
CASA GRANDE RUIN

BY

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CONTENTS

	Page
Introduction	295
Location and character	295
History and literature	295
Description	298
The Casa Grande group	298
Casa Grande ruin	306
State of preservation	306
Dimensions	307
Detailed description	309
Openings	314
Conclusions	318

ILLUSTRATIONS

	Page
PLATE LI. Map of Casa Grande group.....	298
LII. Ground plan of Casa Grande ruin.....	302
LIII. General view of Casa Grande ruin.....	305
LIV. Standing wall near Casa Grande.....	307
LV. Western front of Casa Grande ruin.....	309
LVI. Interior wall of Casa Grande ruin.....	310
LVII. Blocked opening in western wall.....	312
LVIII. Square opening in southern room.....	314
LIX. Remains of lintel.....	317
LX. Circular opening in northern room.....	319
 FIG. 328. Map of large mound.....	 301
329. Map of hollow mound.....	304
330. Elevations of walls, middle room.....	315

CASA GRANDE RUIN

BY COSMOS MINDELEFF

INTRODUCTION.

LOCATION AND CHARACTER.

The Casa Grande ruin, situated near Gila river, in southern Arizona, is perhaps the best known specimen of aboriginal architecture in the United States, and no treatise on American antiquities is complete without a more or less extended description of it. Its literature, which extends over two centuries, is voluminous, but of little value to the practical scientific worker, since hardly two descriptions can be found which agree. The variations in size of the ruin given by various authors is astonishing, ranging from 1,500 square feet to nearly 5 acres or about 200,000 square feet in area. These extreme variations are doubtless due to difference of judgment as to what portion of the area covered by remains of walls should be assigned to the Casa Grande proper, for this structure is but a portion of a large group of ruins.

So far as known to the writer no accurate plan of the Casa Grande ruin proper has hitherto been made, although plans have been published; and very few data concerning the group of which it forms a part are available. It would seem, therefore, that a brief report presenting accurate plans and careful descriptions may be of value, even though no pretention to exhaustive treatment is made.

HISTORY AND LITERATURE.

The earlier writers on the Casa Grande generally state that it was in ruins at the time of the first Spanish invasion of the country, in 1540, and quote in support of this assertion Castañeda's description of a ruin encountered on the march.¹ Castañeda remarks that, "The structure was in ruins and without a roof." Elsewhere he says that the name "Chichiltieale" was given to the place where they stopped because the monks found in the vicinity a house which had been inhabited by a people who came from Cibola. He surmises that the ruin was formerly

¹ Castañeda in Ternaux-Compans, *Voyage de Cibola*. French text, p. 1, pp. 41, 161-162. (The original text—Spanish—is in the Lenox Library; no English translation has yet been published.)

a fortress, destroyed long before by the barbarous tribes which they found in the country. His description of these tribes seems to apply to the Apache.

The geographic data furnished by Castañeda and the other chroniclers of Coronado's expedition is very scanty, and the exact route followed has not yet been determined and probably never will be. So far as these data go, however, they are against the assumption that the Chichilticale of Castañeda is the Casa Grande of today. Mr. A. F. Bandelier, whose studies of the documentary history of the southwest are well known, inclines to the opinion that the vicinity of Old Camp Grant, on the Rio San Pedro, Arizona, more nearly fill the descriptions. Be this as it may, however, the work of Castañeda was lost to sight, and it is not until more than a century later that the authentic history of the ruin commences.

In 1694 the Jesuit Father Kino heard of the ruin, and later in the same year visited it and said mass within its walls. His secretary and usual companion on his missionary journeys, Mange by name, was not with him on this occasion, but in 1697 another visit was paid to the ruin and the description recorded by Mange¹ in his diary heads the long list of accounts extending down to the present time.² Mange describes the ruin as consisting of—

A large edifice, the principal room in the center being four stories high, and those adjoining it on its four sides three stories, with walls 2 varas thick, of strong argamasa y barro (adobe) so smooth on the inside that they resemble planed boards, and so polished that they shine like Puebla pottery.

Mange also gives some details of construction, and states that in the immediate vicinity there were remains of twelve other buildings, the walls half fallen and the roofs burned out.

Following Mange's account there were a number of descriptions of no special value, and a more useful one written by Padre Font, who in 1775 and 1776 made a journey to Gila and Colorado rivers and beyond. This description³ is quite circumstantial and is of especial interest because it formed the basis of nearly all the accounts written up to the time when that country came into our possession. According to this authority—

The house forms an oblong square, facing exactly the four cardinal points, and round about it there are ruins indicating a fence or wall which surrounded the house and other buildings. The exterior or plaza extends north and south 420 feet and east and west 260 feet.

Font measured the five rooms of the main building, and recorded many interesting details. It will be noticed that he described a sur-

¹An English translation is given by H. H. Bancroft, *Works*, iv, p. 622, note. Also by Bartlett, *Personal Narrative*, 1854, vol. ii, pp. 281-282; another was published by Schoolcraft, *Hist. Cond. and Pros. of Am. Ind.*, vol. iii, 1853, p. 301.

²Quite an extensive list is given by Bancroft (*op. cit.*, pp. 622-625, notes), and by Bandelier in *Papers Arch. Inst. of Amer.*, American series, i, p. 11, note.

³A number of copies of Font's *Journal* are known. Bancroft gives a partial translation in *op. cit.*, p. 623, note, as does also Bartlett (*op. cit.*, pp. 278-280); and a French translation is given by Ternaux Compans, ix, *Voyages de Cibola*, appendix.

rounding wall inclosing a comparatively large area; and nearly all the writers who published accounts prior to our conquest of the country in 1846 based their descriptions on Font's journal and erroneously applied his measurement of the supposed circumscribing wall to the Casa Grande proper.

The conquest of the country by the "Army of the West" attracted attention anew to the ruin, through the descriptions of Colonel Emory and Captain Johnston. The expedition passed up the Gila valley, and Colonel Emory, in his journal, gives a fanciful illustration and a slight description. The journal of Captain Johnston contained a somewhat better description and a rough but fairly good sketch. The best description of that period, however, was that given by John Russell Bartlett, in his "Personal Narrative," published in 1854.

Bartlett observed that the ruin consists of three buildings, "all included within an area of 150 yards." He described these buildings and gave ground plans of two of them and elevations of the principal structure. He also gave a translation of a portion of Font's journal, as well as the previous description of Mange. He surmised that the central room of the main building, and perhaps the whole structure, was used for the storage of corn.

Bartlett's account held place for nearly thirty years as the main reliance of compilers, and it forms today one of the most circumstantial and comprehensive descriptions extant. Other descriptions appeared at intervals of a few years, some compiled from Bartlett and Font, others based on personal observation, but none of them containing anything new, until the account of Mr. A. F. Bandelier, published some ten years ago,¹ is reached.

Mr. Bandelier described the large group, of which the Casa Grande forms a part, and gave its dimensions as 400 meters (1,300 feet) north and south by 200 meters (650 feet) east and west. He also described and gave measurements of the Casa Grande proper and discusses its place in the field of aboriginal architecture. In a later publication² he discussed the ruin at somewhat greater length, and presented also a rough sketch plan of the group and ground plans of the Casa Grande and of the mound north of it. He gave a short history of the ruin and quite an extended account of the Pima traditions concerning it. He considered the Casa Grande a stronghold or fortress, a place of last resort, the counterpart, functionally, of the blockhouse of the early settlers of eastern United States.

In 1888 Mr. F. H. Cushing presented to the Congrès International des Américanistes³ some "Preliminary notes" on his work as director of the Hemenway southwestern archeological expedition. Mr. Cushing did not describe the Casa Grande, but merely alluded to it as a sur-

¹Archaeological Inst. of Amer., 5th Ann. Rep., 1884.

²Papers Archaeol. Inst. of Amer., Amer. ser., iv, Cambridge, 1892, p. 453 et seq.

³Berlin meeting, 1888; Comptes-Rendus, Berlin, 1890, p. 150 et seq.

viving example of the temple, or principal structure, which occurred in conjunction with nearly all the settlements studied. As Mr. Cushing's work was devoted, however, to the investigation of remains analogous to, if not identical with, the Casa Grande, his report forms a valuable contribution to the literature of this subject, and although not everyone can accept the broad inferences and generalizations drawn by Mr. Cushing—of which he was able, unfortunately, to present only a mere statement—the report should be consulted by every student of southwestern archeology.

The latest contribution to the literature of the Casa Grande is a report by Dr. J. Walter Fewkes,¹ also of the Hemenway expedition, under the title "On the present condition of a ruin in Arizona called Casa Grande." Two magnificent illustrations are presented, engravings from photographs, showing general views of the ruin, as well as a number of views depicting details, and the ground plan presented at the end of the report is the best so far published. It is unfortunate that this author was not able to give more time to the study of the ruin; yet his report is a valuable contribution to our knowledge concerning the Casa Grande.

DESCRIPTION.

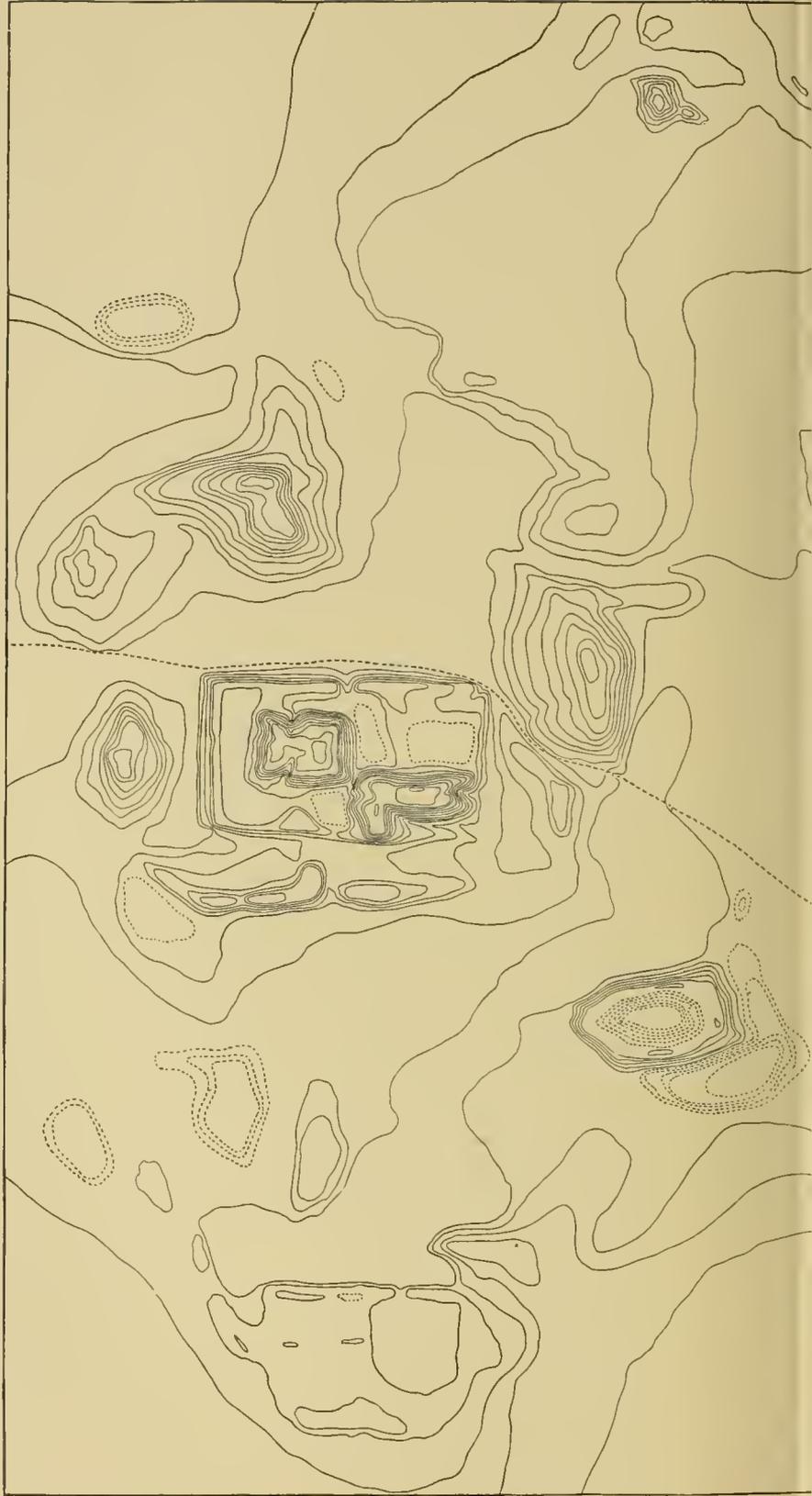
THE CASA GRANDE GROUP.

The Casa Grande has been variously placed at from 2 leagues to 2 miles south of Gila river. The writer has never traversed the distance from the ruin to the river, but the ruin is about a mile from Walker ranch, which is well known in that neighborhood, and about half a mile from the river. This question, however, is not of much importance, as the ruin is easily found by anyone looking for it, being located directly on one of the stage routes from Casa Grande station, on the Southern Pacific railroad, to Florence, Arizona, and about 9 miles below, or west of, the latter place.

The name Casa Grande has been usually applied to a single structure standing near the southwestern corner of a large area covered by mounds and other debris, but some writers have applied it to the southwestern portion of the area and even to the whole area. The latter seems the proper application of the term, but to avoid confusion, where both the settlement as a whole and that portion which has formed the theme of so many writers are referred to, the settlement will be designated as the Casa Grande group, and the single structure with standing walls as the Casa Grande ruin.

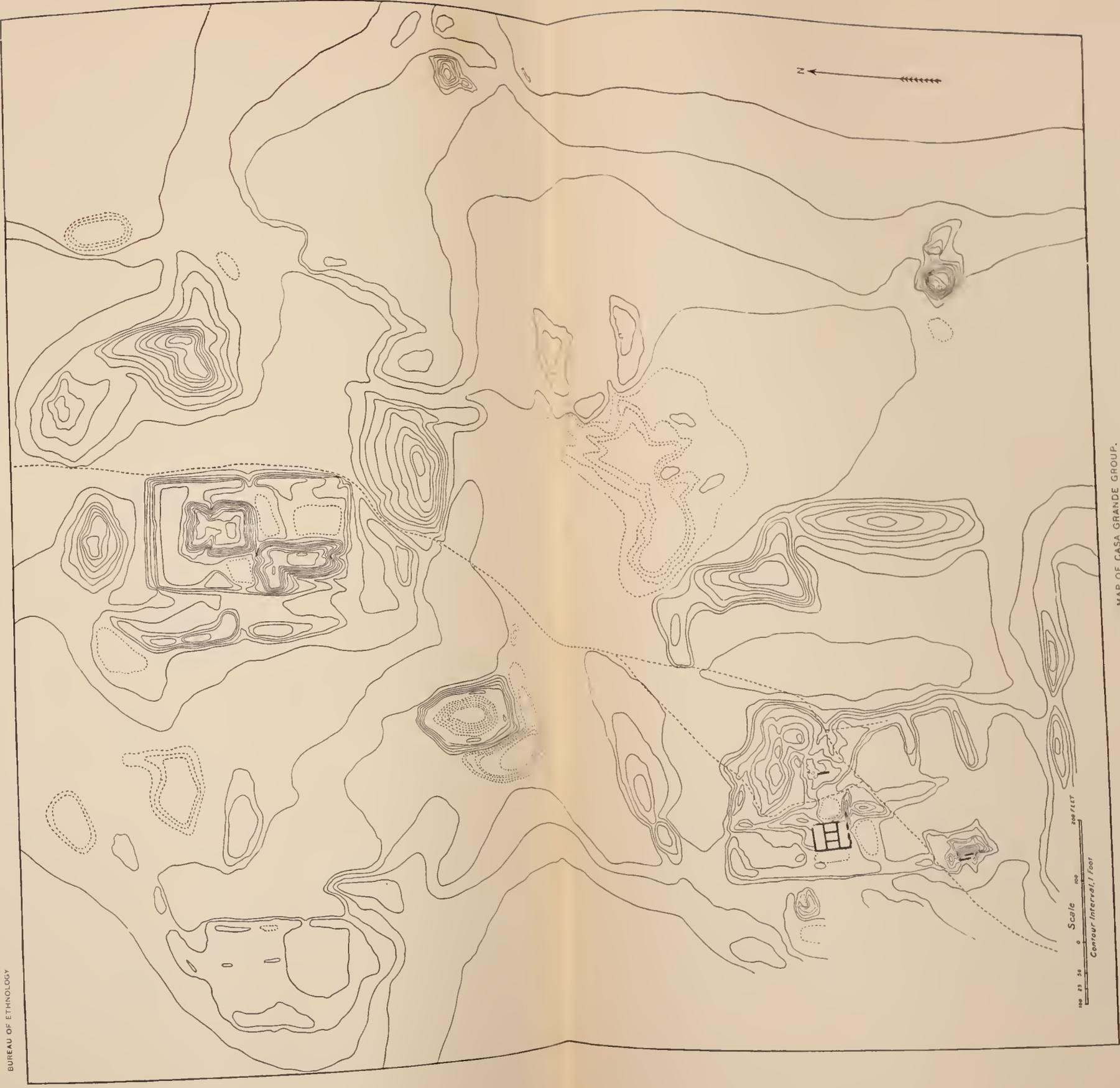
Probably no two investigators would assign the same limits to the area covered by the group, as the margins of this area merge imperceptibly into the surrounding country. The accompanying map (plate LI) shows this area as interpreted by the writer. The surface covered

¹Jour. of Amer. Ethn. and Arch., Cambridge, 1892, vol. ii, page 179 et seq.





MAP OF CASA GRANDE GROUP.



MAP OF CASA GRANDE GROUP.

by well defined remains, as there shown, extends about 1,800 feet north and south and 1,500 feet east and west, or a total area of about 65 acres.

The Casa Grande ruin, as the term is here used, occupies a position near the southwestern corner of the group, and it will be noticed that its size is insignificant as compared with that of the entire group, or even with the large structure in the north-central part of it. The division of the group into northern and southern portions, which has been made by some writers, is clearly shown on the map; but this division is more apparent than real. The contour interval on the map is one foot—a sufficiently small interval to show the surface configuration closely and to bring out some of its peculiarities. Depressions are shown by dotted contours. It will be noticed that while most of the mounds which mark the sites of former structures rise but 10 feet or less above the surrounding level, the profiles vary considerably, some being much more smoothed off and rounded than others, the former being shown on the map by even, “flowing” contours, while the latter are more irregular; and it will be further noticed that the irregularity reaches its maximum in the vicinity of the Casa Grande ruin proper, where the ground surface was more recently formed, from the fall of walls that were standing within the historical period.

External appearance is a very unsafe criterion of age, although in some cases, like the present, it affords a fair basis for hypothesis as to comparative age; but even in this case, where the various portions of the group have presumably been affected alike by climatic and other influences, such hypothesis, while perhaps interesting, must be used with the greatest caution. Within a few miles of this place the writer has seen the remains of a modern adobe house whose maximum age could not exceed a decade or two, yet which presented an appearance of antiquity quite as great as that of the wall remains east and southeast of the Casa Grande ruin.

The application of the hypothesis to the map brings out some interesting results. In the first place, it may be seen that in the lowest mounds, such as those in the northwestern corner of the sheet, on the southern margin, and southwest of the well-marked mound on the eastern margin, the contours are more flowing and the slopes more gentle than in others. This suggests that these smoothed mounds are older than the others, and, further, that their present height is not so great as their former height; and again, under this hypothesis, it suggests that the remains do not belong to one period, but that the interval which elapsed between the abandonment of the structures whose sites are marked by the low mounds and the most recent abandonment was long. In other words, this group, under the hypothesis, affords another illustration of a fact constantly impressed on the student of southwestern village remains, that each village site marks but an epoch in the history of the tribe occupying it—a period during which there was constant,

incessant change, new bands or minor divisions of the tribe appearing on the scene, other divisions leaving the parent village for other sites, and the ebb and flow continuing until at some period in its history the population of a village sometimes became so reduced that the remainder, as a matter of precaution, or for some trifling reason, abandoned it en masse. This phase of pueblo life, more prominent in the olden days than at present, but still extant, has not received the prominence it deserves in the study of southwestern remains. Its effects can be seen in almost every ruin; not all the villages of a group, nor even all the parts of a village, were inhabited at the same time, and estimates of population based on the number of ruins within a given region, and even those based on the size of a given ruin, must be materially revised. As this subject has been elsewhere¹ discussed, it can be dismissed here with the statement that the Casa Grande group seems to have formed no exception to the general rule, but that its population changed from time to time, and that the extent of the remains is no criterion of the former population.

It will be noticed that in some of the mounds, noticeably those in the immediate vicinity of the Casa Grande ruin, the surface is very irregular. In this instance the irregularity indicates a recent formation of surface; for at this point many walls now marked only by mounds were standing within the historical period. External contour is of course a product of erosion, yet similarity of contour does not necessarily indicate either equal erosion or equal antiquity. Surface erosion does not become a prominent factor until after the walls have fallen, and one wall may easily last for a century or two centuries longer than another similarly situated. The surface erosion of a standing wall of grout, such as these under discussion, is very slight; photographs of the Casa Grande ruin, extending over a period of sixteen years, and made from practically the same point of view, show that the skyline or silhouette remained essentially unchanged during that period, every little knob and projection remaining the same. It is through sapping or undermining at the ground surface that walls are destroyed. An inspection of the illustrations accompanying this paper will show what is meant by sapping: the external walls are cut away at the ground surface to a depth varying from a few inches to nearly 2 feet. After a rain the ground, and that portion of the walls at present below its surface, retains moisture much longer than the part of the walls which stands clear; the moisture rises by capillary attraction a foot or two above the ground surface, rendering the walls at this level softer than elsewhere, and as this portion is more exposed to the flying sand which the wind sweeps over the ground it is here that erosion attains its maximum. The wall is gradually cut away at and just above the ground surface until finally the base becomes too small to support it and it falls en masse. Then and not till then surface erosion becomes an important factor and the profile of

¹See pp. 179-261 of this Report, "Aboriginal Remains in Verde Valley."

the mass becomes finally rounded. But it will be readily seen that a slight difference of texture, or thickness, or exposure, or some trifling difference too minute for observation, might easily add many decades to the apparent age of a mound. The walls once fallen, however, the rounding or smoothing of the mounds would probably proceed at an equal rate throughout the group, and study of the profile gives a fairly good estimate as to the comparative age of the mounds. On this basis the most ancient mounds are those specified above, while the most recent are those in the immediate vicinity of the Casa Grande ruin. This esti-

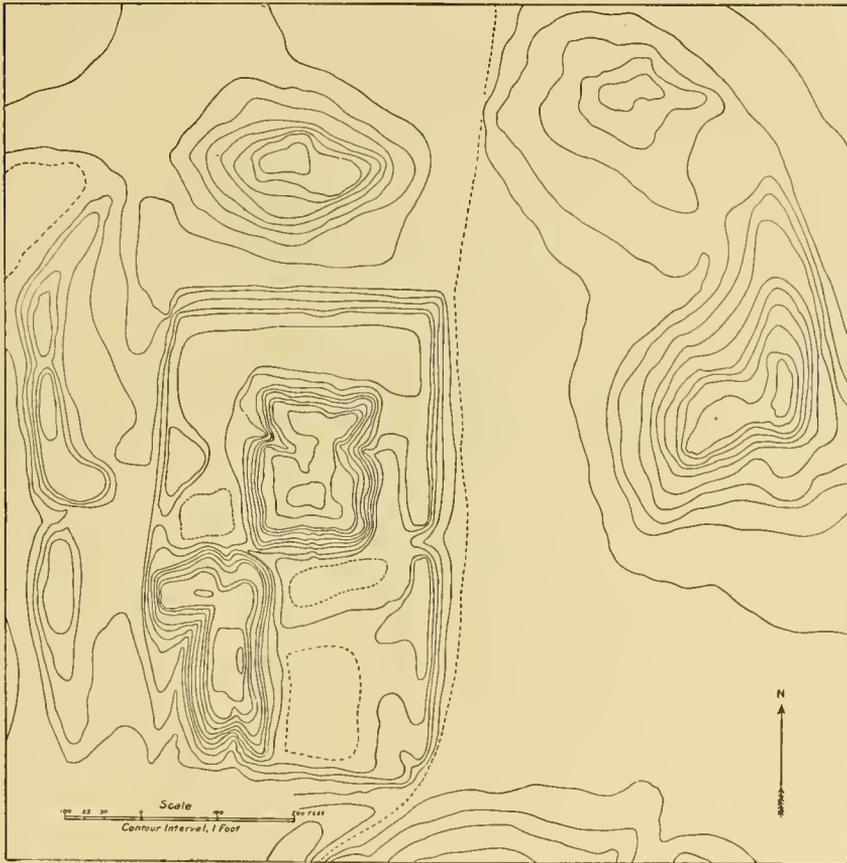


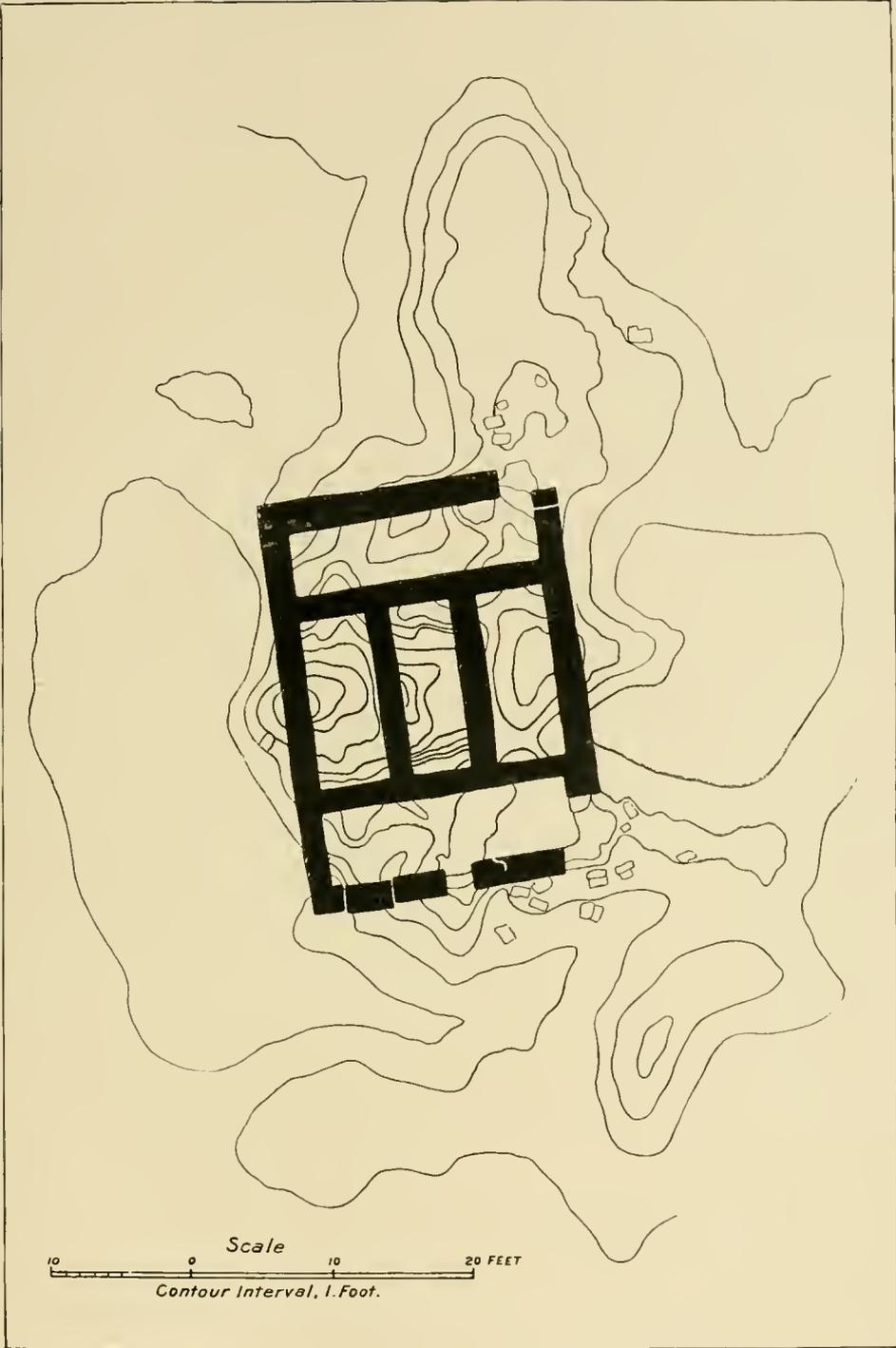
FIG. 328.—Map of large mound.

mate accords well with the limited historical data and with the Pima traditions, which recount that the Casa Grande ruin was the last inhabited village in this vicinity.

Probably intermediate in time between the Casa Grande ruin and the rounded mounds described above should be placed the large structure occupying the northern-central part of the map. This mound is deserving of more than a passing notice. It consists of two mounds,

each four or five times the size of the Casa Grande ruin, resting on a flat-topped pedestal or terrace about 5 feet above the general level. The summits of these mounds, which are nearly flat, are some 13 feet above this level. The sides of the mounds slope very sharply, and have suffered somewhat from erosion, being cut by deep gullies, as shown in figure 328, which is an enlargement from the map. It has been stated that these structures were mounds, pure and simple, used for sacrifice or worship, resembling somewhat the well-known pyramid of Cholula; but there is no doubt that they are the remains of house-structures, for a careful examination of the surface on the slopes, reveals the ends of regular walls. The height is not exceptional, the mound on the east being less than 3 feet lower, while the one on the southeast lacks less than 4 feet of its height. The characteristic feature, however, and one difficult to explain, except on the hypothesis stated, is the sharp slope of the sides. It will be noticed that the raised base or terrace on which the mounds are located is not perfectly flat, but on the contrary has a raised rim. This rim seems quite inconsistent with the theory which has been advanced that the terrace was built up solidly as a terrace or base, as in that case it would seem natural that the slope from the base of the mounds to the edge of the terrace would be continuous.

There is an abundance of room between the crest of the rim and the base of the terrace for a row of single rooms, inclosing a court within which the main structures stood, or such a court may have been covered, wholly or partly with clusters of rooms, single storied outside, but rising in the center, in two main clusters, three or more stories high. Such an agglomeration of rooms, might under certain conditions produce the result seen here, although a circumscribing heavy wall, occupying the position of the crest of the rim and inclosing two main clusters each rising three or more stories, might also produce this result. The difficulty with the latter hypothesis is, however, that under it we should expect to find a greater depression between the base of the mounds and the edge of the terrace. The most reasonable hypothesis, therefore, is that the space between the base of the mounds and the edge of the terrace was occupied by rooms of one story. This would also help to explain the steepness of the slopes of the mounds themselves. The walls of the structures they represent, being protected by the adjacent low walls of the one-story rooms, would not suffer appreciably by undermining at the ground level, and if the central room or rooms of each cluster were higher than the surrounding rooms, as is the case in the Casa Grande ruin, the exterior walls, being usually heavier than the inner walls, would be the last to succumb, the clusters would be filled up by the disintegration of the inner walls, and not until the spaces between the low one-story walls surrounding the central cluster were nearly filled up would the pronounced disintegration of the outer walls of the structures commence. At that period the walls were prob-



GROUND PLAN OF CASA GRANDE RUIN.

ably covered and protected by *débris* dropping from above, and possibly the profile of the mounds was already established, being only slightly modified by surface erosion since.

About the center of the eastern side of the terrace, and also on the western side, the water which falls on the surface of the structure is discharged through rather pronounced depressions at these points. These depressions are not the work of running water, though doubtless emphasized by that agency, but represent low or open spaces in the original structure, probably passageways or gateways. Furthermore, before or inside each gateway there is a slightly depressed area, just where we would expect to find it under our hypothesis, and showing that the process of filling in is not yet completed. If the structure were to remain undisturbed for some decades longer these spaces would doubtless be filled up from material washed from the mounds, giving eventually a continuous slope from the base of the mounds to the edge of the terrace.

On the eastern margin of the map and in the southeastern corner two small and sharply defined mounds, differing in character from any others of the group, are represented. That shown on the eastern margin rises about 6 feet and the other about 10 feet above the surrounding level, and both stand out alone, no other remains occurring within a hundred yards in any direction. These mounds seem a thing apart from the other remains in the group; and it is probable that they represent the latest period in the occupancy of this site, or possibly a period subsequent to its final abandonment as a place of residence. Analogous remains occur in conjunction with some large ruins in the north, and there they represent single rooms, parts of the original structure kept in a fair state of preservation by occasional repairs while the remainder of the village was going to ruin, and used as farming outlooks long after the site was abandoned as a place of residence. As these farming outlooks have been discussed at some length in another paper¹ it is not necessary here to enlarge upon their function and the important part they play in Pueblo architecture. If the high mounds in question mark, as supposed, the sites of farming outlooks such as those which are found in the north, they indicate that the occupancy of the region in which they occur was continued after the abandonment of the Casa Grande structure by the people who built it or by people of similar habits and customs.

An inspection of the map will show a number of depressions, some of quite large area, indicated by dotted contour lines. The principal one occurs a little west of the center of the area, and is worth more than a passing notice since similar structures are widely distributed throughout this region. It may be roughly characterized as a mound with excavated center. The ground for some distance about the structure (except for two depressions discussed later) is quite flat. From this

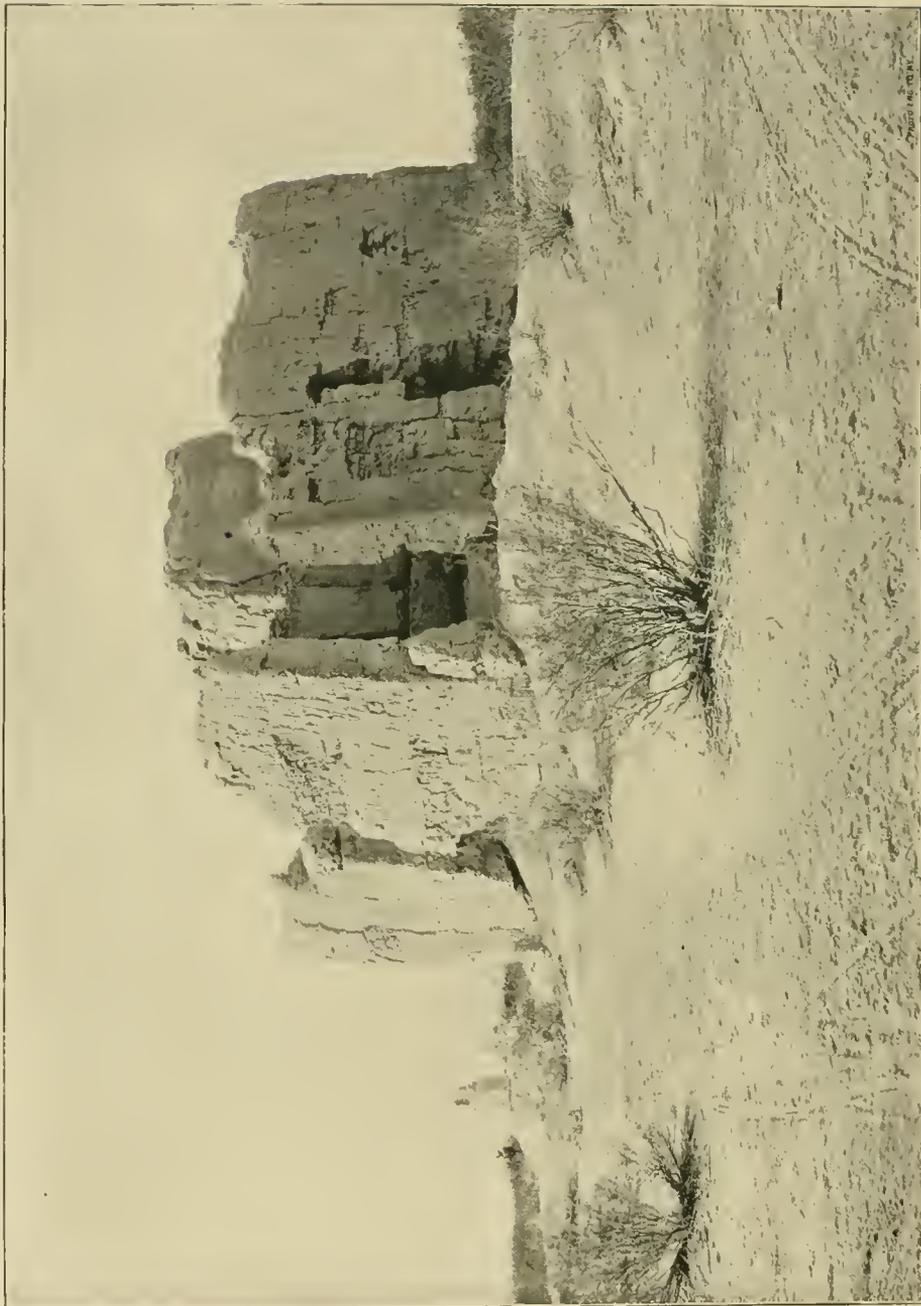
¹ A Study of Pueblo Architecture; 8th Ann. Rep. Bur. Eth., 1891, pp. 86, 227, and elsewhere.

flat surface as a base the structure rises to a height of 5 feet. From the exterior it has the appearance of an ordinary mound, but on reaching the top the interior is found to be hollowed out to a depth which even at the present day is below the surrounding surface, although not below the depressions adjoining. The main structure or mound is shown in figure 329 (an enlargement from the map). It measures on top of the crest 150 feet from north to south and about 80 feet from east to west, but covers a ground area of 200 feet by 120 feet or over half an acre. The crest is of the same height throughout, except for slight elevations on the eastern and western sides and a little knoll or



FIG. 329.—Map of hollow mound.

swell in the southwestern corner. There is no indication of any break in the continuity of the crest such as would be found were there openings or gateways to the interior. The bottom of the depression in the main structure is at present about a foot below the surrounding ground surface, but it must have been originally considerably more than this, as the profile indicates long exposure to atmospheric erosion and consequent filling of the interior. No excavation was made and the character of the construction can not be determined, but the mound is apparently a simple earth structure—not laid up in blocks, like the Casa Grande ruin.



GENERAL VIEW OF CASA GRANDE RUIN.

To the east and to the west are two large depressions, each about 5 feet below the surrounding ground surface, evidently the places whence the material for the construction of the mound was obtained. Yet the amount of material removed from these excavations must have been considerably in excess of that used in the construction of the mound, and this excess was doubtless utilized in neighboring constructions, since it is hardly to be supposed that it was carried away to any considerable distance.

The purpose of this hollow mound, which is a fair type of many similar structures found in this region, is not clear. Mr. Frank Hamilton Cushing, while director of the Hemenway southwestern archeological expedition, found a number of these structures and excavated some of them. From remains thus found he concluded that they were sun-temple, as he termed them, and that they were covered with a roof made of coiled strands of grass, after a manner analogous to that in which pueblo baskets are made. A somewhat similar class of structures was found by the writer on the upper Rio Verde, but these were probably thrashing floors. Possibly the structure under discussion was for a similar purpose, yet its depth in proportion to its size was almost too great for such use. The question must be left for determination if possible by excavation.

In the southern central part of the map is shown another excavation, covering a larger area than any of the others, of very irregular outline and from 3 to 4 feet deep. It is apparently older than the others and probably furnished the material for the house structures northeast and southwest of it. Bordering the depression on the south there are some low mounds, almost obliterated, which probably were the sites of other house structures.

Scattered about the area shown on the map there are several small depressions, usually more regular in outline than those described. The best example is situated near the northeastern corner of the area. It is situated in the point of a low promontory, is about 3 feet deep, almost regularly oval in outline, and measures about 50 by 100 feet. A similar depression less than 2 feet deep occurs near the northwest corner of the area, and immediately south of the last there is another, more irregular in outline, and nearly 3 feet deep. There are also some small depressions in the immediate vicinity of the Casa Graude ruin and of the mounds north of it.

With a single exception none of these depressions are so situated that they could be used as reservoirs for the storage of water collected from the surface, and the catchment area of the depressions is so small and the rate of evaporation in this area so great that their use as reservoirs is out of the question. It is probable that all of the smaller depressions represent simply sites where building material was obtained. Possibly the ground at these points furnished more suitable material than elsewhere, and, if so, the builders may have taken the trouble to transport

it several hundred yards rather than follow the usual practice of using material within a few feet of the site. This hypothesis would explain the large size of the depressions, otherwise an anomalous feature.

CASA GRANDE RUIN.

STATE OF PRESERVATION.

The area occupied by the Casa Grande ruin is insignificant as compared with that of the entire group, yet it has attracted the greater attention because it comprises practically all the walls still standing. There is only one small fragment of wall east of the main structure and another south of it.

The ruin is especially interesting because it is the best preserved example now remaining of a type of structure which, there is reason to believe, was widely distributed throughout the Gila valley, and which, so far as now known, is not found elsewhere. The conditions under which pueblo architecture developed in the north were peculiar, and stamped themselves indelibly on the house structures there found. Here in the south there is a radical change in physical environment: even the available building material was different, and while it is probable that a systematic investigation of this field will show essentially the same ideas that in the north are worked out in stone, here embodied in a different material and doubtless somewhat modified to suit the changed environment, yet any general conclusion based on the study of a single ruin would be unsafe. In the present state of knowledge of this field it is not advisable to attempt more than a detailed description, embodying, however, a few inferences, applicable to this ruin only, which seem well supported by the evidence obtained.

The Casa Grande ruin is located near the southwestern corner of the group, and the ground surface for miles about it in every direction is so flat that from the summit of the walls an immense stretch of country is brought under view. On the east is the broad valley of Gila river, rising in a great plain to a distant range of mountains. About a mile and a half toward the north a fringe of cottonwood trees marks the course of the river, beyond which the plain continues, broken somewhat by hills and buttes, until the view is closed by the Superstition mountains. On the northwest the valley of Gila river runs into the horizon, with a few buttes here and there. On the west lies a range of mountains closing the valley in that direction, while toward the southwest and south it extends until in places it meets the horizon, while in other places it is closed by ranges of mountain blue and misty in the distance. In an experience of some years among northern ruins, many of them located with special reference to outlook over tillable lands, the writer has found no other ruin so well situated as this.

The character of the site occupied by the ruin indicates that it belongs to a late date if not to the final period in the occupancy of this



STANDING WALL NEAR CASA GRANDE.

region, a period when by reason of natural increase of numbers, or perhaps aggregation of related gentes, the defense motive no longer dominated the selection of a village site, but reliance was placed on numbers and character of structures, and the builders felt free to select a site with reference only to their wants as a horticultural people. This period or stage has been reached by many of the Pueblo tribes, although mostly within the historical period; but some of them, the Tusayan for example, are still in a prior stage.

A ground plan of the ruin is shown in plate LII, and a general view in plate LIII. The area covered and inclosed by standing walls is about 43 feet by 59 feet, but the building is not exactly rectangular, and the common statement that it faces the cardinal points is erroneous. The variation from the magnetic north is shown on the ground plan, which was made in December, 1890. The building comprised three central rooms, each approximately 10 by 24 feet, arranged side by side with the longer axes north and south, and two other rooms, each about 9 by 35 feet, occupying respectively the northern and southern ends of the building, and arranged transversely across the ends of the central rooms, with the longer axes running east and west. Except the central room, which was three stories in height, all the rooms were two stories above the ground. The northeastern and southeastern corners of the structure have fallen, and large blocks of the material of which they were composed are strewn upon the ground in the vicinity. It is probable that the destruction of these corners prior to that of the rest of the building was due to the disintegration of minor walls connected with them and extending, as shown by the ridges on the ground plan, northward from the northeastern corner and eastward from the southeastern corner. These walls doubtless formed part of the original structure and were probably erected with it; otherwise the corners of the main structure would not have been torn out or strained enough to fall before the rest of the building was affected.

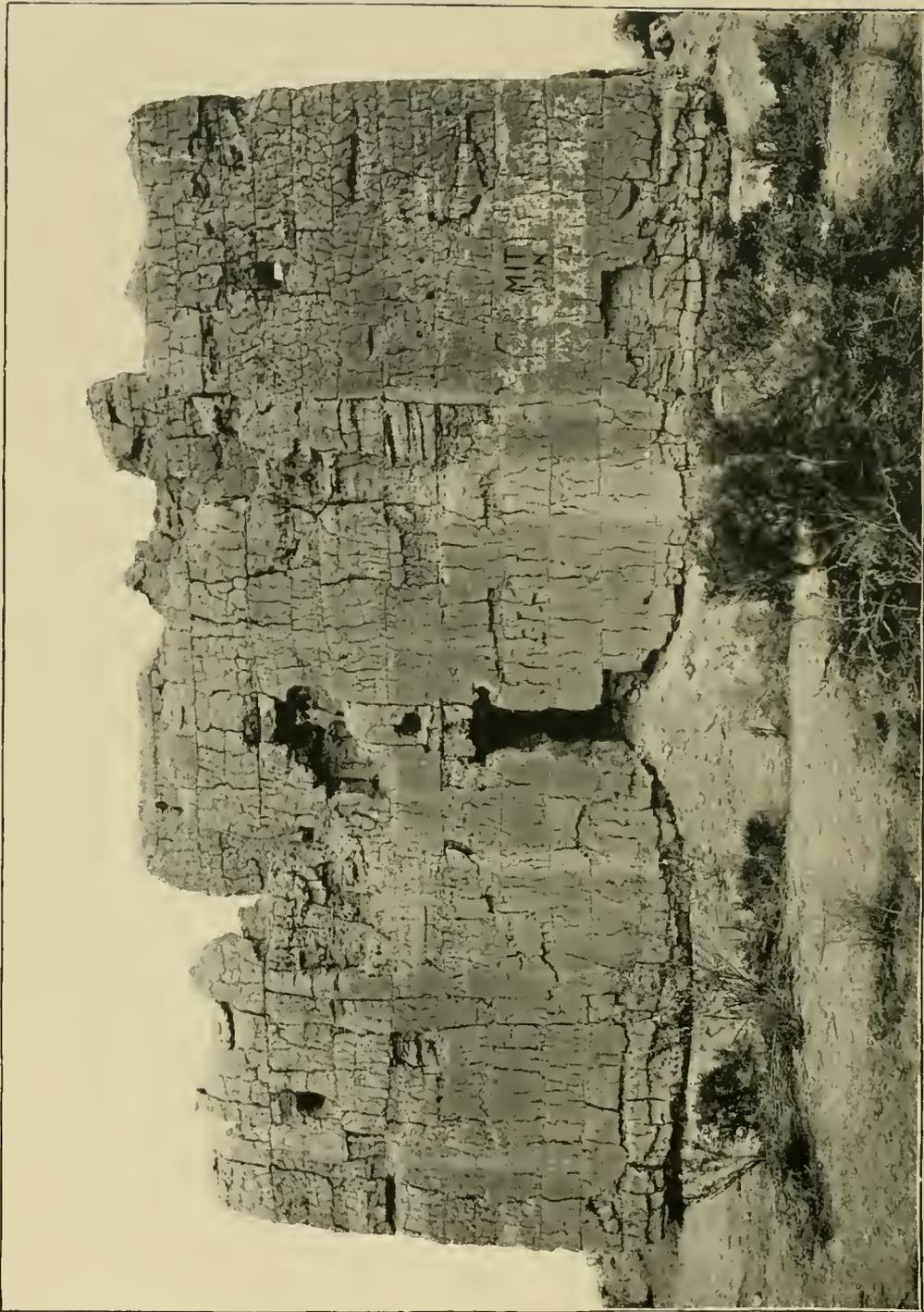
It is not likely that the main building originally stood alone as at present. On the contrary there is every reason to suppose that it was connected with other buildings about 75 feet east of it, now marked by a bit of standing wall shown on the map (plate LI), and probably also with a small structure about 170 feet south of it, shown in plate LIV. These connections seem to have been by open courts inclosed by walls and not by continuous buildings. The court east of the ruin is well marked by the contours and seems to have been entered by a gateway or opening at its southeastern corner.

DIMENSIONS.

It is probable that the area immediately adjacent to the ruin, and now covered by mounds, carried buildings of the same time with the main structure and was occupied contemporaneously with it or nearly so. This area, well marked on the map, measures about 400 feet

north and south, and 240 feet east and west. It is not rectangular, although the eastern and western sides, now marked by long ridges, are roughly parallel. The northeastern corner does not conform to a rectangular plan, and the southern side is not more than half closed by the low ridge which extends partly across it. This area is doubtless the one measured in 1776, by Padre Font, whose description was copied by later writers, and whose measurements were applied by Humboldt and others to the ruin itself. Font gave his measurements as those of a circumscribing wall, and his inference has been adopted by many, in fact most, later writers. A circumscribing wall is an anomalous feature, in the experience of the writer, and a close inspection of the general map will show that Font's inference is hardly justified by the condition of the remains today. It seems more likely that the area in question was covered by groups of buildings and rows of rooms, connected by open courts, and forming an outline sometimes regular for a considerable distance, but more often irregular, after the manner of pueblo structures today. The long north and south ridge which forms the southeastern corner of the area, with other ridges extending westward, is quite wide on top, wide enough to accommodate a single row of rooms of the same width as those of the ruin, and it is hardly reasonable to suppose that a wall would be built 10 or 12 feet wide when one of 4 feet would serve every purpose to which it could possibly be put. Furthermore, the supposition of an inclosing wall does not leave any reasonable explanation of the transverse ridges above mentioned, nor of the long ridge which runs southward from the southeastern corner of the ruin.

The exterior walls rise to a height of from 20 to 25 feet above the ground. This height accommodated two stories, but the top of the wall is now 1 to 2 feet higher than the roof level of the second story. The middle room or space was built up three stories high and the walls are now 28 to 30 feet above the ground level. The tops of the walls, while rough and much eroded, are approximately level. The exterior surface of the walls is rough, as shown in the illustrations, but the interior walls of the rooms are finished with a remarkable degree of smoothness, so much so as to attract the attention of everyone who has visited the ruin. Mange, who saw the ruin with Padre Font in 1697, says the walls shine like Puebla pottery, and they still retain this finish wherever the surface has not cracked off. This fine finish is shown in a number of illustrations herewith. The walls are not of even thickness. At the ground level the exterior wall is from $3\frac{1}{2}$ to $4\frac{1}{2}$ feet thick, and in one place at the southern end of the eastern wall, is a trifle over 5 feet thick. The interior walls are from 3 to 4 feet thick at base. At the top the walls are reduced to about 2 feet thick, partly by setbacks or steps at the floor levels, partly by exterior batter, the interior wall surface being approximately vertical. Some writers, noting the inclination of the outer wall surface, and not seeing the interior,



WEST FRONT OF CASA GRANDE RUIN.

have inferred that the walls leaned considerably away from the perpendicular. This inference has been strengthened, in some cases, by an examination of the interior, for the inner wall surface, while finely finished, is not by any means a plane surface, being generally concave in each room; yet a line drawn from floor level to floor level would be very nearly vertical. The building was constructed by crude methods, thoroughly aboriginal in character, and there is no uniformity in its measurements. The walls, even in the same room, are not of even thickness, the floor joists were seldom on a straight line, and measurements made at similar places, e. g., the two ends of a room, seldom agree.

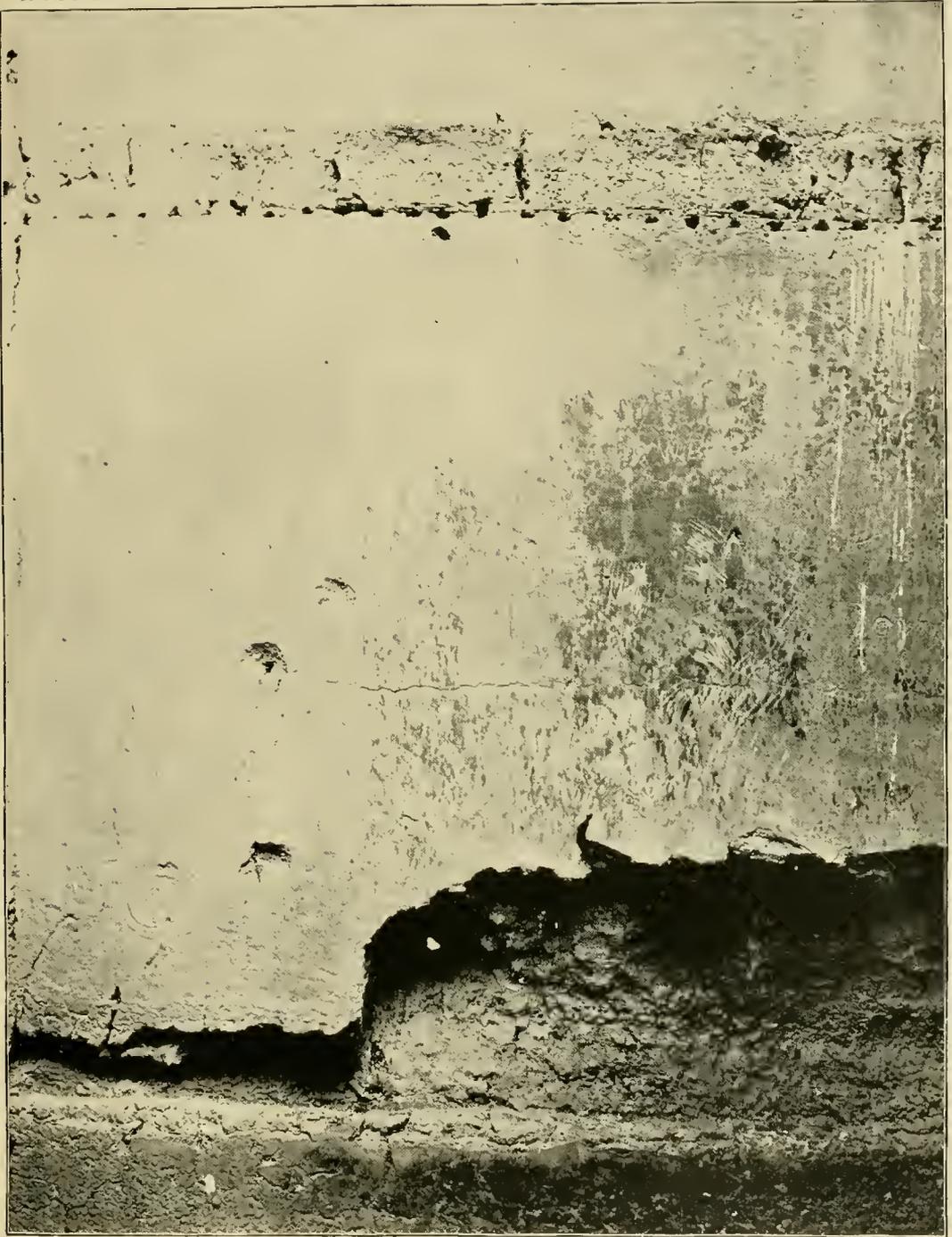
A series of precise measurements gives the following results: Outside eastern wall, at level 3 feet above center of depressed area adjoining the ruin on the east, 59 feet; western wall at same level, 59 feet 1 inch; northern and southern walls, at same level, 42 and 43 feet respectively. These measurements are between points formed by the intersection of the wall lines; the northeastern and southeastern corners having fallen, the actual length of standing wall is less. At the level stated the northern wall measures but 34 feet 4 inches, and the southern wall 36 feet 10 inches. A similar irregularity is found in the interior measurements of rooms. The middle room is marked by an exceptional departure from regularity in shape and dimensions. Both the east and west walls are bowed eastward, making the western wall convex and the eastern wall concave in reference to the room.

Precise measurements of the middle room at the second floor level, 8 feet above the base previously stated, are as follows: Eastern side, 24 feet 8½ inches; western side, 24 feet 2 inches; northern side, 9 feet 3½ inches; southern side, 9 feet 1 inch. The eastern room is a little more regular, but there is a difference of 11 inches between the measurements of the northern and southern ends. A similar difference is found in the western room, amounting there to 6 inches. The northern and southern rooms do not afford as good bases for comparison, as a corner is missing in each; but measurements to a point where the interior wall surfaces would intersect if prolonged, show variations of from 6 inches to a foot. The statement that the ruin exhibits exceptional skill in construction on the part of the builders, is not, therefore, supported by facts.

DETAILED DESCRIPTION.

The Casa Grande ruin is often referred to as an adobe structure. Adobe construction, if we limit the word to its proper meaning, consists of the use of molded brick, dried in the sun but not baked. Adobe, as thus defined, is very largely used throughout the southwest, more than nine out of ten houses erected by the Mexican population and many of those erected by the Pueblo Indians being so constructed; but, in the experience of the writer, it is never found in the older ruins, although seen to a limited extent in ruins known to belong to a period

subsequent to the Spanish conquest. Its discovery, therefore, in the Casa Grande would be important; but no trace of it can be found. The walls are composed of huge blocks of earth, 3 to 5 feet long, 2 feet high, and 3 to 4 feet thick. These blocks were not molded and placed in situ, but were manufactured in place. The method adopted was probably the erection of a framework of canes or light poles, woven with reeds or grass, forming two parallel surfaces or planes, some 3 or 4 feet apart and about 5 feet long. Into this open box or trough was rammed clayey earth obtained from the immediate vicinity and mixed with water to a heavy paste. When the mass was sufficiently dry, the framework was moved along the wall and the operation repeated. This is the typical pisé or rammed-earth construction, and in the hands of skilled workmen it suffices for the construction of quite elaborate buildings. As here used, however, the appliances were rude and the workmen unskilled. An inspection of the illustrations herewith, especially of plate LV, showing the western wall of the ruin, will indicate clearly how this work was done. The horizontal lines, marking what may be called courses, are very well defined, and, while the vertical joints are not apparent in the illustration, a close inspection of the wall itself shows them. It will be noticed that the builders were unable to keep straight courses, and that occasional thin courses were put in to bring the wall up to a general level. This is even more noticeable in other parts of the ruin. It is probable that as the walls rose the exterior surface was smoothed with the hand or with some suitable implement, but it was not carefully finished like the interior, nor was it treated like the latter with a specially prepared material. The material employed for the walls was admirably suited for the purpose, being when dry almost as hard as sandstone and practically indestructible. The manner in which such walls disintegrate under atmospheric influences has already been set forth in detail in this report. An inhabited structure with walls like these would last indefinitely, provided occupancy continued and a few slight repairs, which would accompany occupancy, were made at the conclusion of each rainy season. When abandoned, however, sapping at the ground level would commence, and would in time level all the walls; yet in the two centuries which have elapsed since Padre Kino's visit—and the Casa Grande was then a ruin—there has been but little destruction, the damage done by relic hunters in the last twenty years being in fact much greater than that wrought by the elements in the preceding two centuries. The relic hunters seem to have had a craze for wood, as the lintels of openings and even the stumps of floor joists have been torn out and carried away. The writer has been reliably informed that as late as twenty years ago a portion of the floor or roof in one of the rooms was still in place, but at the present day nothing is left of the floors except marks on the vertical walls, and a few stumps of floor joists, deeply imbedded in the walls, and so high that they can not be seen from the ground.



INTERIOR WALL OF CASA GRANDE RUIN.

The floors of the rooms, which were also the roofs of the rooms below, were of the ordinary pueblo type, employed also today by the American and Mexican population of this region. In the Casa Grande ruin a series of light joists or heavy poles was laid across the shorter axis of the room at the time the walls were erected; these poles were 3 to 6 inches in diameter, not selected or laid with unusual care, as the holes in the side walls which mark the places they occupied are seldom in a straight line, and their shape often indicates that the poles were quite crooked. Better executed examples of the same construction are often found in northern ruins. Over the primary series of joists was placed a layer of light poles, $1\frac{1}{2}$ to 2 inches in diameter, and over these reeds and coarse grass were spread. The prints of the light poles can still be seen on the walls. The floor or roof was then finished with a heavy coating of clay, trodden down solid and smoothed to a level. A number of blocks of this final floor finish, bearing the impress of the grass and reeds, were found in the middle room. There is usually a setback in the wall at the floor level, but this practice was not followed in all the rooms.

The position of the floor is well marked in all cases by holes in the wall, into which beams projected sometimes to a depth of 3 feet, and by a peculiar roughness of the wall. Plate LVI shows two floor levels, both set back slightly and the upper one strongly marked by the roughness mentioned. This roughness apparently marks the thickness of the floor in some cases, yet in others it is much too thick for a floor and must have had some other purpose. The relation of these marks to the beam holes suggests that in some cases there was a low and probably narrow bench around two or more sides of the room; such benches are often found in the present Pueblo villages.

The walls of the northern room are fairly well preserved, except in the northeastern corner, which has fallen. The principal floor beams were of necessity laid north and south, across the shorter axis of the room, while the secondary series of poles, $1\frac{1}{2}$ inches in diameter, have left their impression in the eastern and western walls. There is no setback in the northern wall at the first floor level, though there is a very slight one in the southern wall; none appears in the eastern and western walls. Yet in the second roof level there is a double setback of 9 and 5 inches in the western wall, and the northern wall has a setback of 9 inches, and the top of the wall still shows the position of nearly all the roof timbers. This suggests—and the suggestion is supported by other facts to be mentioned later—that the northern room was added after the completion of the rest of the edifice.

The second roof or third floor level, the present top of the wall, has a decided pitch outward, amounting to nearly 5 inches. Furthermore, the outside of the northern wall of the middle room, above the second roof level of the northern room, is very much eroded. This indicates that the northern room never had a greater height than two stories, but probably the walls were crowned with low parapets. In this connec-

tion it may be stated that a calculation of the amount of débris within the building and for a distance of 10 feet about it in every direction, the interior floor level being determined by excavation, showed an amount of material which, added to the walls, would raise them less than 3 feet; in other words, the present height of the walls is very nearly the maximum height.

Subsequent to this examination the ruin was cleared out by contractors for the Government in carrying out a plan for the repair and preservation of the ruin, and it was reported that in one of the rooms a floor level below that previously determined was found, making an underground story or cellar. This would but slightly modify the foregoing conclusion, as the additional débris would raise the walls less than a foot, and in the calculation no account was taken of material removed from the surface of the walls.

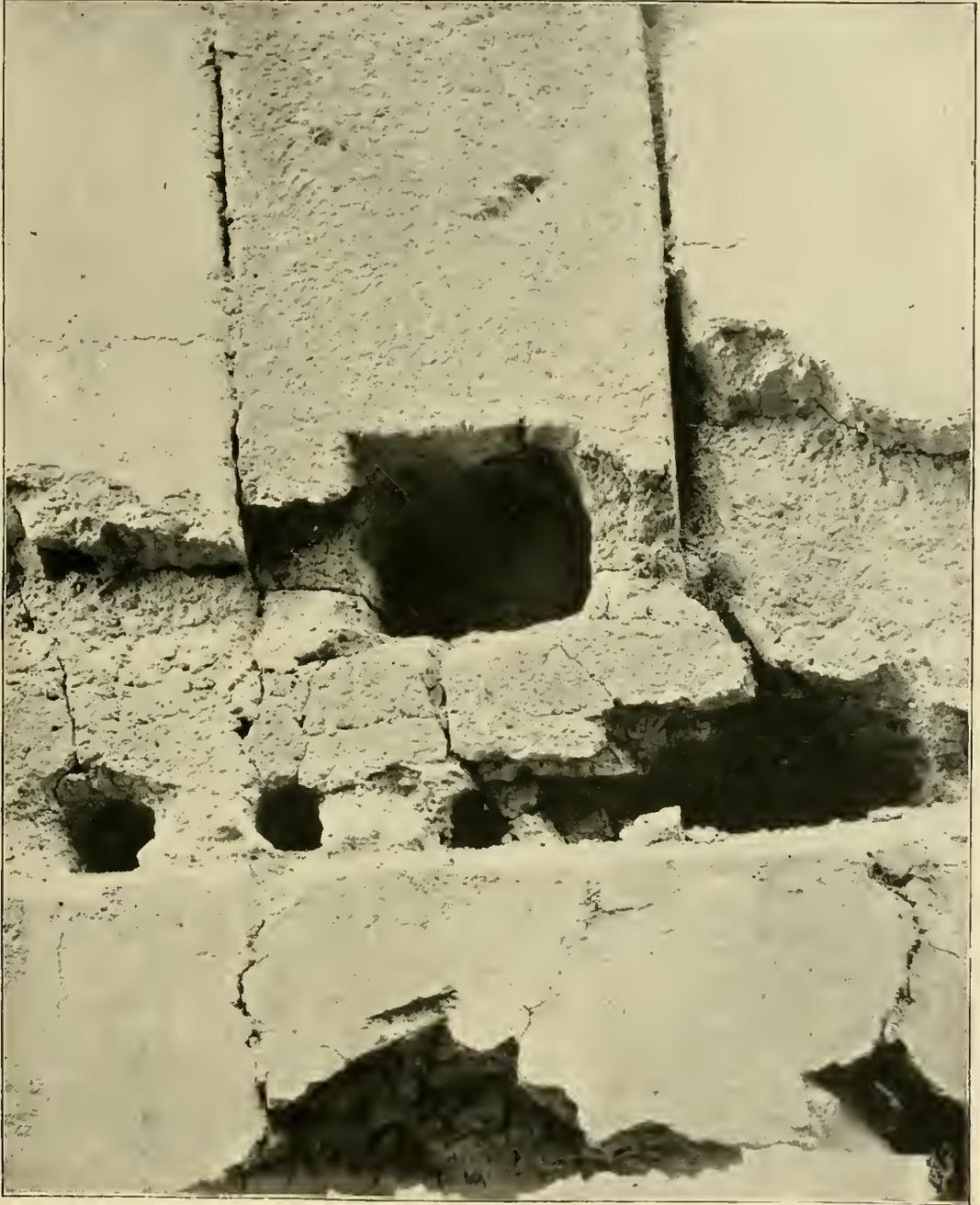
In support of the hypothesis that the second roof level of the northern room was the top roof, it may be stated that there is no trace of an opening in the walls above that level, except on the western side. There was a narrow opening in the western corner, but so well filled that it is hardly perceptible. Doubtless it formed a niche or opening in the parapet.

The southern wall on the first roof level still preserves very clear and distinct impressions of the rushes which were used in the construction of the roof. In some cases these impressions occur 3 inches above the top of the floor beams, in others directly above them, showing that the secondary series of poles was very irregularly placed. In the eastern and western walls the impressions of rushes are also clear, but there they are parallel with the wall surface. The rushes were about the thickness of a pencil.

The floor joists were 3 to 4 inches in diameter, and as a rule projected into the wall but 5 to 8 inches. In some places in the northern wall, however, they extended into the masonry as much as 3 feet 3 inches. The beams were doubtless cut by guess, at the place where trees of the requisite size were found, according to the method employed by the Pueblo Indians today, and if, as supposed, the northern room was built after the rest of the structure, the excess in length would necessarily be found in the northern wall.

In the roof construction previously described rushes or canes formed the third member, and in the northern room the wall is rough immediately above the impressions of rushes, and projects 8 to 12 inches. This feature is well marked; it may be a remnant of the clay covering of floor or roof, but it is almost too thick for that and possibly marks the position of a low bench, as previously suggested. The bottoms of the openings come just to or a trifle above the top of this marking.

The walls of the western room were smoothly finished and the finish is well preserved, but here, as in the northern room, the exterior wall of the middle room was not finished above the second roof level, and



BLOCKED OPENING IN WEST WALL.

there is no doubt that two stories above the ground were the maximum height of the western rooms, excluding the parapet. The eastern wall presents a marked double convexity while the western wall is comparatively straight in a horizontal line, but markedly concave vertically above the first roof level. Below this level it is straight. The floor beams were from 3 to 6 inches in diameter. The marks in the eastern wall show that the beams projected into it to a nearly uniform depth of 1 foot 4 inches. In the western wall, however, the depth varies from 1 to 3 feet. The beams which entered the eastern wall were very irregularly placed, the line rising in the center some 3 or 4 inches. The beams of the second roof level show the same irregularity and in the same place; possibly this was done to correct a level, for the same feature is repeated in the eastern room.

The walls of the southern room are perhaps better finished and less well constructed than any others in the building. The beam holes in the southern wall are regular, those in the northern wall less so. The beams used averaged a little smaller than those in the other rooms, and there is no trace whatever in the overhanging wall of the use of rushes or canes in the construction of the roof above. The walls depart considerably from vertical plane surfaces; the southern wall inclines fully 12 inches inward, while in the northeastern corner the side of a doorway projects fully 3 inches into the room. The broken condition of the southern wall indicates carelessness in construction. The weakest point in pisé construction is of course the framing around openings. In the southern wall the openings, being doubtless the first to give way, are now almost completely obliterated. In the center of the wall there were two openings, one above the other, but not a trace of lintels now remains, and the eastern half of the wall now stands clear from other walls. Probably there was also an opening near the southwestern corner of the room, but the lintels giving way the wall above fell down and, as shown on the ground plan (plate LI), filled up the opening. This could happen only with exceptionally light lintels and exceptionally bad construction of walls; one of the large blocks, before described as composing the wall, must have rested directly above the opening, which was practically the same size as the block.

The walls of the eastern room were well finished, and, except the western wall, in fairly good preservation. The floor beams were not placed in a straight line, but rise slightly near the middle, as noted above. The finish of some of the openings suggests that the floor was but 3 or 4 inches above the beams, and that the roughened surface, already mentioned, was not part of it. The northern wall of this room seems to have run through to the outside, on the east, as though at one time it formed the exterior wall of the structure; and the eastern wall of the building north of this room is separated from the rest of the wall by a wide crack, as though it had been built against a smooth surface. The western wall of this room shows clearly that in the con-

struction of the building the floor beams were laid on the tops of the walls, and that the intervening spaces were filled with small lumps of material up to a level with or a little above the upper surface of the beams, the regular construction with large blocks being then resumed.

In the middle room many blocks bearing the imprint of grass and rushes were found, and the rough marking of the walls just above the floor beams is covered in places in this room with masonry composed of these grass marked blocks projecting some distance into the room, indicating that in this room at least they mark the position of a bench. These blocks occupy the whole thickness of the setback at the second roof level—perhaps an indication that the upper story was added after the building was occupied.

OPENINGS.

The Casa Grande was well provided with doorways and other openings arranged in pairs one above the other. There were doorways from each room into each adjoining room, except that the middle room was entered only from the east. Some of the openings were not used and were closed with blocks of solid masonry built into them long prior to the final abandonment of the ruin.

The middle room had three doorways, one above the other, all opening eastward. The lowest doorway opened directly on the floor level, and was 2 feet wide, with vertical sides. Its height could not be determined, as the top was completely broken away and merged with the opening above, but the bottom, which is also the floor level, is 6 feet 9 inches below the level of the first roof beams. The doorway of the second story is preserved only on the northern side. Its bottom, still easily distinguishable, is 1 foot 6 inches above the bottom of the floor beams. It was not over 2 feet wide and was about 4 feet high. The upper doorway is still well preserved, except that the lintels are gone. It is about three inches narrower at the top than at the bottom and about 4 feet high.

In addition to its three doorways, all in the eastern wall, the middle tier of rooms was well provided with niches and holes in the walls, some of them doubtless utilized as outlooks. On the left of the upper doorway are two holes, a foot apart, about 4 inches in diameter, and smoothly finished. Almost directly above these some 3 feet, and about 2 feet higher than the top of the door, there are two similar holes. Near the southern end of the room in the same wall there is another round opening a trifle larger and about $4\frac{1}{2}$ feet above the floor level. In the western wall there are two similar openings, and there is one each in the northern and southern walls. All these openings are circular, of small diameter, and are in the upper or third story, as shown on the elevations herewith, figure 330. The frequency of openings in the upper or third story and their absence on lower levels, except the specially arranged openings described later, supports the hypothesis that none of the rooms except the middle one were ever more than two



PHOTO. LNU. CO. NY.

SQUARE OPENING IN SOUTH ROOM.

stories high and that the wall remains above the second roof level represent a low parapet.

In the second story, or middle room of the middle tier, there were no openings except the doorway in the eastern wall and two small orifices in the western wall. In the middle of this wall there is a niche about 18 inches below the roof, and a foot below this is a round-cornered opening measuring about 7 by 8 inches extending through the wall. This opening was on a level with another in the western wall of the western room, and commanded a far-reaching though contracted view toward the west. Below and a little northward is a similar though somewhat larger opening corresponding to an opening in the western wall of the western room.

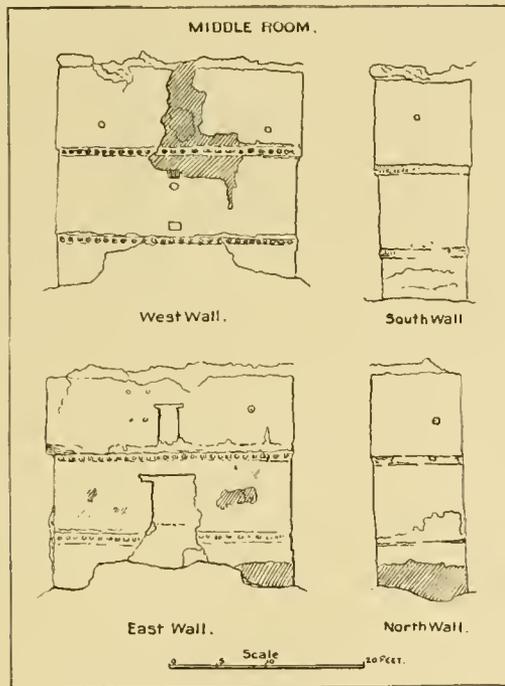


FIG. 330.—Elevations of walls, middle room.

The upper doorway in the western wall of the western room is much broken out, but the top can still be traced. It was 4 feet 5½ inches in height and 1 foot 11 inches wide at top. The opening was blocked by solid masonry built into it and completely filling it up to within 10 inches of the top. This upper space, which is on a level with the upper hole in the middle room, seems to have been purposely left to allow an outlook from that room. The filling block is level on top and flush with the wall inside and out. At a height of 12 inches above the lower edge of the floor beams below it, and perhaps 3 inches above the floor, is the lower edge of a roughly square opening a foot across, cut

out from the block itself and inclined slightly downward toward the exterior. It was plastered and smoothly finished. This opening corresponds to the one in the middle room already described. This filling block, with the orifice under discussion, is shown in figure 330, and in detail in plate LVII.

The lower doorway, shown in figure 330, is much broken out, and although now but 2 feet $1\frac{1}{2}$ inches wide at its narrowest part, no trace of the original surface remains on the northern side. The opening was 4 feet $6\frac{1}{2}$ inches high and probably less than 2 feet wide, with vertical sides.

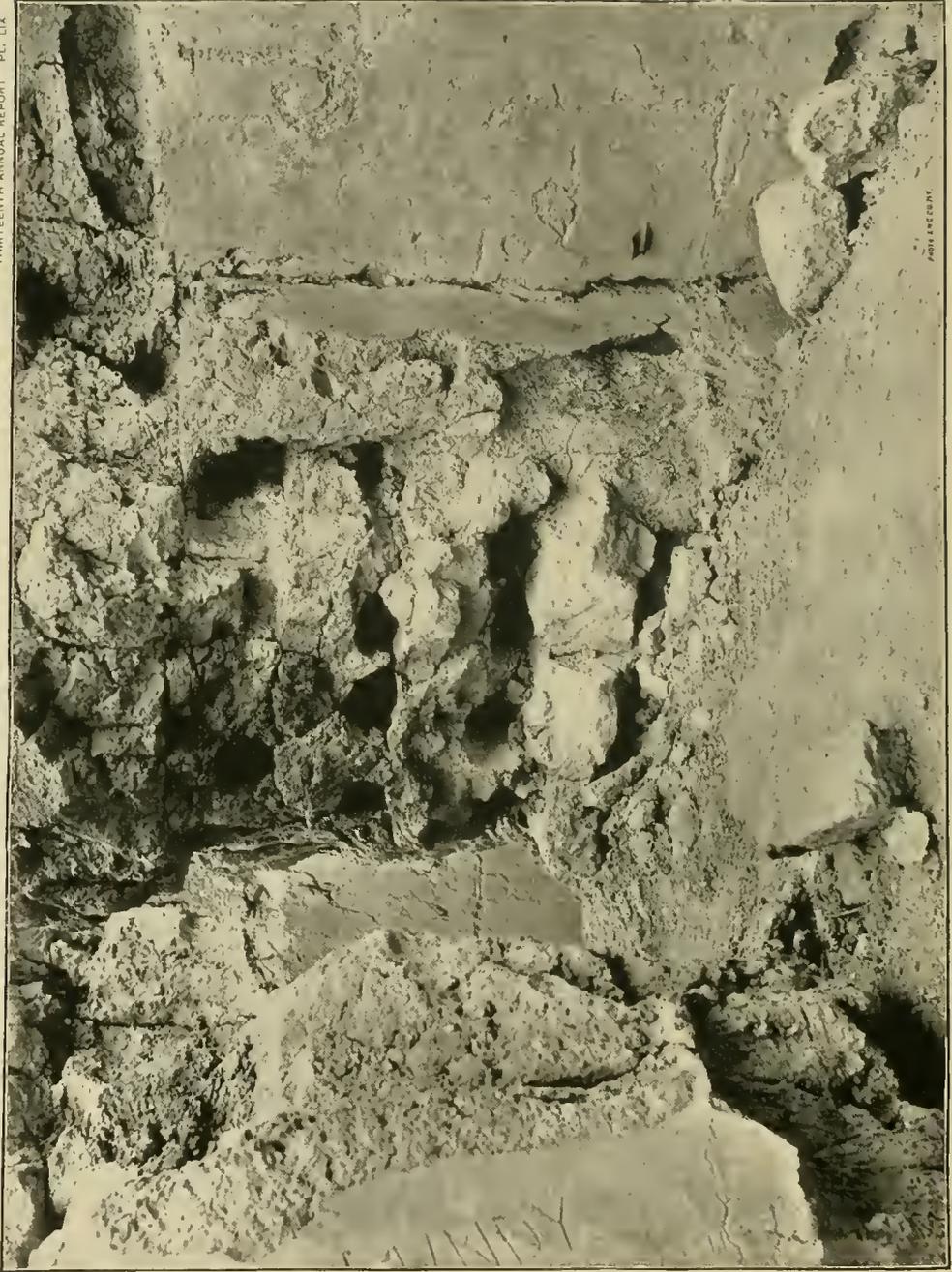
In the western wall of the southern room there was but one opening. This is about 9 inches square, finished smoothly, and occurs in the upper room, about 6 feet 5 inches above the floor. It is shown in plate LVIII. The doorway between this room and the western room was smoothly finished and is in good order except the top, which is entirely gone. It was covered with double lintels made of poles 2 to 4 inches in diameter, the lower series about 3 inches above the top of the door. The opening was originally filled in like that described above, leaving only 8 or 10 inches of the upper part open. The lower part of the block was pierced by a square hole, like that in the western room, but this has weathered or been broken out and the block has slipped down, so that now its top is 1 foot $5\frac{1}{2}$ inches below what was formerly the top of the opening. The top of the filling block is still smooth and finished and shows across its entire width a series of prints probably of flat sticks about an inch and a half wide, though possibly these are marks of some finishing tool. The marks run north and south.

The opening below the one just described was so much filled up at the time of examination that none of its features could be determined, except that it was bridged by two tiers of sticks of the usual size as lintels. The subsequent excavation before referred to, however, apparently disclosed an opening similar to the one described, and, like it, filled nearly to the top with a large block.

A little west of the middle of the northern wall there are three niches, arranged side by side and about $6\frac{1}{2}$ feet above the first roof beams. The niches are 10 inches high, a foot wide, and about a foot deep, and are about 8 inches apart. They are smoothly finished and plastered, but were roughly made.

The eastern opening in the northern wall, opening into the east room, is well preserved except the top, which is missing. It measured 4 feet $2\frac{1}{2}$ inches in height and 1 foot 11 inches wide at the bottom, the top being nearly an inch narrower. It carried two tiers of lintels of medium size.

The gap in the southern wall of the southern room, shown in the plan, though now open from the ground up, represents the location of two doorways, one above the other. Remains of both of these can still be seen on the ends of the walls. No measurements can be obtained.



REMAINS OF LINTELS.

The large fallen block near the southwestern corner of the room, which undoubtedly slipped down from above, shows a finished surface at the ground level inside, but above it no trace of an opening can be seen, possibly because the ends of the walls above are much eroded.

The upper opening in the eastern wall of the eastern room was apparently capped with a single lintel composed of five sticks 4 to 6 inches in diameter laid level on the top of a course of masonry. The bottom of the opening is filled either with washed-down material or with the remains of a block such as that previously described. This opening is the most irregular one in the building, the top being nearly 4 inches narrower than the bottom, but the northern side of the opening is vertical, the southern side only being inclined inward. The opening was 4 feet 11 inches high and 1 foot $8\frac{1}{2}$ inches wide at the bottom. The opening immediately below that described, which was the ground floor entrance from the east, is so much broken out that no evidence remains of its size and character. There appears to have been only one row of lintel poles.

The eastern opening in the southern wall of the northern room is well preserved, the lintels having been torn out by relic hunters without much destruction of the surrounding masonry. It was neatly finished, and its bottom was probably a little above the first roof level. The edges of the openings were made straight with flat sticks, either used as implements or incorporated into the structure, and forming almost perfectly straight edges. Marks of the same method of construction or finish are apparent in all the other openings, but the remains are not so well preserved as in this instance. Possibly the immediate lintels of openings were formed of thin flat sticks, as the lintel poles are often some inches above the top of the opening. In this opening the supporting lintel was formed of a number of poles 2 to 4 inches in diameter, irregularly placed, sometimes two or three in vertical series with very little filling between them. This construction has been characterized as a Norman arch. The opening was originally 1 foot 11 inches at the top and 4 feet 6 inches high. The bottom is $1\frac{1}{2}$ inches wider than the top.

The upper opening in the western end of the southern wall is much like that just described. A small fragment of masonry above the lintel remains, and this is within a quarter of an inch of the top of the opening. Above the opening there was a series of rough lintel poles, 3 to 5 inches in diameter, arranged in three tiers with 4 to 6 inches of filling between them. Prints of these sticks are left in the wall and show that some of them were quite crooked. Probably they were of mesquite, obtained from the immediate vicinity. The edges of the openings were finished with flat sticks, like those described, and its bottom was 6 inches to a foot above the floor. The height of the opening was 4 feet 3 inches and its width at the top 2 feet, at the bottom 2 feet $1\frac{1}{4}$ inches.

The opening immediately below the last described is filled with débris to the level of the lintel. Above this, however, there is a series of three tiers of sticks with 6 to 8 inches of masonry between them vertically, sometimes laid side by side, sometimes separated by a foot of masonry. Some of these lintel poles, as well as those of the opening above it, extend 3 feet into the wall, others only a few inches. The lower sides or bottoms of the holes are washed with pink clay, the same material used for surfacing the interior walls. Perhaps this was merely the wetting used to make succeeding courses of clay stick better. This opening is shown in plate LIX.

Near the middle of the northern wall there are two openings, one above the other. The upper opening was finished in the same manner as those already described. But two tiers of poles show above it, though the top is well preserved, and another tier may be buried in the wall. There are indications that the opening was closed by a block about 2 feet thick and flush with the outside. The height of the opening was 4 feet 5 inches, width at top 1 foot 4½ inches, and at the bottom 1 foot 10 inches. It narrows a little from north to south.

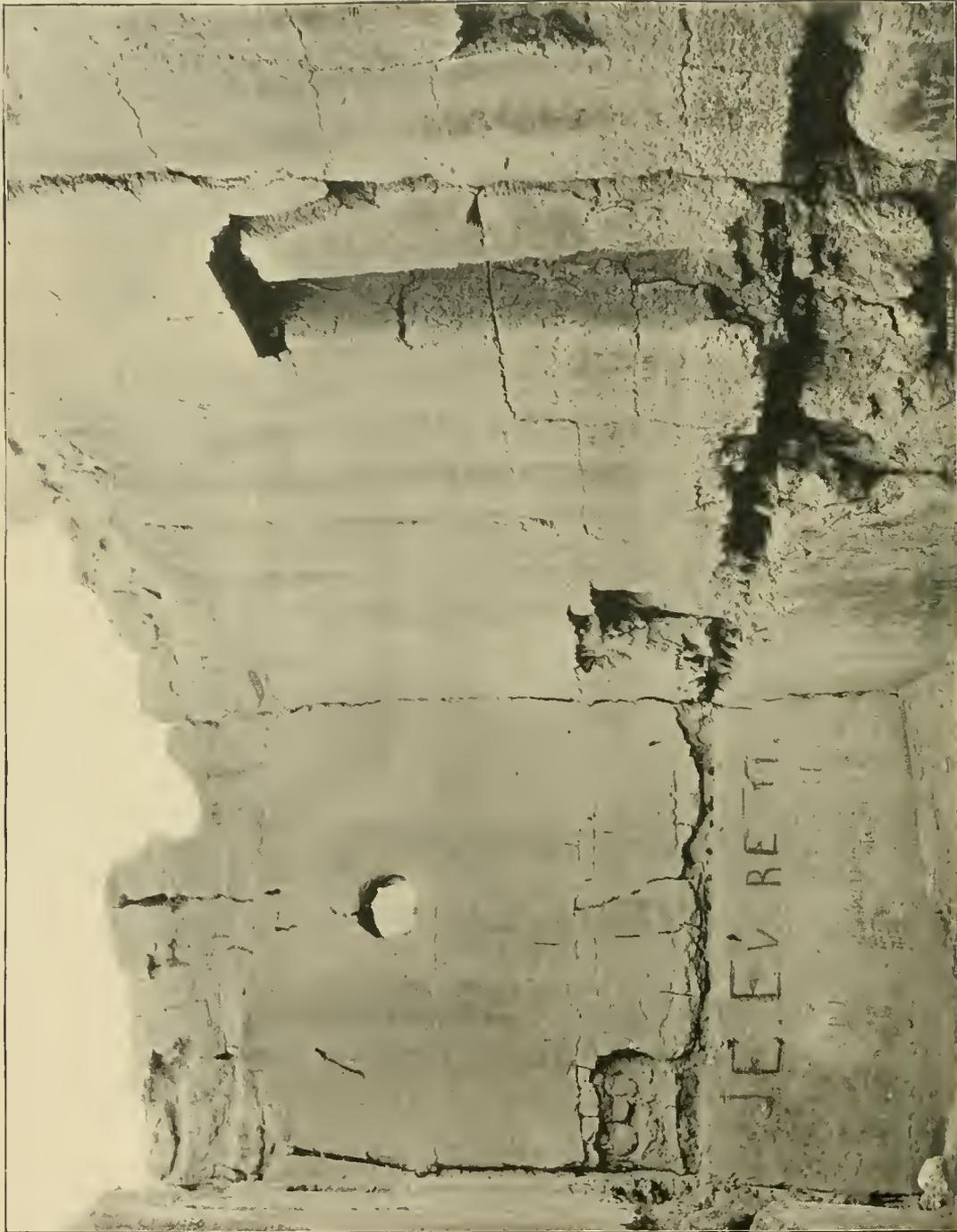
The lower opening is so much broken out that little remains to show its character. There is a suggestion that the opening was only 2 feet high, and there were probably three tiers of lintels above the opening, the top of which was 2½ feet below the roof beams, but the evidence is not so clear as in the other instances.

In the middle of the western wall, at a height of 5 feet 8 inches above the first roof level, there is a large, roughly circular opening or window, 14 inches in diameter. This is shown in plate LX. It is smoothly finished, and enlarges, slightly, outward.

CONCLUSIONS.

As before stated, any conclusions drawn from a study of the Casa Grande itself, and not checked by examination of other similar or analogous ruins, can not be considered as firmly established, yet they have a suggestive value.

From the character of the remains it seems probable that the site of the ruins here designated as the Casa Grande group was occupied a long time, not as a whole, but piecemeal as it were, one part being occupied and abandoned while some other part was being built up, and that this ebb and flow of population through many generations reached its final period in the occupation of the structure here termed the Casa Grande ruin. It is probable that this structure did not exist at the time the site was first occupied, and still more probable that all or nearly all the other sites were abandoned for some time before the structure now called the Casa Grande was erected. It is also probable that after the abandonment of the Casa Grande the ground about it was still worked by its former population, who temporarily occupied, during the horticultural season, farming outlooks located near it.



CIRCULAR OPENING IN NORTH ROOM.

The methods employed in the construction of the buildings of the Casa Grande were thoroughly aboriginal and characteristically rude in application. A fair degree of adaptability to purpose and environment is seen, indicating that the Casa Grande was one, and not the first, building of a series constructed by the people who erected it and by their ancestors, but the degree of skill exhibited and amount of ingenuity shown in overcoming difficulties do not compare with that found in many northern ruins. As architects, the inhabitants of the Casa Grande did not occupy the first rank among pueblo-builders.

It is probable that the Casa Grande ruin as we see it today shows very nearly the full height of the structure as it stood when it was abandoned. The middle tier of rooms rose to a height of three stories; the others were but two stories high. It is also probable that the building was enlarged after being once completed and occupied. At one time it probably consisted of four rooms on the ground plan, each two stories high. The northern tier of rooms was added afterward, and probably also the third room in the central tier.

The Casa Grande was undoubtedly built and occupied by a branch of the Pueblo race, or by an allied people. Who these people were it is impossible to determine finally from the examination of one ruin, but all the evidence at hand suggests that they were the ancestors of the present Pima Indians, now found in the vicinity and known to have formerly been a pueblo-building tribe. This conclusion is supported by the Pima traditions, as collected by Mr. Bandelier, who is intimately acquainted with the documentary history of the southwest, and whose knowledge of the Pima traditions is perhaps greater than that of anyone else now living. In his various writings he hints at this connection, and in one place he declares explicitly that the Casa Grande is a Pima structure. None of the internal evidence of the ruin is at variance with this conclusion. On the contrary, the scanty evidence is in accord with the hypothesis that the Casa Grande was erected and occupied by the ancestors of the Pima Indians.