1
Tabular	2	--	--	1	--	--	1
Unclassified	3	2	--	--	--	1	--
Scrapers							
End-scrapers	3	2	--	--	--	1	--
Flake side-scrapers	1	--	1	--	--	--	--
Corner-notched	1	--	1	--	--	--	--
Knives							
Triangular bifacial	2	1	--	--	1	--	--
Irregular bifacial	1	1	--	--	--	--	--
Bifacial knife fragments	3	--	--	--	1	2	--
Flake knives	2	1	--	--	--	1	--
Drills							
Cottonwood points used as drills	2	--	--	--	--	2	--
Perforators	2	1	--	--	--	1	--
Gravers	2	--	--	--	1	1	--
Choppers	3	--	--	--	1	2	--
Hammerstones	14	6	--	--	2	6	--
Cores	22	9	--	1	5	6	1
Total	**67**	**26**	**2**	**2**	**11**	**23**	**3**

60° to greater than 90°. The larger angle is probably a result of successive resharpenings. Edgewear is present on both specimens. On one it consists of minute step flaking on the dorsal face of the working edge, which suggests use primarily in scraping. On the other the basal part of the working edge is abraded: this suggests use primarily as a push-plane. Both of the complete examples were found on the surface. Two fragmentary specimens, consisting of portions of the working edge are tentatively included in this type. They were found on the surface of 4-Riv-202.

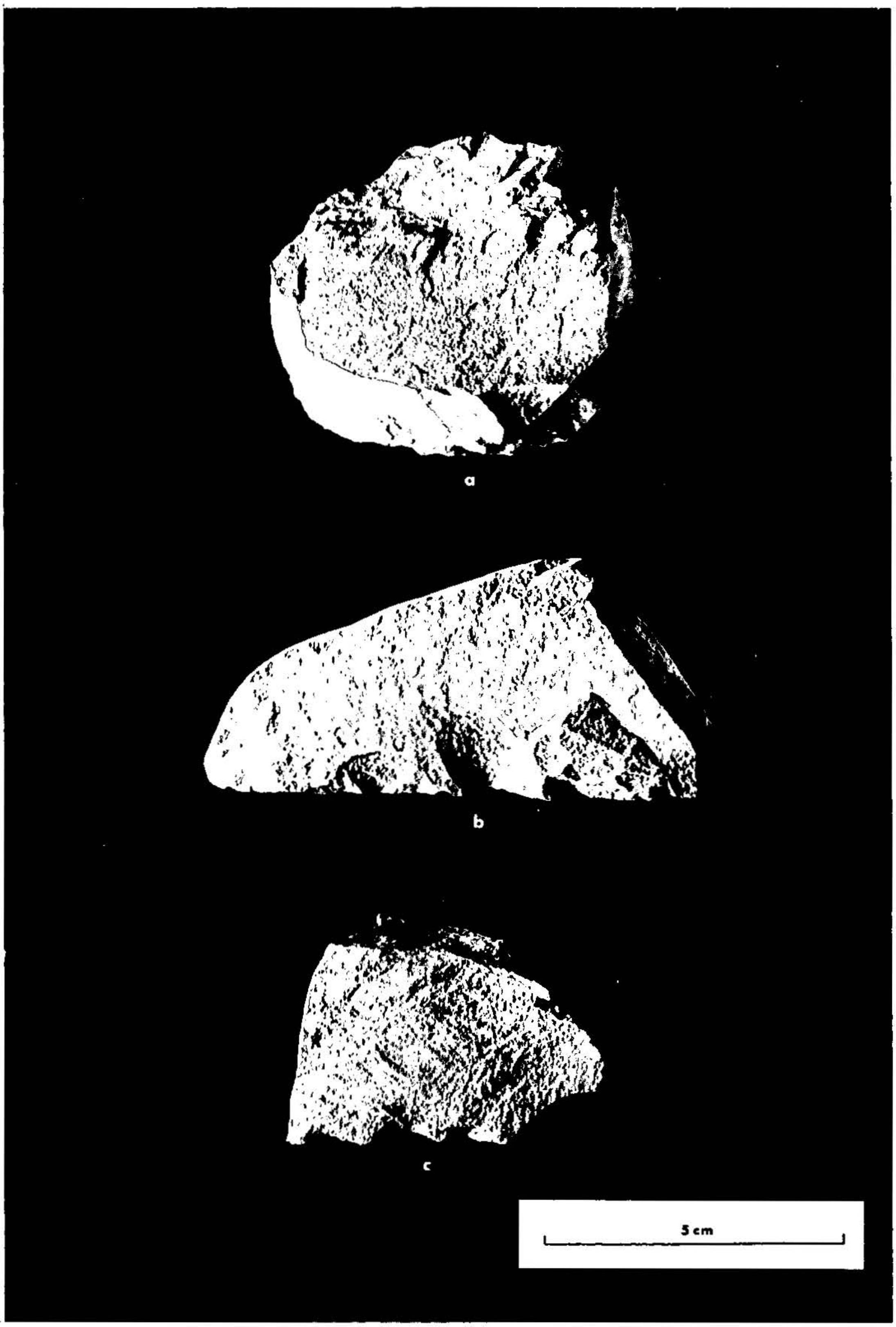
Tabular Scraper Planes (Plate 18a)

Number of Specimens: 2
Distribution: 4-Riv-452 (1); 4-Riv-455 (1)
Material: Rhyodacitic porphyry (1); fine-grained quartzite (1)
Dimensions: 6.1 x 5.6 x 1.3 cm; 7.0 x 6.8 x 2.0 cm

Specimens in this category have dorsal and basal surfaces that are nearly parallel planes. Similar specimens have been described by Kowta (1969:23) in the Sayles Complex as lowback uniface scrapers.

Specimen 18-61 (Plate 18a) is roughly ovate in outline and displays a working edge along about two-thirds of the basal perimeter. The working edge is steeply step fractured at an angle that varies from 60° to 90°. There is moderate abrasion on a small portion of the working edge, which is suggestive of scraping. A secondary, less well-defined working edge occurs along about one-third of the dorsal surface perimeter opposite the basal working edge. The second specimen has an irregular outline and a straight working edge along about one-third of the basal perimeter. The angle of the working edge is about 60°. Battering marks opposite the working edge indicate secondary use as a hammerstone.

Plate 18. Scraping implements. Plate 18a: tabular scraper plane; b-c: Unclassified scraper plane-like implements. Plate 18a: 18-61, rhyo-dacitic porphyry; b: 16-110, fine-grained metamorphic; c: 16-208, fine-grained metamorphic. (Photographed items coated with ammonium chloride powder.)


a
b
c
5 cm

Other Scraper Plane-Like Implements (Plate 18b, c)

Number of specimens: 3
Distribution: 4-Riv-202 (2); 4-Riv-464 (1)
Material: Latitic porphyry (1); fine-grained (2)
Dimensions: 8.4 x 2.8 x 2.8 cm; 5.0 x 3.3 x 2.4 cm; 10.6 x 6.2 x 3.2 cm

Several implements were apparently used as scraper planes but do not particularly resemble conventional scraper planes in form or method of manufacture. The working edge on each specimen is formed by two intersecting fracture planes. The angle of the working edge is thus that of the intersecting fracture planes, and the working edge is therefore straight. They were not intentionally flaked, but probably occurred naturally or resulted from the breaking of a hammerstone.

All three specimens are complete implements. The angles of the working edges are 35°, 50°, and 55°, respectively. Two of the specimens were resharpened by percussion, and one of these bears remnants of a working edge extremely dulled by abrasion prior to resharpening. The pattern of the wear suggests use as a push-plane. The third example shows some step fracturing from use on the working edge and was apparently also used as a hammerstone.

Scrapers

Scrapers are not well represented in the assemblages from sites in the Perris area. There are only five examples: three are end scrapers, one is a sidescraper, and one is a notched form that could have served as both an end and a sidescraper.

End-scrapers (Plate 19h, i)

Number of specimens: 3
Distribution: 4-Riv-202 (2); 4-Riv-464(1)
Material: Chert (1); fine-grained gabbro (2)
Dimensions: 3.6 x 2.8 x 1.3 cm; 4.2 x 3.2 x 1.3 cm; 5.3 x 3.6 x 1.6 cm

Examples in this category are crudely flaked, roughly triangular in overall outline, and somewhat plano-convex in cross section. They are broadest near the working edge and taper toward the opposite end.

Two of these snubnose or end scrapers have steeply flaked (about 85°) working edges. On one the edge extends across the broad end in a semicircle. On the other the working edge comprises only about 30° of arc midway between the end and side of the object. A third specimen was apparently not intentionally sharpened. The cutting edge is a result of the intersection of large flake scars at an angle that varies from 50° to 70°. All show use-wear in the form of abrasion on the working edge.

Flake Side-scraper (Plate 19g)

A single small specimen is fashioned from a thin flake. The lateral edges are straight and are steeply pressure flaked unifacially at an angle of 80° to 85° to form the scraping edges. This specimen is from 4-Riv-463, measures 24 x 17 x 4 mm, and is of white opal.

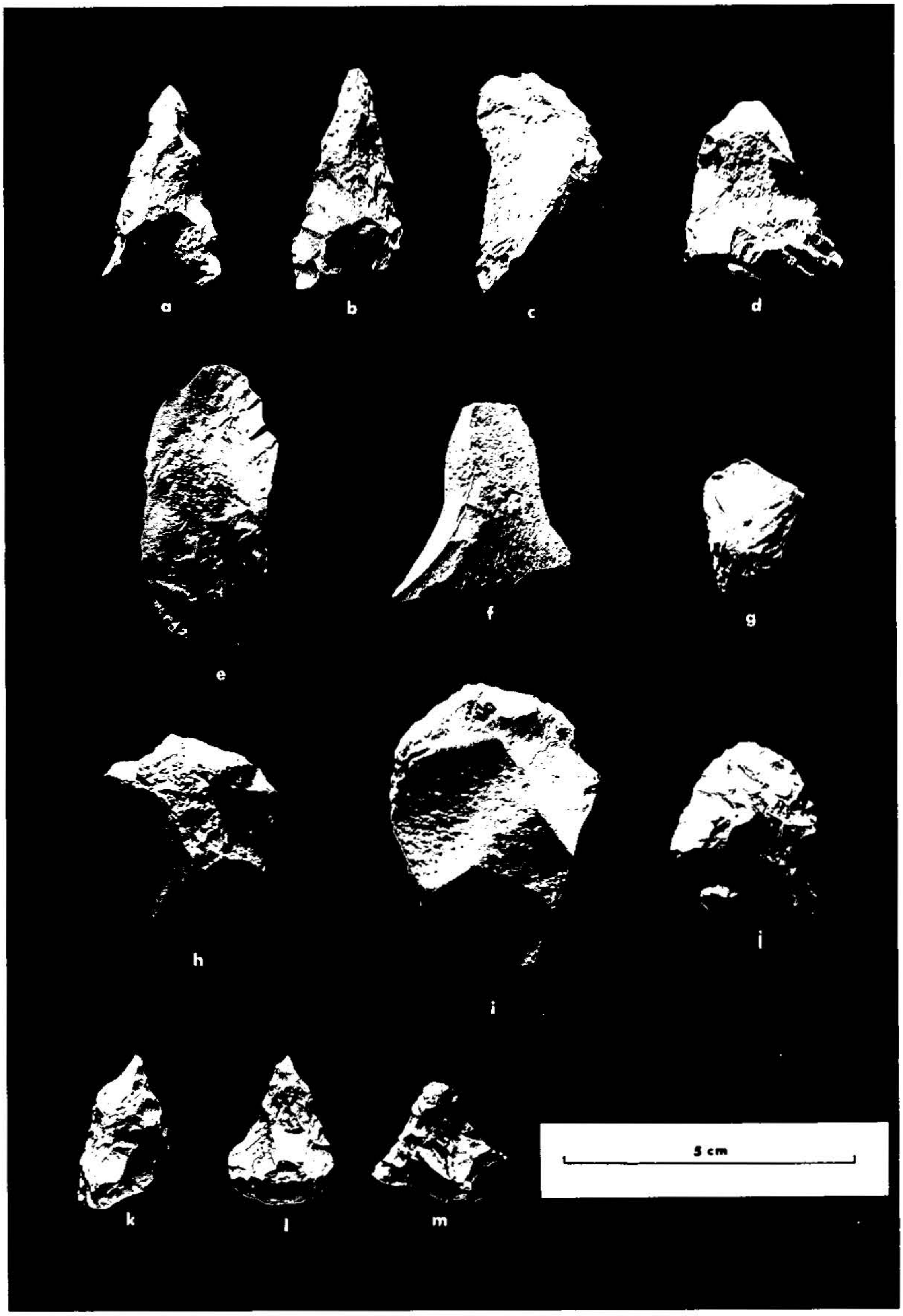
Corner-notched Scraper (Plate 19j)

The single specimen may represent a reworked Elko Corner-notched projectile point (Heizer and Baumhoff, 1961), which it superficially resembles. It is, however, almost exclusively unifacially flaked. The base is thinned by the removal of a single large flake. One of the notches is poorly developed, and the lateral edges converge to form a blunt point. The object is interpreted as a scraper that was once hafted. Both the lateral edges and the blunt distal end could have served as scraping edges. Only the distal end, which is beveled at an angle of 85°, is worn smooth from use. The bevel of the lateral edges averages only about 40°. The specimen is from 4-Riv-463, is made of chalcedony, and measures 30 x 25 x 7 mm. It weighs 5.6 g.

Knives

Knives also form only a small percentage of the flaked stone assemblage. There are eight speci-

Plate 19. Various flaked stone implements. Plate 19a-b: Triangular bifacial knives; c: Irregular bifacial knife; d: Bifacial knife fragment; e-f: Flake knives; g: Flake side-scraper; h-i: End-scrapers; j: Corner-notched scraper; k-l: Gravers; m: Perforator. Plate 19a: 16-192, chert; b: 20-78, slate; c: 16-286, chert; d: 21-470, black flint; e: 16-118, fine-grained gabbro; f: 21-958, slate; g: 17-28, opal; h: 21-427, chert; i: 16-283, fine-grained gabbro; j: 17-11, chalcedony; k: 21-597, chalcedony; l: 20-98, chert; m: 16-23, jasper. (Photographed items coated with ammonium chloride powder.)



mens of which two are triangular bifaces; two are thin, sharp, unmodified flakes used as knives; one is a bifacially worked flake, irregular in form; three are bifacially worked fragments. All are classified as knives either because of obvious dulling of the cutting edges and abrasion of the surfaces and/or because they are bifacially flaked and do not conform to any other artifact category.

Triangular Bifacial Knives (Plate 19a, b)

Number of specimens: 2
Distribution: 4-Riv-202 (1); 4-Riv-331 (1)
Material: Slate (1); chert (1)
Dimensions: 3.6 x 2.0 x .9 cm; 3.9 x 1.9 x .5 cm
Weight: 4.2 g, 2.95 g

These specimens resemble large triangular projectile points. Both have cutting edges that are smoothed and dulled from use. They appear to have been flaked by percussion with little or no pressure retouch.

Irregular Bifacial Knife (Plate 19c)

A single specimen is a bifacially retouched flake and is roughly crescentic in form. It is only minimally retouched by pressure flaking. It is of chert, from 4-Riv-202, and measures 39 x 21 x 8 mm.

Bifacial Knife Fragments (Plate 19d)

Number of specimens: 3
Distribution: 4-Riv-331 (1); 4-Riv-464 (2)
Material: Chert (1); jasper (1); black flint (1)

One specimen, 21-470 (Plate 19d) is extensively worn on the edges and on the flake ridges of both surfaces.

Flake Knives (Plate 19e, f)

Number of specimens: 2
Distribution: 4-Riv-202 (1); 4-Riv-464 (1)
Material: Fine-grained gabbro (1); slate (1)

These knives are merely very thin unmodified flakes that have been used sufficiently for cutting to dull a portion of the delicate edge. The flake faces intersect at an angle of about 5° to form the cutting edges.

Drills

Two projectile points of the type Cottonwood Triangular, variety concave base (described above), display step fracturing on the lateral edges and abrasion on both the lateral edges and blade faces. These items are believed to be drills and were probably used while hafted, possibly with a bow to provide the rotating motion. Both are from 4-Riv-464; one is of obsidian, the other of quartz (Plate 15r, w).

Perforators

Number of specimens: 2
Distribution: 4-Riv-202 (1); 4-Riv-464 (1)
Material: Jasper (1); porphyry (composition ?) (1)
Dimensions: 22 x 23 x 7 mm; other is fragmentary

Objects included in this category are suitable for making perforations but differ in form from the drills described above. They are roughly triangular in outline and are bifacially pressure flaked. The lateral edges are slightly concave and are minutely step flaked. The complete specimen (16-23, Plate 19m) has a rather blunt tip, and the thickness of the basal end suggests that hafting would have been diffitult or impossible. The other specimen is a midsection fragment.

Gravers

Number of specimens: 2
Distribution: 4-Riv-331 (1); 4-Riv-464 (1)
Material: Chert (1); chalcedony (1)
Dimensions: 25 x 17.5 x 7 mm (complete); 26 x 15 x 9 mm (fragmentary)

Objects are classified as gravers on the basis of a fine denticulate tip. They are also suitable for use in perforating, and are bifacially flaked.

One example has a basal end and proximal lateral edges dulled by very steep bifacial pressure retouch. It is suitable for holding between the thumb and forefinger. It is quite thick near the basal end, but tapers and becomes thin near the tip

(Plate 19l). The other example apparently lacks the basal portion and decreases in thickness only near the tip. It may be the reworked end of a longer bifacial implement (Plate 19k).

Choppers

Number of specimens: 3
Distribution: 4-Riv-331 (1); 4-Riv-464 (2)
Material: Fine-grained gabbro (1); massive metasiltstone (1); banded cherty metasiltstone (1)

These objects suggest use as massive heavy-duty choppers. They are apparently cores that had edges suitable for use in chopping; these edges are heavily step fractured. Each example was subsequently used as a hammerstone, and the chopping edges are therefore battered.

Hammerstones

To discuss hammerstones as a category of flaked stone artifacts is to some degree misleading because almost every form of available rock seems to have been used for hammering. This is particularly true with regard to ground lithic artifacts; for example, many manos are broken and battered, suggesting use for hammering purposes. In addition, most of the hammerstones included in this discussion are not intentionally flaked stone objects, but are merely cobbles, cores, choppers, fragments of rock, and the like that are battered in one place or another. A wide variety of materials is represented. The 14 hammerstones included here (excluding groundstone objects used for pounding) have the following distribution: 4-Riv-202 (6); 4-Riv-331 (2); 4-Riv-464 (6).

Cores

Cores from the Perris Reservoir locality are another difficult class of artifacts to describe. The more coarsely grained specimens in particular are difficult to interpret because they may have been used as hammerstones or may have resulted from the breaking of a hammerstone, and thus not be true cores from which flakes were struck. Some of the objects included here as cores are therefore also included in the paragraphs on hammerstones and choppers, and vice versa. A few specimens are of chert or flint, but most are of more coarsely grained igneous and metamorphic rocks. The distribution of 22 examples is as follows: 4-Riv-202 (9); 4-Riv-452 (1); 4-Riv-455 (1); 4-Riv-331 (5); 4-Riv-464 (6).

Table 18 shows the distribution of flaked stone artifacts other than projectile points among the various sites.

CERAMIC ARTIFACTS

Thomas P. O'Brien

A total of 131 potsherds were recovered from the five sites excavated in the Perris Reservoir area. These sherds were classified as Tizon Brown, Lower Colorado Buff, and Jeddito Yellow Ware. Other ceramic artifacts included eight pipe fragments and one complete pipe. Two additional specimens appear to be parts of an effigy figure but are too fragmentary for clear identification. The distribution of ceramic artifacts by site is presented in Table 19.

Tizon Brown Ware

Eight-four sherds were classed as Tizon Brown Ware. One of these sherds was a rim, and another was a constricted neck section; the remainder were body sherds. The Tizon Brown sherds from the Perris Basin had the following characteristics:

1. Mineral inclusions and/or temper:
   subangular to opaque quartz
   feldspar
   biotite flakes

   All of the minerals identified as temper may be recovered from decomposing granite or the residual clay that results from such decomposition. Thus their presence may be the result either of the clay source chosen or of purposeful addition by the potter. The inclusion and/or temper size is fine to coarse on the Wentworth scale (Wentworth, 1933).

2. Construction technique: coiling.

3. Modeling and shaping technique: paddle and anvil.

4. Finishing tecnhique: smoothing.

5. No decoration present.

6. Firing technique and related factors: fired in a poorly controlled oxidizing atmosphere. Core: oxidation occurred differentially through the core. The interior and exterior surfaces are usually completely oxidized. The center commonly exhibits a carbon streak. The result is the following color gradient: 7.5YR 5/3 to 5/1 for the enterior; 7.5YR 4/1 to 2/1 for the core, sometimes darker; 7.5YR 5/4 to 7.5YR 4/1 for the interior (Munsell Soil Color Chart, 1954). Firing clouds occur frequently.

7. Fracture: crumbling.

8. Hardness: 3 to 4 on the Mohs scale.

9. Thickness:
   maximum - 10 mm
   minimum - 3 mm
   average - 4.5 to 5 mm

10. Vessel shape: The sherds in the Perris assemblage are too fragmentary to permit the

TABLE 19
DISTRIBUTION OF CERAMIC ARTIFACTS BY SITE

		4-Riv-202		4-Riv-463		4-Riv-452		4-Riv-331		4-Riv-464	
	Total	Number	Percent in assemblage	Number	Percent in assemblage	Number	Percent in assemblage	Number	Percent in assemblage	Number	Percent in assemblage
Vessel Fragments											
Tizon Brown	84	42	77.8	18	81.8	--	--	10	62.5	14	37.8
Lower Colorado Buff	43	12	22.2	1	4.6	2	100.0	6	37.5	22	59.5
Jeddito Yellow	4	--	--	3	13.6	--	--	--	--	1	2.7
Totals	131	54	100.0	22	100.0	2	100.0	16	100.0	37	100.0
Other Ceramics											
Pipes and fragments	9	2		2		1		3		1	
Unfired clay objects	4	--		--		--		3		1	
Unidentified fragments	2	--		1		--		1		--	

reconstruction of vessel shape. Ethnographic sources (Euler and Dobyns, 1958; Meighan, 1959) indicate that Tizon Brown Ware vessels were commonly globular in form with wide-mouthed to flaring or recurved rims. Narrow-mouthed, constricted neck vessels were also represented.

11. Comparative comments: Tizon Brown Ware was first described by Colton (1939) and later revised (Euler and Dobyns, 1958). Meighan (1959) subsequently added a new type — Palomar Brown — the only type of the ware whose distribution is limited to southern California. The time range of the ware is put at 700 AD to 1900 AD on the basis of sherds dated in Arizona (Euler and Dobyns, 1958). It is found over a wide area of northern Arizona as well as in southern California (Harner, 1957). The precise temporal and geographic relationship between northern Arizona Tizon Brown and Tizon Brown from Perris Basin is not clear, although the initial date at Perris is certainly later than 700 AD. The sherds from the Perris Basin fit the general description of the ware, but cannot be assigned to specific types. All of the Tizon Brown sherds resembled both the Aquarius and Cerbat Brown types (Euler and Dobyns, 1958). Because of this problem, it was thought best to call all of the Perris sherds Tizon Brown without making type distinctions. (See below for further remarks on Tizon Brown taxonomy.)

Lower Colorado Buff Ware

Forty-three sherds were classified as Lower Colorado Buff Ware. One was a rim and one other was a constricted neck sherd. All the rest were body sherds.

1. Mineral inclusions and/or temper: variable — rounded sands, quartz, feldspar, occasionally hornblende, crushed sherds. Temper size: fine to coarse on the Wentworth scale.

2. Construction technique: coiling.

3. Modeling and shaping technique: paddle and anvil.

4. Finishing technique: smoothing.

5. Decoration: Three examples of Parker Red-on-buff, a type of Lower Colorado Buff Ware, exhibited a red slip. The rest were undecorated, and no incised or appliqued decoration was present.

6. Firing technique and related factors: fired in an oxidizing atmosphere. Core: because of the fairly consistent oxidizing atmosphere, the core color and texture were consistent throughout in almost all of the Lower Colorado Buff sherds. Carbon streak was rare. The sherds exhibited the following range of colors: 5 YR 5/1, 5YR 6/3, 5YR 5/4, 5YR 5/3, and 7.5YR 6/2. Interior surfaces were almost universally darker in chroma than exterior surfaces. This was due to firing in an inverted position, which gives the interior less oxygen. Firing clouds were infrequent.

7. Fracture: crumbling.

8. Hardness: 4 to 5 on the Mohs scale.

9. Thickness:
   maximum - 9 mm
   minimum - 3 mm
   average - 5 mm

10. Vessel shape: no diagnostic sherds were present, but ethnographic data indicate that vessel forms were often globular and tended to have a high percentage of restricted necks (Schroeder, 1958).

11. Comparative comments: Lower Colorado Buff Ware was first described by Schroeder (1952), and additional types were added by Kroeber and Harner (1955). A descriptive revision has recently been presented by Schroeder (1958).

The time range for Lower Colorado Buff Ware in Arizona is 800 AD to post-1900 AD. It occurs throughout northern Arizona and was widely traded along the Colorado River to parts of the Mojave and Colorado Deserts (Schroeder, 1958).

Jeddito Yellow Ware

Four sherds appeared to fit the general description of Jeddito Yellow Ware as presented by Colton (1956). One was a rim sherd, and the others were body sherds.

1. Mineral inclusions and/or temper: not visible

without a glass. Texture: silt to very fine on the Wentworth scale.

2. Construction technique: coiling.

3. Finishing technique: smoothing.

4. Decoration: one sherd was decorated with a brownish pigment in linear-angular designs.

5. Firing technique and related factors: fired in an oxidizing atmosphere. Oxidation was thorough. Exterior surface to core to interior surface color range was an even 2.5Y 8/2 in three sherds to 2.5Y 8/2 to 2.5Y 7/2 to 2.5Y 8/2 in the decorated sherd. Carbon streak and firing clouds were absent.

6. Fracture: somewhat shattering.

7. Hardness: 4 to 5 on the Mohs scale.

8. Thickness:
   maximum - 7 mm
   minimum - 6 mm
   average - 6.5 mm

9. Vessel shape: the one decorated rim sherd is probably a fragment of a shallow bowl.

10. Comparative comments: the four sherds fit the general description of the ware and closely resemble the type Bidahochi Polychrome; however, they lack the decoration characteristic of the type. The temporal distribution of the ware in northern Arizona is 1250 AD to present (Colton, 1956). The geographic range is the southern part of the Hopi Indian Reservation, Arizona, but the ware was widely traded (Colton, 1956).

Unfired Clay Objects

Four unfired clay objects were found in the Perris Basin excavations. Three were recovered at 4-Riv-331 and one at 4-Riv-464. They varied in shape from flat, trapezoidal forms to irregular spheres and ranged in size from 1.1 to 3.5 cm in length, and 0.9 to 3.0 cm in width. Color varied from 10YR 5/2 to 10YR 8/1.

Unidentified Clay Objects

One fragment of an effigy figure was found at 4-Riv-331. It was spatulate in shape, measured 10.5 x 10.5 x 2.0 mm, and was painted red. The second fragment, which was recovered at 4-Riv-463, was 18 mm long and gourd shaped. The bulbar end is 9 mm in diameter, spherical, and joined to a stem 5 mm in diameter. Similar fragments were reported by Kowta *et al* (1965) from the Christensen-Webb site in Menifee Valley to the south of the reservoir locality.

Ceramic Pipes (Plate 14g, h)

One pipe and eight fragments were recovered. All appeared to be bow pipes (cf. Rogers, 1936; True, 1970). The one complete pipe was 45.5 mm in length with a diameter at the distal opening of 15 mm. The distal opening was conical in shape and was made by scraping. Thickness of the wall was 5 mm. This pipe has been aboriginally modified; portions of each end were cut off, and both edges were smoothed. The flange was removed and its stump abraded to an almost smooth surface. Ceramic pipes are said to have been horizon markers in southern California, appearing by 1750 AD in the San Luis Rey II Complex, which continued till 1850 AD (Meighan, 1954).

Implications of the Ceramic Assemblage

Temporal Implications. In general, the ceramic artifacts found in the Perris area do not serve as useful time markers, in part because the time spans assigned to them are quite long, but also because the date of their initial occurrence in southern California is not well controlled. In an article in this publication, Bettinger discusses the available data and concludes that ceramics in the Perris area probably pertain to the period after 1650-1700 AD.

Functional Implications. The small size and fragmentary nature of the ceramic assemblage found at Perris preclude comprehensive functional statements. However, some tentative suggestions are in order. A careful inspection of all sherds revealed that 18 of those classified as Tizon Brown had carbonized plant remains on either exterior or interior surfaces, but none of the Lower Colorado Buff sherds showed such evidence. It is interesting to note that ethnographic sources indicate that closed vessel shapes useful for storage predominate among buff wares, while open shapes appropriate for food preparation are common among brown wares. On the basis of this limited evidence, one might offer the idea that at Perris these two wares served slightly different purposes. Specifically, both wares were used as storage vessels, but Tizon Brown vessels were also used in food preparation. If this suggestion were accepted, it could explain an interesting anomaly in the relative frequency of the two wares at various sites in the Perris area.

As Table 19 shows, brown wares outnumber buff wares at all sites but one by a ratio of 2 to 1. However, at 4-Riv-464 the ratio is nearly reversed. (Site 4-Riv-452 is omitted from consideration because of the sample size.) It has been suggested elsewhere that 4-Riv-464 may have been a base camp that was occupied for longer periods than the other sites, which served as temporary food collecting and processing stations. If buff ware were used exclusively for storage, it would be expected to predominate at the base camp. The brown wares, used at least in part for food preparation, should then be more common at the temporary sites. It is emphasized that this suggestion is intended to apply only to the ceramic assemblage from the Perris area and not to southern California as a whole.

Remarks on the Taxonomy of Tizon Brown Ware

Attempts have been made to distinguish and describe separate types within the larger grouping of Tizon Brown Ware (cf. Euler and Dobyns, 1958; Schroeder, 1958; Meighan, 1959). When similar typing was attempted on the present sample of plain brown ware sherds, six of them appeared to correspond to Meighan's Palomar Brown, while all the rest merely fell within the Tizon Brown range of variation. No decorated or wiped sherds were present. The present type descriptions were found to be inadequate for further segregation into types and some discussion of this inadequacy is appropriate here.

The diagnostic characteristics of various types are not sufficiently precise and restrictive to allow consistent divisions. Temper, which is one of the prime diagnostics of Tizon brown "types," does not break down into discrete categories. Rather, it seems to form a continuum of intergrading textures, colors, and percentages of inclusions. The constituents of the temper are all mineralogic components of granitic rock. Since another of the primary characteristics of Tizon Brown Ware is that it is made from residual clays (which are found near their decomposing granitic sources), it seems quite possible that at least in southern California, most of the variation in temper is due to regional variation in clay sources rather than to "mental templates" followed by potters. Color is also held to be diagnostic, but due to such factors as poorly controlled firing methods, it too is subject to a great deal of noncultural variation. Many surface colors can be observed on a single vessel.

What are the implications of these observations? The first is that taxonomic criteria within Tizon Brown must be made more precise. If more precision is not possible, then fewer types are in order. As anthropologists we try to determine culturally significant factors in our artifactual remains. If attributes are not culturally significant, they are useless to our goals. On this basis, it would seem expedient, while recognizing the ware Tizon Brown, to ignore the presently defined types when dealing with southern California ceramics. Regional variations can be noted as they become objectively distinguishable as culturally meaningful entities.

BONE AND SHELL ARTIFACTS

Carol L. Mix

This paper describes examples of worked bone and shell from the Perris Reservoir excavations.

Worked Bone

A total of 100 fragments of bone show some evidence of having been worked. Only one worked bone item appears to be complete; the remainder are fragments of larger specimens. Among the categories of bone artifacts represented are 48 awls and fragments, one probable strigil, three flakers, two bone tubes, six notched tools, and one probable saw. There are also 40 fragments of bone that display some form of modification but that are not sufficiently complete to classify as to specific category. These artifacts are discussed in the following paragraphs and the distribution of specimens among the five excavated sites is shown in Table 20.

Bone Awls and Fragments (Plate 20k-n)

Number of specimens: 48

Distribution: 4-Riv-331 (11); 4-Riv-464 (29); 4-Riv-202 (2); 4-Riv-452 (1); 4-Riv-463 (5)

TABLE 20
DISTRIBUTION OF BONE AND SHELL ARTIFACTS BY SITE

		Assemblage					
Category	Total	4-Riv-331	4-Riv-464	4-Riv-202	4-Riv-452	4-Riv-463	Survey
Worked Bone							
Bone awls and fragments	48	11	29	2	1	5	--
Strigil (?) fragment	1	--	--	--	--	1	--
Flakers	3	1	--	--	--	2	--
Bone tube fragments	2	--	2	--	--	--	--
Notched tools and fragments	6	1	3	--	--	2	--
Saw (?) fragment	1	--	1	--	--	--	--
Unclassified fragments	40	7	22	7	1	3	--
Total	**101**	**20**	**57**	**9**	**2**	**13**	--
Worked Shell							
Pendants							
Haliotis pendant	1	--	1	--	--	--	--
Glycymeris pendant	1	--	--	--	--	1	--
Beads							
Olivella biplicata, spire removed	4	2	--	--	--	1	1
Olivella dama, spire removed	7	1	4	--	--	2	--
Olivella dama, barrel	2	2	--	--	--	--	--
Olivella biplicata, lipped							
Thin lipped oval	1	1	--	--	--	--	--
Thin lipped round	1	1	--	--	--	--	--
Full lipped	1	1	--	--	--	--	--
Full lipped (?)	2	--	2	--	--	--	--
Lipped bead fragments	1	1	--	--	--	--	--
Perforated *Argopecten* valve	1	--	--	1	--	--	--
Abraded *Haliotis* fragments	2	1	--	--	--	1	--
Total	**24**	**10**	**7**	**1**	--	**5**	**1**
Unworked Marine Shell Fragments							
Haliotis sp.	21	4	9	1	--	7	--
Laevicardium elatum (Sow.)	2	1	--	--	1	--	--
?*Pododesmus cepio* (Gray)	1	--	--	--	1	--	--
Unclassified	4	1	1	--	2	--	--
Total	**28**	**6**	**10**	**1**	**4**	**7**	--

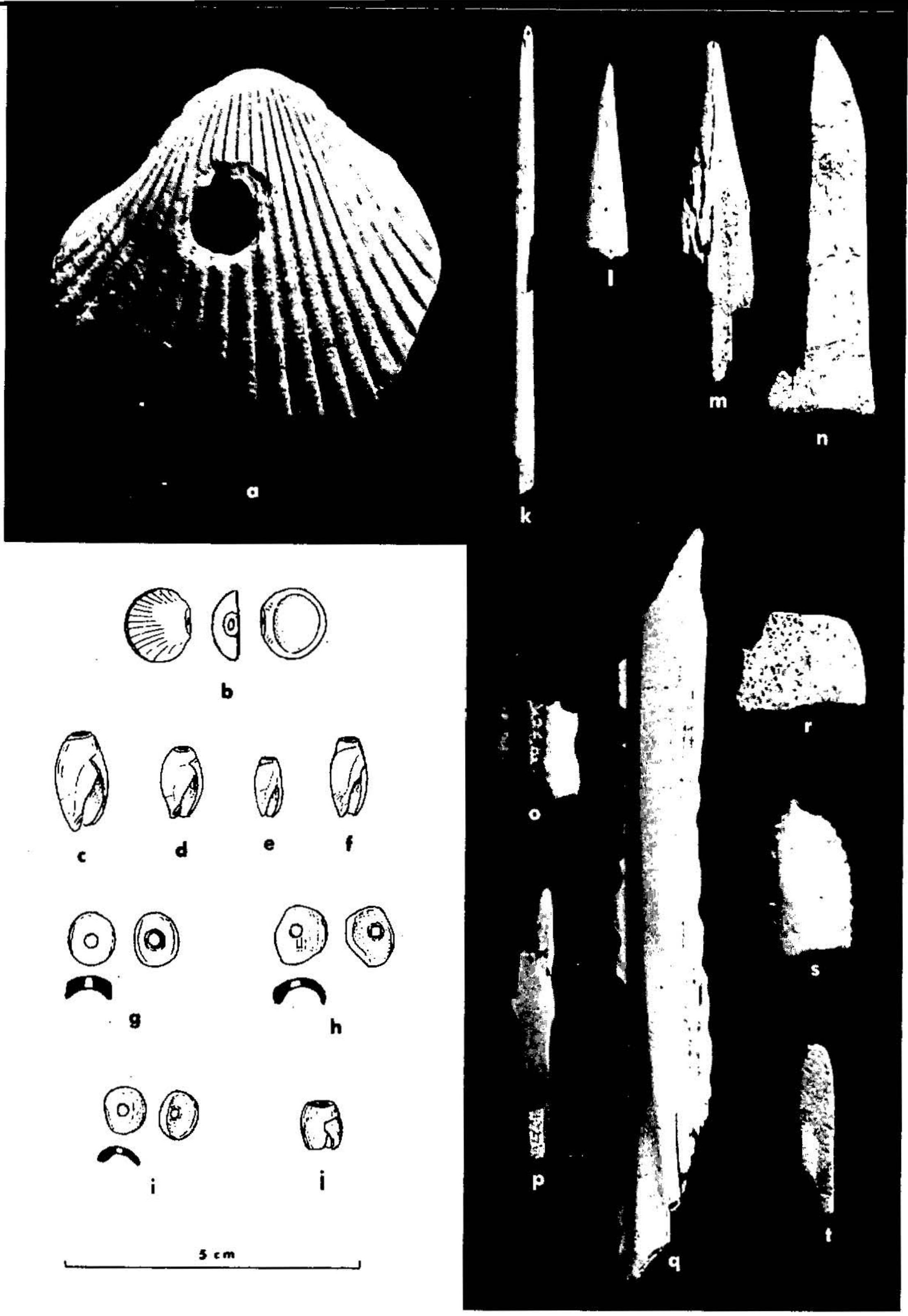


Plate 20. Artifacts of bone and shell. (All artifacts drawn to same scale.) Plate 20a: 16-234, perforated *Argopecten* valve; b: 17-331, *Glycymeris* sp. pendant; c: 19-468-1, *Olivella biplicata*, spire removed bead; d: 17-111, *Olivella biplicata*, spire removed bead; e: 20-119, *Olivella dama*, spire removed bead; f: 21-461, *Olivella dama*, spire removed bead; g: 20-311, *Olivella biplicata*, thin-lipped oval bead; h: 20-360, *Olivella biplicata*, full-lipped bead; i: 21-510, badly weathered *Olivella biplicata*, full-lipped (?) bead; j: 20-179, *Olivella dama*, barrel-shaped bead; k: 21-379, awl or needle; l: 21-594, awl tip; m: 20-301, awl tip; n: 20-160, awl; o: 20-138, notched tool fragment (Note notch worn in right edge.); p: 21-527, notched tool fragment (Note wear on right edge.); q: 17-341, complete notched tool (Note worn notches on right edge and notches prepared by flaking on left edge.); r: 17-301, strigil fragment (?); s: 21-300, saw fragment; t: 17-377, flaker tip. (Photographed items coated with ammonium chloride powder.)

These specimens are all fragmentary, and most of them appear to have been made from split mammal bones, perhaps in the manner described by Bennyhoff (1953). They all display longitudinal scratches and striations that are apparently a result of their original manufacture by abrasion on stone. They also display a polish that is apparently a result of use. The original form of most specimens cannot be determined. Several distal end fragments are present in the sample, one of which is burned, suggesting an attempt to harden it in fire. The distal fragments have lateral edges that taper at varying angles. The specimens illustrated in Plate 20k-n show the range of formal variation in the sample.

Specimen 20-160 (Plate 20n) is the only awl sufficiently complete to warrant description. The fragment is now 64 mm long, 11 mm wide, and 7 mm thick at midpoint. It is made from an ungulate metapodial bone, an articulating end of which forms the handle of the tool. A point was formed on the awl by grinding off one lateral edge at an angle of about 30°. The distal end is polished and smoothed from use.

Strigil Fragment (?) (Plate 20r)

A specimen of worked bone from the Peppertree site (4-Riv-463) is tentatively classified as a strigil (sweat scraper) fragment. It measures 22 x 18 x 2.5 mm and shows deep striations through a smooth polish on both faces and on three edges.

Flakers (Plate 20t)

Number of specimens: 3
Distribution: 4-Riv-331 (1); 4-Riv-463 (2)

Three examples are classified as flaking tools. They are distal fragments of objects that have been intentionally blunted by cutting and/or abrasion and that show many minute scratches, cuts, and indentations that probably result from use in pressure flintknapping.

Bone tubes

Number of specimens: 2
Distribution: 4-Riv-464 (2)

Bone tubes or large bone beads are represented by two fragmentary specimens. Both appear to be made from hollow long bones of rodent or rabbit-sized animals. They are highly polished. Original dimensions cannot be determined.

Notched Tools (Plate 20 o-q)

Number of specimens: 6
Distribution: 4-Riv-464 (3); 4-Riv-463 (2); 4-Riv-331 (1)

This category includes fragments of bone that display pronounced abrasion on their lateral edges. The wear pattern generally is one of shallow notches perpendicular to the long axis of the object. The depth of the notches is presumably in part a function of the amount of use to which the tool was subjected and varies from almost imperceptible to 1.3 mm. It is suggested that these items were used as thong stretchers, bark strippers, or fiber shredders or in some similar process that brought them into perpendicular contact with the material being modified.

There are two patterns of wear represented that may have functional implications: the first pattern is one of transverse striations visible to the naked eye and is present on four of the five examples; the second displays no such striations. Whether or not the striations are present, all these shallow notches are very highly polished. It does not appear on close examination that the polish is a result of fusion onto the surface of opal molecules, as is the case with sickle gloss described by Witthoft (1967).

One apparently complete specimen (Plate 20q) displays one lateral edge that is heavily polished from use (the right edge in the illustration), and another that has been unifacially percussion flaked, probably in preparation for use (the left edge in the illustration). It seems reasonable to suggest that these items may have functioned in the preparation of plant materials for basket making or repair.

Saw Fragment (Plate 20s)

This category is represented by a single specimen from the Charles Mott site (4-Riv-464). It measures 26.5 x 14 x 3.5 mm and is made from a large split cannon bone. It has been unifacially pressure flaked to form a delicate serrated edge. While the object could have served as an effective saw, it does not show use-wear.

Unclassified Worked Bone

Number of specimens: 40
Distribution: 4-Riv-331 (9); 4-Riv-464 (20); 4-Riv-202 (7); 4-Riv-452 (1); 4-Riv-463 (3)

The 40 items in question here are generally small fragments of bone that show cut marks, striations, polish, or other evidence of modification. Many of them were found during analysis of the faunal remains. While it is conceivable that some fraction of them may represent awl fragments, which were the most common bone implements recognized in the collection, they are simply presented here as modified fragments of uncertain function.

Worked Shell

Artifacts of shell include nineteen *Olivella* spp. beads and fragments thereof, one *Glycymeris* sp. pendant, one *Haliotis* sp. pendant, and one perforated *Argopecten* sp. valve. There are also 28 specimens of shell that do not show modification by man but that are of marine origin. The shell artifacts were examined by Chester King of San Jose, who also read and commented on this manuscript. Jack Mount of the Department of Geology, University of California at Riverside, compared the worked shell with type specimens in conchological collections in that department for species determination. The distribution of the shell specimens among the excavated sites is indicated in Table 20.

Perforated *Argopecten* Valve (Plate 20a)

A single perforated right valve of *Argopecten circularis aquisulcatus* (Carpenter) was found at the Dead Dog site. This is a northern Pacific coast subspecies of *Argopecten (Aequipecten) circularis* that occurs in the Gulf of California and on the Pacific coast of Baja. The valve has a height of 65 mm, and the perforation was punched from the interior surface. The wings have been removed, and small portions of the peripheral edge have been ground off.

The function of this artifact is uncertain. The size of the perforation (13 mm in maximum dimension) would argue against its being a pendant. Similarly modified valves were found at the Hohokam site of Snaketown (Gladwin *et al*, 1938) and at site 4-Ora-190 near Newport Bay (Ross 1970). An almost identical specimen (catalog number 4-447) is preserved in the collections of the Archaeological Research Unit, Unviersity of California, Riverside. The latter specimen is part of a donated collection, and, other than that its origin is southern California, data are lacking. It has asphaltum around the central perforation and on the entire peripheral edge. Minute particles of what appears to be asphaltum adhere to the interior surface of the specimen from Dead Dog. If the size of the perforation and the presence of asphaltum are indicative of former function, paired valves may have been cemented together on a shaft to form a rattle.

***Haliotis* sp. Pendant**

Several thin laminations with a 1 mm perforation are identified as fragments of a *Haliotis* sp. shell pendant. These fragments were found together at the Charles Mott site. They are irregular in form, and the original form of the pendant cannot be determined.

***Glycymeris* sp. Pendant** (Plate 20b)

One small pendant of *Glycymeris* cf. *subobsoleta* was found at the Peppertree site. It has a height of 11 mm and a length of 12 mm. A perforation about 1 mm in diameter was formed by grinding off part of the umbo. The immature and slightly eroded condition of the specimen precludes positive species identification.

***Olivella* spp. Beads** (Plate 20c-j)

Nineteen *Olivella* beads and bead fragments were found. These were of two species — *Olivella biplicata* from the Pacific coast and *Olivella dama* from the Gulf of California. The following types are represented in the collections:

Olivella biplicata, spire removed (Plate 20c, d)

Number of specimens: 4 (including 2 fragmentary)
Distribution: 4-Riv-463 (1); 4-Riv-331 (2); Survey (1)
Dimensions (complete specimens): 16.6 x 9.5 mm; 11.6 x 7.2 mm

Beads of *Olivella* shells that are essentially complete except for the removal of part or all of the spire by breaking or grinding are common in archeological contexts across much of California over the past 7,000 years. One of the specimens (20-135) is split lengthwise and only one-half complete. Present length is 15.1 mm. The portion of the shell containing the callus is missing, and species is inferred on the basis of robusticity. It shows removal of a small portion of the spire by abrasion and extensive grinding of the base. The remainder of the specimens do not have modified bases.

Olivella dama, spire removed (Plate 20e, f)

Number of specimens: 7 (including 2 fragmentary)
Distribution: 4-Riv-463 (2); 4-Riv-331 (1); 4-Riv-464 (4)
Dimensions (complete specimens): 11.2 x 5.8 mm; 13.2 x 6.6 mm; 10.1 x 5.3 mm; 12.8 x 6.5 mm; 12.3 x 6.3 mm

These are similar in form and manufacture to the *Olivella biplicata*, spire removed, beads but are less robust. They are also distinguished from the latter species by the longer callus, which extends past the aperture to the suture marking the appearance of the next whorl (Silsbee, 1958). (See also Plate 20c, f.) This bead type does not necessarily have the same chronological depth as the *Olivella biplicata*, spire removed, type. Presumably the temporal dimension of the type could be worked out because of its widespread occurrence in dated contexts in the Southwest.

Two of the beads show additional modification: Specimen 17-288 has a U-shaped notch cut about 2 mm deep to the next suture in the remaining portion of the spire. The notch is polished and may have facilitated the method of stringing. Specimen 21-500 has a polished V-shaped notch cut 3.8 mm into the wall at the end of the aperture, opposite the callus. This notch may also have facilitated stringing.

Olivella dama, barrel (Plate 20j)

Number of specimens: 2
Distribution: 4-Riv-331 (2)
Dimensions: 8.6 x 6.3 mm; 10.0 x 6.9 mm

The spires and bases of these specimens have been removed from the shells by abrasion to form the barrel-shaped beads.

Olivella biplicata, lipped discs (Plate 20g-i)

Number of specimens: 6 (including 1 fragmentary)
Distribution: 4-Riv-331 (3); 4-Riv-464 (3)

These beads can be graded into several variants but actually constitute a series. They are all made from a portion of the wall of the shell which contains the callus. The holes are conical and were drilled from the interior surface. The following variants and dimensions are represented:

Form	Bead diameter	Hole diameter
Thin lipped, round	7.5 mm	2.1 mm
Thin lipped, oval	8.5 mm (max.)	2.3 mm
Full lipped	9.7 mm	2.0 mm
Lipped fragment	9.0 mm	?
Full lipped? (weathered)	8.6 mm (max.)	1.6 mm
Full lipped? (weathered)	8.2 mm	2.0 mm

Since these variants (thin lipped, round; thin lipped, oval; full lipped) form a graded series, and given the size of the sample from Perris Reservoir, it is perhaps unwise to regard these beads as representatives of hard and fast types. They date from AD 1500 to 1800 (Chester King, personal communication, 1972). Most of them are quite heavily weathered.

Worked *Haliotis* sp. Fragments

Number of specimens: 2
Distribution: 4-Riv-463 (1); 4-Riv-331 (1)

Two fragments of *Haliotis* sp. shell each have a straight abraded edge. Original form of the objects cannot be determined.

Unworked Marine Shell Fragments

Twenty-eight fragments of marine shell show no evidence of modification. Of the identifiable specimens, 21 are of *Haliotis* spp., 2 are *Laevicardium elatum* (Sowerby), and 1 is probably *Pododesmus cepio* (Gray). Four specimens are unidentifiable as to genus. The distribution of the various taxa is indicated in Table 20.

Discussion

Of particular interest from the standpoint of possible external connections is the occurrence at Perris Reservoir of marine shell from the Gulf of California. In addition to the nine beads of *Olivella dama*, the small pendant of *Glycymeris* cf. *subobsoleta* was also derived from the gulf. Certain of the unmodified marine shell fragments may have also come from the gulf, but since they also occur on the outer coast of Baja and/or the coast of California, their origin in either area cannot be established.

FAUNAL REMAINS

by
Stephen Hammond

The analysis of faunal remains recovered during excavation of the Perris Reservoir sites was undertaken in an attempt to establish local aboriginal subsistence patterns and to assess any inter-site and intra-site variability in those patterns. The floral and faunal environment of the Perris Reservoir has already been dealt with at some length by Bettinger ("Environment and Ethnography," in this publication) and will be considered here only to the extent that it is pertinent.

The Sample

The total sample of faunal remains recovered consisted of 21,740 bones or bone fragments. Of these, 5,376 were identified in terms of skeletal parts and taxonomic groups. The rest of the remains were unidentifiable, having no articular surfaces or other diagnostic features. The distribution of the faunal remains is summarized by site in Table 21.

The 5,376 identified skeletal elements represent a minimum of 1,027 individual animals. Jackrabbits and cottontails are the species most commonly represented, constituting about 73 percent of the total number of individuals. Small rodents, especially pocket gopher, woodrat, and ground squirrel, dominate the balance of the collection, and a variety of waterfowl, carnivores, ungulates, and reptiles are also represented. Most of the animals were probably killed and eaten by the late prehistoric aboriginal inhabitants of the Perris Reservoir sites. Some animals in the sample may owe their presence to noncultural factors. For example, it seems likely that some percentage of the burrowing rodents were residents of the archeological sites and died of natural causes rather than having been killed and brought to the sites by humans. However, it is unlikely that they represent more than a small portion of the total sample.

Procedure

All mammal and reptile bones were identified by comparison with skeletal material in collections at the University of California, Riverside, and at the Los Angeles County Museum of Natural History. Publications by Hall and Kelson (1959) and Olsen (1971) were also consulted. The identification of all bird bones was done by Mrs. Charmion R. McKusick, who used the comparative avifauna collections of the Arizona Archeological Center at the University of Arizona, Tucson.

After the bones were identified, an estimate was made of the minimum number of individuals per species at each site. The method used was that proposed by White (1953: 397). This involves listing the identified skeletal elements within a particular stratigraphic or depositional unit by lefts and rights (e.g., left mandible-right mandible, left humerus-right humerus) and then using the most numerous element as the unit of calculation for each species. For example, if right mandibles from cottontail rabbits are most numerous, then the number of right mandibles is also the minimum number of individuals of that species. This pro-

TABLE 21
DISTRIBUTION OF THE FAUNAL SAMPLE BY SITE

Site	Minimum number of identified animals	Number of identified skeletal elements	Number of unidentifiable bone fragments
Oleander Tank (4-Riv-331)	325	1,620	4,972
Charles Mott (4-Riv-464)	320	1,878	4,800
Dead Dog (4-Riv-202)	85	355	1,858
Pictograph (4-Riv-452)	48	106	673
Peppertree (4-Riv-463)	249	1,417	4,061
Total	1,027	5,376	16,364

cedure may introduce a slight error on the conservative side because we cannot be certain that all rights match all lefts or vice versa, a situation that is unavoidable.

Another factor that potentially contributes to the conservatism of certain estimates of minimum numbers is the loss of smaller bones and bone fragments through the one-quarter-inch mesh screens used in the excavations. This loss factor results in a significant under-representation of smaller mammals.

The magnitude of this loss has been assessed by Thomas (1969), who has shown that 75 to 100 percent of the bones of animals the size of meadow mice and pocket gophers are not retained by screens of this size. Similarly, the loss factor for animals the size of ground squirrels ranges from 39 to 100 percent, while that for cottontail and jackrabbit varies from 38 to 88 percent. Loss figures for larger animals are not significant.

We are convinced that these figures point to an underestimate on our part of the minimum numbers of individuals represented by animals of ground squirrel size or smaller. Our estimates for these animals might be more accurate if they were doubled. However, we are uncertain that this problem also applies in the case of cottontails and jackrabbits. Although Thomas' loss figures pertain to all skeletal elements without distinction, we suspect that these ratios may vary significantly for different elements, depending on their size. For the larger elements on which our estimates of minimum numbers are based (e.g., mandibles, scapulae, humeri), the loss may be negligible. In the absence of empirical data, we will assume that no significant loss of critical skeletal elements has occurred and that our estimates for animals of this size and larger are essentially correct.

Data

This section treats the distribution of faunal remains at each of the five excavated sites. Implications of the data in terms of dietary change over time, seasonality, butchering patterns, and variation in site function will be dealt with in a later section.

The Oleander Tank Site (4-Riv-331). The Oleander Tank site and the investigations conducted there have been described by O'Brien in this publication. The site is situated at the southwest end of the north arm of the Mount Russell-Bernasconi

TABLE 22
IDENTIFIED FAUNA RECOVERED FROM THE OLEANDER TANK SITE (4-Riv-331)*

	Depth in cm									
Species	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**	**100-120**	**120-140**	**140-160**	**160-180**	**Total**
Snake	--	1	2	2	1	3	--	1	--	10
Hawk	--	1	--	1	--	--	--	--	--	2
Quail	--	1	1	--	--	--	--	--	--	2
Raven	--	--	--	--	--	1	--	--	--	1
Cottontail	14	18	22	20	15	9	5	4	2	109
Jackrabbit	11	18	29	21	16	12	5	6	1	119
Ground squirrel	--	2	2	2	2	2	3	--	1	14
Gopher	2	3	1	4	3	3	1	1	--	18
Kangaroo rat	--	1	1	2	1	1	--	1	--	7
Wood rat	2	2	5	2	3	1	2	--	1	18
Coyote	--	1	1	1	2	--	--	--	--	5
Badger	2	2	3	--	--	--	--	--	1	8
Bobcat	--	--	--	--	1	--	--	--	--	1
Mule deer	1	--	2	1	2	1	1	--	1	9
Mountain sheep	--	--	--	1	--	--	--	1	--	2
Total	**32**	**50**	**69**	**57**	**46**	**33**	**17**	**14**	**7**	**325**

* Minimum numbers of individuals derived from identified fragments.

Hills complex. It is backed by steep slopes, heavily dotted with granite boulders and outcrops, and faces out over a broad valley floor. Vegetation characteristic of the coastal sage scrub community is the dominant ground cover on the site. However, both the valley grassland and chaparral communities are found within a 2-km radius of the site so that their resources would also have been readily available to resident populations. In contrast, the marsh and alkali flat communities to the east are no less than 5 km away, a distance that no doubt restricted their availability.

Information on faunal remains recovered from the Oleander Tank site is presented in Table 22. Jackrabbits and cottontails are the most common species, representing 70 percent of the total number of individuals. Rodents are next in importance, followed by lesser numbers of carnivores, artiodactyls, birds, and reptiles. There is no evidence of significant change in the relative importance of these species through the span of time represented by the deposit.

The faunal assemblage recovered at the Oleander Tank site is available year-round, so that given the evidence of the fauna alone, the season of occupation cannot be specified. The absence of waterfowl may indicate that the site was unoccupied when such species were available. More likely, it may reflect that the aquatic communities and their resources were not exploited because of the distance of such communities from the site.

The Charles Mott site (4-Riv-464). In an article in this publication, Robarchek discusses the work at the Charles Mott site. The site is situated near several springs on the south slope of Mount Russell (Plate 12). The hill slopes around the site are very steep and dry and are covered with granitic boulders and bedrock outcrops. Coastal sage scrub is the dominant vegetational cover of the site, but all the biotic communities recognized in the Perris Reservoir area lie within a 2-km radius.

The site is divided into five loci (Plate 13), four of which were excavated. These vary in age. Loci 2 and 3 contain deposits that pertain to both the early and late periods of occupation at Perris Reservoir. (See Bettinger, "Dating the Perris Reservoir," in this publication.) Material from Loci 1 and 4 falls entirely within the late period.

Faunal remains from the Charles Mott site are presented in Tables 23, 24, and 25. Considering the site as a unit (Table 23), lagomorphs are the most common taxon, accounting for about 75 percent of the total minimum number of individual animals. Jackrabbits outnumber cottontails by a ratio of 3 to 2. Also present are 29 rodents, 20 carni-

TABLE 23
IDENTIFIED FAUNA RECOVERED FROM THE CHARLES MOTT SITE (4-Riv-464)*

Species	Loci 1	2	3	4	Total
Pond turtle	–	1	--	--	1
Snake	2	--	--	1	3
Eared grebe	1	--	--	--	1
Pied-billed grebe	1	–	--	--	1
Great blue heron	1	–	--	--	1
Unidentified duck	1	1	--	1	3
Pintail	--	--	--	--	1†
Quail	3	1	--	--	4
Coot	--	1	1	--	2
Poor-will	--	1	--	--	1
Cottontail	45	37	12	3	97
Jackrabbit	63	52	19	8	142
Ground squirrel	4	2	--	--	6
Gopher	3	7	--	2	12
Kangaroo rat	2	3	--	--	5
Deer mouse	1	–	--	--	1
Wood rat	2	1	2	--	5
Coyote	4	2	1	1	8
Raccoon	--	1	--	--	1
Weasel	--	1	--	--	1
Badger	4	--	2	1	7
Skunk	--	1	--	--	1
Bobcat	--	1	--	1	2
Mule deer	6	4	1	1	12
Mountain sheep	1	--	--	--	1
Domestic pig	--	1	--	--	1
Total	**144**	**118**	**38**	**19**	**320**

* Minimum numbers of individuals derived from identified fragments. A dagger (†) indicates that provenience data is lacking.

TABLE 24
IDENTIFIED FAUNA RECOVERED FROM LOCUS 1 OF THE CHARLES MOTT SITE (4-Riv-464)*

Species	Depth in cm 0-20	20-40	40-60	Total
Snake	1	--	1	2
Eared grebe	1	--	–	1
Pied-billed grebe	1	--	--	1
Great blue heron	1	--	--	1
Unknown duck	1	--	--	1
Quail	3	--	--	3
Cottontail	24	16	5	45
Jackrabbit	29	29	5	63
Ground squirrel	--	4	--	4
Gopher	--	3	--	3
Kangaroo rat	1	1	–	2
Deer mouse	1	--	--	1
Wood rat	1	1	--	2
Coyote	2	2	–	4
Badger	3	1	--	4
Mule deer	3	2	1	6
Mountain sheep	1	--	–	1
Total	**73**	**59**	**12**	**144**

* Minimum numbers of individuals derived from identified fragments.

TABLE 25
IDENTIFIED FAUNA RECOVERED FROM LOCI 2 AND 3, CHARLES MOTT SITE (4-Riv-464)*

	Depth in cm										
Species	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	Total
Pond turtle	--	1	--	--	--	--	--	--	--	--	1
Unidentified duck	--	--	--	--	1	--	--	--	--	--	1
Quail	--	--	1	--	--	--	--	--	--	--	1
Coot	--	1	--	1	--	--	--	--	--	--	2
Poor-will	--	--	--	1	--	--	--	--	--	--	1
Cottontail	8	10	6	7	6	3	2	2	2	3	49
Jackrabbit	16	13	10	9	7	6	4	1	1	4	71
Ground squirrel	--	1	--	--	1	--	--	--	--	--	2
Gopher	1	--	--	2	1	1	--	1	--	1	7
Kangaroo rat	--	--	--	1	--	1	1	--	--	--	3
Wood rat	--	2	--	1	--	--	--	--	--	--	3
Coyote	--	2	--	1	--	--	--	--	--	--	3
Raccoon	--	--	1	--	--	--	--	--	--	--	1
Weasel	1	--	--	--	--	--	--	--	--	--	1
Badger	1	--	--	1	--	--	--	--	--	--	2
Skunk	--	--	--	--	--	1	--	--	--	--	1
Bobcat	--	--	--	--	1	--	--	--	--	--	1
Mule deer	1	1	--	--	2	1	--	--	--	--	5
Domestic pig	--	--	--	--	1	--	--	--	--	--	1
Total	**28**	**31**	**18**	**24**	**20**	**13**	**7**	**4**	**3**	**8**	**156**

* Minimum numbers of individuals derived from identified fragments.

vores, 14 birds (including 9 waterfowl), 14 ungulates (including 1 domestic pig), and 4 reptiles (3 snakes and 1 turtle). Seasonally sensitive fauna include one immature duck tentatively identified as a bufflehead, and two immature dabbling ducks (McKusick, personal communication). These suggest late summer or early fall occupation. The largest numbers of individuals are from Loci 1 and 2, the areas of the site most intensively excavated. In general, the relative proportion of various taxa does not vary significantly among the four loci.

The presence of an immature domestic pig (represented by one deciduous molar) is rather curious. There are two possible explanations that can account for its presence at the site. First, the animal might have been obtained by the aboriginal inhabitants of the site from Europeans, either directly or via other aboriginal groups. This seems unlikely in view of the absence of other early European goods in the assemblage. Alternatively, the animal may have been brought to the site in recent years. If after it was killed the bones were deposited on the surface, rodent activity could account for their presence in the midden.

As indicated above, the deposits at the Charles Mott site span an appreciable length of time, thus facilitating an assessment of change in the composition of the faunal assemblage over time. The fauna from Locus 1 (late period, Table 24) do not change significantly over time in terms of the relative importance of various species. The only possible exception involves the appearance of several species of waterfowl, represented by at least four individuals, in the top 20 cm of the deposit. However, the implications of this late appearance are unclear in view of the sample size.

Loci 2 and 3 (Table 25) contain deposits pertaining to both the early and late periods of occupation. The sample from early period deposits (below 120 cm) consists almost exclusively of lagomorphs, both cottontail and jackrabbit. Late period deposits contain a much wider variety of species, notably mule deer and waterfowl. As in the case of Locus 1, the significance of this variation is unclear, although we suspect it is partly a function of sampling error.

The Dead Dog site (4-Riv-202). Investigations at this site are described by Bettinger in this publi-

TABLE 26
IDENTIFIED FAUNA RECOVERED FROM THE DEAD DOG SITE
(4-Riv-202)*

Species	Locus A (Depth in cm) 0-20	20-40	40-60	60-80	Total	Locus B (Depth in cm) 0-20	20-40	40-60	60-80	80-100	100-120	120-140	Total	Combined Total
Eared grebe	--	--	--	--	--	--	1	--	--	--	--	--	1	1
Pied-billed grebe	--	--	--	--	--	1	--	--	--	--	--	--	1	1
Cottontail	–	3	2	2	7	2	4	8	4	1	1	--	20	27
Jackrabbit	2	3	3	3	11	2	6	8	5	2	1	1	25	36
Ground squirrel	–	--	1	--	1	--	1	--	--	--	--	--	1	2
Gopher	–	2	--	--	2	--	--	--	--	1	--	--	1	3
Kangaroo rat	–	1	--	1	2	--	--	2	1	--	--	--	3	5
Wood rat	--	–	1	--	1	--	--	--	--	--	--	--	–	1
Domestic dog	1	--	--	--	1	--	–	--	--	--	--	--	--	1
Coyote	--	--	--	--	--	--	--	--	1	--	--	--	1	1
Badger	1	--	--	--	1	--	--	--	1	--	--	--	1	2
Mule deer	--	2	--	--	2	1	--	--	1	--	--	--	2	4
Mountain sheep	--	--	--	--	--	--	--	1	--	--	--	--	1	1
Total	**4**	**11**	**7**	**6**	**28**	**6**	**12**	**19**	**13**	**4**	**2**	**1**	**57**	**85**

* Minimum numbers of individuals derived from identified fragments.

cation. The site is located at the mouth of a small stream canyon less than 1 km east of the Charles Mott site. Like the latter, it has access to all the biotic communities recognized in the study area, although it is closer than any other site to the former marshes.

The Dead Dog site was not extensively excavated, and the faunal sample recovered is relatively small. In general, however, it is similar in composition to assemblages recovered at the other excavated sites. Table 26 is a summary of the sample from the Dead Dog site.

Lagomorphs are the most abundant animals in the sample, accounting for 74 percent of the total number of individuals. Jackrabbits outnumber cottontails four to three. Rodents are the next most important group, followed by artiodactyls, carnivores, and waterfowl. The relative importance of these taxonomic groups does not vary significantly, either spatially or stratigraphically. The fauna are not seasonally sensitive.

The Pictograph site (4-Riv-452). In an article in this publication, Hammond describes the results of work at this site. It is situated at the base of the northwest slope of the Bernasconi Hills about 2 km south of the Charles Mott site (Figure 5). Coastal sage scrub covers the site and the lower slopes of the hills immediately behind it. Chaparral dominates the higher, steeper slopes. The site faces out across a former valley grassland community. The aquatic communities and the alkali flats are on the opposite side of the Bernasconi Hills.

As at the Dead Dog site, the faunal assemblage from the Pictograph site is quite small, representing only 48 individual animals. Nevertheless, it is much like the assemblages at the other excavated sites (Table 27). Lagomorphs are most abundant, accounting for 71 percent of the individuals in the assemblage. Cottontails and jackrabbits are equal in number, with 17 individuals of each represented. Other animals present include rodents, carnivores, artiodactyls, and reptiles. All of the species in the sample from the Pictograph site occur in the immediate vicinity year-round so that no inferences of the season of occupation can be drawn solely on the basis of the faunal remains.

TABLE 27
IDENTIFIED FAUNA RECOVERED FROM THE PICTOGRAPH SITE (4-Riv-452)*

Species	0-20	20-40	40-60	60-80	80-100	100-120	Total
Snake	--	--	1	--	--	--	1
Cottontail	3	4	4	4	1	1	17
Jackrabbit	1	8	4	2	1	1	17
Gopher	--	3	--	1	--	--	4
Kangaroo rat	1	1	--	1	1	--	4
Wood rat	--	--	1	--	--	--	1
Meadow mouse	1	--	--	--	--	--	1
Coyote	--	--	--	1	--	--	1
Bobcat	--	--	1	--	--	--	1
Mountain sheep	--	1	--	--	--	--	1
Total	**6**	**17**	**11**	**9**	**3**	**2**	**48**

* Minimum numbers of individuals derived from identified fragments.

TABLE 28
IDENTIFIED FAUNA RECOVERED FROM AREAS 1 AND 3, PEPPERTREE SITE (4-Riv-463)*

	Depth in cm							
Species	0-10	10-20	20-30	30-40	40-50	50-60	60-70	Total
Cottontail	2	2	2	1	1	--	--	8
Jackrabbit	5	2	1	3	1	3	--	15
Ground squirrel	--	--	--	1	--	--	--	1
Gopher	1	--	1	--	--	--	--	2
Kangaroo rat	--	--	1	--	--	--	--	1
Wood rat	1	1	--	--	1	--	--	3
Coyote	--	1	--	--	--	--	--	1
Badger	--	--	--	--	--	--	1	1
Mule deer	--	--	1	--	--	--	--	1
Mountain sheep	1	--	--	--	--	--	--	1
Total	10	6	6	5	3	3	1	34

* Minimum numbers of individuals derived from identified fragments. In Area 3 depth is below discarded sterile overburden.

The Peppertree site (4-Riv-463). This site is described by Wilke in this publication. It is also located at the base of the northwest slope of the Bernasconi Hills about 1 km southwest of the Pictograph site (Figure 5). Biotic communities in the immediate vicinity are the same as those around the Pictograph site. However, the residents of the Peppertree site also had easy access to aquatic communities along the San Jacinto River some 2 km to the southeast by way of Bernasconi Pass.

Excavations were conducted in three areas, referred to as Areas 1, 2, and 3. Areas 1 and 3 yielded relatively few faunal remains and the deposits of Area 1 were badly disturbed. Information on fauna from these areas is presented in Table 28. Area 2 represents the longest stratigraphic sequence known to date from the Perris Reservoir, spanning both the early and late periods of occupation. Level *e* is the lowest level assigned to the late period at the Peppertree site (Table 29).

TABLE 29
IDENTIFIED FAUNA RECOVERED FROM AREA 2, PEPPERTREE SITE (4-Riv-463)*

	Arbitrary level											
Species	a	b	c	d	e	f	g	h	i	j	k	Total
Snake	1	1	--	--	1	--	--	--	--	--	--	3
Unknown duck	--	--	1	--	--	--	--	--	--	--	--	1
Ring-necked duck	--	--	--	1	--	--	--	--	--	--	--	1
Bufflehead	--	--	1	1	--	--	--	--	--	--	--	2
Quail	--	--	--	--	--	--	1	--	--	--	--	1
Sandhill crane	--	--	--	--	1	--	--	--	--	--	--	1
Cottontail	13	9	9	12	6	5	3	1	3	2	1	64
Jackrabbit	16	15	17	17	11	5	4	4	3	3	1	96
Ground squirrel	1	--	2	--	1	1	--	--	--	2	--	7
Gopher	--	1	1	2	--	--	--	--	1	--	--	5
Kangaroo rat	--	--	--	1	--	--	--	--	--	--	--	1
Wood rat	3	2	1	2	1	--	--	--	--	--	--	9
Coyote	--	1	--	1	--	1	--	--	1	--	--	4
Badger	1	1	--	1	--	--	1	--	1	--	--	5
Bobcat	1	--	--	1	--	1	--	--	--	--	--	3
Mule deer	1	--	--	1	--	--	1	--	--	1	--	4
Pronghorn antelope	--	--	1	--	--	--	--	--	--	--	--	1
Mountain sheep	--	1	2	--	1	--	2	--	1	--	--	7
Total	37	31	35	40	22	13	12	5	10	8	2	215

* Minimum numbers of individuals derived from identified fragments.

TABLE 30
TOTAL IDENTIFIED FAUNA RECOVERED FROM ALL EXCAVATED SITES*

Species	Oleander Tank (4-Riv-331) Number	Oleander Tank (4-Riv-331) Percent in assemblage	Charles Mott (4-Riv-464) Number	Charles Mott (4-Riv-464) Percent in assemblage	Dead Dog (4-Riv-202) Number	Dead Dog (4-Riv-202) Percent in assemblage	Pictograph (4-Riv-452) Number	Pictograph (4-Riv-452) Percent in assemblage	Peppertree (4-Riv-463) Number	Peppertree (4-Riv-463) Percent in assemblage	Perris Reservoir assemblage Number	Perris Reservoir assemblage Percent in assemblage
Western pond turtle (*Clemmys marmorata*)	--	--	1	.312	--	--	--	--	--	--	1	.097
Unidentified snake (*Serpentes*)	10	3.076	3	.937	--	--	1	2.083	3	1.204	17	1.655
Eared grebe (*Podiceps caspicus*)	--	--	1	.312	1	1.176	--	--	--	--	2	.194
Pied-billed grebe (*Podilymbus podiceps*)	--	--	1	.312	1	1.176	--	--	--	--	2	.194
Great blue heron (*Ardea herodias*)	--	--	1	.312	--	--	--	--	--	--	1	.097
Unidentified duck (*Anatidae* sp.)	--	--	3	.937	--	--	--	--	1	.401	4	.389
Pintail (*Anas acuta*)	--	--	1	.312	--	--	--	--	--	--	1	.097
Ring-necked duck (*Aythya collaris*)	--	--	--	--	--	--	--	--	1	.401	1	.097
Bufflehead (*Bucephala albeola*)	--	--	--	--	--	--	--	--	2	.803	2	.194
Unidentified hawk or kite (*Accipitridae* sp.)	1	.307	--	--	--	--	--	--	--	--	1	.097
Red-tailed hawk (*Buteo* cf. *jamaicensis*)	1	.307	--	--	--	--	--	--	--	--	1	.097
California quail (*Lophortyx californica*)	2	.615	4	1.250	--	--	--	--	1	.401	7	.681
Lesser sandhill crane (*Grus c. canadensis*)	--	--	--	--	--	--	--	--	1	.401	1	.097
American coot (*Fulica americana*)	--	--	2	.625	--	--	--	--	--	--	2	.194
Poor-will (*Phalaenoptilus nuttallii*)	--	--	1	.312	--	--	--	--	--	--	1	.097
Common raven (*Corvus corax*)	1	.307	--	--	--	--	--	--	--	--	1	.097
Cottontail rabbit (*Sylvilagus* spp.)	109	33.538	97	30.312	27	31.764	17	35.416	72	28.915	322	31.353
Black-tailed jackrabbit (*Lepus californicus*)	119	36.615	142	44.375	36	42.352	17	35.416	111	44.578	425	41.382
California ground squirrel (*Citellus beecheyi*)	14	4.307	6	1.875	2	2.352	--	--	8	3.212	30	2.921
Southern pocket gopher (*Thomomys bottae*)	18	5.538	12	3.750	3	3.529	4	8.333	7	2.811	44	4.284
Kangaroo rat (*Dipodomys* spp.)	7	2.153	5	1.562	5	5.882	4	8.333	2	.803	23	2.239
White-footed mouse (*Peromyscus* sp.)	--	--	1	.312	--	--	--	--	--	--	1	.097
Dusky-footed wood rat (*Neotoma fuscipes*)	18	5.538	5	1.562	1	1.176	1	2.083	12	4.819	37	3.602
California meadow mouse (*Microtus californicus*)	--	--	--	--	--	--	1	2.083	--	--	1	.097
Coyote (*Canis* cf. *latrans*)	5	1.538	8	2.500	1	1.176	1	2.083	1	.401	16	1.557
Domestic dog (*Canis familiaris*)	--	--	--	--	1	1.176	--	--	--	--	1	.097
Raccoon (*Procyon lotor*)	--	--	1	1.176	--	--	--	--	--	--	1	.097
Long-tailed weasel (*Mustela frenata*)	--	--	1	.312	--	--	--	--	--	--	1	.097
Badger (*Taxidea taxus*)	8	2.461	7	2.187	2	2.352	--	--	6	2.409	23	2.239
Spotted skunk (*Mephitis mephitis*)	--	--	1	.312	--	--	--	--	--	--	1	.097
Bobcat (*Lynx rufus*)	1	.307	2	.626	--	--	1	2.083	3	1.204	7	.681
Mule deer (*Odocoileus hemionus*)	9	2.769	12	3.750	4	4.705	--	--	5	2.008	30	2.921
Pronghorn antelope (*Antilocapra americana*)	--	--	--	--	--	--	--	--	1	.401	1	.097
Mountain sheep (*Ovis* cf. *canadensis*)	1	.307	1	.312	1	1.176	1	2.083	8	3.212	12	1.168
Domestic pig (*Sus* sp.)	--	--	1	.312	--	--	--	--	--	--	1	.097
Total	**325**	**100.000**	**320**	**100.000**	**85**	**100.000**	**48**	**100.000**	**249**	**100.000**	**1,027**	**100.000**

* Minimum numbers of individuals derived from identified fragments.

As at all other sites in the Perris locality, lagomorphs are the most common species, accounting for about 73 percent of the total faunal assemblage. Jackrabbits outnumber cottontails in Area 2 by a ratio of nearly 3 to 2. The balance of the fauna includes rodents, ungulates, carnivores, and waterfowl.

Most of the animals from the Peppertree site can be found locally during all seasons of the year. The exceptions are three water birds: an immature unidentified dabbling duck, a ring-necked duck, and a lesser sandhill crane. The immature duck suggests occupation of the site in late summer or early fall. The ring-necked duck is locally resident only during the period from mid-October through early May, while the crane is available from about late September through March or April (Grinnell and Miller, 1944). The presence of the latter two species suggests that at some time the Peppertree site must have been occupied between late fall and late spring. Occupation during other seasons as well is not ruled out.

In general the relative importance of various species does not vary significantly over time. However, it is interesting to note that waterfowl are confined to late period deposits above level *e*. This is consistent with the restriction of waterfowl to the upper levels of the deposits at Loci 1 and 2 of the Charles Mott site. Whether the consistent restriction of these species to late period deposits is a reflection of change in the subsistence economy or a function of sampling error remains unclear.

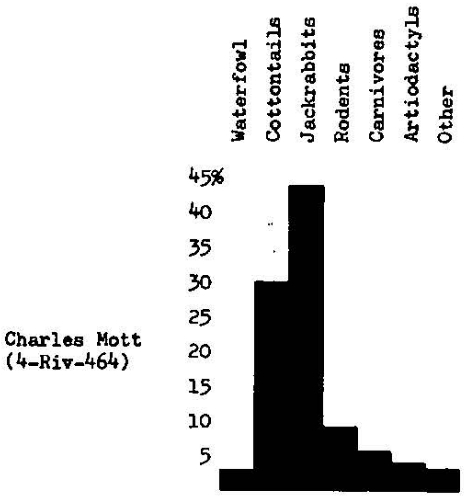
Discussion

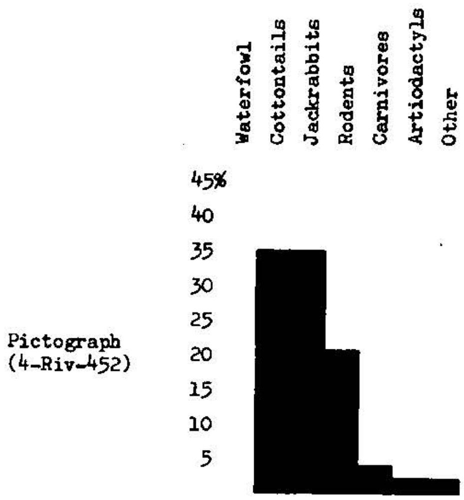
The data presented above are sufficient to permit certain observations and inferences about the subsistence patterns of the late prehistoric aboriginal inhabitants of the Perris area. The most commonly hunted game animals were cottontail and jackrabbits, which collectively represent about 73 percent of the total minimum number of individuals in the sample. The balance is made up of rodents, carnivores, artiodactyls, birds, and reptiles in order of relative importance (Table 30). If meat yield per individual is considered, the relative importance of the several taxa is somewhat different.

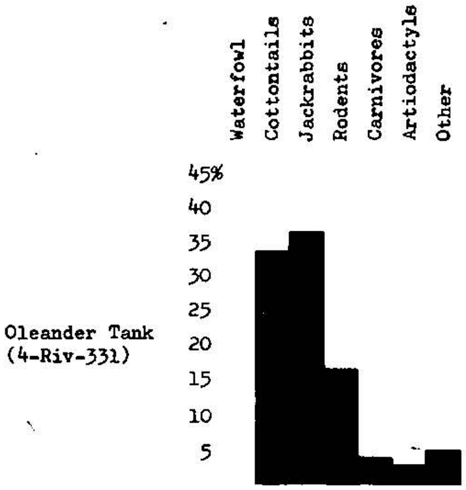
If we assume that each of the 43 deer, mountain sheep, and antelope in our collection yielded about 45 kg of usable meat (cf. White, 1953), then these species collectively produced about 1,935 kg of meat. Cottontail and jackrabbit probably contributed no more than about 1.1 kg of meat per individual on the average, so that the 747 individuals in the sample represent about 820 kg. Figuring the 136 rodents at no more than .5 kg per individual, we estimate a value of 68 kg. If this figure were doubled to compensate for under-representation of rodents as a function of screening technique, a value of 136 kg would be obtained. Since we are only dealing with minimum numbers of individuals of each category, these figures must not be taken to represent absolute estimates of meat consumed. However, they do suggest that artiodactyls (especially deer) contributed the greatest bulk of meat overall, although lagomorphs were probably more commonly eaten on a day-to-day basis.

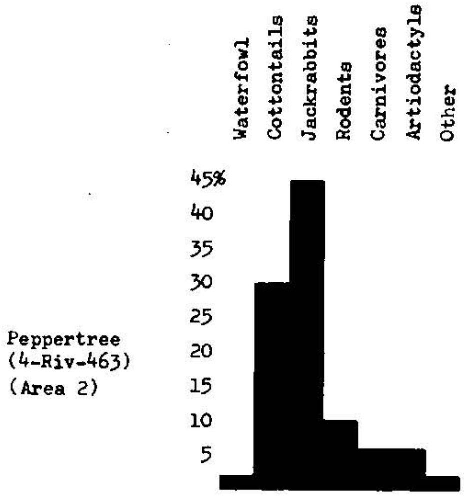
There is little variation in the relative importance of various species at the excavated sites (Figure 23). The principal differences are in the representation of waterfowl and the relative importance of lagomorphs and rodents. Waterfowl are present in the recovered samples from three sites — Charles Mott, Dead Dog, and Peppertree — but are entirely lacking at the Pictograph and Oleander Tank sites. Since the faunal sample from Pictograph is very small, amounting to only a minimum of 48 individual animals, the absence of waterfowl may simply be a function of sampling error. The site is certainly within reasonably close proximity to aquatic communities. The complete absence of waterfowl at the Oleander Tank site, which yielded the largest faunal sample among the excavated sites (a minimum of 325 individual animals), is less likely attributable to sampling error than to aboriginal behavior patterns represented at the site. The inhabitants of this site apparently failed to exploit the resources of the aquatic communities. Recent work on modern hunter/gatherers by Lee (1966, 1968) and others shows that there is a limit to the distance over which people forage on a daily basis; interestingly enough, this distance is apparently shorter in the Perris locality than that reported elsewhere.

Both Oleander Tank and Pictograph have lower ratios of jackrabbits to cottontails and rodents than do the other sites (Figure 23). This difference parallels that observed in the distribution of waterfowl but is less readily explainable. In the case of Pictograph, sampling error may well be a factor. In the case of Oleander Tank, the difference may well reflect some variation in the size or composition of resident aboriginal groups. As Bettinger in "Environment and Ethnography" in this publication shows, jackrabbits were commonly hunted by drive techniques, employing the efforts of communal groups, while rodents and cottontails were more successfully taken by individual hunters using snares and traps. Perhaps the groups occu-









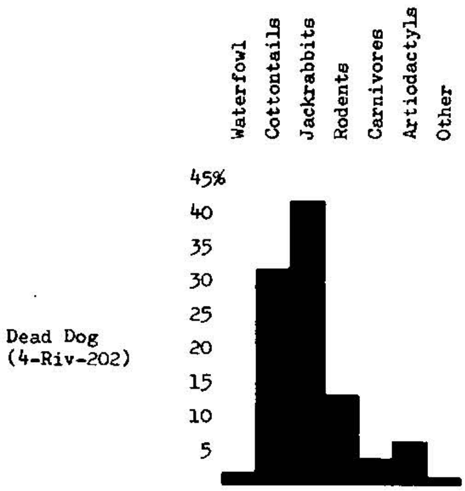


Figure 23. Relative importance of faunal categories at excavated sites (minimum number of individual animals).

pying the Pictograph and Oleander Tank sites were smaller than those at the other sites, so that communal hunting efforts were less frequently undertaken.

There is little change in the relative importance of various species over time in the Perris Reservoir locality. The only exception involves the restriction of waterfowl to the later phases of occupation at the Peppertree and Charles Mott sites (Tables 24, 25, and 29). This may involve an intensification in local resource exploitation as a result of imbalance between population size and regional resource distribution along the lines suggested by Jefferson in an article in this publication.

With minor exceptions the fauna are not seasonally sensitive and thus cannot directly indicate the time of the year that the excavated sites were occupied. The exceptions are waterfowl. At the Peppertree site a lesser sandhill crane, which is locally resident from September through April, and a ring-necked duck, which could have been taken between mid-October and early May, provide seasonal implications. The only other seasonally sensitive specimen from Peppertree is an immature unidentified dabbling duck, which suggests late summer or fall occupation. At the Charles Mott site, the presence of three immature waterfowl point to autumn occupation. The matter of seasonality of occupation at Perris Reservoir is discussed at some length by Wilke in his summary paper in this publication.

Butchering and cooking techniques are reflected in the representation of various skeletal elements and the general character of the bone waste. All the more common species were represented by the full range of skeletal elements. The only exception to this generalization is in the case of animals the size of lagomorphs or smaller, which are represented primarily by the largest elements of the skeleton (mandibles, humeri, scapulae). This is more likely a reflection of the inefficiency of the screening technique used in collecting the sample than of prehistoric aboriginal butchering practices. In the case of artiodactyls, we specifically note that all skeletal elements are represented in proportion to their expected frequency. This suggests that these animals were killed in the immediate vicinity of the Perris sites and brought back to camp for butchering. In general the bones of all animals were extremely fragmentary. This probably results from aboriginal preparation and consumption practices. Long bones of large animals were probably split and cracked for marrow. The extreme fragmentation of lagomorph and rodent bones is apparently a function of the ethnographically known practice of preparing such animals for consumption by crushing them in a stone mortar. (See Sparkman, 1908: 197-198; Michelson, 1967.) The frequency of charred bone suggests that most game was roasted rather than boiled.

FLORAL REMAINS

Michael Gardner, Lesley McCoy, and Stephen Brown

This paper discusses floral remains from the Perris Reservoir excavations. We wish to acknowledge the Geology Department of the University of California at Riverside for permission to use its flotation facility; Oscar Clarke of the Herbarium, University of California at Riverside; and Norah van Kleeck of the Department of Agriculture, State of California, for assistance in identification of floral remains.

Background Information

Reconstruction of prehistoric diets has long been hampered by a lack of specific information about plant foods. Although research among contemporary hunter-gatherers (e.g., Lee, 1968; Woodburn, 1968: 51) has shown that plant foods may comprise 60 to 80 percent by weight of the total dietary intake, plant materials are not commonly recovered from archeological sites because of their tendency to decay. Notable exceptions are dry deposits from caves and certain open sites, some of which have yielded a remarkable variety of plant remains.

Recent research has revealed that carbonized plant remains, especially seeds, may be more commonly preserved in archeological deposits than previously thought. An efficient method for recovery of carbonized seeds and other plant parts has been offered by Struever (1968a). In this method, midden containing suspected seeds, bone fragments, and other materials is placed in a liquid, and the organic constituents are suspended to varying degrees according to differences in their specific gravities. The method is variously referred to as "flotation," "liquid separation," or, as employed here, "water separation."

Methods similar to that employed here have proved remarkably successful in recovery of plant remains in the Midwest (Struever, 1968a; Munson, Parmalee, and Yarnell, 1971) and in Southwest Asia (Helbaek, 1969). Most of the floral remains from Perris Reservoir were recovered by the water separation method, although some were collected directly from the middens during excavation. In addition to providing data on the relative importance of plant foods, the data are useful in attempting to bracket the season of occupation at various sites.

Procedure

Midden samples collected for water separation were of two types. The first consisted of soil, charcoal, and ash collected from hearths and earth ovens. These facilities were expected to yield floral remains as by-products of cooking activity. In most cases all fill from such features was collected during excavation, so the size of individual samples varies according to the size of the feature and the amount of fill it contained. Twelve such samples were analyzed. Samples of the second category were of soil collected from stratigraphic columns spanning the maximum depth of the deposits at all sites. These samples were collected to determine whether hearths and other cooking facilities contained representative samples of preserved plant remains at a given site or only a biased portion of those remains. Twelve such samples were subjected to analysis.

In general, the procedure for water separation of the midden samples followed that of Struever (1968a). Since no source of running water was available in the field, an artificial stream built by the Geology Department at the University of California at Riverside was used. The apparatus consisted of a rectangular concrete tank 7.6 m long, 1.6 m wide, and 0.6 m deep with a concrete partition down the center. This central divider was open at either end to permit a cyclical flow of water. Inflow valves at one end of the tank permitted establishment of a current in either direction around the central divider at a variable rate of flow. Water level in the tank was controlled by an adjustable drain at the opposite end.

The midden samples were poured into 40 cm square wooden separation containers with 0.5 mm nylon mesh bottoms. Styrofoam floats attached to the containers suspended them in the current. As the midden samples were poured into the screen-bottomed containers, fine carbonized material floated on the surface of the water, while heavier material (sand, debitage, and the like) settled to the bottom of the container. Some of the plant material became waterlogged and also sank but was easily recovered by raising the container a few centimeters and rapidly lowering it, thus causing the waterlogged material to rise toward the surface, where all carbonized material was collected with a fine-mesh tea strainer. Most of the soil components (fine sands, silts, and the like) passed through the bottom mesh and washed away. A 0.5-mm mesh screen was placed vertically in the current a short distance downstream to trap escaped particles and thus prevent contamination of subsequent samples. Material recovered with the tea strainers consisted of charcoal fragments, carbonized seeds, bone fragments, rootlets, and the like and was set aside out of the wind to dry. Identifiable plant remains (mostly carbonized seeds) were separated from the rest of the material under a low-power binocular microscope. Flakes, bone fragments, and other cultural materials were sorted from the coarse residue that remained in the separation containers.

The Data

The twelve samples analyzed from hearths and earth ovens produced a total of 329 identifiable seeds, nutshell fragments, and other plant parts. These data are presented in Table 31. In addition, more than 300 seeds and nutshell fragments were recovered in the course of excavation. These are reported in Table 32. Twelve analyzed samples from a stratigraphic column in Area 2 at the Peppertree site (4-Riv-463) produced no plant remains other than fragments of wood charcoal. Since seven samples from cooking facilities in the same excavation area produced seeds and other plant remains in some quantity (Table 31), an explanation for the discrepancy is in order.

Ethnographic sources (Bean and Saubel, 1972; Barrows, 1900: 64) indicate that in early historic time, seeds of herbs and grasses were often parched by Cahuilla women with basketry parching trays containing live coals. Since the parching tray had to be continuously shaken to prevent burning of the basket or the seed being parched, it is to be expected that some of the seed would have been accidentally shaken from the basket from time to time (Helbaek, 1970: 210). Seeds falling on the ground are apt to be stepped on and crushed or to decay eventually. However, seeds that might fall into cooking fires would become carbonized, and some of them would probably burn completely. If carbonized but not completely burned, such seeds could remain intact almost indefinitely. Since cooking fires probably provided the live coals for parching, it seems likely that the parching process would be carried out near these facilities. This is believed to be the explanation for the presence of seeds in hearth fill but not in the stratigraphic column samples. Certain carbonized specimens resemble fragments of nutshell. These are tentatively identified as acorn (*Quercus* spp.) hull fragments or endocarp fragments of hollyleaf cherry (*Prunus ilicifolia*). This seems reasonable in view of the presence at occupation sites of bedrock mortars, which are ethnographically associated with the processing of these foods. The presence of these fragments in the cooking fires may point either to the discarding of waste products in the fires or the use of them for fuel.

Floral remains were identified by the senior author under the supervision of Oscar Clarke, Senior Museum Scientist of the Herbarium at the University of California at Riverside. Norah van Kleeck, Division of Plant Industry, California State Department of Agriculture checked identifications and identified some of the more troublesome specimens. Specimens were compared with samples in the Herbarium, and against literary sources, notably Markin and Barkley (1961).

The following sections discuss the floral remains from the various sites at Perris Reservoir.

The Oleander Tank Site (4-Riv-331)

This site has been described by O'Brien in this publication. Three samples — two from hearths (Features 1 and 2) and one from an earth oven (Feature 11) — were analyzed by water separation (Table 31). Most notable is the occurrence in Feature 1 of goosefoot (*Chenopodium* sp.), saltbush (*Atriplex* sp.), amaranth (*Amaranthus* sp.), and chia (*Salvia Columbariae*). This complex of plants can be exploited for seed between early summer and fall.

Some 50 uncarbonized seeds of desert squash (*Cucurbita foetidissima*) were also recovered in the midden at a depth of 40 to 50 cm. These probably represent a rodent food cache. A single seed of the same species at a depth of greater than 120 cm (also not carbonized) may have been aboriginally deposited.

The Charles Mott Site (4-Riv-464)

The Charles Mott site and the excavations conducted there have been described by Robarchek in this publication. Only one sample, drawn from the fill of a hearth (Feature 13, Locus A), was subjected to water separation analysis (Table 31).

Exigencies of time prevented identification of all seeds recovered from this sample. Approximately one-half the seeds were identified, and the remainder were saved for future reference. There is no reason to believe that the identified portion is

TABLE 31
FLORAL REMAINS RECOVERED BY WATER SEPARATION*

Taxa	Peppertree site (4-Riv-463)							Charles Mott site (4-Riv-464)	Oleander Tank site (4-Riv-331)			Dead Dog site (4-Riv-202)	Total seeds from all samples	Total samples in which seeds appear
	F11	F14	F13	F9	F4	F1	F6	F17	F11	F1	F2	F1		
Cupressacea														
Juniperus sp.	--	--	--	1	1	--	--	--	--	--	--	4	6	3
Rosacea														
Prunus ilicifolia (see Fagacea)														
Adenostoma fasciculatum	1†	1†	--	--	3†	--	1†	--	--	1†	--	--	7†	5
Fagacea														
Quercus sp. (or *Prunus ilicifolia*) (fragments)	6	--	--	6	--	--	--	35	--	--	1	3	51	5
Quercus sp. gall	--	--	--	--	--	--	--	1	--	--	--	--	1	1
Chenopodiacea														
Chenopodium sp.	3	--	--	16	18	4	3	57	1	3	--	2	107	9
Atriplex sp.	22	3	--	10	13	--	1	17	--	1	--	--	67	7
Amaranthacea														
Amaranthus sp.	--	--	1	--	3	1	1	4	--	1	--	2	13	7
Amaranthus Palmeri	--	--	--	--	--	--	--	36	--	--	--	--	36	1
Labiatae														
Salvia Columbariae	--	--	--	1	--	2	1	1	--	1	--	--	6	5
Graminae														
Festuca sp.	--	--	--	1	--	--	--	1	--	--	--	--	2	2
Agrostis sp.	--	--	--	1	--	--	--	--	--	--	--	1	2	2
Unidentified Graminae	1	--	--	--	--	6	--	7	4	--	1	6	25	6
Juncacea														
Juncus sp.	--	--	--	--	--	3	--	--	--	--	--	--	3	1
Papaveracea														
Papaver sp.	--	--	--	--	1	--	--	1	--	--	--	--	2	2
Compositae														
Helianthus sp.	--	--	--	--	--	--	--	--	--	--	--	1	1	1
Unidentified seeds	9	3	--	8	11	5	9	77	1	9	--	17	149	10
Total	**42**	**7**	**1**	**44**	**50**	**21**	**16**	**237**	**6**	**16**	**2**	**36**	**478**	

* Figures refer to the number of seeds recovered. Exceptions indicated by a dagger (†) are leaves or leaf fragments and a single *Quercus* gall.

not representative of the entire sample.

A total of 237 seeds was examined, of which about 32 percent were unidentifiable. Goosefoot, saltbush, and amaranth are the most commonly represented seeds in the sample, accounting collectively for over 71 percent of those identified. Other species present include chia, poppy (*Papaver* sp.), fescue (*Festuca* sp.), and various grasses (*Graminae*). Nutshell fragments probably represent either acorns or hollyleaf cherry, both of which are found in nearby chaparral communities. A single seed of olive (*Olea europa*) is considered intrusive.

The bulk of the seeds present in Feature 13 are available for harvest from early summer through fall.

The Peppertree Site (4-Riv-463)

The Peppertree site has been described by Wilke in this publication. It yielded the longest stratigraphic sequence of occupational deposits yet investigated at the reservoir locality, spanning more than 2,000 years. The samples analyzed (compare Table 31 and Figure 14) likewise span some 2,000 years as indicated by the following radiocarbon age determinations on features from which water separation samples were taken:

F4 — 215±60 radiocarbon years BP
F9 — 870±80 radiocarbon years BP
F14 — 2200±80 radiocarbon years BP

Seven samples — six from hearths and one from an earth oven (Feature 9) — were analyzed by water separation. Of the identified botanic remains, saltbush and goosefoot occurred in five samples, amaranth in four, and chia in three. Present in either one or two samples were poppy, needlerush (*Juncus* sp.), fescue, bentgrass (*Agrostis* sp.), and juniper (*Juniperus* sp.). The data suggest that goosefoot, saltbush, and amaranth were exploited as a complex throughout most of the span of occupation represented at the site.

Juniper was not recorded in botanic surveys conducted at Perris Reservoir. It occurs at similar elevations in the Gavilan Hills about 12 to 15 km

TABLE 32
FLORAL REMAINS RECOVERED FROM MIDDEN DEPOSITS DURING EXCAVATION*

Provenience	Number	Identification	Comment
Charles Mott site (4-Riv-464)			
Locus 1			
2S/4W, 10-20 cm	1	*Olea europa*	Intrusive
8S/2W, 10-20 cm	2	*Umbellularia californica*	
2S/18W, 10-20 cm	1	*Umbellularia californica*	
8S/2W, 30-40 cm	3	Unidentified	
14N/14W, 0-10 cm	2	*Umbellularia californica*	
8N/12W, 30-40 cm	1	Unidentified	
8N/12W, 40-50 cm	1	*Prunus ilicifolia*	
Oleander Tank site (4-Riv-331)			
Unit 10, 120-130 cm	1	*Cucurbita foetidissima*	
Unit 2, 40-50 cm	50+	*Cucurbita foetidissima*	Probable rodent cache
Dead Dog site (4-Riv-202)			
Locus A			
Unit 2, 0-10 cm	1	*Quercus* sp.	
Peppertree site (4-Riv-463)			
Area 2			
Unit 4B, level g	100+	*Schismus* sp.	Intrusive, probable rodent cache
Unit 4B, level g	30+	*Brassica geniculata*	Intrusive, probable rodent cache
Area 1			
Unit 2, 0-10 cm	100+	*Lupinus microphyllus*	Intrusive, rodent cache
Unit 2, 10-20 cm	2	*Umbellularia californica*	
Unit 2, 30-40 cm	1	*Gaestrum coronatum*	Probably intrusive

* Water separation was not involved in recovery.
"Number" means the number of seeds per sample.

to the southwest, where it commonly grows on the valley floors. Its absence at Perris Reservoir today does not mean that it was never present; rather, juniper may have existed there and subsequently been obliterated in modern times by agricultural practices. Needlerush commonly grows around springs and may have been obtained either on the site itself or in the San Jacinto River drainage to the east of the Bernasconi Hills.

Leaves of chamise (*Adenostoma fasciculatum*) were present in four of the seven samples. Chamise was used for the building of structures, for arrowshafts, for medicinal purposes, and also for firewood (Bean and Saubel, 1972: 29-30). Any of these uses could account for its presence in the samples. Several pockets of noncarbonized seeds were recovered during excavation (Table 32). These probably represent recent food caches of rodents.

In general, the plant remains from the Peppertree site suggest that occupation there occurred in the summer and early fall.

The Dead Dog Site (4-Riv-202)

The Dead Dog site is described by Bettinger in this publication. Only one sample, from an earth oven designated Feature 1, was subjected to analysis. This sample produced a total of 36 carbonized seeds and nutshell fragments. Seventeen of the seeds were unidentifiable. Of the remainder, grasses are the most common, followed by juniper, unidentified nutshell (either hollyleaf cherry or acorn), amaranth, goosefoot, and sunflower (*Helianthus* sp.).

These plant remains were associated with a radiocarbon age determination of <150 radiocarbon years BP. In terms of seasonality, they suggest that Feature 1 was used during the summer and fall. Seeds characteristic of marsh communities (e.g., bulrush, cattail, needlerush), which were expected in this sample because of proximity to the marsh community that existed in aboriginal times, were not found.

Synopsis of Plant Uses

The following is a brief discussion of some of the major uses of the plants that were identified in the course of the research. All the information regarding plant use is extracted from Bean and Saubel's (1972) extensive Cahuilla ethnobotany, unless otherwise identified.

Adenostoma fasciculatum. Chamise is not reported to have been used as a food. It was used medicinally by boiling the leaves and branches to bathe infections and swellings. The root was a preferred firewood, reaching a diameter of up to 0.3 m and providing excellent coals for roasting. Branches were used for arrowshafts and in building ramadas and fences.

Amaranthus spp. Seeds of amaranth – the *quelites* mentioned by Garces as growing in the vicinity of Perris Reservoir in 1774 (Bolton, 1930 [II]: 345) – were parched, ground, and made into mush. The leaves were boiled and eaten as greens and used as potherbs.

Atriplex spp. Saltbush seeds were parched and ground to be used in the making of mush and bread. The leaves and roots were used as soap. Leaves could be chewed fresh, steamed and the fumes inhaled, or smoked when dry for relief of nasal congestion. The roots and blossoms were used by the Zuni for ant bite treatment (Jaeger, 1941: 53).

Chenopodium spp. Goosefoot seeds were parched and ground into flour. The roots and leaves were used as soap. The sap was used as gum and in the treatment of internal parasites.

Cucurbita foetidissima. Wild squash was used primarily as a soap. The dried gourds were used as ladles, as syringes for feminine hygiene, and as rattles. Powdered gourd was used as a shampoo. Medicinally, the roots and green gourds were used in the treatment of skin ulcers, and dried roots were boiled and used as an emetic or physic.

Gaestrum coronatum. No reference was found describing a prehistoric use of this mushroom. We believe that the specimen may have been deposited in the midden by small animals.

Graminae. The seeds of various grasses were collected, frequently parched to remove the husks, ground into flour, and eaten as mush or bread-like cakes.

Helianthus sp. The common sunflower seed is very high in protein (up to 43 percent). The seeds were dried and ground and mixed with flour from other seeds to make mush and bread.

Juncus sp. Seeds of needlerush are not reported as having been eaten, although they are large and easily gathered. The stems were collected, split in three strips, and used in the making of baskets.

Juniperus sp. Juniper berries were eaten both fresh and, when dried and ground, as mush and bread.

Papaver sp. Poppy seeds were not eaten, but they were used as a sedative for babies, and the pollen was used as a facial cosmetic by women.

Prunus ilicifolia. The hollyleaf cherry fruit contains a large seed that was made edible by grinding in a mortar and leaching, the same process used in the preparation of acorns.

Quercus spp. Acorns have long been recognized as a major – perphaps *the* major – food source in aboriginal California. The acorn was prepared for consumption by drying the meat, crushing it in the mortar, and leaching the tannin away with a leaching basket and water. Sometimes a shallow basin was scooped in sand and used instead of the basket. The flour was either boiled into mush or baked into a bread.

Salvia Columbariae. Chia is a plant of many uses. The seeds were ground and made into mush, which was eaten or used as a poultice for infection. Single seeds were used as eye cleaners, and alkaline water was rendered potable by adding chia seeds. A drink was made by boiling the seeds.

Umbellularia californica. California laurel or bay was apparently not used aboriginally for food, although Bean and Saubel report that the fumes of crushed leaves were inhaled to cure headaches.

Discussion

Reconstruction of the plant food component of the prehistoric diet at the Perris locality on the basis of seed samples recovered by water separation is beset with certain problems. First, the sample consists only of those foods that were parched or charred in the course of preparation. Plant foods routinely prepared by other methods not involving the application of fire to intact specimens (e.g., roots) are unlikely to be recovered. Second, the sample has been drawn entirely from sites of a single category: occupation sites. Seed processing stations – the most common sites at Perris – were not tested by excavation; therefore, the plant foods processed there are unrecorded. It is possible that the assemblage of plant foods exploited and processed at these sites was quantitatively or qualitatively different from that recovered at the occupation sites. However, in view of the fact that sites of both types occur in the same general environmental setting and thus have similar access to the same set of potential plant foods, it is suspected that the differences are not significant. This problem is now being investigated through excavations under the supervision of the senior author at several processing stations in the Perris area.

In addition to problems with the sample itself, further difficulties were encountered with the identification of individual seed specimens. The carbonization of seeds often results in alterations of seed shape (e.g. swelling). Further damage is caused in the recovery process, the fragile seeds commonly being fragmented even in the course of careful handling. As a result of these and other factors, seeds are often difficult to identify and may even be misidentified by less sophisticated observers. For example, several seeds that we identified tentatively as *Chenopodium* sp. were subsequently shown by Ms. van Kleeck to be specimens of *Atriplex* sp. with the bracts burned and/or broken off.

Regardless of these problems, we can offer some comments on prehistoric plant diet at Perris Reservoir and its implications for the interpretation of seasonality of the occupation. The most important plant foods identified were *Chenopodium*, *Atriplex*, *Amaranthus*, and various *Graminae*, especially *Agrostis* and *Festuca*, and the specimens identified as *Quercus* and/or *Prunus*. This particular complex of plants can be collected locally from summer through early autumn, and it indicates that sites in the Perris area were certainly occupied during these seasons. To this complex may also be added chia (*Salvia Columbariae*), which was an important food aboriginally (cf. Bean and Saubel, 1972: 136-38), and which was recovered (albeit in small quantity) from 5 of the 12 analyzed samples. This species characteristically becomes available for harvest in late spring and early summer. We are inclined to place greater emphasis, for purposes of dietary reconstruction, on the number of samples in which seeds of a given taxon occurred than on the total number of seeds present. However, it should not be overlooked that an abundance of seed of a particular taxon may reflect more frequent use of that taxon as well as a clumsy parching operation. The only way satisfactory conclusions can be reached in this regard is by having a large number of analyzed hearth samples and observing the number of samples in which a taxon repeatedly occurs.

In terms of variation over time, it is noted that there are no significant differences among samples collected from deposits spanning more than 2,000 radiocarbon years at the Peppertree site. Although dietary change over time at Perris Reservoir is not ruled out, the plant data now available will not support such an interpretation.

Summary

A modified version of the method of water separation described by Struever (1968a) has been successfully employed for recovery of carbonized plant remains at Perris Reservoir. Samples analyzed consisted of fill from hearths and other cooking facilities at four excavated sites and a series of midden samples from a stratigraphic column in the deposits at the Peppertree site. Only the samples from cooking facilities yielded carbonized seeds. It is believed that the sample of seeds recovered represents those lost while being parched or roasted.

Data presented in Table 31 suggest that amaranth, goosefoot, saltbush, chia, and various grasses formed a complex of regularly exploited plant foods. Remains of acorn hulls and/or hollyleaf cherry seeds and juniper seeds indicate use of these larger-seeded plants for food also. Since these species are available for harvest between early summer and late fall, occupation of the reservoir locality for exploitation of plant foods may be inferred for that period. Data from the Peppertree site suggest that this pattern of plant exploitation is one of considerable antiquity, at least 1,000 and perhaps as much as 2,000 years old.

DATING THE PERRIS RESERVOIR ASSEMBLAGES

Robert L. Bettinger

Time placement of the Perris Reservoir archeological components is crucial to understanding both relationships between sites and the significance of the entire locality in southern California prehistory. Radiocarbon determinations and time-sensitive artifacts, including projectile points, ceramics, and shell beads, provide a basis for inferences about the ages of the deposits.

Time-Sensitive Artifacts

Projectile Points

(See Wilke, "Flaked Stone Artifacts," in this publication).

Eighty-seven projectile points recovered at the Perris locality are divided into four time-sensitive types: Cottonwood Triangular (eighty specimens), Cottonwood Leaf-shaped (one specimen), Desert Side-notched (five specimens), and Elko Eared (one specimen). The Cottonwood series (Lanning, 1963: 252-253), including triangular and leaf-shaped types, first appears in the Great Basin after AD 1300 (Clewlow, 1967). Bettinger and Taylor (n.d.) have identified the series as a time marker in the southwestern Great Basin for the Marana Period, which dates from AD 1300 to historic times. Desert Side-notched points are essentially contemporaneous with those of the Cottonwood series (Baumhoff and Byrne, 1959; Clewlow, 1967), and are also indicators of the Marana Period. The Elko series occurs in the western Great Basin between 1000 BC and AD 600 (O'Connell, 1967) and marks the recently defined contemporaneous Newberry Period in the southern Great Basin (Bettinger and Taylor, n.d.).

Ceramics

(See O'Brien, "Ceramic Artifacts," in this publication.)

There are 131 vessel sherds in the collections from Perris Reservoir. Eighty-four of these are classified as Tizon Brown Ware, forty-three as Lower Colorado Buff Ware, and four as Jeddito Yellow Ware. Two of these wares — Lower Colorado Buff and Tizon Brown — are well established time markers in northern Arizona and along the lower reaches of the Colorado River, where they span the interval from about AD 700 to the Historic Period (Harner, 1957; Euler and Dobyns, 1958). However, the date of their initial appearance in interior southern California remains in question. Hubbs *et al* (1960: 216) report a radiocarbon age of 960±100 radiocarbon years (AD 990) on a component containing sherds of unspecified type in a site on the east shoreline of now-extinct Lake LeConte (Imperial Valley). Meighan (1959) puts the first appearance of Palomar Brown, a variant of Tizon Brown, at about AD 1600 in the coast ranges of northern San Diego County but admits that this is only a guess. A carbon sample obtained expressly for the purpose of dating the first appearance of Palomar Brown at the Marana site (4-Riv-381) (Bettinger, unpublished field notes) near Temecula, Riverside County, some 100 km south of Perris Reservoir, has yielded an age of 500±80 radiocarbon years (AD, 1450; UCLA-1650A). For the present, we consider the appearance of both Tizon Brown and Lower Colorado Buff Wares in cismontane southern California as essentially contemporaneous and suggest that they were present as early as AD 1450 to 1600.

Jeddito Yellow sherds are not common in southern California, and the four sherds recovered at Perris do not provide a substantive basis for cross dating. However, since this ware is commonly found in northern Arizona between AD 1250 and 1850, the temporal implications of its appearance in the Perris Reservoir collections are consistent with those of the Tizon Brown and Lower Colorado Buff Ware sherds (Colton, 1956).

Shell Beads

(See Mix, "Bone and Shell Artifacts," in this publication.)

Time-sensitive shell beads are not abundant at Perris Reservoir. There are only six specimens of lipped *Olivella biplicata* discs. These beads are of several definite styles. At Oleander Tank, one thin-lipped oval disc occurred at a 70 to 80 cm depth, and one specimen of the thin-lipped round variant occurred in the 10 to 20 cm level. These beads are characteristic of late contexts (about AD 1500 to 1700) across much of central, coastal, and southern California (Bennyhoff and Heizer, 1958; King, 1972: 5). Also in the 70 to 80 cm level at Oleander Tank was a single specimen of the full-lipped variety, which follows the thin-lipped variety in time, and is thus very late (King, 1972: 5).

Badly weathered lipped beads were also present at the Charles Mott site, one specimen having come from the middle levels in Locus 1 and the other from the upper levels of Locus 2. Nine beads of the species *Olivella dama* from the Gulf of California may also have temporal implications, but the chronology of gulf species has not yet been worked out for California. *Olivella biplicata* spire removed beads were found at three sites, but since these were used over most of the last 7,000 years, they are of no help in establishing the chronology of the Perris assemblages.

Basin Metates

A category of artifact that occurred in low frequency but that appears to have chronological implications at Perris Reservoir is the basin metate. Two of these items were present in Area 2 at the Peppertree site, both stratigraphically between radiocarbon dates of 870±80 and 2200±80 radiocarbon years. (See below.) At the Oleander Tank site one basin metate underlay projectile points of the cottonwood series. At Locus B, Dead Dog site, a single basin metate underlay all examples of Cottonwood series points. While the data are limited, they clearly suggest that the basin metate is an implement of considerable time depth. If the radiocarbon dates at Peppertree actually bracket the time span in which these metates were used at Perris Reservoir, they should fall in the interval of 1000-2000 years ago. In any event their stratigraphic placement would suggest an age of between 600 and about 2,000 years.

Radiocarbon Determinations

Samples of carbonized plant material from deposits at three sites in the Perris Reservoir area were dated by the radiocarbon method. Each of these was plotted against the Suess (1970) curve of secular variations to convert radiocarbon age into actual calendar dates. This curve reveals past fluctuations in the production rate of radiocarbon and thereby permits reasonably accurate assessment of the actual significance of radiocarbon dates. It compares radiocarbon ages of bristlecone pine samples against their known dendrochronologic ages and indicates that in some cases material with several distinct tree-ring dates may have the same age in radiocarbon years. Due to the statistical error involved in computing both the age of a given sample and the curve itself, where two or more tree-ring dates have the same radiocarbon value, the corrected calandar date of the sample is given as the range between the two most extreme tree-ring dates. By means of this conversion method, the radiocarbon ages of samples from Perris Reservoir have been corrected for secular variations and converted into ranges of calandar years in Table 33.

At the Peppertree site (4-Riv-463), samples were analyzed from two hearths and one earth oven in Area 2. Feature 14 (2200±80 radiocarbon years; corrected to 380-200 BC: UCLA-1817) is a hearth at the base of the cultural deposit. It underlies all the time-sensitive artifact types at the site. It is associated with a few ground stone artifacts and small amounts of debitage and faunal remains. Feature 9 (870±80 radiocarbon years; corrected to AD 1100-1220: UCLA-1815) is an earth oven from an intermediate position in the cultural deposit. The upper extent of this cooking pit occurred

TABLE 33
RADIOCARBON DATES FROM PERRIS RESERVOIR

Laboratory number	Age in C-14 years	Calendar date	Calendar date corrected for secular variations	Provenience
UCLA-1815 (UCR-101)	870±80	AD 1080	AD 1100-1220	Peppertree site (4-Riv-463), Feature 9
UCLA-1816 (UCR-102)	215±60	AD 1735	AD 1570-1650	Peppertree site (4-Riv-463), Feature 4
UCLA-1817 (UCR-103)	2200±80	250 BC	380-200 BC	Peppertree site (4-Riv-463), Feature 14
UCLA-1818 (UCR-104)	210±60	AD 1740	AD 1650	Charles Mott site (4-Riv-464), Feature 13
UCLA-1819 (UCR-105)	<150	< AD 1800	< AD 1680	Dead Dog site (4-Riv-202), Feature 1

stratigraphically in level *g*. The radiocarbon date thus pertains to a level that contained the earliest occurrence of Desert Side-notched and Cottonwood series projectile points at that site and is well below the few sherds of Jeddito Yellow Ware and Tizon Brown Ware. The date is about 200 years older than the earliest generally accepted dates for these projectile points (Bettinger and Taylor, n.d.). Feature 4 (215±60 radiocarbon years; corrected to AD 1570-1650: UCLA-1816) — a hearth — was one of eight features located on a living surface. Associated artifacts include Cottonwood series projectile points, but ceramic vessel sherds were lacking on the living floor although they were present in the level immediately above.

An age of 210±60 radiocarbon years, corrected to AD 1650 (UCLA-1818), was obtained on carbonized plant materials from a hearth (Feature 13) in Locus 1 at the Charles Mott site (4-Riv-464). Associated with the feature were Desert Side-notched and Cottonwood series projectile points and *Olivella* lipped disc beads. Ceramic sherds of Lower Colorado Buff Ware and Tizon Brown Ware occurred in the arbitrary level immediately above.

Charcoal taken from a rock-lined pit (earth oven) (Feature 1, Locus B) associated with the living surface noted at the Dead Dog site (4-Riv-202) yielded an essentially modern date (less than 150 radiocarbon years; corrected to younger than AD 1680: UCLA-1819). A second laboratory count on the sample confirmed this determination. Although this date seems anomalous, the corrected date (younger than AD 1680) is in essential agreement with the younger dates at the Peppertree and Charles Mott sites.

The artifacts associated with the living floor included one unclassified projectile point and a single perforated *Argopecten* valve. Tizon Brown Ware and Lower Colorado Buff Ware ceramics and several Cottonwood Triangular projectile points occurred stratigraphically above Feature 1, but they could not be directly linked to the floor itself. Historic artifacts were not present in either of the excavation units where the living surface was exposed, although they are commonly found in the uppermost levels of the deposit throughout the site.

Discussion

The above evidence provides a basis for the definition of two time periods to which the Perris Reservoir assemblages belong. These time periods are derived from the temporal implications of artifacts and from the radiocarbon age determinations and are intended simply as a means of ordering present and future data. They are not intended to segregate particular subsistence and/or settlement adaptations. Since the following time periods will undoubtedly be subdivided and refined in the future, it is preferable not to identify them with specific proper names or numbers but to refer to them only as "early" (before AD 1300) and "late" (about AD 1300 to 1800). These periods are discussed briefly as follows:

"Late" Period

The bulk of the occupational evidence at Perris Reservoir is derived from this period. The inception of the period is placed at AD 1300 because this is a generally accepted date for the appearance of a set of artifact forms over a major sector of western North America (Clewlow 1967; Bettinger and Taylor, n.d.). All the classified small projectile points, including the Cottonwood series and the Desert Side-notched type, pertain to this period and span the duration of it. Other artifact forms that fall within the period but that have shorter temporal duration are lipped disc beads of *Olivella biplicata* (AD 1500 to 1800) and, at Perris Reservoir at least, ceramics of Lower Colorado Buff Ware and Tizon Brown Ware. On the basis of radiocarbon dates from three sites at Perris Reservoir, it must be concluded that ceramics there date from about AD 1600 or later. This date is in close agreement with the estimate of Meighan (1959) for the inception of ceramic use in the southern California coast ranges.

At three sites — Dead Dog, Charles Mott, and Oleander Tank — late period middens are deep, and both ceramics and projectile points occur throughout the deposits. At the Peppertree site, however, Cottonwood series points exhibit a continuous vertical distribution beginning not less than 30 cm below the lowest occurrence of ceramic vessel sherds. There are three possible explanations for this. First, the apparent precedence of projectile points may be due to sampling error (only five sherds were found in Area 2 — see Table 3). A Fisher Exact Test (Siegel, 1956: 95-104) indicates that in the long run, the observed distribution of ceramics and projectile points can be expected one out of seven times under purely random conditions and is therefore not rare enough to be considered statistically significant.

Disregarding such statistical reservations, a second possibility is that Peppertree is the only site at Perris that was occupied just before the late period, sometime after AD 1300 or so, which marks the appearance of Cottonwood series projectile points, but before about AD 1450 to 1600, when use of ceramic vessels apparently began. This would explain the presence of projectile points and the lack of generally younger artifact types, including thin-and full-lipped *Olivella* beads and Tizon Brown and Lower Colorado Buff sherds. Such an interpretation would imply that following early period occupation, the Dead Dog, Oleander Tank, and Charles Mott sites were abandoned and then reoccupied during the late period. Besides being unwieldy, this interpretation cannot be supported by existing evidence since at none of these sites is there any indication of a hiatus in occupation.

A third alternative is that the relatively late appearance of ceramic vessel sherds at Peppertree is due to a shift in the function of that site. Thomas (n.d.) has noted that in the Reese River Valley in west central Nevada, ceramics are present only at relatively permanent winter camps in the pinyon-juniper zone, although there is abundant evidence of contemporaneous aboriginal activity in adjacent biotic communities. According to this interpretation, all sites at Perris would have been occupied throughout the late period. During the first part of this period, ceramics were used in conjunction with more permanent camps at Perris, but they were neither used nor produced during relatively short-term occupations at the Peppertree site. Later, a settlement shift involving the intensified use of local resources resulted in longer occupations there. A concomitant shift in tool types involved the use of ceramic containers. It is worth noting that two ceramic items — one pipe fragment and one probable figurine appendage — occurred below and hence predated the actual appearance of ceramic vessels in Area 2 at the Peppertree site. The first alternative of the three just described is preferable since it is in the fullest accord with extant data. Thus defined, the late period at Perris Reservoir encompasses the San Luis Rey I and II phases of Meighan (1954) and equates with the Marana Period of Bettinger and Taylor (n.d.). A terminal date of AD 1800 has been rather arbitrarily chosen. Since the excavations failed to recover such hallmarks of early California as porcelain, glass beads, and the like, it is believed that aboriginal use of the Perris Reservoir locality terminated either before or at the same time as Spanish settlement of the region.

"Early" Period

The early period at Perris Reservoir applies to all levels that predate the recognized time markers of late prehistoric time. Evidence now at hand pertaining to the early period includes a single Elko-Eared projectile point from Locus 2 at the Charles Mott site, which probably dates from somewhere between 1000 BC and AD 600 (O'Connell, 1967), a radiocarbon date of 2200±80 years BP from Feature 14 at the Peppertree site, and a few basin metates, which appear to date earlier than the Cottonwood series and Desert Side-notched projectile points (older than AD 1300). The period is not well understood, but there is currently nothing by way of either radiocarbon age determinations or known artifact styles to suggest that it extends into the past beyond 1000 BC. Admittedly, the evidence of occupation in the early period is probably in part ambiguous because of a paucity of known time-marker artifact styles. Evidence from Area 2 of Peppertree would seem to suggest continuous sporadic use of the reservoir locality after 2200±80 radiocarbon years ago.

Since the main body of this report was written, additional excavations at the Dead Dog site have revealed the presence there of projectile points of the Rose Spring series (Lanning, 1963) and the Eastgate series (Heizer and Baumhoff, 1961). Chronologically, these projectile point styles date from the period AD 600-1300 (Bettinger and Taylor, n.d.). As far as is presently known, the styles occur in low frequency at Dead Dog, but they do tend to fill in the temporal hiatus between the Elko series of the early period and the Cottonwood series of the late period. They also support the notion of a continuous occupation of the locality, as suggested by the stratigraphic occurrence of bone scraps and debitage in Area 2 at Peppertree, rather than separate "early" and "late" occupations.

Thus defined, the early period at Perris Reservoir spans the Haiwee Period and part or all of the Newberry Period of Bettinger and Taylor (n.d.).

Note added in proof: Since this text was written, an additional radiocarbon age determination was obtained through the courtesy of Rainer Berger and Jerome Kimberlin of the Isotope Laboratory, Institute of Geophysics and Planetary Physics, UCLA. Charcoal from Feature 6, on the occupation surface in Area 2, Peppertree site (4-Riv-463), yielded an apparent modern radiocarbon age (UCLA-1871). See Figure 14 for the stratigraphic relationship between this feature and Feature 4, which yielded a radiocarbon age of 215±60 years.

BIBLIOGRAPHY

ANTEVS, ERNST
1948 Climatic changes and pre-white man. *University of Utah, **Bulletin*** 38:168-91.

ANTEVS, ERNST
1955 Geologic-climatic dating in the West. *American Antiquity* 20: 317-35.

ANTEVS, ERNST
1962 Late Quaternary climates in Arizona. *American Antiquity* 28: 193-98.

ASCHMANN, HOMER
1958 Great Basin climates in relation to human occupance. *University of California Archaeological Survey, Report* 42: 23-40, Berkeley.

ASCHMANN, HOMER
1959 The evolution of a wild landscape and its persistence in southern California. *Association of American Geographers, Annals* 40(3): 34-57.

BARROWS, DAVID P.
1900 *The ethno-botany of the Coahuilla Indians of Southern California.* The University of Chicago Press, Chicago. Reprinted 1967, Malki Museum Press, Banning.

BAUMHOFF, MARTIN AND J. S. BYRNE
1959 Desert Side-notched points as a time marker in California. *University of California Archaeological Survey, Report* 48: 32-65, Berkeley.

BEAN, LOWELL JOHN
1972 *Mukat's People: the Cahuilla Indians of Southern California.* University of California Press, Berkeley.

BEAN, LOWELL J. AND KATHERINE SIVA SAUBEL
1961 Cahuilla ethnobotanical notes: the aboriginal uses of oak. *University of California Archaeological Survey, Annual Report* 1960-61: 237-45, Los Angeles.

BEAN, LOWELL JOHN AND KATHERINE SIVA SAUBEL
1972 *Temalpakh: Cahuilla Indian knowledge and usage of plants.* Malki Museum Press, Banning.

BENNYHOFF, JAMES A.
1953 Bone, antler, and claws. *In* The archaeology of the Napa region, edited by R. F. Heizer. *University of California Anthropological Records* 12: 265-72.

BENNYHOFF, JAMES A. AND ROBERT F. HEIZER
1958 Cross-dating Great Basin sites by California shell beads. *University of California Archaeological Survey, Report* 42: 60-92, Berkeley.

BETTINGER, ROBERT AND R. E. TAYLOR
n.d. Time periods in interior southern California prehistory. *Nevada Archaeological Survey, Research Papers* (In press, ms. 1972).

BINFORD, LEWIS R.
1968 Post-Pleistocene adaptations. *In New perspectives in archeology,* edited by Sally R. Binford and Lewis R. Binford, pp. 313-41. Aldine Publishing Company, Chicago.

BINFORD, SALLY R. AND LEWIS R. BINFORD
1969 Stone tools and human behavior. *Scientific American* 220 (4): 70-84.

BIRDSELL, JOSEPH B.
1968 Some predictions for the Pleistocene based on equilibrium systems among recent hunter-gatherers. *In Man the hunter,* edited by Richard Lee and Irven DeVore, pp. 229-40. Aldine Publishing Company, Chicago.

BOLTON, HERBERT EUGENE
1930 *Anza's California expeditions.* Vols. I-V. University of California Press, Berkeley.

BROWN, ALAN
1966 The aboriginal population of the Santa Barbara Channel. *University of California Archaeological Survey, Report* 69, Berkeley.

CALIFORNIA DESERT ARCHAEOLOGICAL COMMITTEE
1970 Proposed archaeological element for the California Desert Study. Unpublished ms., United States Department of the Interior, Bureau of Land Management, Riverside. Xerox.

CAMPBELL, ELIZABETH W. AND WILLIAM H. CAMPBELL
1935 The Pinto Basin site. *Southwest Museum, Paper* 9.

CAMPBELL, ELIZABETH W. AND WILLIAM H. CAMPBELL
1937 The archaeology of Pleistocene Lake Mojave. *Southwest Museum, Paper* 11.

CASTETTER, EDWARD F., WILLIS H. BELL AND ALVIN GROVE
1938 Ethnobiological studies in the American Southwest, VI, Early utilization and the distribution of Agave in the American Southwest. *University of New Mexico Bulletin, Biological Studies* 5 (4).

CLARKE, DAVID L.
1969 *Analytical Archaeology.* Methuen and Company, Ltd., London.

CLEWLOW, C. WILLIAM, JR.
1967 Time and space relations of some Great Basin projectile point types. *University of California Archaeological Survey, Report* 70: 141-49, Berkeley.

COLTON, HAROLD S.
1939 An archaeological survey of northwestern Arizona, including the description of fifteen new pottery types. *Museum of Northern Arizona, Bulletin* 16.

COLTON, HAROLD S.
1956 Jeddito Yellow Ware. *In* Pottery types of the Southwest, edited by H. S. Colton. *Museum of Northern Arizona, Ceramic Series* No. 3C.

DRIVER, HAROLD E.
1941 Culture element distributions: XVI, Girls puberty rites in western North America. *University of California Anthropological Records* 6: 21-90.

DRUCKER, PHILIP
1937 Culture element distributions: V, Southern California. *University of California Anthropological Records* 1: 1-52.

EULER, ROBERT C. AND HENRY DOBYNS
1958 Tizon Brown Ware. *In* Pottery types of the Southwest, edited by H. S. Colton. *Museum of Northern Arizona, Ceramic Series* No. 3D.

FISHER, R. A.
1934 *Statistical methods for research workers.* Oliver and Boyd, Edinburgh.

FLANNERY, KENT V.
1968 Archaeological systems theory and early Mesoamerica. *In Anthropological archaeology in the Americas,* edited by Betty Meggars, pp. 67-87. Anthropological Society of Washington, Washington.

FRITTS, H. C.
1965 Tree-ring evidence for climatic changes in western North America. *Monthly Weather Review* 93: 421-40.

GEIST, VALERIUS
1971 *Mountain sheep: a study of behavior and evolution.* University of Chicago Press, Chicago.

GLADWIN, HAROLD S., EMIL W. HAURY, E. B. SAYLES AND NORA GLADWIN
1938 Excavations at Snaketown: Material culture. *Gila Pueblo, Medallion Paper* XXV.

GOODMAN, RUTH AND R. RASKOFF
1964 The Bernasconi site in southern California. Southwest Museum, *The Masterkey* 38 (1): 17-25.

GRANT, CAMPBELL
1965 *Rock paintings of the Chumash,* University of California Press, Berkeley.

GRANT, CAMPBELL
1967 *Rock art of the American Indian.* Thomas Y. Crowell Company, New York.

GREENWOOD, ROBERTA
1969 The Browne site. *Society for American Archaeology, Memoir* 23.

GRINNELL, JOSEPH AND ALDEN H. MILLER
1944 *The distribution of the birds of California.* Cooper Ornithological Club, Pacific Coast Avifauna 27.

HALL, E. RAYMOND AND KEITH R. KELSON
1959 *The mammals of North America* (2 vols.). Ronald Press, New York.

HARNER, MICHAEL J.
1957 Potsherds and the tentative dating of the San Gorgonio-Big Maria Trail. *In* An Indian trail complex of the central Colorado Desert, edited by Francis J. Johnston and Patricia J. Johnston. *University of California Archaeological Survey, Report* 37: 22-39, Berkeley.

HARRINGTON, J. P.
1934 A new original version of Boscana's historical account of the San Juan Capistrano Indians of southern California. *Smithsonian Miscellaneous Collections* 92(4).

HARRINGTON, MARK R.
1957 A Pinto site at Little Lake, California. *Southwest Museum, Paper* 17.

HAYDEN, JULIAN D.
1969 Gyratory crushers of the Sierra Pinacate, Sonora. *American Antiquity* 34: 154-61.

HEIZER, ROBERT F. AND MARTIN A. BAUMHOFF
1961 The archaeology of two sites at Eastgate, Churchill County, Nevada: I. Wagon Jack Shelter. *University of California Anthropological Records* 20: 119-37.

HEIZER, ROBERT F. AND M. A. BAUMHOFF
1962 *Prehistoric rock art of Nevada and eastern California.* University of California Press, Berkeley.

HELBAEK, HANS
1969 Plant collecting, dry farming and irrigation agriculture in prehistoric Deh Luran. *In* Prehistory and human ecology of the Deh Luran Plain, by Frank Hole, Kent V. Flannery, and James Neely. *University of Michigan, Museum of Anthropology, Memoirs* 1: 383-426. Ann Arbor.

HELBAEK, HANS
1970 Paleo-ethnobotany. *In Science in archaeology,* edited by Don Brothwell and Eric Higgs, pp. 206-214. Praeger Publishers, New York.

HESTER, T. R. AND R. F. HEIZER
1972 Problems in the functional interpretation of artifacts: scraper planes from Mitla and Yagul, Oaxaca. *University of California Archaeological Research Facility, Contribution* 14: 107-23, Berkeley.

HICKS, FREDERICK
1958 Archaeological investigations in the Yucaipa Valley. *San Bernardino County Museum Association, Quarterly* 6(1).

HOOPER, LUCILE
1920 The Cahuilla Indians. *University of California Publications in American Archaeology and Ethnology* 16: 315-80.

HUBBS, CARL L.
1955 Water, fish, and man in southern California. (Abstract). *Southern California Academy of Sciences, Bulletin* 54(3): 167-68.

HUBBS, CARL L.
1957 Recent climatic history in California and adjacent areas. University of California, Committee on Research in Water Resources, *Conference on Recent Research in Climatology, Proceedings,* pp.10-22. La Jolla.

HUBBS, CARL L., GEORGE S. BIEN AND HANS E. SUESS
1960 La Jolla natural radiocarbon measurements I. *Radiocarbon* 2: 197-223.

HUBBS, CARL L., GEORGE S. BIEN AND HANS E. SUESS
1965 La Jolla natural radiocarbon measurements IV. *Radiocarbon* 7:66-117.

HUDSON, DEE C.
1971 Proto-Gabrielino patterns of territorial organization in south coastal California. *Pacific Coast Archaeological Society, Quarterly* 7 (2): 49-76.

JAEGER, EDMUND C.
1941 *Desert wild flowers* (Revised edition). Stanford University Press. Stanford.

JOHNSON, KEITH L.
1966 Site LAn-2, a late manifestation of the Topanga Complex in southern California Prehistory. *University of California Anthropological Records* 23.

KING, CHESTER
1971 Chumash inter-village economic exchange. *The Indian Historian* 1 (4): 30-43.

KING, CHESTER
1972 Research results. *Society for California Archaeology, Newsletter* 6 (6): 4-5

KING, CHESTER, THOMAS BLACKBURN AND ERNEST CHANDONET
1968 The archaeological investigation of three sites on the Century Ranch, western Los Angeles County, California. *University of California Archaeological Survey, Annual Report* 1968: 12-107, Los Angeles.

KIRK, DONALD R.
1970 *Wild edible plants of the western United States*. Naturegraph Publishers, Healdsburg.

KOWTA, MAKOTO
1969 The Sayles Complex: A late milling stone assemblage from Cajon Pass and the ecological implications of its scraper planes. *University of California Publications in Anthropology* 6.

KOWTA, MAKOTO, J. A. APPLETON, JR., D. V. HARRIS, S. A. M. LANE AND C. A. SINGER
1965 Excavations of the Christensen-Webb site, Menifee Valley, 1963-64. *San Bernardino County Museum Association, Quarterly* 13(2).

KROEBER, ALFRED L.
1908 Ethnography of the Cahuilla Indians. *University of California Publications in American Archaeology and Ethnology* 8: 29-68

KROEBER, ALFRED L.
1925 Handbook of the Indians of California. *Bureau of American Ethnology, Bulletin* 78.

KROEBER, ALFRED L.
1932 Mission Indian basketry designs. *American Museum of Natural History, Guide Leaflet* 55.

KROEBER, ALFRED L. AND M. J. HARNER
1955 Mohave pottery. *University of California Anthropological Records* 16 (1).

KRZYWICKI, LUDWIG
1934 *Primitive society and its vital statistics*. Macmillan and Company, London.

LANNING, EDWARD P.
1963 Archaeology of the Rose Spring site, Iny-372. *University of California Publications in American Archaeology and Ethnology* 49: 237-336.

LEE, RICHARD B.
1965 Subsistence ecology of the King Bushmen. Unpublished Ph.D. dissertation. Department of Anthropology, University of California, Berkeley.

LEE, RICHARD B.
1966 !Kung Bushmen subsistence: an input-output analysis. *In* Contributions to anthropology: ecological essays, edited by David Damas, pp. 73-94. *National Museums of Canada, Bulletin* 230.

LEE, RICHARD B.
1968 What hunters do for a living, or, how to make out on scarce resources. *In Man the hunter*, edited by Richard Lee and Irven DeVore,pp. 30-48. Aldine Publishing Company, Chicago.

LINSDALE, J. M. AND P. TOMIEN
1953 *A herd of mule deer.* University of California Press, Berkeley.

MANN, H. B. AND D. R. WHITNEY
1947 On a test of whether one of two random variables is stochastically larger than the other. *Annals of Mathematical Statistics* 18: 50-60

MARKIN, ALEXANDER C. AND WILLIAM D. BARKLEY
1961 *Seed identification manual.* University of California Press. Berkeley and Los Angeles.

MARSHALL, JOHN
1956 *The Hunters* (16mm film). Film Study Center, Peabody Museum, Harvard University, Cambridge.

MARTIN, ALEXANDER, HERBERT S. ZIM AND ARNOLD L. NELSON
1951 *American wildlife and plants: a guide to wildlife food habits.* McGraw-Hill Book Company, New York. Reprinted 1961, Dover Publications, Inc., New York.

MARTIN, PAUL S. AND PETER J. MEHRINGER, JR.
1965 Pleistocene pollen analysis and biogeography of the Southwest. *In The Quaternary of the United States,* edited by H. E. Wright, Jr., and David G. Frey, pp. 433-52. Princeton University Press, Princeton.

MCCOWN, B. E.
1955 Temeku: a page from the History of the Luiseño Indians. *Archaeological Survey Association of Southern California, Paper* No. 3.

MEIGHAN, CLEMENT W.
1954 A late complex in southern California prehistory. *Southwestern Journal of Anthropology* 10: 215-227.

MEIGHAN, CLEMENT W.
1959 Archaeological resources of Borrego State Park. *University of California Archaeological Survey, Annual Report* 1958-59: 26-44, Los Angeles.

MICHELS, JOSEPH W.
1964 The Snow Creek rock shelter site (Riv-210). *University of California Archaeological Survey, Annual Report* 1963-64: 85-128, Los Angeles.

MICHELSON, RALPH C.
1967 Pecked metates of Baja California. Southwest Museum, *The Masterkey* 41 (2): 73-77.

MUNSELL COLOR COMPANY, INC.
1954 *Munsell soil color charts.* Munsell Color Company, Inc., Baltimore.

MUNSON, PATRICK J., PAUL W. PARMALEE AND RICHARD A. YARNELL
1971 Subsistence ecology of Scovill, a terminal Middle Woodland village. *American Antiquity* 36 (4): 410-31.

MUNZ, PHILIP A. AND DAVID D. KECK
1959 *A California Flora.* University of California Press, Berkeley.

MURDOCK, GEORGE PETER
1949 *Social structure.* The Macmillan Company, New York.

O'CONNELL, JAMES F.
1967 Elko Eared/Elko Corner-Notched projectile points as time markers in the Great Basin. *University of California Archaeological Survey, Report* 70: 129-40, Berkeley.

O'CONNELL, JAMES F.
n.d. Recent prehistoric environments in southeastern Califirnia. *In* Man and environment in the late prehistory of southeast California, edited by J. F. O'Connell. *University of California Archaeological Survey, Annual report,* Los Angeles. (In press, ms. 1972).

OLSEN, STANLEY J.
1971 Zooarchaeology: animal bones in archaeology and their interpretation. *McCaleb modules in Anthropology* 2: 1-30. Addison-Wesley Publishing Company, Inc., Reading.

PYLE, ROBERT L.
1961 *Birds of southern California: annotated field list.* (Revised edition; originally published 1953). Los Angeles Audubon Society, Los Angeles.

RIDDELL, FRANCIS A.
1960 The archaeology of the Karlo site (Las-7), California. *University of California Archaeological Survey, Report* 53, Berkeley.

ROGERS, MALCOLM
1936 Yuman pottery making. *San Diego Museum of Man, Paper* 2.

ROGERS, MALCOLM
1939 Early lithic industries of the lower basin of the Colorado River and adjacent desert areas. *San Diego Museum of Man, Paper* 3.

ROSS, LESTER
1970 4-Ora-190: A descriptive site report of a late prehistoric horizon site in Orange County, California. *Pacific Coast Archaeological Society, Quarterly* 6 (2): 1-136.

RYAN, R. MARK
1968 *Mammals of Deep Canyon, Colorado Desert, California.* The Desert Museum, Palm Springs.

SANDBURG, DELMAR E., JR.
1972 A pictograph site near Los Angeles. Southwest Museum, *The Masterkey* 46 (1): 18-26.

SCHOOLCRAFT, HENRY R.
1851- 1857 *History of the Indian tribes of the United States: Their present conditions and prospects, and a sketch of their ancient status.* J. B. Lippincott Company, Philadelphia.

SCHROEDER, ALBERT H.
1952 A brief survey of the lower Colorado River from Davis Dam to the international border. United States Department of Interior, National Park Service, Santa Fe.

SCHROEDER, ALBERT H.
1958 Lower Colorado buff ware. *In* Pottery types of the Southwest, edited by Harold S. Colton. *Museum of Northern Arizona, Ceramic Series* No. 3D.

SCHULMAN, E.
1947 Tree-ring hydrology in southern California. *University of Arizona, Laboratory of Tree-Ring Research, Bulletin* No. 4.

SCHULMAN, E.
1956 *Dendroclimatic changes in semiarid America.* University of Arizona Press, Tucson.

SIEGEL, S.
1956 *Non-parametric statistics for the behavioral sciences.* McGraw-Hill Publishing Company, New York.

SILSBEE, JOAN M.
1958 Determining the general source of California *Olivella* shells. *University of California Archaeological Survey, Report* 41: 10-11, Berkeley.

SPARKMAN, P. S.
1908 The culture of the Luiseño Indians. *University of California Publications in American Archaeology and Ethnology* 8: 187-234.

STEWARD, JULIAN H.
1929 Petroglyphs of California and adjacent states. *University of California Publications in American Archaeology and Ethnology* 24: 47-238.

STEWARD, JULIAN H.
1933 Ethnography of the Owens Valley Paiute. *University of California Publications in American Archaeology and Ethnology* 33: 233-350.

STEWARD, JULIAN H.
1938 Basin-Plateau aboriginal sociopolitical groups. *Bureau of American Ethnology, Bulletin* 120.

STRONG, WILLIAM DUNCAN
1929 Aboriginal society in Southern California. *University of California Publications in American Archaeology and Ethnology* 26: 1-349.

STRUEVER, STUART
1968 Flotation techniques for the recovery of small-scale archaeological remains. *American Antiquity* 33 (3): 353-62.