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THE ELLIS LANDING SHELLMOUND

BY

N. C. NELSON

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INTRODUCTION.

Of more than four hundred artificial shell deposits known in the San Francisco Bay region, perhaps none is of more general scientific interest than the large accumulation at Ellis Landing, near Richmond. This mound, besides being a conspicuous archaeological feature, furnishes incontestable evidence of having survived a considerable subsidence of the bay country which occurred subsequent to the arrival of primitive man, and has for these reasons been singled out for special investigation by the Department of Anthropology of the University of California.

The opportunity for systematic work on an extensive scale did not present itself until the summer of 1906. Previous to that time, during a period extending over several years, the University Museum had acquired by gift and by purchase a fairly representative collection of artifacts, numbering about two hundred and fifty specimens. While generally representative of the given culture, the value of this collection lay chiefly in the

added incentive it gave for a careful examination of the mound.

In August, 1906, at the request of Professor John C. Merriam, the writer, assisted by Mr. A. W. Wepfer, excavated a radial trench in the Ellis Landing shellmound. The work here was carried on continuously for four weeks, and was completed by the writer in December of the same year. The results obtained seemed sufficient for a preliminary report; and no further work was in immediate contemplation, when a fortunate circumstance arose. A portion of the mound material was sold for grading purposes; and in July and August, 1907, during the removal of the deposit, the writer was present to collect what artifacts and skeletal remains were uncovered. The archaeological data then at hand were deemed all that it was practicable to obtain, under the circumstances, as the remaining uninvestigated horizons of the mound were below sea-level. But, in order to round out the work, several additional weeks were given to a study of the geological factors concerned in the mound's history. This involved, besides some general observations on the local physiography, a determination of the nature and depth of the foundation of the mound, as well as the lateral extent of the deposit, and the grade of the submerged slope. Finally, in February, 1908, at the suggestion of Professor Merriam, the writer sank a shaft to the bottom of the mound in order to obtain some clue to the culture conditions represented in the strata below sea-level.

The work on the Ellis mound is a part of the regular investigation of the problem of prehistoric man in California carried on by the Department of Anthropology through the generosity of Mrs. Phoebe A. Hearst. It has been done under the immediate direction of Professor John C. Merriam, to whose counsel and encouragement what of permanent value the results may possess will be largely due. To Mr. George Ellis of Richmond thanks are due, not only for repeated permission to cull the mound, always generously extended, but also for assistance rendered and unvaried courtesy. Acknowledgment is made also for assistance and suggestions received from Professors A. L. Kroeber, R. S. Holway, A. C. Lawson, and Mr. H. O. Wood of the faculty; and to Dr. Harold W. Fairbanks and others not connected with the University.

THE MOUND IN RELATION TO ITS PHYSICAL ENVIRONMENT.

GEOGRAPHIC LOCATION.

The Ellis Landing shellmound is situated on the northeastern shore of San Francisco Bay proper, directly north of Brooks Island¹ (pl. 36). The marsh, fringing the greater portion of the bay shore, is here only six hundred yards wide; and on the shore edge of this rapidly eroding belt lies the mound, itself now more than half destroyed by wave action. The situation is peculiar and has given rise to several interesting but unfounded popular theories. The site in no way conforms to the general conditions observed now in more than four hundred instances, as there is neither fresh water nor firewood, excepting driftwood, anywhere within miles. In summer the locality is exposed to very strong southerly winds rushing to the hot interior valleys; and only in the dry season, if at any time of the year, is the mound quite approachable except by boat or artificial bridging. These facts collectively serve as sufficient occasion for a consideration of the history of the region.

TOPOGRAPHY OF THE REGION.

To the casual observer who visits the mound-site, the region appears as a broad valley, cut short at both ends by the bay waters, but in width stretching from the Berkeley Hills on the east to a range of hills about three and a half miles to the west. The western range, known as the Potrero San Pablo, is a narrow six-mile stretch of hills rising suddenly about half a mile west of Ellis Landing and extending in a northwest-southeasterly direction, parallel to the general trend of the Mt. Hamilton Range on the east and the Tiburon Peninsula on the west. Brooks Island is geologically a part of this range, and was probably connected with it until within comparatively recent times.

¹ Cf. the San Francisco Quadrangle (California) of the Topographic Map of the United States, by the United States Geological Survey, on which the mound-site may be located at the intersection of 37° 55' N. latitude and 122° 21' 30" W. longitude. Twelfth Street of the city of Richmond, if extended across the marsh, would also intersect the mound.

On the north the so-called valley opens almost squarely with its whole width on San Pablo Bay; to the south it fronts on San Francisco Bay, the distance between the two bodies of water averaging four miles and a half. The whole region constitutes a plain about sixteen or seventeen square miles in area. This plain is treeless, except along the creeks crossing the northern end. It is quite flat, the only irregularities being two hillocks which rise abruptly from the flat surface. One of these, Cerrito, a small, round knoll, lies in the south-central portion of the plain, above the general level of which it rises 140 feet; and the other, a much smaller outcrop, is located slightly south of the east-central part of the tract, less than half a mile from the base of the Berkeley Hills.

About one-third of the flat is tide land or salicornia marsh, which is wedged into the tract from both the north and the south along its western side, and separates the remainder of the plain from the abrupt slope of the Potrero Hills. Until recently a narrow belt of the wet land stretched the entire distance across the north end of the plain, separating the dry land from San Pablo Bay; but on the south, at Stege, there has been, as far back as any one remembers, a gap in the marsh belt made by a small tongue of the upland which fronts the bay waters with a six to eight-foot bluff.

The remaining dry land portion of the tract has now the rough outline of an isosceles triangle, with its six-mile base along the Berkeley Hills and its apex at the Santa Fe yards in the west end of Richmond, the marsh being here less than a fourth of a mile wide, and at present made habitable.

The general surface character of the triangle is that of a delta; and the larger portion of it has the characteristic shape and curvature of a crescent fan. The easiest grade on the fan, 125 feet in three and one-half miles, is that from the apex of the triangle to a point a little south of the center of the base. Immediately north of this point, on a slightly lower plane, Wildcat Creek emerges from the Berkeley Hills. From this stream the steepest descent runs northward for half a mile to the point at which San Pablo Creek leaves the hills at a level fully fifty feet below that of Wildcat. These two creeks, both well north

in the tract, after some meanderings westward, across a relatively low and level plain, finally unite at the perimeter of the dry land and empty through the marsh into San Pablo Bay. The low, level form of the northern part of the delta-like formation is probably not due to any process of degradation; for while both streams, owing doubtless to the artificial restriction of the water flow in recent years, have cut channels twenty to twenty-five feet deep in the alluvium, their banks are generally higher than the flanking plain. This fact would seem to warrant the inference that formerly, under normal conditions, the streams overflowed their banks occasionally during the winter freshets, and that they perhaps had very shallow beds and meandered irregularly over the plain.

The remaining larger portion of the upland tract to the south of Wildcat Creek is not drained by anything that can strictly be termed a stream, and does not seem very productive. There are some very slight superficial indications of old creeks that once crossed the area. One or two of these run between Stege and the Berkeley Hills, another skirts the east base of the Cerrito, and a third seems to have crossed the plain somewhere half-way between Cerrito and the city of Richmond, passing in all probability close by the Ellis Landing mound on its way to San Francisco Bay.

GEOLOGIC FEATURES OF THE REGION.

Depth of the Alluvial Formation.—From the records of wells driven on the flats east of Richmond it is seen that the alluvium contains a number of irregularly radiating streaks of water-bearing gravels ranging in different places from three feet to several hundred feet below the surface. Of late years, it appears that many of the shallow wells on the flat have gone dry, owing probably to the fact that both the Standard Oil Company and the People's Water Company have driven a large number of wells in various places on the tract.

Three well-borers testify independently to these general facts; and one of them, Mr. Boorman, who has driven wells in the neighborhood since the late fifties, says that for an extra good flow of water he has been in the habit of boring from seventy to

one hundred feet on the higher portion of the flat, near the town of San Pablo; but that on the lower margin, as for example in the southwestern part of Richmond, he has been obliged always to go down 250 to 260 feet; and in places he has bored 170 feet without getting water at all. One fact worth mentioning was the statement made by Mr. Boorman, that in drilling along the southwestern margin he usually found a layer of sea-shells at about one hundred and fifty feet below the surface.

In addition to this general information, accurate data were obtained relative to a number of deep wells recently bored by the People's Water Company. This company has several groups of wells at different places on the flat, and the increasing demand for water makes it necessary to add continually to the number. Thus three or four wells have lately been driven in the old town of San Pablo, close to the south bank of the San Pablo Creek. The wells are practically in the mouth of the San Pablo Cañon, and very close to part of the old formation constituting the Berkeley Hills. Nevertheless, these borings are from 150 to 170 feet deep and end in cemented clay and gravel.

The most interesting series of wells is situated near San Pablo about one mile out on the flood-plain. Here, beginning near the north bank of San Pablo Creek, fourteen wells are arranged in two straight lines running northward for half a mile immediately west of and roughly parallel to the Southern Pacific railway. The surface grade runs from sixteen to twenty-four feet above sea-level, the highest point being nearest the creek. The two lines of wells are 480 feet apart and the seven wells in each line are also separated by the same distance. Seven of these borings have been completed and elaborate records, together with samples of the various strata perforated, are available.

The southernmost of these wells, next the creek, is 412 feet deep and strikes solid bed-rock at 375 feet below sea-level. The general result, obtained by plotting the entire series of borings, is that the surface of the old underlying formation slopes westward at from ten to twenty-five feet in 480 feet horizontal, and that the slope of the same surface northward for half a mile averages twenty-seven feet to every 480 feet horizontal, the grade in one place being actually as much as fifty feet to the 480 foot

unit. As the samples indicate, the water-bearing beds, nearly five hundred feet in thickness, are clearly enough of alluvial origin.²

There can therefore be no doubt that the whole tract in question is a recent fill and that the outcropping hillocks mentioned belong to an earlier topography. The accumulation of the delta material may have been greatly aided by the position of the Potrero San Pablo, which lies at an angle to the main axis of the bay, ready to catch not only the scourings from the Wildcat and San Pablo cañons but also much of the silt poured through Carquinez Strait into San Pablo Bay.

Activity of Erosion.—As to the signs of erosion of the older formations, it may be observed that a large portion of the western shore of the Potrero San Pablo is characterized by uniformly high and steep cliffs; while the east side of the range slopes gradually to the marsh level, except for the last mile or so at the north end, where, as in the continuation of the formation across the San Pablo Strait, the shore line is likewise high and steep. One possible inference from this fact is that the steep cliffs have been worn on both sides of the range, where well exposed, since the last sinking movement. It may be suggested, furthermore, that Brooks Island to the south was probably insulated in the same way, the channel now separating it from the Potrero Range being only six to eight feet deep at lowest tide. But subsidence alone might account for the island, as one of the shellmounds situated here, partly on solid rock, has part of its foundation fully fifteen feet below ordinary high tide.

Subsidence and its Effects.—Whatever may or may not be accounted for by erosion, it is evident that some of the most striking features of this region are directly traceable to comparatively recent subsidence, as has been shown by competent investigators. The investigations conducted at Ellis Landing seem to contribute two facts to the evidence of subsidence available from purely physiographic studies, *viz.*: that at least a part of the movement, certainly not less than eighteen feet, has taken place

² The writer is personally indebted to one of the Water Company's engineers, Mr. Frank T. Oakley, for the data on which the conclusions are based.

since the advent of a race of people with a tolerably advanced type of culture; and that the movement itself was neither one sudden drop nor yet a single slow but continuous process.

At the present time such observations as can be made seem to show that the coast line is still advancing landward in the Richmond district. On the north, San Pablo Bay has advanced in places through the marsh fringe and has only recently removed the last remnants of a shellmound once well back on the dry land. But, on the whole, the process here is insignificant. On the south, however, erosion is more general and rapid. At present the whole stretch of shore from Ellis Landing to Stege, a distance of more than two miles, may be seen to move forward from year to year. Mr. Ellis, who has lived at the Landing about forty years, states that as late as twenty years ago the shellmound which is described in this paper was not only intact, but was actually protected by a strip of marsh thirty to forty feet wide. At that time it was considered too much trouble to wheel mound material across the marsh to a barge on the shore, and Mr. Ellis's father preferred to run a small canal from one of the marsh creeks up close to the mound on its land side.³ At the present time, as may be seen on plate 48, the shore line has advanced 160 feet on the mound itself. The total distance eroded in approximately twenty years is therefore 200 feet, or an average of ten feet a year, which amount tallies almost exactly with the observed wear during the past three winters. But these figures should not be taken too strictly, for while erosion goes on all along the line from Ellis Landing to Stege, the rate is probably quite unequal.

The reason for the very rapid advance of the shore line cannot be definitely stated, but a suggestion may be ventured. At lowest tide one may walk over the rather firm tide flat for more than half a mile south from the mound, *i.e.*, about half-way to Brooks Island.⁴ The bottom, which is about three feet below the marsh level near the shore, slopes only three and one-half feet to this half-mile point and then drops suddenly some six feet. It seems

³ Surveyors also claim that a line was once run on the marsh some 250 feet outside the present beach.

⁴ Persisting hearsay evidence has it that in early historic days it was possible to walk from Stege to Brooks Island dry-shod at low tide.

to the writer entirely probable that the Richmond marsh once reached south almost to this sudden drop, if not farther; and that the cause of the rapid removal of the marsh may be the recently made gap between Point Potrero and Brooks Island. At any rate, but for the presence of this channel, the waters off the Ellis mound would be comparatively quiet and a silting process would probably be in progress. The present tide-flat is, however, the result, not of recent deposition but of recent erosion. And the time required for the removal of the half-mile of marsh surface would, at the present rate of cutting, approximate 260 years. Whether this reversal, from deposition to erosion, is due to the insulation of Brooks Island by either erosion or subsidence or both, the writer must leave for others to determine. Enough has been stated to show that the bay region has experienced a complicated bit of history since human beings entered upon the scene.

Recent Deposition.—While erosion has been in process on the outskirts of the marsh in very recent times, silting and deposition have taken place in the protected central region. The old settlers around San Pablo speak of a large lagoon that occupied the region west of the town, between San Pablo and Wildcat creeks, for a long time after their arrival in the early fifties. At times the creeks flooded the whole region about the old Spanish town, and on one or two occasions the ranchers were forced to seek refuge on a shellmound situated on the bank of the upper stream. Other hearsay evidence, but from seemingly good sources, is to the effect that there was not long ago an open channel or tidal race along the east base of the Potrero Hills, connecting San Pablo Bay with San Francisco Bay proper. It is stated that the channel was navigable for scows as late as fifteen years ago, and it is vouched for definitely that in 1862 a steamer "large enough to go to China" went through. However, the silting up of this channel was no doubt hastened by artificial means.

SITUATION OF THE MOUND WITH RESPECT TO RECENT GEOLOGIC CHANGES.

The position of the mound itself may once more be given as on the submerged southwestern perimeter of the San Pablo-Wild-

cat fan.⁵ It is imbedded in an average of about thirteen feet of fine silt, but rests on a firm gravel foundation.

Several weeks, succeeding the time spent on actual excavation, were given to probing around and through the mound, at the points indicated on plate 48. For this purpose a strong two-inch pipe, cut into suitable sections, was used. The sections were provided with a half-inch slit on one side so that the pipe afforded a complete view of the material penetrated. Measurements and samples could also be taken at any place on the column.

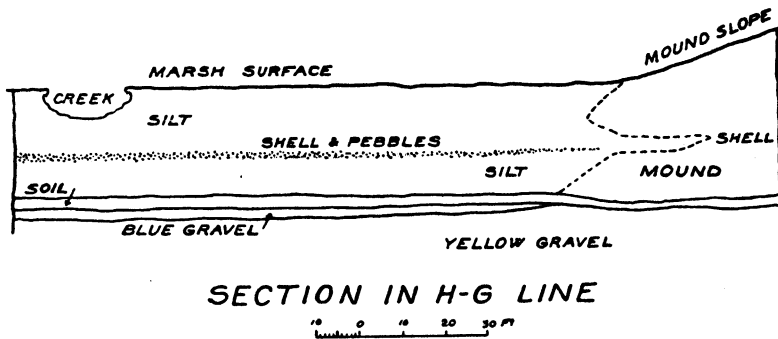


Fig. 1.

Fifty-five of these probings were registered and duplicated—in cases of doubt, several times. The result was the establishment of a practically even plane underlying the mound and its immediate vicinity, with, however, a perceptible tilt seaward and a sudden drop on the lower side, immediately beyond the mound base, along a northwest-southeasterly line. The approximate basal perimeter of the mound was also marked out, and the slope of the submerged portion determined in several places.

Considerable interest attaches to the peripheral mound slopes. Much time and care was given to determining with exactness the nature and extent of the peculiar silt wedges that are seen to enter the mound material at the extremities of the A-B section shown in plate 49, fig. 2. The accompanying figure illustrates

⁵ As may be observed on the map, the Ellis mound is only one of twelve or thirteen deposits situated on the delta, partly in the north where the streams now are, and partly along the south border where streams were formerly. There are in addition sixteen shell deposits on the Potrero San Pablo and four on Brooks Island.

the same phenomenon in the section taken at the H-G line on plate 48.

It seems to the writer that the fine silt or mud which surrounds and covers the mound to a depth ranging from eleven to sixteen feet could not have been deposited except in quiet waters—waters too quiet, in fact, to disperse the shell deposit itself. At the same time, the deposition would seem to have taken place in water of some depth and not as at present, during periodical inundations of the marsh; because the silt in the immediate vicinity of the refuse heap contains only faint traces of vegetable matter below the upper two feet, except a stratum of peat, more than nine feet thick, which is encountered at a depth of ten feet on the seaward side of the mound. Furthermore, the carefully ascertained oblique slope of the upper face of the silt wedge would seem to indicate that the deposition of silt and mound material was for a time simultaneous. It is possible, of course, that the shell deposition at this level was not artificial, although observation of conditions at the present surface does not show that the mound is weathering or degrading to any appreciable degree; furthermore, the silt wedge does not extend around the entire mound.

Another unexplained feature is the thin streak of shell and fine pebbles which extends in a horizontal plane as much as three hundred feet away from the mound in all directions. It would seem as if, when the plane of the silt deposition was at the level of the apex of the wedge, there had been some unusual disturbance such as was never repeated.

As to the foundation itself, where examined, it is generally composed of medium coarse, yellow gravel. In some places about a foot of dark, sticky material intervenes between the gravel and the mound deposit, these patches being evidently soil or material made up of finer drift which had been covered with vegetation. It therefore appears that the mound was begun on dry land that had been above sea-level for a considerable period of time. In many places, however, the shell appears to rest directly on the gravel; and this, near the perimeter on the sea side, becomes blue or bluish green in color and is mixed with a good deal of sand.⁶

⁶ For a broader treatment of the physiography of the San Francisco Bay region as a whole and its relation to shellmounds and shellmound culture, see the author's paper entitled *Shellmounds of the San Francisco Bay Region*, *Univ. Calif. Publ. Am. Arch. Ethn.*, Vol. 7, pp. 312-318.

THE MOUND AS AN ARCHAEOLOGIC FEATURE.

GENERAL DESCRIPTION.

Difficult of access, the Ellis Landing shellmound was never cultivated, as is usually the case with these fertile deposits; but, being overgrown with low bushes, *Baccharis Douglasii*, it has been for years through the shooting season a rendezvous for duck-hunters. On a stormy winter's day, at high tide, the mound may be seen at times a lonely island, completely surrounded by water which attains a depth of fully two feet on the marsh behind it (see pl. 37, fig. 1). At such times, in the past few years, the destruction of the mound went on at an extraordinary rate, the steep sea-wall caving and sliding as fast as the surf could remove and undermine. The waters in motion were able to suspend most of the fine material, which was worked off to both sides and rolled in over the marsh, making a bar on the east side about four hundred feet long and to the west another bar measuring a hundred and fifty feet in length. These extensions average thirty feet in width and a little over two feet in depth (see pl. 38, fig. 2). The two bars, together with the mound which separates them, afford a straight and smooth beach 850 feet long,—the only beach for miles around on which one can walk with comfort and convenience. On this beach the material heavier than shell (which constitutes the main portion of the deposit) grades off according to size and weight in either direction from the mound, only the finest pebbles and shell fragments being carried to the extremities of the bars; and here at low tide, one need not look long in vain for either artifacts or skeletal material.

Size.—As shown on plate 48, the portion of the mound actually visible has a roughly triangular outline. Considering the straight three hundred-foot shore side as the base, the perpendicular distance to the apex on the north or land side is 170 feet. The other two sides of the triangle are of unequal length, and curve, one outward and the other inward, from the hypothetically straight lines.

The greatest height of the mound above the marsh level was seventeen feet, and the greatest depth below the same level

(obtained out on the tide flat) is nearly sixteen feet; but the actual vertical distance from the highest point on the mound, as found in 1906, to the bottom immediately below was approximately 28 feet and 6 inches. The slope and contour, as indicated on plate 48, were fairly even, with the exception of the summit, which was dotted with a number of saucer-like depressions. Some of these measured as much as twelve feet in diameter and slightly over two feet in depth. They were probably old house-pits.

In addition to the natural processes which are at work, and which are certain to accomplish the mound's destruction in the near future, the accumulation has also been subject to artificial disturbance, and much of the material has been taken away for filling and grading around the Landing. As has already been stated, it was found most convenient to remove this ballast by way of an artificial canal run over to the edge of the mound from one of the marsh creeks (see pl. 38, fig. 1); and after more than forty years of this work, there is now, on this edge of the mound, an oval excavation measuring 70 by 100 feet (see pl. 48, and also pl. 38, fig. 1). This cavity runs back almost to the highest portion of the mound, and is excavated down practically to the marsh level. Out of it came many skeletons and artifacts, most of which are now scattered among individual curio-collectors.

The preceding description, it should be noted, refers to the mound as it appeared in 1906. The mound as it was before subsidence may be determined approximately from the data given on plates 48 and 49.

In order to obtain the mound's outline with reasonable accuracy, a straight east-and-west line was laid off on the beach, and a point in it least liable to disturbance was chosen as zero. This zero, located at the intersection with the A-B section, was used as a reference point throughout the work of 1907, both for locating specimens and for plotting the mound. The latter was accomplished by staking out, with the beach line as a base, two rectangles about the respective sea and land portions of the mound, the perimeter of which was then determined by measurements taken at every twenty-five-foot interval. On the sea portion of the mound this work had to be done during the intervals of low tide, and here permanent stakes were set to mark the surface

perimeter and also the two-, the four-, and the six-foot depths of the shell. Beyond the six-foot depth it was not practicable to determine the mound slope except by special probing at greater intervals, as indicated, for example, by the short K-L and M-N sections on plate 48. Similar work was done to determine the mound slope under the marsh proper, and the result is a tolerably accurate basal perimeter.

The submerged portion of the mound slope is smooth and fairly uniform except along the northeast and southwest borders, where occur the peculiar wedges already considered. Oblong in form, with a regular curve on the east side, and the extraordinarily sharp indentation on the west side, the deposit gives the impression of having been started from two centers. This conclusion, perhaps of no vital significance, is based partly on the fact that it is not uncommon in the bay region to find even as many as four mounds joined together along some creek bank.

The extreme northwest-southeast length of the mound measured at the base is 460 feet and the width averages 245 feet. With a probable height of about thirty feet along the summit ridge, the volume is calculated to have been approximately 1,260,000 cubic feet. Of this volume only about 490,000 cubic feet cropped out of the marsh, and of that portion again less than half was left in 1906.

Age.—The length of time required for the accumulation of such a large volume of refuse has been considered by the writer in a recently published paper⁷ on the general distribution of shellmounds in the bay region, and it is hardly necessary to repeat here either argument or calculation. The estimate, which was made on a volume basis, places the age of the Ellis mound at approximately 3,500 years,—a figure which, as previously observed, accords closely with independent calculations made on similar deposits found in Denmark and in the Aleutian Islands.

THE EXCAVATIONS.

Trench.—The first excavation consisted of a trench carried from the highest portion of the mound out to the marsh edge (see pl. 48). The line selected followed the old Ellis excavation

⁷ See *op. cit.*, p. 345.

as closely as possible in order to facilitate the disposal of the dirt, which after examination was easily thrown over into this hollow. The trench measured 108 feet in length and six feet in width. It was carried down for the most part as far as the ground waters permitted, *i.e.*, to about six inches below the marsh level, the exception being simply a narrow ledge left for staging purposes along a portion of the western wall in the deeper part of the cut. The opposite wall was kept straight and perpendicular, and its special and characteristic features were charted as the work progressed (see pl. 49, fig 1). All objects uncovered were located by two horizontal measurements referable to a fixed point at the end of this wall near the center of the mound; and by a third, vertical measurement, taken on the wall itself, opposite each particular object.

The volume handled approximated 5,500 cubic feet, and the total number of determinable artifacts obtained was seventy-eight, with many more of doubtful character. Besides a large quantity of animal bones, sixteen human skeletons were uncovered, most of them complete and in comparatively good condition. The positions of the latter are specifically indicated on plate 49, figure 1, and the characteristic methods of disposal are illustrated on plate 50, figure 1.

Mound Removal of 1907.—The removal of a large part of the mound for grading purposes in 1907 afforded a most excellent opportunity for further study at comparatively slight expense. As shown on plate 48, the portion removed took in a rectangular section on the seaward side, measuring about 60 by 160 feet. With three to four teams of horses moving about within these limits, the archaeological work was necessarily done at some disadvantage. All possible care was taken, but expeditious work was sometimes the first essential. The only practical way to obtain location figures was by a series of stakes set at five-foot intervals along two adjacent sides of the excavation. From these the horizontal position with reference to the zero point on the base line could be obtained very easily and quickly. The depth in most cases had also to be estimated from the same stakes. In spite of these difficulties, no unusual discrepancies were apparent when the general nature of the finds was compared with the more

carefully studied conditions obtaining in the trench of the previous year. The workmen were very considerate; and when, as happened repeatedly, a half-dozen or more human skeletons were exposed at one time, they worked in other parts of the cut until the material could be removed.

The work was completed in two weeks, the material moved amounting to about 67,500 cubic feet. The number of artifacts obtained was two hundred and sixty-five, with an additional half-dozen remaining in the hands of the workmen. One hundred and twenty-six human skeletons were also uncovered, but of that total number about ten were lost.

Shaft.—With a fairly complete knowledge of conditions prevailing in the dry upper portion of the mound, there was the urgent need for some clue as to the culture below the water-line. Probings had shown the depth and general composition; but as to the fauna represented, or the artifacts and skeletal material, not a single fact was available. The possibility of reaching the bottom through a strong head of water at least eleven feet deep seemed a little doubtful, without a heavy outlay for extraordinary means. However, during a dry period in February, the attempt was made and accomplished in less than three days at a very small cost. Three men were employed, two of them being kept busy at the pump while the writer with the third man carried on the digging operations. Under the circumstances, the dirt could not be carefully looked over at the time of removal from the shaft, and was therefore laid out on the surface according to horizons and later thoroughly examined. The material taken out of the shaft amounted to 560 cubic feet. All of this came from below the high-tide level; but only 325 cubic feet of the total volume were brought from beneath the normal ground-water line, which is about two feet six inches lower than the level of the highest tide observed. The yield of artifacts was thirty-eight in number. Of human remains there were obtained scattered fragments of two individuals, found seven feet below the high-tide line, and two nearly complete skeletons close to the bottom (see pl. 49, fig. 1, and pl. 50, fig. 2, nos. 273 and 274). No animal bones were found in the lower eight feet of the shell deposit; in fact, only three or four fragments were obtained in the entire shaft.

The place chosen for the shaft closely adjoined the section wall of the trench near the center of the mound (see pl. 48). This position allowed a partial completion of the charted section in the same vertical plane (see pl. 49, fig. 1); and to get this addition as accurately as possible some risk was taken by digging the shaft without sinking any curb, caving being quite negligible except at the bottom.

INTERNAL STRUCTURE OF THE MOUND.

The internal structure of the Ellis mound, while not so extraordinary as that of the accumulation at Emeryville, is very peculiar. As shown on plate 49, figure 1, the upper six or eight feet of the deposit is comparatively coarse material, being made up chiefly of partly broken mussel shells together with an intermixture of broken and unbroken clam shells. A certain amount of disintegration is apparent near the surface of the layer; but apart from this the material, which is laid down in decidedly irregular planes, is of uneven texture. Beds of ashes, bunches of stones, now and then wavy layers or lenses and pockets of distinct kinds of broken or unbroken shells are common; but there are no well-defined strata of raw and calcined material such as marked the upper part of the Emeryville mound.⁸ The line which marks the division between this loose superficial material and the substructure is very definite and, in the main, regular. Below it the material is of an almost uniformly fine and compact nature, and likewise of a nearly homogeneous composition.

The structure here, as at Emeryville, is not well defined, the bedding planes being readily distinguishable only at some few points, for instance near the bottom of the shaft, where they are horizontal. For a thorough appreciation of the difference between the two parts of the mound attention is called to plate 39.

There is no evident explanation of the difference between the upper and lower portions of the mound, unless indeed it be that a very great interval of time separates the two portions of the deposit or that a new mode of life was suddenly established on the mound. It has been suggested, partly on physiographic evi-

⁸ Uhle, M., The Emeryville Shellmound, *Univ. Calif. Publ. Am. Arch. Ethn.*, Vol. 7, No. 1, 1907.

dence in the region, that the finely broken and compact substructure was once submerged; and that the upper, loose material is the deposit added since the reappearance at the surface of this older portion of the mound. While the vertical movement itself might not be impossible in a region so unstable, submergence would have tended to disperse the shells rather than to disintegrate them; and if for a time the mound had sunk to depths beyond disturbance, some evidence of silt deposition on its surface should be apparent. Of this, however, there is not a trace. One point of which the writer has not been able to make sure is the relation of this line of demarcation to the silt wedges previously mentioned as entering the submerged mound slope (pl. 49, fig. 2). Apparently there is no connection; but the supposition that there must be some relation is scarcely avoidable.

CONSTITUENTS OF THE MOUND COMPOSITION.

The question of the elements entering into the composition of the shell deposits in the San Francisco Bay region has already been considered by the writer at some length in an earlier paper.⁹ As was there pointed out, the shells of certain species of clam and mussel are common to all the mounds; but in addition to these there are present a number of less common species which are often somewhat localized. Besides the shells, which as a rule constitute the bulk of the refuse, there are varying quantities of charcoal, ashes, stones, and pebbles; and these latter elements in certain localities practically replace the shells altogether.

Shells.—The mound at Ellis Landing is made up largely of clam and mussel shells, the former in an unbroken condition being very conspicuous in the upper part of the mound (pl. 49, fig. 1). Now and then a few oyster shells, or even small pockets of them, occur; but they are almost negligible in quantity. This is worthy of note, as in the shellmound on Point Isabel, little more than two miles away, there is an extensive layer of oyster shells over two feet thick. Given in descending order of frequency, the following is a list of shell species as identified with the help of Professor Merriam:

⁹ *Op. cit.*, pp. 335-338.

Mussels, <i>Mytilus edulis</i> and <i>M. californianus</i> .	<i>Cerithidea californica</i> .
Clams, <i>Macoma nasuta</i> .	<i>Purpura crispata</i> and <i>P. canaliculata</i> .
Oysters, <i>Ostrea lurida</i> .	<i>Haliotis rufescens</i> .
Cockle, <i>Cardium corbis</i> .	<i>Acmaea patina</i> .
<i>Tapes staminea</i> .	<i>Olivella biplicata</i> .
	<i>Helix</i> , sp.

Probably all but the last two kinds named in the above list were used for food. Whether they were eaten in a raw or prepared condition does not appear, but the common occurrence of bits of baked clay fitting the form of mussel shells in various horizons of the deposits suggests that the mussels at least may sometimes have been baked. A comparison of the above shell species with the list from the Emeryville mound published by Dr. Uhle exhibits identity throughout. Quantitatively considered, however, some variation is noticeable; there being, for instance, a greater abundance of oyster shells at Emeryville and a much larger number of the univalves, *Purpura* and *Cerithidea*, at Ellis Landing.

Special attention may also be directed to the noticeable variation of the preponderating shell species represented in the section wall of the Ellis mound (see pl. 49, fig. 1). The lower portion of this accumulation is composed almost exclusively of mussel shells, and it is only in the upper eight feet that the clam shells become at all plentiful. This fact seems to admit of one or two possible interpretations: either the local physiography of early shellmound times was very different from that of the present day or else the mound people possessed boats of some sort.¹⁰

¹⁰ Don Jose de Cañizares, the able Spanish pilot who conducted the first thorough survey of San Francisco Bay in the year 1775, in the report to his superior, Lieutenant Ayala, describes some interesting native crafts of that day. The pilot makes note of two Indian rancherias, one situated near the head of the San Francisco Peninsula and another near the west end of Carquinez Strait. With the latter community, which he says consisted of about four hundred souls, he had repeated dealings, visiting them in all four times; and he writes: "This Indian village has some scows or canoes, made of tule, so well constructed and woven that they caused me great admiration. Four men get in them to go fishing, pushing with two-ended oars with such speed that I found they went faster than the launch." In the log of the *San Carlos*, which was anchored near Angel Island during the absence of Cañizares, Commander Ayala has himself entered the statement that fifteen Indians came on a raft and were taken on board. Translations by E. J. Molera of the documents in question, together with a photographic reproduction of the first map of San Fran-

As is well known, the mussel lives only on rock-bound shores and must therefore, in recent geological times, have been relatively scarce in San Francisco Bay. The nearest, in fact almost the only locality on the east side of the bay where the Ellis mound people could have obtained this apparent mainstay of their existence would have been along what is now the Potrero San Pablo and Brooks Island. If these were insulated from the beginning, as they were in late prehistoric times, boats would have been required to reach the habitat of the mussel. If the people had no boats, then it must be that they were able to reach the outcropping range dry-shod, the mussel being in that case confined to the western side, as at the present day. To the writer the latter alternative seems the more probable, though this should not be taken to exclude entirely the possibility that the mound people possessed from the earliest times some sort of sea-going craft. There is one important objection to the supposition that the mound people possessed no boats and were therefore unable to reach the west shore of the bay, where the mussel is extremely plentiful. As is shown on the map appearing as plate 36, the inhabitants of over thirty more or less contemporaneous mound-sites were dependent on a strip of coast, which, at the present time, does not exhibit an abundance of the molluscs in question. It is possible, of course, that the mussel was once more plentiful on the Potrero shore, and that the mounds were not all populated at one and the same time.

The precise reason for the scarcity of clam shells in the lower portions of the mound is no less obscure than the reason for abundance of mussels. It is probably also to be explained on the supposition that in early prehistoric days the San Pablo-Wildcat delta extended as dry land directly to the eastern base of the Potrero San Pablo, as well as to Brooks Island. There was consequently no mud beach in the vicinity of Ellis Landing where clams could thrive. But in relatively late shellmound

cisco Bay, are to be found in a small volume entitled *The March of Portolá and The Discovery of San Francisco Bay*, published by the California Promotion Committee, San Francisco, 1909.

There is also both hearsay and printed evidence that the Indians who lived at Sausalito subsequent to 1838 were in the habit of carrying the mails to and from San Francisco on rafts of their own construction.

times the subsidence of the region flooded the lower margin of the delta and insulated the Potrero San Pablo, producing a stretch of shallow and comparatively quiet water in which silt could deposit to make a suitable habitat for the clam. Whether this explanation was in fact the origin of the clam supply or not, the Ellis mound people appear suddenly to have come to depend very largely upon this mollusc; and that the insulation of the Potrero and the consequent greater difficulty of obtaining the mussel had something to do with their change of diet seems probable, allowing even that the people possessed boats.

Vertebrate Remains.—The easily obtainable mollusca, while clearly preponderant, were by no means the only animal food which the primitive people living on the Ellis mound were able to secure. In the upper levels of the mound a fair variety of vertebrates are represented, though in a very fragmentary condition. Among these are two unguulates, several sea and land carnivores, one or two cetaceans, a small number of bird species, and a very limited quantity of bones representing two or three species of fishes.

Without the necessary material for comparison, the faunal remains have not thus far been thoroughly studied; but the following is a tentative list of only partly identified species:

Deer, <i>Odocoileus</i> , sp.	Sea-lion, <i>Zalophus californianus</i> .
Elk, <i>Cervus</i> , sp.	Seal, <i>Phoca</i> , sp.
Antelope, <i>Antilocapra americana</i> .	Porpoise, <i>Phocaena communis</i> .
Sea-otter, <i>Enhydra lutris</i> .	Whale, indet.
Raccoon, <i>Procyon lotor</i> .	Skates, sting-rays.
Badger, <i>Taxidea</i> , sp.	Several fishes, indet.
Skunk, <i>Mephitis occidentalis</i> .	Ducks.
Wildcat, <i>Lynx</i> , sp.	Several birds, not determined.
Coyote, <i>Canis</i> , sp.	
Dog, <i>Canis familiaris</i> (probably modern).	

In the main this list agrees with that of the fauna obtained by Dr. Uhle¹¹ at the Emeryville mound, and it may almost be taken for granted that such specific differences as appear to exist are purely accidental. There is, however, a decided difference in the occurrence of the osseous remains at the two places. For

¹¹ *Op. cit.*, p. 18.

while at Emeryville the species identical with those at Ellis Landing were found rather irregularly distributed, but quite abundant even at the bottom of the deposit, in the Ellis mound not a single animal bone was obtained in the lower eight or nine feet. As the test was made with a shaft measuring only six feet square, this may of course be accidental;¹² but it was generally noticeable in all parts of the mound, above sea-level, that the remains of vertebrates decreased from the surface down, most of them being confined to the loose superstructure.

Charcoal and Ashes.—With the great bulk of shell there is mixed a large amount of charcoal and ashes and possibly some earth. Clear, white or yellowish ashes occur sometimes in thin streaks, or it may be in lumps (pl. 49, fig. 1); but their presence, like that of charcoal, is detectable throughout the mound. Some careful tests of the material show that in the upper part of the mound the shell and pebbles make up about 80 per cent. of the total volume, while in the finer and more compact substructure the volume of shell and pebbles is reduced to only 60 per cent. of the mass, the remainder being suspensible in water. It is difficult, however, to say how much of this suspensible material is ashes, and how much may be disintegrated shell and fine earth.

Rocks and Pebbles.—The supposition that some earth is mixed into the composition is based on the presence throughout the mass of a surprising lot of small pebbles. These actually make up no less than 0.4 per cent. of the total volume. Besides the small pebbles there is scattered through the deposit a large quantity of broken and unbroken stones. In size these stones vary from small fragments up to slabs and boulders of forty pounds weight. Their distribution is not at all uniform, the stones occurring often in groups or bunches numbering as many as two hundred specimens (pl. 49, fig. 1). In view of the fact that many of these groups were imbedded in ashes, it seems probable that they were used as fireplaces; although in certain instances this was apparently not their use. The most remarkable occurrence of the latter kind was found in the trench, where, some eight feet

¹² On the other hand it may be accident that so many animal bones were found at the bottom of the Emeryville mound in the Uhle excavation, as the portion of the mound excavated was probably not the original center of the refuse collection.

below the surface, there were discovered about eighty schist slabs built together into a nearly spherical solid mass measuring about $2\frac{1}{2}$ feet in diameter (pl. 49, fig. 1, close to right-hand end). There is no apparent explanation of this structure unless it bore some relation to an infant burial found not far from it.

The rocks represented, with some few exceptions, are not native in the immediate locality. After several varieties of sandstone, the most common rock is a mica schist. With this there are the glaucophane and actinolite schists. There are green, blackish and red cherts, of which the last-mentioned kind crops out on Brooks Island and also near the northeastern extremity of the Potrero San Pablo. Basalts of several varieties are common, and a very porous andesite was used quite frequently for mortars. Rhyolite, diabase, quartz, and obsidian are also present in lesser quantities. A number of chalcedonic amygdules and nodules of various shapes were also found.

The actual localities where these various rocks could have been procured are not in every instance definitely known to the writer; but the nearest occurrence of obsidian is in the neighborhood of Clear Lake, about one hundred miles to the north. A number of rocks, usually of the native kinds, showed indications of barnacles, still firmly attached. Apparently these specimens were originally removed from a salt-water beach such as is not now found in the immediate vicinity.

HUMAN REMAINS.

The Ellis mound was used from the beginning for burial purposes. This fact is not in itself remarkable, even were it not known to have been a world-wide practice to bury in the refuse-heaps, because interment in any other place would have been comparatively difficult under primitive conditions. There are no sand beaches on the bay shore, and the soils of the region are tough, and in fact quite impenetrable during the dry season to any but the best modern implements. These facts should, of course, not be taken as the precise and only reasons for shell-mound interments, either here or in any other part of the world. It seems probable, however, that many such customs, even those having the strictest religious motives behind them, originated somehow in mere external necessity.

Number and Distribution.—One hundred and forty-six skeletons, more or less complete, were obtained during the excavation. To this figure should be added about fifteen remains which were lost during the work of 1907, several being uncovered and removed by relic hunters who frequented the mound on Sundays. Taking the sum, 160, as the approximate total of human remains obtained from all levels of the refuse-pile by handling a little more than 72,000 cubic feet of material, it would appear that the entire mound, estimated to have had a volume of 1,260,000 cubic feet, might contain about 3,000 skeletons. In the opinion of the writer this figure is probably much too low. For if the mound, as previously suggested, is anywhere from three to four thousand years old; and if in its later stages it could support about one hundred people at any given time, the pile should contain more nearly 10,000 skeletons; provided most of the individuals comprising the one hundred or more successive generations were interred on the spot. To say that the mound did not count one hundred inhabitants is merely to lengthen its age, unless the per capita amount of refuse is increased beyond what seems probable.¹³ The apparent discrepancy in the figures given above may perhaps be accounted for in part by the following observations.

As will be observed on the section-wall (pl. 49, fig. 1), the distribution of the burials is far from uniform. Skeletons were indeed obtained at all levels of the deposit, from about two feet below the surface to within a few inches of the bottom, or about twenty-eight feet below the summit; but most of the material was found in the horizon lying between the loose superstructure and the water level. It may well have been an accident, of course, that only two complete remains were found in the shaft, below sea-level. This excavation if moved a foot or two to one side or another might have yielded entirely different results. But as it is, the number found in the shaft raised the average rather than lowered it. The horizon which really reduced the average (to one skeleton per 456 cubic feet) was the upper six to eight feet of the deposit. Why so few skeletons were found here is not clear. It is true that some burials may have been removed from

¹³ The estimated average is 120 cubic feet per life of thirty-three years.

this level, as considerable surface digging has been done in recent years; but this work was not so systematic as to account wholly for the notable scarcity of skeletal material. Cremation may have been introduced in late times, but if so, it was not uniformly practiced; in fact indisputable evidence of its use, such as has been found in a shellmound on Carquinez Strait, is wanting.

Other evidence that may have some bearing on the case is found in the fact that most of the skeletons found represent either men and women of mature years or infants apparently not beyond the foetal stage. Excepting two or three finds, children and young people were not represented. The meaning of this is uncertain. It is conceivable that only the old and infirm lived permanently on this and similar mounds, while the young and active portion of the population risked life in the interior of the Coast region. It may perhaps also be accounted for in a measure by a very low death rate among adolescents.

Methods of Burial.—It is to be regretted that no good photographs are available to show the characteristic dispositions of the skeletal remains, there having been little time to spare for photographing under the conditions obtaining when the skeletons were uncovered. In all possible cases, however, the essential facts regarding the position and arrangement of the bones were noted and charted, and figure 1 of plate 50 is appended to show what the camera could not accomplish.

Three general methods of disposal obtained, and two of these it seems are somewhat localized horizontally. The prevailing method, found in all parts of the mound, was to place the body on one side with the legs drawn up (knees to the chest or heels to the buttocks) and the arms flexed, the head often resting on the folded hands. Along the east side of the excavation of 1907 many of the remains lay face down with arms and legs both folded well under the trunk. In the trench, at the north end of the mound, several skeletons lay stretched out full length, generally supine but sometimes prone. Cardinal directions, it will be seen, were not observed, and as for horizontal disposition, it varied also, the head being often either higher or lower than the trunk.

Group burials were not uncommon. Figure 1 on plate 50 shows how two or three individuals were sometimes placed together spoon-fashion. At one place, in the eastern part of the mound, fourteen individuals were found that appeared to belong to one group. They were all doubled up and laid face down in three tiers, within a space measuring less than six by ten feet on the horizontal and three feet in depth. The principal object here, as in nearly all the other burials, seems to have been to dispose of the remains in the smallest possible space. Perhaps the preparation of a grave was not considered an easy undertaking even in this loose material. That graves were actually dug, in preference to any other methods that might have been followed in placing the dead out of harm's way, is suggested by a number of observations.

As evidence of intrusive burials the even depth of the graves shown on the section-wall may be noted (see pl. 49, fig. 1). If it be assumed that most of these individuals were buried when the mound surface followed the line dividing the loose upper portion from the compact substructure, these graves were dug to an average depth of four feet, which is about as deep as the Indians of historic times ever went. Another indication that the mound people sometimes dug into the refuse deposit far enough to disturb the remains of the dead already buried is found in the frequent occurrence of isolated human bones, often but a section of the femur or some other relatively strong bone. Finally, at one place in the trench four skeletons (nos. 82, etc.) were found in the same horizon and so close together that they were at first looked upon as a group burial. Upon closer examination, however, it was found that the right femur of the lowest individual was inverted, and that several of his missing ribs were lying about three feet away under a mortar in which rested the head of the topmost skeleton. It seems probable that we have here, instead of a group burial, four different interments almost in the same spot.

While there is thus little evidence of care either in the selection or the preparation of the grave, with the body itself it was often otherwise. With the infants were usually found a handful or so of small disk beads made from the *Olivella* shell, or else

some larger perforated disks or pendants of abalone shell (pl. 45, figs. 5, 6, 7, and 8). In the case of women, mortars, pestles, and awls were not unusual accompaniments. With the men, pipes, charmstones, obsidian blades and smaller weapons were frequently found. Sometimes the male skeletons were also covered with a heavy layer of red ochre or paint, a phenomenon which held true even to the lowest skeleton uncovered (see pl. 50, fig. 2, no. 274).

Nature of the Remains.—The skeletal material as brought to the University Museum forms a large collection. The finds range from a few fragments to complete skeletons, which are usually more or less broken. About a dozen skulls were preserved entire, and perhaps as many more can easily be repaired. On the whole, compared with burials in ordinary earth, the state of preservation of these remains is quite remarkable. The age of the different burials, as judged by depth in the deposit, is no criterion as to stage of preservation, the bones obtained from the bottom of the mound being in better condition than many of those found near the top. In some instances, near the water-line, the bones were heavily incrustated. The only skeleton found in perfect condition was obtained about two feet below the surface (pl. 50, fig. 1, no. 205, and pls. 40-41, fig. 1). Of this specimen only one bone was partly decomposed, the remainder being clean and white and hard.

Circumstances have not as yet permitted a careful examination of all this material, and it is not possible to state whether the physical characters of these people are certainly distinct from those of the recent inhabitants of this region. In the two skulls shown on plates 40 and 41 the types found in this mound are illustrated. The skull with the more pronounced superciliary ridges (pls. 40-41, fig. 2) was taken from a point slightly below high tide, and the other (pls. 40-41, fig. 1) came from about two feet below the mound surface.

The teeth in many of the crania are ground down below the line of the enamel, and the jaws themselves quite generally show marked effects of suppuration. The anomaly of a tooth grown well up into the nasal cavity may also be mentioned. There was noticed also a series of fused cervical vertebrae, and an elbow

joint ankylosed in a flexed position. Other unnatural developments or diseased conditions of the bone were found, but on the whole the collection presents no very extraordinary features, either natural or diseased.

MATERIAL CULTURE.

As indicative of the life and culture of the prehistoric mound-dwellers at Ellis Landing there were obtained of implements, weapons and ornaments a total of about 630 specimens. Of this number, however, only 380 are accompanied with data of any kind, the remainder having been picked up on the beach or procured from Mr. Ellis, who obtained them from time to time either on the beach or in the old excavation. Many of these artifacts, although of course made of such relatively non-perishable materials as bone and stone and shell, are mere fragments; but as the range of types is comparatively limited, several complete representatives are available of all but two or three.

In attempting to give some account of these specimens it is deemed unnecessary to enter here upon any elaborate or detailed description, inasmuch as Dr. Uhle has so lately discussed the culture of a shellmound in the near vicinity. The various well-recognized types of implements are simply mentioned in groups and only the new forms receive specific attention.

IMPLEMENTS OF STONE.

Mortars and Pestles.—Perhaps the most evenly distributed objects in the Ellis mound were mortars and pestles. They occurred, in a fragmentary condition, at all levels of the deposit; but a few complete or unbroken specimens were uncovered. In size the mortars range from a small, perfectly worked specimen that may be hidden in the hand (pl. 42, fig. 2) to an example like a small tub, eighteen inches in diameter. The weight runs from thirteen ounces to about one hundred pounds. The forms vary from semi-spherical to bucket-shaped; and the workmanship, though sometimes crude and careless, often shows deliberate attention to details. The material used is mostly basalt, though sandstone, and sometimes a very hard metamorphosed rock, are found in several cases.

The pestles vary in length from a hand's breadth to eighteen inches, and their weight runs as high as six and one-half pounds. All grades of finish from the roughly pecked, or even natural adaptations, to smooth and highly polished specimens are to be seen. Two or three possess the constricted top figured by Moorehead and designated "phallic form," or Stockton type.¹⁴

One striking peculiarity in regard to the mortars and pestles is the broken condition in which they were usually found. For example, each of two of the strongest and heaviest mortars obtained (Mus. nos. 1-13240 and 1-11233) were broken into ten and thirteen pieces respectively. In the case of one of these it is difficult to imagine what force would have been exerted to break squarely in two a vessel of hard rock with sides and bottom almost six inches thick.

Another noticeable point about the mortars and pestles is their finished condition. This fact linked with another, namely, that the rock used is not native to the region, makes it reasonably certain that the implements in question were manufactured at a distance and in some way freighted to the mound.

Hammer Stones.—Closely related to the mortars and pestles is a series of oval and discoidal stones that were evidently used for striking. Some of them have either one or both of the mortar and pestle characteristics (pl. 42, fig. 3). That is to say, some have the shape of a short pestle with small depressions in one, two, or more of its sides; and others are cylindrical or discoidal, the end depressions being sometimes natural and adapted for holding the stone in striking with its edge, or the depression may be clearly artificial. A stone similar to the discoidal form is said to be used by the present-day Indians for cracking nuts and acorns. The various forms here recognized must have had several different uses, however. They exhibit no particular workmanship.

Rubbing or Whetstones.—It is difficult to apply any term other than "rubbing stone" to certain varying forms made of sandstone, all of which present one or more flat surfaces that have resulted from use. There are several of this kind in the collection, and one or two of them show marks of having been brought into shape by some pecking process (pl. 42, fig. 4).

¹⁴ Moorehead, W. K., *Prehistoric Implements* (1900), p. 288, fig. 2.

Grooved Sinkers.—Another crude type of implement is the so-called grooved sinker. About fifty of these were obtained from the mound; and, until the shaft was dug, they were thought to be confined to the upper four or five feet of the deposit. As they are supposed to have been used for weighting fishing nets, this conclusion fitted well the fact that the few osseous remains of fishes were also found to be confined to the surface layer. But when the excavation was carried below the water-line the sinkers appeared again, and continued to the bottom, twelve specimens being found in the shaft alone. If, then, these grooved stones were used for fishing, the very earliest dwellers about the mound must have been peoples of no inferior ability.¹⁵ What they did with the fish, unless they dried and cured them to take inland, is a mystery. Apparently very few were eaten on the mound site.

The so-called sinkers are more or less flat and oval objects, averaging half a pound in weight (pl. 42, fig. 1). The rough groove is in all cases transverse to the long axis of the stone,¹⁶ but its continuity varies. If the stone is thin and flat, the groove usually encircles the whole mass; while if the stone is rough, say triangular in cross-section, there is no notching except on the corners. A practical man of to-day would make such sinkers in exactly the same way. One of these stones is rather broad and flat, and has its constriction so near one end that, were it not of brittle material, it would instantly be taken for a celt or axe.

Perforated Sinkers.—Another type of implement which perforce must be classed as a sinker is a crude, usually shapeless stone, provided with either a natural or an artificial perforation. Of this sort the collection exhibits fourteen specimens, all of which were bought from Mr. Ellis, who obtained them supposedly from the portion of the mound above the ground-water line. As no exact data bearing upon their occurrence is at hand and the forms are in no sense peculiar, the series is not fully illustrated

¹⁵ Cañizares, in the passage already quoted, states that the Indians living on Carquinez Strait in 1775 went fishing on their tule rafts and that they presented him with several species of fish, among them the salmon. See *The March of Portolá*, p. 66.

¹⁶ Mus. no. 1-9142 is a possible exception. But the encircling element in this case is a sharp incision rather than a shallow groove. For an illustration, attention is called to Moorehead, *op. cit.*, p. 277, fig. 415—1: specimen also from Middle California. The collection contains in addition a spherical stone (diam. 1¾ inches) that bears evidence of once having been provided with a sharply incised groove (Mus. no. 1-9143).

in this place. They are simply either angular or slightly water-worn pebbles of any chance shape, thin and flat (pl. 47, fig. 20), oblong, spherical or cylindrical. Two or three of the fourteen available bear some evidence of having been brought into cylindrical and plummet-like shapes by artificial means, but the amount of work done in all but one instance is very small. One of these dressed specimens (no. 1-10644), illustrated by figure 17, plate 47, and another example entirely in the rough (no. 1-10649) have each been provided on the body portion with a series of roughly parallel incisions that circle the objects transversely.¹⁷ This particular feature seems to serve no useful purpose and may therefore be considered ornamental. On this basis the two specimens should perhaps be classed with either pendants or charmstones rather than with sinkers.

The ordinary perforated sinker is in no sense artistically wrought. Its purpose was almost certainly a practical one. The perforation, drilled in every case from opposite sides, is always near the edge or at one end and not, as in many ornamental pieces, near the middle. But the general type ranges in size and shape from the small pendants illustrated on plate 47 to the charmstones to be described in the following section.

Charmstones.—The great variety of forms generally designated charmstones were well represented at the Ellis mound. More than seventy were obtained, the specimens being found only in the upper levels of the deposit. In shape they range from nearly spherical to long, slender forms with more or less pointed ends. Plate 43 illustrates the most characteristic forms. That most of them were intended for suspension is indicated in some cases, as in figures 3 and 6, by asphalt still remaining on one end, this substance sometimes showing actual impressions of the fiber used. In other cases, illustrated by figures 5 and 7, there is a knob or a perforation at one end. In a so-called phallic form, named and partially illustrated by Moorehead,¹⁸ both ends are

¹⁷ A similarly grooved specimen lacking the perforations was found in the mound at Emeryville (see Uhle, *op. cit.*, fig. 8, pl. 12); and others of like form have been obtained at Santa Barbara and the adjacent islands. For illustrations of the latter finds, see F. W. Putnam in the Wheeler Rep. on U. S. Geogr. Surveys west of the 100th Meridian (1879), Vol. 7, pp. 211 and 212, figs. 89, 90, and 91.

¹⁸ *Op. cit.*, p. 281, fig. 421.

supplied with a knob as well as a perforation, as shown in figure 4.¹⁹ The skill and taste displayed in most of these forms are admirable. It should be added that some of the specimens show excellently the triple process by which they were brought into shape. The stone was first worked down by rough chipping or scaling; after that it was pecked, and finally ground or polished. No particular kind of rock seems to have been preferred by the charmstone workers. Examples were found made of steatite, serpentine, sandstone, and rhyolite. In one instance the attempt had been made to dress and fashion a piece of actinolite.

Obsidian Blades, Spear-points, and Arrow-points.—Some excellent work was done by the shell mound people in chert and obsidian. The last-mentioned substance appeared to be absent from the eastern portion of the mound, but in the vicinity of the trench it was present in tolerably well-worked condition from the top of the mound to the bottom. Plate 44 illustrates all the various forms obtained.

The finest pieces found were some large double-pointed obsidian blades, the largest of which (figure 6 of plate 44) measured nine and one-half inches in length. Two such, with several charmstones and two pipes, were found with the painted skeletal remains of a large male (no. 149, indicated on plate 50). With the group burial in the trench were found several similar but smaller specimens more like those shown in figure 8. In this place there were also obtained several triangular pieces of obsidian (fig. 15) measuring, some of them, four and five inches in length. The facets on several of these appear to be ground smooth; and in the specimen figured, flaking has been begun along both sides of one of the angles, as if the intention of the maker was ultimately to fashion a spear-point. If this was not the real purpose of these, it is difficult to imagine that they could have been used for anything but drilling, and for such they seem too blunt. It is of course entirely possible that they had no specific use.²⁰

¹⁹ Mus. no. 1-10641 has a knob at one end only; and the protruding portion of this element (which is precisely like the knob on fig. 4) has been ground away on two opposing sides.

²⁰ The Indians on the Hupa Reservation are known to have employed two such pieces of obsidian in removing the beard.

Scattered about at various levels in the mound were also found numerous smaller specimens of obsidian. In size and outline these vary considerably. The largest, like figures 3, 4, 5, 11, and 14 of plate 44, were presumably spear-points; while figures 1, 9, and 10 show slightly different forms of stemmed arrow-points. As may be observed on figures 7 and 9, these obsidian implements were sometimes finely serrated.

Besides working obsidian, the Ellis mound people sometimes tried other closely allied rock substances, such as flint, chert, and quartz. Some of these attempts are illustrated by figures 2, 11, 12, 13, and 14 of plate 44, which show clearly enough that they were not so easily worked as obsidian. The specimen numbered 14 is made from a chocolate-colored substance resembling a very hard slate.

Figures 1, 2, 3, and 4 on plate 44 were found at various but not absolutely certain depths below the ground-water level.

Cylindrical Stones, New Forms.—Figures 9 and 10 on plate 43 show examples of a number of small, smoothly-worked stones that were found in the Ellis mound. These objects are nearly equal in size, but they vary somewhat in form; some, like figure 9, being cylindrical, while others, like figure 10, have different diameters at opposite ends and resemble in general outline an ordinary cork. The squarely cut ends vary, in that some are true planes while others are slightly concave. Their use can scarcely be surmised.²¹ It may be that they are simply sections of broken charmstones ground smooth at the ends.

Figure 9 is almost cylindrical with slightly rounded edges. It measures $\frac{7}{8}$ of an inch in length and has a diameter of $1\frac{1}{8}$ inches.

Figure 10 is not absolutely symmetrical but it is about $1\frac{5}{16}$ of an inch long, with a diameter measuring on the average $\frac{7}{8}$ and $1\frac{5}{16}$ of an inch respectively.

Pipes.—The most remarkable of the new forms found in the mound were probably the two or three steatite pipes shown on plate 45. Figure 3 was found with the group burial in the trench, and is a small cup-shaped specimen with a perforation

²¹ Two different suggestions have lately been made to the writer regarding the purpose of these specimens. One is that they were used as labrets, and the other that they were used as rests or anvils on which to crack nuts and acorns.

through the bottom. There is no evidence that it was used for smoking, other than its general resemblance to pipes in use by some of the modern Indians.

The bowl is $\frac{15}{16}$ of an inch high, and measures $1\frac{1}{16}$ inches in external diameter at the top. The rim is $\frac{1}{16}$ of an inch through and thickens gradually towards the bottom, which measures $\frac{3}{16}$ of an inch at the perforation. The perforation itself is $\frac{3}{16}$ of an inch in diameter, measured at the bottom, but it widens slightly toward the bowl. The bowl was worked out by a revolving drill or some other implement manipulated in a similar manner.²²

The other two pipes, *i.e.*, figures 1 and 2 on plate 45, were taken with the painted skeleton mentioned above. These specimens are about three and one-half inches long. One of them, figure 2, is notable for its shiny, black polish, and strongly resembles a bottle neck, even to the extra band at the smaller end.²³ The other specimen presents the natural color of the smoothly ground stone, and is further distinguished by a thin flange or collar close to the smaller end. Both are thin-walled, and represent on the whole rather skilled workmanship. The method of perforation is a little uncertain, but the specimen shown by figure 2 seems to have been drilled from opposite ends by some revolving device; figure 1, while it may originally have passed through the same process, has since been enlarged by a lengthwise rasping stroke. From the condition of the smaller end of the bore it seems probable that figure 2 had a mouthpiece of bone or wood inserted, similar to the pipes found at Santa Barbara and on the islands off the coast of Southern California.²⁴

Figure 1 is $3\frac{1}{8}$ inches long, about $\frac{7}{8}$ of an inch in external diameter at the larger end, and tapers to about $\frac{1}{2}$ of an inch at the smaller. The collar is situated $\frac{5}{8}$ of an inch from the smaller end, is $\frac{1}{16}$ of an inch thick at the edge and increases to $\frac{1}{8}$ of an inch next the body of the pipe. The extreme diameter of the collar is $\frac{7}{8}$ of an inch, the same as the greatest external diameter of the tube. The bore is $\frac{3}{8}$ of an inch at the smaller end and continues almost uniform for two inches forward and then gradually widens to $1\frac{1}{16}$ of an inch.

²² Mus. no. 1-10684 is a specimen very similar in outline, but has a shallow bowl carved out in each end. The two bowls are connected by a perforation drilled through the center of the piece.

²³ Mus. no. 1-4552 is a specimen of the same general form recorded as obtained, about 1870, six feet below the surface near Vallejo.

²⁴ See Moorehead, *op. cit.*, pp. 239-240, and also F. W. Putnam in the Wheeler Reports upon the U. S. Geogr. Surveys west of the 100th Meridian, Vol. 7, pp. 125-134.

Figure 2 is $3\frac{5}{8}$ inches long, has diameters respectively $1\frac{5}{16}$ of an inch at the larger end and $1\frac{1}{16}$ of an inch next the band; the band portion being itself $\frac{3}{4}$ of an inch. The bore at the smaller end is $\frac{7}{16}$ of an inch. It decreases in the course of one inch to a diameter of $\frac{1}{4}$ of an inch, and then gradually widens to about $\frac{3}{4}$ of an inch.

There remains to observe that while these pipes are perhaps unique as regards precise form, they are essentially of the type found in the mounds on the Pacific Coast from Puget Sound to Southern California.²⁵ The type in fact is still in use among the Coast Indians, as for example the Hupas of Northwestern California.²⁶

IMPLEMENTS OF BONE AND ANTLER.

Awls and Needles.—Plate 46 illustrates various forms of bone implements found in the Ellis mound. The most common type was the awl, which occurred chiefly in the upper part of the mound, but samples of which were found down almost to the ground-water line. Normally these awls, as indicated by figures 4, 5, 9, and 10, are four or five inches long and are made from one of three specific limb bones of certain ungulates. The neatest and most ordinary form, still in use among present day Indians, is a somewhat flattened implement made from either end of the lateral half of a metapodial (figs. 9 and 10). Sometimes a slightly different form is made by splitting the bone a second time, giving a small triangular cross-section (fig. 4). Occasionally the distal end of the tibia was used, but this bone does not split so regularly. The anconeal process of the ulna (fig. 5) was also quite frequently used, as it has been by shellmound people in many parts of the world. Many of the awls still retain a beautiful polish.

One noticeable peculiarity about many of the awls from the Ellis mound is a longitudinal groove worn on either or both of the flat sides. These grooves, partly shown by figures 5 and 10, are sometimes worked clear through the handle, thus producing

²⁵ Harlan I. Smith, *Shellheaps of the Lower Frazer River*; *Mem. Am. Mus. Nat. Hist.* (1903), vol. 4, p. 181. By the same author, in the same series, see also vol. 2, *Archaeology of the Thompson River Region* (1900), p. 429.

²⁶ P. E. Goddard, *Life and Culture of the Hupa*; *Univ. Calif. Publ. Am. Arch. Ethn.* (1903), vol. 1, pp. 36-37.

in it a long, narrow slit. Whether this feature is due to use or was deliberately made for some special purpose does not appear.

Of finely pointed implements there were also found some slender needles or bodkins, with and without eyes,²⁷ measuring eight or nine inches in length (fig. 8). There are also in the collection some stouter implements with duller points, made sometimes from antlers, and sometimes from the penis bone of the sea-lion. No elkhorn wedges were found.

Bone Blades.—Some fragmentary implements of unknown use were found with the group burial in the trench (Burial no. 82, etc.). They are examples of thin bone blades, often a foot or more in length, that curve transversely like a shoehorn and are sometimes perforated at one end.²⁸ Only two broken and decayed specimens were obtained at the Ellis mound and these are very similar to the one figured by Dr. Uhle from the Emeryville mound.²⁹

A remarkable specimen of this type is figured on plate 46, figure 7, a longitudinal curving blade with a rounded point. The specimen is 6 inches long, $\frac{5}{8}$ of an inch across at the broad square-cut end, and only $\frac{1}{16}$ of an inch thick. It is white and polished like ivory, although it was found in the sea wall about eight feet below the surface. But for its curve it might serve admirably as a paper knife.³⁰

Notched Bones.—Figure 6 on plate 46 shows a sample of the peculiarly notched scapulae illustrated by both Dr. Uhle³¹ and Professor Moorehead³² as occurring in other parts of California. The specimens found do not, however, give any further clue to the real purpose of these implements.

²⁷ The writer found no specimens provided with eyes, but Mr. Ellis has (or had) two or three examples of this kind, said to have been found in the old excavation. Their exact occurrence cannot be established beyond the certainty that they were found above the water line.

²⁸ A specimen was lately found in one of the shellmounds in Alameda that measured about 18 inches in length, 2 to $2\frac{1}{2}$ inches in breadth and somewhat less than $\frac{1}{8}$ of an inch in thickness.

²⁹ *Op. cit.*, pl. 8, fig. 5.

³⁰ Fig. 3, another specimen of a bone blade, was entered on the plate by mistake. It was found by the writer in the Emeryville mound, and is probably an arrow-point.

³¹ *Op. cit.*, pl. 9, fig. 17.

³² *Op. cit.*, p. 236, fig. 363.

Bone Whistles.—A unique find was that of a number of ornamented bone whistles, some of which are illustrated by figures 10 and 11 of plate 45. These occurred well down in the mound with the large group burial. On first being uncovered the writer saw one set, consisting of six or eight, lying side by side, as if they might have been a connected series like the Pan's pipe. The individual instruments are tubular bird bones of varying lengths and diameters. About midway they are provided with a circular vent opposite which, on the inside, is placed a lump of pitch or asphaltum sloping off in either direction. Some specimens are also more or less decorated on the outside with small disk beads set in asphaltum.

Fork-like Bone.—Among the new forms of bone implements there is shown by figure 1 of plate 46 a fork-like bone about four inches long. Part of the handle is missing. The specimen, found at a depth of twelve feet, bears a suggestive resemblance to some of the combs figured by Harlan Smith³³ from the shellmounds on the Lower Frazer River and to others figured by Nelson³⁴ from the Eskimo about Behring Strait. Professor Kroeber thinks it resembles a ceremonial implement sometimes used by the modern Indian girl on the occasion of her initiation into womanhood, when for some time she may not touch her head directly with her fingers.

Barbed Bone.—A second form not noticed before, at least in the shellmounds of the bay region, is illustrated by figure 2, plate 46. It is simply a piece of strong, split limb bone, pointed at one end and provided with a barb on one side. Excepting for a longitudinal curve it might readily be taken for a harpoon point of the common North Pacific coast type.

Shuttle-shaped Implement.—Perhaps the most interesting of the new forms of bone work found in the Ellis mound is illustrated by the accompanying text figure.³⁵ The object is difficult

³³ *Op. cit.*, Vol. IV, p. 177.

³⁴ Nelson, E. W., *The Eskimo about Behring Strait, 18th Ann. Rep. Bur. Ethnol.* (1896-7), p. 57.

³⁵ The Museum specimen, no. 1-11186, is much decayed and in a very imperfect condition. The illustration is made from a slightly different specimen recently found in one of the Alameda shellmounds, and by courtesy of the custodian, Mrs. M. H. Krautle, Librarian of the Alameda Public Library.

to describe in words; but in size and general outline it bears some resemblance to an ordinary sewing machine shuttle. Although made from exceedingly hard bone the carving has been done with great precision; every angle is sharp and definite, the curvature is even and the entire surface is smooth or semi-polished.



Fig. 2.

The specimen figured is $1\frac{7}{8}$ inches long and the greatest diameter of the partly rounded end is $\frac{5}{8}$ of an inch, exactly twice that of the stem portion remaining where a transverse groove has been cut into it from three of the sides. The object is asymmetrical, the side of it not affected by the transverse groove being straightened and flattened somewhat. The rounded portion comes to a definite though blunt point; and the angular portion, which is made of four plane surfaces (two that are parallel and two that approach each other), is cut off squarely; the end being itself a perfect square measuring $\frac{1}{4}$ of an inch across.

The use of such an object can scarcely be surmised. Its general nature as well as the workmanship it reveals is strongly suggestive of Alaska and Eskimo culture. The amount of work required to fashion it, and the care with which it has been done, seem to indicate that the specimen had some very definite function; and inasmuch as it does not appear to represent any animal and possesses no decoration of any kind, it may be assumed that its purpose was strictly utilitarian.

INDICATIONS OF POTTERY.

In two instances during the excavation clay was met with, once in a raw and once in a baked condition, that showed contrived form. Museum no. 1-13380 was a mass of burnt clay, found, partly shattered by the plow, at a level about three feet below the surface. Nothing suggestive can be made by trying to fit the remaining fragments. They are well-burnt although hardly of the proper sort of clay for good vessels. On one side some of the pieces present a distinctly smooth and curved surface, while the other side is marked by the lines of some vegetable fiber pressed against the clay in its raw condition. The other find is no. 1-13398, which was obtained about ten feet below the surface of the mound. It consists of some fragile bits of raw,

bluish clay mixed with finely broken shell and which, when exposed by the scraper, had the form of a bowl. This bowl as originally observed, with only the rim cut away, was about twelve inches in diameter and probably about four inches deep. The thickness of the bowl increased from the rim towards the bottom, the respective measurements being approximately one and one-half and three inches. At best such a bowl or dish could have served only as a stationary receptacle. It fell in pieces on removal.

INDICATIONS OF TEXTILE WORK.

The direct evidence of any textile art practiced by these mound people is even more meager than the indications of their work in clay. At the same time it is difficult to imagine the purpose of the numerous awls and needles in the upper portion of the mound unless they were used in making baskets or in preparing clothing of some sort. The only direct evidence of the presence of textile work consists of some thin layers of charred or blackened organic material showing definite indications of pattern work. It must be stated, however, that these indications of possible fiber work occurred very near the surface.

UTENSILS ADAPTED FROM SHELLS.

Aside from their use in making ornaments, sea-shells seem to have been little used by the occupants of the Ellis mound. Strictly speaking, there is no evidence that these people ever made use of shells for anything but ornaments; at the same time, the repeated occurrence, with human remains, of large specimens of abalone shells points to their probable adaptation as receptacles. They might well serve the purpose of dishes although the line of apertures extending across the deeper part of the shell appears not to have been plugged up with asphaltum or any other non-perishable substance, as was the practice in Southern California. Aside from these grave-finds of abalones, a number of large, heavy *Tapes* shells were obtained, which it would seem might have been used for various household purposes.

AESTHETIC ATTAINMENTS.

In the foregoing descriptive review of the remaining evidences bearing on the material culture of the Ellis mound people, little reference has been made to their exhibition of artistic instinct. Ornaments, as such, are few; and what may technically be termed decoration is a rarity. Nevertheless, were even all direct evidence of taste lacking, it might still with justice be urged that these people showed a fine sense of form, particularly in the making of charmstones and of obsidian implements. Many of the former exhibit most pleasing curves and are as symmetrical as if they had been turned on a lathe; while the latter, usually symmetrical in outline, often have their varying and beautiful forms worked out in most delicate detail, far beyond utilitarian requirements. Mention has already been made of beads, pipes, and decorated musical devices, each of which surely suggests a people relatively advanced in the primitive culture stage.

One of the characteristic methods of decoration, employed quite extensively by the California Indians, especially in the southern part of the state, was to fasten the decorative elements by means of asphaltum. It is interesting to find that the same method was used for a long time by the prehistoric peoples of the bay region. This fact is perhaps best illustrated by some purely ornamental objects found by Dr. Uhle³⁶ at Emeryville, but the bone whistles (pl. 45, fig. 10) are fair samples of this work.

After all is said on the matter of artistic bent, it must be admitted that the attainments of these prehistoric peoples of the San Francisco Bay region fall far short of that recognized in the mound culture represented on the coast of Southern California and the adjacent islands. With the peoples of the San Francisco Bay region art and utility did advance hand in hand from the beginning, but the range of expression, especially in shell and stone, was comparatively limited.

Shell Ornaments.—Some of the ornaments used by these people were made from sea-shells. Plate 45 shows four of the forms obtained, and two additional forms may be seen in figures

³⁶ *Op. cit.*, pl. 9, figs. 8, 9, 10, and 11.

1 and 2 on plate 47. These six forms are however either common beads or simple pendants, there being no such quantity or variety of shell-work as in the Santa Barbara region or in the islands off Southern California.

Figure 5 (pl. 45) is a fragment of perforated abalone shell. This type of ornament occurs in both circular and quadrilateral forms, is provided with either one or two perforations near the center, and is sometimes ornamented with incised straight lines near the margin.

Figure 6 (pl. 45) shows some broken ends of perforated abalone shell pendants. These are sometimes two or three inches long and taper to a point opposite the perforated end. The margin is occasionally ornamented by criss-cross lines or as in the other type above mentioned.

Figure 7 (pl. 45) shows examples of small concavo-convex disk beads made apparently from *Olivella* shells. Not many of these characteristic California beads were obtained in the mound; and those found occurred with human remains.

Figure 8 (pl. 45) is the only sample of an entire *Olivella* shell found in the mound. It is perforated at the apex and strings readily.

Figure 1 (pl. 47) is a nearly circular pendant beautifully iridescent and probably of abalone shell, though it is unusually thin. The piece is concavo-convex, measures about $2\frac{1}{2}$ inches in diameter and is provided with a perforation near the edge.

Figure 2 (pl. 47) is a fragment of a washer-like ornament made of abalone shell. It is a nearly flat disk $1\frac{1}{2}$ inches in diameter with a perforation about $\frac{1}{2}$ of an inch across. The outer margin, on one side, is marked at more or less regular intervals with short incised lines. This singular specimen was obtained from Mr. Ellis, who cannot vouch for its exact occurrence.

In addition to these illustrated specimens there was obtained a single example (no. 1-13024) of a small conical shell, *Acmea patina*, which may have had the apex artificially ground away. The perforation at any rate made it ready for suspension; and shells of this sort are said to have been used by late Indians of the California Coast as a "drop" for ear-rings.

Stone Ornaments.—From Mr. Ellis were also obtained quite a number of small or delicately worked stone implements that could hardly have had any other purposes than to serve as ornaments. All the different forms of this lot are illustrated on plates 45 and 47. Among them is a fragment of a circular disk or ring, a piece of perforated mica, and a whole series of pendants. The forms of these pendants, it will be observed, are circular, triangular, and oblong. Their lengths vary from three-fourths of an inch to two and one-half inches, and their weights

range from the merest fraction of an ounce to slightly over two ounces.

Figure 3 (pl. 47) is a form of ornament similar to the washer-like shell disk described above (fig. 1). Only a small arc of the piece is present; but it indicates a disk, about $\frac{3}{16}$ of an inch thick, which had a diameter of 3 inches, and a large circular hole in the center measuring exactly 1 inch across. Near the outer edge there is a small perforation drilled from opposite sides. The specimen is made of mica-schist.

Figure 4 (pl. 47) is a piece of mica with a single small perforation through the center.

Figure 5 (pl. 47) is a circular stone about 1 inch in diameter, lenticular in cross-section, with a small perforation near the edge. The convex surfaces are ornamented by a number of straight, incised lines that, on one side, cross the center, forming true diameters. The specimen is made from a soft, slate-colored stone which readily takes a shiny, bluish-black polish.

Figure 6 (pl. 47) is a triangular pendant also polished a beautiful black. It measures less than one inch from the smallest angle to the opposing side, and is lenticular in cross-section. The perforation is near the apex of the smallest angle; and the opposite ends of this bore are connected by a slight incision or notch which runs over the apex-edge of the stone as if to keep the suspending thread in place.

Figure 4 (pl. 45) is the only specimen of this lot of stone ornaments found by the writer. It is a fragment of steatite that may have served as a lanceolate pendant. Being 1 inch wide and having a maximum thickness down the center of $\frac{3}{16}$ of an inch, it is lenticular in cross-section. The perforation is drilled from opposite sides, and the portion of the stone between the perforation and the shallow notch crossing the end is polished almost black from wear of the string by which the ornament was suspended.

Figure 7 (pl. 47) is a comparatively long and slender pendant-like stone. It is roughly oval in cross-section and is provided at one end with a groove for suspension.

Figure 8 (pl. 47) is a fragment of a pendant of rather hard, slate-like rock. It is rectangular in cross-section.

Figures 9, 10, 11, 12, 13, 14, and 16 (pl. 47) are somewhat similar pendants made of a very soft greenish stone, probably a serpentine, that takes a slight polish. Some of them are sharp cones and others are roughly lozenge-shaped.

Figure 15 (pl. 47) is a peculiar boat-shaped specimen, which is not provided with a perforation.

Figure 19 (pl. 47) is a roughly bottle-shaped specimen, somewhat heavier than any heretofore described. It weighs about $1\frac{1}{2}$ ounces.

Figure 18 (pl. 47) is the largest specimen grouped with this class. It is made from soft limestone, and is oblong in general outline, with a nearly oval cross-section. Some larger specimens of this form occur in the collection, and these it would be difficult to classify. They might have been either pendants or charmstones.

Figures 17 and 20 (pl. 47) are specimens already described in connection with perforated sinkers. Figure 17 might be classified as one of

three things: a pendant, a sinker, or a charmstone. Figure 20 is a roughly angular bit of stone, $1\frac{1}{8}$ inches long and a half-ounce weight, provided with a perforation near the smaller end. The specimen had doubtless a useful rather than an ornamental purpose.

It must be stated that none of the forms figured on plate 47, excepting no. 1, were found by the writer. They were obtained from Mr. Ellis, who picked them up from time to time on the beach in front of the mound. Their occurrence can therefore not be accurately established beyond the certainty that they came from the portion of the mound above the ground-water line.

Bone Ornaments.—Bone seems not to have been used to any great extent for decorative purposes. Only a few sections of tubular bird bones were obtained, mostly from the loose upper portion of the mound. The larger of these specimens may have been intended for whistles similar to those illustrated on plate 45; but the shorter pieces were hardly intended for any such purpose. They might have been strung in some way and thus served as beads; though their scarcity and manner of occurrence do not suggest that usage. One specimen, plate 45, figure 9, is of interest because it is ornamented by two clean-cut spiral incisions running in opposite directions; and some of the diamond spaces produced by these spirals are further embellished by criss-cross work.³⁷

SUMMARY AND CONCLUSIONS.

The Ellis Landing shellmound is situated on the northeast shore of San Francisco Bay, upon the submerged portion of a large fan or delta of geologically recent origin. It rests upon solid gravel, but is more than half buried in fine silt, which attains a depth about it ranging from eleven to sixteen feet. Above the surface of this silt, now covered with vegetation, the high tides rise at times more than two feet; so that it is fair to assume that the region has sunk at least eighteen feet since the ancient inhabitants began to accumulate the refuse deposit. The precise nature of the geological movement recorded by the mound is difficult of determination; but it seems to have comprised

³⁷ For similar pieces from other parts of California see Moorehead, *op. cit.*, p. 272, fig. 411.

several separate stages, some of downward movement and possibly some of elevation.

The mound is one of the largest of over four hundred deposits of a similar nature that line the shores of San Francisco Bay. It measured originally 460 feet in length, 250 feet in width, and about 30 feet in height. The great volume, approximated at 1,260,000 cubic feet, is estimated to have been accumulating for a period extending over three to four thousand years.

The refuse composing the mound is made up largely of broken shells of the common clam and mussel, but some other species such as the oyster, the cockle, and the abalone are also sparingly represented. To these molluscan remains is added a considerable mixture of ashes, broken rock, pebbles, animal bones, human skeletons, artifacts, etc. The preponderating shell species change, quantitatively, from the bottom of the mound to the top; and there is also a sudden alteration in the structure and general nature of the deposit which indicates a possible gap in the history of the occupancy of the site. The animal bones, which are confined almost entirely to the upper half of the deposit, represent many species, and prove the mound-dwellers to have become in time very successful hunters.

The mound was used from its beginning as a burial place, and doubtless also as a residence site, there being several house-pits in good state of preservation upon it when first examined. The marshy or inundated territory surrounding the refuse heap made it for a long period difficult of access, and seemingly also unfit as a dwelling-place because neither fire-wood nor fresh water was near at hand. Nevertheless the mound has unquestionably been occupied subsequent to its partial submergence; and was no doubt the home of California aborigines at a time not long prior to the discovery and settlement of the country by Europeans.

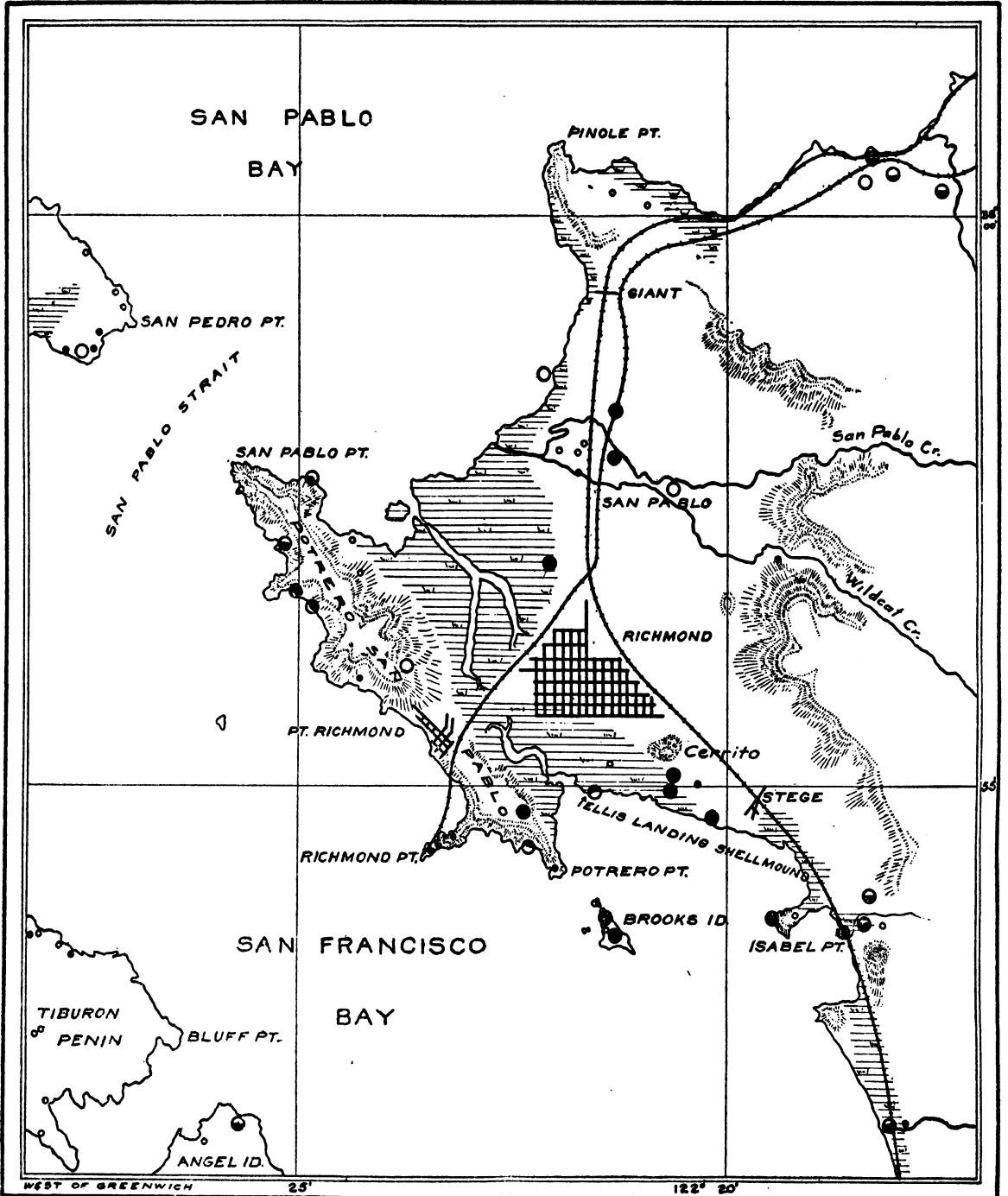
The material culture of the shellmound builders is represented only by a broken chain of evidence. Enough is present, however, to show that though the first people who camped on this site were by no means of the lowest known savage order, their knowledge and dexterity increased at an accelerating pace, as time went on, and this too, we may be sure, without any stimulating impulse from modern civilization. The first inhabitants, however ancient

they may have been, possessed some roughly made stone implements; they prepared vegetable foods; they knew the use of fire; and they painted and buried their dead. The last people to dwell on the mound had, besides a series of exceedingly well-made stone implements, quite a variety of bone tools as well as several forms of ornaments made of bone and shell. There is reason to believe that they tried to fashion vessels and other objects out of clay, and that they made baskets and dressed skins. They were skilled hunters on land and sea, and consequently must have had boats of some sort. The numerous kinds of stone used for implements in later times makes it reasonably certain that the mound people either made long journeys to the coast and also to various interior portions of the country, or had trade relations with those parts. Judging from the generally finished condition of the stone implements in question, it seems probable that these were manufactured at a distance and therefore perhaps not by the shell-mound people themselves.

In concluding it may be well to point out that the same general types of implements prevail from the bottom of the refuse heap to the top. Certain notable additions were made in later times, and the progress towards perfection of manufacture is generally marked; but aside from these normal changes there are no important breaks in the culture represented. This means that if more than one people have lived on the mound, whether these were friendly migrants or disputing enemies, they were all essentially of the same type of culture, and the last occupants of the shellmound at Ellis Landing were probably Indians similar to those that have lived in Middle California within historic times.

EXPLANATION OF PLATE 36.

Map of the San Francisco Bay region in the vicinity of the Ellis Landing Shellmound, showing all the ancient refuse deposits known in this area.



EXPLANATION OF PLATE 37.

Fig. 1.—The Ellis Landing Shellmound at high tide, viewed from near the high land edge of the marsh. Brooks Island to the right. See text, pp. 360, 369.

Fig. 2.—The sea wall of the Ellis Landing Shellmound as it appeared in 1906, before excavation. View looking east. *Cf.* pl. 38, fig. 2.

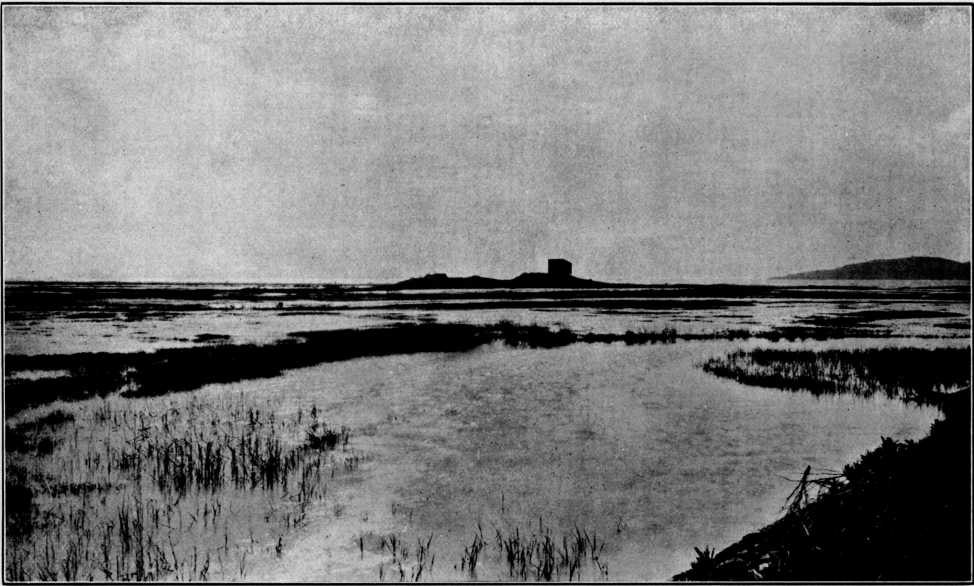


FIG. 1.

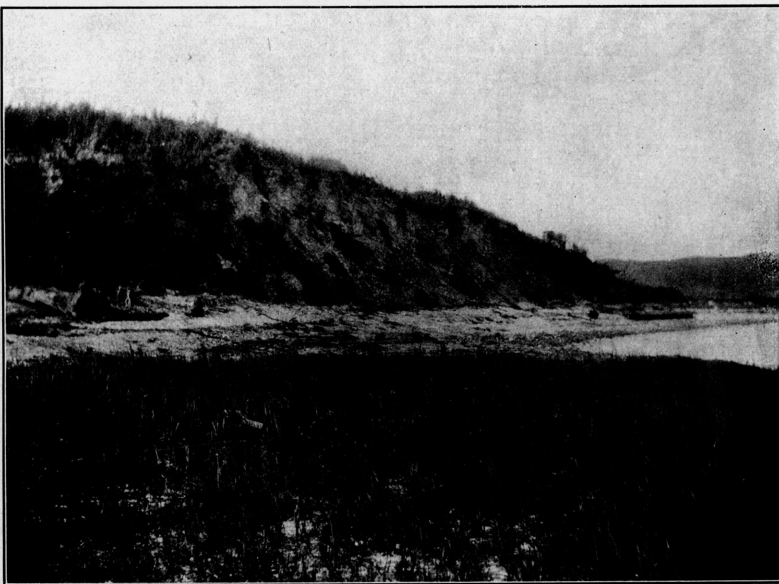


FIG. 2.

EXPLANATION OF PLATE 38.

Fig. 1.—Near view of the Ellis Landing Shellmound, looking seaward, taken after the highest central portion had been removed. Artificial canal in foreground.

Fig. 2.—The Ellis Landing Shellmound after excavation, showing also a portion of the recently made shell bar. View looking west. *Cf.* pl. 37, fig. 2. See text, p. 360.

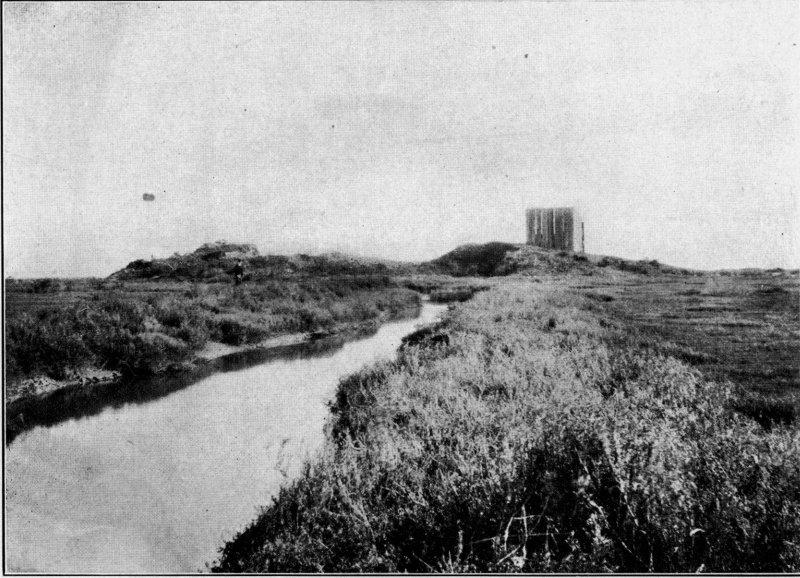


FIG. 1.

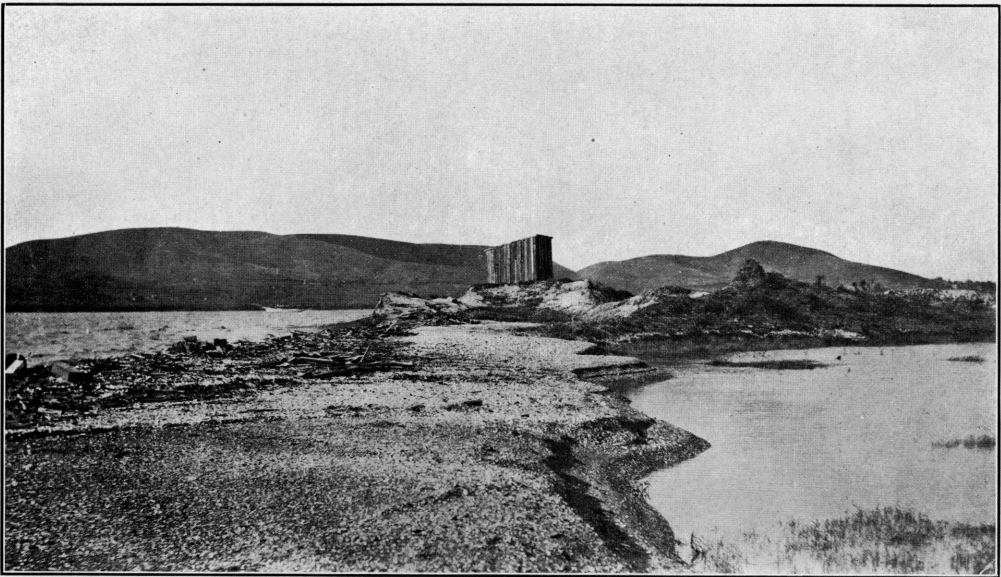


FIG. 2.

View of a portion of the section wall of the trench, showing sudden transition in the nature of the mound composition. See pl. 49, fig. 1, for the place where the photograph was taken. See text, pp. 374-375.



Fig. 1.—Male skull from the Ellis Landing Shellmound, found about two feet below the surface (see pl. 50, no. 205). For profile see pl. 41, fig. 1. Text, p. 384.

Measurements:

Length (glabello-occipital)	183 mm.	
Breadth (lateral maximum)	140	
Height (basion-bregma)	141	approximate
Gnathic— <i>x</i> (basion-alveon)	103	approximate
Gnathic— <i>y</i> (basion-nasion)	104	approximate
Diameter, frontal minimum	91	
Diameter, bizygom. maximum.....	138	approximate
Breadth of nose, maximum	28	
Height of nose	50	

Cephalic Index, 76.50

Gnathic Index ($\frac{x \times 100}{y}$), 99.03

Nasal Index, 56

Fig. 2.—Male skull from the Ellis Landing Shellmound, found eleven feet below the surface and below the high tide line. (See group 230 on pl. 50.) For profile see pl. 41, fig. 2. Text, p. 384.

Measurements:

Length (glabello-occipital)	195 mm.	
Breadth (lateral maximum)	143	
Height (basion-bregma)	142	
Gnathic— <i>x</i> (basion-alveon)	91	approximate
Gnathic— <i>y</i> (basion-nasion)	100	
Diameter, frontal minimum	100	
Diameter, bizygom. maximum.....	147	
Breadth of nose, maximum	25	
Height of nose	52	

Cephalic Index, 73.34

Gnathic Index ($\frac{x \times 100}{y}$), 91 approximate

Nasal Index, 48.07



FIG. 1.

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FIG. 2.

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EXPLANATION OF PLATE 41.

Fig. 1.—Profile view of skull shown in figure one of the preceding plate.
From Ellis Landing Shellmound.

Fig. 2.—Profile view of skull shown in figure two of the preceding plate.
From Ellis Landing Shellmound.



FIG. 1.



FIG. 2.

EXPLANATION OF PLATE 42.

Fig. 1.—Sample specimen of the numerous grooved sinkers (text, p. 387).

Fig. 2.—Miniature mortar (text, p. 385).

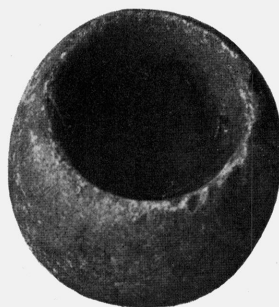
Fig. 3.—Portion of a hammer stone with a mortar-like depression in one side (text, p. 386).

Fig. 4.—Sample of a rubbing stone (text, p. 386).

All figures $\times \frac{1}{2}$.



1



2



3



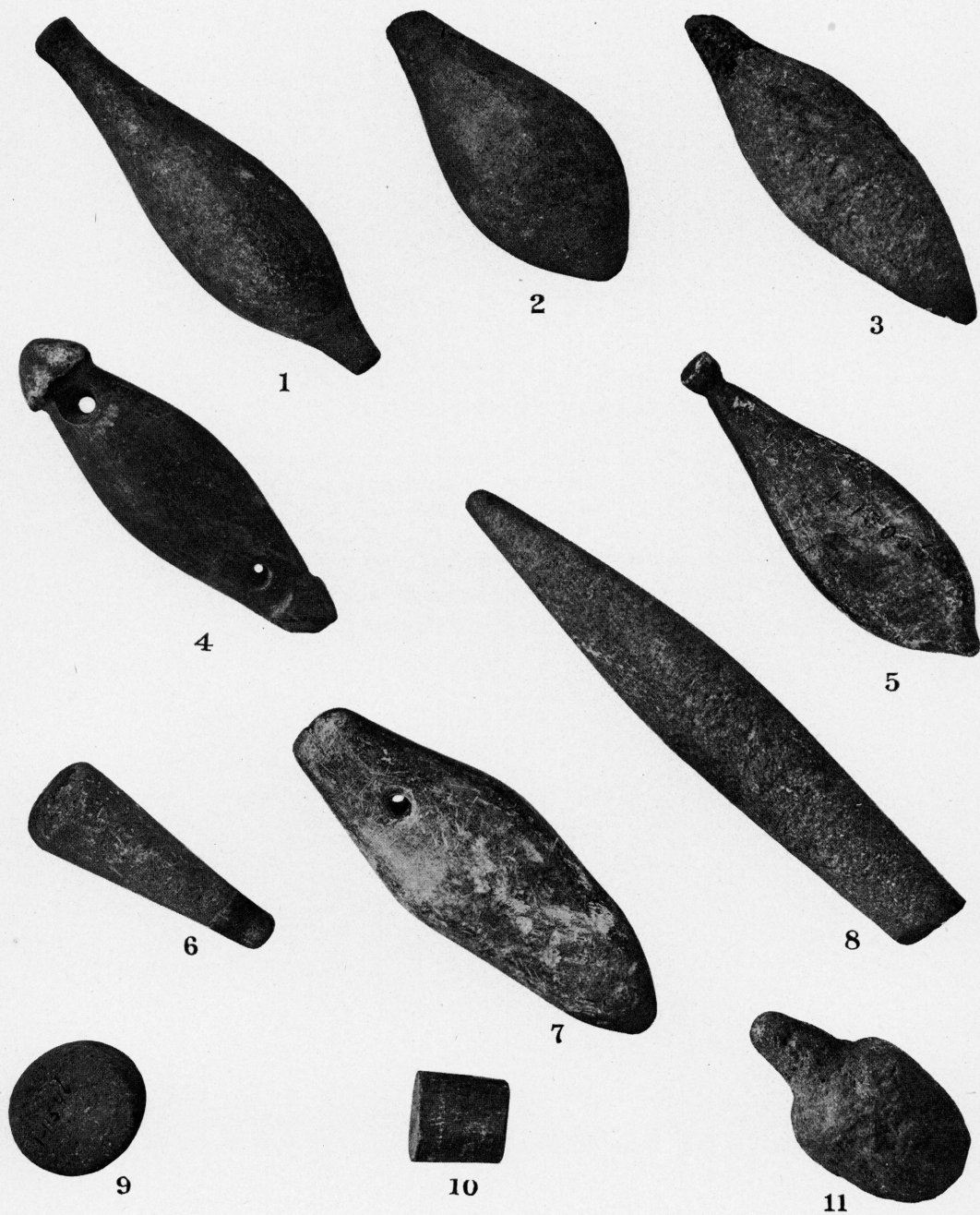
4

EXPLANATION OF PLATE 43.

Figs. 1-8, and 11.—Various forms of charmstones, with knobs or perforations for suspension. Figs. 3 and 6 have asphaltum on the tip ends. Figs. 2, 6, and 8 incomplete. Fig. 11 unfinished. See text, p. 388 *et seq.*

Figs. 9-10.—Cylindrical stones, possibly ear plugs. See text, p. 390.

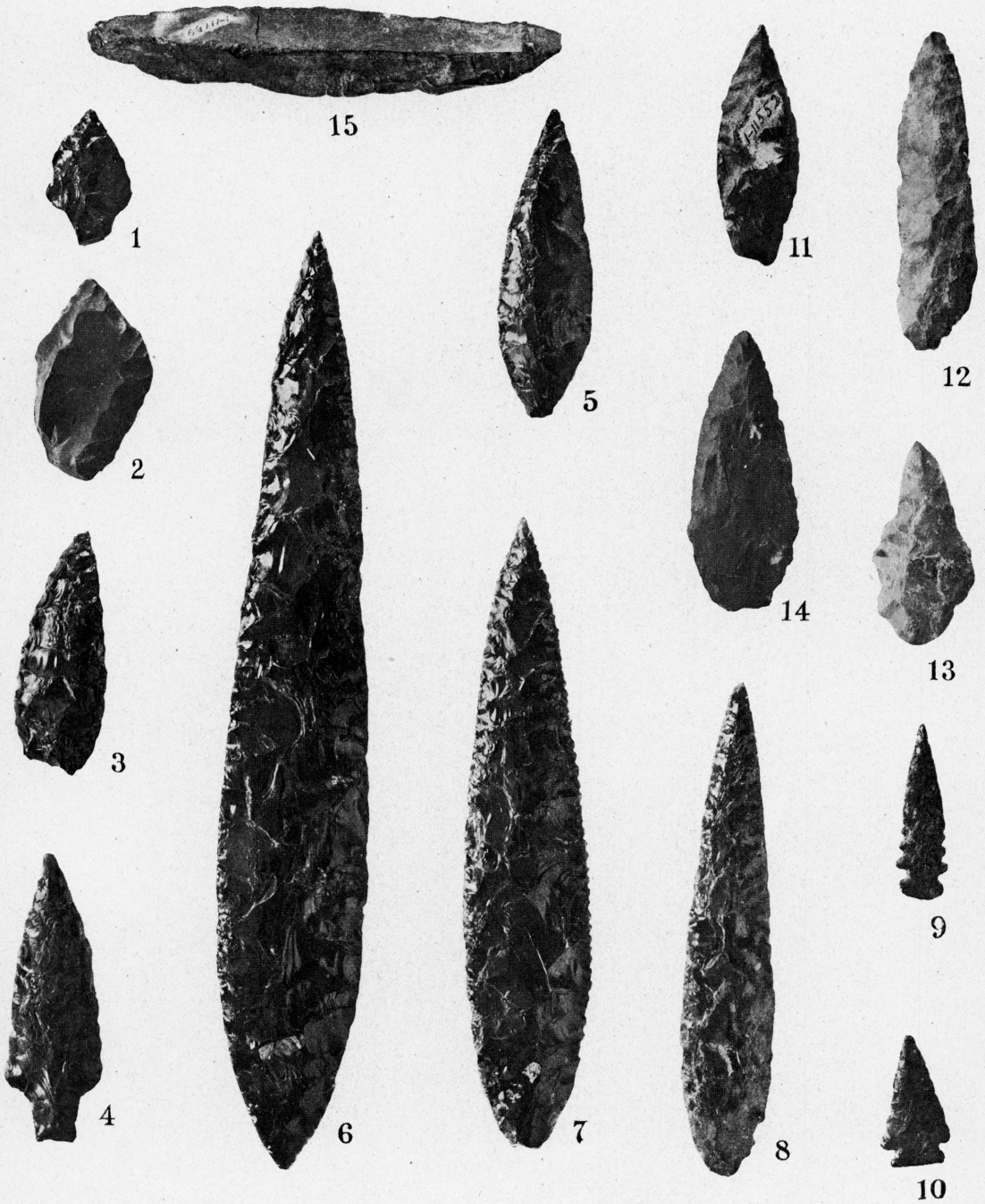
Both figures about one-half natural size.



EXPLANATION OF PLATE 44.

Obsidian and chert implements of various forms and grades of finish.
See text, p. 389 *et seq.*

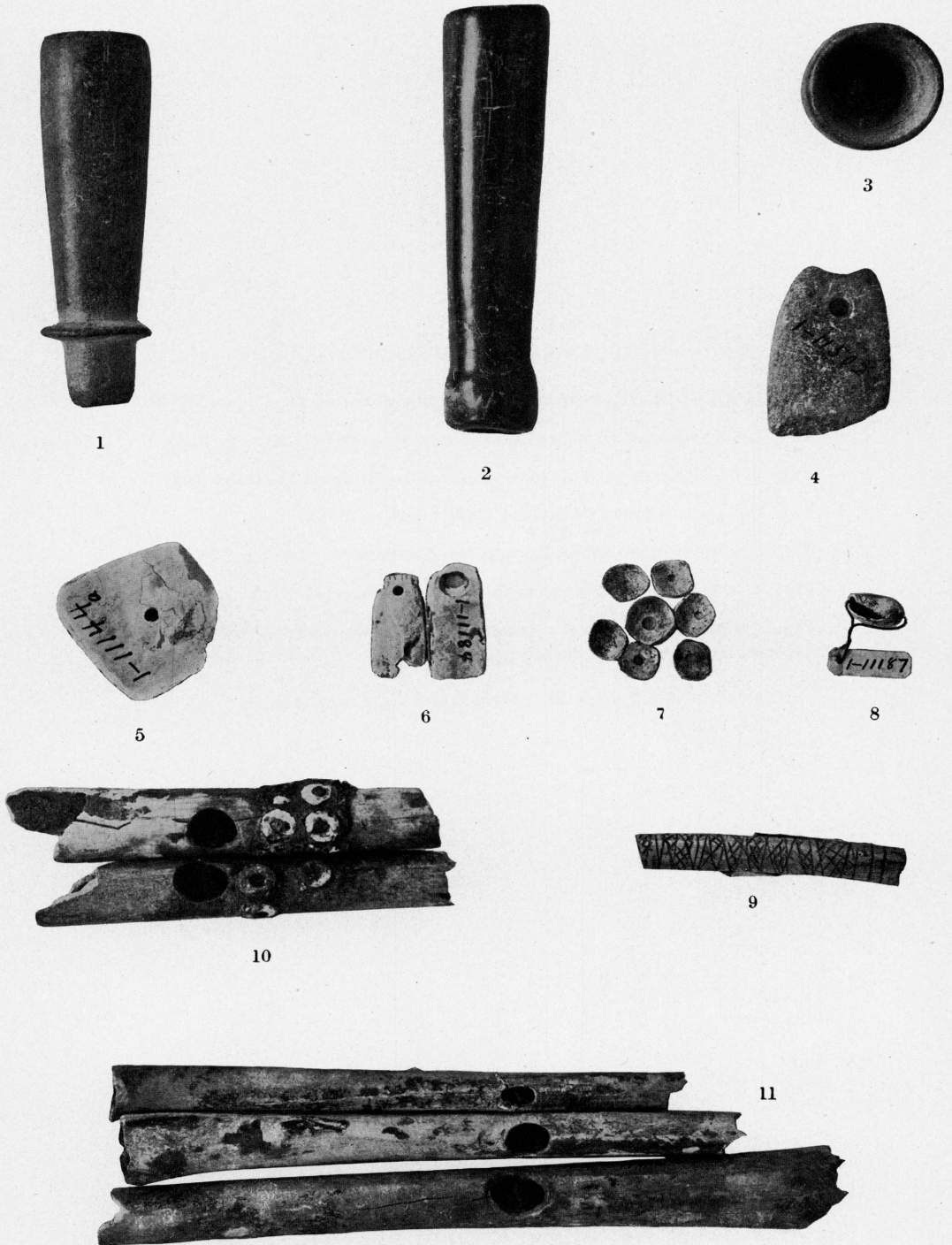
All figures $\times \frac{1}{2}$.



EXPLANATION OF PLATE 45.

- Figs. 1-3.—Pipes of steatite, fig. 2 highly polished (text, pp. 390-391).
 Fig. 4.—Fragment of a perforated stone pendant (text, p. 398).
 Figs. 5-6.—Pendants of abalone shell, fragmentary (text, p. 398).
 Fig. 7.—Disk beads of Olivella shell (text, p. 398).
 Fig. 8.—Perforated Olivella shell used as a bead (text, p. 398).
 Fig. 9.—Tubular bird bone with incised criss-cross work (text, p. 44).
 Figs. 10-11.—Portions of a musical instrument made of bird bones, fig. 10 ornamented with beads (text, pp. 394, 397).

All figures about two-thirds natural size.



EXPLANATION OF PLATE 46.

Fig. 1.—Fork-like bone, incomplete (text, p. 394).

Fig. 2.—Barbed bone (text, p. 394).

Fig. 3.—Bone arrow-point(?). See footnote 30.

Figs. 4, 5, 8-10.—Bone awls of varying form (text, p. 392).

Fig. 6.—Scapula with notched edge (text, p. 393).

Fig. 7.—Bone blade, thin and polished (text, p. 393).

All figures $\times \frac{1}{2}$.



EXPLANATION OF PLATE 47.

Fig. 1.—Pendant of abalone shell (text, p. 398).

Fig. 2.—Fragment of washer-like ornament of abalone shell (text, p. 398).

Fig. 3.—Fragment of washer-like ornament of stone (text, p. 399).

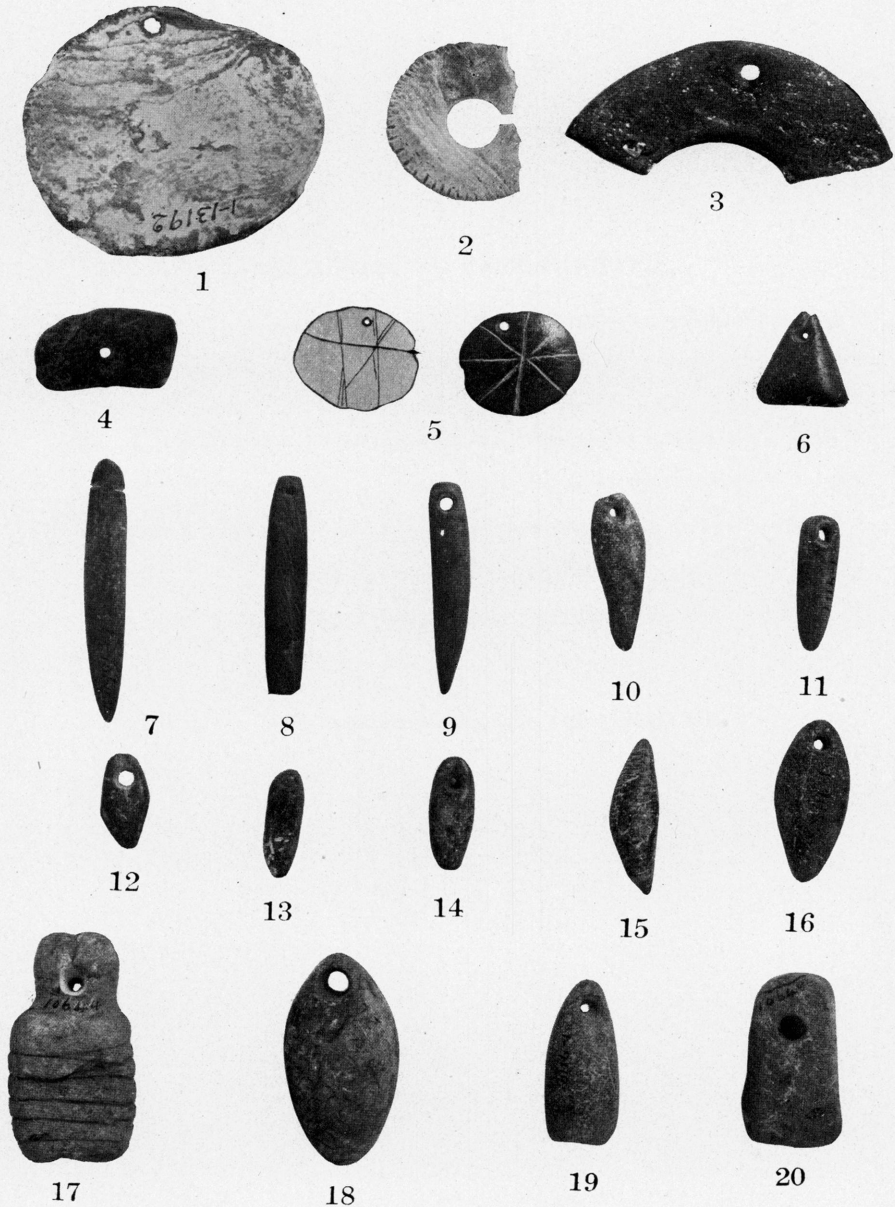
Fig. 4.—Perforated mica pendant (text, p. 399).

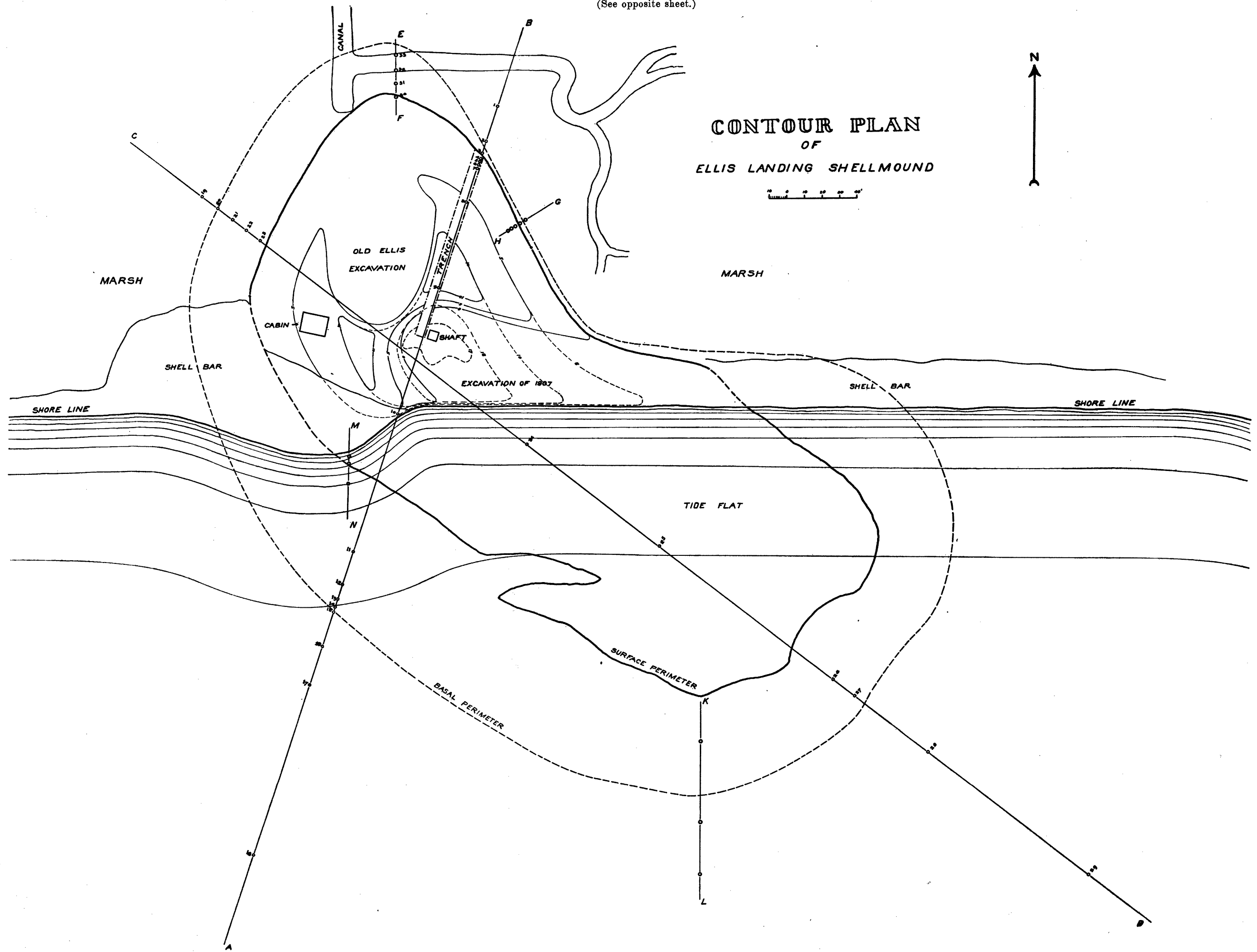
Fig. 5.—Circular stone pendant, obverse and reverse sides (text, p. 399).

Fig. 6.—Triangular stone pendant (text, p. 399).

Figs. 7-20.—Oblong pendants, mostly perforated (text, p. 399, also 388).

All figures about one-half natural size.



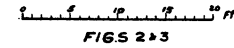
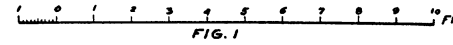


VERTICAL SECTIONS

OF

ELLIS LANDING SHELLMOUND

SCALES



The explanation of plate 49 accompanies the sections of the mound.
(See opposite sheet.)

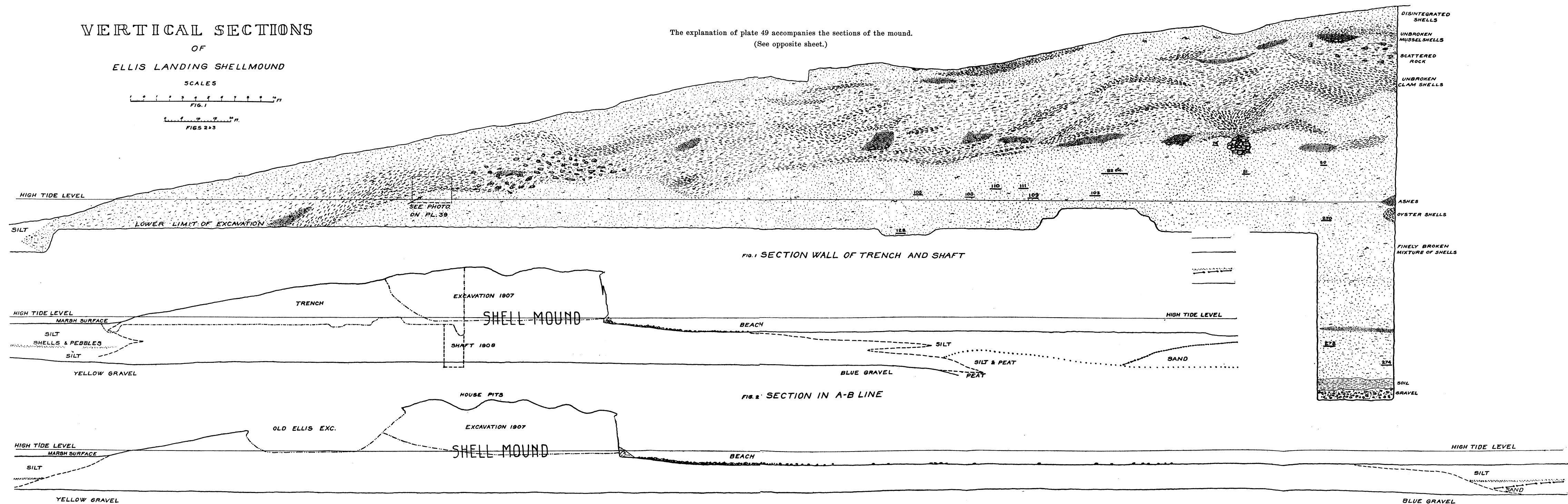


FIG. 1 SECTION WALL OF TRENCH AND SHAFT

FIG. 2 SECTION IN A-B LINE

FIG. 3 SECTION IN C-D LINE

DISINTEGRATED SHELLS
 UNBROKEN MUSSEL SHELLS
 SCATTERED ROCK
 UNBROKEN CLAM SHELLS

ASHES
 OYSTER SHELLS
 FINELY BROKEN MIXTURE OF SHELLS

SOIL
 GRAVEL

HIGH TIDE LEVEL

HIGH TIDE LEVEL

HIGH TIDE LEVEL

HIGH TIDE LEVEL

HIGH TIDE LEVEL

MARSH SURFACE

SILT

SHELLS & PEBBLES

SILT

YELLOW GRAVEL

TRENCH

EXCAVATION 1907

SHELL MOUND

SHAFT 1908

BEACH

BLUE GRAVEL

SILT

SILT & PEAT

PEAT

SAND

OLD ELLIS EXC.

EXCAVATION 1907

SHELL MOUND

BEACH

HOUSE PITS

SILT

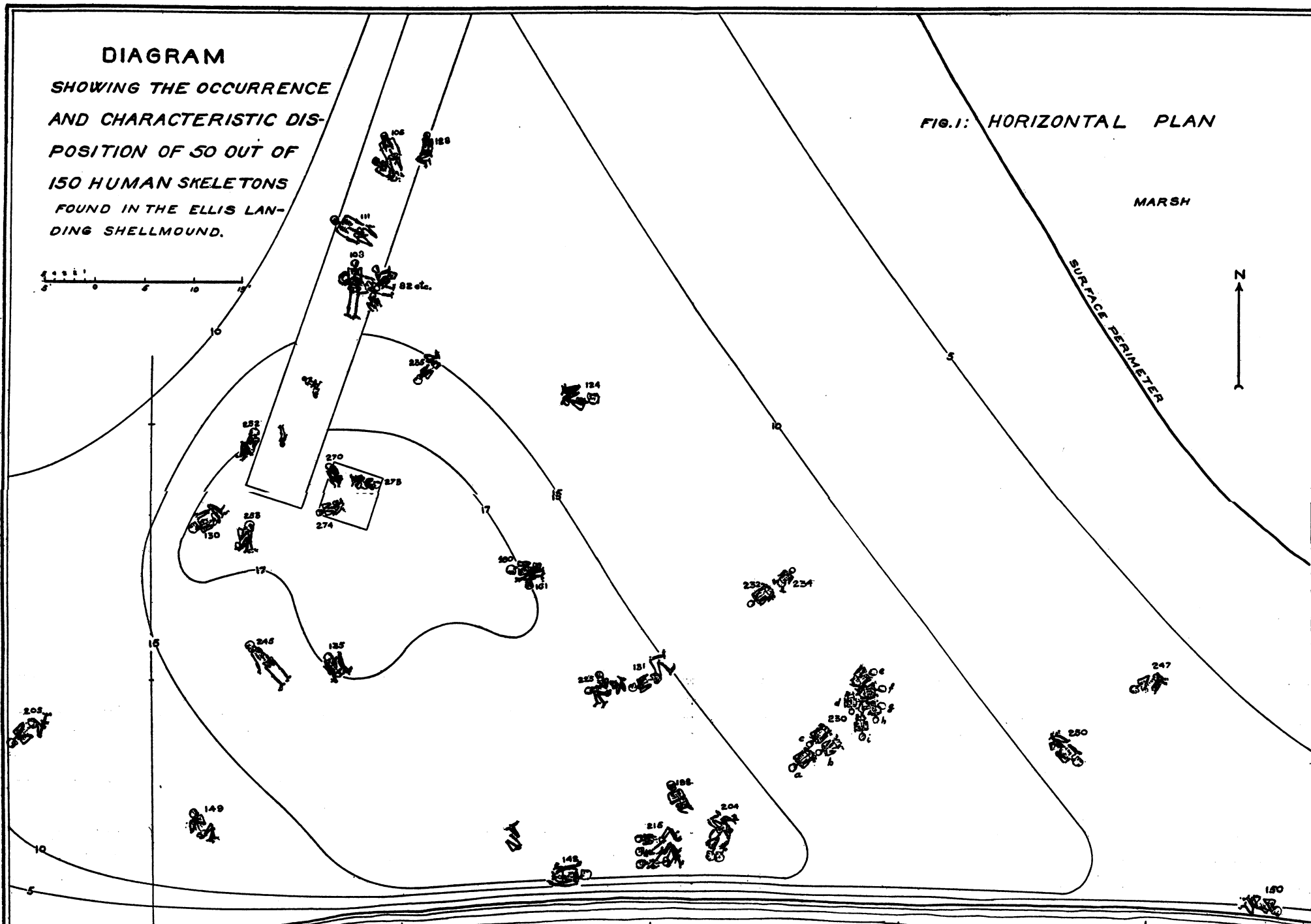
SAND

BLUE GRAVEL

DIAGRAM

SHOWING THE OCCURRENCE AND CHARACTERISTIC DISPOSITION OF 50 OUT OF 150 HUMAN SKELETONS FOUND IN THE ELLIS LANDING SHELLMOUND.

FIG. 1: HORIZONTAL PLAN



BEACH

FIG. 2: VERTICAL DISPOSITION.

