7. ARCHAEOLOGY OF CCO-137, THE "CONCORD MAN" SITE

Robert F. Heizer

Introduction

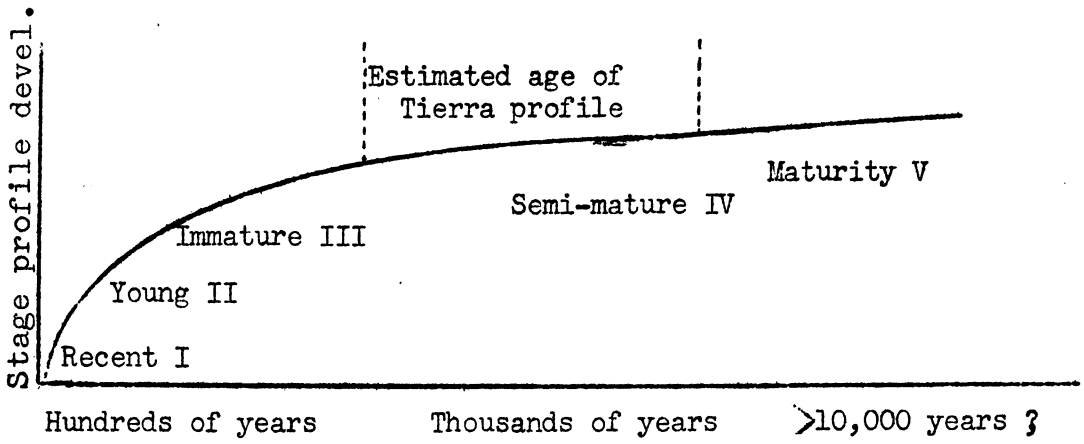
In August, 1946, Mrs. Robert Enge of 21 Gregory Lane, Concord, California assisted by her neighbor, Mrs. Al Stone, began digging a pit in her back yard which was to become a swimming pool. At a depth of 5.5 feet from the surface they encountered 2 human burials, and reported these to the Contra Costa County Coroner, Dr. C.L.Abbott, M.D.. The coroner examined the remains, and with Dr. W. Thompson, his autopsy surgeon, wrote a very creditable report on the bones, concluding that they represented those of Indians and were to be attributed considerable age judging from the depth at which they were found. Dr. Abbott released the skeletal material to the University of California Museum of Anthropology.[1]

On September 12, 1946 the University was advised by Mrs. Enge and Dr. Abbott of the find, and at the former's invitation, carried out excavations in the swimming pool area. From this excavation, in an area 20 by 40 feet, were recovered 5 additional human burials and a small quantity of artifacts.

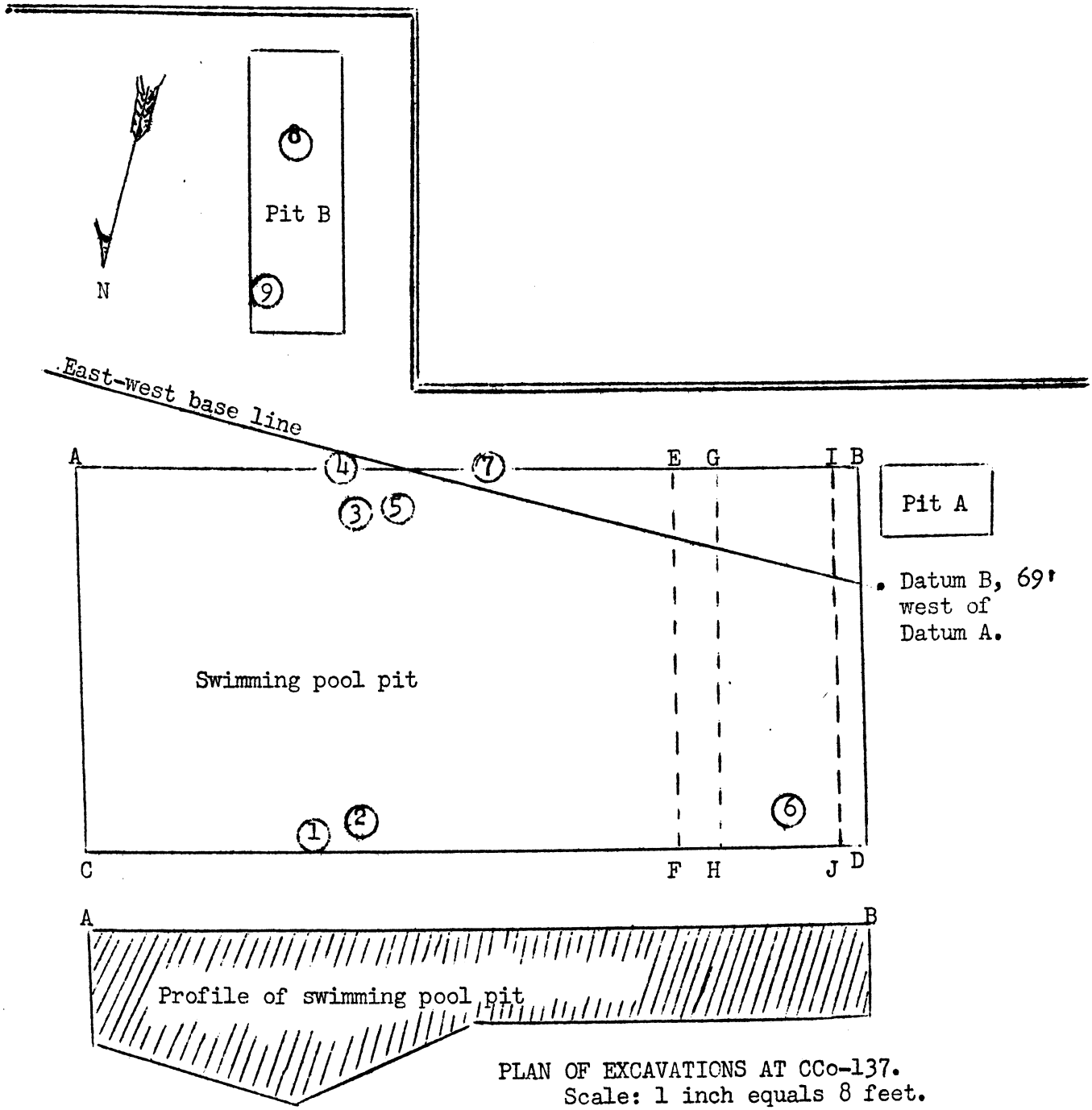
The particular interest which attaches to this site is the situation of the occupation stratum containing artifacts, living refuse and graves, which lay buried under 48 inches of sterile soil. This soil overburden constitutes presumptive evidence of antiquity of the underlying human material.[2]

We acknowledge our thanks to President R. G. Sproul who made available, from his Emergency Fund, the funds needed to carry out the excavations of September 12 to 22, 1946. Colleagues who visited the site and gave us their opinions include Professors C.O. Sauer, Earle Storie, E. W. Gifford, Charles Camp, T.D. McCown, A. L. Kroeber, J. W. Durham, R.A. Stirton, S. Welles, R. L. Olson, N. Talliaferro, and F. Harradine. R. Vanderhoof of Stanford University and O. P. Jenkins, State Division of Mines, also inspected the site. Dr. Henry P. Hansen, Oregon State College, analyzed some soil samples for pollen, but failed to detect any evidence. R. A. Stirton has identified the faunal remains, E. W. Gifford has determined the molluscan species from the midden deposit, and S. F. Cook has made a chemical analysis of the human bones. Students who laid aside their own work to assist in the investigation are W. Massey, R. Newman, C. E. Smith, K. Stewart, R. Beardsley, F. Riddell, and F. Fenenga. To all of these we offer our appreciation.

The several excellent maps and diagrams printed in this paper were drawn by Mrs. Donald Baum and Dr. Adan Treganza. To both I acknowledge my special indebtedness.

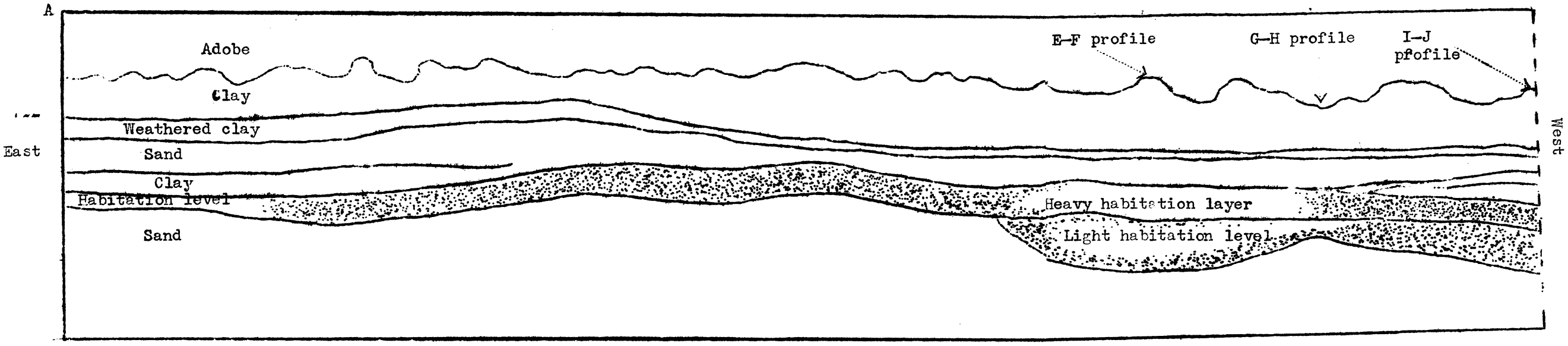


SCHEMATIC ILLUSTRATION OF THE PROBABLE RATE OF PROFILE DEVELOPMENT WITH PERIODS OF TIME. Particularly "designed" for environmental conditions comparable to those at the Concord Site (CCo-137.)

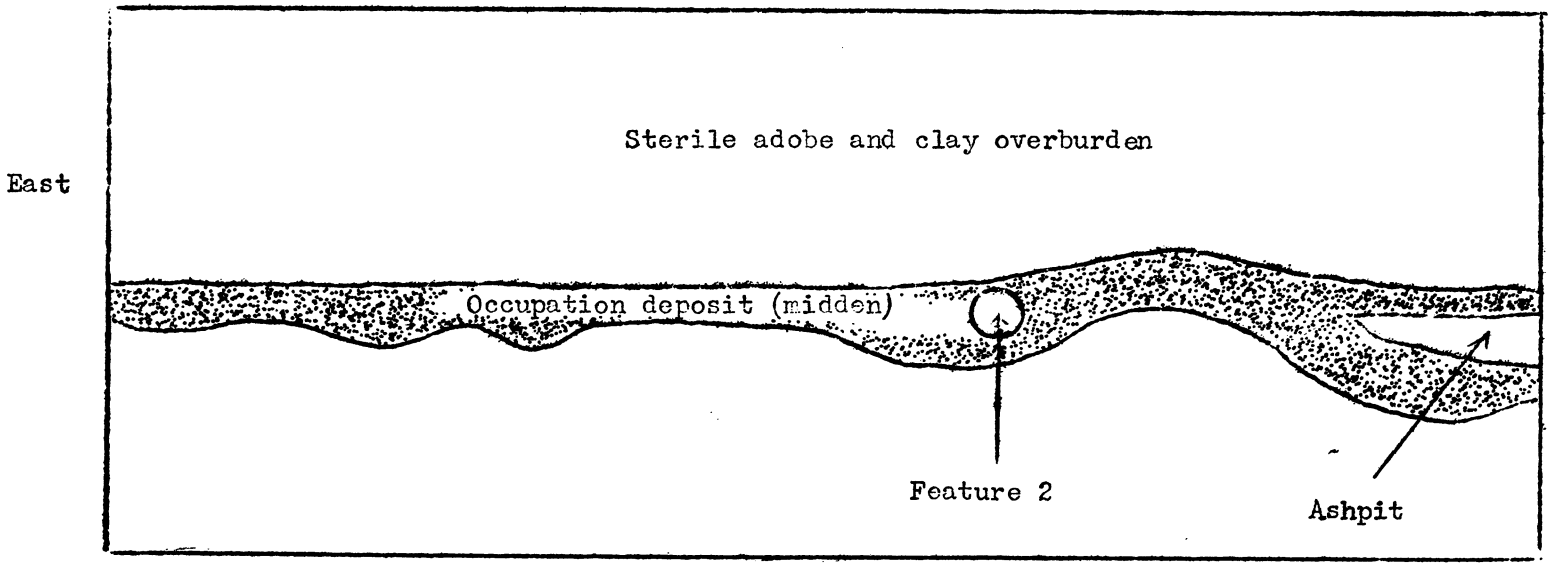


PLAN OF EXCAVATIONS AT CCo-137.
Scale: 1 inch equals 8 feet.

FIGURE 1



A-B PROFILE ALONG SOUTH WALL OF POOL



E-F profile of
site C8o-137

Scale: 3/8 inch to 1 foot

FIGURE 2

Location of Site CCo-137.

The site lies 3.5 miles north of the town of Walnut Creek at an elevation of 50 feet above sea level just east of a branch of Grayson Creek and .5 mile west of Walnut Creek, a somewhat larger stream which flows north, in a deep and narrow trench, to empty into the marshy shore of Suisun Bay some 4 miles beyond. The Ignacio Valley, whose main drain is Walnut Creek, is from 2 to 4 miles wide and 8 miles long, and site CCo-137 lies at about its center toward the western edge.

Stratigraphy and Cultural Deposit

As may be seen in Figs. 2 and 3, the habitation level formed a continuous stratum averaging about 14 inches in thickness. Although its upper surface and lower surface were somewhat irregular, this stratum lay in an approximate level plane. The irregularities of the surface of this stratum may be in part due to degradation or erosion, and its uneven bottom is almost certainly ascribable to disturbance of the subsoil by the occupants of the site. Burials, for example, usually lay in graves filled with refuse deposit and excavated into the subsoil. The stratigraphic profiles shown in Figs. 2, and 3 would indicate that the original surface upon which the refuse accumulated was slightly irregular, and the culture level more or less followed the dips and rises of the original surface. The buried habitation layer has been traced by Mr. Boyd and Mr. Cole 125' northwest, 40' east, and 55' west of the center of the swimming pool. The habitation level consisted of a dark colored earth containing fire-cracked stones (evidencing the stone-boiling of foods), bones of food animals (see list of species infra), discarded marine and freshwater mollusk shells (see list of species infra), finely divided charcoal and ash, and the like -- it was, in brief, a typical Californian midden deposit.[3]

Lying over the occupational level was a deposit 48 inches thick of naturally laid alluvial soil which, according to the opinion of Storie and Harradine (see their report infra), took a long time to be deposited, and at least as much additional time to develop a semi-mature profile. Fig. 4 indicates that the final occupation of the site (44"-46" level) followed a brief period of flooding as evidenced by the silt deposition at 46" to 48" lying upon the main occupation deposit.

Storie and Harradine speak of "ponded sediments." Allyn G. Smith and G. D. Hanna of the California Academy of Sciences have identified in the alluvial soil above the culture level the shells of Anodonta, Pisidium occidentale Newcomb, Planorbis vermicularis Gould, Helisoma tenue Philippi, and Lymnaea disidiosa Say, pointing out that this assemblage would normally occur in a freshwater lake.

It is difficult to envisage a lake occupying Ignacio Valley with the present topography. The present surface of the site lies at 50 feet above sea level, and 20 feet above the present level of

Walnut Creek. The valley surface on the bank of Walnut Creek is about 8 feet below the surface of the CCo-137 occupation level. That considerable alluvial deposition has occurred in the floodplain of the creek is shown by the discovery within one mile of CCo-137 at site CCo-135 of occupation levels in the Mokelumne aqueduct cut into the Walnut Creek floodplain sediments at a depth of 6 feet from the surface. A second nearby discovery was made at site CCo-133 of a human skeleton lying at a depth of 5 feet from the surface and covered with undisturbed alluvial soils. These would indicate a general deposition in the Ignacio Valley of alluvium following an early occupation by man. I have been unable to secure from any geologist, geographer or physiographer any coherent or convincing reconstruction of the events and changes which must have occurred if the alluvial soils capping the culture stratum at CCo-137, the hearths at CCo-135, and the skeleton at CCo-133 were laid down in a body of water. Perhaps they are the bottom sediments of lakes or ponds, but to my mind the probable explanation lies in assuming a gradual aggradation of outwash and overflow silts from the hills to the west and in the floodplain of Walnut Creek. This deposition must have been fairly continuous, gradual, and covered a long period of time, and in the process there could have occurred local physiographic changes in terms of level due to uplift, subsidence, soil creep, alterations in the drainage pattern, and the like.

The present situation of site CCo-137 as a habitation spot for primitive man is not particularly favorable. Fresh water is some distance away, the nearest being at Grayson Creek or Walnut Creek, each about .5 mile distant. A former stream channel which must have carried considerable water at one time was located immediately west of the site. This channel, marked by pea- to thumb-size gravel, lies under several feet of alluvium and runs in a south-north direction. Such a stream, perhaps a former distributary of Grayson or Walnut Creek, may in high water and flood, have been one of the sources of the sediments which now cover the culture level of CCo-137. The source, course, and destination of this former stream needs further investigation.[4]

The Human Remains

In all, 9 human burials were recovered from the CCo-137 habitation level. Burials 1 and 2 were excavated by Mrs. Enge and Mrs. Stone who report that they lay fully extended on the back (supine). Burial 2 is further described as having the right lower leg crossed over the lower left. Both ladies dug the remains out carefully after first exposing them, and we are inclined to agree that their observations are correct. Burials 3-9 were all flexed. All lay either at or below the level of the habitation refuse at depths of 54 to 68 inches. Average depth of the 9 burials is 63 inches. The grave pits were dug from the shallow habitation layer into the sterile sand base. Calculating the habitation layer at not less than 44" from surface, the burial pits could have been not less that 10" or more than 24" deep. These are average for Central California site graves. The burials were not concentrated, but lay isolated (nos. 6,8,9), in pairs (nos. 1,2;3,5) or in greater numbers (nos. 3,4,5,7). Probably more burials lie unexcavated south of the east-west datum line from 35 to 50 feet west of Datum A.

The bones are not only heavily encrusted with a calcareous accretion which can be removed by prying with a knifeblade, but are also heavily mineralized. Everything about the bones is reminiscent of the skeletal material from the older Middle and Early Horizon sites of the lower Sacramento Valley, and quite unlike anything thus far noted for the San Francisco Bay region.

Dr. T. D. McCown is preparing a report on the CCo-137 skeletal remains which will be published in a future number of this series.

The Artifacts

The dark occupational refuse stratum produced very few artifacts. We estimate that our excavation turned over not more than 600 cubic feet of occupation refuse, and from this we recovered only 3 actual artifacts not associated with burials.[5] The remainder of the artifacts were burial accompaniments.

Dissociated artifacts: A sandstone mortar rim fragment (length 8 cm., width, 3.5 cm., height 2.7 cm.) came from 50'8" W/0'0" N-S of Datum A. It is apparently, though not certainly because of its small size, close to type B.2 mortars of the Interior Valley.[6] At 66'9" W/3'6" S of Datum A came an antler tine 13.5 cm. long whose tip appears to be worn. It may be tentatively identified as a punch or flint flaker. A fortuitous mammal bone splinter awl with a sharpened tip came from Pit B. It is 5.4 cm. long and 1.0 cm. wide.

Artifacts with burials: An obsidian blade 17.2 cm. long, 3.1 cm. wide and 1.0 cm. thick was found on the chest of burial 7. One side is slightly convex, the other has a suggestion of a keel or ridge. In shape, material and technique it is indistinguishable from numerous specimens in UCMA from Napa Valley and Lower Sacramento Valley sites of Middle Horizon times.

With burial 5 were 3 shell ornaments made of green-backed abalone (Haliotis cracherodii.) The largest was reel-shaped with two central perforations and measured 13 cm. long by 8.5 cm. in width. Affixed by calcareous accretion to the convex back surface were several shell beads. Two rings (a pair?) of the same shell from burial 7 are 3.3 cm. in diameter and have a central hole 1 cm. in diameter. They are classed as type C (1),[7] and they may be noted as typically Middle Horizon in time.

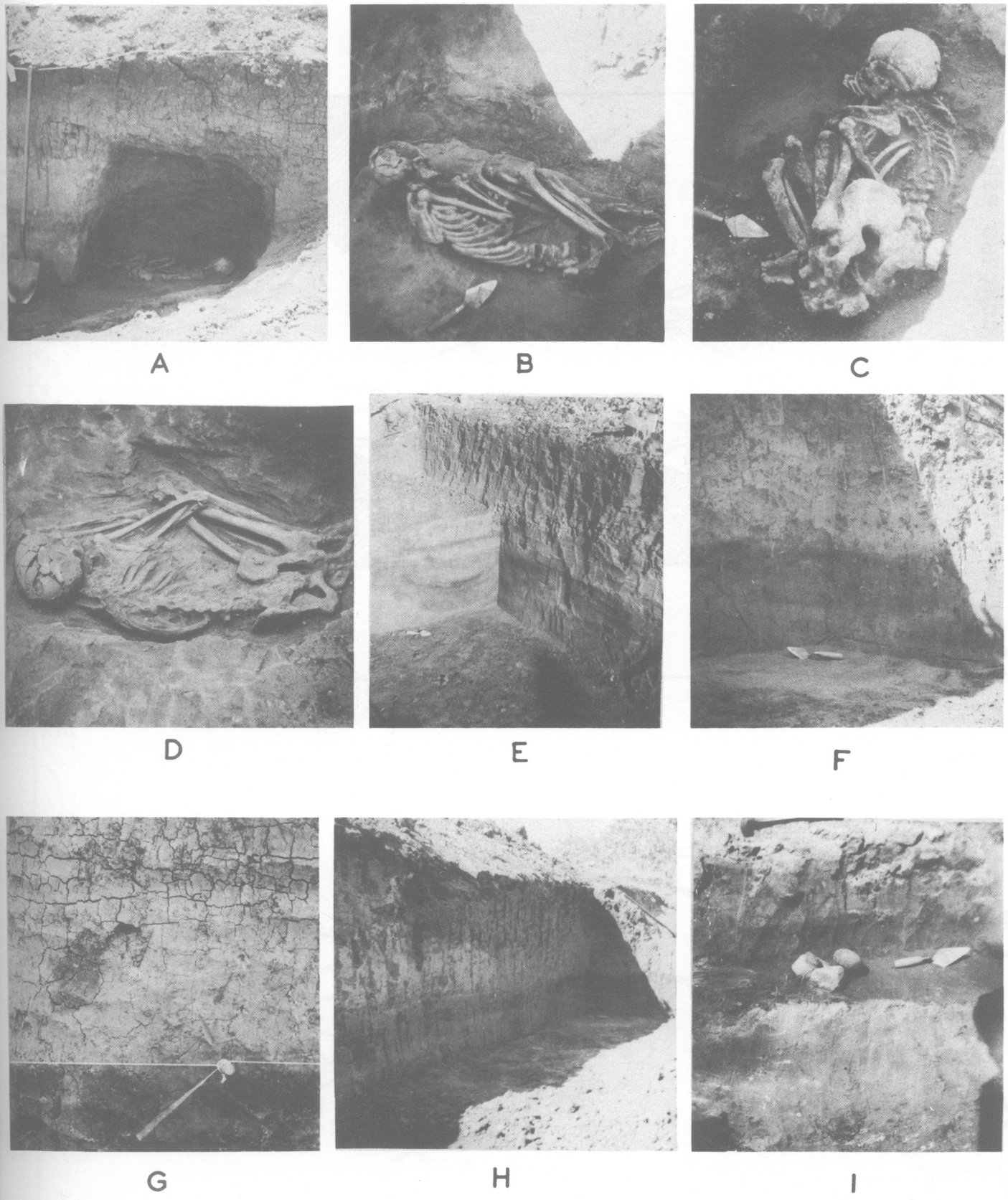
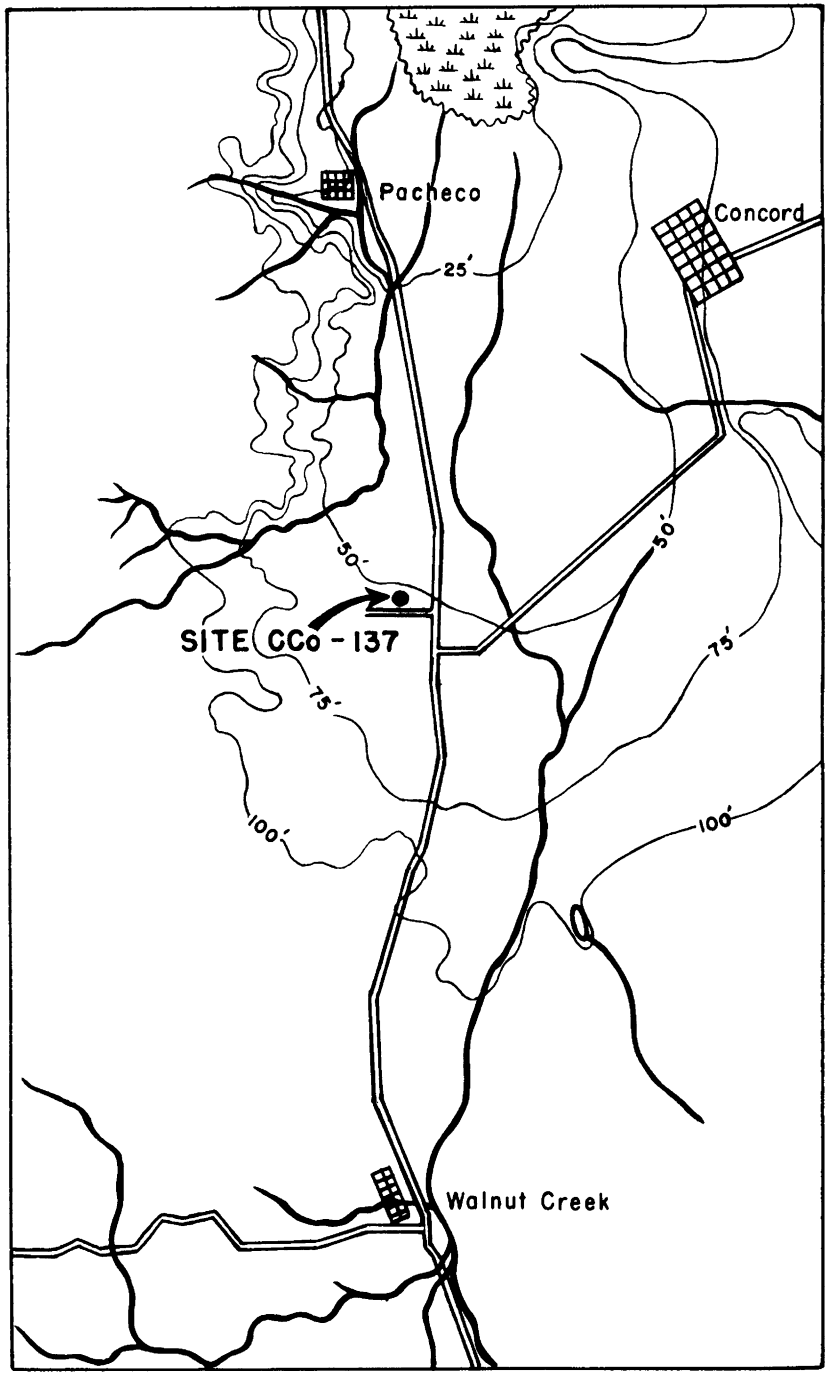
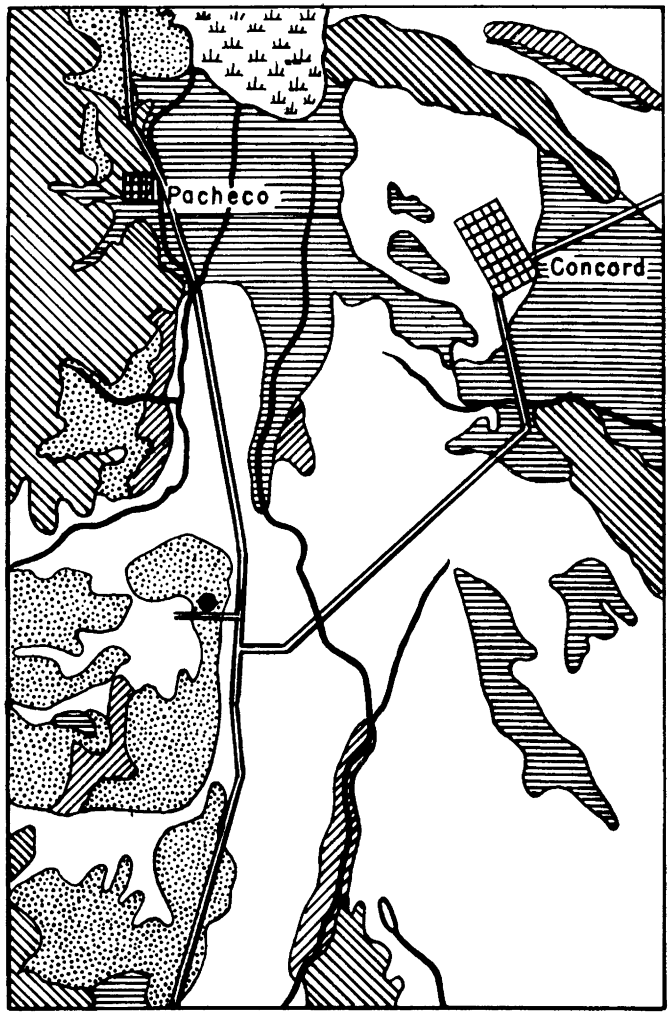


PLATE 1. BURIALS AND STRATIFICATION, SITE CCo-137

PLATE 2



← TOPOGRAPHIC MAP OF CONCORD REGION



SOIL TYPES IN CONCORD REGION

- RECENT
- YOUNG
- IMMATURE
- SEMI MATURE
- UPLAND SOILS

1 MILE

From three burials (nos. 1,2,5) came 45 small Olivella biplicata shells with ground-off spires. They range in length from 7 to 11 mm. The almost exclusive use of such small whole shell beads is most typical of the Early Horizon.[8]

Two burials (nos. 5,7) yielded 465 small round Olivella cupped disc beads 5 mm. in diameter. They are conically drilled from the concave surface. This type of bead is most characteristic of Middle Horizon sites, but also occurs in the Late culture period.

Burials no. 5 and 7 produced 82 flat disc beads of clamshell (Saxidomus?, Macoma?) which are badly corroded. They are conically drilled, range from 6 to 9 mm. in diameter, and appear to have been made individually rather than by the "production method" familiar to the recent Indians.[9] Closely similar beads are known from one site (Sac-73) which is Middle Horizon in time.

Two thin birdbone tubes or beads came from a grave, probably burial no. 7, though this allocation is uncertain due to a catalogue confusion. They measure 2.5 cm. long, 1.5 cm. diameter. Such beads occur in both coast and Interior sites throughout the entire span of prehistoric occupation.

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EXPLANATION OF PLATES 1 and 2.

Plate 1. a, burial no. 7; b, burial no. 6; c, burial no. 4; d, burial no. 8; e, charcoal lined pit 58 feet west of Datum A; f, dark occupation stratum in northwest corner of swimming pool pit; g, south wall of pool. Stake marks top of dark occupation stratum lying under dense light colored clay; h, south wall of excavation (A-B line of Fig. 2), lower dark colored band is occupation stratum; i, Feature 2, cache of large pebbles, probably cooking stones for stone-boiling.

Plate 2: Contour map is based upon the U. S. Army War Department Corps of Engineers Concord Quadrangle, Grid Zone "G", 15 minute series, 1943.

Soils map is based upon the county map contained in E.J. Carpenter and S.W.Cosby, "Soil Survey of Contra Costa County, California." U.S.Department of Agriculture, Series 1933, No. 26, 1939.

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BURIAL TABULATION, SITE CCO-151.

	Burial No.								
	1	2	3	4	5	6	7	8	9
Posture: flexed on side or back*			X	X	X*	X	X	X	X
extended on back	X	X		X					
Orientation	W	W	W	W	W	W	W	W	SE
Age	A	A	A	I	A	A	Ad	A	Al
Sex	M	F	F	?	F	M	F	F	M
Depth from surface (inches)	60	60	63	54	66	66	62	68	64
Associated artifacts									
Small spire-lopped Olivella beads	X	X			X				
Circular, conically drilled Olivella and Macoma disc beads					X		X		
Reel-shaped Haliotis ornament					X				
Subcircular Haliotis discs					X				
Type NAb obsidian blade							X		
Red paint (hematite)								X	X
Animal claws									X

A, adult; Ad., adolescent, I, infant

Identification of Faunal Remains

Professor R. A. Stirton identified remains of bear (Ursus colusus), raccoon (Procyon sp.), dog or coyote (Canis sp.), deer (Odocoileus), bird, turtle, fish and various small rodents from the collection of bones dug from the buried habitation layer. This is a representative list of food species judging from what most Central California refuse deposits produce. All are of living species which occupy the region today or in the recent past.

At one spot was a pile of broken deer bones which may represent the disposal of the remains of a meal or a parcel of garbage gathered from a house and buried in a shallow pit.

Identification of Mollusks used for Food.

From the thin habitation layer were recovered the shells of oyster (Ostrea lurida), and mussel (Mytilus edulis, Gonidea angulata, Margaritifera margaritifera.) Ostrea and Mytilus live in the saltwater bay; Gonidea and Margaritifera come from either a freshwater stream or pond. Identification of mollusks was performed by E. W. Gifford.

In connection with the marine mollusks found at CCo-137, it is of interest to note some observations made 80 years ago by W. Blake:

"Dr. Blake stated that he had been to Lafayette, Contra Costa County, to see a mound of shells. It was at a distance of about eighteen miles from the salt water. Upon examination he found them to be salt water shells, mussels, oysters, etc. He further stated that he did not think it was the Indians who had carried them for food to that distance, as it was far, and it was not a desirable spot for such a use, and his opinion was, that the valley in the immediate vicinity has been a salt water bay. That he intended, however, to make a further examination at some future time. The altitude of the mound is about ten feet, and its extent one hundred by fifty yards. There were also skeletons of Indians and bones of deer, etc., in the mound, besides many flint chips.

Prof. Bolander said that in Mendocino County the Indians now carry mussels, etc., to still greater distances from the sea." [10]

Blake apparently changed his mind, for a a subsequent meeting it is noted that," Dr. Blake stated, in regard to the shell mounds near Lafayette, that he had learned from an old Californian that the Indians were formerly in the habit of gathering shell fish on the coast, and carrying them ten or fifteen miles inland for food." [11]

No reasonable doubt can exist that the occupants of site CCo-137 brought the oysters and mussels to their village in the shell from the saltwater bay up the valley a few miles, to there open, extract and eat the meats, and discard the shells where they remain as part of the occupation refuse deposit.

Chemical Composition of Human Bone

Professor S. F. Cook analyzed several samples of bone from CCo-137 burials with the following results:

Organic matter	10.27
Ca	28.85
CO_2	7.67
H_2O	4.92

The ratio of P/CO_2 for the CCo-137 bone is 1.49. From two Early Horizon sites to the northeast, we note the P/CO_2 ratio is 1.35 for SJo-142 and 1.43 for Sac-107. It appears that, chemically speaking,

CCo-137 is closer to the Early Horizon sites (SJo-142, SJo-68, Sac-107, SJo-56) than to Marin County Late Horizon sites, or to Lower Sacramento Valley-Delta Middle Horizon sites. On this basis alone, the site probably dates from lower (i.e. early) Middle Horizon times.

Analysis of Refuse Deposit

The habitation layer is a stratum composed largely of soil, colored black from charcoal resulting from fires, and containing food refuse in the form of mollusk shells, and animal bone. It is strongly calcareous. Cook and Treganza[13] determined that the percent of bone, by weight, in the habitation deposit was .0198; of rock, 2.90[14]; of shell, .1388; of charcoal, .00130.

Conclusions

To the present writer, the cultural evidence (artifacts and burials) indicate strongly that site CCo-137 should be classified as Middle Horizon in type and time. In terms of years, though this is frankly a guess, I should date the site as somewhere between 1500 and 3500 years old. The midpoint of this range, 2500 years ago or roughly 500 B.C. seems not unreasonable for reasons set forth elsewhere[15], and because the pedologic report of Storie and Harradine (infra) bears out the conclusion of reasonable antiquity. It is admitted that my own estimate of 2500 years and that of the soil experts of a 4000 year minimum is widely different, but since at the present time we have nothing better than guesses to rely upon, we shall have to be satisfied in concluding that, in the opinion of certain workers, the site and its contents may be from two to four millenia old.

It is hoped that a radiocarbon (C-14) dating will be determined for this site. Such a date, in addition to signifying the precise time when the Middle Horizon culture of the Central California coast was in force, will offer evidence of the amount of time required to deposit a soil layer 4 feet thick, and for this deposit to undergo the necessary profile development to arrive at what Storie and Harradine call, in their report which immediately follows, "semi-mature".

Robert F. Heizer
Director, UCAS

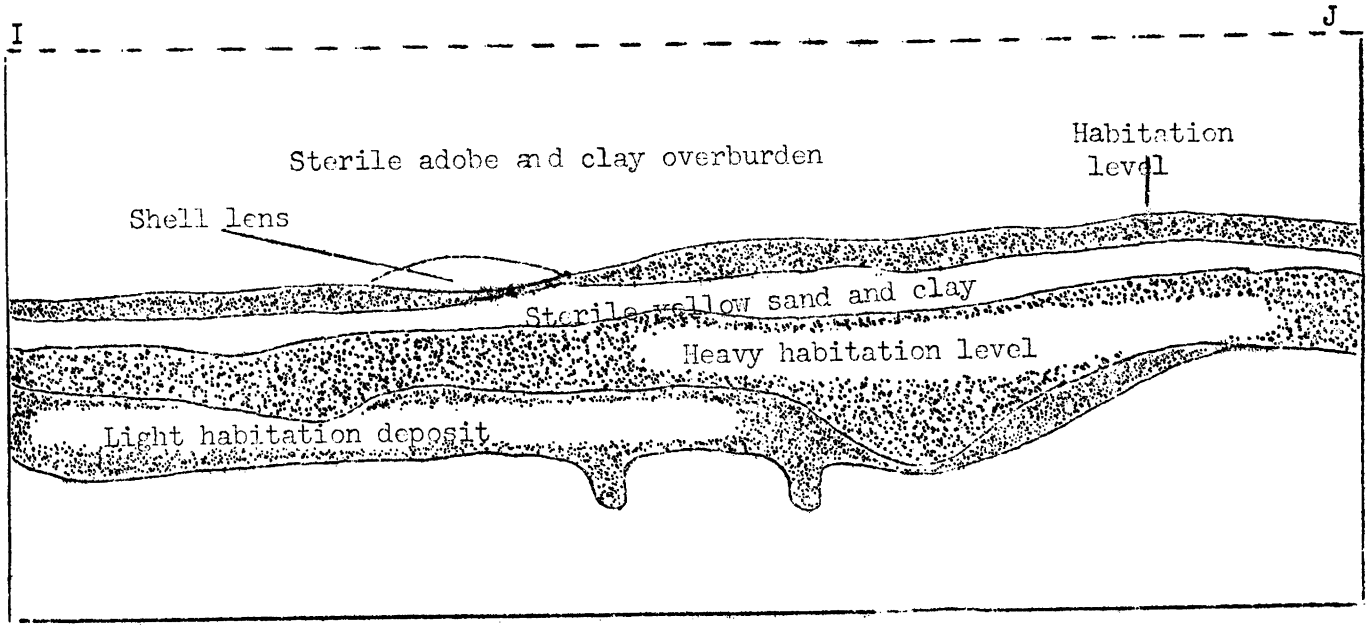

Figure 3. Stratification along I - J line.

NOTES AND BIBLIOGRAPHY

1. Numbers 12-7393/7401, UCMA. A copy of the Coroner's report is filed in the UCAS records. The cultural material is catalogued as follows in UCMA: 1-68299/68324; 1-69071/69085; 1-84358/84370; Accession No. 880.

2. This site has already been mentioned in the literature by R. K. Beardsley, "Culture Sequences in Central California Archaeology." American Antiquity, 14:1-28, 1948; S. F. Cook and A.E.Treganza, "The Quantitative Investigation of Indian Mounds". UCPAAE 40, no. 5, 1950; R. F. Heizer, "The Archaeology of Central California, I: The Early Horizon." UC-AR 12, no. 1, 1949; K. Macgowan, Early Man in the New World. New York, 1950.

3. Cf. Cook and Treganza, Op. cit. in note 2; A. Treganza and S.F.Cook, "The Quantitative Investigation of Aboriginal Sites: Complete Excavation with Physical and Archaeological Analysis of a Single Mound." American Antiquity, vol. 13, pp. 287-297, 1948. See also S. F. Cook. "Physical Analysis as a Method for Investigating Prehistoric Habitation Sites." UCAS-R 7, Paper No. 1, pp. 2-5, 1950.

4. A beginning of this study has been made by H.A.Boyd and L. Cole, "Some Age and Space Relations of the 'Concord Man'," Ms in UCAS files.

5. Compare with C. Meighan, "Observations on the Efficiency of Shovel Archaeology" UCAS-R 7, Paper no. 4, pp. 15-20, 1950, table 2.

6. J.B.Lillard, R. F. Heizer and F. Fenenga. "An Introduction to the Archeology of Central California." Sacramento Junior College, Dept. of Anthropology, Bull. 2, 1939, p. 9.

7. Ibid.

8. R. F. Heizer, Op. cit. in note 2, p. 17.

9. Cf. J. W. Hudson "Pomo Wampum Makers". Overland Monthly 30:101-108, 1897.

10. Proc. Calif. Acad. Sci. 4: 156, 1873.

11. Ibid., p. 161.

12. See R. F. Heizer, Op. cit. in note 2, for a cultural analysis of these sites and the Early Horizon culture. The chemical data cited here are from S. F. Cook, "The Fossilization of Human Bone: Calcium, Phosphate and Carbonate. UC-AR, in press.

13. Cook and Treganza, Op, cit. in note 2, Tables 3,4.

14. All rock in the midden layer was saved during excavation of the pool area. This rock consists of fire-cracked fragments from the stone-boiling of foods. The total amount recovered amounted to 51 pounds.

15. Heizer, Op. Cit. in note 2, p. 39. Incidentally, site SJo-68, the latest settlement known of the Early Horizon, has recently been dated by W.F.Libby, using the radiocarbon (C_{14}) method, as being 4052± 160 years old.

APPENDIX I

AN AGE ESTIMATE OF THE BURIALS UNEARTHED NEAR CONCORD, CALIFORNIA, BASED ON PEDOLOGIC OBSERVATIONS[1]

R. Earl Storie and Frank Harradine[2]

The unearthing of several human skeletons from a swimming pool excavation at the Robert Enge residence near Concord, California, afforded an excellent opportunity for collaboration between the Department of Anthropology and the Division of Soils in an effort to establish an approximate age of the burials. The nature of the actual contents of the burial pits and allied data were of concern to the anthropologists on the project, whereas the writers of this report, as soil technologists, were interested more in the nature and sequence of soil horizons and other data lying above the burial pits.

It became evident after the first critical observations at the excavation that a "long time" had been necessary for the parent soil material to be deposited above the burials. Also an equally long or longer time was necessary for the soil forming processes to differentiate this soil material into horizons characteristic of a semi-mature profile. Unfortunately there is no definite correlation between the degree of maturity of soils as evidenced by horizonal characteristics and actual age in years. Only an estimate of the actual age in years of a given soil profile can be offered after the variable factors of soil forming processes are considered and correlated with logical reasoning based on known facts of soil behavior.

A schematic diagram showing the sequence of horizons of a Tierra soil profile and other strata overlying the burial pits is contained in Fig. 4.

Beginning with the primary occupational zone at a depth of 48 inches from the present eroded land surface, the sequence of events and probable time involved is thought by the writers of this report to be as follows:

1. After an indefinite period of occupation at the 48 inch depth a relatively short period of flooding and rapid deposition of four inches of fine sandy material was deposited, causing a temporary vacancy of occupation.
2. The second, or terminal occupation at approximately 44 inches from the present surface was brief and terminated by an invasion of ponded, or very slowly moving waters. These waters carried very fine sandy and silty sediments that were slowly deposited and ultimately built up a layer of parent material about 14 inches deep over the terminal occupational level.

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1. Report by the Division of Soils, University of California, Berkeley.

2. Soil Technologist and Assistant Soil Technologist, respectively (1947).

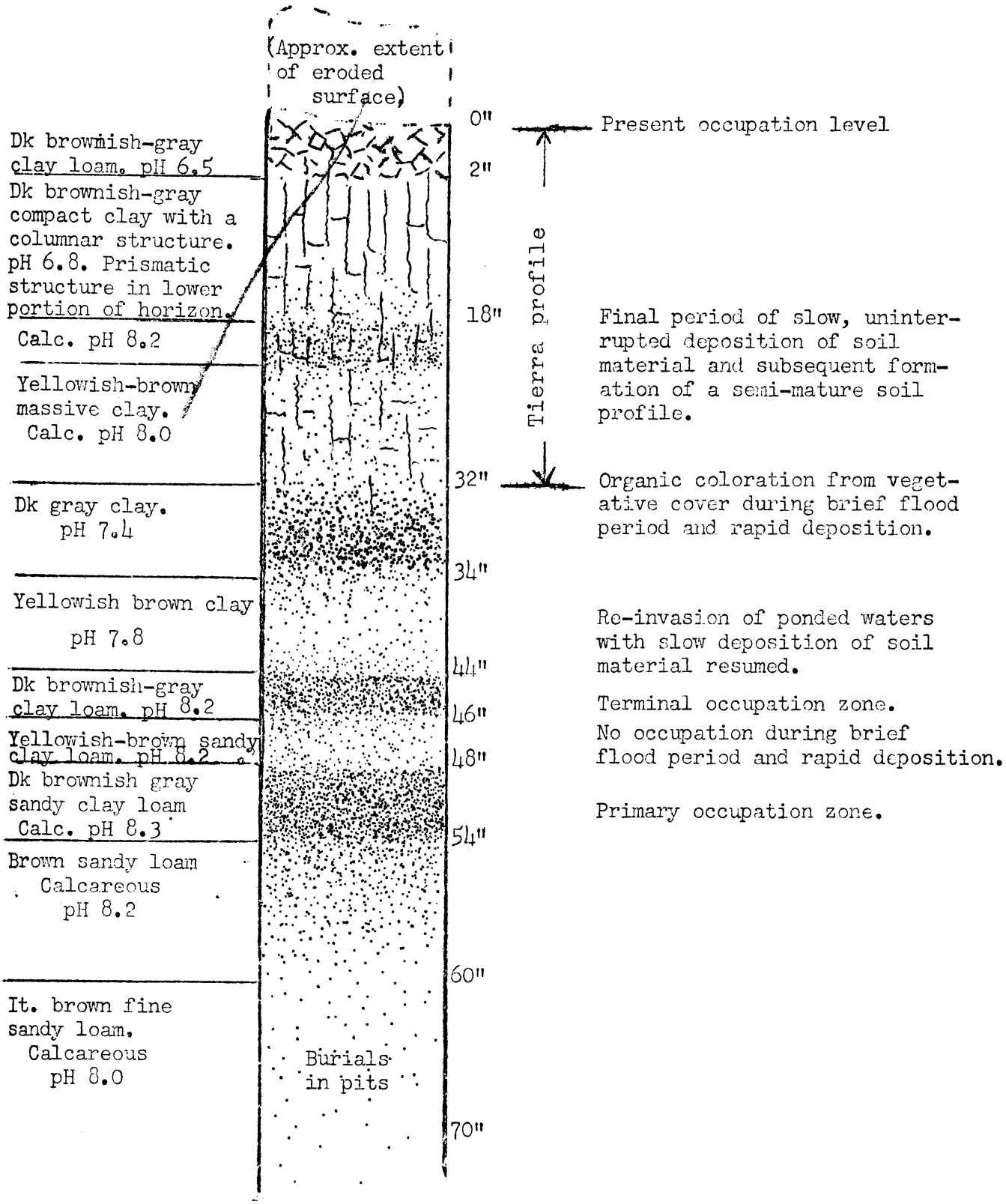

FIGURE 4. SCHEMATIC DIAGRAM SHOWING SEQUENCE OF HORIZONS OF TIERRA SOIL PROFILE AND OTHER STRATA OVERLYING BURIAL PITS.

3. Apparently the waters receded for a short time allowing the growth of plants. This is partially evidenced by a two inch dark colored layer of soil which presumably was darkened by decayed vegetative matter.
4. The final depositional period was probably continuous, but certainly very long in duration. The absence of stratification and fineness of the particles comprising this material, together with other criteria, lend almost conclusive proof that this last deposit was very slowly laid down by still waters.
5. It is from this medium and fine-textured marine deposition that a characteristic semi-mature profile of the Tierra series has weathered. (A sketch with brief notations describing the Tierra Soil overlying the burials is contained in Fig. 2. A more detailed series description of a typical Tierra soil appears at the conclusion of this report.)

The age of a soil is seldom considered in terms of years by a soil scientist. It is generally based on the degree and characteristics of horizontal differentiation which in turn categorically arranges soils into five periods or stages of maturity.

Two soils derived from identical parent materials but formed under different climatic and topographic conditions may not reach the same state of profile maturity at a given time in years. A brief description of the five stages of maturity are as follows:

I. Recent profiles are without definite horizons of eluviation or illuviation; relatively unweathered recent or very immature soils.
II. Young profiles have slightly compacted subsoil horizons but without clay accumulations; slightly weathered immature soils.
III. Immature profiles have compact subsoil horizons with distinct clay accumulations; moderately weathered immature soils.
IV. Semi-mature profiles have very compact, semi-cemented horizons with high clay accumulations; strongly weathered.
V. Mature profiles have cemented, rock-like hardpan horizons or compact and highly colloidal clay horizons; fully weathered mature soils.

An attempt is made in Figure 1 (top) to graphically present the writers' theories, or estimates at least, as to the rate of profile development in terms of years.

A brief summation of the known and observable facts regarding the soil mass above the burials, together with conclusion by inference, will follow:

1. The parent soil material overlying the terminal occupational zone was slowly deposited by ponded or slowly moving water. Fineness of material, the absence of stratification, and occurrence of very small marine shell deposits comprises the principal substantiating evidence. It is estimated to have taken from about 1000 to 3000 years for this deposition to take place.

2. The general character of the Tierra profile is consistent with the definition of a semi-mature soil. Such criteria as the dense columnar structural units in the subsoil; concentration of lime in the lower subsoil prismatic units, and range in pH values are indicative of a long period of leaching and profile development. In process of soil formation to a stage of semi-maturity in this Tierra profile is believed to have taken from 3000 to 5000 years. This interval of time must be added to the time already allowed for the deposition of the parent soil material.
3. In the writers' final analysis then, an age estimate of the burials, based on pedological observations, would have occurred between 4000 and 8000 years ago.

TIERRA SERIES SOILS

The Tierra series includes dark-colored slightly acid soils developed from extremely compact or partly consolidated old sedimentary deposits. These soils occur in the valleys and coastal plains of southwestern California where the mean annual precipitation ranges from 12 to 20 inches. They are grassland soils, somewhat prairie-like in character. Many areas are on concave slopes adjacent to drainageways. They are closely associated in places with Chamise soils, which are a lighter brown and generally occupy slightly steeper and longer slopes at higher elevations, where the soils of the two series lie adjacent to each other.

I. Soil Profile: (Tierra fine sandy loam)

1. Dull grayish-brown or very dark brownish-gray friable, slightly acid fine sandy loam; about 8 inches thick.

2. Dark-gray, dark grayish-brown, or nearly black sandy loam or clay loam that is plastic when wet and hard when dry. This layer is about 12 inches thick.

3. Dark-gray, dark brownish-gray, or black stiff, plastic sandy clay containing a rather large proportion of coarse sand and fine gravel. This layer is about 13 inches thick and grades to

4. Extremely compact or partly consolidated substratum of old sedimentary deposits that is generally more firmly cemented with silica or iron in the upper part and less cemented, though still of semiconsolidated character, at greater depths. This material occurs to a depth exceeding 6 feet.

II. Variations: The heavier-textured soil types arenmore plastic in the surface soil and have a slightly heavier and more plastic subsoil. They are generally darker colored in the surface soil. In a few included areas along swales and on foot slopes the cemented substratum lies at a depth of 60 inches or more.

As mapped in the vicinity of Concord in the Contra Costa soil survey (see Pl. 2), small areas of Tierra soils are somewhat eroded along the lower margin of the terrace lands west of Walnut Creek. The surface soil in most of these bodies is clay loam and the subsoil may not be so tight and compact as typical. The parent material and lower subsoils frequently contain lime. The lime in the lower subsoils has weathered from the parent material lime and concentrated through leaching to the lower horizons.

III. Topography: Upland terraces, most of which have been cut by erosion into rolling or hilly relief. Many areas occur adjacent to drainageways in concave slopes.

IV. Drainage: Surface drainage is good but the heavy impervious subsoil retards the downward movement of water, and, following heavy rains, the soil becomes saturated and boggy.

V. Natural Vegetation: Under virgin conditions these soils are thickly covered with native grass and scattered trees such as oaks.

VI. Use: Many areas are used for grazing, which is very good during winter and spring. Some areas are farmed to barley, grain hay, and beans, and yields are fair to good.

VII. Distribution: Central and southwestern California near the Coast Range.

Type Location: Santa Ynez Area, California.

Series established: Salinas Area, California, 1925.