COLLECTED PAPERS

OF

ROBERT F. HEIZER

1937-1957

Volume Two

RUSH
1/4 BIND
ANTHRO
LIB

ANTHROPOLOGY

Cat as v. 2
of Collected Papers
for Anthropology

CONTENTS

14

A Manual of ARCHAEOLOGICAL FIELD METHODS

REVISED EDITION

THE NATIONAL PRESS
MILLBRAE, CALIFORNIA

A Manual of ARCHAEOLOGICAL FIELD METHODS

Prepared for use by

THE ARCHAEOLOGICAL SURVEY AND THE
DEPARTMENT OF ANTHROPOLOGY OF THE
UNIVERSITY OF CALIFORNIA AT BERKELEY

Edited by
ROBERT F. HEIZER

REVISED EDITION

THE NATIONAL PRESS
MILLBRAE, CALIFORNIA

Revised edition, 1950

Manufactured in the United States of America

PREFACE

This handbook has been compiled by a group of graduate and major undergraduate students in the Department of Anthropology of the University of California at Berkeley. An instructional and advisory guide of this sort has long been needed here, and the present work, we believe, will be of assistance in introducing beginning students to the subject of archaeological methods.

The authors are fully aware that there are a number of methods which can be employed in site survey, excavation, classification of cultures, and the like. In some measure, they have indicated this awareness by refraining from recommending any special technique and have pointed to the sources in the literature of archaeology where alternative methods are described.

It should be clearly understood that this work has been written with the Central California area in mind and that it is directed toward beginning students in archaeology. Our efforts may be noted by other American archaeologists, and we will welcome from them suggestions for improving our methods.

The editor and his volunteer coworkers express their appreciation to the Institute of Social Sciences of the University of California for a subvention used to defray typing and illustrating costs.

This work is in no sense official; it was conceived and executed in spare time, with the various sections being prepared and critically discussed in weekly evening meetings from October 1948 to March 1949.

Authors of the various sections are: William Y. Adams (V); James Bennyhoff (VI A-C); Chester Chard (XV part); Franklin Fenenga (II); David M. Fredrickson (XV part); Robert Greengo (XV part); Robert F. Heizer (III, XVI, XIX, XX); William King (XVIII); William C. Massey (XIII); Clement Meighan (XII A-D); John C. Mills (IV); Albert Mohr (VI D); Russell W. Newman (VIII part, XIII E); Arnold R. Pilling (IX, XVII); Francis Riddell (VIII part); and A. E. Treganza (VII, XI, XIV).

The preparation of this handbook has been a cooperative project not only on the individual level, but on the institutional level as well. A. E. Treganza of San Francisco State College, Franklin Fenenga and F. Riddell of the California Archaeological Survey, and R. F. Heizer of the Department of Anthropology of the University of California at Berkeley, have each contributed to the volume.

Robert F. Heizer
Editor for the Authors,
Students in the Department
of Anthropology of the University of California at
Berkeley

[March 1949]

PREFACE TO REVISED EDITION

In the past ten months this work has gone through its first printing. We have taken this opportunity to make certain changes in the Manual. Section IV has been revised by F. Fenenga, this revision consisting primarily of a more simplified outline of surveying procedure. Section XX, by R. F. Heizer, is an attempt to present to introductory students some information on chronological methods. This presentation is primarily a guide to the special literature illustrating the matter of archaeological chronology. In addition to the above only minor corrections of wording or spelling have been made.

The authors wish to express their appreciation to other archaeologists who were good enough to volunteer their criticisms of the present work. This revised edition will, we hope, help in making up for some of the obvious deficiencies of the first printing.

The authors
April 1950

CONTENTS

MAPS

FIGURES

I. INTRODUCTION

This handbook of archaeological method has been prepared in order to assist University students whose primary aim is that of becoming archaeologists and to aid non-professional students of California prehistory through the explication of the aims and methods employed in the excavation and systematic recording of archaeological remains.

It is obvious that the results of excavation are not limited simply to the bones of and implements once used by the former Indian inhabitants of an area. If the collecting of artifacts and the satisfying of curiosity were the primary objectives of excavation, then there would be no distinction between the scientific archaeologists and the "pot hunter" or vandal who collects for personal gain or private pleasure. The archaeologist digs in order to learn as much as possible about the culture and life of prehistoric times, and the way in which he digs and the completeness of his recording of the evidences of human activity which are uncovered by his shovel will be the measure of his high purpose as a student of the past. The excavator can never forget that every site, and every object and feature contained in it, is unique and that a specimen once extracted from its matrix can never be seen again in its original context. Photographic and notebook records of an excavation are, therefore, the essential documents which accompany the specimens recovered, and these must be of an order of exactitude and completeness that future prehistorians will find adequate for their specialized investigations. Like all natural resources, archaeological sites are exhaustible, and it is the duty of all excavators to do well whatever they undertake in the way of primary field research.

From W. Taylor's recent work, A Study of Archeology (1948: 154-156), comes the following statement on the responsibility and objectives of the archaeologist with which the authors of this handbook are in agreement:

> "The archivist and the experimental scientist may with impunity select from their sources those facts which have for them a personal and immediate significance in terms of some special problem. Their libraries and experimental facilities may be expected to endure, so that in the future there may be access to the same or a similar body of data. If, however, it were certain that, after the archivist's first perusal, each document would be utterly and forever destroyed, it would undoubtedly be required of him that he transcribe the entire record rather than just that portion which at the moment interests him. He would have difficulty in justifying his research if, knowingly, he caused the destruction of a unique record for the sake of abstracting only a narrowly selected part.
>
> "The gathering of data from archeological sites, in nearly every instance, involves the destruction of the original record. Only to the extent to which that record is transposed to the archeologist's notes is it preserved for study either by the collector himself or by other students. A good axiom for archeologists is that 'it is not what you find, but how you find it,' and it is superfluous to point out that 'how you find it' can be told only from notes and not specimens. An archeological find is only as good as the notes upon it. Therefore only one objective can be sanctioned with regard to the actual excavation of archeological sites: that of securing the most complete record possible, not only of those details which are of interest to the collector, but of the entire geographic and human environment. That which is not recorded is most often entirely lost. In such a situation, selection implies wanton waste . . . Within his broadly given cultural and geographic universe, the archeologist is a technician concerned with the production of data, and, although he should be aware of the concepts and goals of many disciplines, he should not be restricted in his exploitation of the site by the dictates of any of them. Time will come in his study and analysis when these factors will again assume the major role, but when he puts spade to ground the archeologist should be dedicated to an exposition unconfined except by the broadest stretch of the cultural and geographic frame of reference. This is what makes archeology a technique and the archeologist, as archeologist, a technician. His particular problems are concerned with the production of data. When he makes use of these data to some purpose, he becomes affiliated with the discipline whose concepts he employs and whose aims he serves.
>
> "Likewise, the archeologist is obligated to preserve, whether in publication or some permanent repository, the full body of his empirical data and records. Since he has destroyed the original record, his transcript and the recovered specimens are the only substitute. The archeologist has no more justification in submerging part of the record than he would have had in destroying, without record, a part of the original site. Practical considerations, such as space and money, have sometimes been blamed for the failure to preserve the record fully. However valid these factors may be, the extent of their victory over the ideal of full preservations is a measure of the defeat of the very excavations which have been accomplished."

II. AREAL SITE SURVEY

A. PURPOSE OF ARCHAEOLOGICAL SITE SURVEY

An archaeological site survey is designed to provide information on the number, the location, and the nature of the archaeological remains in a given region. It is the logical first step in the archaeological exploration of a given area--a necessary preamble to the planning of an excavation project. In specific terms, the assembling of a systematic site survey is useful in the following ways:

1. As a training project for students and informed amateurs, the prosecution of a site survey affords experience in archaeological method and does not result in the destruction of potential information which invariably accompanies any kind of excavation.

2. The site survey provides the information the archaeologist needs in order to choose a particular site for excavation. By use of these data he can tell which sites are in greatest danger of destruction, which sites have been

least disturbed, at which sites the owner is receptive to excavation work, and in many instances the survey will offer clues to the culture represented at the site.

3. A site survey may, in itself, provide answers to special problems in such fields as ethnogeography and demography. For example, a special study might be made of the relationship between village site locations and any one of such economically important features of the natural environment as streams, oak groves, mussel rocks, slope and exposure, and so forth. Such a study could not be made before there was abundant and exact information on site locations.

4. Site surveys will provide the worker with information on the relative amount of destruction of sites in various parts of the state, hence they will indicate the areas in which excavation projects are most necessary.

Not a single county in California has been thoroughly and adequately explored for archaeological sites and only a minor number of smaller areas have been intensively examined for prehistoric remains. Until such exploration has been completed, we are scarcely in a position to evaluate even partially the archaeological resources of the state.

Methods and problems of archaeological site survey have been discussed by a number of writers. Amongst the longer comments are works by Fisher (1930), Guthe (1928, 1931), Colton (1932: 4, 8), Campbell (1940), O. C. Stewart (1947 a, 1947 b), Brainerd (1948), Wissler (1923), Parker (1929), and Atkinson (1946: chap. 1).

B. METHODS OF ARCHAEOLOGICAL SITE SURVEY

In preparation for a site survey of a given region, the archaeologist should familiarize himself first with all previous archaeological and ethnographic work in the area. Almost every group of Indians in California has been subjected to detailed study and the sections on ethnogeography in these reports locate and identify the Indian villages which were occupied within historic times; many of these villages are now archaeological sites. Local and county histories often provide information on site locations. At Berkeley is a file of ethnographic village names in California with a set of accompanying maps showing site locations.

Nearly every community boasts local amateur historians and local amateur archaeologists and these individuals are the second major source of preparatory information. When their services can be enlisted, they are of invaluable help, not only for what they can tell, but for the other local contacts which they can establish. An integral part of the archaeological survey is the description and illustration of local collections of archaeological materials (see section XVII). All specimens for which the owner can ascribe site locations should be noted. Illustrations can be either scale or outline drawings or photographs. Very often this can best be done if the archaeologist offers to make a catalogue of the collection, one copy of the catalogue to be turned over to the collector.

The third source of information for the archaeological site survey is the actual physical inspection of the terrain by the field worker. Methods will vary with the availability of roads, the density of the population, and other factors but every circumstance requires the archaelogist to explore every bit of the area which he has selected for survey on foot. Obviously such field work is time consuming and the time allotted for survey must bear a realistic relationship to the extent of the area chosen for exploration. Under ideal circumstances, two men should be able to explore and make a record of about five sections of land (5 sq. miles) per day of field work.

Field work can best be done by teams of two men each. Larger numbers are not only unnecessary but may actually be disadvantageous because of interference with stock and crops. It is just as important to secure permission from property owners for the necessary entry connected with site survey as it is when excavation is undertaken. There does not seem to be any short cut around this obligation; careful attention to the closing of gates and to avoiding property destruction attendant upon climbing fences, tramping through planted crops, and similar urban disregard for rural rights will enable the field worker to avoid a prejudicial local reputation.

The necessary portable equipment for field survey comprises the following:

<u>List of equipment carried by a two-man survey crew</u>

Musette bag or knapsack with shoulder straps for carrying equipment
Paper sacks for collecting specimens
100-foot wire-reinforced cloth tape, or steel tape
Small entrenching shovel for emergency excavation and clearing features
Camera, exposure meter, and extra films
Paint brush or light whisk broom for clearing features
4-inch pointer's trowel for exposing features
Pencils for writing notes and marking sacks
Hand level for rough contour work
USGS quadrangle sheets for locating sites
Ruler for making sketch maps and calculating map distances
Protractor for making sketch maps
Compass for determining directions and map making
Spring-back notebook containing Site Record, Feature Record, Petroglyph Record, Continuation Sheet forms, etc., Artifact Record slips, graph paper for mapping, and plain paper for notes

Various additions or substitutions might be made to cover local circumstances or to suit personal preferences. Such a pack can be carried easily by one worker for a day. The second worker can be responsible for carrying a lunch and surface specimens found in the course of survey.

The camera recommended is chosen for light weight and simplicity of operation; workers at Berkeley prefer a twin lens reflex, $2\frac{1}{4}$ x $2\frac{1}{4}$ roll film camera. More elaborate cameras recommended for other archaeological purposes (see section XII) are disadvantageous because of weight and bulk and especially because of the difficulty of obtaining any but the conventional sizes of roll film in small towns.

When a site is located, it should be accurately and completely described, photographed, located on a map, and the surface should be searched for special site features and for artifacts. The method of recording site data is described below in subsection C.

Ordinarily, excavation is not a part of survey, but on occasion burials or other features may be partially exposed by erosion or plowing. The tools necessary for emergency excavation are included in the pack. Heavier tools and boxes may be carried in the car where they will be available if needed.

C. THE USE OF A MINIMUM SITE DATA RECORD FORM

The accompanying form for the recording of site survey data represents one method of securing and preserving data on site locations and site descriptions.[1] The form is a bare minimum. It should be augmented by photographs, descriptions of special features (petroglyphs, bedrock mortars, house pits, stone architecture, etc.), and by description of surface collections. Every entry should be filled in as fully and as legibly as possible.

The site survey form is so organized that blocks of related inquiries occur together. Thus the first seven entries are designed to provide accurate and adequate information on the location of the site, entries 8 through 12 supply information on the ownership and tenancy of the site, entries 13 through 19 provide for a description of the physiographic situation of the site, entries 21 through 25 call for a definition of conditions which have modified or may modify the site, items 26 through 29 describe the aboriginal cultural features observed, and items 31 through 36 provide for a history of the record. Every entry should be filled in as fully as possible and any information which will not fit in the space allotted on the form should be recorded on an Archaeological Record Continuation Sheet, a copy of which is shown on page 6.

The specific entries call for information which can be secured readily in the field during the course of survey work.

[1]Similar site survey data forms have been printed by virtually every organization carrying on archaeological research. The minor differences which they display reflect areal specializations and personal interests.

1. Site.

Any convenient designation for the site may be used in initial field work. Most field workers simply number the sites serially in the order in which they are found. Systematic site designations employed jointly by the California Archaeological Survey and the Smithsonian Institution River Basin Surveys consist of a hyphenated three-unit symbol, viz: first, a numeral representing the state (California is, alphabetically, the fourth state in the union and is represented by "4"); secondly, a three-letter abbreviation representing the county (see list of county abbreviations below); and, thirdly, a number representing the order of designation of sites within a county. Thus the thirty-fourth site located in Santa Cruz County, California, would be represented by the symbol 4-SCr-34. In situations where there is no possible doubt as to what state is involved, the first symbol may be omitted. This official system of site designation should be used only after consultation with the master survey file records.

2. Map

This entry calls for the name of the map on which the site location is marked. The state is not entirely covered by maps of a scale and with detail suitable for site survey records. The closest approximation to a complete coverage is in the series of quadrangle maps published by the U. S. Geological Survey (scales vary from 1/24,000 to 1/125,000). The most useful guides to maps are the Index of Topographic Mapping in California (published by the State Division of Water Resources, 1948) and the guides published by the

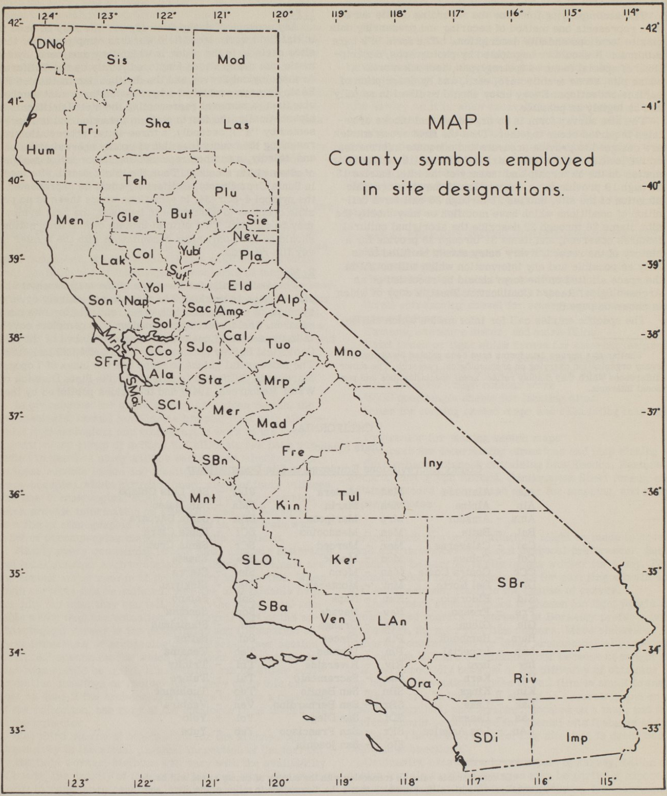
CALIFORNIA

State Symbol = 4

County Abbreviations Employed in Site Designations*

Ala - Alameda	Mad - Madera	SLO - San Luis Obispo
Alp - Alpine	Mrn - Marin	SMa - San Mateo
Ama - Amador	Mrp - Mariposa	SBa - Santa Barbara
But - Butte	Men - Mendocino	SCl - Santa Clara
Cal - Calaveras	Mer - Merced	SCr - Santa Cruz
Col - Colusa	Mod - Modoc	Sha - Shasta
CCo - Contra Costa	Mno - Mono	Sie - Sierra
DNo - Del Norte	Mnt - Monterey	Sis - Siskiyou
Eld - Eldorado	Nap - Napa	Sol - Solano
Fre - Fresno	Nev - Nevada	Son - Sonoma
Gle - Glenn	Ora - Orange	Sta - Stanislaus
Hum - Humboldt	Pla - Placer	Sut - Sutter
Imp - Imperial	Plu - Plumas	Teh - Tehama
Iny - Inyo	Riv - Riverside	Tri - Trinity
Ker - Kern	Sac - Sacramento	Tul - Tulare
Kin - Kings	SBn - San Benito	Tuo - Tuolumne
Lak - Lake	SBr - San Bernardino	Ven - Ventura
Las - Lassen	SDi - San Diego	Yol - Yolo
LAn - Los Angeles	SFr - San Francisco	Yub - Yuba
	SJo - San Joaquin	

* Of considerable value in connection with the survey of county areas will be the excellent map of California which shows the dimensions in miles of the state, and the number of square miles in each county. This was published first on Sheet V of The Geologic Map of California (Jenkins, 1938) and reprinted in Calif. State Div. of Mines, Bull. 118, pt. 2, fig. 43, 1941.


MAP I.
County symbols employed in site designations.
DNo
Sis
Mod
Tri
Sha
Las
Hum
Teh
Plu
Men
Gle
But
Sie
Nev
Lak
Col
Yub
Pla
Sut
Yol
Eld
Son
Nap
Sac
Amo
Alp
Sol
Cal
Tuo
Mno
SJo
CCo
SFr
Ala
Sta
Mrp
SMa
SCl
Mer
Mad
Fre
Iny
SBn
Mnt
Kin
Tul
SLO
Ker
SBr
SBa
Ven
LAn
Riv
Ora
SDi
Imp
124° 123° 122° 121° 120° 119° 118° 117° 116° 115° 114°
42° 41° 40° 39° 38° 37° 36° 35° 34° 33°

University of California, Department of Anthropology

ARCHAEOLOGICAL SITE SURVEY RECORD

1. Site__________ 2. Map__________ 3. County__________

4. Twp.__________ Range__________ ¼ of__________ ¼ of Sec.__________

5. Location__________

__________ 6. On contour elevation__________

7. Previous designations for site__________

8. Owner__________ 9. Address__________

10. Previous owners, dates__________

11. Present tenant__________

12. Attitude toward excavation__________

13. Description of site__________

____

14. Area__________ 15. Depth__________ 16. Height__________

17. Vegetation__________ 18. Nearest water__________

19. Soil of site__________ 20. Surrounding soil type__________

21. Previous excavation__________

22. Cultivation__________ 23. Erosion__________

24. Buildings, roads, etc.__________

25. Possibility of destruction__________

26. House pits__________

27. Other features__________

28. Burials__________

29. Artifacts__________

____

____

30. Remarks__________

____

31. Published references__________

32, UCMA Accession No.__________ 33. Sketch map__________

34. Date__________ 35. Recorded by__________ 36. Photos__________

University of California

ARCHAEOLOGICAL______________RECORD: CONTINUATION SHEET

Site No.______________;______________No.__________

Item No.

Recorded by______________________________ Date______________

State Reconstruction and Reëmployment Commission (1945). These are available for about two-thirds of the area of California. Very similar maps have been prepared by the War Department and the U. S. Forest Service for about one-half the area not covered by U. S. G. S. sheets. The areas which have not been mapped are, for the most part, the areas of least dense population and of least economic importance, and, consequently, surveys of these areas can be postponed most easily. Special maps are always prepared in advance of engineering activity by the Corps of Engineers and the Bureau of Reclamation. Street maps are available for all urban regions. They have been published by various commercial concerns and can be purchased at stationery stores and at the larger newsstands. County maps are published commercially and may also be secured from the County Tax Assessor's or Engineer's office. Stocks of topographic maps are carried by many stationery stores, bookstores, and scientific supply firms. If local distributors cannot supply maps, they can be secured from the original mapping and publishing agencies as follows:

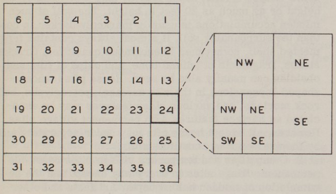
1. Office of Map Information, U.S. Geological Survey, Washington 25, D.C.
2. Commanding Officer, Army Map Service, 6500 Brooks Lane, Washington 16, D.C.
3. Regional Forester, U.S. Forest Service, 630 Sansome Street, San Francisco 11, Calif.

3. County

The full name of the county in which the site is located should be recorded.

4. Location in terms of the Public Land Surveys

The township and section within which a site is located can be read from any recent, large-scale U. S. G. S. map. In maps of one inch to the mile and smaller scales, section numbers are not given. The sketch below illustrates the standard method of section designation. It is desirable to locate sites more specifically than to section. This can be achieved by quarter-section and quarter-quarter section designation as illustrated in the accompanying figure.



Designation of sections within a township (left), designation of quadrants of sections and quarter sections (right)

5. Location

When section designations cannot be secured, this entry should be filled in so as to give an equally specific site location. Thus in the maps of the army engineers this line would be used for a grid coordinate location; for maps of Spanish Land Grant portions of the state, location should be by azimuth readings to prominent landmarks.

6. Contour elevation

Information as to site elevation above sea level can be read directly from any topographic map. It provides additional information for relocation of the site.

7. Previous designations for the site

It is important that any known site name or number in previous use be recorded in order that museum specimens collected by previous investigators may be correctly allocated to the particular site.

8. Owner and 9. Address

This information is necessary for correspondence with the owner for the purpose of securing excavation permits. This information often aids in the location of the site.

10. Previous owners

Previous owners may have information about the history of the site, its modifications, or collections of specimens.

11. Present tenant

It is important to know the name of the individual on the land for public relations purposes.

12. Attitude toward excavation

If this information can be secured in the field, it may make extensive correspondence unnecessary. Any stipulations by the tenant as to excavation should be recorded in detail.

13. Description of site

This entry should describe the type of site (see section on types of sites) and its general physiographic location. A representative entry might read: "shell midden on rocky point about 40 feet above valley floor."

14. Area

This should be accurately approximated by pacing or measuring with a tape.

15. Depth

Thickness of deposit mass can be recorded only when the site is cut by a stream, a road cut, or when survey plans call for test excavations.

16. Height

This measurement should be recorded whenever the deposit has a distinct mound form.

17. Vegetation

This entry calls for a record of native plants which grow on the site. A number of plants, notably tobacco, pigweed, Jimson weed, horehound and buckeye have been noted as being peculiarly associated with archaeological sites.

18. Nearest (fresh) water

Direction and distance to the nearest supply should be recorded.

19. Soil of site

The nature of the site deposit should be described in as great detail as possible. The word "midden," for example, should be modified by such words as loose or compact, ashy, shell-bearing, etc.

20. Surrounding soil types

These should be described, whenever possible, by reference to a California Soil Survey Report published by the U. S. Department of Agriculture.

21. Previous excavation

Any evidence of previous archaeological excavation at the site should be recorded. Obvious pits, local tradition, or printed accounts may provide the information.

22. Cultivation

The number of years of cultivation and mention of the specific crop are useful in estimating the amount of modification of the surface and the time of the year at which excavation is most feasible.

23. Erosion

Sites on the banks of degrading streams or on sea cliffs are exposed to erosion that will ultimately result in their destruction. Even gully wash can rapidly decrease the extent of a site. The nature and extent of any such erosion should be noted.

24. Buildings, roads, etc.

Any modern cultural features which may have modified the site or which may limit the area available for excavation should be described. Such features will appear on the sketch map on the reverse side of the site record sheet.

25. Possibility of destruction

This entry should describe any circumstances, either physiographic or cultural, which threaten the site. Selection of a site for excavation depends in large part upon the imminence of its destruction.

26. House pits

These are the most common surface feature of sites in Central California. House pits should be counted, measured, and plotted on the site diagram on the reverse of the sheet. In a full site description, each separate house pit should be fully described on a Feature Record form, and a reference to this record entered on the Survey Sheet. The number and size of the house pits at an undisturbed site can offer a clue to the approximate population of the site.

27. Other features

Any surface features of aboriginal human origin should be described. Those most frequently found in Central California include: pictographs and petroglyphs, bedrock mortars, bedrock metates, quarries, rock shelters, and, in very recent sites, wood structures such as house remains and grave markers. Feature Record forms should be used to describe any of these and a cross reference to such a record should be made in this space.

28. Burials

Any evidence of the use of the site for burial should be recorded. Such evidence might consist of surface finds of human bones, local traditions of burials having been found, or the presence of grave markers.

29. Artifacts

This entry should record the location of any artifacts recovered from the site. Surface collections made on the site survey, local private collections, and specimens in museums should all be noted. When collections from the site are extensive, many additional pages may be necessary.

30. Remarks

This column may be used for any pertinent additional data not called for on the form. It is often used for "recommendations for additional work."

31. Published references

Bibliographic reference should be made to any published account of the site whether in the ethnographic literature, historical literature, or in archaeological literature.

32. UCMA Accession No.

Specimens received by the University of California Museum of Anthropology are given an accession number. This number is a cross file reference to all correspondence, technical reports, and publications describing the collection.

33. Sketch map

A sketch map showing the route of access, the relationship of the site to its physiographic environs, and major site features should be drawn on the back of the Site Record form. Be sure to indicate cardinal directions and scale. Item 33 should record the name of the individual who drew the sketch map.

34. Date

Enter here the date of filling out the Site Record.

35. Recorded by

Use full name of person recording the data.

36. Photos

Refer by field catalogue number or by roll and file number to the photographs taken on the site. The final record should contain the museum catalogue numbers of these negatives.

D. TYPES OF SITES OF ARCHAEOLOGICAL INTEREST IN CALIFORNIA

A knowledge of what to look for is a prerequisite to successful site survey. Of course, no two sites are exactly alike, but the following descriptions define general types of remains which are of frequent occurrence in California.

1. Permanent village sites are represented by accumulations of midden material which may be as small as 50 feet or as large as a quarter of a mile in diameter. When located on a flat surface, they often have the form of a low, dome-shaped mound, which may be only a few inches in height or as much as 20 feet in height. The soil of such midden accumulations is usually markedly darker in color than the surrounding soil. It almost always contains fragmented shell, sometimes in enormous quantities. Cracked stones, fragments of animal bone, and chips of flint and obsidian can usually also be seen. House pits (saucer-shaped depressions in the site surface), petroglyphs, bedrock mortars, and various other features may be associated as surface features with permanent village sites. However, all except house pits may occur separately and by themselves may constitute sites.

2. Camp sites and temporary village sites resemble permanent village sites in every way except that the accumulation of midden has no depth. Artifacts and other evidences of occupation occur on the surface, sometimes in considerable quantities, but the temporary nature of the utilization of the spot has not resulted in the development of a deep accumulation-refuse earth deposit.

3. Caves or rock shelters formed by a natural cavity in a rock exposure or an overhanging cliff may have attracted aboriginal occupation through the protection from enemies, heat or cold, or rain. Small shelters were often used for storing or caching objects (cf. Campbell, 1931). The rocks are often blackened from smoke, and the walls

may bear petroglyph designs. Such sites may occur anywhere in California except in level alluvial regions, and may yield important cultural remains which have been preserved through dryness of the deposit mass. Exfoliation of stone from the roof or walls of such shelters may bury the evidence of occupation so that excavation is necessary to determine whether the site was used.

4. Mines and quarries are most easily recognized by the quantity of discarded tools and the rejected spalls or unused masses of the quarried material. For a description of numerous California remains of this type see Heizer and Treganza (1944) and for North America in general see Ball (1941).

5. Bedrock mortars are found every place in Central California where exposed rock surfaces occur. They are represented by conical pits in horizontal rock surfaces. In size they vary from 3 inches in diameter by 1 inch deep to 10 inches in diameter by 14 inches deep. The number at a single site may vary from one to several hundred. Pestles may still be present in the pits or may lie near the milling place. Bedrock metates are also known to occur. Both frequently are associated with habitation sites.

6. Petroglyphs are rocks which bear painted, pecked, or incised designs. They may occur either as isolated sites or as features of habitation sites. For a description of many such sites see Steward (1929) and for special methods of recording petroglyph data see Fenenga (1949). A regular form for recording petroglyphs is shown below, and its use is fully described in Fenenga (1949).

7. Isolated finds of artifacts or skeletons should be recorded as to exact locations, but such materials can never be of as much importance as similar objects which occur in fuller cultural context.

8. Special cemeteries are of very rare occurrence in Central California. Where they occur (especially in the Southern San Joaquin Valley), they occupy the summits of knolls not far from permanent village sites. They cannot be located easily except by accidental uncovering.

9. Mourning ceremony areas (called locally "burning grounds") are found in the central Sierra Nevadas. They are recognized by quantities of calcined and melted glass beads on the surface. Aboriginal artifacts may also occur.

10. Buried sites may be found in the vicinity of aggrading streams. They may be sites of any of the previously described types. They are of especial importance because their age may be approximated by geological dating of the overburden of alluvium.

E. THE SELECTION OF A SITE FOR EXCAVATION

Before beginning a job of archaeological excavation, the investigator must be able to assure himself that he is professionally qualified and technically equipped to undertake the particular job he has outlined. Such qualification includes not only a knowledge of archaeological objectives and archaeological field methods, but also a thorough knowledge of all the previous anthropological work in the specific area with which he is concerned. Over and above these requisites, the archaeologist must have the necessary administrative ability to direct the men who are working with him and to ensure smooth public relations with local residents. Finally, the institution which supports excavation must be able to provide permanent adequate care for the resultant collection and funds or means for the publication of the results.

The excavator who cannot fully assure himself that all these prerequisite conditions will be met, no matter what his intentions may be, is committing an act of vandalism against a natural resource of ultimate public interest. Professional and amateur archaeologists are aligned together in condemning any excavating activity which does not result in the full publication of the results of a careful, correct excavation.

The reasons for carrying on archaeological excavation at any particular place and time include the following:

1. Conservation of information.--When archaeological sites are threatened with destruction by such natural agencies as erosion or by such cultural agencies as road building, dam building, leveling for irrigation, etc.

2. Solution of a defined problem.--So little archaeological work has been done in California that the definition of a problem is often as simple as, for example, "to determine the nature of the archaeological remains in the Southern Sierra Nevada foothills."

3. Training of students.--A large proportion of all archaeological excavation is carried on by colleges and universities committed to the professional training of students who will ultimately themselves direct such work.

The selection of a site for excavation depends in some measure upon which of these three general reasons is the paramount objective of the archaeologist. Where conservation is the primary interest, the site selected will be the one threatened with earliest destruction. When several sites will be destroyed simultaneously (as in a dam basin), the site which promises to offer the most information should be the one selected. Generally speaking, the less a site has been disturbed (by recent occupation, by cultivation, by previous digging, etc.), the more information it will yield. Usually the larger and deeper a site is, the greater the chance for sequential occupation, hence the greater the chance for cultural stratification.

When an archaeologist decides to excavate a site in order to solve a previously defined problem, he will select his site upon the basis of information obtained from a survey of the region in which he is interested. This survey might include test pit excavation in each of a number of sites designed to determine the depth of the deposit and the nature of the cultural material. For example, if he wished to test the archaeological relationships between the Coast Miwok and Miwok of Clear Lake, he might begin by excavating a site in each area which had yielded glass beads of the early 19th century.

When the training of students is the primary objective of excavation, the archaeologist will usually choose one closely resembling a site which has already been excavated in order that he may be well prepared for the type of material which the site will yield and can therefore devote a large proportion of time to training activities. Such a choice will also permit the archaeologist to guess in advance what types of archaeological experience will be offered the students by knowing whether or not natural or cultural stratification, burials, structural remains, or other material will probably be found.

The number of man days of labor available for excavation will indicate how large a job can be undertaken. Method of disposal of back dirt, frequency of artifacts, burials and other features, and hardness of the soil are variable elements which limit the amount of excavation accomplished per day. The archaeologist can seldom count on removing more than about 125 cubic feet of soil per man day and his selection of a site should consider labor limitations.

PETROGLYPH RECORD

1. Site______________________ 2. Cross Reference Survey Record____________________

3. Face_____________ 4. Dimensions of Decorated Area______________________________

5. Horizontal Location____

6. Kind of Rock____

7. Position of Rock____

8. Method of Decoration: pecked ( ); rubbed grooves ( ); painted ( ); other ( )

9. Colors____

10. Design Elements____

____

____

11. Superimposition____

12. Natural Defacement____

13. Vandalism____

14. Associated Features____

15. Additional Remarks____

____

____

____

____

____

____

____

16. Published References____

____

17. Sketch__________________________ 18. Scale of Sketch__________________________

19. Photo Nos.____

20. Recorded by____ 21. Date_________________

III. INTERPRETATION OF DATA

The title of this section and its position toward the beginning of the handbook will probably evoke in the reader's mind a question whether this subject is not more properly and logically one to be considered after the excavation is done, when the materials recovered are being studied. The beginning student of archaeology, for whom this work is being prepared, cannot fail to do better work if he has some realization of the fact that the aim of all his digging and preservation of remains in some permanent repository is to find out how people lived in the past. Archaeological techniques per se can never yield all the data for such a reconstruction, since the non-material aspects of culture (e.g., language, religious practices, social organization, government, law, mythology, etc., etc.) leave few or no traces when the people who produced that culture are gone. Only those aspects of life which are expressed in material form can the excavator hope to recover in quantity. With this meager portion of the richer past he must be content and utilize to the utmost degree in his interpretation (cf. Braidwood, 1946a; Atkinson 1946: chap. 6).

At this point we reproduce a lengthy quotation from A. L. Kroeber's recent book[2] on the significance of archaeological objects:

> "When a human hand has made any article, one can judge from that article what its purpose is likely to have been, how it was used, how much intelligence that use involved, what degree of skill was necessary to manufacture the article. All such artifacts--tools, weapons, or anything constructed--are a reflection of the degree of culture or civilization, elementary or advanced, possessed by the beings who made them.
>
> "On the whole the evidence to be got from artifacts as to the degree of advancement of their makers or users is greater than the information derivable from the structure of skeletons. A large brain does not always imply high intelligence. Even a much convoluted brain surface may accompany a mediocre mind. In other words, the correlation between body and 'mind' is incomplete, or has not been worked out. On the other hand, an advanced type of tool implies more skill in its making or its use, and therefore a decided development of the use of intelligence. Similarly, if we find nothing but simple tools occurring among any past or present people, we may be sure that their civilization and their training have remained backward.
>
> "It is true that one cannot infer from a particular manufactured object the mentality of the person or the people who owned and used it. An imbecile may come into possession of a good knife and even possess some ability in using it. But he can acquire the knife only if there are other individuals in his community or time who know how to smelt iron and forge steel. In short, even a single jackknife is proof that human ingenuity has progressed to the point of making important discoveries, and that arts of relatively high order are being practiced. In this way a solitary implement, if its discovery is thoroughly authenticated, may help to establish a relatively high or low degree of civilization for a prehistoric period or a vanished race.
>
> "An implement manufactured by human hands of the past . . . is something made by a human being and reflecting the development of his intelligence into culture . . . In a metaphorical sense, the implements of the past may well be spoken of as the fossils of civilization. They are only its fragments, but they allow us somewhat to reconstruct the mode of life of prehistoric peoples and utterly forgotten nations, in much the same way as the geologist and paleontologist reconstruct from actual fossils the forms of life that existed on the earth or in the seas millions of years ago."

The archaeologist should prepare himself for his field work by a critical reading of all the important literature concerning his special area. From this survey he will gain a knowledge of what is known; in addition, he will probably visualize problems not seen by his predecessors. With this background and stimulated by the desire to try his hand at general and specific problems which he feels his field work will help to solve, the archaeologist is ready to select his site for excavation (section II E).

Among the variety of indications of the life of the people who lived on the site being excavated the archaeologist must keep in mind the significant ones and should make notebook observations of such points as the following. The food supply or economic basis of the group can be estimated by vegetal and animal remains (cf. section X) and by utensils employed in food preparation. Thus, in Central California, fish bone, molluscan shells, vertebrate animal bones, carbonized seeds, fire-cracked cooking stones, stone mortars and pestles, and weapon parts will all contribute to the definition of the ancient economic pattern. Some animals whose bones are present will have been secured for their skins rather than flesh, and identification of these species may offer some insight into the material employed for clothing. If animal bones are abundant, stone or bone skin-dressing tools may also occur frequently, the two observations together pointing to an emphasis on hide preparation.

A piece of baked clay may show a textile impression, and from a series of such imprints the basketry techniques of a former population may be reconstructed (cf. Holmes, 1881). In the clay-using, non-pottery making areas of California this sort of indirect evidence of basketry, plus the presence of sharp pointed bone awls (used in the manufacture of basketry) and occurrence of fire-cracked stones may furnish sufficient evidence to permit the archaeologist to state that the prehistoric people practiced stone-boiling of foods in perishable baskets.

The association of two or more objects, or the correlation of two phenomena in a site deposit, or the observed relationship between some feature of an archaeological site and the environmental surroundings often leads to rewarding inferences concerning life of prehistoric times. Artifacts, and indeed sites as a whole, are clues to human action, and the archaeologist should think of himself as a detective charged with the practical task of extracting as much as possible in the way of the reconstruction of past

---

[2] A. L. Kroeber. Anthropology. New York, 1948, revised edition, p. 623. By permission of the publishers, Harcourt Brace and Co.

events and human activity. Indeed, only by doing this can he approximate a living reconstruction of the past.

The economic life of a primitive people is intimately associated with the elements of its physical environment (climate, fauna, flora, topography, geology, drainage, etc.). There is no better preparation for understanding this interrelationship than a careful reading of the various monographs on Central California tribes in the UC-PAAE and UC-AR series and the relevant chapters in Kroeber's Handbook of the Indians of California.

The houses of the departed villagers whose daily life the digger is investigating may also yield important clues to the size of the family, the complex of household utensils, daily habits, and the like. Here again a knowledge of these details as recorded by the ethnographer from living Indians may prove invaluable in directing certain inquiries and tests of the archaeological data. This technique, it is scarcely necessary to point out, will be most useful and reliable when dealing with recent archaeological sites while the more distant the remains are from the present time, the less reliable and productive will the method become (see Wauchope, 1948).

Religion may be expressed in the form of tangible objects of ceremonial paraphernalia, like charmstones, or, directly, in the mortuary complex. The rigid conformity to extended burial by the Early horizon population of Central California, for instance, must have had a religious connotation. The invariable orientation of the body axis in the westerly direction is probably also an expression of a religious belief that the home of the dead or the path of the soul lay in this direction (cf.Heizer, 1949). In a group with a hunting-gathering economic pattern, there is reason to anticipate some religious observances connected with seed-ripening, animal fertility, and the like, and not uncommonly some indication of the existence of such ceremonies may be observed by the person <u>who is aware of the possibility</u>.

Some aspects of the social situation in antiquity may occasionally be registered in archaeological deposits. Thus a lavishly endowed grave will certainly indicate a wealthy person, a religious practitioner, or a socially or politically eminent person. To which category the buried person belonged in life is a problem for the archaeologist to determine. The differential treatment of individuals according to sex and age may also yield important clues to the social status and role of men and women and this social position may vary considerably through the life span of members of the society. Graves of babies or young children containing a wealth of offerings certainly attest something more than affection and grief felt by parents or relatives on the death of the individual.

Skeletal remains will afford valuable information on age at death, cause of mortality, bone injuries, and certain diseases present in the population, and the total records of skeletal finds may at some future date be employed for demographic studies. S. F. Cook's several monographs published in the University of California Ibero-Americana series (Nos. 17, 18, 21-24) are invaluable background for all archaeologists working in the California field since they are largely concerned with the subjects of disease, population, and social factors which are, at least in part, susceptible to archaeological verification. From the strictly archaeological viewpoint the observations made by N. E. Nelson (1909) in his San Francisco shellmound survey are today important as an example of how observation data may be analyzed.

Much more could be said, but enough has been outlined to demonstrate the main point that the archaeologist must prepare himself as completely as possible in order to be able to take advantage of everything the site has to offer. An occasional omission or failure to observe some significant fact may be condoned as human fallibility, but to be consistently blind to important facts as they are presented to the archaeologist's eyes by the spade or trowel is inexcusable. No matter how precise and accurate may be the archaeologist's methods, he must know <u>how</u> and <u>what</u> to observe and workers must continually seek an improvement of the techniques of observation. As Daniel (1943:59-60) has written, "We cannot justify our claim to be scientific at present unless, together with our technical advances and our accumulation of new data, there goes a new critical appreciation of the method and nature of archaeological science." The terminal bibliography contains a section on "Functional Interpretation of Data" which lists printed articles concerned with making archaeological data culturally meaningful. This recent interest, perhaps most incisively stated by W. Taylor (1949), is in part a reaction to the "typological catalogues" which characterize so much of American archaeological literature. For other works which either employ archaeological data in some unusual manner or for special purpose, or aim at producing a reconstruction of prehistoric life and times, the student is referred to those of Schenck and Dawson (1929:404-405), H. Smith (1910), Steward (1937b), Lewis and Kneberg (1946), Clark (1947, chap. 6), Steward and Setzler (1938).

IV. PREPARATION FOR EXCAVATION

The surveying techniques necessary to the preparation of an archaeological record <u>do not</u> ordinarily require the expensive equipment employed by the topographic surveyor. Nor is a special knowledge of the use of logarithmic tables a prerequisite to archaeological surveying. Extreme care to avoid personal errors, imagination in solving problems arising out of special situations and the ability to substitute field expedients for technical equipment <u>are</u> required. The primary need, however, is a knowledge of what the archaeologist desires to achieve by the use of surveying techniques. Minimally, these would include: a topographic map of the area of archaeological interest, a systematic method for measuring and referring to the locus of "finds," and a series of stratigraphic drawings representing profiles of the cross sections of the deposit. Surveying methods similar to those described here are outlined in Cole (1930), Cole and Deuel (1937:24-27, fig. 16), and Byers and Johnson (1939:192-198). Methods employing more elaborate equipment are described in Atkinson (1936, Chap. 3) and Detweiler (1948). The best available guide is that of Debenham (1947). Other useful reference works are Gannett, 1906; U.S. War Dept., 1941, 1944.

The preparation of a map of the archaeological site is a necessary preliminary to excavation. The function of the map is to show what the site looked like before excavation, the location of excavation units (pits, trenches, etc.) and, ultimately, the location of subsurface features encountered in excavation. When site features are complex, it may be necessary to prepare several maps representing the site at different levels or at different stages of development.

If a site is large and the surface is marked by complex irregularities, it is usually an economy to secure the services of a professional topographic surveyor who possesses the necessary technical equipment for making a map of the site. For most California sites the archaeologist can himself prepare a plat and contour map of accuracy equal to professional standards. It is this type of mapping which will be described.[2a]

A. EQUIPMENT NECESSARY FOR MAPPING

Draughting equipment required includes a drawing board, to which a sheet of cross section paper (10 x 10) is affixed by taping or tacking at the corners, a supply of sharp drawing pencils (no. 3H), a ruler for horizontal measurements and a protractor for measurements of bearing. Measurements on the ground require a Brunton pocket transit (Fig. 2) or a lensatic compass (Fig. 2, a) for measurements of azimuth (bearing), a 100-foot steel or copper reinforced linen tape for horizontal measurements (Fig. 2, b, c) and a sighting level (hand level) and leveling rod for vertical measurements. An alternative leveling method will be described, in which a carpenter's level and a straight edge can be substituted for the sighting level and leveling rod.

B. ESTABLISHING A DATUM POINT

The datum point is the control point to which all measurements refer. It should be located, as nearly as possible, central to the area of archaeological interest (and the area which will be mapped). Actual central location on the site itself is not practicable, since subsequent excavation may result in the destruction of the datum location. In such case, the datum point should be established at one corner of the site grid (see part C and Fig. 4).

When a relatively permanent terrain feature (rock outcrop, solid foundation of a modern building, etc.) occupies a convenient location, a cross painted within a circle on this feature may be used as the datum point. When such a permanent location is not available, the datum point should be marked by driving a metal rod into the ground or, better still, setting a metal rod in a block of cement, and burying this block in the ground so that a short section of the rod protrudes above the surface. Any available rod-shaped piece of metal will do. Segments of gas pipe or a length of angle iron are frequently used. The metal datum rod should be painted with a brightly colored, weatherproof paint. If the datum point is to be used as a point from which magnetic bearings are taken, then the rod must be of non-magnetic metal. The datum point should be located where it will not be disturbed by such activity as plowing (beneath a fence line is often the best such location). It must be remembered that the datum point will be used not only in the course of mapping and excavating the site but will guide future workers to the location of the excavated sections. The datum should be located at a point where it can be seen from the site.

The field notes must contain a description of the object used as a datum point and explicit details as to its location. The datum point should be marked on all maps (the conventional symbol is a cross enclosed within a circle). If the datum point lies beyond the limits of any of the maps or plats made of the site, its location should be designated in the margin by direction and distance.

On large sites it may be desirable to set up secondary datum points. These should be designated sequentially, "Datum B," "Datum C," etc., and their locations must be defined in relationship to Datum A. The notes (and preferably the map) should contain the necessary information on distance and direction of secondary datum points from the main datum.

C. THE GRID SYSTEM

As an aid in mapping and as a method of designating the gross location of finds, archaeologists customarily mark off a site with two sets of parallel lines, each of the sets intersecting the other at right angles. The interval between the lines is usually either five feet or ten feet, the smaller grid interval having advantages in small, deep sites, the larger interval serving better in large, shallow sites. The grid is marked on the site by driving stakes under the intersections of the lines. Pointed wooden stakes, 18 inches long and 1 inch square, serve as well as engineer's locating stakes and cost much less. A small nail driven into the top of the stake will mark the exact intersection.

In laying out the grid, two precautions are necessary. First, in stretching the tape along each grid line, the tape should be taut and level. That is, measurements must be horizontal measurements, not measurements along the slope gradient. Secondly, grid lines should run north to south and east to west (with reference to either magnetic or true north, whichever is used in mapping).

The best method for designating the stakes which mark the grid intersections is in terms of the grid interval. For example, if the datum point is at the southwestern corner of a 10-foot grid system (as in Fig. 4), the southern row of stakes would be labeled 0 N(orth); the second row would be labeled 10 N; the third row, 20 N, etc. The western row would be labeled 0 E; the next row east, 10 E; the third row east, 20 E, etc. Thus each stake would bear a distinguishing designation written n N/n E (n standing for the distance in feet) in one or another cardinal direction from the point of origin of the grid system--i.e., the datum point. An alternative method of grid designation in which stakes in one ordinate are numbered as left or right (L or R) of a base line which crosses the center of the site is illustrated in Figure 1.

[2a]The preparation of topographic maps designed to show the relationship of an archaeological site to the local physiographic environment such as have appeared in Heizer (1949, map 5), Black (1944, Fig. 1), and Wedel (1941, Fig. 2) are desirable in archaeological reports but require a degree of surveying training beyond the scope of this manual. Generally speaking, the methods described here are impractical for mapping an area larger than 200 yards square.

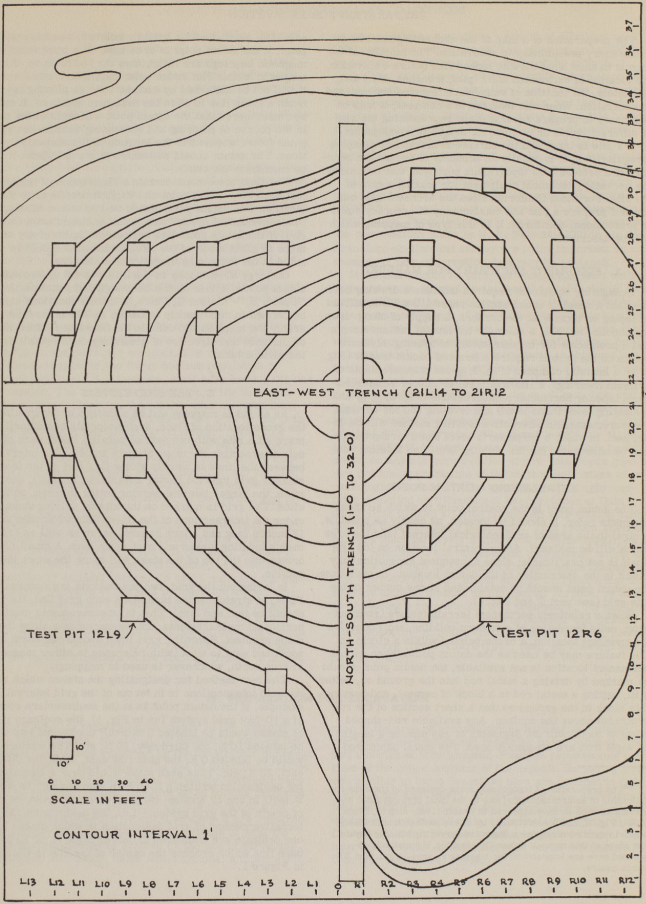


Figure 1. Site Sac-107 laid out for exploratory excavation

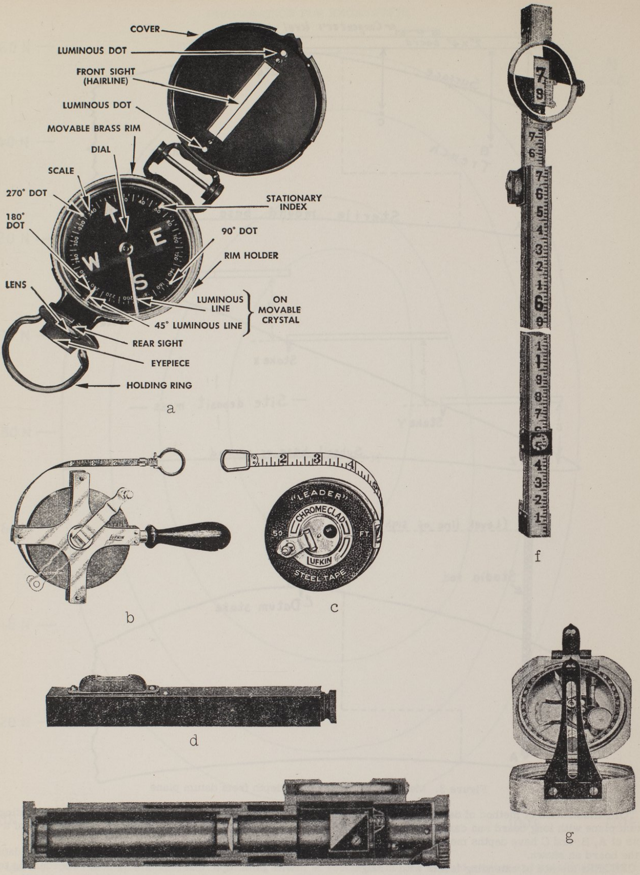


Figure 2. Some equipment useful for site mapping. a, U.S. Army lensatic compass; b, c, 100-foot steel tapes; c, d, hand levels; e, leveling rod with target; f, Brunton pocket transit.

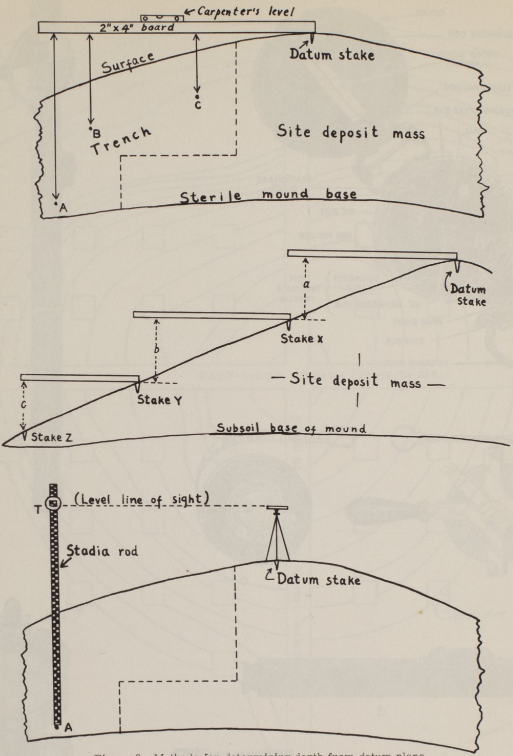


Figure 3. Methods for determining depth from datum plane

TOP: Illustration of method of determining depth from datum plane with long board and carpenter's level. Artifacts at A, B, and C have depths measured from the bottom of the board as shown.

CENTER: Method of extending levels with straight 2″ x 4″ board and carpenter's level. Site surface at stake Z is total feet and inches of sum of distances a, b, c below datum stake. This method is useful in extending the datum plane level and in making a contour map of a site without instruments.

BOTTOM: Method of determining depth from datum plane with telescopic level and stadia rod. Procedure is to place rod base at point where artifact (A) lies, sight through level and read elevation on target (T).

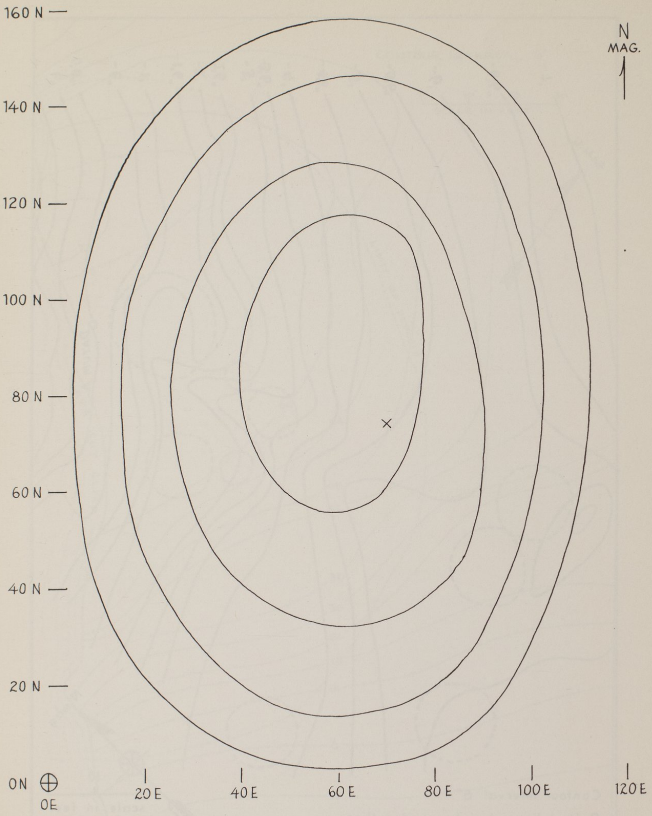


Figure 4. Contour map of a mound site showing datum at southwest corner of grid system and coordinate grid system. Object at X is 74′ north and 70′ east of Datum A.

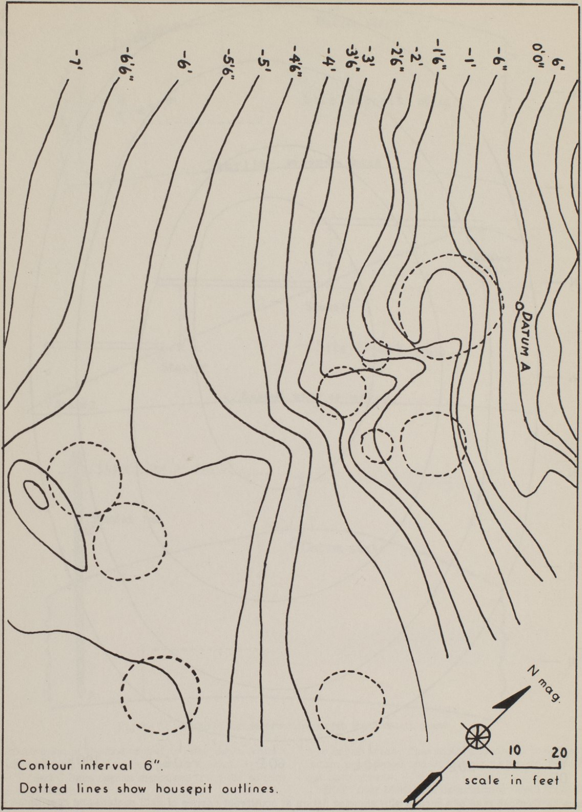


Figure 5. Contour map of site Fre-27

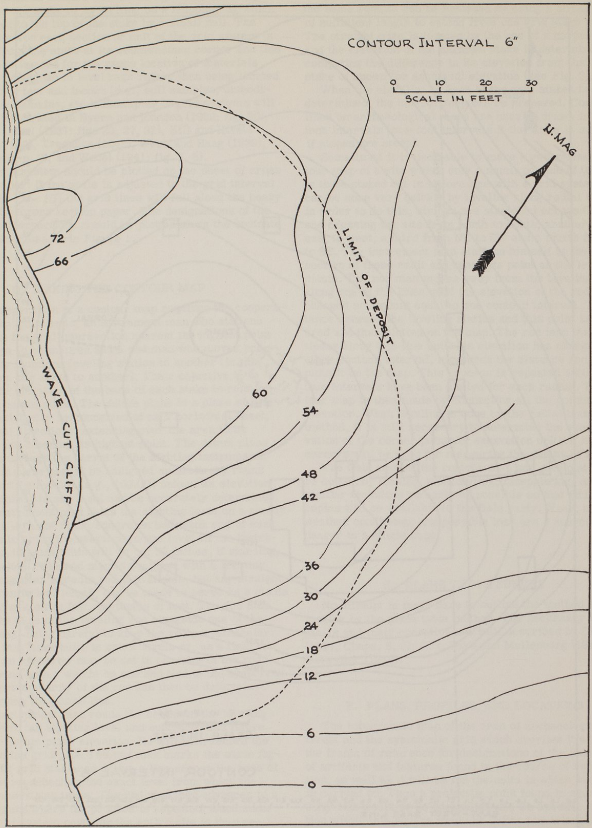


Figure 6. Contour map of Mrn-232B

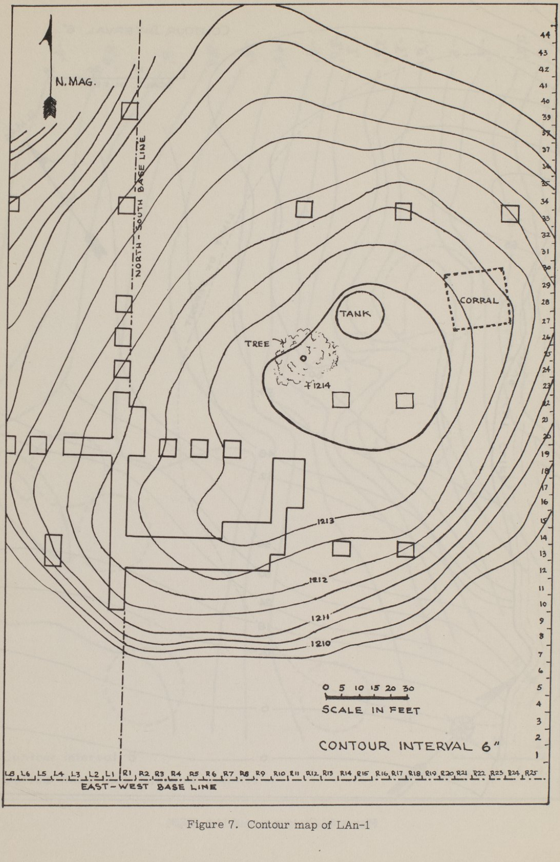


Figure 7. Contour map of LAn-1

Each stake is labeled with its designation, either by writing on the stake or by writing on a shipping tag which is attached to the top of the stake by a small nail. The designation for each section or unit of the grid system is derived from the stake at its southwestern corner and this designation is used for the gross location of materials which are assigned to level bags rather than being located precisely in feet and inches (e.g., soil samples, unmodified faunal remains, etc.). Examples of grid systems will be found illustrated in Byers and Johnson (1939: fig. 20), Cole and Deuel (1937: figs 20, 27, 32), Hill and Kivett (1940:151-153), Treganza (1948), Webb and Haag (1939), Webb (1939, p. 7), and Wedel (1941: fig. 3, 8).

The grid system should be plotted on the sheet of cross section paper. If the scale is adjusted to the grid interval (1″ = 5′ or 1″ = 10′) the grid lines will fall along the heavy lines on the cross section paper. The designations of the grid line intersections should be plotted along the ordinate and the absicissa as in Figure 1.

D. MAKING THE CONTOUR MAP

The preparation of a contour map requires the cooperation of two individuals, an instrument man who stations himself at the grid intersection nearest the highest point of the area to be mapped and a rod man who moves progressively from one leveling station to another (in this case, from one stake to another). Their objective is to record the elevation of the base of each stake in relationship to a datum plane. The datum plane is a plane of reference which may be conceived of as a horizontal sheet, level in all directions, extending over the area to be mapped, and clearing its highest point. The datum plane will pass through the barrel of the sighting instrument. The datum plane should be assigned an arbitrary round figure as its elevation (e.g., 100.00′) unless its elevation in relationship to sea level can be accurately determined.

The instrument man rests the sighting level on a steadying rod, a straight stick, square on both ends and of such length as to bring the eyepiece to eye level (if the instrument man is seated this will be ca. 30 inches, if standing, ca. 66 inches). The rod man is equipped with a leveling rod, an engineer's stadia rod if available, but any straight stick, of sufficient length, can be made to serve as a stadia by marking it off in feet and tenths of feet. The rod man places the base of the leveling rod alongside one of the grid stakes, being careful to keep the rod perpendicular. The rod may have built-in spirit levels or, as a field expedient, an eyescrew may be set in one side of the rod and a string with a weight on one end tied to the eyescrew. The perpendicularity of the rod can then be determined by observing the plumb line.

The instrument man reads the height on the leveling rod through his sighting level and subtracts this figure from the datum plane elevation. He will then record the result on his grid plat. The rod man marks the same figure on the grid stake and draws a line across the base of the stake representing the exact level from which the measurement was taken. The rod man then advances to a second stake where the process is repeated. Each stake of the grid system covering the entire site is thus recorded.

If a sighting level is not available to the archaeologist, the same results can be achieved by using a straight edge of sufficient length to extend from one grid stake to another. The straight edge is leveled by the use of a carpenter's level and the elevation of the unknown stake is determined by computing the difference in its elevation from that of the stake of known (or assumed) elevation (see Fig. 3).

When the elevation of each of the grid stakes has been determined, the contour map can be prepared. Contour lines on archaeological maps are usually drawn in six-inch intervals (one-foot intervals if the scale is small or if slopes are steep).

Sometimes it is desirable to make a generalized contour map of a site where only a small portion of the site is to be staked out in accordance with a grid system. This can be done very quickly by leveling along radial transits. In order to do this, strings are stretched across the site, one crossing the site from north to south, another from east to west, a third from NE to SW and a fourth from NW to SE. The instrument man stations himself at the intersection of these radii and uses this point as the leveling datum. The rod man moves away from the leveling datum along one of the lines until the elevation of the rod has changed an amount equal to one contour interval. The distance between the leveling station and this point is measured and then plotted on the map. The rod man then continues along this line until his elevation has changed another contour interval, measures the distance and again plots it on the map. This process is repeated until the contour intervals have been plotted for each radius. The contour map is then made by connecting all the points of like elevation. When leveling is done by the radial transit method, it is still necessary to determine the exact elevation of the corner points of excavation units if these corners will be used for measuring the depths of finds.

The field copy of the contour map and grid plat should be copied by tracing, photostating, blueprinting, or some similar technique as early as possible so that additional copies will be available to the field party. Wear, adverse weather conditions, and possible loss are a source of danger to a single copy.

E. PLANE TABLE SURVEY

No attempt is made here to outline the method of map making by the plane table method. The necessary instruments and their operation are well described by Debenham (1947, Chaps. 8, 9); Cox, Dake and Muilenburg (1921); Detweiler (1948).

F. PLANS, PROFILES, AND LOCATIONS

The topographic map of the area of archaeological interest and the systematic grid which overlies it will be the frame of reference for designations of the locations of artifacts and features found in the course of excavation, as well as it will be for the units in which excavation is carried on. Thus a projectile point found in square 20N/35E would be so designated and its specific location within this square would be defined by triangulation (cf. fig. 9) or its complete location could be more simply designated in coordinate terms, for example, 22′6″ N 37′4″ E of Datum A. When plats or plans are drawn of site features (usually at a much larger scale than that of the topographic map) the corners and key point within the plat must be located with reference to the datum.

Some archaeologists prefer to designate depth in terms of both the actual surface at a point directly above the find spot and the datum plane but even in those situations where depth from datum plane appears to have no relevance to the stratigraphic situation, it may be necessary to use datum plane depth because the actual surface above the find spot is no longer present. To obtain datum plane depth, one man holds the leveling rod with its lower end at the find spot, a second man sights with the hand level from the leveling station and the reading is subtracted from the datum elevation. If the contour map has been made with sufficient care, actual depth can be determined by comparison.

The horizontal location of any stratigraphic profile should be defined with reference to the datum point and the vertical location of stratigraphic lines should be defined with reference to the datum plane on the profile drawing.

V. METHODS OF EXCAVATION

A large number of published works have concerned themselves with excavation techniques, and references to some of these will be found in section XX.

A. TOOLS

The number and variety of implements which have been employed in archaeological excavation throughout the world is practically limitless. So many special or unusual conditions are likely to be met in the course of excavation that even a bare minimum of equipment must necessarily include a variety of tools. Subject to the limitations imposed by finances, convenience of transportation, and storage in the field, the more the better is a sound general rule.

The following list comprises those implements which have been found essential in Central California archaeology. Large or expensive tools and special equipment will generally be supplied by the institution sponsoring the dig. UCMA and CAS have an ample supply of all equipment to outfit several ordinary crews.

Long-handled, round-point standard no. 2 excavating shovels are recommended. Spades, scoops, and square-point shovels are virtually useless owing to their inability to penetrate any but the softest earth. In the last analysis, the bulk of excavation consists of moving dirt; hence the shovel is the trademark of archaeology and perhaps its most indispensable tool. In Central California it is used more commonly for straight excavation than any other implement and for all backfilling. Ordinarily, enough shovels should be provided so that one may be issued to every member of the crew. The conditions and methods of use of shovels and other tools will be discussed in greater detail below. Shovel handles should be sandpapered occasionally and treated with linseed oil.

Heavy, sharp, stout handled "railroad" picks are most frequently used, though lighter miner's picks or short army pick-mattocks are easier to handle and are preferred by some archaeologists. The use of picks may result in considerable damage to artifacts, and they are generally employed only to loosen deposit too hard for shovels to penetrate. They are nevertheless essential in Central California archaeology, where calcareous and other very hard deposits are often encountered in sites, especially those of the Early and Middle horizons. If this is known to be the condition of the deposit in the site to be excavated, picks should be provided for every member of the crew. Otherwise two or three should be sufficient for the dig.

UCMA has a number of sizes and grades of screens for use under varying circumstances (fig. 8). The sifting of excavated earth through screens enables the archaeologist to recover many materials which might otherwise be overlooked. They are most commonly used for sifting deposit yielding an exceptionally large quantity of artifacts, or very small artifacts such as beads. Screens are also important for sampling site content to determine the actual quantitative composition of the mound deposit. It is almost universal practice to screen the earth removed from the proximity of burials in Central California. Occasionally, when time permits, all excavated deposit is screened.

If a limited amount of screening is contemplated, small window-grade "hand" screens are most convenient. These may be made up in several sizes, in order to "nest" together for more convenient transportation. For more extensive screening shaker screens, which are rocked on a carriage, are useful. The number and variety of screens provided for a dig must depend on the character of the site, but two or three hand screens would probably be a minimum for any site, and a shaker screen should be included whenever possible.

It is often necessary to have water in the immediate vicinity of the excavations, and galvanized buckets are the most useful containers. Burials and artifacts are often washed in situ preparatory to photographing. Buckets are also of occasional use in bailing out ground water from the excavations.

Soil samples from below and around the site at various depths may be important. These are most easily secured with an auger, preferably six or more feet in length. Ordinarily one should be sufficient for a dig. A 2-inch diameter worm auger and a 4-inch barrel auger are usually employed. These can be bought, or borrowed from the Division of Soils of the University.

A tape is indispensable, and should be at least 50 feet long; 100 feet is preferable; one should be sufficient. The measuring tape is essential in marking off the site according to the coördinate system, preparatory to excavation. Steel tapes are superior to cloth ones, though far more expensive, and white-faced tapes are easier to read and less likely to be misread. Tapes must be cared for by oiling and cleaning.

The following smaller implements are also considered essential. It is advisable for each excavator to be provided with one of each, since they may not be otherwise supplied.

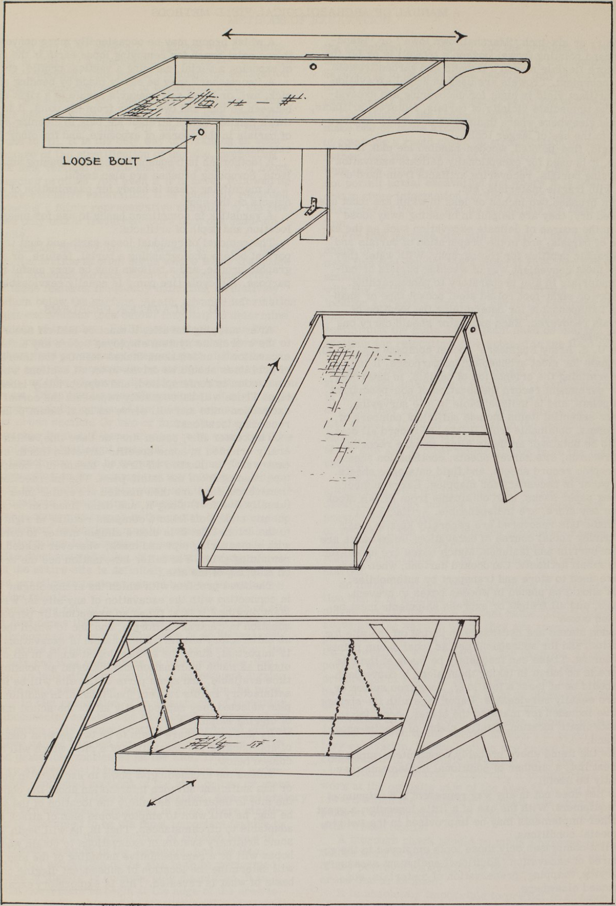


Figure 8. Some screens for archaeological use

A four- or six-inch "Marshalltown Iowa" or "Standard" brand pointing trowel (mason's trowel) is by far the best. More flexible mason's trowels and garden trowels are inconvenient. Trowels are used in actual excavation where artifact yield is high; for uncovering and excavating in the immediate vicinity of burials, features, artifacts, etc., and elsewhere where damage to materials might result from the use of larger tools.

A rigid, fine-pointed, wooden-handled ice pick is advisable. It is used for exceptionally delicate excavation in exposing burials, recovering artifacts from hard deposit, with fragile materials, etc.

Paint brushes two inches or less in width are most useful. Used dry, they are helpful in brushing away loose earth in the course of delicate excavation such as the exposure of burials, and in the preparation of burials and stratigraphic profiles for photography. With water they are the most convenient way of washing burials or cultural materials in situ preparatory to photographing.

A six- or eight-foot rolled steel pocket tape or snap-rule is indispensable for determining the location of materials recovered. Each excavator should carry one in his pocket.

The U. S. Army Engineers' pocket compass (ca. $1.00) is adequate for most archaeological purposes. It is used for determining the orientation of burials, in determining for permanent record the location of non-permanent datum points, and is indispensable in site surveying.

Other essential items include sufficient numbers of blank forms, obtainable from UCMA, to record all data likely to be obtained; artifacts slips, feature records, burial records, site survey sheets, continuation sheets, photographic record sheets, and field catalogue sheets. Graph paper is necessary for mapping. Large numbers of strong paper sacks, also obtainable from UCMA stock or from any store, are indispensable. Artifacts and other materials recovered are generally kept in small sacks during actual course of excavation; large sacks are used for burials and features. Match boxes are useful for storing small artifacts. Cardboard cartons, when feasible, are used to store and transport by automobiles. Burials should be placed in wooden boxes to prevent breakage, and all freight or express shipments must be in wooden boxes.

Wooden stakes are necessary in laying off the site for excavation, and for subsequent use as local datum points in measuring. These can frequently be made at the site, but there is no harm in taking them along if convenient. They should be at least a foot long. Long iron spikes or bolts are equally serviceable. Paper tags with tie-strings should be included for marking the stakes according to their coördinate location. Lastly, plenty of pencils should be on hand.

While the items above probably constitute a minimum equipment list, a number of additional implements may frequently be useful.

This list does not in any way represent a maximum of useful equipment. With the use of a little ingenuity, a great many other implements may be improvised in the field to meet special conditions.

The list comprises only those tools employed in the actual course of excavation. Additional equipment necessary in surveying, mapping, preservation of materials, etc., is discussed elsewhere.

A whisk broom may be occasionally more convenient than a paint brush for removing loose earth in the course of exposing a burial, cleaning a vertical profile, etc.

A "scratcher" may be easily made by bending an ice pick, awl, or large sail-maker's needle to a right angle between an inch and two inches from the point. It is sometimes handier than a straight ice pick in cleaning earth out of burials in the course of exposure, and for other delicate work.

A toothbrush is frequently used for cleaning small objects. Scrubbing brushes are also useful.

A magnifying glass is handy for examination of small objects on the spot.

A yardstick is sometimes handy to use for measuring location and depth of artifacts.

The removal of residual loose earth and dust is important before photographing a burial, feature, or stratigraphic profile, and a bellows may be very useful for this purpose. A bicycle tire pump is equally serviceable.

B. EXCAVATION PROBLEMS

After mapping the site, it must be laid off according to the coordinate system employed before any actual excavation is undertaken. Stakes defining the intersections of grid lines should be driven in on all sections where excavation is contemplated, and appropriately labeled with tags. These will subsequently represent the corners of excavation units and will serve as local datum points in recording locations.

The center line, datum line, or base line, which is generally oriented in some specific direction (north-south or east-west), is marked off first by means of a compass and tape reading from the datum point. The intersections of transverse lines are then marked at regular intervals (usually five feet) along it, and these lines can be subsequently staked off from a compass reading at right angles to the datum line. It is then a simple matter to determine with a measuring tape and mark, wherever needed, the remaining grids. For fuller information see the section on mapping of the site.

The first problem with which the archaeologist is faced in connection with the excavation of any site is: Where to start digging? It is at times an exceptionally perplexing question in Central California, and one to which there is no satisfactory answer. The location of excavation units is important, since the archaeologist wants in all cases to obtain as much information and material as possible in the time available, and some parts of the site will be far more satisfactory in this respect than others. In addition, the plan selected may subsequently affect the actual methods of digging employed.

By and large, there seem to be two general concepts of approaching the excavation of a site, which will be discussed below.

Unless the archaeologist plans to excavate an entire site, or has sufficient advance information about the context of the site to determine definitely the location of the area to be dug, he will want to employ some plan of attack that is adaptable to circumstances. That is, he will begin with some arbitrary system of excavations to obtain what he hopes will be a representative sampling of the site, and will determine the location of subsequent digging on the basis of what is revealed. This is exploratory excavation.

The best and most generally employed way of obtaining what is literally a representative cross section of the site is by trenching. This means commencing excavation in a lineally connected series of excavation units (i.e., squares delineated by the lines of the coordinate system). A trench has a number of specific advantages over excavation in disconnected units. For one thing, it is easier to dig and to fill. It is the only way of obtaining an accurate picture of the stratification of the site, presenting a single long vertical profile instead of a series of short, disconnected profiles. And even if it is never followed up with more extensive excavation, it is generally regarded as producing a fairly representative sampling of the site, provided only that it traverses more than one quadrant of the site.

The location of trenches may depend on surface indications. Excavation is often begun where there are house pits or an abundant surface yield of cultural material, both of these features frequently indicating a relatively high return below the surface. Again, advance information from test excavations (see below) may help to determine the location of trenches. Failing other indications it is common practice to run one or more trenches through the highest (and presumably deepest) part of the site. Trenches need not necessarily be straight, but may be L-shaped, or take whatever direction circumstances seem to warrant. Often two intersecting trenches at right angles are dug through the center of the site as representing the best cross section. Or two or more disconnected trenches may be dug if there appears to be more than one center of concentration of material in the site.

The trench may also be begun in one of several ways, again depending on the judgment of the individual. If the trench is to be entirely exploratory and there are few surface indications, a beginning is sometimes made with a completely connected trench in the center of the site, so that subsequent indications may be immediately followed up. An alternative is to begin in a series of alternate or otherwise disconnected units. If completion of the trench through the entire site is definitely contemplated, it is frequent practice to begin at one or both edges and work toward the middle.

Trenches are not, of course, an infallible index of site content, and hence their use in exploratory excavation is generally augmented by the excavation of additional units in other areas of the site. These serve as a check on the trench data and may sometimes be more valuable than the latter in indicating the location of subsequent digging. They have been used alone, but rarely, and for the most part only in test excavation. The advantages of trenching over disconnected excavations have been discussed above.

Excavation units whose location is determined entirely in advance can be carried out only where there is fairly specific prior information about the site. This is non-exploratory excavation. It includes excavation of an entire site, large connected sections of the site, or one or more trenches where no further work is planned. Non-exploratory trenches are commonly employed in sites where stratification is presumed to be the most important feature to be noted, such as in the excavation of rubbish heaps in the Southwest, mounds in the Southeast, and the like.

Where full excavation of the site is to be performed, the course of digging is considerably simplified. It is then most convenient to begin at the edge of the area to be excavated and work straight through as though it were a single unit. In this way, unless a stratigraphic profile is to be preserved, excavated earth may be thrown into the completed units behind, and the problem of eventual backfilling becomes negligible. Even if the completed excavation is to be kept open, backdirt may be thrown off to the sides without danger of covering units which may subsequently have to be cleared again for excavation.

Occasionally the archaeologist finds it necessary to make one or more excavations primarily for the purpose of obtaining a rapid check on stratification or site content, rather than the recovery of materials. This is particularly true in the course of surveying, where time generally does not permit actual excavation and where it is desirable to obtain some information for the record concerning the character of the site and its suitability for later excavation.

For this purpose test pits are dug. They may be of any shape or size according to their purpose, but are rarely over five feet square. As a general rule they are of the smallest convenient size. Their limits need not coincide with any of the grid coordinates but, in any case, their location and extent should be carefully recorded on the site map in the same way as regular excavations. It is essential that the main datum point used be marked and directions for relocating it be entered in the field notes.

The location of test excavations in the course of surveying is governed to a great extent by the same considerations which determine the location of exploratory trenches in actual excavation. In conjunction with fuller excavation of a site they are often dug in areas where the soil of the site appears to differ from that in the section under excavation; and to check stratification and content at the edge of the site and at other points distant from the main excavations.

The final decision as to the location of excavations must always rest with the individual. Even non-exploratory excavation does not involve any kind of commitment, and any previously conceived plan of work should be abandoned or revised if the circumstances encountered seem to indicate it. It is, however, almost always advisable to complete the excavation of any individual unit which has been started.

So many considerations may affect the plan of excavation that it is doubtful if any archaeologist has ever employed exactly the same system twice. The factors listed above and the ways in which they are generally met are the principal ones, but a great many more are worth considering. Prevailing wind direction, for example, is often important enough to be taken into account in determining the orientation of a trench and especially the direction in which backdirt is thrown. Again, a crop or other vegetation cover (e.g., poison oak, fruit trees, large oaks) may preclude excavation on some parts of the site. Some attention should be given to the matter of where to begin non-exploratory excavation. Where burials are known to be oriented consistently in a specific direction, as in the Early horizon culture of Central California, it is important to begin work at the opposite side of the area to be dug from that toward which the heads are oriented. The physical anthropologist would rather work with broken foot bones than with broken skulls.

A thorough check should be made wherever possible before work is begun to determine the location and extent of any previous excavation on the site, so that disturbed areas can be avoided.

It is absolutely impossible to predict in advance which of the many factors mentioned here may be encountered in the course of any archaeological excavation, or how. For that reason the only safe universal rule which can be stated in regard to the location of excavations is that any system employed should be flexible enough to be adaptable to any circumstance which may arise. Such adaptation must rest on the judgment of the individual in charge of the excavations.

C. METHODS OF EXCAVATION

The method of actually digging units, like the method of locating them, varies according to the character and content of the site. Here again a number of standard systems are in use.

Occasionally a unit or a connected series of units is dug entirely in a horizontal direction from one side to the other, a single vertical face from surface to site bottom being maintained at all times. When optional this method has little to recommend it unless it is necessary to observe and record or photograph the exact stratigraphic position of every artifact (which is almost never necessary). The danger of materials falling out unseen is considerable, and if they do, their location is lost forever. Furthermore, the method precludes the use of any implement but a trowel in soft deposit.

The vertical face method is, nevertheless, the most feasible way of excavating very hard deposit which requires the use of a pick, and as such it finds limited use in Central California. It is rarely necessary to work the entire depth of a unit in this manner, however.

Level-stripping is a widely used variation of the vertical face system. It consists of excavation in a staggered series of vertical faces, from six inches to a foot or more in height, at successive depths, and looks in cross section like a set of steps (cf. Martin, Quimby and Collier, 1946: fig. 1). The result is that levels, rather than coordinate squares, are excavated as discrete units by the workers assigned to them.

Obviously such a method is advantageous only when it can be carried out over a fairly large area, and this must be known in advance; hence it is restricted to non-exploratory excavation, either in trenches or open sections. The principal advantage of level-stripping is in facilitating the observation of stratification and the segregation of materials from different strata. Each vertical face generally extends the depth of a single stratum of the site. The method is in frequent use in the Eastern and Southeastern United States, where stratified sites are common. It necessitates the exclusive use of small excavating implements.

The unit-level method is probably the most common method of excavating sites showing little stratigraphic variation. Here the technique is to dig each section defined by the lines of the grid system vertically as a discrete unit, each being completed by the excavator before another is begun. This is done in a succession of separate levels, each usually 6 or 12 inches deep, the excavation of one level being completed before the next is begun. The unit-level system makes available to exploratory excavation some of the advantages of level stripping. Stratification is easily noted, and it is impossible to lose the approximate vertical location (depth) of any artifact. Unlike any of the other systems, it can be, and generally is, done with a shovel. Occasionally two or more adjacent units are excavated together in this fashion. Deposits from each unit-level may be screened to recover artifacts and other items not noticed at the moment of discovery.

No system of excavation should be rigidly enforced, but all must be adaptable to any conditions which may be encountered, according to the judgment of the individual. It may at times be advisable to combine two or more of these methods, or even to devise new ones. In the notes of any excavation, a careful statement on excavation methods should be set down in order that future workers may know how the materials were recovered.

D. FACTORS AFFECTING EXCAVATION

A number of local factors affect the methods of excavation employed in Central California. The first of these is the size of crews. In contrast to many other parts of the country, archaeology in Central California is almost invariably conducted by very limited numbers of workers on any one site; less than a dozen on the average. This means that it is rarely possible to dig an entire site or even the larger part of a site.

Second, surface collections on Central California sites generally provide very little information about site content, and other advance information is usually lacking. The combination of these considerations makes exploratory excavation practically mandatory.

The most important special consideration in Central California archaeology is the character of the culture complex under investigation. Experience has shown that, regardless of culture horizon, the most significant and revealing cultural feature in this area is almost invariably the burial complex. Half or more of all materials recovered are found in association with burials, and the cultural variations which have been observed in regard to the burial complex have contributed more to anthropological understanding of prehistoric California than any other excavation information.

Exploratory excavation is, therefore, pursued with the primary objective of locating burials; and the finding of them will be the chief factor in determining the location of further excavations. For one thing, a burial almost never lies wholly within a single excavation unit, and hence its discovery necessitates the immediate digging of one or more adjacent units. When time is limited, it may be advisable to excavate only that part of the unit under which the burial is presumed to lie; in extreme urgency it is permissible to undercut trench or pit walls to recover burials which lie considerably below the surface. When any excavation of this sort is being conducted in the vicinity of a burial which has been discovered, a screen or box should be placed over the exposed part of the burial to prevent damage. If these are lacking, the burial may be recovered with earth and its location marked.

Burials very frequently occur in concentrated areas (cemeteries) within sites in Central California, and the discovery of a skeleton will generally be the signal for expanded excavation in the immediate vicinity. Other features which may determine the location of subsequent extension of the excavation unit are house floors, which are often followed out through the excavation of all units within which they lie; high concentrations of dissociated cultural material; or any feature which may strike the excavator as unusual or aberrant. In short, excavation is carried out in such a way as is calculated to give the greatest return in materials and information.

Trenching is by far the most common technique of exploratory excavation in Central California, owing to the specific advantages listed above. The great majority of sites in this area are mounds, which are particularly adaptable to trenching.

Because burials are commonly the principal feature sought in Central California archaeology, the unit-level system of excavation has generally been found most satisfactory. The level-stripping system is, of course, eliminated by the impossibility in most cases of determining in advance the location and extent of excavations. Stratification is rarely sufficient to warrant it. The use of the unit-level system means that when a burial is discovered, the unit will already have been excavated nearly to the depth at which it lies, and the more delicate work of exposing and recovering it can begin at once. This is not true, of course, if the burial lies partially in an unexcavated unit (see above). If the vertical-face system is used, the discovery of a burial will necessitate a great deal more vertical excavation in the area in which it is presumed to lie before exposure can be started.

The size of crews in Central California archaeology is another factor which makes the use of the unit-level method of excavation more practical. The vertical-face system and the level-stripping system are virtually impossible unless a fairly large connected area is being dug at the same time, or unless a non-exploratory trench is being excavated, and both of these are uncommon in Central California. Furthermore, the unit-level system alone permits of the use of shovels and hence considerably more rapid excavation--a factor of considerable importance when small crews are employed. The types of materials generally recovered in this region are not excessively damaged by the use of shovels, and a shovel properly used can be an accurate and delicate instrument.

However, the character and composition of sites in Central California, as elsewhere, vary considerably, and techniques of excavation must be varied accordingly. The virtual necessity of employing the vertical-face system in very hard deposit has already been mentioned. The archaeologist must always decide what adaptations are called for.

E. EXCAVATING A STANDARD UNIT

The preceding discussions of techniques employed in archaeology have been largely theoretical. In order to give a clearer picture of their actual, practical application in the course of ordinary excavation, it may be worth while here to describe chronologically the process of digging a "typical" excavation unit in Central California. This will further serve to illustrate the proper or usual use of the tools employed, a topic which has not previously been discussed.

By a "typical" unit is meant one which shares all the characteristics most commonly found in excavation in Central California. Actually such a unit will rarely be encountered; the vast majority will exhibit at least one special feature which will mark them off from the general average.

The average excavation unit will be five feet square, and its limits will be defined, except where special considerations necessitate modification or exception, by the intersecting lines of the coordinate system. These will be represented on the site by stakes, each bearing a tag giving its coordinate location and marking the corners of the unit. A majority of the sites will themselves be mounds, consisting of soft, dark midden deposit of indefinite depth, often overlaid by a shallow layer of sterile topsoil and underlain by sterile subsoil which is usually gray, yellow, or red clay.

Before beginning excavation of a unit, it is necessary to decide where the excavated earth is to be thrown. Care should be taken to avoid piling it on the surface of any other unit which is likely to be subsequently excavated, or anywhere where it will be difficult to replace at the end of the dig.

Two considerations should be kept in mind at the beginning of excavation. The first of these is the danger of cave-ins--not inconsiderable in the very soft and often damp deposit characteristic of Central California sites. As a general rule, in making any excavation which is likely to be carried to a depth of four or five feet or more, the walls of the pit or trench should be sufficiently sloped inward to insure their stability. The use of this technique means that not all of the deposit contained within a unit as defined on the surface will actually be excavated. The remaining earth lying between the theoretical and actual limits of the unit may, however, be subsequently dug when an adjoining unit is excavated. In such cases care should be taken that materials recovered within this remainder are located for the record within their correct unit according to the site map. The depth to which excavation will be carried in any unit can often be determined quite accurately in advance from its position on the site and indications from near-by excavations. The subsoil contour at the base of a site is usually fairly regular.

Second, it should be remembered that the stakes marking the corners of excavation units must be used in recording the location of all materials subsequently recovered, and their location must therefore be carefully preserved. Regardless of method of excavation, the most satisfactory way of doing this is to leave them standing on top of substantial columns of earth, which are not excavated (i.e., broken down and examined) until the stakes can have no possible further utility. Again, since these columns will lie partially within four separate units, the location of materials eventually recovered from them should be carefully determined. Columns which obstruct the excavation of a burial must, of course, be immediately removed.

Frequently the uppermost stratum, up to six inches or so in depth, of an excavation unit will consist of topsoil. This is often sterile (lacking in archaeological material of any kind). The presence or absence of topsoil, which differs markedly from midden deposit, can be easily determined by test excavation. Even where topsoil is absent, the uppermost few inches of a site, often containing the root systems of a vegetation cover, may be sterile.

Where sterility has been absolutely determined, the surface layer can be dug off with a shovel and thrown aside without examination. This situation exists only when the site yields no surface materials of any kind. Obviously the excavation of any unit must begin with a careful examination of the surface. The presence of surface finds indicates either that the topsoil has been cultivated or otherwise disturbed, or is absent; in any case it is a signal that all deposit within the unit from the surface down must be examined.

When all sterile material, if present, has been removed from the top of a unit, the business of actual archaeological excavation begins. In our "typical" Central California excavation unit this is done with a shovel. Working first along the base of one wall and systematically across to the base of the opposite one, the entire floor of the unit is turned over to a depth equivalent to the length of the shovel blade (6 to 12 inches). As each successive shovelful of dirt is dug, it is spread as thinly as possible over a clean section of the floor of the unit with the edge of the shovel, and carefully examined. If an artifact or other object to be recovered is revealed, its location should be immediately ascertained and recorded on the necessary form before excavation is resumed. After the earth has been examined, it can be scraped into a pile out of the way if necessary. The course of excavation is considerably simplified if this loose, excavated earth is thrown out of the unit and onto the backdirt pile at fairly frequent intervals, rather than being allowed to accumulate in the bottom of the pit. As each unit level is completed, the floor of the pit should be scraped clean and carefully inspected. As the excavation unit becomes deeper, the two (or four) walls should be watched for evidences of pits or stratigraphic layers.

Most of the excavation in Central California is conducted in the manner outlined above. Thus each unit is dug downward in successive levels to site bottom. However, certain special features which require refinements or modifications of technique are almost invariably encountered in the course of excavating any unit. The method of using a shovel is, of course, to place the point on the earth and drive it downward almost vertically as far as possible by pressure of the foot against the back of the blade. If, in so doing, the blade makes contact with any object whatever, the shovel should be immediately withdrawn and the object investigated with a trowel. Should any material worth recovering be revealed, all general excavation ceases until it has been exposed, recorded, and removed. The special excavation techniques employed in recovering burials, cremations, features, and artifacts are discussed elsewhere. If the object cannot be exposed without further large-scale excavation, it should be carefully protected while the latter is in progress. A trained excavator develops, before long, a "touch" or "feel" which serves him so well that the slightest contact with an object is sufficient for him to release pressure and avoid breaking the object. Many experienced workers can tell, from contact, whether they have struck bone, obsidian, burned clay, or stone.

Many other circumstances may make the use of shovels inadvisable--notably the presence of exceptionally numerous and/or small artifacts or of fragile materials. Where these are known to be present, general excavation is normally conducted with a trowel. The best system is to work against a vertical or slanted face of fairly restricted depth (not over a foot), slicing off and examining small amounts of earth at a time with the edge of the trowel. Digging vertically by prying with the point or scraping with the edge of the trowel is poor technique and may result in damage to artifacts. The trowel and the shovel are virtually the only two implements used in general excavation of midden deposit in Central California; the remaining tools which have been listed above are restricted to specific work in the recovery of materials. Picks have no place in the excavation of soft deposit.

Calcareous (hardpan) and other very hard deposits are not uncommonly encountered in Central California sites of the earlier horizons and require considerable modifications of technique. The restrictions which they impose make excavation appear rather unscientific, but there is no alternative, since archaeology here begins to resemble a quarrying operation. Most hard deposit can be dug only with a pick. The first excavations are unavoidably slow and arduous. Once the hard layer has been penetrated, however, further excavation is considerably less difficult. The easiest method is to work against a vertical face extending the depth of the hard deposit. Large chunks may then be dislodged from the face by repeated blows with the sharp point of the pick against the top of the hard layer from three to six inches back of the vertical edge. The excavator must, of course, stand facing toward this vertical face in a previously excavated area when using the pick.

The large chunks of hardpan thus dislodged can then be broken up by a sharp blow with the side of the head of the pick and examined. Needless to say, it is impossible to pulverize this material sufficiently to ensure the recovery of every artifact without a tremendous expenditure of time and effort, and breaking it up into lumps the size of a fist is generally considered sufficient. As a practical matter most calcareous hardpan deposits are not of an adherent nature and, when struck with a blunt instrument, will break cleanly away along the plane of any extraneous object imbedded within them, so that most artifacts do show up when the chunks are hit.

Where more careful work is required by the proximity of a burial or other circumstances which govern the use of a trowel in soft midden deposit, a geologist's or other small "hand" pick is used in hardpan. Still more delicate work can only be done, although inconveniently, with an ice pick, sometimes pounded like a chisel.

In some parts of Central California, particularly the Sacramento-San Joaquin delta region where the average land contour is less than five feet above sea level, the water table is so close to the surface that ground water will actually be encountered above site bottom (indicating that the alluvial sediment has subsided since the site was first occupied). Unless a power-operated pump is available, there is no really satisfactory way of overcoming this obstacle. However, midden deposit below the water level is generally so soft and fluid that it can be probed with a stick, shovel, or trowel, and this is perhaps the best solution.

The unit should be dug down to the lowest level at which the ground is still firm enough to stand on. Then, beginning against the base of one wall and working across the unit, the last few inches of solid earth are removed and examined and the muck beneath is probed. If the shovel or other probe encounters any object, there is no alternative but for the excavator to try to reach it with his hand. If the object is found to be a disassociated artifact, its approximate depth and location can be taken (best done with a yardstick) and it can be removed. If it is a burial or feature worth exposing for notation and photography, the only solution is to dig a sump in the immediate vicinity, deeper than the level at which the burial or feature lies, and bail it continuously with buckets while the object is being exposed.

Bailing is only possible for burials fairly close to the surface of the water. Deeper burials can only be recovered by wading in after them. The depth and location of these deeper deposits can merely be approximated, but the more important matter of the position and relation of associated objects and materials can be determined by feeling with the hand, and can be recorded immediately by a second person standing by with notebook or burial record sheet.

A pump, however, is far superior to any of these make-shift methods, and efforts should be made to obtain one wherever any considerable amount of important material is found to lie below water level.

Wherever possible, units are always excavated down to the base of the site or, in other words, to subsoil. The difference between midden deposit, usually a dark loam, and subsoil, commonly a very fine clay in Central California, is so marked that no excavator should have any difficulty in determining when he has reached site bottom.

Subsoil is always sterile unless it was disturbed by the inhabitants of the site. At the time of the site's earliest occupation, however, there was, at least in some cases, presumably no accumulation of site deposit, and hence the earliest burials may often be found interred in the subsoil. For this reason it is general practice to excavate the first foot or two of subsoil below site bottom in the same manner in which the midden deposit itself is excavated. Always be certain that the excavation of a unit has conclusively gone far enough into sterile subsoil so that there is no possibility of missing burials or artifacts.

F. BACKDIRT AND BACKFILLING

Almost invariably, the archaeologist excavates a site under the agreement that he will leave the land undamaged or as he found it. This means that when excavation is completed, all excavated earth must be replaced in the trenches and pits, and the surface left level and smooth. Backfilling is one of the unavoidable consequences of archaeology, and its ultimate necessity should be borne in mind at all times in the course of excavation. A little foresight in the distribution of backdirt may save a great deal of trouble in backfilling.

In exploratory excavation, excavated earth is generally piled as compactly as possible on the surface at one side of the unit. Do not see how far you can throw the excavated earth--it must all be returned to the hole from which it came. To insure sufficient earth to fill all excavations at the end of the dig, any area on which backdirt is to be thrown should be <u>completely</u> cleared of any vegetation or other cover. Otherwise a considerable amount of dirt may settle and become packed among the plants or other matter and be very difficult to move.

Dirt should not be placed in such a way that it covers the surface of units which are likely to be subsequently excavated. Overly large dirt piles should be avoided, as they are difficult to handle and may necessitate moving the dirt a considerable distance when it is replaced. Unless a stratigraphic profile is to be preserved, it is perfectly permissible to throw earth from one unit into another which has been completely excavated. The principal point is to keep some pattern of backfilling in mind at all times during the course of excavation, so that at the end of work every pit or trench can be refilled with loose earth as near at hand as possible. The earth should be sufficiently packed so it will not settle too much in subsequent rains. While a hole is being filled, the earth should occasionally be tramped on and probed with shovels to pack it down firmly.

Backfilling almost invariably proves a slower job than was anticipated, so that it is of extreme importance to allow adequate opportunity for it when working against time limitations. On the average it takes one excavator from two to three hours to completely refill one five by five unit which has been excavated to a depth of five feet.

A digging crew can sometimes borrow a Fresno scraper or "Mormon board" scraper from a local rancher. Either of these, hooked to a team of horses, a jeep, pick-up truck, or even a passenger car, will fill a site more easily and rapidly than workers with shovels. There is a belief, admittedly open to challenge, that hand-filling is "good for the soul."

G. CAVE EXCAVATION

The excavation of cave sites involves a great many special considerations which do not affect open sites and brings consequent specializations of technique. Limited space, lack of light, distinctive character of the deposit, and especially the far greater preservation of perishable cultural materials in dry caves are all factors which profoundly affect methods of excavation.

Cave sites are not, at least at the present time, an important phenomenon in Central California, and their excavation will not be further discussed here. The following is a representative list of references from which further information on the methods of excavation employed in caves may be obtained: Champe (1947:10-14, fig. 3); Cressman (1942:22, figs. 3-10, 22, 63, 64, 75-79); Cressman, Williams and Krieger (1940:3-5, figs. 1-4, 11-14); Harrington (1933:pls. 8, 12, 15, and text figures <u>passim</u>); Loud and Harrington (1929:1-24, figs. 1-6, pls., 2, 3, 7-9); Steward (1937a:8-9, 91-93, 107, figs. 1, 2, 39, 40, 44, 45, pls. 1-5); Wheeler (1938); Huscher (1939); Zingg (1940: map facing p. 5).

VI. RECORDING EXCAVATION DATA AND COLLECTING ARTIFACTS

During excavation it must be remembered that a site is in a larger sense itself an artifact, resulting from human activity. Under most circumstances digging destroys this artifact, and it is therefore necessary that the archaeologist record by means of notes as complete a description as possible of the site as it is being dug, ever mindful of the fact that his observations will be the only source available to reconstruct the former occupation of the site once excavation has been completed. The object of note taking is to form a running commentary on what is done and how it is done, not merely what is found. The notes should be a record of technique as well as of results, so that future work may be guided by the achievements or errors of a particular dig.

From Taylor (1948:191) comes the following statement:

"... it is possible to say without injustice to any particular field worker that, however carefully the archeologist preserves his findings either in the form of notes or specimens, he always finds that there is information which he needs for his analysis but which he does not have in his records. Critical details will beg for elaboration and clarification during laboratory study, but there will be no way of bettering the situation. Only experience and the failings of former jobs will tell the archeologist what he should be on the lookout for in his next investigation. For these reasons there is only one axiom to be remembered: when in doubt, preserve! Many things which may seem trivial and merely an added burden at the time of excavation may turn out to be of great importance to a full-blown cultural picture. It is worth preserving these data at the expense of a little extra labor and the following out of a few blind leads. When in doubt, preserve!"

Notes should be kept in a bound notebook to prevent loss of loose pages. The type used by surveyors, in which one side of each page is cross sectioned, is extremely useful, for it provides an immediate scale which can be used for drawing artifacts in proper proportion or for mapping. A soft dark pencil of at least No. 2 hardness is most convenient for writing, as it is easily read and more permanent. Attention should be paid to legibility, particularly of numbers, and no esoteric symbols should be used. Notes should be kept in such a condition that they could be understood by anyone referring to them and should be kept as clean as possible under the working conditions.

Any necessary elaborations of data recorded briefly on the site card or site map should be placed in the notes. The datum location should be entered, and an abstract of the plan of the grid layout. While the excavating is being done, particular attention should be accorded depths, stratification, and concentrations.

When the crew is ready to begin actual digging, the site designation, date, and excavation unit should always be stated. Presence and depth of sterile topsoil should be carefully noted at horizontal intervals frequent enough to demonstrate any variation. Depth of plowing or other surface disturbances, such as house foundations, posts, or pits, are of great consequence. The depth of unit levels should be entered and any change noted. Condition of the midden deposit should be given, with reference to composition (shell, sand, ash, clay, etc.), contents (bone, artifacts, stone, etc.), color, consistency (degree of compactness or friability), moisture content, and amount of disturbance by rodents. These factors should receive constant attention and any variations should be noted. Any indications of natural causes should be stated. For example, moisture content may vary considerably, and, while the date will indicate the season, any recent natural or artificial irrigation (rain included) should be recorded.

Stratification is of the utmost importance. It may be visible in the walls of the excavation as a sharp change in color of the midden, by layers of different composition or contents, by a change in consistency. Whatever its nature, an exact depth can usually be given, at frequent intervals. Or stratification may be a gradual transition, lacking distinctness, to be discerned by more subjective observations depending on noted concentrations, though evidence should be more than mere impression. No exact depth can be given, but the general area of change can probably be recorded. This frequently applies to consistency and to contents, such as unmodified rocks. Any stratigraphy of artifact types and animal bone will appear after a study has been made and need not bother the excavator in the field. If no stratification is apparent, it should be so stated.

The tools used should be mentioned. If one level is screened and others are troweled or spaded, a difference in the number of recovered artifacts may result and the several techniques must be taken into account. The methods employed to handle special problems should be included in the notes. For example, if the midden extends below the water table, it should be stated whether water was bailed out of the pit, the muck placed in screens and washed, or what other means of attack were used.

One of the most important functions of the notebook is to keep a record of artifacts which are not included in the permanent collection from the site. This includes such variable data as fragile artifacts which cannot be preserved, inferential evidence such as imprints, the number and nature of ash concentrations encountered, isolated changes in midden consistency, or other phenomena lacking sufficient definition to be recorded as a feature. Occasionally artifacts are too large or of such common occurrence and uniform type that it would be impractical to retain them in a museum. In such cases a full notebook and photographic record should be kept of the number and amount of variation, particularly if any depth difference is noticeable. For large artifacts drawings with dimensions and cross sections should be made in the notebook.

It is also useful to place check references in the notes on the number and location of soil samples obtained and any special pedologic tests which were made and the results obtained.

After the return from the field a permanent copy, preferably typewritten, should be made of the notes and filed where it will be accessible to other students. Problems arise repeatedly from special studies made of the site or its contents, and field notes are of great value to orient students going into a new area.

A. RECOGNITION AND HANDLING OF ARTIFACTS IN THE FIELD

An artifact may be defined as any object manifesting visible human modification. Obvious artifacts, such as projectile points, pipes, or harpoons, are easily recognized by their purposeful manufacture. Any difficulty usually arises from fragmentary pieces or crudely made specimens, but there should be some clue in the shape, material, or method of manufacture to tell whether the piece was made by man.

However, a large portion of man's handiwork is unobtrusive, often resulting without conscious intent from the use of some implement. The solution to such problems depends largely on the experience of the excavator, which can only result from handling and observing the actual specimens. This discussion will emphasize certain typical observations to be made before an object is discarded as unmodified. Careful inspection is the most essential requirement. The eye soon becomes experienced in noticing a meaningful luster or the presence of scratches so that a comprehensive glance is sufficient to indicate the possibility of human modification and the need for more careful scrutiny.

Stone.--One of the most common techniques of manufacture is that of chipping or flaking stone, of sufficient importance to be dealt with at length in section VI D. Another large group of artifacts comprises those resulting from abrasive action. Facets or angularities usually appear when the object is held so that the light reflects from the questioned surface, if the object was made by man. Often the surface is so localized or in such a position that natural causes are impossible. Smoothness is often a useful determinant if the object is not waterworn. Differences in color and in luster are also frequent guides, especially if edges are concerned. Holes and cavities bored in stone by sea worms or clams are usually set at angles with parallel sides and lack the evidence of tool abrasion, conical cross section, or other signs of human manufacture. Ground quartz crystals lack their normal sharp angular edges and clearness. Recognition of abraded surfaces must be acquired by experience. A new student should acquaint himself with the rubbing surfaces of manos, metates, abrading slabs, and similar artifacts before going into the field.

Roughened, macerated edges or ends provide evidence of use in pounding. These localized areas are frequently the only identifying feature of hammerstones, mauls, and crude pestles. Pecked stones usually reveal rough depressions.

Care must be taken in distinguishing between natural and artificial scratches on stone. Man-made incisions usually are localized in some regular pattern or in such conflicting directions that no natural agency could be responsible. Grooving frequently reveals a smoothness, polish, or regularity, if made by humans, while notching usually occurs in some pattern.

Particular attention should be paid to evidence of decoration. Smooth flat surfaces should be held to the light and examined for incising, punctate designs, or applied color. Color frequently appears best when the artifact is wet, but water must be applied only if the color is fast and will not be dissolved.

Pottery and baked clay.--Pottery and baked clay become problems in certain areas of California. Small, unpainted sherds frequently need rather detailed examination to determine their ceramic nature. Curved surfaces, concave or convex edges indicative of the usual coiling, and granular texture are useful guides. Baked-clay objects should be scrutinized for impressions, especially of textiles (i.e., basketry), and for modeling.

Bone and antler.--Before any bone is classed as unworked, it should be examined carefully for traces of modification, especially at the ends. Bones were frequently cut or scratched unconsciously in the quartering of a carcass, leaving marks which are unmistakable. The reader is referred to Kidder (1932:197, fig. 166) for examples of such bones.

The transverse cutting of long bones was a very frequent process by which a V-shaped channel was cut deep enough to allow breakage, leaving a characteristic lip (see Kidder 1932:201, fig. 170). As the articular ends were occasionally utilized for various purposes by the removal of the cancellous interior, they should be examined for evidence of this. Another common example of bone working is cannon bones in the process of being split by "sawing" along the natural medial groove. The excavator should familiarize himself with the unmodified bone and inspect all such bones for man-made changes.

Rounded surfaces and polish are the best determinants by which tools may be distinguished from unmodified fractured bones. All edges and tips should be examined for smoothness and luster, for such artifacts as splinter awls, bone tubes, and scapula tools can easily be overlooked.

Natural foramina should be distinguished from artificial holes which are frequently conical or have traces of cutting. Similarly, teeth with normal polish and grooving from wear should not be confused with artifacts. Incised bone is of common occurrence, but marks of gnawing by rodents or the etching of bone by root action should not be mistaken for evidence of artistic expression.

Shell.--The most easily overlooked shell objects are spoons having only the slightest smoothing of their edges. Any doubtful pieces should be given more attention. Slight traces of notched edges frequently occur and artificial holes are one of the best determinants, as are incised or punctate decorations. Grinding off the spires of Olivella shells and other evidence of cutting should be kept in mind. Familiarity with complete and unmodified shells is a very useful aid.

Perishable artifacts.--Under most conditions wood, fibers, and other plant materials will not be preserved any length of time. However, these objects are often encountered in two special situations in California. One of these is pre-interment grave-pit burning, by which such artifacts as baskets, string, and other textiles, and various wooden objects are preserved by charring. Any ash concentrations should be examined carefully for traces of such remains. In dry caves an even greater amount of organic material fails to decay if water is absent; this is one of the best opportunities for reconstructing the former culture. All pieces of wood should be examined for sharpened ends, evidence of cutting or pounding, and burned pits or ends. Little will be missed if the cultural deposit is screened, and bits of textile, scraps of leather, quids, and fecal matter are saved.

Miscellaneous objects.--Any objects of European manufacture are of extreme importance if they are definitely associated with the cultural deposit and are not intrusive.

If some object is questionable, it is usually advisable to save it until it can be examined more carefully. It is possible that repeated occurrence of some crude object will indicate a definite type of artifact for the site.

There are also a great number of objects, essential in the analysis of the former occupation of a site, which cannot be classed as artifacts because they do not bear any visible modification by man. They can be recognized in two ways:

1. By their occurrence out of normal context. The most abundant example is unmodified animal bone. Its presence in the mound is usually the result of man's quest for food and raw materials. Natural death may account for the presence of animal bone in cave middens and in open sites; the explanation depends on the articulation and completeness of the bones, on the determination of the species represented, and on other evidence of animal occupation of the cave. Likewise most of the seeds, grass, and other plant remains from cave middens should all be saved or noted unless they can safely be ascribed to non-human residents. Unmodified stones are meaningful in sites in the fluvial delta and in shellmounds, where their presence can usually be assigned to the actions of the former inhabitants. Quartz crystals, concretions, and foreign minerals are other examples. To recognize the significance of such objects it is essential that the archaeologist be aware of the general physiography of the local region before he begins work, and that he be familiar with the na-

ture of the archaeological sites of the region and their contents.

2. By definite association. The most significant associations are those involving burials; even unworked objects derive meaning from their position in relation to the human remains or modified artifacts. Unnatural concentrations of unmodified objects or their occurrence in regular patterns are treated as features, examples being fireplaces, cooking stones, or caches of charred acorns. Sometimes an unmodified object is used as an artifact, e.g., a shell used as a container.

B. THE EXCAVATION OF ARTIFACTS

Various tools are used in the excavation of artifacts; occasionally a number of different tools will be needed. Their selection depends on the material from which the particular artifact is made, on the surrounding medium, and on individual preference. The trowel is an all-purpose implement, but special conditions sometimes require other techniques; carbonized textiles, for instance, are a special problem. If the surrounding soil is soft and dry, a stream of air is often a satisfactory means of exposure. If the midden is wet, it may be practical to remove the whole concentration with a shovel and let it fall apart along natural lines of cleavage. If the work is below water level, a small directed stream of water may be useful in removing the coating of mud on the artifacts. Hand picks or railroad picks may be required to cut through hardpan.

All artifacts should be treated as fragile until the excavator is certain of their condition. Direct contact of the excavating tool with the artifact should be avoided, the enclosing medium being removed by such processes as lifting, brushing, or blowing--seldom by scraping. Shell ornaments, antler, and micaceous sheets, especially when wet, require extreme care in excavation to prevent their disintegration. Even charmstones were often made of minerals which tend to decompose with time or after having been in contact with fire.

Whenever possible, an artifact should be excavated in situ, and never extracted until completely exposed and after any associations have been noted. No matter what the material, breakage may result from pulling or prying. Equally important is the loss of possible associations. Before the artifact is removed, its position should be analyzed, including its relationship to other artifacts or features, stratigraphic position, disturbance or conveyance by rodents, or other indications of change after deposition. A photograph and sketch are desirable if there is a significant association suggesting the use of an object, its time of deposition, or other information. If there is an implication of geological antiquity in the associations or stratigraphic position of an artifact, it should not be removed at all, if this is practicable, until competent authorities have viewed it in an undisturbed condition.

If it is necessary to clean an object in order to determine whether it has been worked, its position should be noted before removal. While it is being cleaned, any evidence of adhesive wrapping, shell appliqué, etc., should be watched for and not removed (see section XIII for proper cleaning techniques).

C. THE RECORDING OF UNASSOCIATED ARTIFACTS

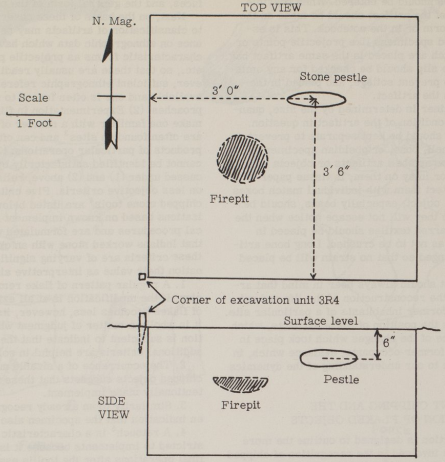
After an artifact has been exposed, its position must be recorded. This information is as significant as the artifact itself. No adequate analysis of the excavation can be made unless each artifact can be accurately placed in relation to other cultural remains. Essential evidence of the extent of cultural change during the occupation of the site is provided when the horizontal locations reveal a clustering, in a particular area of the site, of certain artifacts from which some former activity may be inferred.

Individual judgment must determine which artifacts are not of sufficient importance to warrant exact location; varying with the site, these will always be unassociated and will usually consist of homogeneous objects of such common occurrence that the unit and approximate depth of the level bag provide adequate information on their position. Typical artifacts of this kind are notched net-sinker in Northwestern California, simple baked-clay objects in Central California, and potsherds in Southern California. Fragments which have no diagnostic value (e.g., tips or medial sections of projectile points or awls) may also be included in the level bag. If cultural stratification is known to be present and some common type or material does not conform to the normal distribution, exact depths of aberrant specimens is desired.

The level bag should always bear the site designation, excavation unit, and date, as well as the pertinent range in depth. This range will not be the same for every site; thus, while 6-inch levels are customary, lesser or greater intervals may better suit the particular conditions.

An artifact slip should be made out for all complete specimens or for those fragments which retain some recognizable characteristic which would allow typological identification. The primary purpose of this form is to preserve the record of the location and any remarks on the occurrence of an artifact until such information can be entered in the field catalogue. In addition, it provides an alternative record in case of loss or destruction of the field catalogue or the artifact itself. The advantage of a second record makes the use of the artifact slip preferable to the noting of specimens on the artifact bag. If the slip is not used, special attention should be paid to the completeness of the data entered on the artifact bag, including the sketch of the object.

A sample artifact slip is shown in figure 9. The excavation unit must always be stated. Horizontal measurements are taken from some corner stake agreed upon before the beginning of excavation and are added to the total distance from the datum. If this stake is no longer in position at the time of excavation, it may be necessary to take the measurements from the opposite corner and subtract the value obtained from the length or width of the excavation unit. The compass direction of the reference corner should always be recorded. These measurements are taken parallel to the unit walls and are usually expressed in terms of the cardinal directions. Either direction, N-S or E-W, may be taken first, but as a convenience in later cataloguing it is preferable to be consistent in the order in which the measurements are recorded.



Univ. of Calif. Mus. Anthro. - Artifact Record

Description *Stone pestle (complete, length 10", diameter 4")*

Site *Sol-2* Date *3/4/49*

Pit or Tr. No. *3R4* Depth *6"*

Location *3* ft. *6* in. *N* of Datum *SW corner*

3 ft. *0* in. *E* of Datum *SW corner*

Remarks *Near firepit (recorded as Feature 21)*

Recorded by *AB Lord* Field No. *Sol-2 - 439*

Figure 9. Diagram of excavation unit showing method of triangulation in locating artifacts, and Artifact Record form containing information on location of pestle found in excavation unit 3R4. The measuring tape may be hooked on the corner stake by a nail driven in the top of the stake. The tape should be held level and the object's position determined with a plumb bob. Location by triangulation must be carefully done to insure accuracy.

In determining depth from surface, any irregularity should be allowed for. Pertinent remarks on association, position, or condition should be entered. When possible, a tracing or sketch of the artifact should be made on the back of the record form or in the notebook. This is essential for duplicated specimens like projectile points or shell ornaments which are placed in the same artifact bag. When completed, the slip should be checked for any omissions, then folded to prevent soilage, and placed in the same container with the artifact.

The proper container is determined by the size, quantity, material, and condition of the artifact in question. Large stone objects should be kept separate to prevent damage to fragile shell, bone, or obsidian specimens. It is usually safest to wrap shell artifacts or objects with appliqué, adhesive, or inlay on them, in tissue paper or toilet paper and protect them with individual match boxes or sacks. Any small object, especially beads, should be wrapped or boxed so they will not escape notice when the sack is emptied. Charred textiles should be placed in cardboard boxes so as not to be crushed. Long bone artifacts should be arranged so that no strain will be placed on them.

The archaeologist should always bear in mind that artifacts are basic to the reconstruction of the life and cultural pattern of the former inhabitants of a particular site. Equally important is the position of these artifacts, which may provide evidence of the changes which took place in the activities of the former occupants, evidence which, in turn, may contribute to our understanding of the dynamics of culture.

D. FLINT CHIPPING AND THE RECOGNITION OF FLAKED OBJECTS

The following section is designed to outline the more important principles involved in the recognition of chipped stone objects. A considerable knowledge of these elements not only is essential in field work and the preparation of reports, but is also useful to those engaged in scientific illustration.

The technique of flint chipping is usually employed to shape stone and to form margins suitable for cutting, scraping, drilling, and perforating. This is done by the removal of flakes or chips from the raw material through the application of force on or near its edge (fig. 10 F-H). When a chip is removed, the newly created surface is convex in cross section, tending to be conchoidal or shell-like in appearance (fig. 10 I). On the original mass this leaves a concave "flake scar," which is the mirror image of the flake removed (fig. 10 I).

The removal of these spalls is the basic element of flint chipping and is commonly accomplished by one of two methods--percussion or pressure (described below). The ability to recognize the flake scars left by these techniques is essential. This ability cannot be gained by reading alone, but requires thorough first-hand experience with flint chipping. Though proficiency in the technique is not necessary, continued experimentation will add greatly to one's understanding of the subject.

Identification of chipped stones.--The identification of chipped artifacts and reject material is best approached in the following manner:

First, determine from the flake scars as much as possible concerning the flaking method and the manner in which it has modified the original piece of material. Note the relationships between this modification, unworked surfaces, and the general form of the piece.

Next, on the basis of these observations, three approaches to classification of artifacts may be suggested: (1) Reliance on ethnographic data which have established such characteristic forms as projectile points, spears, knives, etc., so that these are usually readily recognized. However, sufficient ethnographic references are not always available and one is often forced to rely upon other approaches. (2) Experimentation in flint chipping which will make one familiar with a number of reject forms. These are often found on sites[3] and can often be identified as products of particular operations. (3) For objects which cannot be identified satisfactorily by the procedures discussed under (1) and (2) above, reliance must be placed on less objective criteria. Five criteria for identifying chipped stone tools[4] are listed below. They are generalizations based on known implement forms or technological procedures and are formulated with the assumption that Indians worked stone with an objective in mind. Singly these criteria are of varying significance, but in combination their value as interpretive aids is considerable.

1. A regular pattern of flake removal is a good criterion, if the modification is at all extensive. As the number of flakes becomes less, however, its value decreases until it is wholly a matter of judgment what amount of modification is sufficient to indicate that the piece is a tool. Often additional criteria are helpful in solving this problem.
2. The occurrence of a sizable number of similarly chipped objects suggests that these may constitute an intentionally made implement.
3. Similarity to an already recognized type of tool is an indication that the specimen also is a tool.
4. A retouch[5] is a characteristic almost wholly restricted to implements because it is usually one of the final operations after the tool is essentially complete.
5. Signs of use, such as a light battering, "flaking back,"[6] or dulling of a chipped edge or point, are a confirmation that the object is a tool which has been used for chipping, scraping, or boring, as the case may be. Occasionally battering and "flaking back" may be the result of the tool's secondary use as a hammerstone. However, evidence of more intensive use can usually be recognized, since it is almost always exhibited on the several prominent angularities instead of being restricted to the working edge.

Usually all specimens to which the criteria above do not apply are wastage of some sort. These waste pieces ordinarily comprise all, or almost all, of the rejects. The

[3]Although reject material is usually discarded, it is sometimes an important source of information on technological methods employed. An excellent demonstration of this may be found in Roberts (1935: 19-20).

[4]For lack of better words, tool and implement are here used to designate all intentional forms (except unmodified primary flakes) created as the final result of a flaking operation.

[5]A retouch is the removal of irregularities (usually by pressure) from a previously worked edge or surface by means of more refined flaking.

[6]"Flaking back" is the removal of spalls from an edge through the use of the edge in chopping, scraping, etc. It may be a result of either pressure or percussion.

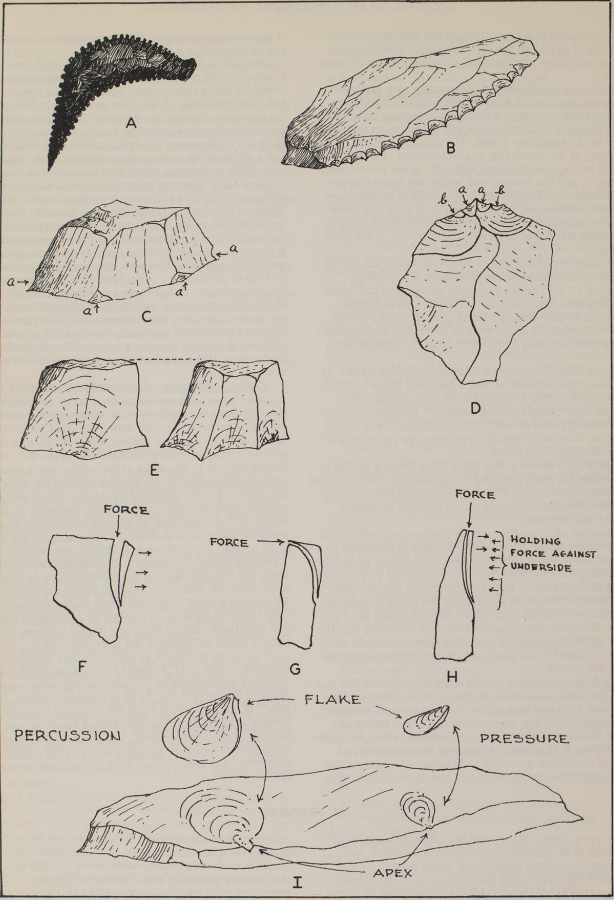


Figure 10. Chipped stone artifacts and flint flaking technique

few specimens which have some of the five features characteristic of tools can usually be identified as forms to be expected in the production of associated chipped stone objects.

The preceding characteristics usually are sufficient to identify implements from reject material, but there will always be occasions when no satisfactory conclusion can be reached, although these will decrease as the experience of the examiner grows. The observer cannot always be certain of the fracturing characteristics of a particular piece of stone, the intentions and skill of the person working with it, and the results with which the stone chipper was satisfied. If, in addition, a specimen is fragmentary, patinated, waterworn, sandblasted, or if it is of a material (like quartz) that does not show flake scars clearly, its identification may be even more difficult, if not impossible.

The illustrations of figure 10 demonstrate the analytical approach outlined in the preceding paragraphs.

Figure 10 A-C shows generally recognized tool types. For descriptions of the wide variety of chipped stone forms, the reader should consult general works on the subject (Holmes, 1919) as well as individual archaeological reports (Amsden, 1935, 1937; Rogers, 1939; Wilson, 1899).

Figure 10 A illustrates a bifacial, pressure-flaked object, the whole exterior of which has been shaped. Ethnographic information identifies it as "an artificial bear claw for bear-impersonating dancers" (Schenck and Dawson, 1929:372; Barrett and Gifford, 1933:213) and establishes the form as a definite type developed through particular flaking procedures.

Figure 10 B shows a thin flake from which a series of short chips has been removed (by pressure) in a line along the margin of one side. The regularity suggests that this is an intentionally fashioned tool. This type is usually called a side scraper.

A number of large flakes have been struck from about the periphery of the planate side or base of the piece shown in figure 10 C. After this was done, the angular projections left at the points marked "a," were removed by pressure flaking from the base. If this modification had not been carried out, it might be argued that the piece was simply a waste core, a mass from which needed flakes were removed. However, this pressure retouch indicates that the larger piece is in itself a tool. The specimen would ordinarily be classed as a plane, which is a variety of scraper for heavy duty.

Two flakes have been struck from each side of the margin of the piece illustrated in figure 10 D. Small projections have been battered off at "a" and a slight amount of "flaking back" has occurred at "b." The extent and type of flaking exhibited by this specimen raises the question whether it is actually a tool, but the battering and "flaking back" can probably be considered confirmation of its intentional manufacture and use as such. This type of implement, especially if better developed, would usually be classed as a bifacial chopper.

One side of the flake shown in figure 10 F consists of a large bulb of percussion, while on the opposite surface there are three flake scars. All the apexes are at the same end. The regularity of the flake scars might indicate that the specimen (despite its thinness) is a tool conceived on somewhat the same principle as those shown in figures 10 B and C. However, experimentation with flint chipping and a study of the technological aspects of the manufacture of the specimens would also indicate that it could be either a flake trimmed from a plane like the one shown in figure 10 C, or a flake removed from a core for use. Which of these three possibilities is the most likely would depend on other factors. If there were similar pieces showing the same bulb and scar arrangement and if heavy planes (fig. 10 C) occurred, a trimming flake would be suggested. However, if a number of pieces showed no bulb of percussion, a tool type would be more likely. On the contrary, if there was evidence of the use of flakes of this material in the manufacture of small implements, the piece might be a flake removed for this purpose. From this sort of indirect approach, based on the presence or absence of certain objects, a reasonable conclusion may be reached, if the application of objective test criteria are not possible.

Flaking techniques.--In percussion flaking the piece of material is held against some slightly yielding support, such as one's leg (protected by leather), and a blow is struck on or near the edge with a small stone or a short length of wood, bone, or antler. When the blow is directed parallel to the surface from which the flake will be removed (fig. 10 F, H), while at the same time a reasonable amount of pressure is maintained against the same surface (by one's leg), the spall will be longer than if the force is applied obliquely (fig. 10 G) and this pressure is not maintained. In this operation no special preparation is needed when the force is to be directed at a surface, but if it is to be applied to a thin edge, it is first necessary to employ a process called "clipping." Clipping consists of rubbing some hard object (usually the hammerstone or other flaking tool) along the margin to degrade the thin edge and thereby provide a solid base upon which to deliver the blows (fig. 10 H). In general, scars left by percussion flakes are relatively large, broad, and deeply concave, and often show a slight battering at the apex (fig. 10 I).

A common method of pressure flaking is to hold the material in the hand (protected by leather) and to detach the flake by pressing on or near the edge with a pointed piece of antler or bone. As in percussion flaking, "clipping" is often necessary and the length of the chip is largely controlled by the direction of the force and the amount of pressure exerted. Ordinarily, flake scars resulting from pressure chipping are smaller, relatively narrower, and less concave than those made by percussion.

VII. FEATURES

The word "feature" is used here to denote those material items in or about archaeological sites which are either atypical of the general run of the deposit or not frequently encountered on the surface or in the vicinity of an aboriginal habitation. Generally speaking, features constitute something which is not brought back to the laboratory or museum. Thus, an ash lens, house floor, cache of unworked stones, earth oven, storage pit, and the like are generally called features. Groups of artifacts such as a cache of charmstones or net-sinkers, raw implement material chunks found together, or an animal burial in a site may also be called features.

No two archaeological sites are the same; therefore, each one must be approached as a new and unique problem. Though most Central California sites follow the same general pattern as to material nature of deposit and artifact occurrences, it still holds that even the trained archaeologist can foresee little prior to his shovel work. The recognition of features in any site depends, in large part, upon close observation and care in excavation. In the examination of a new site, especially in a region where little previous work has been done, every object when first encountered should be considered a potential artifact or feature. Exposure should then be made with a trowel and brush until the nature of the find can be determined. Too often features are recognized as such only after they have been partially or completely removed or destroyed. The student will learn that experience and good judgment are his best aids.

All features should be written up on a standard feature sheet, a photograph should be taken, and, if possible, a sketch should be placed on the back of the data sheet. If a complex of artifacts is associated with a given feature, they should be collected as a unit and a notation of their association entered in the field catalogue in the "Remarks" section.

The following is a list of features which have in the past been noted as of common occurrence. This does not, of course, exclude the possibility that new varieties may be encountered.

A. SURFACE FEATURES

Features which occur on the surface of a deposit or in the near vicinity of a site are most readily recognized. Although many of the surface features may be included in the data recorded on the site survey sheet, others require additional and more detailed study. A discussion of such features follows:

House site depressions.--Indicate on a scaled drawing the number of houses, their location on the site and in relation to one another, orientation of doorway, and any architectural features present.

Ceremonial dance house.--Record same information as above but locate the feature in relation to the village as a whole as well as to the individual houses. A diameter and pit depth measurement should be included.

Borrow pits.--Borrow pits are rare but do occur. They may be confused with dance house depressions or large house pits. Excavation may settle the point. Occasionally auxiliary sites are made from earth borrowed from the main deposit. If these are noted, they may offer an explanation to any depressions on the surface of the larger site.

Bedrock mortars.--If a rock exposure occurs near a site and contains mortar holes, the type of rock, number of holes, their depths, and the shape of the mortar cavity should be noted.

Quarry sites.--Sometimes sites may be found in proximity to lithic outcrops which were exploited by the natives. At such sites the quarry material should be identified and the amount of quarry refuse estimated. If any working face can still be identified, it should be mentioned, as well as any evidence of the mining tools employed.

Workshops.--"Workshops" imply that some material, generally of a lithic nature, was transported to a site for manufacturing purposes. Such areas as listed above may in themselves constitute a site or they may occur as concentrations on a large habitation site. The type, nature, and amount of material should be noted.

Pictographs and petroglyphs.--These, whether directly on or near a site, should be recorded and written up on a separate record form (see section II C). Painted or inscribed rocks may also occur alone, and by themselves constitute a site.

B. INTERNAL FEATURES

Internal features are by far the hardest to recognize and describe. Any unusual observation made during the course of excavation should be recorded as a feature regardless of its apparent unimportance at the time of discovery. The method of exposure of internal features varies according to the nature of the material, though usually a standard procedure may be followed (see section V).

Floors.--Domestic or ceremonial use, the nature of the material, the density, and the dimensions should be noted as well as postholes, hearths, etc. (see section IX).

Hearths.--These should be noted in relation to house floors, type of rock composing the hearth, amount of ash, and any evidence of food remains (mammal and bird bone, shellfish, carbonized plant remains, etc.)

Shell lenses.--On the ocean coast these features are common but still require mention as features since they indicate some information about the diet in aboriginal times.

In addition to the list above, the following should be noted and written up as features: concentrations of stones or artifacts, concentrations of animal or bird bones, storage pits, intrusive pits, and animal and bird burials. Though the burials may be recorded on a standard burial form, they nevertheless constitute a special feature in the site.

Use of the feature record form.--To facilitate recording of essential data regarding surface or internal archaeologic features of a site, a prepared sheet is used. Each entry is numbered to facilitate cross reference and use of a Continuation Sheet if there is need for additional data. An explanation of the entries, arranged by the order of their numbers, follows:

1. Features are numbered sequentially (1, 2, 3, etc.) as they are recorded.
2. Site name or number.
3. Depth from surface directly above the feature. If feature itself has a thickness, note whether measurement refers to top, bottom, or midpoint of feature.
4. If datum plane level is employed rather than actual surface, enter here the depth.
5. Designation of excavation unit (trench, pit number, etc.).
6. Coordinate location in feet and inches from a datum point.
7. Name, type, and identification of feature.
8. Itemization and brief description of objects or components of the feature.
9. Length, width, thickness (horizontal and vertical extent).
10. Association with or relation to stratigraphic levels.
11. Further observations, if space is needed.

University of California California Archaeological Survey

ARCHAEOLOGICAL FEATURE RECORD

1. Feature No.______________________________ 2. Site__________

3. Depth from surface__________________ 4. Depth from datum plane__________

5. Excavation unit____

6. Horizontal location____

7. Definition____

____

____

8. Associated objects and features_____________________________

____

____

____

____

____

9. Dimensions____

10. Stratigraphic notes____

____

11. Additional plates____

____

____

____

12. Exposed by__________________________ 13. Reported by__________________

14. Date______________ 15. Photo______________ 16. Sketch______________

12. Name of person responsible for exposure and clearing of find.
13. Name of recorder.
14. Date of recording data on this sheet.
15. Photograph number. If no photograph is made, so specify.
16. Location of sketch (reference to notebook, separate sheet, or obverse side of feature record).

VIII. EXCAVATION AND RECORDING OF SKELETAL REMAINS

The purpose of this section is to describe briefly some of the most important aspects of exposing, recording, and removing burials. Artifacts and features associated with burials from burial complexes that deserve the most careful attention by the archaeologist. All techniques used must be directed toward the identification and recording of every detail that might be of some significance. Burials are seldom if ever haphazardly interred but reflect the mortuary customs of the group.

A. TYPES OF INTERMENTS[7]

I. Burial
   a. Primary burial--physical remains of an articulated corpse
      1. Fully extended
         Dorsal side (Lillard, Heizer and Fenenga, 1939:pl. 6b; Wedel, 1941:pl. 15b)
         Ventral side (Heizer and Fenenga, 1939:pl. 1a; Lillard, Heizer and Fenenga, 1939: pl. 5a,b,c; pl. 6a,c,d,e,f)
      2. Semi-extended (Lillard, Heizer and Fenenga, 1939:pl. 27a; Lillard and Purves, 1936: pl. 1)
      3. Semi-flexed (Lillard and Purves, 1936:pl. 35; Wedel, 1941:pl. 17b,c; pl. 18c)
      4. Tightly flexed
         Dorsal side (Lillard, Heizer and Fenenga, 1939; pl. 16c; pl. 27c,d; Lillard and Purves, 1936:pl. 34)
         Ventral side (Lillard and Purves, 1936:pl. 2; Orr, 1943:pls. 2, 5, 8, 9, 10, 11)
         Right side (Heizer and Fenenga, 1939:pl. 1c; Lillard, Heizer and Fenenga, 1939:pl. 16e,f; Wedel, 1941:pl. 7a)
         Left side (Lillard and Purves, 1936:pls. 3 and 4; Wedel, 1941:pl. 14c,d; pl. 16a)
      5. Sitting (No published illustrations known, but the custom is recorded in archaeological sites and in the ethnographic literature.
   b. Secondary burial--disarticulated skeletal parts. The result of stripping or allowing the flesh to rot off, followed by collection and burial of the bundle of bones. Must be distinguished from primary burials disturbed by rodents or previous excavation.

II. Cremation
   a. Primary cremations--burned in place. Large size of burned area indicates corpse cremated in grave.
   b. Secondary cremations--redeposited ashes. Small area of burned remains indicates corpse cremated elsewhere and ashes placed in a small pit.

A specialized type of primary burial is called pre-interment grave-pit burning. Bones may show scorching and charring though not nearly as complete as in cremation (Lillard, Heizer and Fenenga, 1939).

B. EXPOSING THE BURIAL

As soon as a burial is discovered, knowledge of techniques and the observance of certain precautions will materially aid in proper exposure. All the possible problems cannot be discussed here; the individual worker's sense and ingenuity may be relied upon to cope with special contingencies.

The excavator must attempt to orient himself on the position of the burial as soon as it is discovered. Since the skull is usually highest, it will be most often discovered first in stripping operations. It is necessary to find and identify several points on the skeleton to determine its exact location and position. This should entail as little actual exposure as possible in order to protect the burial from rough handling. A knowledge of the shape and relative position of the major bones of the body is necessary for identification of the exposed parts (fig. 11). If the excavator is not familiar with these through handling the various bones, he should secure an inexpensive booklet as a guide until experience renders it no longer useful (Boots and Shirley, n.d.; Foster, 1931). As soon as the beginner has identified a few critical points such as the skull, pelvis, knees, and elbows, he can, by placing his own body in a similar position, readily visualize the probable extent and dimensions of the burial. This should be done before further exposure is attempted.

One of the most satisfactory methods of exposing a burial is by blocking it out as soon as the position and extent is determined. This consists of leaving the burial embedded in its matrix on a pedestal while the surrounding dirt is cleared away and a level floor established. The height of the pedestal will be variable but a foot is about the minimum. This not only gives a more convenient working height but also prevents loose dirt from drifting back onto the burial. This technique may not always be feasible; where it cannot be used, good exposures are still possible. A word of warning must be inserted. If any trace of a pit in which the burial was placed remains, this must be preserved and then the pedestal technique cannot be used. For example, burials in the sterile subsoil of a mound may show the grave pit because of a difference in color and texture between the mound soil and the subsoil.

Burials should generally be exposed from the top downward. There are, however, certain exceptions to this rule. It is obviously inefficient to be continually sweeping loose dirt over previously cleaned areas. To avoid this it is advisable to expose the central areas first, especially the cavities of the rib cage, abdomen, and pelvis. Once these are cleaned, it will be time to expose the arms and legs that lie on the outside of the burial. Arms and legs should be exposed from upper to lower, the hands and feet last. These consist of numerous small bones that are easily disturbed after they have been exposed.

Certain areas within a burial should be given special

[7]See Committee on Archaeological Terminology, 1941.

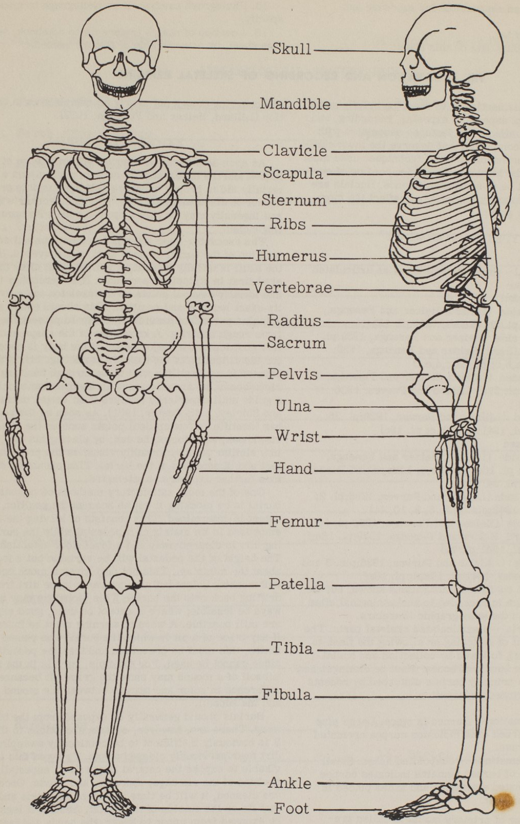


Figure 11. Bones of the skeleton

attention. It is obvious that non-perishable items of shell, bone, and stone which are worn as ornaments, either strung or on clothing, will remain after the perishable items have disappeared. Therefore, valuable clues may be gained by observing the exact location of such objects at special places. For example, necklaces may be indicated by beads, etc., found around the neck and shoulders and upper rib cage, headdress ornaments around the skull, wristlets along the arm, waistband and skirt ornaments in and around the pelvic cavity. Ornaments are not infrequently placed in the hands and mouth, and these areas should be carefully investigated. One item often not recognized by beginners is powdered red ocher, which is occasionally found with burials. In this form the red ocher stains the bones a dull brick red color and may stain the soil surrounding the bones. Even though it cannot be collected, it should be recorded as a burial association.

Complete cremations obviously present a different problem to the excavator. The local accumulation of ash and charred wood and bone usually serves to delimit the cremation, and careful troweling and brushing will define the horizontal limits of the cremation in the surrounding matrix. Once this is done, a vertical profile may be obtained by cutting down in the middle of the cremation, exposing a side view and showing the depth of the ash and charcoal lens. This may also give clues to the exact cremating procedure if relative abundance of charcoal or bone appears at different levels. The remains of a cremation must be scrutinized carefully to see if carbonization has preserved traces of normally perishable objects, especially wood. Then the ashes must be sifted carefully in a screen to recover artifacts and large bone fragments.

Pre-interment grave-pit burning offers unique opportunities for preserving perishable material. Baskets, matting, string, cloth, netting, seeds, and wooden artifacts are frequently preserved through carbonization. These are usually found slightly under the burial and can be identified if the underlying carbonized layer is carefully brushed. Layers of baskets and matting are not unusual, but only the top layer can be exposed until the skeleton is removed. Such remains are extremely fragile and should not be exposed until the skeleton is clean and ready for recording. For preservation of such material see section XIII.

If burials are found in a hard matrix, the excavator should not attempt to remove the hardened materials from certain fragile areas on the skeleton while it is in the ground. Such regions as the eye sockets, nasal cavity, ear opening, scapula, and sacrum are easily damaged by sharp tools and can best be cleaned later. Block removal of completely articulated burials in position can be achieved by special techniques (Orr, 1942a; Antle, 1940).

Two methods of removal of a complete burial in situ have been developed and successfully employed at Berkeley. In the first, the burial is partly exposed and isolated on a block or pier of earth. About six inches beneath the bottom of the grave, the pier is cut through with a coarse saw or long butcher knife. Then a flat sheet of heavy galvanized tin is pushed and pulled through this cut to form the base for the upper part of the pier on which the burial lies. The insertion of the iron sheet is difficult, and must be done carefully to prevent disturbance of the bones. If the upper sides of the block are wrapped around with wide layers of sacking and tied with string, this will help in keeping it intact. In the meantime a wooden box has been constructed about eight inches deep and with one long side left open. The skeleton, still encased in earth and resting on the iron sheet, may then be pushed into the box and the side board nailed on. The sacking can be removed, earth packed down around the sides to fill any holes, and the skeleton exposed by brushing away the earth. After the exposure is completed, the block of earth may be saturated with dilute acetone-celluloid or gasoline-paraffin. Such boxes containing skeletons are useful for museum displays or to demonstrate to students burial position or method of exposure of a burial.

A second method was once employed to remove the ceremonial burial of a bear encountered in a prehistoric cemetery at site CCo-138 (cf. Heizer and Hewes, 1940: pl. 1). The bones were first fully exposed. Next, a careful scale drawing of the burial was made on a large sheet of cross-section paper (the scale used was one-half actual size). Then, at each end of the long axis of the skeleton a datum stake was set up. These two stakes were of equal height, and a stout wire was extended between them over their tops. Employing this leveled wire as the datum plane, the elevation of each end of every visible bone was determined, and these measurements were recorded. After the burial was photographed, the bones were taken up and marked as right or left side. The field crew then spent several evenings reconstructing the burial within a box. When completed, it was taken to the museum in an expedition panel-delivery sedan. This method has an advantage over the technique of removal in situ, since the box is not so heavy; it is, however, much more time-consuming. Any boxes made to receive skeletons should be screwed together and reinforced with angle irons.

C. BURIAL RECORDS

Sketching the burial often presents a serious problem to beginning students. A sketch is never omitted, although the amount of detail may vary according to the time available and the skill of the recorder. In general the best criterion is that the sketch must be as complete and accurate as time and skill permit. Anyone can sketch a burial and an archaeologist must strive to overcome lack of formal training and artistic ability by patience and practice. Anatomically correct sketches are preferable to stick figures. These can be done regardless of drawing ability by sitting down in a position where a good view of the burial is obtained and drawing each bone exactly <u>as it appears to the sketcher from that position</u>, attempting to reproduce perspective by relative size. The use of deep shading and hachuring tends to obscure the drawing. It must be emphasized that the sketcher must make the drawing from one position only, for the perspective will change with different views. All artifacts are sketched in and also labeled, either by numbers or in the margin. An arrow designating magnetic north must appear in the sketch. The most convenient place for the sketch is on the coordinate ruled back of the burial record sheet.

Although it is true that the sketch and photographs somewhat duplicate each other, it should be obvious that no one can be certain of the photograph until it is developed and printed. Also small details and especially artifacts are often difficult to identify in burial photographs taken under adverse conditions. These can be easily identified on the sketch and form a valuable supplement to the photographs.

The accompanying burial record sheet contains entries

University of California California Archaeological Survey

ARCHAEOLOGICAL BURIAL RECORD

1. Bur. No.__________2. Site____________________3. Excavation unit______________

4. Location__________________of datum__________________to__________________

5. Depth from surface__________6. Depth from datum plane____________to____________

7. Stratification____

8. Matrix______________________________9. Condition____________________________

10. Bones absent (or present)____

11. Sex_________________12. Age_____________

13. Pathology____

14. Type of disposal____

15. Position of body____

16. Left side ________Right side________Back________Face________Sitting__________

17. Position of head________side________back,________face, facing______________

18. Orientation____________________________19. Size of grave____________________

20. Associated objects (itemize)____

____

____

____

____

21. Remarks____

____

____

____

____

22. Exposed by__________________________23. Recorded by__________________________

24. Photo______________________25. Sketch____________________26. Date____________

for the various items of pertinent information usually deemed necessary for complete recording of a burial. A brief explanation and guide to the use of this record form according to the numbered entries follow.

1. By site.
2. Name and/or number.
3. Pit or trench, etc.
4. Feet and inches by direction (ex. 50′ 8″ N, 18′ 4″ W). Use nearest datum measuring to a point on burial--usually the skull.
5. In inches to center of burial.
6. See section on laying out site. Often measured to skull.
7. Designate burial stratum if it occurs.
8. Type of soil around burial (ex. shell midden, midden, sterile, etc.)
9. Poor, fair, good, excellent.
10. Delete inappropriate one, only a rough count needed.
11. Leave blank unless certain. Refer to page 43.
12. Leave blank unless certain. Refer to page 43.
13. Only obvious and striking features.
14. See page 38.
15. See page 38.
16. See page 38.
17. Insert side or check appropriate blank: give facing direction.
18. Refers to the direction in which the head lies in relation to a line between the skull and center of the pelvis.
19. The two largest dimensions at right angles.
20. List artifacts and features.
21. Anything not covered above and considered pertinent, such as disturbed burials, etc.
22. Give name or initials.
23. Give name or initials.
24. Enter photo number, see section on photography.
25. Indicate whether on reverse or separate sheet.
26. Date recorded.

D. REMOVING THE BURIAL

After the burial is exposed, recorded, and photographed, it should be removed in order to safeguard the skeleton and associated artifacts. Recording and labeling of artifacts are covered in section VI. Some techniques for the care of the bones will be discussed here.

Wooden boxes, made to size, are the ideal containers for skeletons both in the field and in shipment to the laboratory. They afford far more protection than do cardboard cartons and they do not fall apart when they get damp. Once made, they will last for ten years of field work. The ends should be made of $\frac{1}{2}$-inch or $\frac{3}{4}$-inch stock, the sides, top, and bottom of $\frac{3}{8}$-inch stock. Experience has shown that the following <u>inside</u> measurements are adequate for the skeletons of normal adults: 24 inches long, 9 inches wide, $8\frac{1}{2}$ inches deep. A number of smaller boxes should be provided to care for the skeletons of children and fragmentary or partial skeletons.

The burial number, skeleton catalogue number, or other pertinent data should be painted on the box. Cards tacked or glued to the box are frequently lost in transportation. To be on the safe side, it is well to stick a tag inside the foramen magnum or tie one to one of the long bones as well.

Long bones should be wrapped separately in sheets of newspaper. The cranium, the mandible, the vertebra, fragmentary bones, and the bones of each hand and foot should be placed in separate paper bags and labeled (e.g., bones of left hand, burial no. 12, site Sol-52). This will ensure against the loss of small bones, teeth, fragments, etc. The use of shredded paper is a nuisance both in the field and in the laboratory. Crumpled newspaper provides adequate protection, is easily obtained, and readily disposed of.

In packing, the cranium should be placed at one end, the heavy long bones packed next, and the lighter bones placed on top. These recommendations apply, of course, to skeletal material which is in a fairly good state of preservation. Bones which are friable or wet require some attention in the field and this will be discussed elsewhere.

Care must be taken in removing the bones from the matrix to avoid breakage. This is best accomplished by undercutting each bone with a trowel and lifting it all at once. The bones on top must be removed first. Gradual and over-all pressure is necessary on the larger bones to prevent snapping. Each bone is scraped as clean as possible as it comes out and the dirt is left in the burial pit. Any indication of beads or other small artifacts will mean that this dirt must be screened before it is thrown away. The skull and pelvis are most difficult to remove and must be handled with great care.

If time and water are available, bones may profitably be washed in the field. If the matrix is hard and calcareous, it can often be removed much more easily immediately after exposure than after it has dried. A tub or bucket of water, brushes, small dull knives, and ice picks are usually sufficient to clean the bones in the field. Each skeleton must be kept separated to avoid mixing. Drying is best done on screens to facilitate drainage and in the shade to prevent cracking and peeling.

Unless a complete field laboratory is set up, there is little purpose in mending broken bones in the field. Very brittle and friable bone can be strengthened for shipment by applying several coats of very thin cellulose dissolved in acetone. If possible, the bones should be clean and dry before this is done, since this type of binding is markedly less satisfactory on damp material (Bentzen, 1942; Lewis and Kneberg, n.d.).

Aging, sexing, and noting pathology on a skeleton are more certain after the bones have been removed and the critical points examined by handling.

E. AGING AND SEXING SKELETAL MATERIAL

<u>Aging</u>.--It is possible to estimate the approximate age of a burial by examination of the skeletal development, if the skeleton is in reasonable condition. The age groupings listed below are given as one example of age divisions; the student should consult the works of Hooton (1946), Hrdlička (1948), Stewart (1934), Todd (1920-1921), Todd and Lyon (1925), and Renaud (1939) if more accurate groupings are desired.

<u>Age groups</u>.--1. Infant (birth to 3 yrs.): to complete eruption of deciduous dentition.

2. Young child (3 yrs. to 6 yrs.): from complete deciduous dentition to eruption of first permanent teeth, usually first molars.

3. Older child (6 yrs. to 12-13 yrs.): from first erup-

tion of permanent dentition to eruption of second molars. No long bone epiphyses united as yet.

4. Adolescent (13 yrs. to 18 yrs.): from eruption of second molars to eruption of third molars. This is quite variable and the end of this period should show almost all epiphyses joined to the long bones except the head of the humerus, lower end of radius and ulna, and the upper crest of the pelvis.

5. Sub-adult (18 yrs. to 21 yrs.): the third molar may be erupting and the epiphyses mentioned above united. Closure of the sagittal suture of the skull begins near the end of this period.

6. Young adult (21 yrs. to 35 yrs.): all epiphyses except the medial end of the clavicle are united. This latter unites within this period. The sagittal suture is usually closed near the end of this period. Other sutures show beginning of closure.

7. Middle-aged adult (36 yrs. to 55 yrs.): cranial sutures show marked closure and some obliteration. In California tooth wear is marked and some teeth are usually lost. This will probably include the largest group of adult burials.

8. Old adult (56 yrs. to 75 yrs.): all sutures very advanced and many obliterated. Tooth wear is excessive and few teeth remain at death. Pubic symphysis shows marked erosion of surface.

9. Very old adult (over 76 yrs.): very few skeletons will fall into this group. All sutures are obliterated and teeth will probably be entirely lacking.

Sexing.--Determination by a trained observer of sex in adult skeletal material can be accurate in 80 to 90 per cent of all complete burials. Subadult specimens can so rarely be accurately determined that such attempts will be misleading. The regions giving the most reliable results are, in order of their importance: the pelvis, the skull, the major long bones. In every known sex criteria there is a gradual transition from hyperfeminine to hypermasculine expression with the middle ground indeterminate as to sex. Since it is not uncommon to find typically feminine characters in an otherwise masculine skeleton and vice versa, determination of sex depends on the preponderance of traits characteristic of one or the other sex in each individual. The primary rule in determination is to assess as many characters as possible before making a judgment.

Pelvic Sex Characteristics

	Male	Female
Subpubic arch	Narrow	Broad, diverging
Greater sciatic notch	Narrow, deep	Broad, shallow
Acetabulum	Large	Small
Pelvic inlet	Small, narrow	Large, broad
Pelvic wings (ilia)	Large, vertical	Small, flaring
Sacrum	Long, narrow	Short, broad
Muscular impressions	Strong, heavy	Light, smooth
Ischium-pubis index	Small	Large

Cranial Sex Characteristics

	Male	Female
Supraorbital ridges Mastoid process Occipital crest Malars Supramastoid crests Mandible	Large, well developed	Smaller, less developed

Long Bone Sex Characteristics

	Male	Female
Muscle attachments	Larger, rougher	Smaller, smoother
Femur head diameter	Generally more than 46 mm.	Generally less than 46 mm.
Articular ends of bones	Larger	Smaller

Without further information it is not feasible to attempt sexing on the basis of the brief checklist given here. Since accurate sex determination is largely based on experience, it is advisable to handle numerous specimens of known sex. If this is not possible, the student must at least study drawings of skeletal material, mainly of the pelvis, found in all good anatomy texts and take into the field some illustrations of osteological sex differences. Further information on sex characteristics of bones may be gotten from the works of Heyns (1947), Hooton (1946), Hrdlička (1947), Krogman (1939), and Washburn (1948).

IX. STRUCTURAL REMAINS

Structural remains are uncommon in Central California archaeology, but because of their rarity they are important, and the excavator should be ever watchful for them.

Structural features in California fall into two types, each to be handled in its own way. The most common and only aboriginal type is the wooden structure of which house postholes, interior pit excavations, and hearths are usually the sole remains. The adobe, stone, or wood surface structure of the historic period is the second type of architectural remain.

Before excavation in any area, the excavator should investigate the ethnological building types (cf. Krause, 1921; Barrett, 1916; Kroeber, 1925; McKern, 1923). During the excavation, the remains of aboriginal structures may be indicated by a house pit depression in the surface of the site, by the discovery of a hard-packed dirt floor, by the discovery of the postholes themselves, by the unearthing of a central hearth, and by the finding of a stratum of refuse, rootlets, or ash. When any of these features are present, special care should be taken in excavation. A trowel is recommended to carry on further work. After the hard-packed floor of the house has been located, it should be cleared carefully with small hand tools (whisk broom and trowel). Postholes should be cleaned with special care. A structural feature of this type should be photographed in the early morning light when the shadows within the postholes are heaviest. The floor plan of a structural feature should be recorded with great care, for excavation destroys all data. It is recommended that the posthole pattern and floor plan be drawn to scale on graph paper. The depth of each hole, its diameter, and the distance between holes should be measured and noted, as well as the distance between specific house posts and any correlated features such as a hearth, storage pit, or doorway. In Californian sites, house floors, when encountered, are often only partial--later aboriginal or burrowing-rodent activity having destroyed a portion of them. Published references to archaeological structural remains occurring in California are Wedel (1941), Woodward (1938), Strong (1935b), Olson (1930:20), Harrington (1948).

Superior techniques employed in the excavation of structural remains have been carried out in the Southeastern United States. For examples of this type of excavation see Webb (1938, 1941) and Webb and DeJarnette (1942). W. D. Strong (1935a:73-74) has detailed the methods of Nebraska earth lodge excavation.

X. RECOVERY AND SIGNIFICANCE OF UNMODIFIED FAUNAL REMAINS

A usual problem facing the archaeologist is the collection of unmodified animal bone and shell and the identification of genera and species. This information is needed to determine the diet of the former inhabitants of the site, to verify the nature of the economy, and to supply data from which the season of occupancy, the hunting range, religious taboos, or other cultural-faunal associations may be inferred. Changes in the local fauna are frequently indicated; white settlement has already caused the disappearance of numerous species found in aboriginal sites (cf. Morse, 1925). The archaeological faunal collections will therefore become increasingly important to zoologists in the study of former animal life and of the pathology and variation within species.

G. K. Neuman (in Cole and Deuel, 1937:265-268) presents a typical analysis of the faunal remains from a site. The occurrence of extinct faunal remains with Folsom points was responsible for the recognition of the antiquity of the artifacts and the ensuing discoveries of other early cultures. The hitherto unknown existence of bison in Illinois and their limited sojourn there was revealed by faunal associations with certain aboriginal cultures. Howard (1929:378-384), by a study of the avifauna of the Emeryville shellmound site, was able to reach some important conclusions concerning its year-round occupation and to gain insight into various hunting activities of the inhabitants. Molluscan remains are of prime importance in determining trade routes and cultural relationships (cf. Brand, 1938). From these few examples it is apparent that unmodified vertebrate and invertebrate remains can make important contributions both to the archaeologist and zoologist. Such possibilities justify, indeed necessitate, the proper collection and preservation of these remains. Hough's valuable paper (1930) on ancient Pueblo subsistence was written on the basis of archaeological collections.

All bone found during the excavation of a site should be examined carefully for any evidence of workage. It is usually sufficient to save only those unmodified pieces which retain an articular end or some distinctive feature which would permit identification. Medial fragments or splinters can be discarded unless some special analysis is to be made of midden contents by weight or volume. Tips of tines are essential for the generic identification of antlered animals. Shells to be kept for identification should be as complete as possible.

If the midden is of sufficient depth, it is desirable to collect the unmodified bone from each excavation unit by specified levels, usually six or twelve inches deep. In shellmounds a representative sample of the midden should be taken at adequate horizontal intervals. It is possible that some faunal change may be represented or that a shift occurred in the diet or economy during the occupation of the site.

The archaeologist can seldom make the necessary identifications, though the illustrated type of field key prepared by Brainerd (1939) is useful to give a general idea of the animals found. It is customary to seek the aid of a qualified zoologist or conchologist for exact identifications. The bones should first be cleaned by washing or brushing. To aid in the handling of the large quantity of bone acquired in excavating, the UCMA has prepared an Unmodified Animal Bone slip (see p. 45). Molluscan remains can be handled in the same way. Each lot (usually a level bag) is given a catalogue number. To avoid confusion in the identification, each bone in a particular lot should be given a different letter (e.g., No. 134-A, 134-B, etc., etc.). The site should be located exactly to allow the classifier to check on the area from which the material was collected. The frequency of faunal remains in the site and any unusual feature about the bone or its association should be noted under "Remarks." A short description of the ecology of the region limits the range of possible species present. Gilmore (1946) and Hargrave (1938) present additional suggestions which would aid the zoologist in his identification.

The material can then be packed and sent to the classifier, who can record his findings on the back of the slip. Upon the return of the collection, the slips can be filed and will then form a permanent, complete record of the animals found archaeologically in a certain area.

XI. STRATIGRAPHY AND CHRONOLOGIC METHODS

The recognition and definition of stratigraphy in aboriginal deposits is one of the more important aspects of excavation (Wissler, 1946). It is through the recognition of stratigraphic differences within a site and assigning time differences to cultural differences between sites that the sequential cultural history of an area is derived. Stratigraphy may be demonstrated in several ways with the use of unrelated sets of data. Techniques vary according to the nature of the materials available. In rare instances, stratigraphy may be so obvious as to be seen in the field, more frequently it becomes apparent only through a physical or chemical segregation of the materials recovered after completion of the excavation.

Stratigraphy is a tool whereby the archaeologist seeks to obtain two things: (1) evidence of cultural change and (2) time differences (chronology) which may be either relative or absolute (cf. Clark, 1947: chap. 5). The accomplishment of either requires various approaches.

Changes in custom may be detected in the differences that appear in the artifactual and non-artifactual aspects

UNIVERSITY OF CALIFORNIA MUSEUM OF ANTHROPOLOGY

UNMODIFIED ANIMAL BONES U.C.M.A. No.______

Site____

Township__________ Range__________ Section__________ County__________

Excavation unit____________________________________

Location____

Depth__________________ Stratum__________________

Remarks, observations on occurrence____________________

Excavated by____________ Photograph____________ Date________

Identification (over) by____________________ Date________

IDENTIFICATION RECORD

Cat. No.	Age	Part	Identification

Key--J, juvenile; A, adult; O, complete bone; P, proximal end; D, distal end

Obverse and reverse of Unmodified Animal Bone Record Sheet

University of California — California Archaeological Survey

STRATIGRAPHY RECORD

1. Site ______________________________

2. Stratigraphy record form no. ______________________________

3. Location in site ______________________________

____

____

4. Nature of stratification ______________________________

____

____

____

____

____

____

____

5. Associated features or artifacts ______________________________

____

____

____

____

6. Soil samples collected ______________________________

____

____

7. Stratigraphic diagram drawn by ______________________________

8. Scale used in sketch ______________________________

9. Photographic record no. ______________ 10. Date ______________

11. Further data contained in ______________________________

____

of a deposit as they occur from the surface to the bottom of the site. A shift in human economy may also be detected upon examination of the organic refuse such as animal and plant remains. When present, stratigraphic differences generally appear in a laboratory examination of the total data.

The actual organic and inorganic constituents of a deposit and the position they bear to one another form part of the cultural and physical history of the site. Features such as ash and shell lenses or house floors all contribute to a better appraisal of the content of an aboriginal culture. Such features are best observed and recorded from the side walls of long trenches and test pits. Stratigraphic data of this nature should be recorded in scale drawings. In the long trenches at Buena Vista Lake sites Strong and Wedel were able to record directly the visible profiles by devising a "stratagraph" (Stirling, 1935:pl. 10).[8]

If a cultural sequence is determinable for any given site, it may be extended to other sites in the immediate area. Demonstrations of this technique employing both surface and excavated cultural materials are to be found in papers published by Kroeber (1916), Spier (1917), Vaillant (1937), Nelson (1916b), Ford (1938), and Olson (1930). The use of dated historical materials occurring in an archaeological context may be of the utmost importance in developing a cultural sequence. With the aid of such dated objects, a departure into the past can be made from an absolute point in time. For California the value and demonstration of such a method may be found in papers by Heizer (1941a, 1941b) and Beardsley (1949). Elsewhere in North America this approach has yielded valuable results as inspection of the papers by Strong (1933, 1936, 1940), Wedel (1936), Vaillant (1938), Steward (1942), and Parsons (1940) will show.

In working with stratigraphic deposit, it is assumed the "Law of Superposition" is valid. That is, the deepest deposits are the oldest and the surficial levels are younger. As a note of caution, there have been specific instances in archaeology when, as a result of unusual circumstances, this law has failed (Hawley, 1937; Crabtree, 1939). When disturbed stratigraphy results from intrusive burials or storage pits, however, some physical evidence can generally be detected.

Judicious use of the typological approach (see section XV) may also yield indications of temporal sequence. No student of archaeology will be wasting his time by reading the works of Petrie (1899, 1901, 1904), Uhle (1903), Kidder (1924), Willey (1945), Clark (1947:chap 5), and Lothrop (1941:183-199).

A. SOILS AND SOIL PROFILES

Specialists in paleobotany ("pollen experts"), diatoms, glacial varves, and tree rings have been especially helpful in constructing absolute and relative chronologies by analyzing materials from archaeological deposits. Thus far, diatoms and tree rings are not useful in California archaeology. Here, a new method is being attempted by chemical analysis of human bones from archaeological sites. Preliminary reports on this method are now published (Cook and Heizer, 1947; Heizer and Cook, 1950).

By analysis of stratigraphic soil samples, some progress has been made toward obtaining insight into aboriginal human ecology (Cook and Treganza, 1947; Treganza and Cook, 1948).

Whether or not the individual is equipped to analyze his specimens, soil samples should be collected from every site excavated. Enough samples should be secured so that the peripheral and central portions of the site are well represented (cf. Treganza and Cook, 1948). The ideal sample is a controlled column about four inches square, extending as deep as the cultural deposit. In addition, a sample of the submound or base should be taken. Before the sample is taken, the area selected should be shaved down to as near a smooth and vertical face as possible. This makes sampling more accurate and possible stratigraphy can be detected. If the mound mass appears homogeneous, drops of dilute hydrochloric acid should be applied at intervals to detect any possible horizons of lime concentration. If there is such a concentration, a sample should be broken at the point of contact and a note of the feature made. If stratigraphy in the form of ash, shell lenses, etc., occurs, a sample should break at those points of stratigraphic contact. Shell and ash concentrations should should not be mixed in a single sample. If neither of these features is present, a sample may be taken at every six-inch interval from the surface to the base. By placing a canvas at the bottom of the pit or trench and holding a paper bag directly below the sample to be taken, the desired section of earth may be removed with a flat knife or trowel. Before starting sampling, it is a good idea to trace on the side wall an outline of the sample to be taken and to indicate where the soil samples are to break. As each sample is taken, it should be labeled with the name of site, the location on site, the sample number, and the depth of the individual sample. The student will find it of advantage to read carefully the papers of Cook and Treganza (1947) and Treganza and Cook (1948).

XII. PHOTOGRAPHIC RECORDS

A. EQUIPMENT

It should be borne in mind that the photographs taken during excavation are part of the scientific record and that these photographs should show maximum clarity and detail (Crawford, 1936). For this reason, miniature cameras (35 mm. and similar sizes) are not recommended for taking black-and-white record pictures. The small negatives will not yield satisfactory prints unless the finest technique is used in handling and processing the film. Generally speaking, the black-and-white negatives should be of the maximum size practical from the point of view of film cost and portability. A four- by five-inch camera of the Graphic-Graflex type is ideal, but these are generally not available because of their bulky size, high initial cost, and relatively high film cost.

The 35 mm. and Bantam cameras come into their own in the field of color photography. These cameras can produce satisfactory transparencies, and color film in larger sizes is so expensive as to be out of the question for ordi-

[8]Through an oversight no discussion of stratigraphic profiles was contained in the first edition of this Manual. The usual stratification encountered in California sites is shown by Nelson (1910, pl. 49), Uhle (1907, pl. 4), and Wedel (1941, figs. 5, 10). Careful study of these will enable the student to draw his own profiles.

nary use. It is desirable to have a set of color slides supplementing the black-and-white photographs. However, since accurate color rendition depends on perfect exposure and since color films will fade, black-and-white pictures are still the most important for the scientific record.

Since archaeological photographs are often taken under unusual light conditions, a good exposure meter (Weston or G.E.) is of great utility. A tripod is desirable for long exposures, and a sunshade for the camera lens will prove valuable in avoiding "light-struck" negatives. Other accessories are left to the discretion of the individual photographer.

Concerning choice of a camera, there are many types of camera which can be used satisfactorily for archaeological photographs. As a guide to the prospective purchaser, the following features are recommended as minimum requirements:

1. A negative size not smaller than 2¼ by 2¼ inches, except for color.
2. A lens speed of f. 6.3 or faster.
3. A shutter speed up to 1/100 of a second.
4. Suitable fixtures for taking time exposures.
5. A built-in tripod attachment.

For special requirements, such as cave archaeology, a flash-bulb attachment is necessary.

Cameras which have the recommended features include folding cameras, reflex cameras, and the larger view cameras. Box cameras have produced excellent photographs, but they do not have the necessary versatility to obtain pictures under poor light conditions. Of the three other types of cameras, each has qualities which the others lack. The folding cameras offer the maximum in compactness; the reflex cameras offer the best focusing device; and the view cameras have a large-size negative. The reflex camera is perhaps the easiest to use for an inexperienced photographer, but all three types of camera are satisfactory: which one is used is largely a matter of personal preference. Purchase price will often determine the choice of camera. In this connection, it might be mentioned that a used camera, purchased from a reputable dealer, is about one-third or one-half cheaper, and just as good as a new camera. Care must be taken in buying a used camera to get one that is guaranteed to be in good condition.

B. PHOTOGRAPHING ARCHAEOLOGICAL SUBJECTS

The site.--Every effort should be made to obtain good over-all views of the site; before, during, and after the excavation. This part of the photographic record is easily neglected, and special attention should be paid to general views of the entire site. The photographer should attempt to picture the shape and height of the site, and the features of the adjoining country, such as streams and vegetation. This generally requires that the photographer be at least 100 yards away from the site itself. Special techniques for photographing the site area include the use of kites, balloons, and the taking of aerial photographs (cf. Merrill, 1941, 1941a; Mackay, 1931; Bascom, 1941). Large areas of the state have been mapped by aerial photographs, and the site under excavation may show up on one of these. It is advisable to study the photomaps of the area in the University library.

Effective site photographs can sometimes be obtained by taking the picture from the top of a tree on or near the site.

Burials.--The primary objective of burial photographs is to show clearly the position of the burial and the relation to it of associated objects which are burial offerings. A large part of the cultural inferences which can be made from archaeological material is derived from the burials and the artifacts which accompany them. Therefore, burial photographs are especially important. A steady tripod will permit the use of medium-grade films rather than the coarse-grained Super XX type. Most beginners think they must have the fastest film available, but by using this type, they sacrifice clarity and detail in enlargements. In taking each photograph, the photographer should consider its potential use as a published illustration.

The most satisfactory black-and-white photographs of burials are obtained when the burial is not in direct sunlight. Bright sunlight will make the contrast between the bones and the shadows behind them too great for maximum detail in the finished print. Burials in the bottom of a pit or trench will be in the shadow of the trench wall at some time during the day; this is the time to photograph the burial. If natural shade is not available, it is worth while to have two of the crew hold a tarpaulin so as to cast shade on the burial. In using color film, conditions are reversed--here bright sunlight is desirable, as a picture taken in deep shade will have a bluish cast.

To increase the contrast between the color of the bones and the color of the earth, the bones may be painted with water or chalk. The condition of the burial may prohibit this treatment, however.

In photographing burials, certain accessories are photographed with the burial. These include a northward pointing arrow, a six-inch ruler (painted black and white in alternate inches), a burial number, and a site designation. The site designation requires a small painted sign giving the county symbol, with the addition of a number for the site. (Information on state and county symbols is given in section II C.) Numbers can be of the type used in grocery stores to mark prices, or black gummed paper numbers can be purchased from stationery supply stores. These objects, photographed with the burial, remove the possibility of confusing one burial picture with another. Even if the burial pictures from several sites should become mixed, the information necessary to identify each burial is shown on the negative. In addition to identification of the burial, orientation is shown by the arrow pointing north, and the six-inch ruler gives a size scale which may be of value in judging the size of artifacts. (The size scale and the arrow may be combined in one object by using an arrow of standard size, painted in bands of alternating colors an inch wide.)

The above-mentioned accessories should be placed not on top of the burial, but a little to one side, so that a picture of the burial alone can be reproduced if desired.

If the special accessories described are not availbale, a trowel should be placed in the picture, pointing north. This gives the orientation of the burial and a rough size scale.

A photograph should be made of the whole burial, and additional closeups of special features may be desirable. In photographing the entire burial, the best position from which to take the picture is directly above the burial. This will minimize the distortion. Sometimes, it is possible to shoot directly down onto a burial from the edge of the excavation. Often, however, an oversize tripod will be the only means of obtaining a picture from above. Clark (1947:fig. 9) and Merrill (1941a:235) show such a tripod. This tripod may be merely a stepladder, rigged so that the photographer can climb to the top and take his picture from this position. If the picture is taken on the ground, it should be taken from the side, rather than from either end of the burial.

Closeups of special features of the burial are of value in preserving cultural information which is destroyed when the burial is removed. For example, an abalone shell carefully fitted over the face of the burial would merit a closeup photograph of the head region. A string of beads which is still in position, a number of projectile points grouped near one hand, and similar grouped objects, are all worth a special photograph. Although these features are supposed to be noted down elsewhere, it is better to use up a roll of film in taking many pictures than it is to discover later that valuable information has been lost by inadequate photographic recording. Also, the photographs can serve as a check on the field notes, and a properly kept photographic record may be of value in settling disputed points.

Features.--For photographic purposes, features may be divided into two groups on the basis of size. Large features include such items as house pits, bedrock mortar areas, and boulders covered with pictographs. In photographing such subjects, it is usually desirable to have a person in the picture. This does not detract from the scientific value of the photograph, and it adds human interest and gives a good size scale for comparison with the feature.

House pits are usually rather difficult to photograph. The edges of the pit are not clearly defined, and the shallowness of most house pits makes them invisible in a photograph unless special care is taken. The best time to take the photograph is when the sun is low on the horizon, so that a shadow is thrown into the pit. Another technique is to scrape the surface of the house pit so that the soil will be different in color from the surroundings. The depth is best illustrated by having someone stand in the middle of the house pit when the picture is taken. Otherwise, if the light is even, the pit will appear flat in the print.

The second class of features includes the smaller accumulations, such as grouped artifacts, concentrations of rock, and similar occurrences. These are usually easy to photograph, and no special technique is necessary. It may be desirable to use the identification symbols referred to in the section on photographing burials.

Soil profiles.--The recording of soil profiles is a task which often presents unusual difficulties. Generally, the differences in color between the various soil types are slight. In black and white photographs these differences may not appear at all. Color photographs will show minor color differences with much greater clarity. However, it is desirable to make black and white photographs also. Three methods may be used to emphasize the different soil strata. First, a trowel can be used to mark the boundary between the soil types. The trowel is run along this line, making a thin groove about an inch deep. Another method is to mark the boundary with a white string which will show up in the picture. This technique is practical only where the line of demarcation is relatively straight; if it has many small curves and kinks, it is too time-consuming to trace these with the string. The third method is a purely photographic technique involving the use of colored filters so as to accentuate the difference between the soil types. This method is reliable only when the photographer has a good knowledge of photographic filters and their use.

Pictographs and petroglyphs.--Petroglyphs are made by pecking a shallow groove in the rock. If the light conditions are proper, the grooves will be filled with shadow, making the petroglyphs stand out clearly from the background. Otherwise, the petroglyph markings can be accentuated with chalk. Since this gives them an artificial appearance in the finished photograph, the use of chalk should be avoided wherever possible. If the petroglyph markings are also filled with some coloring material, chalk should not be put on top of this.

Pictographs are "rock paintings," most often occurring in red and black colors. Pictographs are among the most difficult subjects to photograph well. Even though they appear obvious to the eye, they are often invisible in a black and white photograph. One reason for this is the occasional use of orthochromatic film, which is not sensitive to red. Red pictographs on a light-colored rock will not photograph at all if this film is used.

Since pictographs are usually faded or faint in color, they should never be photographed in bright sunlight. If they are photographed in shadow, they will appear much more clearly, because the relative contrast between the pictograph and the rock is increased. As a last resort, pictographs can also be accentuated with chalk, but the chalk should be used to outline the figures, and never, under any circumstances, to cover up the painted parts.

Pictographs should be photographed and sketched as well as possible, since the pictograph surface will deteriorate under exposure to the elements. This deterioration can be quite rapid, and the preservation of pictograph records should not be left to the "next person to come along."

Excavation technique.--A photograph can often show the excavation technique clearly. The site photographs will show up the over-all technique, such as step excavation or the digging of alternate pits. The excavation levels can also be shown in a photograph of a face or trench wall. For example, a series of parallel lines can be drawn with a trowel on the wall, a line for each six-inch level. This would show that the excavation unit had been carried down in six-inch levels. This information is recorded elsewhere, but a photograph of the type described may be useful for later illustration of the excavation technique.

C. KEEPING RECORDS OF PHOTOGRAPHS

It is essential to keep a file of photographs taken. Each photograph should be recorded and carefully kept so that it is readily accessible.

When the films are sent away to be processed, a reputable photographic dealer should do the work. Some of the cheaper drugstore processing is likely to prove harmful to the negatives and care should be taken that the film is entrusted to a reliable processor. A special note should be attached to each roll, asking that the film be returned in strip form; the negatives should not be cut. This is for

University of California California Archaeological Survey

ARCHAEOLOGICAL PHOTOGRAPHIC RECORD

General subject____

Photographer______________________________ Date____________

Camera____

Roll or Pack No.	Exposure No.	Subject	Looking toward	Neg. Cat. No.

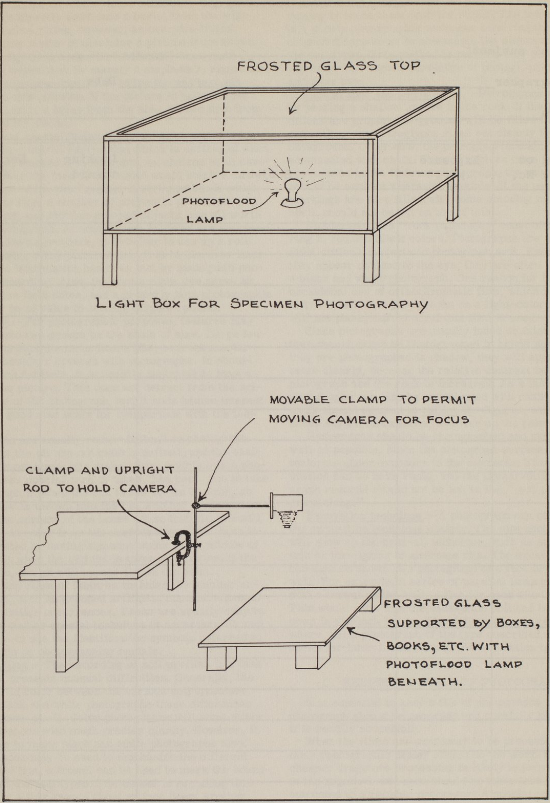


Figure 12. Devices for specimen photography

aid in identification for when several similar pictures have been taken, they are often difficult to identify if they are loose. In the roll, they may often be identified from the sequence in which the pictures were taken. A record of each photograph should be made when the picture is taken; the "Photographic Record Form" is adequate for this purpose.

When the developed roll of film is received, each negative should be carefully identified. Useless negatives (out of focus, double exposed, etc.) can be discarded immediately. Each of the remaining negatives should be placed in an individual envelope, which is numbered. The numbers correspond to numbers on the photographic record form (see attached sheet). After each number the information requested on the record form should be given: date, subject, and other pertinent data. If the negatives are kept in consecutive order, it is an easy matter to find any individual negative. File positive prints in the negative envelope.

D. CARE OF FILM AND EQUIPMENT

The main enemies of film are heat and dampness. Color film is especially liable to damage, and cameras containing color film should not be left in direct sunlight. The film itself should not be kept in metal containers which are left in the sun or carried in the glove compartment of an automobile. These suggestions also apply to black and white film, though it is not so sensitive to climate. Care should also be taken to avoid leaving film in damp or humid places.

Cameras are most liable to damage from the dust and dirt which are unavoidable on an archaeological site. Dust will often settle on the lens of the camera. This should be removed very carefully with lens tissue. Optical glass is soft, and an attempt to remove the gritty particles with a finger or handkerchief may result in a scratched lens. A scratched lens is worthless and must be replaced.

Dust can also cause damage by filtering into the delicate shutter mechanism of the camera. Though most cameras are relatively dust tight, the camera should not be left in a dusty place for several hours at a time.

Light-box for specimen photography.--The most effective background for specimen photographs, except for bleached-white objects, is a pure white effect with no shadows. The simplest device for this is a light-box which can be constructed by anyone with a few tools. A rough sketch of such a box is shown below. The box can be taken into the field or even built there if an alternating current outlet is available.

Any box that is large enough and reasonably light-tight will suffice (fig. 12). The glass surface on top should be about 15 inches square, depending on the size of the specimens to be photographed. A minimum distance of 18 inches between the bulb and glass is necessary to diffuse the light evenly over the glass and prevent cracking from the intense heat generated by a no. 2 photoflood lamp. The glass top should be double-strength or plate glass to withstand the heat and the pressure of the objects photographed. The glass should be frosted on the underside, or, as a field expedient, a piece of opaque overlay paper may be placed over the glass.

Best results from the light-box require a double exposure, which is carried out in the following manner: Place the object or objects to be photographed on the ground glass. With the light-box dark and necessary illumination coming from the sides and above, photograph the specimens. Without moving the camera, recock the shutter, turn off all the lights outside the box, turn on the light-box bulb, and retake the picture on the same film, using one-half to two-thirds the original exposure time. The second exposure with all the light coming from below will white out all shadows around the objects and, if properly exposed, will print a perfectly white background. Obviously, the camera must not be moved in the slightest degree between shots. The exposure time for the second exposure will depend on three factors: the size of the light-box bulb, the distance between the bulb and the glass, and the exposure necessary for the first shot. The first two factors will remain constant for each light-box and can be easily determined by some trial pictures. The last factor will vary continuously, but with practice it can readily be estimated.

The camera is pointed down toward the light-box while taking such pictures. The most difficult problem of the whole procedure is achieving a steady camera mount that will permit vertical shots. A sturdy tripod with a tilting head placed on boxes or tables will work fairly well but for more permanent work some sliding camera support on a vertical rod is advisable. A suggested device is shown in figure 12.

If no support is available and pictures are necessary, the double exposure can be dispensed with. Both outside and light-box illumination can be turned on at once and only one exposure made. This will give satisfactory results only when the overhead light is very strong and the light-box bulb is relatively weak (no. 1 photoflood).

When photographing rough-textured objects, such as basketry and netting, the following device will soften shadows and give a more pleasing effect: Use a long exposure for the shot, two or three seconds if possible, and while the shutter is open, move one of the photoflood lamps slowly around the specimen on one side. This will prevent sharp contrasting shadows between stitches and still give an effect of relief and pattern.

If the student is engaged in noting a private collection, he may find it useful to carry a light-box of this sort with him in order to secure pictures which will be of sufficient clarity for illustrating a printed report.

XIII. CARE AND PRESERVATION OF ARCHAEOLOGICAL SPECIMENS

Following the exposure and notation of an artifact, burial, or animal remains, certain procedures are necessary to ensure that the specimen arrives at the museum in the best condition possible. Failure to take necessary precautions may result in the destruction or breakage of a specimen. The amount of information which an object may supply is partly dependent on its condition. The advice to "treat every specimen as though it were the only one of its kind in the world" is worth heeding (Leechman, 1931: 131).

Field procedures for the care of specimens may be separated into three categories: preserving, repairing, and cleaning. By preservation we mean the process of strengthening a specimen to reduce the possibility of deterioration. Repair, usually with some adhesive, means securing in position separated pieces of the specimen. In practice it may be better to pack separately pieces which can be restored in the museum under optimum conditions. Cleaning of specimens in the field means the removal of dirt to facilitate handling, labeling, and shipping. Repair of specimens and elaborate preservation are rarely needed in California because field work is done relatively close to Berkeley and to the Museum.

A. MATERIALS AND EQUIPMENT

Shellac and alcohol: pure white shellace should be obtained; not orange or compound shellac.

Depending on the use the shellac may be thinned one-half to two-thirds with alcohol. The solution may be kept in a mason jar or mayonnaise jar with a hole punched in the top to receive a round one-half-inch brush. This mixture is used for the hardening of specimens either by spraying or brushing.

Celluloid and acetone: this mixture is best carried in a stock solution which may be thinned with the addition of acetone kept apart for this purpose. "Duco" is the trade name for an adhesive product available in tubes, which is more handy for small repairs. "Ambroid" is the trade name for a similar, slightly more expensive product that has a somewhat objectionable yellow color. Another product is "Alvar" (polyvinyl acetate) which is soluble in acetone. The mixture of celluloid and acetone (or similar products) is useful as an adhesive, and, in thin solution, to harden specimens.

Beeswax and benzine: lumps of beeswax may be dissolved in benzine or gasoline. The mixture is used to coat wet specimens.

Plaster of Paris: this product is supplied in several grades; the "slow-set" gauging variety has the best application. In practice any type will work. Mixed with water, it is useful in jacketing specimens, particularly burials, which are in very delicate condition or are to be preserved entire for exhibition or study. A washpan is desirable for mixing.

Burlap "gunny-sacks": these are used in combination with plaster of Paris.

"Kleenex" or similar tissue: used in combination with shellac and alcohol for preserving "checked" bone.

"Lithiol": a commercial liquid useful for preservation of stone that is disintegrating.

Brushes: paint brushes and whisk brooms used in excavation are available for cleaning specimens. In addition there should be an assortment of brushes of various sizes (half-inch, quarter-inch paint brushes and several water color brushes) for the application of adhesives. These should be cleaned in the appropriate solvent following use.

Sprayers: there are two types of sprayers used in archaeology for blowing adhesives or hardening agents on fragile artifacts. One type is the "nose-throat" atomizer, which has the disadvantage of being difficult to clean. The other is the plunger type used for glass-cleaning preparation. This type is easier to clean and less likely to break in the field. <u>After use, either type of sprayer must be thoroughly cleaned in the solvent of the adhesive</u>.

B. FIELD TECHNIQUES

For ease of reference, procedures employed in the field may be separated according to the materials commonly requiring preservation or repair in Central California: bone, antler, shell, stone, textiles, pottery, baked clay, wood, metals, and possible seeds.

<u>Bone</u>.--Bone specimens include animal and human remains and bone artifacts.

<u>Skeletal remains</u>.--In Central California such remains will ordinarily be encountered as human burials. Following notation, sketching, and photography of each burial, the condition of the bone should be examined. Under ordinary circumstances the bones may be removed as they are and packed in such a way as to avoid the possibility of pressure fracture and friction. Teeth, however, even under the most favorable circumstances, should be secured in their sockets with a dab of celluloid and acetone, or they may be removed and placed in a separate bag or envelope labeled according to burial number and site.

If bones are encountered which are checked or cracked on the surface, the following treatment is necessary: the bone should be left in place and a coating of thin shellac and alcohol applied to the bone over and beyond the crack. Next, a single sheet of cleaning tissue is applied to the surface,and stippled on with a brush that has been dipped in the mixture. After this has thoroughly dried, the bone may be removed and strengthened by the same process on the reverse side. Careful packing of such a specimen is necessary. It must be remembered here that neither shellac nor celluloid will work properly on a damp or wet specimen.

When bone is in an extremely fragile condition and subject to rapid deterioration, it should be cleared of loose dirt in situ. Next it is saturated with acetone, then coated with a thin solution of "Alvar" and acetone. This coat is followed by others. When the solution has dried, the bone is removed and the reverse side is treated. In this way the bone is strengthened and moisture sealed. Careful packing and labeling are necessary (Lehmer, 1939:30; Byers, 1939; Antle, 1940; Burns, 1940).

<u>Jacketing burials for removal complete</u>.--The following method of jacketing skeletal remains has been used successfully by paleontologists for years. It has been used less extensively by anthropologists, but it is the easiest method for the complete removal of entire burials, fragile bones, and artifacts (Camp and Hanna, 10-17; Antle, 1940; Clements, 1936).

When a specimen has been selected for removal in plaster, it must be prepared by careful excavation. Dig all around the burial, preserving the actual matrix in place and exposing as little of the bone as possible. In most soils the specimen will remain on a pedestal; in sand it will not be possible to excavate down the sides and ends of the specimen. If there are any bones exposed, they should be coated with a thin solution of celluloid or shellac. Next the bones are covered with cloth or wet pieces of newspaper to prevent the plaster from adhering to the bone.

The specimen is now ready for jacketing. Burlap sacks, like those used for coal or potatoes, are pulled apart and strips from two to six inches wide and from one to three feet long are cut from the sacking. These strips of burlap are placed in water to soak. Then fill the washpan half full of water and sprinkle the plaster of Paris into it until the plaster comes slightly above the surface of the water. After the plaster has settled, stir the mixture slightly. Wring the water from a strip of burlap; dip it into the plaster; wipe off the excess plaster; and place the strip across the burial at right angles to the main axis of the block. Press each strip firmly over the contours. Repeat the process, overlapping each strip slightly. When the surface is entirely covered in this manner, a long burlap strip or "collar" is wrapped around the edge of the entire block. In some cases--as, for example, an extended burial--the block may be strengthened with sticks or with wire.

After the plaster has set and hardened, excavate below the level of the block and around and below the pedestal. Then carefully turn the specimen over on its plaster cap. Repeat the process on the newly exposed side after removing excess dirt to a few inches from the bone.

The specimen is now ready for transport. The plaster block will stand considerable abuse, but it is best to act on the side of caution in handling it.

Antler.--Generally speaking, antler is like bone and the same treatments and precautions should be used in handling it (Leechman, 1931:140). Wet artifacts of antler should be dried slowly and coated with a thin solution of celluloid when they are thoroughly dry. Specimens in a poor or decomposing condition may be immersed in a jar containing a thin solution of celluloid until the bubbles cease to rise. After drying the specimen, the operation should be repeated.

Shell.--Shell artifacts and specimens in good dry condition may be packed immediately for transport to the museum. However, specimens which are delicate or flaking should be given a soaking in a thin celluloid solution following cleaning. (Leechman, 1931:146; Burns, 1940:154-155; Johnson, 1941.)

Shells taken from damp soil are likely to pulverize when they are dry. Whenever practical, these specimens should be sent to the museum in a container that will preserve their moisture. Otherwise they may be treated as they would be in the museum by cleaning them with a soft brush while they are immersed in a 5 per cent solution of clear gelatin. After this gelatin bath, they are placed directly in a formaldehyde bath. This treatment will form an insoluble protective coating.

Stone.--Stone artifacts rarely need any treatment in the field. Should broken stone artifacts be found, it is preferable to pack them as carefully as necessary and to leave repair for a later time in the museum. Stone which is disintegrated or badly weathered may be treated with "Lithiol" according to instructions on the container.

Pottery.--Although pottery has a very restricted distribution in Central California, a word may be said about its treatment in the field. Unpainted pottery may be safely washed with care; potsherds need special care in packing to avoid damaging the edges. Painted potsherds are best left untreated in the field. It is useful to include a tag with potsherds, warning the museum preparators to use care in soaking any salts from the sherds, particularly painted sherds. For details on care and preservation see: Leechman, 1931:156-157; Lucas, 1932:188-192; Burns, n.d., 160-162.

Baked-clay objects and artifacts.--Follow the same instructions as for pottery.

Metal objects.--Metal objects are found in postcontact sites or horizons. The usual materials are iron, copper, brass, and occasionally silver, gold, or lead. It is absolutely necessary that metal objects, particularly those altered by rust or corrosion, be treated with the utmost care. Under no circumstances should an attempt be made in the field to remove the rust or the corrosion. To do so may mean the loss of the specimen as an artifact and as a potential source of information. Therefore, exact and careful treatment is needed in the field. The museum should be notified and warned against overzealous cleaning and the need for extreme care in handling corroded objects.

The corrosion products of iron may tell the metallurgical specialist a great deal about the age and history of a specimen (cf. Heizer, 1941a:App.). The famous Drake Plate (of brass) was subjected to intensive chemical and microscopic analysis, but the conclusions on its authenticity would have been considerably strengthened had not its discoverer removed the precious patina from its face with abrasives. A good rule to follow is to regard the oxidized surfaces of metal objects as potentially valuable and to refrain from removing these corrosion products.

Iron.--Iron objects generally have been subjected to rust action which may have carried deep into the metal. Treatment of specimens depends on the extent of rusting. Frequently iron objects are so badly rusted that little remains but a thin core of the iron encased in rust (ferric oxide). In such cases it is best to dry the object thoroughly and soak it immediately in a celluloid solution to preserve its shape. Care must be used in handling the object.

Copper and bronze:--Lightly corroded specimens may be cleaned in the museum. Heavily corroded copper should be soaked in clean water to remove salts which may be present, dryed, and coated with a thin solution of celluloid.

Wood.--Wooden objects in a dry state usually need little preparation in the field other than brushing and cleaning. When wooden objects, such as those artifacts found in dry caves, are suspected of insect infestation, they should be coated with a solution of celluloid in acetone. This has the effect of embalming any boring insects and eliminates the need for fumigation in the field. However, any wooden or other specimens of organic origin sent to the museum from dry caves, which may be infested or subject to infestation, should be appropriately labeled. Special cases of preserving wood materials for dendrochronological purposes may arise. These are treated by Hall (1939) and Hargrave (1936).

Wet wood, or wood excavated from damp soil, needs special preparation in the field to assure conservation of the specimens. Damp or wet wood must be kept in this condition until the specimen arrives at the museum. It should be packed in a water-tight container, a coffee-can or large tin, surrounded by wet crumpled paper, moss, or wet cloth. This will preserve the humid condition of the wood. A wood specimen which has lain in water may best be sent back in water to which a 10 per cent solution of wood alcohol may be added as a temporary preservative (Leechman, 1931:151). The rest of the careful preparation necessary for damp wooden objects can then be done in the museum (see Leechman, 1931:151, for details of museum preparation).

Materials from dry caves.--Problems of the archaeologist working in dry caves are caused chiefly by the fragility of perishable materials and by insects which continue to destroy the objects or increase the process of destruction after excavation. In addition, materials such as baskets, skins, cordage, etc., will be found which need special treatment in the museum. For this special problem see Leechman (1931), Laudermilk (1937), Burns (n.d.).

XIV. FIELD CATALOGUE

An important part of the procedure of recording field data is the keeping of a field catalogue. Future reference to artifact location will depend upon the information contained in such a record and from it will come the entry in the permanent museum catalogue. It should always be kept in mind that, though you are the present excavator, some other person may work with your collections, observational data, and records at a future date. The method of recording specimens in a field catalogue depends in part upon the type of site and the nature of the data to be recorded. However, for most Central California sites a grid system may be used, every artifact being located with reference to a known datum point within an excavation unit (see section IV A, B). Once a speciman has been unearthed and the necessary find data are recorded, it is ready for field cataloguing (see section VI).

Actual field cataloguing is generally done in the evening, when in camp; however, it may be done at any time or by any individual who has been left in charge of the camp for the day. The important point is that daily records be kept to prevent loss of information. Occasionally, through accident, artifacts and data records become separated, and the finder's memory fails to respond after several days.

It is recommended that the field catalogue be kept in a book with pages that are bound or clamped rather than in a loose-leaf ring-binder, and that all entries be recorded in black India ink.

When a daily field catalogue is being made of artifacts recovered from more than one site, it is advisable to prefix the specimen number with a site number. Thus, specimen number 8122 from site Sac-6 would appear on the specimen and in the catalogue as Sac-6-8122. Blocks of pages may be reserved for separate sites, so that no page contains data on specimens from more than one site.

Select a clean, inconspicuous spot on the specimen for the field number. A second, permanent museum number will be applied later, and space should be reserved for this. After the ink dries, it is advisable to cover the number with a thin coat of celluloid and acetone for protective purposes. When dark specimens such as slate or obsidian are being numbered an undercoat of white India ink may be applied to provide a surface for the field specimen number. When quantities of shell beads are recovered, it is advisable to tag several specimens of the lot and to number the box in which they are kept. Carbonized material should be tagged after a preservative has been applied and the box numbered.

The box which contains fragile specimens should be so labeled. Instructions for careful handling, repair. or directions not to clean or wash particular specimens should be clearly stated on a red-bordered gummed tag attached to the box containing the specimens. Many finds have been ruined by museum preparators who did not realize that the piece was to receive special treatment.

As artifacts are catalogued, they should be wrapped and packed in boxes suitable for their transport from the field to the laboratory or museum. Boxes which are to be shipped by freight should be of wood and should have a wire binding. Always place inside an address label, for fear the outer label is damaged or destroyed. Pack small, light pieces together and heavy, unbreakable objects (pestles, stone choppers, etc.) in separate boxes for shipment. As boxes are filled, a packing list should be prepared and the box numbered so that the whereabouts of all specimens are known. File the packing lists with the catalogue so that a check may be made when the boxes are unpacked and the final layout of material is made in the laboratory.

The mimeographed Field Specimen Inventory Record (p. 56) has proved useful and may be recommended as containing space for all essential find-data. Number the sheets for each site consecutively, write the site's name or number on each page, and enter the date the page was filled out. The vertical columns contain entries for specimen number, description of the item, provenience, depth, association with a feature, stratigraphic level, and the like, a "Remarks" column, and a column where the premanent museum number may be added later.

After the field catalogue numbers are assigned, notebooks, the burial record sheet, feature record sheet, artifact slip, and photographic record sheet should be reviewed and field specimen numbers entered on these for the purpose of cross reference and identification. This procedure is an absolute necessity if the field records are to be complete and understandable.

XV. TYPOLOGY

Although analysis of excavated material is usually not attempted in the field, there are times when such description, if only of a preliminary nature, may seem advisable.

The manual work of removing artifacts from the ground involves the use of certain tools. So, too, with this less vigorous, but certainly equally important, aspect of archaeology, methodological "tools" are employed. One of the most fundamental tools of this sort is classification. "The purpose of a classification of archaeological material is to arrange the products of aboriginal industry in an order permitting the accurate description of everything found. From this order it should also be possible to determine with a minimum of effort the complete range of variation of all the products of the industrial life of a community, region, or large area depending upon the scope of the particular problem under discussion. Furthermore, the various categories which are segregated in a classification should be so arranged that they can be studied separately or used for comparative purposes. In considering any category in a classification, one should never lose sight of the fact that it is really so closely related to the whole that it can be considered as a unit only in the most general terms." (Byers and Johnson, 1940:33). The excellent discussion by Braidwood (1946b) on classifications should also be read by all archaeologists.

Typology is a method of classification based, as the word implies, on types. Typology as a methodological approach has been the subject of considerable discussion in archaeological literature. By type we mean not only a

UNIVERSITY OF CALIFORNIA DEPARTMENT OF ANTHROPOLOGY

ARCHAEOLOGICAL FIELD SPECIMEN INVENTORY RECORD Sheet No.__________

SITE____________________ COLLECTOR______________________________ DATE______________

Field Spec. Number	Description	Location	Depth	Association	Remarks	UCMA No.

homogeneous group of artifacts but also an ideal artifact, according to the criterion set up, which the actual implements approach. Byers and Johnson (1940:35) say: "The term type is intended to represent the perfect example, exhibiting all the characteristics which differentiate it from other types." This is in essential accordance with the statement by Rouse (1939:11) that a type artifact is "an abstract kind of artifact which symbolizes the group."

Within a group so defined there is usually more or less variation; thus subtypes may be established which group individual pieces having the same or similar variations from the main type.

Typologies based on geometric, morphological, and cultural forms are discussed by Black and Weer (1936:294). These divisions are necessarily rather broad in scope, since they are meant to be applied to a wide range of collected material. It is possible to use these criteria either separately or in combination. In California the preponderance of the material with which one has to deal is amenable to initial classification as to geometric form or shape and morphological form or structure. Another criterion might be the degree of finish of artifacts. A large number of methods of distinguishing typological subdivisions are possible in setting up classifications and defining types of artifacts.

References are cited below to some typologies used to treat different classes of artifacts found as a result of archaeological investigation in California and elsewhere. No particular classification is recommended, but each has been employed advantageously by the authors of the reports listed.

REFERENCES

General works on typology

Black and Weer, 1936:280-294. Brew, 1946:44-66. Byers and Johnson, 1940:32-38. Gorodzov, 1933:95-103. Krieger, 1944:271-288. Rouse, 1939:11-12. Rouse, 1944: 202-204.

Projectile point typologies employed in California

Beardsley, 1946:20-21, fig. 2, p. 25 (San Francisco Bay Region). Chard, n.d. (Hotchkiss site), (Sacramento Valley). Fenenga and Riddell, 1949:209, fig. 58, table 13 (Northeastern Plateau). Gifford and Schenck, 1926:80, fig. 1, p. 81 (Southern San Joaquin Valley). Heizer, 1949 (Sacramento Valley). Heizer, et al., n.d. (Napa region). Johnson, 1940:167-170 (Delta region). Lillard, Heizer and Fenenga, 1939:13 (Sacramento Valley). Schenck, 1926: 239-242 (Emeryville site). Schenck and Dawson, 1929:370-371 (Sacramento Valley).

Projectile point typologies employed elsewhere than California

Black and Weer, 1936:290-291. Brew, 1946:233-235, fig. 172 (Utah). Byers and Johnson, 1940:39-47 (Massachusetts). Committee on stone artifact terminology, 1942: 67-69. Cressman et al., 1940:41 ff. (Oregon). Drucker, 1943:41-42, fig. 6-7 (Northern Northwest Coast). Finkelstein, 1937:197-203. Gladwin et al., 1937:pls. 85-94 (Arizona). Kidder, 1932:13-24, figs. 1-8 (New Mexico). Martin, 1941:206, figs. 72-74 (New Mexico). Martin et al., 1939:64, fig. 29 (New Mexico). Martin and Rinaldo, 1946: 344, fig. 118 (New Mexico). Nelson, 1929. Renaud, 1935a: 4-5; ibid, 1935b:5-8; ibid., 1941:pls. 5,6 (Colorado). Strong, 1932a:88-89 (Nebraska). Strong et al., 1930:77-79 (Oregon). Whiteford, 1947:226-239. Wilson, 1899.

Mortar and metate typologies used in treating California data

Beardsley, 1946:21-22, fig. 3, p. 26 (San Francisco Bay region). Chard, n.d. (Hotchkiss site). Heizer et al., n.d. (Napa region). Johnson, 1942:322-326.(Delta region). Lillard, Heizer and Fenenga, 1939:8-9 (Sacramento Valley). Schenck, 1926:245-247 (Emeryville site). Tregan-za and Malamud, n.d. (Topanga Canyon).

Mortar and metate typologies employed outside California

Bartlett, 1933:1-32 (Arizona). Brew, 1946:231-235, 240, fig. 174 (Utah). Gladwin et al., 1937:pls. 49, 50, 52 (Arizona). Kidder, 1932:66-71, figs. 42-46 (New Mexico). Kluckhohn and Reiter, 1939:63-68 (New Mexico). Loud and Harrington, 1929:140-144, figs. 21, 22, 139, pls. 60, 64 (Nevada). Martin, 1941:186-194, figs. 60-64 (New Mexico). Martin et al., 1939:42-48, figs. 15-22 (New Mexico). Martin and Rinaldo, 1946:328-332, 334, figs. 108-110, 112, 114 (New Mexico).

Pestle typologies established for California materials

Beardsley, 1946:22, fig. 4, p. 27 (San Francisco Bay region). Chard, n.d. (Hotchkiss site). Heizer et al., n.d. (Napa region). Lillard, Heizer and Fenenga, 1939:10-11 (Sacramento Valley). Schenck, 1926:247-249 (Emeryville site). Schenck and Dawson, 1929:387-389 (Sacramento Valley).

Pestle typologies utilized elsewhere than California

Gladwin et al., 1937:pl. 51 (Arizona). Martin, 1941: 196, fig. 67 (New Mexico). Martin et al., 1939:52, fig. 23 (New Mexico). Martin and Rinaldo, 1946:338, fig. 115 (New Mexico). Renaud, 1941:pl. 2 (Colorado).

Charmstone [plummet] typologies employed in California

Beardsley, 1946:22-23, fig. 5, p. 28 (San Francisco Bay region). Chard, n.d. (Hotchkiss site). Fenenga, n.d. (Middle horizon). Gifford and Schenck, 1926:93-97 (Southern San Joaquin Valley). Heizer, 1949 (Early Horizon). Heizer et al., n.d. (Napa region). Lillard, Heizer and Fenenga, 1939 (Sacramento Valley). Schenck, 1926:254-264 (Emeryville site). Schenck and Dawson, 1929:391 (Sacramento Valley).

Bone object typologies employed in analyzing Californian data

Bennyhoff, n.d. (Harpoons). Gifford, 1940:153-237. Orr, 1947:115-132 (Santa Barbara region). Schenck, 1926:214-217 (Emerybille site). Schenck and Dawson, 1929:350 (Sacramento Valley).

Bone artifact typologies used elsewhere than California

Drucker, 1943:52-54, 55-56, 58, 59 (Northern Northwest Coast). Brew, 1946:243-244, figs. 176, 178, 180-181 (Utah). Gladwin, et al., 1937:154-155, pls. 125-130 (Ari-

zona). Hodge, 1920 (New Mexico). Kidder, 1932:195-271, figs. 166-266 (New Mexico). Martin, 1941:224, 226, 228, figs. 71, 83-85 (New Mexico). Martin et al., 1939:70, fig. 32 (New Mexico). Martin and Rinaldo, 1946:350, fig. 121 (New Mexico).

Shell bead and ornament typologies utilized in California

Beardsley, 1946:23-24, figs. 6, 7a, 7b (San Francisco Bay region). Fenenga, n.d. (Middle horizon). Gifford, 1947. Gifford and Schenck, 1926:57-65 (Southern San Joaquin Valley). Heizer, 1949 (Early horizon). Lillard, Heizer and Fenenga, 1939:12-17 (Sacramento Valley). Schenck, 1926:230-239 (Emeryville site). Schenck and Dawson, 1929:373-379 (Sacramento Valley).

Shell bead and ornament typologies employed elsewhere than California

Drucker, 1943:59 (Northern Northwest Coast). Gladwin et al., 1937:137-153, figs. 53-58, pls. 113-124 (Arizona). Kidder, 1932:183-194, figs. 158-165 (New Mexico). Martin, 1941:220, fig. 81 (New Mexico). Martin et al., 1939:68, fig. 31 (New Mexico).

Baked clay object typologies used in California

Gifford and Schenck, 1926:55-56 (Southern San Joaquin Valley). Heizer, 1937:34-50 (cooking stone substitutes). Heizer and Beardsley, 1943:199-207 (figurines). Schenck and Dawson, 1929:360-364 (cooking stone substitutes).

Baked clay object typologies used outside California

Gladwin, 1937:233-245, pls. 195-213, figs. 113-115 (Arizona). Kidder, 1932:112-155, 157-182, figs. 83-157 (New Mexico).

Pottery types (shape, technique) of California

DuBois, 1907:484-486 (Diegueño). Gayton, 1929:239-251, pls. 95-102 (Yokuts and Western Mono). Gifford, 1928:353-373 (Southwest). Rogers, 1936 (Yuma). Rogers, 1945 (Yuma). Treganza, 1942:157-159, fig. 10 (California and Baja California).

XVI. CULTURAL CLASSIFICATION IN CENTRAL CALIFORNIA

A system for classifying the known archaeological cultures and subcultures of the lower Sacramento Valley and Delta regions of Central California was devised in Berkeley in 1947.

Three principal culture "horizons" or periods called Early, Middle, and Late form the major division of the classification. Each horizon of the sequence is broken down into "provinces," which are areas of cultural similarity and geographic consistency. Within the provinces of each horizon are "facies," comprising aggregates of "settlements" (or "components" or "communities"), which show, among themselves, close cultural similarity.

One may speak of a "site" as a spot where human activity is evidenced. But to refer to the Central California refuse-burial mounds simply as sites is awkward, since many of these deposits are stratified. "Settlement," therefore, refers to an occupation deposit level within a site, and only when a single culture deposit level constitutes a site are the terms settlement and site equivalent. The accompanying chart employs the suffix letters "A," "B," "C," for certain site numbers; here "A" refers to the uppermost (and latest) culture level and settlement deposit; "B" to the next inferior one, either stratigraphically or temporally; "C" to the next preceding one, and so on. One can, therefore, speak either of a culture horizon or settlement deposit with specific reference to a site number, or of settlement deposits with the A, B, or C suffix, provided use of the terminology is clearly established by the author.

For further discussion and illustration of the application of this classification scheme, see Beardsley (1949: 3-6) and Heizer (1949:2-4). The general similarity of this method to the McKern or Midwestern classification is obvious. Reference is made to the section on "Culture Classification Methods and Functional Interpretation of Archaeological Data" in the terminal bibliography (see section XX B). It may be further noted that Brew (1946:32-66) has severely criticized such taxonomic systems in archaeology. A somewhat less mechanical system has long been in use in the Old World (cf. Daniel, 1943; Braidwood, 1946c).

XVII. RECORDING LOCAL COLLECTIONS

Information concerning the archaeology of an area may be gained from local, private or civic collections. The amateur collector is often an excellent source for location of sites in his region, and his collections sometimes give a clue to the variety, type, and quantity of material to be expected there. The county, school, or municipal museum, because it is a frequent depository for single finds, can offer a wide sampling of local material.

When a local collection is being inspected, every effort should be made to record full data concerning its contents. Each item in the collection should be described fully; the description should include the type of artifact, the material of which it is made, its size, shape, and general characteristics. Any unusual features such as incising, painting, or other decoration must be particularly noted. The record should list the site from which each specimen came and, if the artifact was acquired by excavation, its association with a burial or with other artifacts or features. If the collection has been catalogued, the identifying numbers or symbols used should be noted. The recorder may find it convenient to use the Archaeological Field Specimen Inventory Record (see section XIV) as a field catalogue. The local catalogue numbers may be entered under "Field Specimen Number."

If the collection can be handled, outline drawings of all specimens should be made. When specimens are mounted or kept in locked cases and not freely accessible, a scale drawing, instead of an outline, may be made. Each drawing should be labeled to ensure correlation with the proper written description.

<table>
<tr><td colspan="2"></td><td colspan="2">Littoral Zone</td><td colspan="5">Interior Valley Zone</td></tr>
<tr><td colspan="2"></td><td>Marin Province</td><td>Alameda Province</td><td colspan="3">Delta Province</td><td colspan="2">Colusa Province</td></tr>
<tr><td colspan="2">HISTORIC TRIBES IN AREA</td><td>Coast Miwok</td><td>Bay Costanoans</td><td colspan="3">Plains Miwok
Southern Patwin
Nisenan</td><td colspan="2">Patwin</td></tr>
<tr><td rowspan="2">LATE HORIZON</td><td>Phase 2</td><td>Estero facies
settlements
Mrn-232-A Mrn-266-A
Mrn-242-A Mrn-206</td><td>Fernandez facies
settlements
CCo-259-A
Ala-328-A</td><td colspan="3">Mosher facies
settlements
Sac-56 Sac-6
Sac-60-A CCo-138</td><td colspan="2">Miller facies
settlements
Col-1-A
Col-2-A</td></tr>
<tr><td>Phase 1</td><td>Mendoza facies
settlements
Mrn-275
Mrn-242-A</td><td>Emeryville facies
settlements
Ala-309-A SFr-7-A
SCl-1-A Mrn-76-A
CCo-250 Sol-236</td><td colspan="3">Hollister facies
settlements
Sac-21 Sac-6
Sac-60-B CCo-138
Sac-107-A</td><td colspan="2">Sandhill facies
settlements
Col-3
Col-1-B</td></tr>
<tr><td colspan="2"></td><td colspan="2">Coastal Province</td><td colspan="5">Interior Province</td></tr>
<tr><td colspan="2">MIDDLE HORIZON</td><td>McClure facies
settlements
Mrn-266-B Mrn-232-B
Mrn-242-B Son-299</td><td>Ellis Landing facies
settlements
CCo-295 CCo-300
Ala-309-B Ala-307
CCo-137?</td><td>Morse facies
settlements
Sac-66 Sac-73
Sac-60-C Sac-113
Sac-107-B Sac-126-B</td><td>Deterding facies
settlements
Sac-99
Sac-101</td><td>Brazil facies
settlements
Sac-43</td><td>Need facies
settlements
Sac-151
SJo-70</td><td>Orwood facies
settlements
CCo-141-B</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="5">Unnamed Province</td></tr>
<tr><td colspan="2">EARLY HORIZON</td><td colspan="2">(Unknown)</td><td colspan="5">Windmiller facies settlements
Sac-107-C SJo-142
SJo-56 SJo-68</td></tr>
</table>

CLASSIFICATION OF CULTURAL AND TEMPORAL RELATIONSHIPS FOR CENTRAL CALIFORNIA

It is strongly recommended that photographs be made of all specimens in a collection (see section XII for the most effective methods). For convenience in taking pictures, specimens can be grouped by site or burial associations. When specimens are associated with burials, this grouping renders the record more complete. A clearly marked scale or ruler must always be included in the photograph to indicate the size of the artifacts. A white celluloid ruler with its alternate inch (or centimeter) divisions blacked out with India ink is well suited for this purpose.

A checklist may be used as a guide in recording collections (cf. Greenman, 1929), although, because of the inflexible nature of a printed list, strict adherence to it may prevent the collection of sufficient data. The checklist should include the following items: (1) the site name or number (if the site has not been previously recorded, a full description should accompany the notes); (2) the collector and date and circumstance of collecting; (3) the original catalogue number (if any); (4) a description of the specimen; and (5) any data on associated specimens.

Notes of local collections should be made at least in duplicate. One copy should be given to the custodian of the collection; another should be deposited with the institution primarily concerned with the recovery of archaeological information in that region. If the recorder expects to carry on extensive work in the area, he will want to keep a copy in his own files. A municipal collection may be of sufficient interest to warrant giving a copy of the report to the local public library. It is, of course, wise to avoid depositing, in a place of ready access to anyone, information that may lead to vandalism, and any disposition of notes on a collection should be made with the full approval of its collector or custodian.

Personal relations established in the course of careful recording of a collection can be valuable for both the collector and the archaeologist. The latter can provide the former with record sheets and instructions for obtaining full data on additions to the collection. The collector will be interested in methods of restoration and preservation of his specimens and will often be open to suggestion concerning methods of excavation. The collector may not be interested in certain types of material and is often willing to donate specimens of this sort to a scientific institution rather than discard them. The archaeologist, by his interest, will demonstrate the value of the collection and should encourage adequate arrangements for its eventual disposition, as well as offering assistance in instructing the collector in approved techniques of collecting and recording.

XVIII. STATE AND FEDERAL REGULATIONS CONCERNING ARCHAEOLOGICAL SITES

California, unlike many other states, lacks a law aimed specifically at limiting the activities of pot hunters. There exists, however, Section 622½ of the State Penal Code (1939), which states: "Every person, not the owner thereof, who wilfully injures, disfigures, defaces, or destroys any object or thing of archaeological or historical interest or value, whether situated on private lands or within any public park of place, is guilty of a misdemeanor." A misdemeanor is punishable by imprisonment in the county jail for a period not to exceed six months, or a fine not to exceed $500 or both.

No information is given in this section on how to obtain permission to excavate state lands, nor is there any limitation concerning persons who may be deemed competent to excavate. Many of the states adjoining California have more comprehensive antiwuities acts. The Oregon statute (Chap. 30, 1935) (1) makes it unlawful to excavate on state lands without permission; (2) requires that such permission be obtained from the State Land Board and the President of the University of Oregon; and (3) provides that permission will be granted only to members of reputable institutions. The state of Arizona has much the same requirements and goes one step further (Sec. 54-1617, 1939), making violations a misdemeanor.

Pot-hunting has been partially restricted in California by the attitudes of some museums of the state. F. W. Hodge, Director of the Southwest Museum, in the article "Pot-hunting: A Statement of Policy" (Masterkey, 1937, 11:108; reprinted in American Antiquity, 1937, 3:184), states the Museum's position. The Southwest Museum refuses to purchase any collections not gathered in a scientific manner, except material brought to light by non-archaeological excavation (e.g., foundation digging, road cuts, etc.) or "collections not known to have been gathered contrary to law."

The Santa Barbara Museum of Natural History suggests (Museum Leaflet, 1945, 20:33) that it does not wish to deal with pot-hunters. The University of California and the California Archaeological Survey, although they have published no statement on the subject, share the attitude of these institutions.

Permission to excavate on state lands must be obtained from the agency having jurisdiction over the lands in question. The State Department of Natural Resources has under it the Division of Forestry, the Division of Fish and Game, and the Division of Beaches and Parks. Information on other state land may be secured by writing to the Secretary of State, Sacramento.

The applicant for permission to excavate on private lands should make every effort to get this permission in writing. For official University excavations, written permission is mandatory. It is important that this permission be obtained from the bona fide owner of the land as well as from the tenant or lessee. Attention should be paid to land adjacent to a railroad right of way. Alternate sections of land are often owned by the railroad, hence are under company jurisdiction.

All lands controlled by the federal government are protected by "The Act for the Preservation of American Antiquities" (Public Law 209, June 1906). It is a misdemeanor to "appropriate, excavate, injure or destroy any historic or prehistoric ruin or monument or object of antiquity situated on lands owned or controlled by the United States . . ."

Permits to excavate may be secured from the secretary of the department having jurisdiction over the land, i.e., the secretaries of the Interior, Agriculture, or War. With the application must be submitted an outline of the intended work, name of the public institution in which the materials are to be deposited, etc. Full information concerning this procedure may be found in "The Uniform Rules and Regulations . . . to carry out the provisions for The Act for The Preservation of American Antiquities" (34 Stat. L. June 8, 1906).

Copies of these various regulations are on file in the offices of the California Archaeological Survey.

XIX. THE NAMES AND DISTRIBUTION OF RECENT CALIFORNIA INDIAN TRIBES

A tribe is generally defined as a territorial and linguistic unit; it comprises a population sharing a common geographical area and language.

A language family comprises a group of genetically related speech groups. English, for example, is a member of the Indo-European family and shares this membership with French, German, Spanish, Italian, Sanskrit, Slavic, Roumanian, etc. Similarly, there are language families of native California, some large and some small. All except one (Yukian) is spoken by tribes outside California.

California tribes are identified by the languages they speak. A total of more than 100 language dialects were spoken in aboriginal times, each of these dialects being a member of one of the seven great linguistic families of native California. This remarkable linguistic diversity exhibited by the Indians of California indicates that the cultural history of these tribes has been long and complex. The archaeologist hopes ultimately to contribute to the history of the speakers of these various linguistic families and perhaps to throw some light on the movements of the tribes--to explain, for example, the scattered distribution of the five Penutian tribes (see map 2, p. 62) and to assist the ethnologist and linguist who are concerned with the problem of the order of appearance in California of the Algonkian, Athabascan, Lutuamian, Yukian, Hokan, Penutian, and Shoshonean speaking peoples. The present distribution of types of culture and language in California raises problems of the source and development of culture and speech that present a challenge to the research worker in ethnology, linguistics, and archaeology. Attempts to state this problem and to contribute to its solution have been made by Kroeber (1917, 1923, 1936) and Klimek (1935; especially 4-11).

A. LIST OF CALIFORNIA TRIBES ACCORDING TO LINGUISTIC FAMILY

Numbers given below correspond to those appearing on map 2. These data are taken from a printed map entitled "Native Tribes, Groups, Dialects, and Families of California in 1770" issued by the Department of Anthropology, University of California, 1929.

ATHABASCAN FAMILY

1. Tolowa
2. Hupa group (Hupa, Chilula, Whilkut)
3. Mattole
4. Wailaki group (Nongatl, Lassik, Sinkyone, Wailaki, Kato)

ALGONKIAN FAMILY

5. Yurok
6. Wiyot

LUTUAMIAN FAMILY

7. Modoc

HOKAN FAMILY

8. Shasta (including the Okwanachu, New River Shasta, Konomihu)
9. Achomawi
10. Atsugewi
11. Yana group (Northern, Central, and Southern Yana; Yahi)
12. Karok
13. Chimariko
14. Pomo group (Northern, Central, Eastern, Southeastern, Northeastern, Southern, Southwestern Pomo dialect groups)
15. Washo
16. Esselen
17. Salinan group (Antoniano, Migueleño, and Playano dialects)
18. Chumash group (Obispeño, Purisemeño, Ynezeño, Barbareño, Ventureño, Emigdiano, Interior and Island dialect groups)
19. Diegueño group (Eastern and Western dialects)
20. Kamia
21. Yuma
22. Halchidhoma
23. Mohave

PENUTIAN FAMILY

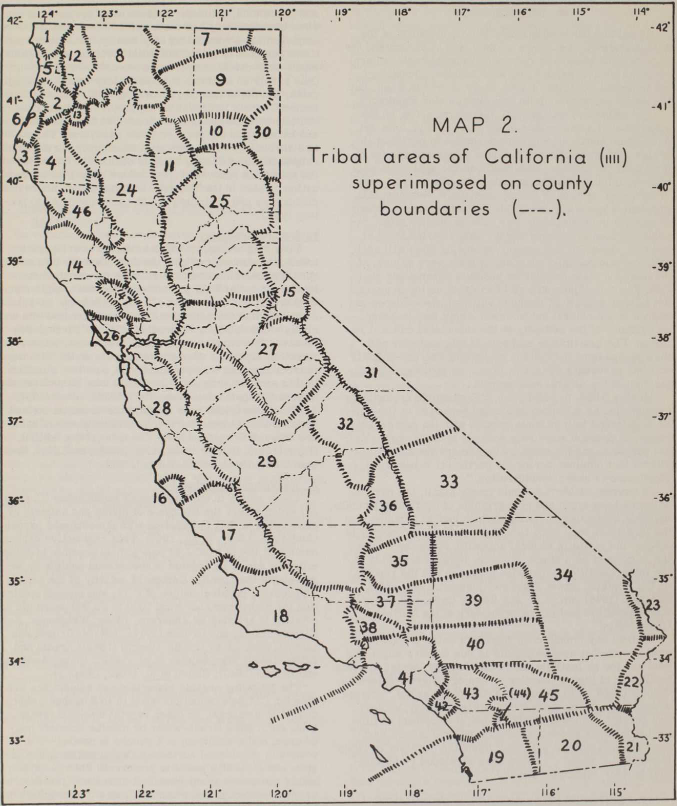
24. Wintun group (Wintu, Nomlaki, Patwin dialects)
25. Maidu (Northeastern, Northwestern, and Southern [Nisenan] dialects)
26. Coast Miwok
27. Interior Miwok (Plains, Northern, Central, Southern dialects)
28. Costanoan (Saklan, San Francisco, Santa Clara, Santa Cruz, Mutsun, Rumsen, Soledad dialects)
29. Yokuts (Northern Valley, Southern Valley, Northern Hill, Kings River, Tule-Kaweah, Poso Creek, Buena Vista dialects)

UTO-AZTEKAN (SHOSHONEAN) FAMILY

30. Northern Paiute (sometimes called Paviotso)
31. Paiute (formerly called Eastern Mono)
32. Monachi (sometimes called Western Mono)
33. Koso (sometimes called Panamint or Shoshone)
34. Chemehuevi (sometimes called Southern Paiute)
35. Kawaiisu
36. Tübatulabal
37. Kitanemuk
38. Alliklik
39. Vanyume
40. Serraño
41. Gabrieleño (mainland [Fernandeño, Gabrieleño] and island [Nicoleño] dialects)
42. Juaneño
43. Luiseño
44. Cupeño
45. Cahuilla (Pass, Mountain, and Desert dialects)

YUKIAN FAMILY

46. Yuki group (Yuki, Huchnom, Coast Yuki dialects)
47. Wappo


MAP 2.
Tribal areas of California (IIII) superimposed on county boundaries (----).
124° 123° 122° 121° 120° 119° 118° 117° 116° 115° 114°
42° 41° 40° 39° 38° 37° 36° 35° 34° 33°
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 (44) 45 46 47

XX. CHRONOLOGICAL METHODS

A. INTRODUCTION

As pointed out briefly in Section XI, the study of the past operates in the sphere of time, and to understand the past we must know with reference to prehistoric cultural evidence what is earlier and what is later. Chronology, the temporal ordering of data, is not an end in itself, but the necessary prerequisite to understanding prehistory.

The authors of this manual, therefore, acting on the suggestion of some critics of the first edition, have set down some observations and references to pertinent literature, on some of the techniques in general use for determining chronology. Most methods are applicable only to certain types of sites or materials. There is no easy or universal method of dating prehistoric remains; this problem is generally one which the archaeologist refers to experts in other fields. Dry cave or shelter sites, deposits formed in swampy areas, deeply buried finds of geologic antiquity, and pottery producing sites will each offer certain possible avenues, by their very nature, of determining their relative or absolute chronologic position. Few techniques will yield an exact dating in years, but a large number of methods will produce evidence of change in the natural environment which may be taken as evidence of the antiquity of the associated cultural remains. The quantitative estimate of this antiquity will then depend upon the opinion of experts who are familiar with the processes of faunal, floral, or physiographic alteration of the natural environment.

Movius (1949, p. 1445) says, "Prehistoric archaeology be regarded as ethnology projected backward in time until it is forced into intimate contact with the natural sciences, on which it must rely entirely both for chronological purposes and for establishing the environmental conditions that obtained during the particular stage of the [Quaternary] under consideration."

Of course, as Movius would freely admit, the physical sciences have made and give promise of continuing to make, valuable assistance in dating archaeological remains. But the important point here is that prehistoric chronology is largely the result of several scientific disciplines working in concert on a single problem. Notable examples of the interscientific cooperative approach are the reports on the Boylston Street Fishweir (Johnson, 1942, 1949), Champe's (1946) report on Ash Hollow Cave, and Cressman's (1942) report on the prehistory of the Northern Great Basin.

Without any intention (or hope!) of being prophetic, it would seem that archaeologists in this country might find real use for an Institute for Geochronology located at some institution of higher learning or one of the great museums. Zeuner (1946, p. v) defines geochronology as the "science which draws its methods from geology, botany, zoology, and physics. Its chief objective, the development of time scales in years which extend back into the distant past beyond the historical calendar, binds the different methods together . . . which . . . have been developed by specialists in their respective fields."

B. METHODS FOR ABSOLUTE CHRONOLOGY

A few methods will yield an exact dating for prehistoric remains. In the eastern Mediterranean and in Yucatan and Guatemala, calendar systems were devised and dates were inscribed on stone monuments. These methods are employed for direct dating only locally, but it is sometimes possible to extend the dated horizons into regions where such calendar systems were not used or known. Only rarely do artifacts such as pottery bear inscribed dates, and the archaeologist dealing with remains of ancient literate, calendar-using peoples must proceed cautiously in assigning dates inscribed on monuments and buildings to the simpler items recovered. The absolute chronology of the Inca area based upon durations of reigns of rulers (Rowe, 1945) is difficult to correlate with the materials recovered from refuse heaps; the same situation obtains in the Yucatan-Guatemala area where dated monuments are of limited use in assigning dates to pottery types.

1. Dendrochronology

Tree ring dating, by which annual growth layers of trees are counted, can give the date when the tree was cut. Only certain woods are reliable for dendrochronological analysis. Well-preserved wood and sizable pieces of charcoal can be utilized. Champe (1946, pp. 23-33) described how the careful collecting of charcoal bits was richly rewarded by a dendrochronology. Charcoal may be saved by wrapping it carefully in Kleenex, toilet paper, or cotton. Opinions vary among experts on the best ways to treat charcoal with preservatives, and in a situation of this sort the archaeologist should take immediate steps to secure expert advice (see Hall, 1939). Glock (1937) and Douglass (1929) have outlined the essential method of dendrochronology. Further published works of value are those of Douglass (1933), Gladwin (1940a, 1940b), Glock (1941), Hawley (1938, 1941), O'Bryan (1949), Schulman (1940, 1941), and Stallings (1939).

2. Radiocarbon (Carbon 14)

There exists in the atmosphere radiocarbon (Carbon 14) which enters the life cycle of plants and animals by conversion to CO_2 by reaction with atmospheric oxygen (Anderson, Libby, et al., 1947). This radioactive carbon has a half life of 5720 ± 47 years. It is possible to determine the age of an organic carbonaceous sample by ascertaining the specific Carbon 14 activity of the sample. The source, physical nature of C 14, and method application for dating remains from 1000 to 30,000 years old are detailed in articles by Anderson, Libby, Weinhouse, Reid, Kirschenbaum, and Grosse (1947a, 1947b); Grosse and Libby (1947); Libby (1946); Merrill (1948); Arnold and Libby (1949); Engelkeimer et al. (1949); Libby, Anderson and Arnold (1949); Calvin et al. (1949, Chap. 1).

The following organic materials and mounts are suitable for C14 determination: wood (4 to 8 ounces), charcoal (4 to 8 ounces), or other vegetal material (grass, peat, etc.). Shell (fresh-water or marine species) can be used, and a minimum of 4 ounces is needed--1 to 2 pounds is considered advisable. Guano and dung are usable, and at least 1 pound is preferred. Bone is unfortunately not usable if any chemical alteration (fossilization or mineralization) has occurred, since the carbonate content would thus have been altered. Possibly bone burned at the time it was deposited (as in a hearth or cremation) could be utilized. Teeth are in the same doubtful class as bone. Bone which has been kept completely dry (as in a cave or shelter) and which is merely dessicated and otherwise chemically unaltered may possibly be used for Carbon 14 analysis. All such materials of known or potential utilization should be collected in screw-top sterile Mason jars, labeled, and kept for future analysis. It is essential that contamination from mold (wet specimens should be dried before bottling) or any other organic material of more recent derivation be guarded against. Full notes should be made at the time the materials are collected. Include date, names of persons present, exact position and depth of specimens, cultural horizon, a statement as to the significance of the date if one should be determined, citations to the pertinent literature referring to the site or culture horizon, and the like. These data should be kept with the sample, and a copy submitted to the analyst for background information.

3. Association of dated historic materials or identifiable sites.

On occasion, where early historic documents, such as journals of explorers, fur traders, missionaries, military reconnaissance parties, and the like, may attest to the fact that certain sites were occupied at the time and more recent sources deny or remain silent on the occupation of the same site, one can assign the terminal occupation of the village and the latest cultural manifestation as dating from the time of the documentary record. In this way, using all available records, some definite knowledge of the particular culture type in operation on a certain date or within a definite time span can be determined (cf. Collier, Hudson and Ford, 1942, p. 113). Strong (1940a, p. 595) summarizes this approach by saying, "Of recent years numerous archaeologists have temporarily shifted their attention from prehistoric horizons of unknown age and affiliations to early historic and documented sites. These have been excavated in order to proceed from the known into the hitherto unknown. Such excavations objectively link history with prehistory and anchor archaeology to meaningful social science." This method is sometimes called the "direct historical approach" and has been discussed by Steward (1942). Its utility has been demonstrated by Wedel (1936, 1938), Strong (1935, 1940b), Will and Spinden (1906), Heizer (1941b), Heizer and Mills (n.d.), Kelly (1945, pp. 4-21), Smith (1948), Swanton (1939), Vaillant (1938).

The occurrence of datable historic objects of metal or glass in refuse deposits or graves may also lead to the absolute dating of a culture phase. The two Norse settlements on the Greenland coast introduced European objects to the Eskimo whose culture (Inugsuk) was thereby dated and furnished a lead for the chronological duration of the various Eskimo archaeological cultures (cf. Mathiassen, 1931).

Quimby (1939, 1941) has discussed this matter, using materials from Michigan and Louisiana. For California, see Heizer (1941a, 1941b), Heizer and Mills (n.d.), Walker (1947).

4. Glacial varve sequence

Baron Gerard de Geer is credited with the discovery that the thin clay laminae of certain deposits were annual layers deposited in melt-water basins by retreating glacial ice. Glacial ice retreat stages back to about 20,000 years can be dated with absolute exactness by varve counts. This method was first applied in the Baltic region by De Geer, and in eastern North America by Ernst Antevs. Although the varve counts are exact, human and cultural remains are not often found in the ancient melt-water basins areas, so that archaeological dating and varve counts are only approximate. Cultural remains which are associated with postglacial features (pluvial lake, terraces, etc.) may therefore be dated with reference to the varve chronology only insofar as the postglacial stage concerned with the deposit in which cultural remains occur may be ascertained, and this identification is always a pretty general one. An archaeological deposit may be determined as having been occupied at a particular point in time when, as the associated diatoms or pollen show, the climate was of a particular nature. The climatic substage may then be cross-correlated with the varve chronology, and through this indirect means a (varve) dating for the site may be determined. The reader is referred here to items 10 and 11 infra. All of Antevs' age determinations for remains of early man in North America are ultimately based on the results of his varve counts. The fact that there are several gaps in the varve sequence which must be filled by estimates makes this dating method less reliable than in the Old World (cf. Bryan and Ray, 1940, pp. 58-67). For expositions of the varve analysis method, see De Geer (1937, 1940), Antevs (1925, 1931, 1935), Zeuner (1946, Chaps. II, III; 1948).

5. Solar radiation periodicity curves

The work of the geologist Soergel, the astronomer Milankovich, and the climatologist Köppen have been brought together by the geochronologist Zeuner and a time scale for the Quaternary erected. The method is specialized, can be employed only by specially trained experts, and will not be of assistance in North American archaeology, at least directly. For the method, see Clark (1947, pp. 137-139), Zeuner (1946), and Antevs (1947a, 1947b).

6. Radium activity dating

This method, the theory and principles of which have been outlined by Merrill (1948), has been under investigation by Austrian and Swedish scientists. H. Pettersson of the Oceanografiska Institutet at Gothenberg, G. Halledauer and B. Karlik of Germany have been involved in the development of the method as applied to dating marine mollusk shells. Published materials known to the author on this subject are in the Berlin Wien Akad. der Wissen. IIa, vol. 134; Mitt. d. Radium Inst. 175, p. 39, 1925; and Resultats des Campagnes Scientifiques of Prince Albert I of Monaco, vol. LXXXI, Monaco, 1930.

7. Paleomagnetism

H. Manley (1949) has recently summarized the information and prospects on a dating method which utilizes the fixed position in certain artifacts, such as brick, pottery, and clays, of magnetic particles. The potentiality of the method lies in dating the artifacts by their declination which is compared to the periodicity curve of the terrestrial magnetic field. Like the radium method (no. 6, supra) this technique remains only one which is potentially useful. Further refinements in technique and interpretation must be accomplished before either can be used to date archaeological remains.

C. TECHNIQUES FOR ACHIEVING RELATIVE CHRONOLOGY

In the majority of archaeological investigations, the excavator must be content with the relative dating of cultures, where, for example, he can show that culture A is older than cultures B and C and culture B is younger than culture C. He may be able to estimate the relative duration of each culture, and point out that culture B endured for approximately twice the length of time that culture A did. His latest culture (C) may terminate at the historic period, and thus be datable, but as to the actual dating of cultures B and A, or the duration of culture A in terms of years, he may be completely in the dark. Most archaeological chronologies are of this sort. There always remains the possibility that some method, known but as yet not applied, or one still awaiting discovery, will furnish the lead for investing the relative sequence with absolute dating. This situation did occur in the American Southwest with the development of dendrochronology, and the newly discovered method of Carbon 14 dating promises to do likewise for some of the local sequences elsewhere in the New World. Zeuner's geochronology based on the curve of solar radiation has injected absolute dating into the Old World Paleolithic sequences, as has the varve chronology of northern Europe for the late and postglacial cultures.

Some of the more widely used or potentially useful techniques for achieving relative chronology are listed below.

1. Stratigraphy

Vertical stratigraphy which can be observed as a result of the excavation of occupation sites is the surest method of determining the order of succession of cultures. It is a method borrowed directly from geology (cf. Grabau, 1924), and its use by American archaeologists dates from as recently as 1916, when N. C. Nelson determined the pottery sequence at the Tano ruins (Nelson, 1916). A. V. Kidder employed the stratigraphic method at Pecos at about the same time, and L. Spier was testing the Trenton argillite culture with vertical sequence in mind (Spier 1916; Wissler, 1916). Petrie employed the stratigraphic method at Lachish, Palestine, in 1890 (Woolley, 1949, pp. 51-52). C. J. Thomsen, the Danish prehistorian, first employed stratigraphy in Old World archaeology in 1836 (Wissler, 1946, p. 2).

Stratification may be visible, as in the case of some mounds of the Mississippi Valley which were built over successively (cf. Setzler and Jennings, 1941, fig. 4), or the stratigraphic sequence may of necessity have to be worked out with statistical methods (cf. Strong and Corbett, 1943; Ford and Willey, 1949, pp. 44-57; Beals, Brainerd and Smith, 1945, pp. 56 ff., Appendix III; Schmidt, 1928; Kroeber, 1940; Olson, 1930).

Rouse (1939, pp. 80-82) shows that most archaeologists assume continuous occupancy of sites, and that different frequencies of types are therefore assumed to be due only to temporal changes of fashion. The worker should be ever aware of the possibility that intermittent or discontinuous occupation constitutes, in itself, a feature in which time is an important factor. Such interrupted occupation may be evidenced in many ways, and the individual worker must determine in each case the evidence for such situations. Intrusive graves or storage pits, superimposition of house floors, and the like may give evidence of time differences.

Renaud (1936, p. 6) cites instances of superimposition of petroglyphs as indicating the sequence of styles and elements.

Stratigraphy may be reversed as evidenced by the examples presented by Vaillant (1931, pp. 220-250), Hawley (1937), and Crabtree (1939).

2. Mineralization (fossilization) of bone

As has been frequently pointed out, buried bone is subject to varying conditions of moisture and soil minerals in different sites, or even in different parts of the same site. As a result, fossilization (the process of replacement of the bone by minerals from the soil and the addition of mineral material, loss of organic matter, and the like) takes place at very different rates in different cases, and a heavily mineralized bone from one location is not necessarily older than an almost unmineralized bone from another.

However, since fresh or living bone is unfossilized, and because most ancient bone is fossilized, the general truth of the axiom that fossilization is a correlate of time holds true. If one could secure a sufficient number of bone samples from a particular area where the bone was subjected to similar soil-moisture-temperature conditions, and covered a sufficiently long time span, it would be possible to make quantitative and qualitative chemical tests to determine whether mineralization of bone was random and accidental or followed a regular and orderly acceleration of degree of mineralization relative to increasing age. This actually has been done, and the latter situation does seem on the whole to prevail. Because the curve of fossilization does not invariably conform to the attribution of age as deduced from archaeological evidence, its employment must be exercised with caution. For the Central California area the application and results thus far obtained by this technique of relative dating are contained in articles by Cook and Heizer (1947), Heizer and Cook (1950), Cook (n.d.). It is hoped that the exceptions to the age-degree of mineralization correlation may yet be explained, and that some tertium quid may be invoked to establish the absolute dating of two or more points on the curve of mineralization.

It may be added here that the chemical analysis of bone method to achieve relative dating is probably best applied to open sites, is technical and not inexpensive because a laboratory is needed, and has not yet been fully worked out so that the several factors (e.g., soil minerals, ground water, temperature) which cause variability (deceleration or acceleration of the fossilization process) cannot at this time be controlled insofar as their individual or joint effects are not fully understood (cf. Barber, 1939; A. Rogers, 1924; Cook, n.d.).

An allied, but different, technique of bone analysis which may demonstrate relative (not absulute) age differences is that called the fluorine method. Most ground waters contain small amounts of fluorine. Fluorine ions combine with the hydroxyapatite crystals of the bone to form fluorapatite, a stable mineral resistant to weathering, leaching, or affinity with other minerals. A bone buried for a very long time will contain more fluorapatite than one buried for only a short time. This fact of increasing F-content with age, together with its application for dating bones, was first announced by J. Middleton (1844), carried further by M. Carnot (1892a, 1892b, 1892c, 1893), and has recently been revived by K. P. Oakley (1948; see also Montagu and Oakley, 1949, pp. 367-69; Heizer, 1950). The F-content method, because of the variability of fluorine content of ground waters and the relative slowness of uptake of fluorine in bone, cannot be expected to yield an absolute time curve. As pointed out by Carnot (1893, pp. 192-193) and Heizer (1950), and as demonstrated by Oakley (citations supra), the F-content of bone technique will be of chief value in determining whether bone implements or human skeletal remains found in association with bones of extinct animals are actually contemporaneous, or whether the human remains represent later intrusions into the level in which the animal bones were already resident. In such instances (cf. Carnot, 1893, pp. 192-193) the supposed contemporaneity can be adequately disproved in the absence of evidence of intrusion of the human remains.

A dating method advanced by Gangl (1936) based upon the fat content of prehistoric bone has failed in California, the only area outside Europe in which this method has been tested.

3. Patination of artifacts

The surface oxidation of artifacts, as pointed out by Service (1941) is a hazardous method of assigning age to the implements. Nevertheless, Renaud (1936, pp. 5-7), Kelly (1938, pp. 3-6), and M. Rogers (1939, pp. 19, 20) argue convincingly for the limited and objective use of this feature to infer relative dating of artifacts. M. Rogers (1939, p. 19) says, "Although the processes of patination and oxidation are understood only to a certain degree, and practically nothing is known about the rate of progress, the phenomena when properly used can be of aid in establishing an implement sequence in localized fields. When types are suspected of being common to two or more industries, or when an age relation between different types is being sought, the procedure leading to a solution must be conducted with certain controls. Only artifacts of the same lithologic composition which have been subjected to the same natural agencies over varying lengths of time should be used for comparative study. The weakness of the system, of course, lies in the fact that the last-named factors can only be roughly estimated. However, I cannot agree with the many who believe patination and oxidation to be worthless diagnostic factors. The investigator who knows both the causative and tempering factors, and is thoroughly familiar with his field, should certainly make an attempt to employ this methodology."

Patination of metals is a similar process of surface chemical alteration. Because of the near absence of metal objects in prehistoric sites in North America, no effort is made here to cite references to the literature beyond the excellent bibliography appended to the article by Fink and Polushkin (1936).

4. Seriation

This term is variously employed by American archaeologists, and is used here as indicating the determination of the sequence of styles, types, or assemblages of types (cultures) by any one or combination of various methods. Stratigraphy may be employed, or the materials may be from surface sites. These several methods of seriation may be judged by investigating the publications by Kroeber (1916); Spier (1917); Ford (1938); Lothrop (1942, pp. 183-199); Petrie (1899, 1901); Rogers (1939, pp. 1-2); Ford and Willey (1949, passim, esp. pp. 38 ff.); Kidder (1931); Renaud (1936, p. 6); Spier (1931); Woolley (1931, pp. 108-111); Holmes (1894). Spier (1931, p. 283) defines the seriation method, "Remains of a stylistic variable (such as pottery) occurring in varying proportions in a series of sites are ranged, by some auxiliary suggestion, according to the seriation of one element (one pottery type). Its validity is established if the other elements (two or more other pottery types) fall in smooth sequences (e.g., the Zuni ruin series obtained by Kroeber and Spier)." An instructive example of seriation compared with the actual stratigraphic sequence is contained in Ford and Willey (1949, p. 52).

In seriation the matter of classification and typology are important, and the student will be well advised to read what Brew (1946), Ford and Willey (1949), Rouse (1939, 1944), Taylor (1948), Krieger (1944), and Movius (1944, pp. 102, 106-108) have to say on this matter.

5. The typological method

Artifact types may be distinguished and their relative antiquity assigned on the presumption that the main criterion (simple to elaborate, poorly preserved to well preserved, crude to refined, etc.) is correlated with age. This is, of course, nothing more than a logical evolutionary arrangement constructed by the archaeologist. The evolution of types may be revealing, but so long as it continues to remain unsupported by concrete facts of relative (or absolute) time dating, it can rise to the level of nothing more than a logical scheme.

This subject is discussed by Atkinson (1946, pp. 172-173) and Clark (1947, pp. 115-118). They point out that when the evidence of associated finds (assemblages, aggregates, industries, find-complexes) is used to check the presumed evolution of a type, the reliability of the evolutionary development may be verified or denied (see also Childe, 1948, p. 51; Braidwood, 1946a, II; M. Rogers, 1939, p. 1).

6. Rate of refuse accumulation

Where no other method suggests itself, some estimate of the rate at which a refuse deposit accumulates may yield a date figure. Providing all of the variable factors (number of houses and occupants, amount of food eaten, firewood burned, etc., etc.) could be exactly controlled, the time required to amass a specified amount of midden could be calculated (cf. Cosgrove, 1932, pp. 100-103). But because the variables can never, with certainty, be raised to the rank of probabilities, any age estimate derived from this method is only an approximation and is quite likely to be so much in error that the calculation was a waste of good time.

R. Pumpelly employed this method at Anau and cited data from Egypt; Nelson (1909, pp. 345-56), Gifford (1916), Schenck (1926, pp. 205-212), and Cook (1946) have attempted to calculate the antiquity of the San Francisco Bay shellmounds by this method; Harrington (1933, p. 171) utilized the rate of increment technique at Gypsum Cave (see also critique by Kroeber, 1948, p. 681); Loud and Harrington (1929, pp. 120-123) used this method as supporting evidence for their estimate of the antiquity of Lovelock Cave; Vaillant (1935, pp. 166-167, 257-258) compares the rate of refuse accumulation at Pecos and certain Valley of Mexico sites; Junius Bird (1948, pp. 21, 27-28) suggests the time involved in the building of an artifact bearing soil profile at Viru; Kubler (1948) determined that the guano comprising the "stacks" off the Peruvian coast and which have produced artifacts of known cultural affiliation from known depths was deposited in annual layers which could be counted, but which also were of sufficiently uniform thickness that depth measurements could be substituted for layer counts. Thus, an artifact found at a depth of so many feet could be calculated as being deposited a certain number of years ago by computing how many annual guano layers would be required to accumulate to equal the depth at which the artifact was recovered. The parallel to the glacial varve counting method (cf. Bryan and Ray, 1940, pp. 57 ff.) is striking.[9] Champe (1936, pp. 32-33) dates some levels of Ash Hollow Cave by dendrochronology and uses the depth factor of dated levels to estimate the time required for the accumulation of the nondated levels. Lothrop (1928, p. 197) estimated the population of a district and the total volume of middens to compute the rate of deposit accumulation in Tierra del Fuego. Strong (1935a, pp. 236-239) estimates the antiquity of the Signal Butte site by calculating the rate of dune migration. These may be taken as examples of the employment of the rate of accumulation method. Morrison (1942, p. 380), Schenck (1926, pp. 208-212), Clark (1947, p. 139), and Woolley (1949, p. 79) have called attention to the difficulties of making and relying upon such age estimates.

This chronological method is the same as that used by geologists in estimating the age of the oceans from the annual increment of sodium or estimating the rate of formation of sedimentary rocks (cf. Zeuner, 1946, Part IV).

7. Distributional method

A possible, though hazardous, method of inferring relative antiquity of two types is on the basis of their comparative distribution; the more ancient being more widespread than the younger, whose distribution is more restricted.

Kroeber (1923) in an avowedly hypothetical historical reconstruction of the history of native culture in California illustrates this technique. Clark (1947, pp. 131-133) discusses the method in archaeology. Workers in the field of Eskimo ethnology and prehistory have employed the distributional method (though not invariably or exclusively for purposes of deriving chronological indications) to advantage, as attest the works of Collins (1937), de Laguna (1934), Larsen and Rainey (1948), and Birket-Smith (1929). Kroeber (1931) gives a general survey of the distributional method. Sapir's Time Perspective (1916) might be read by all American archaeologists with considerable profit. The distributional method must be employed critically, and some precautions are outlined by Linton (1936, pp. 374-381), Dixon (1928), and Wallis (1945).

8. Cross-dating

A type dated in one area (either in a relative or absolute time scale) and occurring elsewhere in association with material which is floating in time, may provide the lead for pegging down the local chronology. Clark (1947, pp. 133-136) discusses this method under the term of "synchronisms." American archaeologists are well aware of this method and the rich results which often may be achieved by its use. It is the basic technique in Krieger's monumental Texas volume (Krieger, 1946); it was employed at Snaketown (Gladwin et al., 1937) and has assisted Middle American archaeologists (cf. Kidder et al., 1946, p. 250) and for long has been in use in the field of Old World prehistory.

Trade objects which are the clearest evidence of actual contemporaneity between two geographically separated cultures[10] may permit the extension of an absolute chronology to a region which has hitherto yielded only materials which can be placed relatively in a sequential scheme. Thus, Kidder et al. (1946, p. 251) and Kidder and Thompson (1938) suggest that the floating Maya Long Count may some day, through the discovery of a chain of cross finds, be equated and synchronized with the Southwestern dendrochronological time sequence (cf. Davis, 1937). In California there is hope of ultimately synchronizing local culture phases with tree-ring dated cultures of the Southwest by means of shell bead and pottery trade objects (cf. Heizer, 1941, 1946; Gifford, 1949).

Synchronisms may also be determined from the evidence of some natural phenomenon, such as a volcanic ash fall which covered a wide area and therefore permits the assigning of a pre- and post-ash fall period to cultural remains under and over the ash (cf. Cressman, 1942; Colton, 1945; Vaillant, 1935, pp. 165-166).

9. Geological methods

Under this general heading will come those archaeological finds which have some relationship with geological features. For example, the physiographic location of sites in positions now unfavorable to occupancy, and evidence of alluvial deposition or erosion, furnish a priori evidence that man lived there before the changes occurred, and the geologist is requested to offer some opinion as to the length of time involved since the evidence of man's presence was laid down.

Former occupation sites may occupy positions which are at the present time to be considered as unfavorable in terms of proximity to drinking water, economic resources, etc. In such cases one should investigate the possibility that climatic changes have ensued since occupation of the site. W. E. Schenck (1926) and N. C. Nelson (1909), who dealt with the Emeryville and Ellis Landing shellmounds on San Francisco Bay, concluded that subsidence of the shore was evidenced by the sub-sea-level base of the midden deposits. Geologists were unable to suggest a subsidence rate, and this observation was therefore unusable as a means for determining age of the cultural deposits. J. Bird (1938, 1946:21) found that some Patagonian shell middens had risen about 15 feet and was able to estimate the minimum rate of shore elevation to achieve the total age of the cultural deposits. T. Mathiassen (1927:6-10; 129-130) showed that the elevation of the shore and consequent shallowing of the sea accounts for the abandonment of that area by whales and thus of the Thule Eskimo who depended so heavily upon this animal for food. The house pits of the former Thule settlements are now 5 to 15 meters higher than when they were built some centuries

[9] Kubler's guano dating and that of Allison (1926), where the rate of growth of stalagmites at Jacob's Cavern was attempted, might as reasonably be included in Part A of this section under the class of absolute or direct chronology.

[10] Trait resemblances between two distant cultures may be so unmistakably due to diffusion that no reasonable doubt may be entertained. But these similarities are to be taken not as evidencing exact synchronisms, but general contemporaneity.

ago. Shore subsidence or sea-level rise in connection with archaeological sites is also discussed by Goldthwait (1935), Bird (1943), Johnson and Raup (1947), Clark (1947, pp. 129-131), and Deevey (1948). The presence of man on the borders of pluvial or postglacial lakes has been proposed by E. W. C. and W. H. Campbell (1935) and E. Campbell et al. (1937). Geologists advance dates for the time when the lakes were full. Providing the evidence of man's presence there at the time the now dry basins were full is sufficiently strong, the cultures are datable.[11] Greenman and Stanley (1943) cite a similar situation at George Lake, Ontario.

The soil overburden of an archaeological deposit may be studied by a geologist who can erect, to quote Kirk Bryan, an "alluvial chronology." The sequence, time, and causes of erosion or deposition may be ascribed to glacial, pluvial, or arid conditions. The following works are offered as examples of the method: Antevs (1949), Bryan (1941, 1948), Bryan and Ray (1940), Bryan and McCann (1943), Cook (1949, pp. 8-10, 16-18, 20-21, 23-24, 35-36, 41-42, 45-48, 51-52, 84-86), Hack (1942, 1945), Judson (1949), J. C. Kelly et al. (1940), Leighton (1936), MacClintock et al. (1936), Schultz (1938).

Soil profiles, per se, may yield some indication of age. The most specific claim advanced for dating the age of soils is by Siniaguin (1943). Other works treating with this matter are by Bryan and Albritton (1943), Hack (1943), Leighton (1934, 1936, 1937), Thorp (1949) and Zeuner (1946, p. 338).

10. Botanical methods

Under this heading we include the study of all plant remains or evidence associated with sites.

The affinity of certain plants for archaeological sites has been repeatedly observed (cf. Griffin, 1948, pp. 3-4; Drucker, 1943, pp. 114-115; Hrdlicka, 1937). Because particular plants find such micro-environments favorable, for reasons of soil chemistry, drainage, or other factors, it is reasonable to suppose that surface sites of different time periods will support somewhat different floras (cf. Larsen, 1950, p. 177). This is certainly the case in Central California where Early, Middle, and Late Horizon sites each favor the growth of certain distinctive plant species. The whole question of floral association of sites is much in need of investigation, since it promises to produce a rough technique for relative chronology.

Paleobotonists can deduce much about the climate and flora of the past from a study of pollen preserved in soils. The collecting and preservation of archaeological botanical materials is treated by Barghoorn (1944). Illustrations of the method and results of pollen analysis are contained in the works by Cain (1939), Cooper (1942), Deevey (1944, 1949), Godwin (1934), Hansen (1942, 1946), Johnson (1942, pp. 96-129), Sears (1932, 1937), Wilson (1949), Knox (1942), Clark (1947, pp. 123-127), and Zeuner (1946, Chap. III).

The botanical identification of wood, charcoal, or fruits may also be of ultimate chronological significance. For examples see Barghoorn (1949), Chaney (1935a, 1935b, 1941), Bailey and Barghoorn (1942).

11. Paleontological methods

The discovery of remains of extinct animals with evidences of man in both the Old and New Worlds has now become commonplace (cf. Stock, 1936). Where any association between bones or artifacts of man and those of extinct animals is found, careful recording of the occurrence should be made, and, if possible, the whole should be kept in situ until one or more paleontologists can study the find in its original position. Such finds are still rare, and because of their probable antiquity, highly important. See Heizer (1948, pp. 1-2) for advice on what to do about the discovery of associated human and extinct animal remains.

Microfossils contained in soil or peat may yield, to expert study, indications of chronological value. For diatom analyses see Conger (1942, 1949) and Linder (1942). For studies of foraminifera see Stetson and Parker (1942) and Phleger (1949).

Molluscs are also sensitive indicators of climate, and their remains (shells) in association with artifacts often furnish excellent information of assistance in erecting an archaeological chronology. See the works of Baker (1920, 1930, 1937, 1942), Boekelman (1936), Eiseley (1937), Griffin (1948), Richards (1936, 1937), Clench (1942), Goggin (1949, p. 23). The remarkable paper by Morse (1925) presents a method of chronology based upon metrical analysis of mollusc shells. Not only could relative chronology be determined by this method, but (at least theoretically) an absolute chronology could be erected. It is to be desired that further work be carried out in this regard.

D. CONCLUDING OBSERVATIONS

No part of archaeology is more difficult, generally speaking, than the determination of chronology. The worker must be ever aware of this problem, and must collect the materials and make the necessary observations while the excavation is in progress which will assist him in making a time determination of his site. Since no two archaeological deposits are ever the same, each excavation will constitute a unique problem. Beyond the mechanical collecting of charcoal, wood, molluscan remains, vertebrate and invertebrate remains, and soil samples which may be of some aid, the cultural materials themselves and the stratigraphy will also be essential elements in any age determination. Stimulating ideas and otherwise ignored approaches to the problem will often result from consultation with specialists in certain disciplines in the natural and physical sciences.

---

[11] Actually, in southern California the evidence of association is not very strong despite the confident assertions of certain workers.

ABBREVIATIONS

AA	American Anthropologist
AAA-M	American Anthropological Association, Memoirs
A Ant	American Antiquity
AJPA	American Journal of Physical Anthropology
AMNH	American Museum of Natural History
-AP	Anthropological Papers
-B	Bulletin
-M	Memoirs
BAE	Bureau of American Ethnology
-B	Bulletin
-R	(Annual) Report
CAS-R	California Archaeological Survey, Reports
FMNH-PAS	Field Museum of Natural History, Publications, Anthropological Series
GP-MP	Gila Pueblo, Medallion Papers
JRAI	Journal of the Royal Anthropological Institute
ICA	International Congress of Americanists (Proceedings)
MAIHF-INM	Museum of the American Indian, Heye Foundation, Indian Notes and Monographs
PM	Peabody Museum
-M	Memoirs
-P	Papers
SAA-N	Society for American Archaeology, Notebook
SDM	San Diego Museum
-B	Bulletin
-P	Papers
SI	Smithsonian Institution
-AR	Annual Report
-MC	Miscellaneous Collections
SM	Southwest Museum
-M	Masterkey
-P	Papers
SWJA	Southwestern Journal of Anthropology
UC	University of California
-AR	Anthropological Records
-IA	Ibero-Americana
-PAAE	Publications in American Archaeology and Ethnology
UCMA	University of California Museum of Anthropology
USGS	United States Geological Survey
USNM	United States National Museum
-P	Proceedings
-R	Reports
YU-PA	Yale University, Publications in Anthropology

XXI. GENERAL REFERENCE BIBLIOGRAPHY

A. FIELD METHODS; THEORY AND AIMS OF ARCHAEOLOGY; FUNCTIONAL INTERPRETATION OF ARCHAEOLOGICAL DATA

Atkinson, R. J. C.

1946 Field archaeology. London

1948 Excavating and the amateur. The Archaeological News Letter, No. 3:1-2

Anonymous

1947 The training of archaeologists. South Afr. Archaeol. Bull. 2:97-99 [Reprinted, with additional comments,from Antiquity 83, 1947]

Bade, W. F.

1934 A manual of excavation in the Near East. Univ. of Calif. Press, Berkeley

Beazeley, G. A.

1919 Air photography in archaeology. The Geographical Journal 53:330-335

Bennett, J. W.

1943 Recent developments in the functional interpretation of archaeological data. A Ant 9:209-218

Braidwood, R. J.

1946 <u>In</u> Human origins. Selected readings, Series II, University of Chicago Bookstore. [Article 12 (Artifacts), pp. 113-120, and Article 14 (Terminology in prehistory), pp. 127-144, are especially valuable.]

Breasted, J. H., Jr.

1939 The place of archaeology in the modern world. Southwestern Lore 5:43-48

Brew, J. O.

1946 Archaeology of Alkali Ridge, southeastern Utah. PM-P 21 [Field methods, pp. 97-102]

British Museum

1920 How to observe in archaeology. Oxford Univ. Press, London

Burkitt, M. C.

1927 Archaeological methods. South Afr. Journ. of Science 24:496-501

Burrows, M.

1941 What mean these stones. Amer. Schools of Oriental Research, New Haven. [Chap. I, Purpose, methods, materials, and interpretation of evidence in archaeology.]

Byers, D. S. and F. Johnson

1939 Some methods used in excavating Eastern shell heaps. A Ant 4:189-212

Caley, E. R.

1949 Archaeological chemistry. Chem. and Engin. News 27:2140-2142

Carpenter, R.

1933 The humanistic value of archaeology. Harvard Univ. Press

Casson, S.

1934 Progress of archaeology. New York [Chap. 1, What the archaeologist wants to do]

Childe, V. G.

1933 Is prehistory practical? Antiquity 7:410-418

1935 Changing methods and aims in prehistory. Proc. of the Prehistoric Society for 1935: 1-15. Univ. Mus. of Archaeol. and Ethnol., Cambridge

1944 Archaeological ages as technological stages. JRAI 74:1-19

1946 Archaeology and anthropology [ethnology]. SWJA 2:243-251

1947 Archaeology as a social science. Third Ann. Rept., Inst. of Archaeol., Univ. of London:49-60.

Clark, G.

1947 Archaeology and society. 2d ed., rev. London

Clark, J. G. D.

1944 Man and nature in prehistory. Inst. of Arch., Univ. of London, Occ. Papers 6:20-28

Cole, F. C. and T. Deuel

1937 Rediscovering Illinois. Chicago

Colton, H. S.

1942 Archaeology and the reconstruction of history. A Ant 7:33-40

Cornwall, I. W.

1948 Scientific prehistory. Science News, No. 8, pp. 7-29. Penguin Books, London

Costes, A.

1929 Manuel de recherches préhistoriques. Paris

Crawford, O. G. S.

1921 Man and his past. Oxford Univ. Press

Daniel, G. E.

1943 The three ages. An essay on archaeological method. Cambridge Univ. Press

Droop, J. P.

1915 Archaeological excavation. Cambridge Univ. Press

1938 La technique des fouilles archéologiques. Mouseion 43-44:221-284. Paris

Fenenga, F.

1949 Methods for archaeological site survey in California. CAS-R 5

Fisher, C. S.

1929 The excavation of Armageddon. Oriental Inst. Communications. [Statement on method of excavation]

Fox, C.

1943 The personality of Britain. Nat. Mus. of Wales, Cardiff. 4th ed., rev.

Garrod, D. A. E. and D. M. A. Bate

1946 Environment, tools and man. Cambridge Univ. Press

Goodwin, A. J. H.

1945 Method in prehistory. South Afr. Archaeol. Soc. Handbook Series, No. 1, Capetown

1947 The orthography of archaeology. Man 47:52 [art. 49]

Guthe, C. E.

1939 The basic needs of American archaeology. Science 90:528-530

Heizer, R. F.

1949 A bibliography of the archaeology of California. CAS-R, No. 4

Holmes, W. H.

1905 Contributions of American archaeology to human history. SI AR [1904], pp. 551-558

Hurst, C. T.

1945 Colorado's old-timers. Southwestern Lore 10:45-56. [Chap. 2, pp. 49-56, methods of excavation. See esp. Pl. 1]

International Institute of Intellectual Cooperation

1940 Manual on the technique of archaeological excavations. Paris

Jackson, A. T.

1935 Technique of archaeological field work. Bull. Central Texas Archaeol. Soc., Vol. 1

Kluckhohn, C.

1940 The conceptual structure in Middle American studies. In The Maya and their neighbors. New York, pp. 41-51

Kroeber, A. L.

1930 Archaeology. Encyclopaedia of the Social Sciences 2:163-167

Kuhn, H.

1941-1942 Zur Methode der Vorgeschichte. Ipek, 15-16: 254-256

Leh, L. L.

1941 Archaeology and the amateur. Southwestern Lore 7:37-42

Lewis, T. M. N. and M. D. Kneberg

n.d. Manual of field and laboratory techniques employed by the Division of Anthropology, University of Tennessee . . . in connection with the investigation of archaeological sites within the TVA Dam reservoirs. Univ. of Tenn., Knoxville. [Mimeographed]

McCown, C. C.

1943 The ladder of progress in Palestine. New York. [Chap. 1 (pp. 1-17) The magic of method; how excavations are carried on.]

McGregor, J. C.

1939 Archaeological problems. Southwestern Lore 5:52-56

Malan, B. D.

1945 Excavation method in South African prehistoric caves. South Afr. Mus. Assoc. Bull., December 1944:1-8

du Mesnil du Boisson, Comte R.

1934 La technique des fouilles archéologiques. Paris

Movius, H. L., Jr.

1944 Early man and Pleistocene stratigraphy in southern and eastern Asia. Peabody Mus. Papers, Vol. 19, No. 3 (pp. 7-8 Prehistoric archaeology: a social science)

1948 The lower Paleolithic cultures of southern and eastern Asia. Proc. Amer. Philos. Soc. 38, Part 4 (pp. 330-331, General statement on aims, methods of prehistory)

Nelson, E. and R. Ritzenthaler

1944 Geological key for [mineral] identification of Indian artifacts. The Wisconsin Archaeologist 25:76-88

Nelson, N. C.

1937 Prehistoric archaeology, past, present, and future. Science 85:81-89

Oxford University Archaeological Society

1940 Notes on archaeological technique. Ashmolean Museum

Petrie, W. M. F.

1904 Methods and aims of archaeology. London

Parker, A. C.

1923 Methods in archaeology. Ontario Provincial Museum Report

1929 The value to the state of archaeological surveys. Bull. Nat. Res. Council No. 74:31-41

Piggott, S.

1948 Archaeology and the amateur. The Archaeological News Letter, No. 1:1-2

Randall-MacIver, D.

1933 Archaeology as a science. Antiquity 7:5-20

Reisner, G. A.

1924 Harvard excavations at Samaria. Vol. I [Chapter on methods of excavation]

Salin, E.

1946 Manuel des fouilles archeologiques. Vol. I. Paris

Steward, J. H.

1944 Re archaeological tools and jobs. A Ant 10: 99-100

——— and F. M. Setzler

1938 Function and configuration in archaeology. A Ant 4:4-10

Strong, W. D.

1936 Anthropological theory and archaeological fact. In Essays presented to A. L. Kroeber. Berkeley. Pp. 359-370

Tallgren, A. M.

1937 The method of prehistoric archaeology. Antiquity 11:152-161

Taylor, W. W.

1948 A study of archaeology. AAA-M 69

Weidenreich, F.

1941 The site and the technique of the excavations of fossil man in Choukoutien, China. Trans. N.Y. Acad. Sci. ser. 2, 4:23-31

Wheeler, N. F.

1930 Excavation. Antiquity 4:173-178

Wilson, J. A.

1942 Archaeology as a tool in humanistic and social studies. Journ. of Near Eastern Studies 1:3-9

Wissler, C.

1929 Archaeology as human interest. Bull. Nat. Research Council No. 74:44-48

1935 The value of archaeology to the advancement of mankind. Bull. Archaeol. Soc. of Brevard College, No. 1, Brevard, North Carolina

1946 The archaeologist at work. Man and Nature Publs., AMNH, Science guide No. 116

Woolley, C. L.

1931 Digging up the past. New York

B. CULTURE CLASSIFICATION METHODS

Brew, J. O.

1946 Archaeology of Alkali Ridge, southeastern Utah. PM-P 21. [Chapters on culture classifications and the taxonomic approach to archaeological cultures]

Colton, H. S.

1939 Prehistoric culture units and their relationships in Northern Arizona. Mus. Northern Arizona, Bull. 17. Flagstaff. [Application of McKern method of culture classification combined with the system proposed by W. and H. S. Gladwin, 1934]

Driver, H. E. and A. L. Kroeber

1932 Quantitative expression of cultural relationships. UC-PAAE 31:211-256 [Technique has archaeological applications]

Gladwin, W. and H. S.

1934 A method for the designation of cultures and their variations. GP-MP 15

Goodwin, J. H.

1931 On some problems of association and chronology in prehistory. South Afr. Journ. of Science 28:51-62

1946 The terminology of prehistory. South Afr. Archaeol. Bull. 1:91-100

Holmes, W. H.

1919 Handbook of aboriginal American antiquities. Part I, The lithic industries. BAE-B 60. [Chapter 9, Culture characterization areas, attempts to set up archaeological culture areas. Holmes establishes 21 for North and South America; of these 16 are North American.]

Kroeber, A. L.

1940 Statistical classification. A Ant 6:29-44

McKern, W. C.

1934 Certain culture classification problems in Middle Western archaeology. Nat. Res. Council, Circular Series No. 17. [Mimeographed]

1939 The Mid-Western taxonomic method as an aid to archaeological culture study. A Ant 4:301-313

Renaud, E. B.

1938 A graphic method of material culture analysis. Southwestern Lore 4:27-29

Rouse, I.

1939 Prehistory in Haiti; a study in method. YU-PA 21

XXII. REFERENCES CITED IN TEXT

Allison, V. C.

1926 The antiquity of the deposits in Jacob's Cavern. AMNH-AP 19, Part 6

Amsden, C. A.

1935 The Pinto Basin artifacts. In The Pinto Basin site. SM-P 9:33-51

Anonymous

1941 Soil analysis and the location of ancient habitations. Antiquity 15:382-383

Antevs, E.

1925 Retreat of the last ice-sheet in eastern Canada. Canada Geo. Surv. Mem. 146

1931 Late-glacial correlations and ice recession in Manitoba. Canada Dept. Mines, Geol. Survey, Memoir 168. Ottowa. [Contains long bibliography]

1935 Telecorrelations of varve curves. Geol. Fören. Stockholm Förh. 57:47-58

1947a Review of F. E. Zeuner, "Dating the Past." Journ. of Geol. 55:527-530

1947b Review of F. E. Zeuner, "The Pleistocene Period." Journ. of Geol. 55:446-450

1949 Age of Cochise artifacts on the Wet Leggett. In Cochise and Mogollon sites, Fieldiana, Anthropology 38, No. 1. Chicago Nat. Hist. Mus.

Antle, H. R.

1940 Some points in bone preservation. SAA-N 1:118-125

Arnold, J. R. and W. F. Libby

1949 Age determinations by radiocarbon content: checks with samples of known age. Science 110:678-680, Dec. 23, 1949

Atkinson, R. J. C.

1946 Field archaeology. London

Bailey, I. W. and E. S. Barghoorn, Jr.

1942 Identification and physical condition of the stakes and wattles from the [Boylston Street] fishweir. In Johnson, 1942, pp. 82-95

Baker, F. C.

1920 The life of the Pleistocene or glacial period. Bull. Univ. Illinois 17:195-370

1930 Influence of the glacial period in changing the character of the molluscan fauna of North America. Ecology 11:469-480

1937 Pleistocene land and fresh-water mollusca as indicators of time and ecological conditions. In Early man, G. G. MacCurdy (ed.), pp. 67-74. Philadelphia

1942 Mollusca contained in the test pit deposits. In Cressman, 1942, pp. 117-119

Ball, S. H.

1941 The mining of gems and ornamental stones by American Indians. BAE-B 128

Barber, H.

1939 Untersuchungen über die Chemische Veränderung von Knochen bei der Fossilization. Palaeobiol. 7:217-235

Barbieri, J. S.

1937 Technique of the implements from Lake Mohave. In The archeology of Pleistocene Lake Mohave. SM-P 11:99-108

Barghoorn, E. S.

1944 Collecting and preserving botanical materials of archaeological interest. A Ant 9: 289-294

1949 Paleobotanical studies of the Boylston Street fishweir. In Johnson (ed.) 1949:49-83

Barrett, S. A.

1916 Pomo buildings. Holmes anniversary volume

——— and E. W. Gifford

1933 Miwok material culture. Bull. of the Public Museum of the City of Milwaukee, 2:117-376

Bartlett, K.

1933 Pueblo milling stones of the Flagstaff region and their relations to others in the Southwest. Mus. Northern Arizona, Bull. 3. Flagstaff

Bascom, W. R.

1941 Possible application of kite photography to archaeology and ethnology. Ill. Acad. Sci. Trans., Vol. 34, No. 2

Beals, R. L., G. W. Brainerd and W. Smith

1945 Archaeological studies in Northeast Arizona. UC-PAAE 44, No. 1

Beardsley, R. K.

1946 Temporal and areal relationships in Central California archaeology. Ph.D. thesis in Univ. of Calif. Library. Berkeley

1949 Culture sequences in Central California prehistory. A Ant 14:1-28

Bennyhoff, J.

n.d. Certain harpoons and fish spears from California. MS Dept. of Anthro., Univ. of California. Berkeley

Bentzen, C. B.

1942 An inexpensive method of recovering skeletal material for museum display. A Ant 8:176-178

Bird, J. B.

1938 Antiquity and migrations of the early inhabitants of Patagonia. Geogr. Rev. 28:250-275

1943 Excavations in Northern Chile. AMNH-AP 38, Part 4. [Pp. 311-313. Discussion of coastal stability in relation to shore sites. No time estimate made, but important indications pointing to probable antiquity result.]

Bird, J. B. (continued)

1946 The archaeology of Patagonia. In Handbook of South American Indians, BAE-B 143, Vol. 1, 17-24

1948 Preceramic cultures in Chicamà and Virú. Mem. Soc. Am. Arch. 4:21-28

Birket-Smith, K.

1929 The Caribou Eskimos. Reports of the fifth Thule exped. 1921-1924, Vol. 5, Part 2

Bixby, L. B.

1945 Flint chipping. A Ant 10:353-361

Black, G. A.

1944 Angel Site, Vanderburgh County, Indiana. Indiana Hist. Soc., Prehistoric Research Series 2, No. 5

——— and P. Weer

1936 A proposed terminology for shape classifications of artifacts. A Ant 1:280-294

Boekelman, H. J.

1936 Report on the mollusks of St. Lawrence Island. Appendix VI (pp. 379-86) in O. W. Geist and F. G. Rainey, Archaeological excavations at Kukulik, St. Lawrence Island, Alaska. Vol. 2, Misc. Publs. Univ. of Alaska, Washington

Boots, C. O. and J. Shirley

n.d. Graphic aids to osteology. Scientific Illustrators. Box 175, North Park Sta., San Diego 4, Calif.

Braidwood, R. J.

1946a The order of incompleteness of the archaeological record. In Human origins. Selected readings, series II, 2d ed., article No. 11, pp. 108-112. University of Chicago, bookstore

1946b Artifacts. Ibid., art. no. 12, pp. 113-120

1946c Terminology in prehistory. Ibid., art. no. 14, pp. 127-144

Brainerd, G. W.

1939 An illustrated field key for the identification of mammal bones. Ohio State Archaeol. and Hist. Quarterly, 48:4-328

1948 Objectives, field procedure, and recording of data. Archaeol. Surv. Assoc., So. Calif.

Brand, D. D.

1938 Aboriginal trade routes for seashells in the Southwest. Yearbook, Assoc. Pac. Coast Geographers, 4:3-10

Brew, J. O.

1946 Archaeology of Alkali Ridge, southeastern Utah, PM-P 21

Bryan, K.

1941 Correlation of the deposits of Sandia Cave, New Mexico, with the glacial chronology. SI-MC 99-45-64

1948 Los suelos complejos y fósiles de la altiplanicie de México, en relación a los cambois climáticos. Bol. Soc. Geol. Mejicana 13:1-20

——— and C. C. Albrilton, Jr.

1943 Soil phenomena as evidence of climatic changes. Am. Journ. Sci. 241:469-490

——— and F. T. McCann

1943 San dunes and alluvium near Grants, New Mexico. A Ant 8:281-290

——— and L. R. Ray

1940 Geologic antiquity of the Lindenmeier Site in Colorado. SI-MC 99, No. 2

Burns, G. E.

1940 A practical method for mending bone. SAA-N 1:98

Burns, N. J.

n.d. Field manual for museums. Nat. Park Service. Washington, D.C.

Byers, D. S.

1939 [Communication on processes for hardening bone artifacts and skeletal material] SAA-N 1:29-30

——— and F. Johnson

1939 Some methods used in excavating eastern shell heaps. A Ant 4:189-212

1940 Two sites on Martha's Vineyard. Phillips Academy, Andover, Mass. Papers of the Robert S. Peabody Foundation for Archaeology, 1:1-104

Cain, S. A.

1939 Pollen analysis as a paleo-ecological research method. Bot. Rev. 5:627-654

Calvin, M., C. Heidelberger, J. C. Reid, B. M. Tolbert, and P. E. Yankwich

1949 Isotopic carbon. Wiley, New York. [Chap. 1 Production and properties of isotopic carbon]

Camp, C. L. and G. D. Hanna

1937 Methods in paleontology. Berkeley

Campbell, E. W. C.

1931 An archaeological survey of the Twentynine Palms region. SM-P 7:1-93

——— and W. H.

1935 The Pinto Basin Site. SWM-P 9

Campbell, E. W. C., et al.

1937 The archaeology of Pleistocene Lake Mohave, a symposium. SWM-P 11

Campbell, T. N.

1940 Organization of the council of Texas archaeologists. Texas Archaeol. News, No. 1 [Mimeographed]

Carnot, M. A.

1892a Recherche du fluor dans les os modernes et les os fossiles. Paris Ac. Sci. C. R. 114: 1189-1192. [Also Journal Pharm. 26:124-125, 1892]

1892b Sur une application de l'analyse Chemique pour fixer l'âge d'ossements humains prehistoriques. Paris, Acad. Sci., C. R. 115: 337-339

1892c Sur la composition des ossements fossiles et la variation de leur teneur en fluor dans les différents étages géologiques. Paris, Ac. Sci. C. R. 115:243-246

1893 Recherches sur la composition générale et la teneur en fluor des os modernes et des os fossiles des différents âges. Ann. Mines 3, Ser. 9, (Mem), 155-195

Champe, J. L.

1946 Ash Hollow Cave. Univ. Nebr. Studies, n.s., No. 1

Chaney, R.

1935a The occurrence of endocarps of <u>Celtis barbouri</u> at Choukoutein. Bull. G. Soc. China 14:99-113, Peking. [See also 12:323-28, 1933]

1935b The food of "Peking Man." News Ser. Bull. Carnegie Inst. of Wash., Vol. III, No. 25, pp. 197-202, Washington

1941 Charcoal from the Double Adobe Site <u>In</u> Sayles and Antevs, 1941, p. 68

Chard, Chester

n.d. Hotchkiss Site (CCo-138) report. MS in files of CAS, Univ. of California. Berkeley

Childe, V. G.

1948 Archaeology as a social science: an inaugural lecture. 3rd Report, Inst. Arch., Univ. of London:49-60

Clark, G.

1947 Archaeology and society. Rev. ed. London

Clements, F. E.

1936 Notes on archaeological methods. A Ant 1:193-196

Clench, W. J.

1942 The mollusks. <u>In</u> Johnson, 1942, pp. 45-66

Cole, F. C. and others

1930 Guide leaflet for amateur archaeologists. Reprint and circular ser., Nat. Res. Council. Washington, D.C.

——— and T. Deuel

1937 Rediscovering Illinois. Chicago

Collier, D., A. E. Hudson, and A. Ford

1942 Archaeology of the Upper Columbia region. Univ. of Washington Publs. in Anthropology 9:1-178

Collins, H. B.

1937 Archeology of St. Lawrence Island, Alaska. SI-MC 96, No. 1

Colton, H. S.

1932 A survey of prehistoric sites in the region of Flagstaff, Arizona. BAE-B 104

1945 A revision of the date of the eruption of Sunset Crater. SWJA 1:345-355

Committee on Archaeological Terminology

1941 A suggested classification and nomenclature for burial location, position, and description. SAA-N 2:70-79

Committee on Stone Artifact Terminology

1942 Stone artifact terminology. SAA-N 2:67-69

Conger, P. S.

1942 Diatoms from Lower Klamath Lake. In Cressman, 1942, pp. 115-116

1949 The diatoms. In Johnson, F. (ed.), 1949, pp. 109-123

Cook, S. F.

1943a The conflict between the California Indian and white civilization, I: The Indian versus the Spanish mission. UC-IA 21

1943b The conflict between the California Indian and white civilization, II: The physical and demographic reaction of the nonmission Indians in colonial and provincial California. UC-IA 22

1943c The conflict between the California Indian and white civilization, III: The American invasion, 1848-1870. UC-IA 23

1943d The conflict between the California Indian and white civilization, IV: Trends in marriage and divorce since 1850. UC-IA 24

1946 A reconsideration of shellmounds with respect to population and nutrition. A Ant 12: 51-53

1949 Soil erosion and population in Central Mexico. Ibero-Americana 34. [Excellent reconstruction of events leading to deposition of soils containing and covering archaeological remains. Numerous instances (see esp. pp. 8-10, 16-18, 20-21, 23-24, 35-36, 41-42, 45-48, 51-52, 84-86) where sufficient evidence is present to enable some dating estimates. Pp. 23-24 rate of soil weathering.]

Cook, S. F. (continued)

n.d. The fossilization of human bone: calcium, phosphate and carbonate. MS. To be published in UC-AR

——— and R. F. Heizer

1947 The quantitative investigation of aboriginal sites: analyses of human bone. AJPA, n.s., 5:201-220

——— and A. E. Treganza

1947 The quantitative investigation of aboriginal sites: comparative physical and chemical analysis of two California Indian mounds. A Ant 13:135-141

Cooper, W. S.

1942 Contributions of botanical science to the knowledge of postglacial climates. Journ. Geol. 50:981-984

Cosgrove, H. S. and C. B.

1932 The Swarts Ruin. PM-P 15, No. 1

Cox, G. H., C. L. Dake, and G. A. Muilenburg

1921 Field methods in petroleum geology. McGraw-Hill, New York

Crabtree, D.

1939 Mastodon bone with artifacts in California. A Ant 5:148-149

Crawford, O. G. S.

1928 Air survey and archaeology. Brit. Ordnance Survey, Prof. Papers No. 7

1936 Archaeological photography. Antiquity, 10:351-352, 486-490

Cressman. L. S.

1942 Archaeological researches in the northern Great Basin. Carnegie Inst. of Washington, Publ. no. 538, pp. 22-23; figs. 3-10, 22, 63, 64, 75-79

———, Howell Williams, and A. D. Krieger

1940 Early man in Oregon. Univ. of Oregon Monographs, Studies in Anthro. No. 3, Eugene, Oregon

Daniel, G. E.

1943 The three ages: an essay on archeological method. Cambridge Univ. Press

Davis, E. C.

1937 Tree rings and the Mayan calendar. Science, n.s., 86, No. 10, Suppl. (Nov. 26)

Debenham, F.

1947 Map making. Blackie and Son, London and Glasgow

Deevey, E. S., Jr.

1944 Pollen analysis and history. Amer. Scientist 32:39-53

1948 On the date of the last rise of sea level in southern New England, with remarks on the Grassy Island site. Amer. Journ. Sci. 246: 329-352

1949 Biogeography of the Pleistocene. Bull. Geol. Soc. Amer. 60:1315-1416

Detweiler, A. H.

1948 Manual of archaeological surveying. Amer. Schools of Orient. Res., Publications of the Jerusalem School. Archaeology: Vol. II. New Haven

Dixon, R. B.

1928 The building of cultures. New York

Douglass, A. E.

1929 The secret of the Southwest solved by talkative tree rings. Nat. Geogr. Mag., Vol. LVI:737-770, Dec.

1933 Tree growth and climatic cycles. Sci. Mo. 37:481-495

Drucker, P.

1943 Archeological survey of the northern Northwest Coast. BAE-B 133:17-142

DuBois, C. G.

1907 Diegueño mortuary ollas. AA 9:484-486

Eiseley, L. C.

1937 Index mollusca and their bearing on certain problems of prehistory; a critique. In Twenty-fifth Anniversary Studies, Phila. Anthrop. Soc., pp. 77-93. Philadelphia

Ellis, H. H.

1940 Flint working techniques of the American Indians: an experimental study. The Lithic Laboratory, Dept. of Anthro., Ohio State Univ.

Fenenga, F.

n.d. The archaeology of Central California: the Middle horizon. MS. Dept. of Anthro., Univ. of California, Berkeley

1949 Methods of recording and present status of knowledge concerning petroglyphs in California. CAS-R 3

——— and F. A. Riddell

1949 Excavation of Tommy Tucker cave, Lassen County, California. A Ant 14:203-214

Fink, C. F. and E. P. Polushkin

1936 Microscopic study of ancient bronze and copper. Trans. Amer. Inst. Min. and Met. Engin. 122:90-120

Finkelstein, J. J.

1937 A suggested projectile point classification. A Ant 2:197-203

Fisher, R. D.

1930 The archaeological survey of the Pueblo plateau. Univ. of New Mexico, Bull. 177. Archaeol. ser. Vol. 1, no. 1

Ford, J. A.

1938 A chronological method applicable to the Southeast. A Ant 3:260-264

——— and G. R. Willey

1949 Surface survey of the Virú Valley, Peru. AMNH-AP 43, Part I. [Pp. 35-37, Relia-ability of surface collections (of pottery); pp. 44-57, analysis of stratigraphic data]

Foster, W. F.

1931 Skeleton and bones. Palm Springs, Calif.

Gangl, I.

1936 Alterbestimmung fossiler Knochenfunde auf chemischen Wege. Oester. Chem. Zeitschr. 39:79-82

Gannett, H.

1906 Manual of topographic methods. USGS ser. F, Geog. 56, Bull. 307

Gayton, A. H.

1929 Yokuts and Western Mono pottery making. UC-PAAE 24:239-251

de Geer, G.

1937 Early man and geochronology. In Early man, G. G. MacCurdy (ed.), pp. 323-326. Philadelphia

1940 Geochronologia suecica principles. Kon. Svensk. Vet. Akad. Handl. 18. Stockholm

Gifford, E. W.

1928 Pottery making in the Southwest. UC-PAAE 23:353-373

1940 Californian bone artifacts. UC-AR 3:153-237

1947 Californian shell artifacts. UC-AR 9:1-132

1949 Early Central Californian and Anasazi shell artifact types. A Ant 15:156-157

——— and W. E. Schenck

1926 Archaeology of the southern San Joaquin Valley. UC-PAAE 23:1-122

Gilmore, R. M.

1946 To facilitate cooperation in the identification of mammal bones from archaeological sites. A Ant 12:49-50

Gladwin, H. S.

1940a Methods and instruments for use in measuring tree rings. GP-MP 27

1940b Tree ring analysis: methods of correlation. GP-MP 28

———, E. W. Haury, E. B. Sayles, and N. Gladwin

1937 Excavations at Snaketown. Vol. 1, Material culture. GP-MP 25. Globe, Ariz.

Glock, W. S.

1937 Principles and methods of tree ring analysis. Carnegie Inst. Publ. 486

1941 [Tree] growth rings and climate. Bot. Rev. 7:649-713

Godwin, H.

1934 Pollen analysis, an outline of the problems and potentialities of the method. New Phytologist 33:278-305, 325-358

1948 The principles and practice of pollen analysis. The Advancement of Science 4:337-338.

Goggin, J. M.

1949 Cultural traditions in Florida Prehistory. In The Florida Indian and His Neighbors. Rollins College, Inter-Amer. Center, Winter Park.

Goldthwait, R. P.

1935 The Damariscotta shell heaps and coastal stability. Amer. Journ. Sci. 30:1-13

Gorodzov, V. A.

1933 The typological method in archaeology. AA 35:95-103

Grabau, A. W.

1924 Principles of stratigraphy. Second ed. New York

Greenman, E. F.

1943 The archaeology and geology of two early sites near Killarney, Ontario. Pap. Mich. Acad. of Sci., Abstr. and Letters 28:505-530

Griffin, J. W.

1948 Green Mound, a chronological yardstick. The Florida Naturalist 22:1-8

Guthe, C. E.

1928 The Committee on state archaeological surveys of the Division of Anthropology and Psychology. Nat. Res. Council. ICA 23:52-59 [Reprinted in Nat. Res. Council, Reprint and circular ser. no. 97]

Guthe, C. E. (continued)

1931 Archaeological surveys. Colorado Mag., Vol. 8, no. 4

Hack, J. T.

1942 The changing physical environment of the Hopi Indians of Arizona. Peabody Mus. Papers 35, no. 1

1943 Antiquity of the Finley Site. A Ant 8:235-41

1945 Recent geology of the Tsegi Canyon. In Beals, Brainerd and Smith, pp. 151-158

Hall, E. T., Jr.

1939 Dendrochronology. SAA-N 1:32-41

Hansen, H. P.

1942 A pollen study of peat profiles from Lower Klamath Lake of Oregon and California. In Cressman, 1942, pp. 103-114

1946 Early man in Oregon. Pollen analysis and postglacial climate and chronology. Sci. Mo. LXII:52-65

Hargrave, L. L.

1936 The Field collection of beam material. Tree Ring Bull., Vol. 2, no. 3

1938 A plea for more careful preservation of all biological material from prehistoric sites. Southwestern Lore, 4:47-51

Harrington, M. R.

1933 Gypsum Cave, Nevada, SM-P 8:12-13

1948 America's oldest dwelling. SM-M 22:148-152

Hawley, F.

1937 Reversed stratigraphy. A Ant 2:297-299

1938 Tree ring dating for Southeastern [United States] Mounds. In BAE-B 118, pp. 359-362

1941 Tree-ring analysis and dating in the Mississippi drainage. Univ. Chicago, Occ. Pap. in Anthro., No. 2

Heizer, R. F.

1937 Baked-clay objects of the lower Sacramento Valley, California. AA 3:34-50

1941a Archaeological evidence of Sebastian Rodriguez Cermeño's California visit in 1595. Calif. Hist. Soc. Quarterly, Vol. 20, no. 4. [Reprinted separately with contributions by A. L. Kroeber and C. G. Fink]

1941b The direct-historical approach in California archaeology. A Ant 7:98-122

1941c Aboriginal trade between the Southwest and California. SWM-M 15:185-188

1946 The occurrence and significance of Southwestern grooved axes in California. A Ant. 11:187-193

Heizer, R. F. (continued)

1948 A bibliography of ancient man in California. CAS-R 2

1949 The archaeology of Central California: I. The Early horizon. UC-AR 12:1-84

1950 On the methods of chemical analysis of bone as an aid to prehistoric culture chronology. CAS-R 7

——— et al.

n.d. Archaeology of the Napa region, California. MS. Dept. Anthro., Univ. of California, Berkeley

——— and R. K. Beardsley

1943 Fired clay human figurines in Central and Northern California. A Ant 9:199-207

——— and S. F. Cook

1950 The archaeology of Central California: a comparative analysis of human bone from nine sites. UC-AR, Vol. 12. no. 3

——— and F. Fenenga

1939 Archeological horizons in Central California. AA 41:378-399

——— and G. W. Hewes

1940 Animal ceremonialism in Central California in the light of archaeology. AA 42:587-603

——— and J. E. Mills

n.d. The people of the mountain: the history of Tsurai Indian village in Trinidad Bay, 1775-1916. MS

——— and A. E. Treganza

1944 Mines and quarries of the Indians of California. Calif. Jour. Mines and Geol., 40: 292-359

Heyns, O. S.

1947 Sexual differences in the pelvis. So. Afr. Jour. Med. Sci., 12:17-29 [Reprinted in Yearbook of Phys. Anthr., 2:267-270. Viking Fund, Inc., 1948]

Hill, A. T. and M. Kivett

1940 Woodland-like manifestations in Nebraska. Nebraska Hist. Mag., 21:143-243

Hodge, F. W.

1920 Hawikuh bonework. MAIHF-INM Vol. 31, no. 3, pp. 65-151

Holmes, W. H.

1881 Prehistoric textile fabrics of the United States, derived from impressions on pottery. BAE-R 3:393-425

Holmes, W. H. (continued)

1894 Holmes, W. H., Natural history of flaked stone implements. Mem. International Congr. of Anthropology. ed. by C. S. Wake. Chicago, pp. 120-139

1919 Handbook of aboriginal American antiquities. BAE-B 60

Hooton, E. A.

1946 Up from the ape. Rev. ed. New York

Hough, W.

1930 Ancient Pueblo subsistence. ICA (23d, New York, 1928) Proc., pp.67-69

Howard, H.

1939 The avifauna of Emeryville shellmound. Univ. Calif. Publ. Zoöl. 32:301-394

Hrdlička, A.

1937 Man and plants in Alaska. Science 86:559-560

1948 Practical anthropometry. 3d ed. Rev. by T. D. Stewart. Wistar Inst., Philadelphia, Penna.

Huscher, H. A.

1939 Comment on the Wheeler method of recording cave data. SAA-N 1:84-89

Ives, R. L.

1941 Photographing translucent, transparent, and multi-colored artifacts. A Ant 6:263-265

1947 Line drawings from unsatisfactory photographs. A Ant 13:323

Johnson, E. N.

1940 The serrated points of Central California. A Ant 6:167-170

1941 Preservation and cleaning of shell material. SAA-N 2:9-10

1942 Stone mortars of Contra Costa County, California. A Ant 7:322-326

Johnson, F.

1942 The Boylston Street fishweir. Papers of the R. S. Peabody Foundation for Archaeology, Vol. 2

——— (ed.)

1949 The Boylston Street fishweir II. Papers of the R. S. Peabody Foundation for Archaeology, Vol. 4, no. 1

——— and H. M. Raup

1947 Grassy Island. Papers of the R. S. Peabody Foundation for Archaeology, Vol. 1, no. 2

Judson, S.

1949 Pleistocene stratigraphy of Boston, Mass., and its relation to Boylston Street fishweir. In Johnson (ed.), 1949, pp. 7-48

Kelley, J. C., T. N. Campbell and D. J. Lehmer

1940 The association of archaeological materials with geological deposits in the Big Bend Region of Texas. Sul Ross St. Teachers Coll. Bull. 21, no. 3

Kelly, A. R.

1938 A preliminary report on archeological explorations at Macon, Ga. BAE-B 119, Anthrop. Pap. No. 1, pp. 1-68

Kelly, I.

1945 The archaeology of the Autlán-Tuxacacuesco Area of Jalisco I: The Autlán Zone. Ibero-Americana 26

Kidder, A. V.

1924 An introduction to the study of Southwestern archaeology. Phillips Acad. Papers of the Southwestern Exped., No. 1. New Haven

1931 The pottery of Pecos. Vol. 1. Papers of the R. S. Peabody Foundation for Archaeology, No. 5

1932 The artifacts of Pecos. New Haven

———, J. D. Jennings and E. M. Shook

1946 Excavations at Kaminaljuyu, Guatemala. Carnegie Inst., Publ. 561

——— and J. E. Thompson

1938 The correlation of Maya and Christian chronologies. In Cooperation in Research, Carnegie Inst. Publ. 501:493-510

Klimek, S.

1935 Culture Element Distributions: I--The structure of California Indian culture. UC-PAAE 37:1-70

Kluckhohn, C. and P. Reiter, eds.

1939 Preliminary report on the 1937 excavations, Bc 50-51, Chaco Canyon, New Mexico. Univ. New Mexico Bull. No. 345, Anthro. ser. Vol. 3, no. 2

Knox, A. S.

1942 The pollen analysis of the silt and the tentative dating of the [Boylston Street fishweir] deposits. In Johnson, 1942, pp. 96-129

Krause, F.

1921 Die Kultur der Kalifornischen Indianer ... Institut für Völkerkunde. 4:1-98

Krieger, A. D.

1944 The typological concept. A Ant 9:271-288

Krieger, A. D. (continued)

1946 Culture complexes and chronology in northern Texas with extension of Puebloan datings to the Mississippi Valley. Univ. Texas Publs. 4640

Kroeber, A. L.

1916 Zuni potsherds. AMNH-AP 18, Pt. 1

1917 The tribes of the Pacific Coast of North America. ICA (19th, Washington, 1915), Proc., pp. 385-401

1923 The history of native culture in California. UC-PAAE 20:124-142

1925 Handbook of California Indians. BAE-B 78

1931 The culture-area and age-area concepts of Clark Wissler. In S. A. Rice, Methods in Social Science. Chicago, pp. 248-265

1936 Culture Element Distributions: III--Area and climax. UC-PAAE 37:101-116

1940 Statistical classification. A Ant 6:29-44

1948 Anthropology. New York

Krogman, W. M.

1939 A guide to the identification of human skeletal material. F.B.I. Law Enforcement Bull., vol. 8, no. 8

Kubler, G.

1948 Towards absolute time: guano archaeology. Mem. Soc. for Amer. Arch. 4:29-50. [Rate of accumulation of guano stacks on islands off Peruvian Coast with artifacts from known dates and cultural affiliations]

de Laguna, F.

1934 The archaeology of Cook Inlet, Alaska. Univ. Penn., Philadelphia

Larsen, H.

1950 Archaeological investigations in southwestern Alaska. A Ant 15:177-186

——— and F. Rainey

1948 Ipiutak and the arctic whale hunting culture. AMNH-AP 42

Laudermilk, J. D.

1937 The preservation of textile remains. A Ant 2:277-281

Leechman, D.

1931 Technical methods in the preservation of anthropological museum specimens. Annual Report, 1929, National Museum of Canada. Bull. 67, pp. 127-158. Ottawa

Lehmer, D. J.

1939 Notes on the field preservation of human bone. SAA-N 1:30. Mimeographed

Leighton, M. M.

1934 Some observations on the antiquity of man in Illinois. Trans. Ill. Acad. Sci. 25:83

1936 Geological aspects of the findings of primitive man, near Abiline, Texas. GP-MP 24

1937 The significance of profiles of weathering in stratigraphic archaeology. In Early man, G. G. MacCurdy (ed.), pp. 163-172. Philadelphia

Lewis, T. M. N. and M. K. Kneberg

1946 Hiwassee Island. Univ. Tenn. Press. Knoxvill, Tenn.

n.d. Manual of field and laboratory techniques employed by the Div. of Anthro., Univ. Tenn. Knoxville, Tenn. Mimeographed

Lillard, J. B., R. F. Heizer and F. Fenenga

1939 An introduction to the archeology of Central California. Sacramento Junior College, Dept. of Anthro., Bull. 1

Lillard, J. B. and W. K. Purves

1936 The archeology of the Deer Creek Cosumnes area, Sacramento County, California. Sacramento Junior College, Dept. of Anthro., Bull. 2

Linder, D. H.

1942 The diatoms [from the Boylston Street fishweir deposits.] In Johnson, 1942, pp. 67-81

Linton, R.

1936 The study of man. New York

Lothrop, S. K.

1928 The Indians of Tierra del Fuego. Contrib. Mus. Amer. Ind. 10

1942 Coclé, an archaeological site of Panama. Pt. II: Pottery of the Sitio Conte and other archaeological sites. PM-M 8

Loud, L. L. and M. R. Harrington

1929 Lovelock Cave. UC-PAAE 25:1-183

Lucas, A.

1932 Antiques, their care and preservation. London

MacClintock, P., E. H. Barbour, C. B. Schultz and A. L. Lugn

1936 A Pleistocene lake in the White River Valley. Amer. Nat. LXX:346-360

Mackay, D.

1931 The airman as archaeological scout. Asia (Aug., 1931). pp. 484-491

Manley, H.

1949 Palaeomagnetism. Science News 12:44-64. Ed. by J. L. Crammer. Penguin Books

Martin, P. S.

1941 The SU site: excavations at a Mogollon village, western New Mexico. 2d season. FMNH-PAS 32:101-271. Publ. No. 526

——— and J. B. Rinaldo

1946 The SU site: excavations at Mogollon village, western New Mexico. 3d season. FMNH-PAS 32:275-382. Publ. No. 601

——— J. B. Rinaldo and M. Kelly

1939 The SU site: excavations at a Mogollon village, western New Mexico. 1st season. FMNH-PAS 32:3-97. Publ. No. 476

———, G. I. Quimby and D. Collier

1947 Indians before Columbus. Chicago

Mathiassen, T.

1931 Ancient Eskimo settlements in the Kangamiut area. Meddel. om Grønland 91, no. 1. Copenhagan

McKern, W. C.

1923 Patwin houses. UC-PAAE 20:159-174

Merrill, R. H.

1941a Photo-surveying assists archeologists. Civil engineering, 11:233-235

1941b Photographic surveying. A Ant 6:343-346

Merrill, R. S.

1948 A progress report on the dating of archaeological sites by means of radioactive elements. A Ant. 13:281-286

Middleton, J.

1844 On fluorine in bones, its source and its application to the determination of geological age of fossil bones. Proc. Geol. Soc. London 4:431-433. [Also Geo. Soc. Journ. 1:214-216, 1845]

Montagu, M.F., Ashley and K. P. Oakley

1949 The antiquity of Galley Hill Man. AJPA 7, n.s., pp. 363-380

Morrison, J. P. E.

1942 Preliminary report on mollusks found in the shell mounds of the Pickwick Landing Basin in the Tennessee River Valley. BAE-B 129:341-392

Morse, E. S.

1925 Shell-mounds and changes in the shells composing them. Sci. Mo. 21:429-440

Movius, H. L., Jr.

1944 Early man and Pleistocene stratigraphy in southern and eastern Asia. PM-P,19 No. 3

1949 Old World paleolithic archaeology. Bull. Geol. Soc. Amer. 60:1443-1456

Nelson, N. C.

1909 Shellmounds of the San Francisco Bay region. UC-PAAE 7:309-348

1916a Flint working by Ishi. Holmes anniversary volume, pp. 397-402. [Reprinted in A. L. Kroeber and T. T. Waterman, Source book in anthropology, pp. 244-249. New York, 1931]

1916b Chronology of the Tano ruins. AA 18:159-180

1929 Classification of projectile points. Nat. Res. Council. Circular, June 11, 1929. Mimeographed. Washington, D. C.

Neuman, G. K.

1937 Faunal remains from Fulton County sites. In Cole and Deuel, 1937, App. V, pp. 265-268

Oakley, K. P.

1948 Fluorine and the relative dating of bones. The Advancement of Science 4:336-337

O'Bryan, D.

1949 Methods of felling trees and tree-ring dating in the Southwest. A Ant. 15:155-156

Olson, R. L.

1930 Chumash prehistory. UC-PAAE 28:1-22

Orr, P. C.

1943 Archeology of Mescalitan Island and customs of the Canaliño. Santa Barbara Mus. Nat. Hist. Occ. Pap. No. 5

1947 Additional Californian bone artifacts in the Santa Barbara Mus. Nat. Hist. In E. W. Gifford, 1947, App. UC-AR 9:115-132

Parker, A. C.

1929 The value to the state of archaeological surveys. Nat. Res. Council. Bull. 74, pp. 31-41

Parsons, E. C.

1940 Relations between ethnology and archaeology in the Southwest. A Ant 5:214-220

Petrie, W. M. F.

1899 Sequences in prehistoric remains. JRAI 29:295-301

1901 Diospolis Parve. Egypt. Explor. Fund. Mem. No. 20

1904 Methods and aims of archaeology. London

Phleger, F. B., Jr.

1949 The foraminifera. In Johnson (ed.), 1949, pp. 99-108

Quimby, G. I., Jr.

1939 European trade articles as chronological indicators for the archaeology of the historic period in Michigan. Pap. Mich. Acad. Sci., Arts and Letters 24, Part 4:25-31

1941 Indian trade objects in Michigan and Louisiana. Papers Mich. Acad. Sci. Arts and Letters 28:543-551

Renaud, E. G.

1935a Arrowhead types of Colorado. Southwestern lore, Vol. 1, no. 1, pp. 4-5

1935b Classification and description of arrowheads. Ibid., no. 2, pp. 5-8

1936 The archaeological survey of the high western plains, eighth report. Pictographs and petroglyphs of the high western Plains. University of Denver, Denver, Colo.

1939 The age [determination] of skulls. Southwestern Lore, 4:62-68

1941 Classification and description of Indian stone artifacts. Ibid., 6:1-36

Richards, H. G.

1936 Mollusks associated with early man in the Southwest. Amer. Nat. 70:369-371

1937 Marine Pleistocene mollusks as indicators of time and ecological conditions. In Early man, G. G. MacCurdy (ed.), pp. 75-84. Philadelphia

Ridgway, J. L.

1937 Scientific illustrations. Stanford Univ.

Roberts, F. H. H., Jr.

1935 A Folsom complex: preliminary report on investigations at the Lindenmeier site in northern Colorado. SI-MC 94, no. 4

Rogers, M. J.

1936 Yuman pottery making. SDM-P 2

1939 Early lithic industries of the lower basin of the Colorado River and adjacent areas. SDM-P 3

1945 An outline of Yuman prehistory. SWJA 1:167-198

Rouse, I. J.

1939 Prehistory in Haiti: a study of method. YU-PA, No. 21

1944 On the typological method. A Ant 10:202-204

Rowe, J. H.

1945 Absolute chronology in the Andean area. A Ant 10:265-284

Sapir, E.

1916 Time perspective in aboriginal American culture, a study in method. Can. Geol. Sur-

Sapir, E. (continued)

vey, Mem. 90. [Reprinted in D. Mandelbaum (ed.), Selected writings of Edward Sapir. Berkeley, 1949, pp. 389-462]

Schenck, W. E.

1926 The Emeryville shellmound. UC-PAAE 23:147-282

——— and E. J. Dawson

1929 Archaeology of the northern San Joaquin Valley. UC-PAAE 25:289-413

Schmidt, E. F.

1928 Time-relations of prehistoric pottery types in southern Arizona. AMNH-AP 30, Pt. 5

Schulman, E.

1940 A bibliography of tree-ring analysis. Tree-Ring Bull. 6:1-12

1941 Some propositions in tree-ring analysis. Ecology 22:193-195

Schultz, C. B.

1938 The first Americans. Nat. Hist. 42:346-356, 378

Sears, P. B.

1932 The archaeology of environment in eastern North America. AA 34:610-622

1937 Pollen analysis as an aid in dating cultural deposits in the United States. In Early man, G. G. MacCurdy (ed.), pp. 61-66, Philadelphia

Service, E.

1941 Lithic patina as an age criterion. Papers Mich. Acad. Sci. 27, Part 4, pp. 553-557

Setzler, F. M. and J. D. Jennings

1941 Peachtree mound and village site, Cherokee County, North Carolina. BAE-B 131

Siniaguin, J. J.

1943 A method for determining the absolute age of soils. Comptes Rendus Acad. Sci. URSS 40:335-336

Smith, H. G.

1948 Two historical archaeological periods in Florida. A Ant. 13:313-319

Smith, H. I.

1910 The prehistoric ethnology of a Kentucky site. AMNH-AP Vol. 6, Pt. 2

Spier, L.

1916 New data on the Trenton Argillite culture. AA 18:181-189

1917 Outline of chronology of the Zuni ruins. AMNH-AP 18:209-331

Spier, L. (continued)

1931 N. C. Nelson's stratigraphic technique in the reconstruction of prehistoric sequences in Southwestern America. In S. A. Rice (ed.), Methods in social science, pp. 275-283. Chicago

Stallings, W. S., Jr.

1939 Dating prehistoric ruins by tree rings. Laboratory of Anthropology, Gen. Series, Bull. 8. Santa Fe

State Reconstruction and Reëmployment Commission

1945 Report and recommendations to the California State Reconstruction and Reëmployment Commission by the State Aerial Mapping Project Committee. Sacramento, Calif.

Stetson, H. C. and F. L. Parker

1942 Mechanical analysis of the sediments and the identification of the foraminifera from the building excavation [the Boylston Street fishweir]. In Johnson, 1942, pp. 41-44

Steward, J. H.

1929 Petroglyphs of California and the adjoining states. UC-PAAE 24:47-238

1937a Ancient caves of the Great Salt Lake region. BAE-B 116:9-10, 91-93, 107

1937b Ecological aspects of Southwestern society. Anthropos, 32:87-104

1942 The direct-historical approach in archaeology. A Ant 7:337-343

——— and F. M. Setzler

1938 Function and configuration in archaeology. A Ant 4:4-10

Stewart, O. C.

1947a Objectives and methods for an archaeological survey. Southwestern lore, 12:62-75

1947b Field manual for an archaeological survey. Ibid., Vol. 13, no. 1

Stewart, T. D.

1934 Sequence of ephiphyseal union, third molar eruption, and suture closure in Eskimos and American Indians. AJPA 19:433-452

Stirling, M. W.

1935 Smithsonian archeological projects conducted under the Federal Emergency Relief Administration, 1933-34. SI-AR for 1934, pp. 371-400

Stock, C.

1936 The succession of mammalian forms within the period in which human remains are known to occur in America. Amer. Nat. LXX:324-331

Stokar, W. von

1938 Prehistoric organic remains. Antiquity, 12:82-86

Strong, W. D.

1933 The Plains culture area in the light of archaeology. AA 35:271-287

1935a An introduction to Nebraska archeology. SI-MC, Vol. 93, no. 10

1935b Archaeological explorations in the country of the eastern Chumash. Explorations and field-work of the Smithsonian Institution in 1934, pp. 69-72

1936 Anthropological theory and archaeological fact. In Essays presented to A. L. Kroeber, pp. 359-370. Berkeley

1940a From history to prehistory in the northern Great Plains. SI-MC 100:353-394

1940b What is a Pre-Amerindian? Science 91: 594-596

——— and J. M. Corbett

1943 A ceramic sequence at Pachacamac. Columbia Studies in Archaeol. and Ethnol., Vol. 1, no. 2

———, W. E. Schenck and J. H. Steward

1930 Archaeology of the Dalles-Deschutes region. UC-PAAE 29:1-154

Swanton, J. R.

1939 Final report of the United States De Soto Expedition Commission. 76th Congr., 1st Sess. House Doc. No. 71

Taylor, W. W.

1948 A study of archeology. AAA-M 69

Thorp, J.

1949 Interrelations of Pleistocene geology and soil science. Bull. Geol. Soc. Amer. 60: 1517-1526

Todd, T. W.

1920-21 Age changes in the pubic bone. AJPA 3:285-334; 4:1-70, 407-424

——— and D. W. Lyon

1925 Ectocranial suture closure. AJPA 8:23-47, 149-168

Treganza, A. E.

1942 An archaeological reconnaissance of northeastern Baja California and southeastern California. A Ant 8:152-163

——— and S. F. Cook

1948 The quantitative investigation of aboriginal sites: complete excavation with physical and archaeological analysis of a single mound. A Ant 13:287-297

——— and C. G. Malamud

n.d. The Topanga culture: first season's excavation of the Tank Site, 1947. MS. In press in UC-AR

Uhle, M.

1903 Pachacamac. Univ. Pennsylvania. Philadelphia, Penna.

U.S. War Department, Engineers

1944a Advanced map and aerial photograph reading. War Dept. Field Manual, FM 21-26

1944b Elementary map and aerial photograph reading. Basic Field Manual, FM 21-25

Vaillant, G. C.

1931 Excavations at Ticoman. AMNH-AP 32, Pt. 2

1935 Excavations at El Arbolillo. AMNH-AP 35, Pt. 2

1937 History and stratigraphy in the Valley of Mexico. Scientific Monthly, 44:307-324. Reprinted in SI-AR [1938], pp. 521-530, 1939

1938 Correlation of archaeological and historical sequence in the Valley of Mexico. AA 40:535-578

Walker, E. F.

1947 Excavation of a Yokuts Indian cemetery. Kern Co. Historical Soc., Bakersfield, Calif.

Wallis, W. D.

1945 Inference of relative age of culture traits from magnitude of distribution. SWJA 1: 142-160

Washburn, S. L.

1948 Sex differences in the pubic bone. AJPA, n.s., 6:199-207

Wauchope, R.

1948 Excavations at Zacualpa, Guatemala. Middle Amer. Res. Inst. Publ. 14. Tulane Univ., New Orleans, La.

Webb, W. S.

1938 An archaeological survey of Norris Basin in eastern Tennessee. BAE-B 118

1939 An archaeological survey of Wheeler Basin on the Tennessee River in northern Alabama. BAE-B 122

1941 The Morgan stone mound. Repts. in Anthro. and Archaeol. Univ. of Kentucky, 5:223-291.

1946 The Indian Knoll: Site Oh 2, Ohio County, Kentucky. Repts. in Anthro. and Archaeol., Univ. Kentucky, 4:115-365

——— and D. L. DeJarnette

1942 Archeological survey of Pickwick Basin in the adjacent portions of the states of Alabama, Mississippi, and Tennessee. BAE-B 129

——— and W. G. Haag

1939 The Chiggerville site. Repts. in Anthro. and Archaeol., Univ. Kentucky, 4:5-62

Wedel, W. R.

1936 An introduction to Pawnee archaeology. BAE-B 112

1938 The direct historical approach in Pawnee archaeology. SI-MC 97, no. 7

1941 Archeological investigations at Buena Vista Lake, Kern County, California. BAE-B 130

Wheeler, S. M.

1938 Recording cave data. A Ant 4:48-51

Whiteford, A. H.

1947 Description for artifact analysis. A Ant 12:226-239

Will, G. F. and H. J. Spinden

1906 The Mandans, a study of their culture, archeology and language. PMP 3, no. 4

Willey, G. R.

1945 Horizon styles and pottery traditions in Peruvian archaeology. A Ant 11:49-56

Williams-Hunt, P. D. R.

1948 Archaeology and topographical interpretation of air-photographs. Antiquity, 22:103-105

Wilson, L. R.

1949 A microfossil analysis of the lower peat and associated sediments at the John Hancock fishweir site. In F. Johnson (ed.), 1949, pp. 84-98

Wilson, Thomas

1899 Arrowpoints, spearheads, and knives of prehistoric times. USNM-R [1897], Pt. 1, pp. 887-944

Wissler, C.

1916 The application of statistical methods to the data on the Trenton Argillite culture. AA 18:190-197

1923 State archaeological surveys; suggestions in method and technique. Nat. Res. Council

1946 The archaeologist at work. Man and Nature Publs. AMNH, Science guide, no. 116

Woodward, A.

1938 The first ethnologists in California. SM-M 12:141-151

Woolley, L.

1947 Digging up the past. Pelican Books, No. A4

Zingg, R. M.

1940 Report on archaeology of southern Chihuahua. Contr. Univ. Denver, Center of Latin-American Studies, Vol. I

Zeuner, F. E.

1946 Dating the past: an introduction to geochronology. London

1948 Recent work on chronology. The Advancement of Science 4:333-335

A