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January,1936, mimeo., pages numbered 41e- 54; illus.

2 - Life Figures on Hohokam Pottery. by John E. Fast and Louis R. Caywood
March, 1936 , mimeo., pp 1 - 4. illus.

3 - Sunset Crater Geological Report. by Vincent W. Vandiver
April,1936 , mimeo., pp numbered 291-298. 1 map.

4 - Mission San Jose de Tumacacori: Choir Loft Problem. by J. H. Tovrea
May,1936 , mimeo., pp numbered 275-378. illus.

5 - White Sands Geological Report. by Vincent W. Vandiver
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6 - Bird Banding in the Southwestern Monuments: Fiscal Year '36. Dale S. King, compilor
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7 - Walnut Canyon Geological Report by Vincent W. Vandiver
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8 - Navajo Geological Report by Vincent W. Vandiver
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9 - Tumacacori Alcoves or Transepts by J. H. Tovrea and Frank Pinkley
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10- Repair and Restoration of Tumacacori,1921., by Frank Pinkley
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11- Kino Mission Records by Robert H. Rose
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12- Kino Mission Records by Robert H. Rose
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27- 1941 Annual Report,Navajo IndianMobile Unit by Gordon Vivian
~~Minus~~ June 30,1941, mimeo, pp 1-3.
28- Birds of Montezuma Castle by Betty Jackson
November 1941, mimeo , pp 1-20
29- Preliminary Report on Ruins Stabilization by A. E. Buchenburg
December 1941, mimeo., pp 1-6.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

SOUTHWESTERN MONUMENTS
SPECIAL REPORT
NO. 1
MISSION
SAN JOSE DE TUMACACORI
PICTORIAL RESTORATION

BY
J. H. TOVREA

Jan. 1936

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

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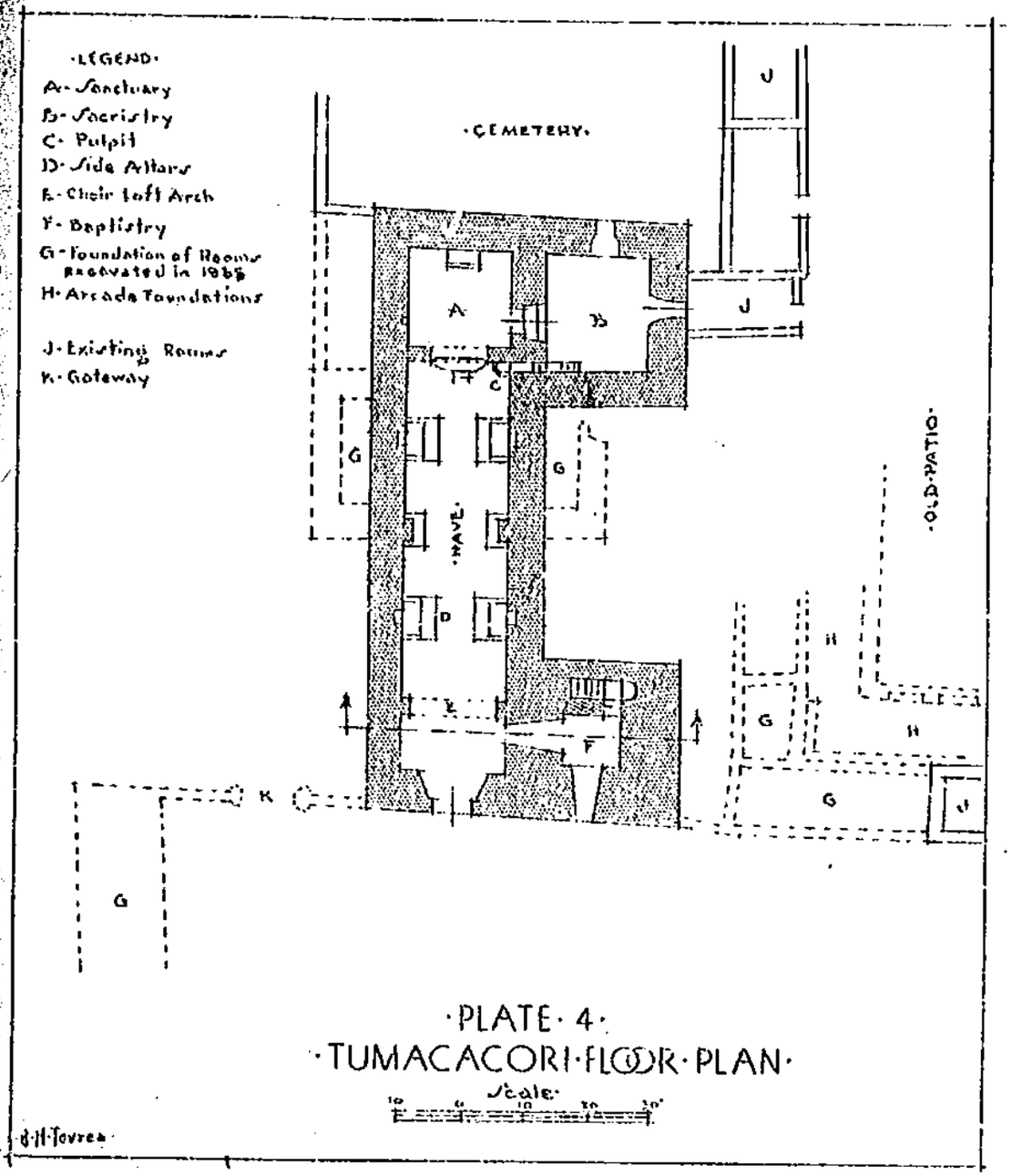


·PLATE· 4·
·TUMACACORI·FLOOR·PLAN·

REPORT ON MISSION SAN JOSE DE TUMACACORI

By J. H. Toyrea

When we pass through the great arched doorway of the old Mission San Jose de Tumacacori, it is usually only a matter of a few minutes before we start wondering what it was like before nature and vandalism destroyed so much of it. Even those who are not particularly interested in old missions cannot help wondering what the ruined altars were like years ago. Perhaps some carry away with them a mental picture of the unfinished bell tower and vaguely try to visualize what it might have been. Those of us who visit the structure often enough find that this wondering gets in the blood and becomes a sort of mild mania. If, eventually, we find ourselves staying awake nights pondering over little flakes of plaster which have different textures, or faded dabs of paint which once might have been parts of intricate and vivid designs, we will begin to find answers for some of the whats and whys.

Last fall the National Park Service decided that answers or clues to unravel some of Tumacacori's architectural problems might be found by a survey of the twenty-odd missions in Sonora, Mexico, which belonged to the same chain as our San Tumacacori. The thought brought action, for a party of six men was sent into Mexico to gather as much data and material as possible for museum exhibits, historical research, and architectural detail. The time was limited to three weeks, as the party had to work fast. A lot of the time was consumed in travel between the missions, as the roads were poor and there was a certain amount of official clearance to be obtained at each site. The party was composed of two architects and an archeologist-historian from San Francisco, a photographer from Washington, D. C., and a geologist and myself from Southwestern Monuments Headquarters. The party obtained some valuable data in the form of measured plans and sections of the better preserved missions, but the time was so limited that many of the details could not be measured though all were photographed. There is no doubt that a wealth of museum material was obtained and the expedition was, I believe, a successful one.

My interest in the trip was concentrated on what could be found that would relate to Tumacacori in the way of restoring in picture form some of her lost details.

Some eighteen years ago, Superintendent Frank Pinkley of the National Park Service started wondering about Tumacacori and set to work putting pieces of the puzzle together. His job was harder than ours because he had to start at the beginning. Now, with parts of the problem solved, it is easier for us to work out other parts. Some of the answers to various parts of Tumacacori's problem outlined in this report, are accompanied with substantial and logical proof. Others are

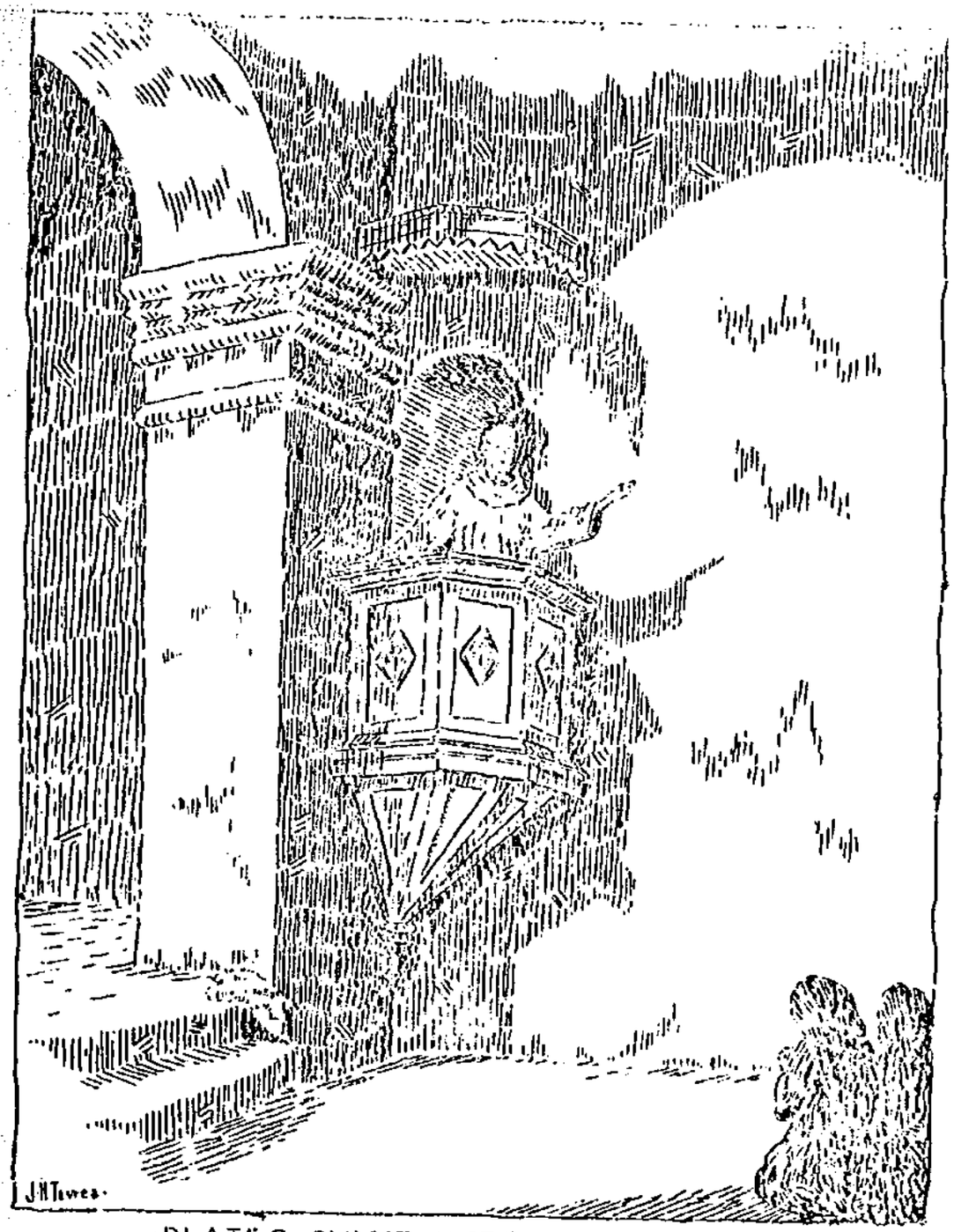
based on comparative observations of the other missions in the chain; and still others can be boiled down to the very best and latest guess.

I found that all the missions in the chain, that we visited, were quite radically different from one another with the exception of Cabrea, which is practically a twin of the Mission San Xavier near Tucson, Arizona. If any of the missions is at all like Tumacacori, it is probably San Ignacio, and it was from it that I gathered data which helped conceive a restoration of Tumacacori's side altars, pulpit, choir loft rail and balustrade. It also gave me a mental picture of what Tumacacori's interior looks like when it was complete with choir loft and altars. It verified in my mind Superintendent Pinkley's idea that by restoring Tumacacori's choir loft, illusions of greater height and size of the nave would be created and the entire picture would be more in keeping with what the builders meant it to be. Without these illusions the nave is out of focus, and when we say to the visitor as he enters the door, "Look--this is the nave which the padres built over a hundred years ago," we are showing him a distorted picture. The padres would have had the visitor view the nave thru the arched opening that upheld the front end of the choir loft; for thru this archway the room would appear longer than it actually was, and, as he walked forward and looked up, his memory of the low ceiling of the balcony loft would make the ceiling of the nave seem higher by comparison.

The missions as a whole made me feel that since the buildings were designed to impart a feeling of mystery and sanctity, so should such a feeling be re-created in Tumacacori, as nearly as would be practicable. This could be done in part by restoring some of the altars complete to the image in the niche. When the visitor enters San Xavier he tiptoes and whispers and is doubly impressed by what he sees. At the present time, the interior of Tumacacori could be mistaken for the interior of an old banquet hall, a fortress or even a storage room. A little restoration here and there would make it impress the visitor that it was the interior of a place of worship and he would be getting a truer picture of the mission.

PULPIT RESTORATION

When I entered San Ignacio, the first detail to catch my eye was the pulpit. The eye is drawn to it immediately because it is a spot of color against the plain grey-white wall. In the dim, shadowy light of the nave the bright colors of this pulpit are softened so that they blend together and assume a velvet-like texture. Indians like bright colors and would no doubt concentrate their attention on this particular spot when the padre was addressing them. All that was left of the Tumacacori pulpit at the time it was decided to restore it, were a few marks on the plaster wall. These marks proved two things; 1. That the floor beams projected at right angles from the two walls behind the pulpit and, 2. That three and one-half feet below the floor level, in



·PLATE·2-PULPIT·RESTORATION·

the corner formed by the intersection of the two main walls, was a mark which indicated the presence of an ornament which might have terminated the point of an inverted pyramidal corbel that supported the floor of the pulpit. With this scanty evidence to work from a square pulpit floor was constructed with the corbel below. This construction was then plastered over. If a pulpit of this square shape were used the speaker could not have faced his listeners in a graceful manner unless he faced directly south where he would be looking along the line of the east wall, or directly west where he would be looking at a wall seventeen feet away and not at his listeners.

It would seem that the ideal horizontal section of a pulpit for this particular situation would be a quarter round, which would permit the speaker to face any direction in the space of ninety degrees. For the purpose of ornamentation, however, this section would not be very satisfactory, as well as being a difficult one to build out of wood. All of the pulpits which we studied in the other missions were some portion of an octagon, depending upon their position. This octagon shape gave the same effect as a circle, was easier to construct, and when ornamented was more pleasing to the eye. The one at San Ignacio looked so appropriate for Tumacacori, if modified a bit, that I made a rough water color of it. Using this as a model, I have made a restoration drawing of a pulpit for Tumacacori. (Plate 2). This pulpit would meet the requirements established by the marks left on the walls by the original pulpit and would, I believe, resemble the original very closely. The construction would be of wood and the colors similar to those of San Ignacio's pulpit. If this pulpit were restored, I believe it would create a pleasing contrast to the present drab interior.

ALTAR RESTORATION

Tumacacori had seven altars--three on each side of the nave and the high altar in the sanctuary. One can imagine how impressive the interior of this old mission must have been when all these altars stood complete, each one enshrining the image of a saint. Could not this picture be more clearly imagined by the visitor if one of these altars were completely restored? The possibilities of such a restoration are shown by the drawing in Plate 3. This particular altar is the first side altar on the left as we enter the building. All that remains of it now is the base, and the lower portion of the altar proper. The flat top has been restored. Existing evidence to support the accuracy of this restoration drawing is in the form of marks on the plaster wall showing the outline of the gabled moulding that frames the altar background, and the small remaining fragments of one of the columns, and one end of the lintle.

The ornamental designs on the column and lintle are painted and were suggested by the designs on other altars of the chain. At least two of the old carved wood images, which are now at San Xavier, belonged

at one time to Tumacacori. I would suggest that models of these images be made, full size, colored true to the originals and restored to the altar niches at Tumacacori. One of these image models in the niche of the restored side altar would make it a complete restoration.

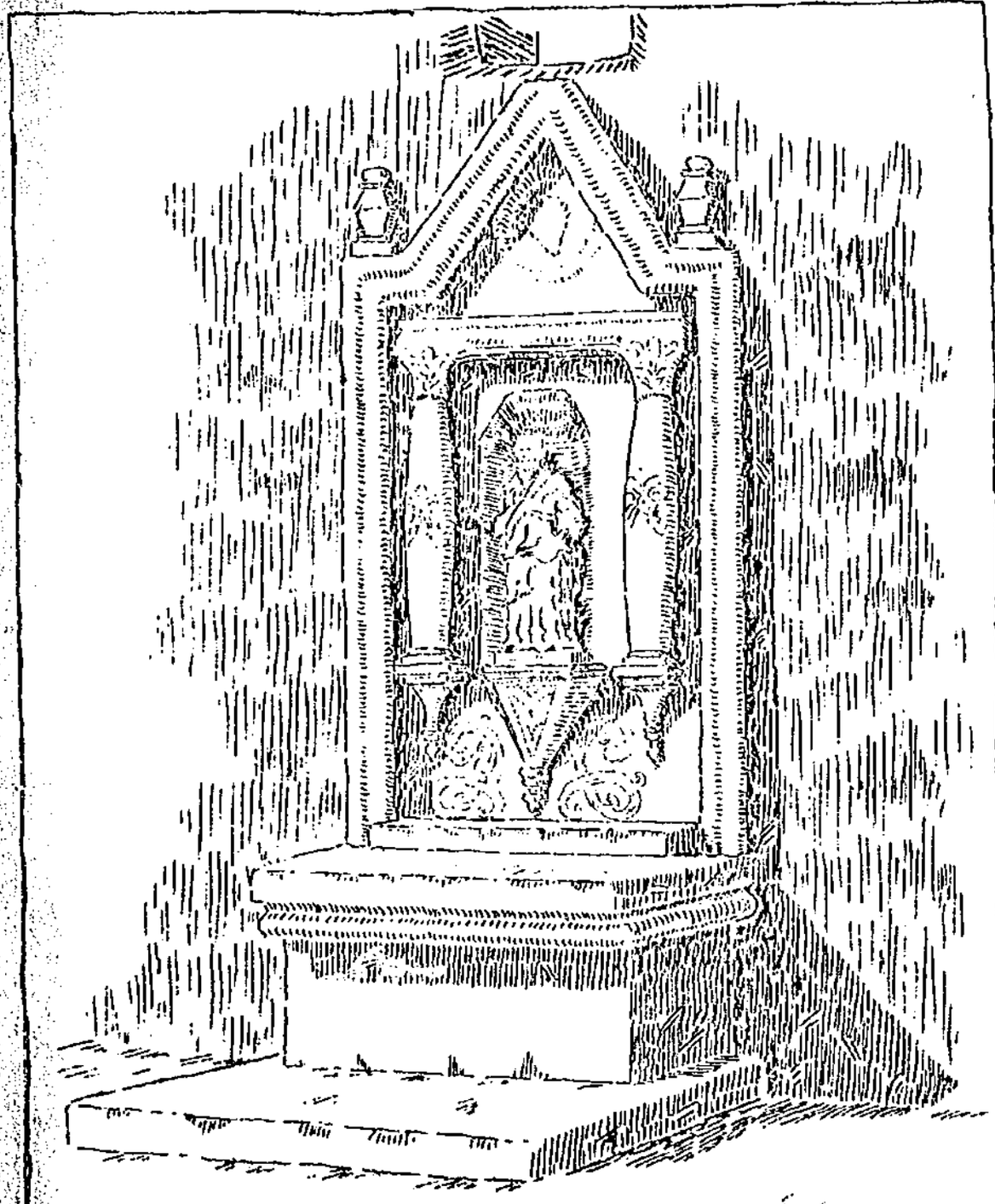
CHOIR LOFT RESTORATION.

A complete restoration of the choir loft has been advocated for several good reasons--the primary one being that of improving the perspective view on entering the building. The arch support at the front of the loft can be easily and accurately restored from photographs of the original arch. The floor we must assume to be of burned brick, as are the loft floors of most of the other missions. The railing and balustrade must be copied also from existing ones in the other missions. Detailed drawings of these existing balustrades were made on the mission trip and are filed ready to use in the event this restoration is ever attempted.

A DISCUSSION OF THE ORIGINAL PLANS

Records show that three buildings were constructed at Tumacacori at different periods, for the purpose of holding religious services. Whether these three missions were three distinct buildings or two buildings, one of which was remodeled and enlarged to make the third, is a question for debate. Last winter, under the competent supervision of Mr. Paul Beaubien, Archeologist, the area east of the present mission was excavated and a number of foundation walls and floors were uncovered and mapped. One rectangular shaped set of foundations, in particular, could have been those of a small church, and is considered by some to be the foundation of the second church at Tumacacori. At one end of the rectangle the foundation walls seem to offset inward for a distance equal to the breadth of the foundation to form what might have been a sanctuary. However, the fact that at the point of offset the two walls are joined together by just the meeting of their respective corners, leads me to believe that they were the foundations of two different buildings constructed at different periods; and I do not think that these foundations represent those of a church, though it is possible.

On the other hand, there are several good arguments which would indicate that the present building has been remodeled and enlarged. Briefly, they are, the presence of plastered foundation walls on each side of the nave--which would indicate that at one time there was an altar alcove on each side of the nave. The opening into these alcoves is clearly outlined by the unbonded adobe brick. The average height of these cracks is eight feet. Excavation has shown also that there were foundation walls crossing the nave just in front of the sanctuary arch and behind what was the choir loft arch. This would indicate that the nave at one time might have been confined within those limits or, at least, was of a different plan, even though the length and width were



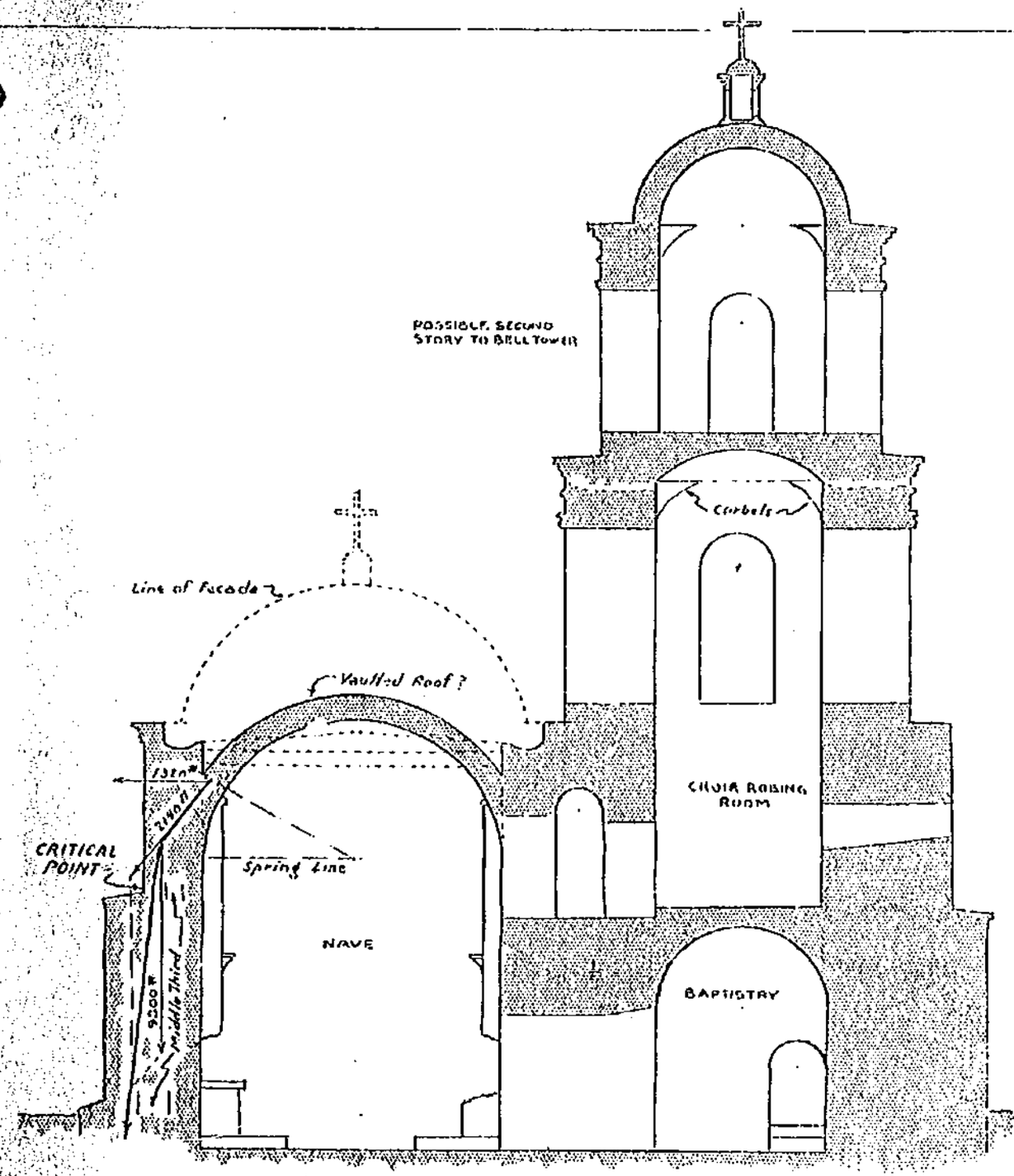
J. M. Torres.

·PLATE·3·SIDE·ALTAR·RESTORED·

wall section creates a force downward of 9,800 pounds per linial foot through the point of the center of gravity. The resultant force between the thrust of the arch and the weight of the wall section completes the line which the thrust of our proposed vault would travel. This line of pressure is the heavy line shown on the wall section. It will be noted that the wall section is divided into thirds at the base of each of the two different wall thicknesses. When a wall section is designed to carry an arch, it is so designed that the line of thrust always stays within the middle third of the wall section. If it runs outside of this middle third, the section is considered unsafe and apt to fail. It will be noted that the thrust line of our proposed arch runs considerably outside of the middle third, both at the offset point and at the base of the section--which are the two critical points. We know then that if a barrel vaulted roof were built there would be great dangor of the side walls failing.* Therefore, since the padres were efficient designers and even tended to over-design, I believe we can safely say that the two-foot offset was not a part of the original plans of the building. That eliminates one theory and leaves us two; namely, that the plans were changed when the offset point was reached, or, the portion of the building above the offset was an addition to the building. I believe that the five-foot section of wall was started with the idea of using the vaulted roof--otherwise a narrower wall section would have been used. I believe that it was intended to carry this thick wall up to the point where the spring line of the arch as figured starts. When the point was reached which is now the offset point of the walls, plans were changed.1.There could be several periods when Tumacacori was abandoned by the padres due to Indian attacks at Tumacacori and other missions farther south. 2. It is possible also that since the Indian labor was not particularly skilled and was very slow, the padres decided to use a flat roof instead of a vaulted one, and so the wall was made narrower from the offset point on up. It will be noted that on each side of the main entrance there are buttress-like columns. (Plate4). It seems logical to assume that they were used to support the back part of the choir loft. However, if this were true, they would be superfluous construction; as the choir loft beams would receive their proper support and bearing in the front wall of the building, and a bear under them would not be necessary. I puzzled over these peculiar columns for a long time before an apparently simple answer presented itself to account for them. When the plans

*This does not, however, rule out the possibility of the intention to use a lighter vaulted roof than the one figured here. It has been my theory that, for lack of funds, they could not erect a barrel vault at the time but designed the walls so the flat roof could later be removed and the barrel vault substituted with the least amount of trouble.

Mr. Tovrea however tells me a thinner section would probably be dangerous, due to the fact that the line of pressure could more easily fall outside of the middle third in a thinner section. - Frank Pinkley



·PLATE·5·
·SECTION·THRU·MISSION·
1/8" Scale

were changed and it was decided to use the flat roof which could be taken care of by a three-foot wall, the designer could easily take care of the offset on the side walls of the nave by putting it on the outside of the building where the break would make the elevation even more pleasing. But the front of the building, the main facade, would be practically ruined if the offset ran across it and divided it into two elements. So in this place he put the offset on the inside of the building where it could be nicely concealed by the choir loft floor. Any offset on the inside of the nave that could be seen would cut down the apparent height of the ceiling. There is nothing much harder to do than to make a radical change in a good set of plans and still keep them good. This is especially true when the building planned is half built. Though Tumacacori is hardly an architectural jewel, it is an interesting building with many pleasing features. The fact that the building is still quite presentable should reflect even more credit to the padre architects.

THE UNFINISHED BELL TOWER

The mystery of the unfinished bell tower will probably always keep us guessing, but the more we think about it and compare it with the bell towers of the other missions of the chain, the more accurate our guessing becomes. Why it wasn't finished has been boiled down to about three or four stock answers which can be found in almost any Mission book. It is the question what would the bell tower have looked like if it had been finished, that we will try to answer.

There are two schools of thought regarding this question. School No. 1 contends that if the tower had been finished it would have consisted of the present single story above the roof line of the nave, topped with a dome, lantern and cross. School No. 2 believes that it was intended to add another story to the present one, making the tower two stories above the roof line of the nave, and on top of the second story a dome, lantern and cross. The second story would be smaller both in height and outside measurement than the present first story. At one time I was a somewhat doubtful School No. 1 advocate, but after I had studied the problem for some time, I finally jumped down off the fence and organized School No. 2. I will try to be impartial and give both sides of the argument so that the reader may draw his own conclusions.

There are three drawings in the report which will be used to illustrate the discussion. Plate 8 shows a restoration with a one-story bell tower; and Plate 6 shows a restoration with two stories.

The arguments in favor of the one-story bell tower are:

1. The brick corbels in the corners at the top of the unfinished tower might indicate that the final dome had been started when work was stopped. It could, however, be a domed ceiling between the two stories

such as we find at Caborca and San Xavier.*

2. The architectural balance would not be any too good with two stories. This is true; but it is also true that the balance is not any too good with one story either. So it might be a question of choosing the lesser of two evils.

3. The fact that they used broken brick to finish the north side of the present tower might show that they did not intend to build another story or they would have had more brick made and would not have had to use the broken pieces. This argument is not a very strong one because they could always make more brick and the use of the broken pieces might have been prompted by economy.

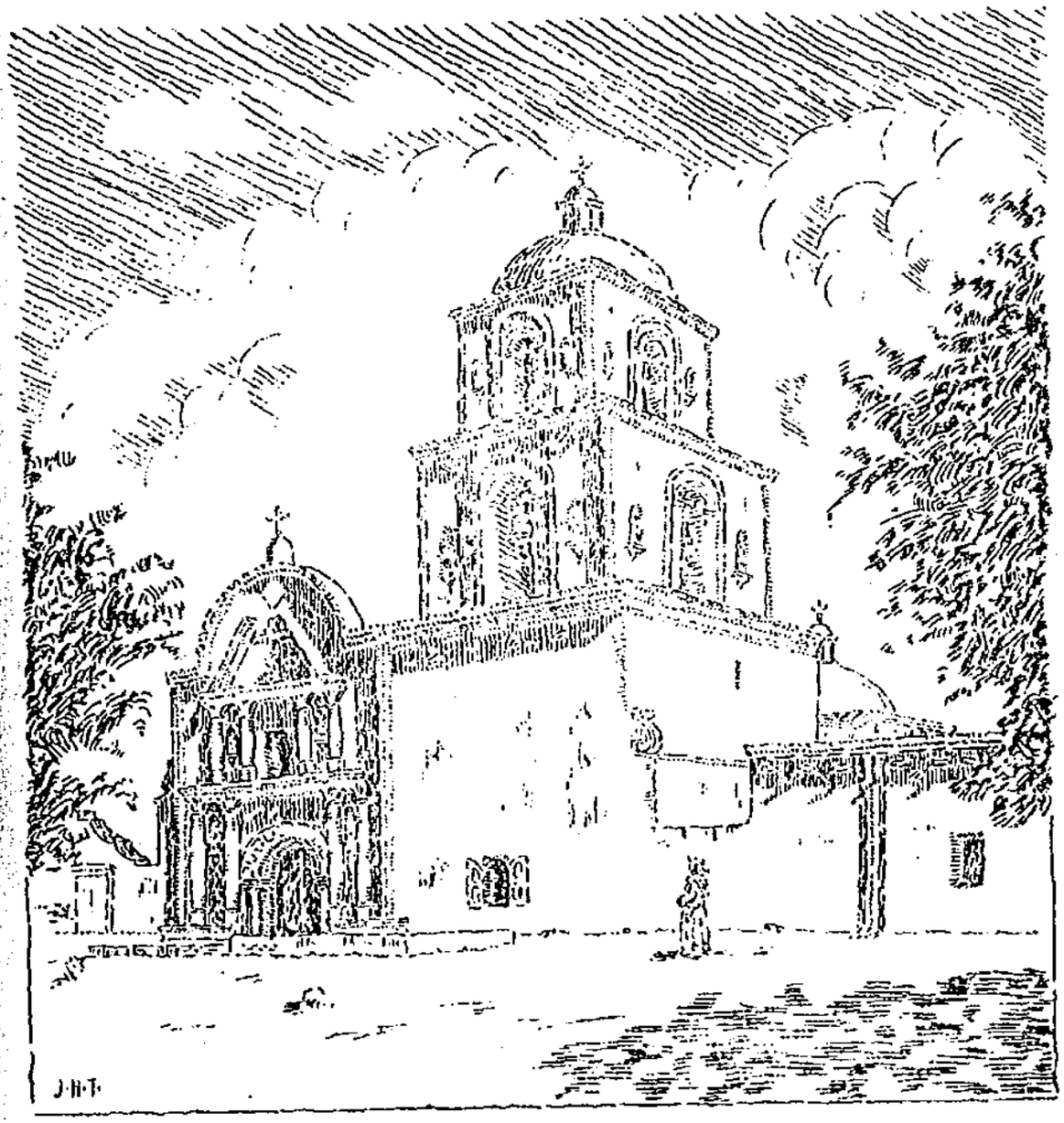
The arguments in favor of the two-story bell tower are:

1. The baptistry side walls have the tremendous thickness of nine feet. This extra heavy wall must have been built for the purpose of supporting a heavy load.** Going up to the choir robing room we find a wall thickness of seven feet six inches--which is two feet thicker than the lower side walls of the nave. Moving on up to the first and only existing story of the bell tower, we find a wall thickness of five feet three inches--which is two feet thicker than the upper walls of the nave. One can hardly believe that this extra two feet of wall thickness was laid just for the sport of laying brick; and it is well to remember that burned brick, which is quite a bit more difficult to manufacture than adobe, was used in the bell tower.***The fact that they used even the broken pieces indicated to me that they prized their burned brick highly and would not have wasted it on unnecessarily thick walls. According

*In which case we should find an outside stair on the existing arches as we do at Caborca and San Xavier. (San Ignacio has no stairway which might indicate that ladders were used in some cases.)

**One fact which has been overlooked is the passageway inside the north, west and south walls of the tower in the first and second stories. These walls might, partly because of this passage and partly because they were to carry a much heavier load, be much thicker than the nave walls. It is true the factor of safety is much greater than necessary, but did the Padres know that?

***The bell arches and piers are not built solidly of burned brick. A shell of burned brick is back-filled with a mexture of adobe mud and rock pluma. You can see this in the south niche in the southwest pier where the brick shell is broken and the back-fill is visible. - Frank Pinkley.



·PLATE·6·TUMACACORI·
·RESTORED·

FACADE RESTORATION

When the Powell Expedition passed by Tumacacori in 1849, one of the members of the party took the time to make an excellent drawing of the facade of the mission together with a long line of buildings to the east of it. The drawing was made in pencil at a very small scale, so that it is quite hard to interpret some of the details. Though some portions of the walls and buildings were then partially in ruins, I have, by a careful study of the picture, been able to work out a complete restoration drawing of the facade together with the high adobe wall on the west and the buildings on the east.

Referring to the drawing (Plate 8), let us analyze the details and I will try to explain why each was restored as it is shown. In order to clearly show the details, it was necessary to make the drawing more or less a working perspective, showing each detail clearly and leaving nothing to the imagination. This did not help the artistic value of the drawing, so please consider it for its working value.

Beginning at the left of the drawing, let us analyze the large archway through the adobe wall. The Powell drawing shows just the beginning of this arch--perhaps two feet of it above the first column west of the mission. The irregular shape of the top of the fragment indicates that the upper portion of the arch was not a concentric circle. The design shown on my drawing is typical of gateways in old Mexico and California Missions, so it is safe to assume that this design is very close to the original. On the west wall of the nave at the point of offset are two scroll shaped buttresses--one at each end of the building. The Powell drawing vaguely shows these and Mr. Pinkley's memory of the marks left by the originals gave me a basis for the design. The Powell drawing clearly indicates that the four columns of the first story of the facade extended down from their present level and rested on bench-like foundations. I have shown the window above the arched doorway as being covered with bars. I doubt if this were true, as iron bars were hard to transport to this new country, and wooden shutters closing from the inside of the building would probably have served the purpose. I have shown a dome on top of the existing story of the bell tower to show what might have been planned for the unfinished tower. It is my belief, however, that a second story was planned for this tower; a discussion of which I have already given. The buildings east of the mission were rather sketchy on the Powell drawing, but a careful study and comparison with a plan of the foundations (Plate 4) excavated last year, made it possible to work out a restoration. The dome shown is a doubtful guess at what the Powell artist shows and it is too far to the east to check with the possible church foundation that was excavated.

I was able to work out graphically the probable location point of the artist when he drew his picture. This point was on a line

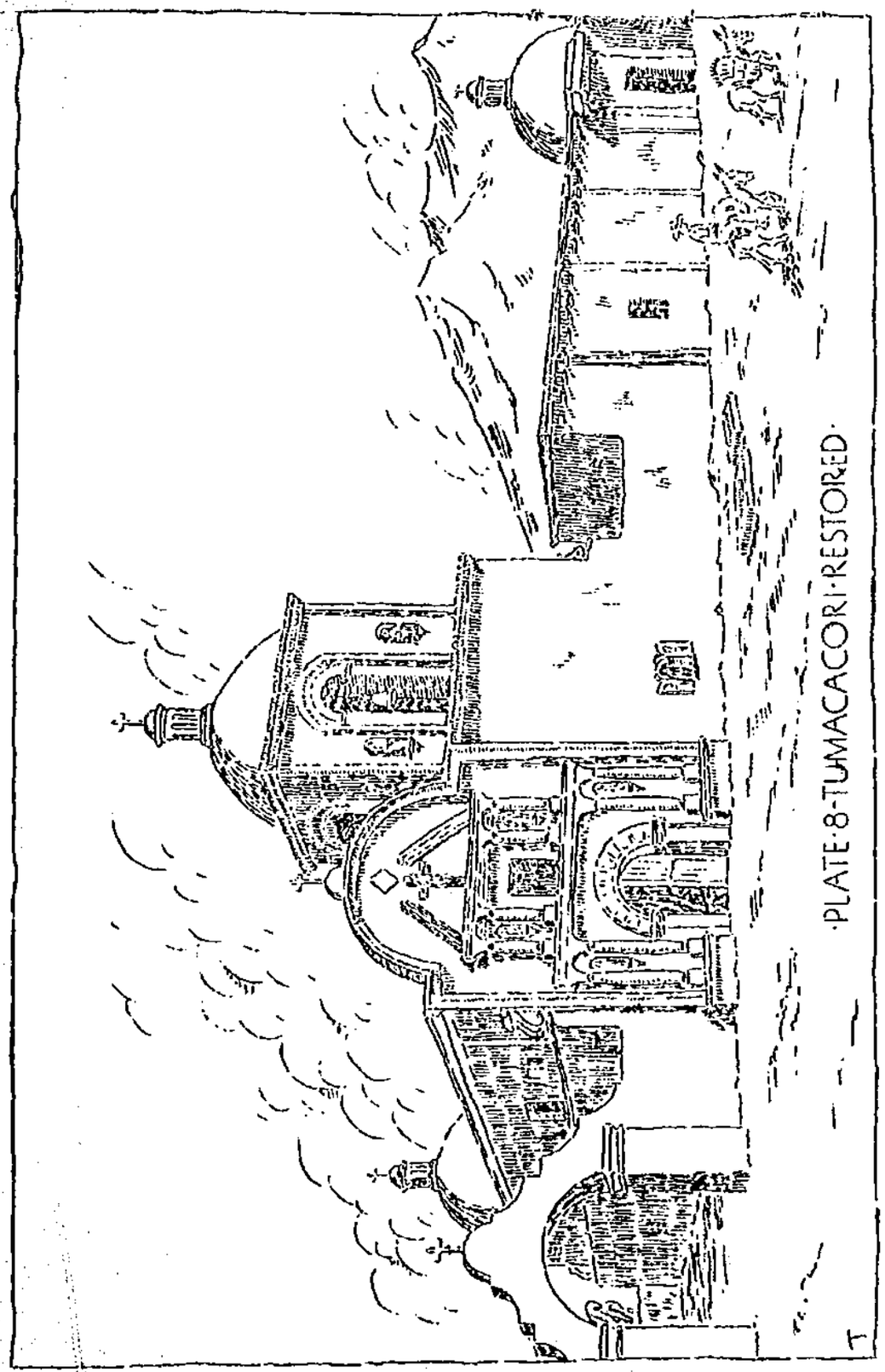


PLATE 8-TUMACACORI-RESTORED

extending from the northwest corner of the mission in a southerly direction, just missing the gate column farthest west from the front of the mission. I plotted the line on the map of the excavated foundations which showed this gateway. I then drew an imaginary picture plane across the southwest corner of the mission; next I moved a point on the known line to a position where the proportion between the distances shown on the Powell drawing for the north and west walls of the mission were the same on the picture plane of the plan. This theoretically fixed the position of the artist and the more accurate his drawing was, the closer he was to this position. In order to check the accuracy of his drawing and thereby check the accuracy of my theoretical point, I located it on the ground at Tumacacori and found that the Santa Rita mountains shown in the background were in almost perfect position in relation to his drawing and the mission also compared well for perspective. Therefore, I assumed my point to be very close to the position of the artist. Returning to the plan of the foundations (Plate 4), I projected lines from this point to various points on the east foundation walls. This gave me distances on my plan picture plane which I could check against the Powell drawing, and in this way I had a basis for making a check comparison of the drawing against the plan of the excavated foundations.

I believe this working study gives an accurate foundation for a more artistic presentation rendering of Tumacacori restored, with the exception of the single story bell tower. A rendering of this nature would be of great interest to the visitor.

RECORDS

Twenty years from now if someone asks the Ranger at Tumacacori detailed questions on what parts of the mission are original and what parts are restored, the Ranger is going to be embarrassed--because the chances are that he will not know. As a matter of fact, he might be embarrassed right now, if questioned closely, because there is no record of what is old and what is restored; which, of course, is not the Ranger's fault. I would respectfully suggest that the National Park Service make detailed measured drawings of the walls of the buildings, showing all restored portions. If this is not done soon this very necessary information will be lost forever.

Twenty years ago we could have made, probably, drawings in true color of almost all the designs on the interior and facade of the mission. Today, I would say that fifty percent of them have weathered away; but there is enough left to make it possible to work out what has been lost. Twenty years from now it is probable that even these traces will be gone. One man could record accurately this information in the form of detailed colored drawings in two weeks' time. This record would greatly assist in the working out of a restoration of the high altar in the sanctuary. I made a color study of the nave cornice

at Tubatama. This simple record will preserve forever this particular detail. Similar records of Tumacacori would preserve, as well as recreate the colored details.

SUMMARY

A brief study of the other missions of the Kino chain convinced me that some restoration was necessary at Tumacacori in order to present it truely to the public as a mission. I have tried to show that perspective, atmosphere, and interest would be improved by the restoration of the pulpit, side alter, and choir loft. The respective restorations are detailed and the methods of arriving at these details are outlined.

As a matter of historical interest I have tried to prove that the plans of the mission were changed when the offset point of the nave walls was reached. In this discussion I proved that the present building could not safely carry a vaulted roof, and explained the presence of the two buttress-like columns on each side of the entrance.

For the purpose of restoration drawings I have tried to prove that it was the intention of the architects to have a two-story bell tower above the roof of the nave. This discussion points out some interesting comparisons on various wall thicknesses.

I have explained how I arrived at the various details of the restoration drawing shown in Plate 8. This drawing not only shows the missions, but also some of the other buildings and walls which existed at one time.

On the matter of records I have tried to impress the necessity of immediately making detailed drawings, showing the location of all restored parts of the mission, and showing all existing painted designs. It is pointed out that a record of the existing designs will assist in working out a restoration of the high altar.

There is no doubt in my mind that the study of the other missions in the Kino chain will continue to bear fruit as I continue to work on the many problems which still remain at Tumacacori.

ADDENDA

The Proposed Museum

Needless to say, I am deeply interested in Tumacacori, and anything that relates to the mission. The proposed museum is so intimately connected with the mission that I feel justified in commenting on the plan which has been submitted. Any criticism which I make of the present plan

of the proposed building, is activated solely by my desire to preserve Tumacacori and present it to the public in the best possible manner.

If we could see the mission as it was a hundred years ago and compare it with the surrounding buildings which had low roof lines and severely plain walls, there is no doubt that the comparison would make the mission look quite magnificent and stately. It has always been the aim of the Catholic Church to construct their buildings of a magnitude that would make them the center of interest in comparison with surrounding buildings. If high roofed buildings had existed at the site of Tumacacori before it was constructed, the mission would have been built on a larger scale, probably. If the existing buildings had artistic wall ornamentation, then tumacacori would have been even more artistic and ornate. In other words, the church was always built to attract the eye, both by its height and by its ornamental facade.

Now suppose the present proposed museum is built at Tumacacori. It is a modern building with plastered walls and having a two-story effect when seen from the outside. Over the main entrance is a large colonaded loggia, to the right of which is a wall surface which has an ornamental niche. The cornice is also topped with ornaments. This modern building is fourteen feet longer than the mission, almost as wide, and is five feet higher than the top walls of the nave. Furthermore, the location of the building is such that the public must see it before they see the mission. Since the building is actually longer and taller than the mission, it is certain to divert the apparent size of the mission. The nice architectural balance of the proposed building will emphasize the crudeness of the mission. In a few words, it is my thought that the public will be admiring and studying the museum building instead of the mission--if the proposed structure is erected.

If we look at Plate 6, the drawing of the mission impresses us that Tumacacori is a rather nice looking church. Now compare it side by side with a drawing of a church like San Francisco. The result would make Tumacacori look smaller and cruder. Comparisons may either improve or injure the appearance of a building. Is there any sound reason why we should injure the appearance of Tumacacori when we can improve it by building the proper sort of building close to it?

My idea of a museum would be to make it as unobtrusive as possible, by keeping its roof line low and unbroken and its wall surfaces plain and simple. By doing this the mission would be seen by the public more as the padres who built it meant for it to be seen by their public.

If the proposed museum were planned to be a restoration of the long low building shown on the right of the mission in Plates 4, 6, and 8, and was built on the site of this original building, it is my belief that two objectives would be accomplished. One of the original buildings would be restored, and the mission, instead of suffering by contrast,

would have its appearance improved. Enough of this building could be restored to amply take care of all administrative needs. A colonade once existed on the north side of this building, facing the old patio east of the mission. This could be restored also as part of the museum building. The one possible objection to this plan is an administrative one. This objection would be that visitors might enter the mission without registering at the museum first. This objection could be overcome by building a low adobe wall in front of the mission in the form of an atrium or courtyard, the gate of which would be an exit only.

SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 2

LIFE FIGURES ON HOHOKAM POTTERY

BY
JOHN E. FAST AND LOUIS R. CAYWOOD

·DEPARTMENT·OF·THE·INTERIOR·
·NATIONAL·PARK·
·SERVICE·

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PAGE/PAGES

SOUTHWESTERN MONUMENTS

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LIFE FIGURES ON HOHOKAM POTTERY

By John E. Faut and Louis R. Caywood.

In the Southwestern United States many different tribes of prehistoric people existed in various localities for long periods of time. Living apart and under different conditions they developed along different lines, and expressed themselves in different ways. The knowledge we have of them is derived from a study of imperishable objects which they left in their houses, graves and rubbish heaps.

In the Gila and Salt River valleys of southern Arizona there lived a people we today call the Hohokam, which is a Pima word meaning "People who are gone." The Pima tribe, together with the closely related tribe, the Papago, which today occupy part of the territory of the Hohokam, may be their descendents. They were different from other prehistoric people in a number of ways.

A characteristic difference is the method of construction of their houses and walled villages, the latter now named compounds. All walls were made of caliche, a native earth found as a sub-stratum about three feet below the present surface. It was mixed with water to make a mortar of a thick consistency which was piled up in layers of approximately twenty to thirty inches by use of the hands.

Another peculiarity of the Hohokam is that they cremated their dead, and after cremation they placed the calcined bones in a pottery vessel or with broken pieces of pottery and buried them. The designs on a great many vessels are of a red or maroon color on a creamy or buff background called Red-on-Buff. The designs are usually well executed, and occasionally portray figures derived from life; human, animal and insect forms, which occur on plates, shallow bowls, jars, ollas and a few special shapes. These figures are usually from three quarters to one and one half inches in height. On the larger vessels they are repeated many times, extending around the vessel in many rows.

Some human figures join hands in what is evidently a circular dance of action and grace. There is also the effect of a circle of animals each stalking the one immediately ahead, and a circle of feeding birds. A whole jar or plate of large size or a repaired one with more than half of the original pieces is rare. It can be inferred that shapes were similar to other utensils of the same period which bore geometric figures; crossed lines, squares, dots, and various other elements. Smaller utensils such as plates and small jars are more likely to have only a few figures and occasionally only one.

It was thought that a minor contribution would be made toward an understanding of Hohokam lives by gathering together and reproducing as many figures representing life forms as possible. Some are shown on the plates following. The pottery of the Mimbres Valley is well

known for its representation of life forms, but many are highly imaginative and exaggerated. For instance, there is a piece showing a man on the back of a grasshopper; there is no mistaking the grasshopper. This is clearly impossible, yet it establishes the fact beyond question that grasshoppers existed during or before the time of the Kimbreños. Although this may be suspected or assumed, where else can one obtain as positive a confirmation of that fact? Similarly, it is hoped that Hohokam figures, when many more are obtained, will show something definitely which is now only suspected.

The plan followed was to visit all collections of Red-on-Buff pottery available, and to photograph the figures. Nearly all figures were secured, however, from fragments of former sites of archeological investigation. The amount of broken pottery, literally tons of it, that comes from an archeological excavation in the southwest can hardly be realized by one not familiar with the work.

Photography rather than sketching was used, because it was necessary to reproduce accurately. One figure may be either a deer or rabbit, another may be either a quail or a parrot, and a less accurate reproduction would tend to throw the identification one way or the other. From a photographic print an outline tracing was made on white cardboard by means of a carbon paper under the print. The tracing was then filled in solid with black India ink.

Much of the design on Hohokam pottery is quite easily rubbed off, and many figures had to be examined closely to make certain of the exact outline. However, the contrast between the bluish-red markings and the buff background was more pronounced in the photograph, when a suitable color filter was used over the lens, than when inspected by eye. In all except ten cases the figures are about eighty percent of the size of the originals, which was the largest percent of reproduction that could be obtained with the cameras at hand. The ten referred to were usually much larger figures in the originals, and were made smaller purposely, as the smaller size was more suitable for reproduction. Two of the figures were built up or re-assembled from a sherd that showed several repeated parts of figures but no complete ones. Each part of the completed figure occurs somewhere on the sherd. With these exceptions, great care was taken to avoid supplying missing parts and lines. For instance, the figures with a basket and staff in one hand (Plate II) would probably hold a crook as do other figures in the same plate if the sherd had not unfortunately been broken off at that point, but this is only a probability and cannot be definitely known.

The figures seem to have been drawn one feature at a time. For instance, a bowl with a line of repeated turtles appears to have had all the bodies painted in first, and the legs and heads added after completion of the bodies. This is evident because the color concentrates in a drop at the end of the brush stroke, visible because it

is a much darker bluish-red than the rest of the line of color, and often when the painter drew the appendages the paint had been thinned and was slightly lighter in color. There is a sureness in the stroke of the brush, which must have been nothing more than a chewed piece of yucca blade or a twig, and a fascination in their repetitive technique that is most interesting, and yet the lines themselves are extremely crude.

No facial features in the human forms are even attempted, excepting rarely a dot representing an eye; in fact, an attempt to make the facial outline with the tools that were available, would have detracted from the artistic value of the product. The little figures are, nevertheless, realistic, and perhaps in many cases portray the life of the times without the least imagination on the part of the observer.

The dancing figures (Plate I) seem almost to be in motion, and the action which they show is characteristic of the social and religious dances of the present day Indian. Today we know that both the Pimas and the Papagos gather from miles around for the social and ceremonial dances. These are gala affairs which everyone attends dressed in his best and all thoroughly enjoying themselves.

In Plate II the figures with the crook predominate. Besides being a utility implement it might have some ceremonial significance, as it appears as part of the regalia of the dancing figures. In modern times the Pimas occasionally used their burden baskets supported by a tumpline across their foreheads. Some of the baskets in the drawings may have been earlier forms of burden baskets. Below is the hump-backed flute player so common to the Pueblo region.

The animal figures which seem to represent dogs, deer, antelope or rabbits (Plate III) are very common, but in form are so much alike that it is hard to tell what kind of animals they are. Below them on the bottom row of Plate III are two figures which are clearly scorpions. The middle figure has not been identified.

On Plate IV bird figures are numerous and a number of different birds are found. Probably the most common is clearly the quail of this region, the Gambel Quail. Others might be Road Runners. Some of the longer-legged birds might be wading birds, probably common at that time in the Gila River Valley.

The last are the reptiles shown on Plate V. Three bird figures are also shown on this plate. The first one may be a Turkey Vulture; the second shows what may be a flock of eagles or hawks. The third was not identified. The reptiles seem to be turtles, lizards and Gila Monsters.

This short paper is only a beginning in the study of figures on Red-on-Buff pottery. It is hoped that it may inspire others to do more work along this line.

Appreciation is gratefully expressed to the following institutions and individuals for their kindness in permitting the writers to study their collections and photograph desirable specimens: The Gila Pueblo Globe, Arizona; The Casa Grande National Monument Museum; The Arizona State Museum, Tucson, Arizona; The Heard Museum, Phoenix, Arizona; and the private collections of Mr. Walter C. Smith, Coolidge, Arizona, and Mr. Carl A. Moosberg, Sacaton, Arizona.

PLATE I

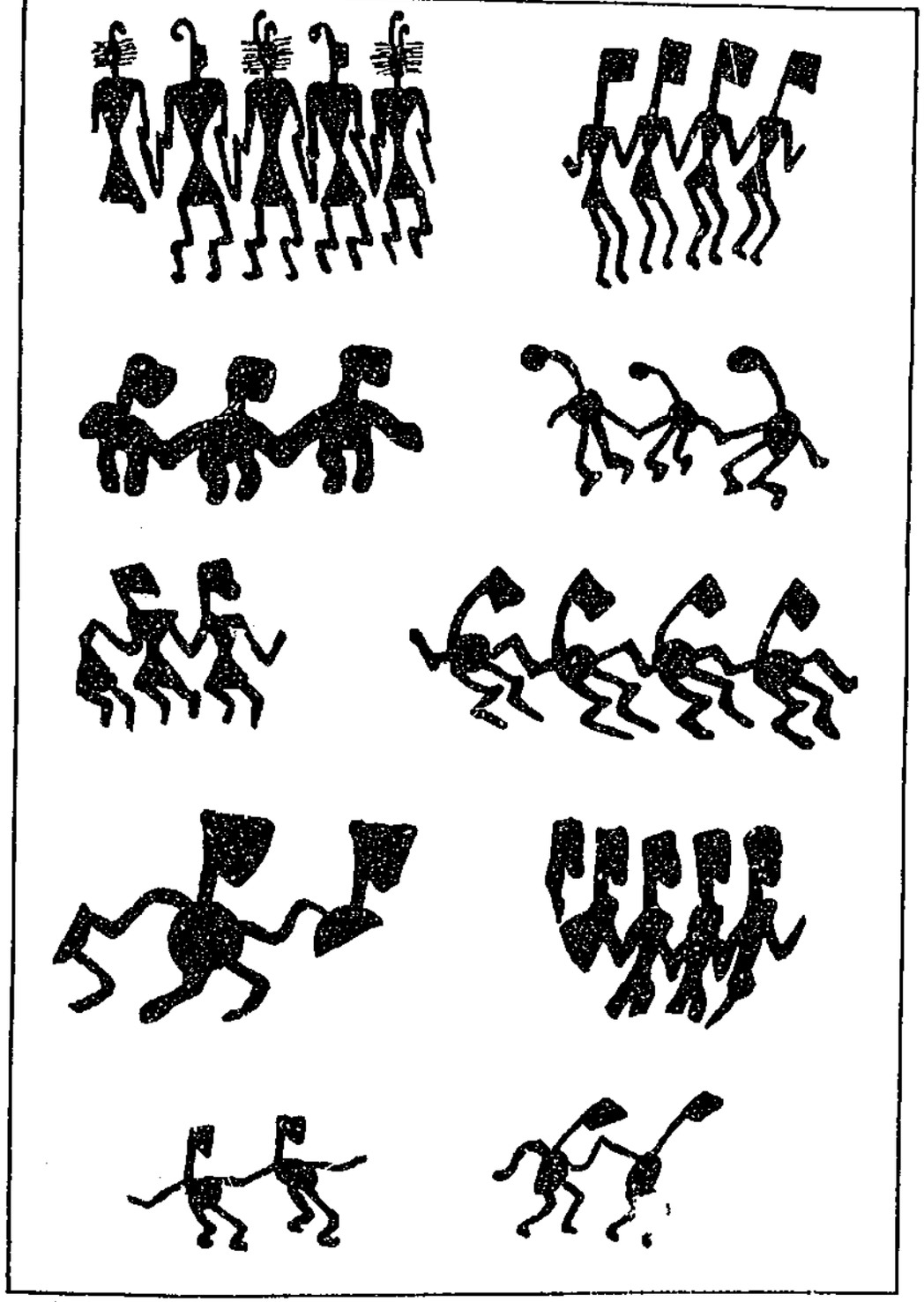
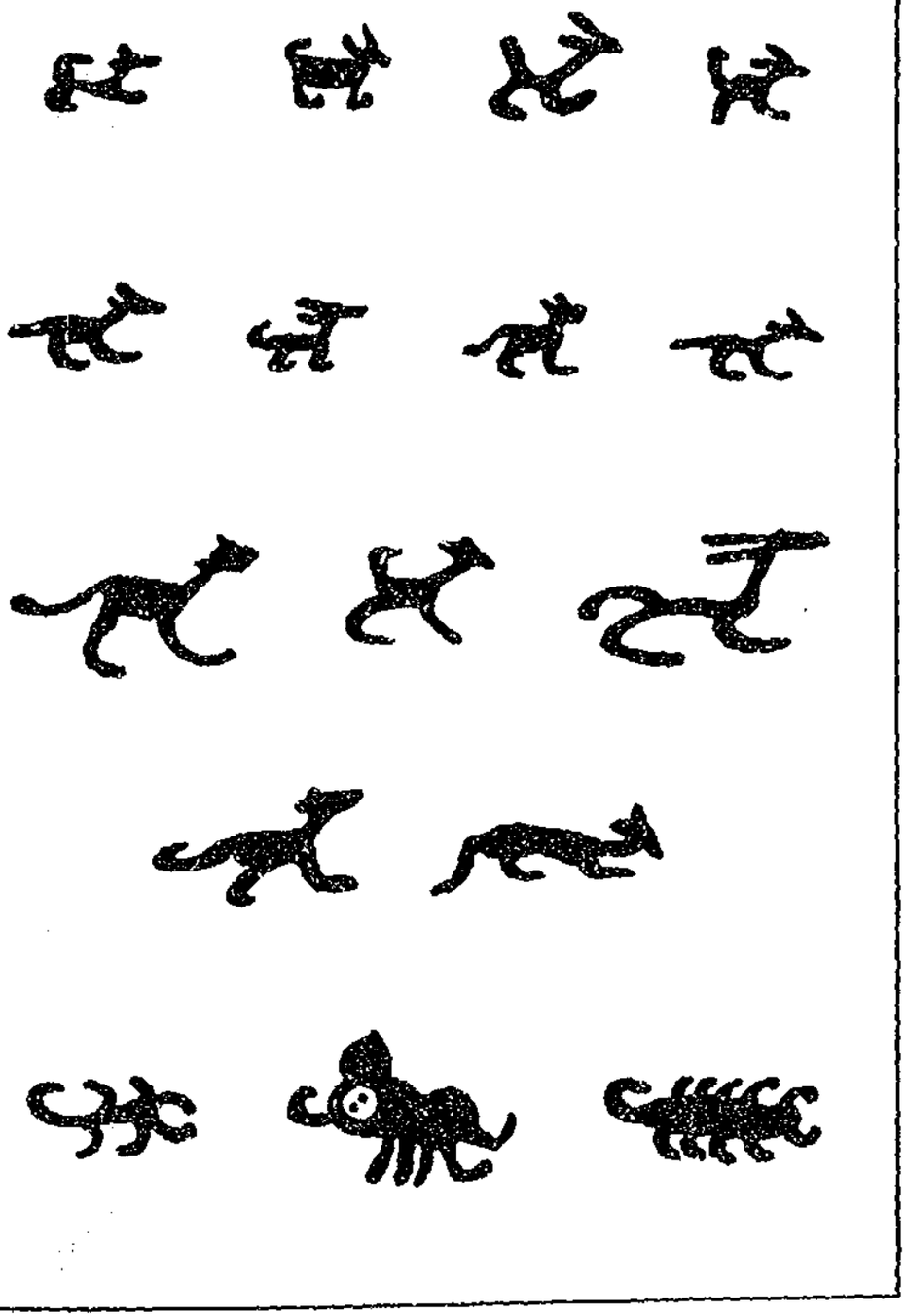
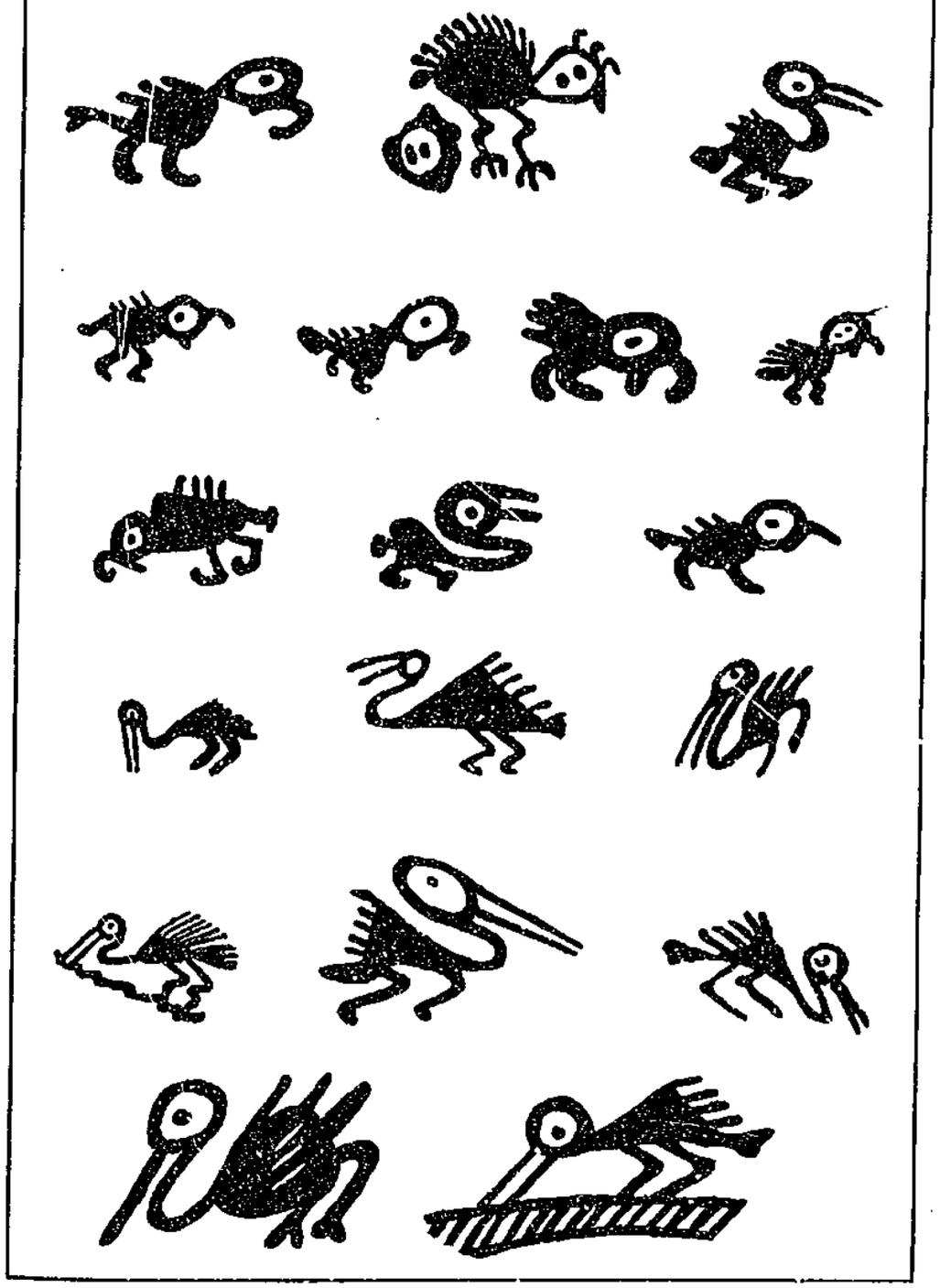
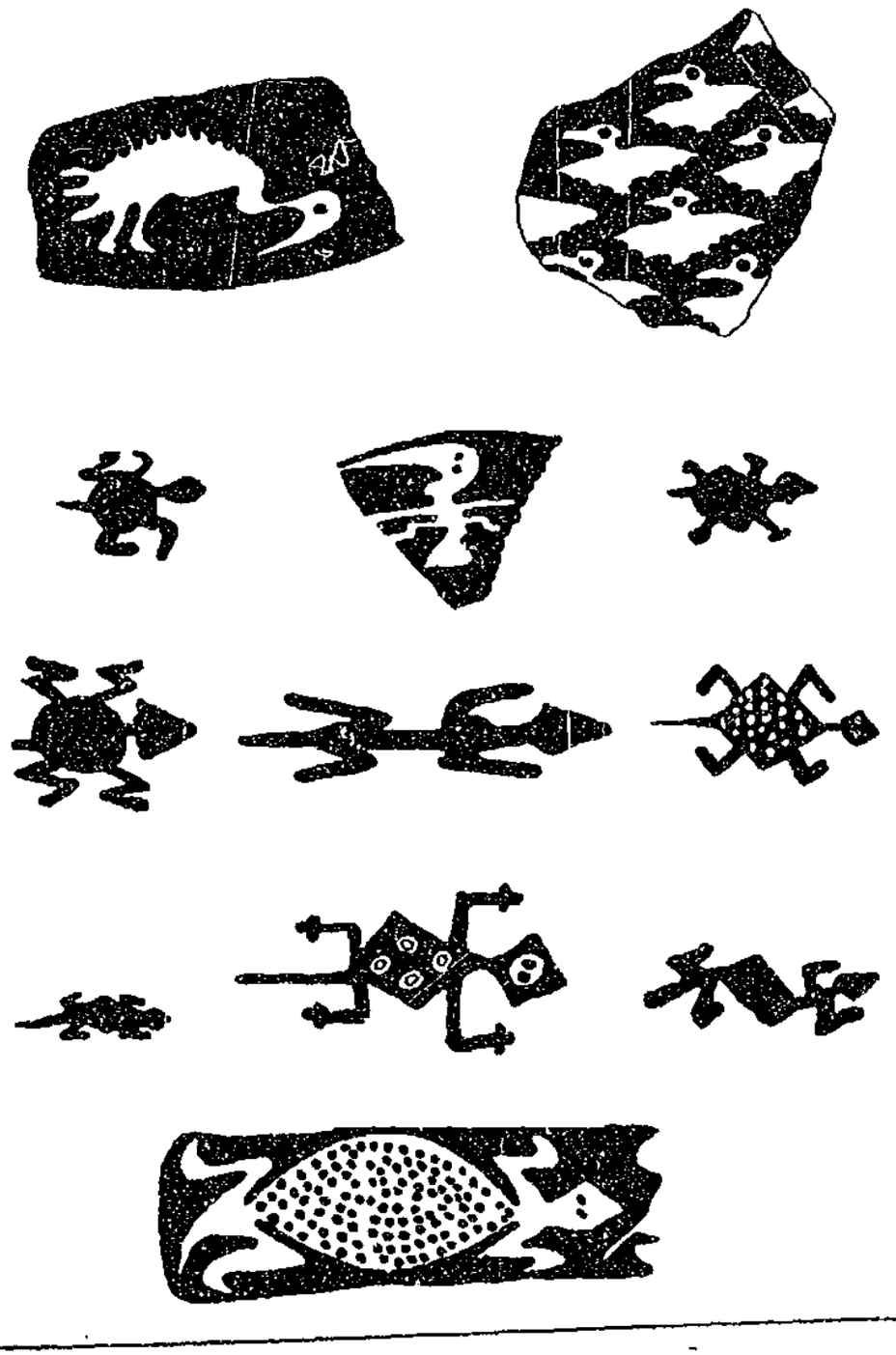


PLATE II.







SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO 3

SUNSET CRATER GEOLOGICAL REPORT

BY
VINCENT W. VANDIVER
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·DEPARTMENT·OF·THE·INTERIOR·
·NATIONAL·PARK·
·SERVICE·

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SKETCH MAP OF SUNSET CRATER

NATIONAL MONUMENT AND VICINITY.....PLATE I

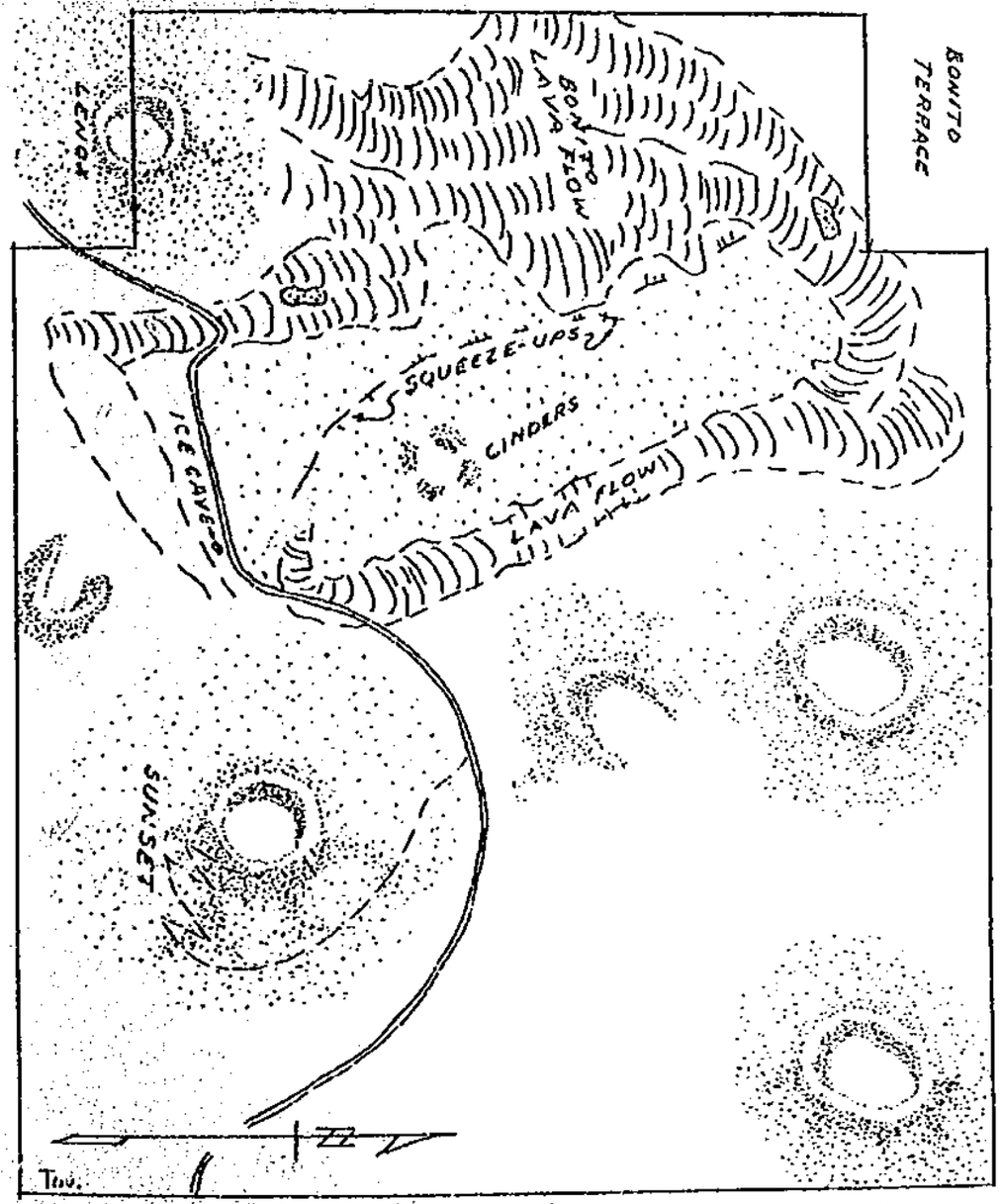

PLATE NO.1
SUNSET CRATER NAT. MON.

SUNSET CRATER GEOLOGICAL REPORT

By Vincent W. Vandiver, Regional Geologist

INTRODUCTION

The almost perfectly preserved crater of an extinct volcano, known as Sunset Crater, was established as a National Monument on May 26, 1930. The name is derived from the various shades of red color of the cinders in the upper portion of the cone which gives the appearance of being illuminated by the setting sun. To the Hopi Indians Sunset Crater was called "Kana-asKatchinki" which refers to the house of Kana-asKachinas, a group of friendly spirits who are supposed to dwell in the crater. The reserve area of the monument contains much of interest besides the remarkable crater and includes very recent lava flows, fissures or vents, contacts of the different flows, and ice caves. The reserve covers 3,040 acres and is located some ten miles east of the summit of San Francisco Mountain. The distance from Flagstaff is seventeen miles. It lies approximately ten miles north of U. S. Highway 66 and is therefore most accessible to a main route of transcontinental tourist travel.

NATURE OF REPORT

H. H. Robinson has given an admirable geological report on the "San Franciscan Volcanic Field of Arizona" in the United States Geological Survey Professional Paper No. 76. Since the facts covering this area, of which Sunset Crater is a part, are presented in such detailed manner in this report that there seems no need for duplication as regards to minute description of the geology. It is not considered possible at any rate to make meritous contribution to such a treatise without months or even years of field work.

It will therefore be my endeavor on the following pages to outline briefly the geological history of the area of Sunset Crater and vicinity; to indicate certain important features connected with this history, which should be brought to the attention of the visitors, by signs along the roads or trails or in a wayside shrine, in order that they will carry away a more complete and vivid picture; and to point out my observations which you may care to consider in any development of the monument, which in my opinion will best portray the geological phenomena of the area. It is also hoped that this resume will be useful to the Rangers assigned to this monument.

PHYSIOGRAPHY

The volcanic field of the San Francisco Mountains occupies a large part of the southern portion of the Colorado plateau region, wherein is located so many of the natural wonders now included in the National Park chain. This field has an area of some 3,000 square miles. Within the large plateau area are lesser plateaus, outlined by canyons trending generally north and south (with the exception of the Grand Canyon of

the Colorado), fault scarps with the same general trend, and erosion escarpments trending mainly east and west. Strictly speaking there are no mountains in the plateau region with the exception of the volcanic masses of Mount Trumbull and the San Francisco Mountains.

The most conspicuous landmark of the San Francisco Mountains is the San Francisco Peak, which attains an elevation of 12,611 feet above sea level, rising approximately 5,000 feet above the surrounding plain. This mountain is surrounded by several other large peaks ranging in elevation from 8,500 to 10,500 feet above sea level. The general area of the volcanic field is studded with cinder cones, but since few of them are more than 700 feet in height, they appear insignificant as one drives among them. They are indeed more impressive when viewed from the tops of some of the larger peaks or if studies on the U. S. G. S. topographic map of the Flagstaff quadrangle. Sunset Crater is one of the more prominent of these cinder cones, having an elevation of 8,000 feet above sea level, and rising some 1,000 feet above the level of the adjacent country.

The drainage for the volcanic area finds its way in due course to the Colorado River. The water courses or washes are comparatively few in number and they naturally radiate from the higher portions of the field. Oak Creek is the only perennial stream existing in the region and it is fed by several large springs which come to the surface at the intersection of two fault planes at the head of the canyon. The climate of the plateau country as a whole ranges according to altitude from semi-tropical to temperate.

Robinson (1) mentions some special characteristics of the lava flows which have caused numerous minor changes in the drainage system of the area. He states that the damming of the water courses has given rise to small lakes, some of which still persist, while others have been drained by the cutting down of the obstruction that formed them, although not before they had been more or less filled with sediment. The grass covered glades, which are a picturesque feature of the landscape throughout the pine forest, generally indicates the location of former lake sites. Two typical examples of drainage modification by lava flows may be observed on the Little Colorado River at Black Falls and Grand Falls. It may be worth while to consider side trips to these two points for people visiting Sunset and Wupatki National Monuments. At least some interesting models could be made of these features for a wayside shrine which would depict the encroachment of lava on the stream and the changes resultant therefrom.

GEOLOGIC HISTORY

The Paleozoic Era of the plateau is admirably represented in the section which is exposed at the Grand Canyon of the Colorado. Various types of sedimentation are represented in this section, extending from

the Tonto platform to the rim of the canyon. Deposits of marine sediments are present which contain shells and corals; beach and flood plain deposits are represented by formations bearing sea weeds and the remains of crab-like animals; also formations of continental origin, such as great thicknesses of dune sands, containing tracks of primitive reptiles or amphibians. Thus during this era there is evidence of repeated fluctuations in the land surface with the resultant encroachment and withdrawal of the seas. At the close of the era the seas had invaded most of northern Arizona as indicated by the widespread distribution of the Kaibab limestone formation and the abundant fossil record of marine life which it includes. This formation forms the rim rock at the Grand Canyon and may be observed in most any direction near Sunset Crater.

The Paleozoic is followed by the Mesozoic Era and from a study of the formations included during this interval it is evident that there were also fluctuations of the sea during this time but in the main the lands were generally depressed. Great thicknesses of sandstones, shales and limestones were deposited on top of the Kaibab formation. At the close of the Mesozoic (Age of Reptiles) the waters retreated and the era of recent life of the Cenozoic followed.

The surface of the earth is rarely stable and constant adjustments are being made even at the present time. When strains or stresses are too great during these crustal movements, faulting and fissuring takes place, and oftentimes quantities of molten lava is poured out on the earths surface through these vents or lines of weakness. Adjustments on a huge scale were in vogue at the close of the Mesozoic when the great Rocky Mountain construction took place.

During the Miocene period of the Cenozoic the area west of the Little Colorado River was rising to form what is known as the Little Colorado Monocline. This may have been due to an intrusion of molten lava which did not reach the surface which is termed as a laccolith. Following this general uplift erosion proceeded at a much more active rate and the Mesozoic formations of the San Francisco Mountains was almost entirely eroded away. In fact parts of the Permian formations of the Paleozoic were stripped.

During the Pliocene period (late Cenozoic) we have the First Volcanic Period of the San Francisco Mountain area. Huge fissures gave vents for the pouring out of sheets of basaltic lava, from 50 to 300 feet in thickness, covering a wide area and extending from the Tonto Rim to Cedar Wash. Following in the latter part of this period the uplifting continued when great north-south faults cut the earth's crust and the Second Volcanic Period began. As tremendous quantities of lava was poured forth on the surface, such prominent peaks as Bill Williams Mountain, Kendrick Peak, Sitgreaves Peak, the San Francisco Peaks, and O'Leary Peak (near Sunset Crater) as well as others were formed. A variety of different types of lava was extruded at this time

but in general they were more acid, contained more quartz, and were therefore lighter in color than the basalt of the First Volcanic Period.

As the plateau continued to rise the erosive agencies became more severe and great canyons were carved on the surface. Several thousands of feet of volcanic rocks were no doubt removed from the crests of the San Francisco Peaks as is indicated by a projected profile of their surface. With physiographic features of the plateau much as it is today the Third Volcanic Period began. To the Third and last general period of volcanic activity in this field, covering a considerable interval of time (beginning near the close of the Second Period and extending into comparatively recent geologic time), some 200 basalt cones and lava flows over 1,200 square miles represent the volcanic activity during this period. Sunset Crater is one of the cones formed at this time. This activity certainly occurred during the quaternary period and presumably during the latter part of this period according to Robinson (1). The state of preservation of the cones and lava flows is so perfect that they may date from historic time. Due to their presence, however, in an arid to semiarid region they naturally retain a much fresher appearance than would otherwise be the case in a humid climate.

Generally speaking throughout the geologic history of the plateau there have been two opposing forces which have produced the detailed topography - erosion, which is destructive; and volcanism, which is constructive.

One question that will probably be asked many times, due to the recent character of the surface evidence of volcanic activity, and that is has the activity actually ceased in this region. Robinson (1) advises as follows on this subject: Broadly speaking it may be said to have ceased. There may be further small outbreaks of basalt, but this does not seem probable in view of the insignificant volume of the latest eruptions compared with the total volume of lava of the last general period of eruption. These very latest outbreaks may be looked upon as representing the final feeble manifestations of a long and very complete cycle of volcanism.

SUNSET CRATER

Sunset Crater is the most dominant feature of the monument. It rises to a height of about 1,000 feet from its base, and its summit has an unbreached crater about one-fourth mile in diameter and 400 feet deep. The upper portion of the cone is covered with tinted cinders and lapilli (little stones). The mountain has received its name from the rainbow effect, where the color of the cinders grades downward from the summit of the cone through the various shades of yellow, orange and red into the black material of the lower slopes. There is practically no evidence that the cone has been shattered by explosions and the fact

that erosion has not produced any noticeable change of form attests somewhat as to its recent age.

Basaltic lava is exposed around the rim of the crater. It has been altered and bleached to tones of yellow and pink by fumarole action. Hot spring minerals may be found in this zone. Sulphur crystals, gypsum and limonite are present. Fragments of sandstone and limestone which have been ejected from the crater are found around the rim. Some of the specimens of sandstone have their stratification preserved in part but the edges have in most cases been well altered due to the action of heat. Most of the limestone has likewise been metamorphosed so that it is now classed as marble.

The eastern rim of Sunset Crater is 150 feet or more higher than the western rim. This characteristic is common among the two hundred cinder cones of the last period of activity. The fact is explained by the reason of the prevailing westerly winds during the main eruption when ash, cinders and lapilli fell in this direction and thereby building up the eastern rim to greater heights.

Because of the various indications of recent activity at Sunset Crater and vicinity, which are more or less visible to the visiting public, the determination of the age of the last eruption has always been an interesting question. Robinson (1) states that the latest cones and flows are older than the pine trees growing at the edge of Bonito lava flow, west of Sunset Peak, which would make them not less than 300 years old and possibly not more than 1,000 years old. A possible Hopi tradition of the eruption of Sunset Crater is mentioned by Dr. Colton (4). Geologists, who are generally credited with being unable to think in terms of a few years, have been content to call it a very recent cone. Exact determinations in this regard have required other means of approach. The ash from this crater undoubtedly covered hundreds of square miles. It is known that this black sand buried numerous pit houses of an ancient people (pueblo) which had been constructed on Bonito Terrace. A number of these houses have been excavated by archeological expeditions of the Museum of Northern Arizona, McGregor (5). Attempts were made to collect additional data from the sites that had been abandoned before, or at the time of the eruption of Sunset Crater. Charred beam material was particularly desirable, as well as information collected as to the nature of the ash fall accumulated above and in the sites, with data as to the pottery in use, artifacts, and types of houses contributing factors.

A trail leads to the summit of the crater and the round trip can be made in one hour if one is rushed for time. It is best however to spend at least a half day on the rim and in the event that the interesting details of the mouth of the crater fails to hold one, there is the magnificent panorama of the Painted Desert, San Francisco peaks, and the Bonito Lava flow below with its many interesting features.

BONITO LAVA FLOW

This lava flow is probably the second most important feature of the monument and is almost entirely contained within the bounderies. The map, Plate 1, which accompanies this report shows the relationship of the lava flow with Sunset Crater. This lava escaped from a vent opened through an older flow of the Third Period and spread out quietly into an intercone basin. As the lava could not flow far it has probably piled up to depths of several hundred feet.

A badly disrupted cone known as Yaponcha Crater is located in the central portion of the flow. The exact nature of this cone is not known. It is possible that it has been the source of some of the lava and that it was disrupted at the time of the flow. Another explanation is that it may have been more or less floated on the lava and thereby disintegrated.

Along the surface of the Bonito flow to the west of the above-mentioned cone and extending in a northwest direction is a large vent or fissure which has also been termed "Anosma" or "squeeze-up." After the surface of the flow had solidified, the fissure tore the surface, and semi-plastic lava was squeezed upward. In places the lava has been forced some ten feet in the air and frequently crumpled under their own weight. This type of flow seems to be rather unique among volcanic phenomena and it has been suggested that there may be some relation to the fact that the main lava flow was dammed.

The Ice Caves immediately west of Sunset Crater on the Bonito flow seems to be the principal attraction to a great many people. In fact at the time of my last visit some people were asking how they could get to the Ice Caves and seemed little concerned or anxious to ask questions regarding the multitude of volcanic phenomena about them. The cave has only been explored a few hundred feet. It is likely that the roof has collapsed in places and it may well be rather extensive. This type of cave is typical of lava flows where the lava has drained away, leaving the solidified roof standing. It is most unusual to enter the cave in summer and find it filled with ice. The details as to the method of the formation of ice caves is not fully understood. Lava is a poor conductor of heat and the cold air which settles to the bottom portions of the cave is protected to a certain extent. It is possible that some interesting information could be collected which might have a bearing on this feature if temperature readings were taken at regular intervals in the cave.

Besides the above-mentioned important points in connection with the Bonito flow there are several others worthy of attention. There are a number of fumaroles at the base of Sunset Crater and vicinity where gases escaped during the last active stage of the crater. A sink hole is shown on the map just east of the Yaponcha crater. In this case the lava flowed out from under the crust forming the sink.

The remains of a hot spring is also shown on the map. It is located very near the large fissure of "squeeze-up" previously discussed. A considerable portion of the Bonito flow is covered by a more recent ash fall. Examples are numerous illustrating this feature and it has been noted that considerable more ash fell on the southern than on the northern end of the flow. Cooling cracks, contacts of the different flows and other fascinating features are prevalent and it is considered that as the monument is developed many other interesting facts will be divulged of interest and importance.

ARCHEOLOGICAL

The Hopi legends of the Sunset Crater region have been described by the staff of the Museum of Northern Arizona. The Museum Notes (4) give a vivid picture of Yaponcha, the Wind God and the Kana-a Kachinas of Sunset Crater. We have endeavored to show how determination of the age of the last eruption of the crater has been made by a study of the remains of pit houses. This type of material when authenticated will form a most important background for a story of the monument.

FUTURE DEVELOPMENT

I do not know if detailed plans have been formulated as to the development of this monument. It seems to me that one custodian could probably take care of Sunset and Wupatki as is now the case. It is my thought that a Wayside Shrine near Sunset could portray all the facts of the monument and that directions from this point could be given to the various trails to illustrate the features in place. Exhibited in the shrine we could arrange generalized sections and inexpensive models to show the different stages of volcanic activity in this field. A collection of the various types of lava, hot spring minerals, rocks and material from the outcrops of sedimentary formations in the surrounding area and corresponding material which has been ejected from the crater would all no doubt prove of considerable interest. I believe that panorama photographs could be taken in this general area and that ink sketches could be made therefrom to serve as a guide to the various trails. Actual trail construction should be kept down to a minimum and it is thought that with the proper use of signs the visitor will be directed sufficiently to see all of the points of interest. It is possible that some sort of a guide to prominent features of the landscape will prove essential from the summit of the crater. Some of these things will of course not be necessary if a permanent ranger is maintained for this monument.

POINTS OF INTEREST

It is considered that the following features of the monument will be worth while calling to the attention of the public when it is developed:

1. Sunset Crater - Signs is what seems to be needed most at the present time especially in view of the fact that there is no permanent ranger present and there is no pamphlet available.

2. Bonito Lava Flow should have markers at different points to better depict the facts for the visitor.

3. Attention should be called to the most important fissures or "squeeze-ups" with signs.

4. An explanation of what we know of the formation of ice caves might well be posted at the entrance of the caves.

5. Fumaroles, sink holes, spatter cones, hot spring remains, contacts of different flows of lava should all be marked by directions from the main road or "turn-around." A sign could very well be erected at each feature explaining briefly its origin.

I am aware that some people object to too many signs but I see no recourse under the present setup of the monument. I am sure that many people go there and see the ice cave and go away with very little knowledge of what has gone on about them. The monument is most accessible to a main artery of travel and many more people will visit the area if a little money is spent on the development. It seems to that there is every justification for some development as Sunset Crater is really one of the most important monuments in the Southwest.

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SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO 4

·MISSION·
·SAN·JOSE·DE·TUMACACORI·
·CHOIR·LOFT·PROBLEM·

BY
·FRANK·PINKLEY·&·J·H·TOVREA·
·DEPARTMENT·OF·THE·INTERIOR·
·NATIONAL·PARK·
·SERVICE·

May·1936

THE TUMACACORI CHOIR LOFT PROBLEM

By Frank Pinkley and J. P. Tovrea

A most interesting theory has recently been developed in connection with studies of the mission at Tumacacori National Monument. It is given here for what it may be worth and we freely admit that it may not check out when more evidence turns up. As the evidence now stands, this theory accounts for some facts which have been puzzling us for the past twelve or fifteen years.

That there have been changes of plan in the construction of Mission San Jose de Tumacacori can be shown, we think, beyond the least question of a doubt. The evidence also points strongly to the fact that there was reconstruction after certain parts of the building had been erected; that is, not only was the plan itself apparently changed here and there before the actual construction of some parts of it had been effected, but certain changes of plan were made which entailed tearing out and rebuilding some portions of the structure. At some future date, after the publication in these pages of Mr. Beaubien's report on his excavations of 1935, an extensive report will probably be prepared which will cover a complete study of all these changes. Working, however, under our regular policy that as soon as we get a new theory or fact we might as well pass it along for criticism and suggestions, we are offering here one of the details which later may be more completely developed and incorporated in the study of all the changes which are indicated in the mission walls.

We believe that Mission San Jose de Tumacacori was under construction for many years longer than the present written records would indicate and was, as a matter of fact, never completed. The modern method of putting large gangs of expert workmen on a construction job and pushing it through to speedy completion was not in use in the old days at Tumacacori. This was due in part to the time and country. The men who worked on this job were undoubtedly drawn from the local community and must be allowed time off to attend to their own work, such as planting, handling and harvesting their crops. The work might also have been stopped at various times and for considerable periods by financial difficulties. The Apache Indians, with their constant menace of raids and forays, no doubt caused their share of delays. We can also turn to the experience of the California Missions where we find many of the present structures took from six to ten years in the building. This factor of an extended period of construction would account for revision of plans and changes in the work during the erection of the church such as might not occur in our present times, and we must, therefore, be willing to look for such changes and make allowance for them.

The present study deals with the right hand or east wall of the church as one enters the front door, and covers and distance from the

front wall some twenty-five feet to the north, and from the floor to the roof. The present condition of this wall is shown in Plate 2. The view is from the west side of the room looking east and shows the large buttress to the east of the entrance doorway at the right side of the picture. To the left of this buttress can be seen the entrance archway to the Baptistery and further to the left is the pilaster which once carried a choir loft arch. Above the archway to the Baptistery is a doorway opening from a second story passage in the tower on what was once the choir loft floor.

The choir loft arch was standing as late as 1889 and we have a picture of it taken that year from a point about under the triumphal arch at the front of the nave. Above and a little to the left of this pilaster will be seen a peculiar curved effect in the wall construction where the plaster has broken away enough to expose it. Closer inspection will show that this curve is roughly centered on the curve of the Baptistery archway. From the high point of this curve, a little below the choir loft doorway, a horizontal line can be seen running to the left and meeting a vertical line which falls vertically parallel to a tangent to the left end of the curve. This triangle, if you will pardon the slightly inaccurate expression, has been the source of hours of study, worry and conjecture on our part. It was originally filled with a grouting of lime mortar, stones and an occasional brick bat. About half of this filling has long ago broken away and disappeared, the remainder is still embedded in the wall. It is totally different from any of the wall construction near it and lies in what appears to have been a plain piece of wall. An examination of the opposite wall of the church discloses the same condition on that side although the plaster, being in a much better condition, covers most of the triangle.

Mr. Beaubien's report on his excavations of 1935 will disclose the plan of foundations which he discovered under the present floor of the church. (See Plate 1.) One of these foundations occurs on each side of the room directly under each of these triangles.

The facts as stated above caused us to begin this study on the possibilities of the church having had two choir lofts or having been planned for a choir loft which was never built, the plan having been changed to a smaller loft whose arch was still standing in 1889, and which we shall refer to hereafter as the "late loft."

We note that the foundations under the floor are adequate to support a much heavier choir loft arch than the late one. The indicated width of the old loft pilaster along the church wall, too, is much greater than the late pilaster. The indications are, then, that the old loft arch was heavier and that the pilaster was thicker from front to back and probably extended further from the wall than the late arch.

We believe the curved line on the wall will explain this for us.

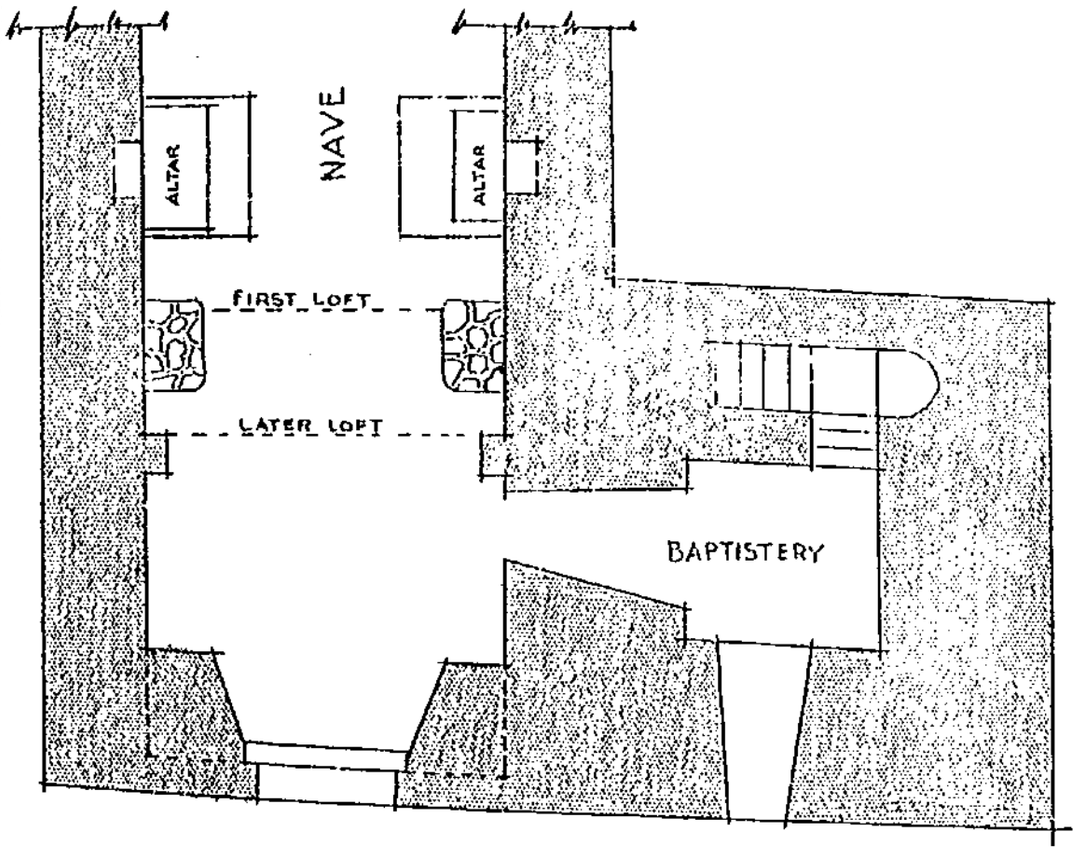
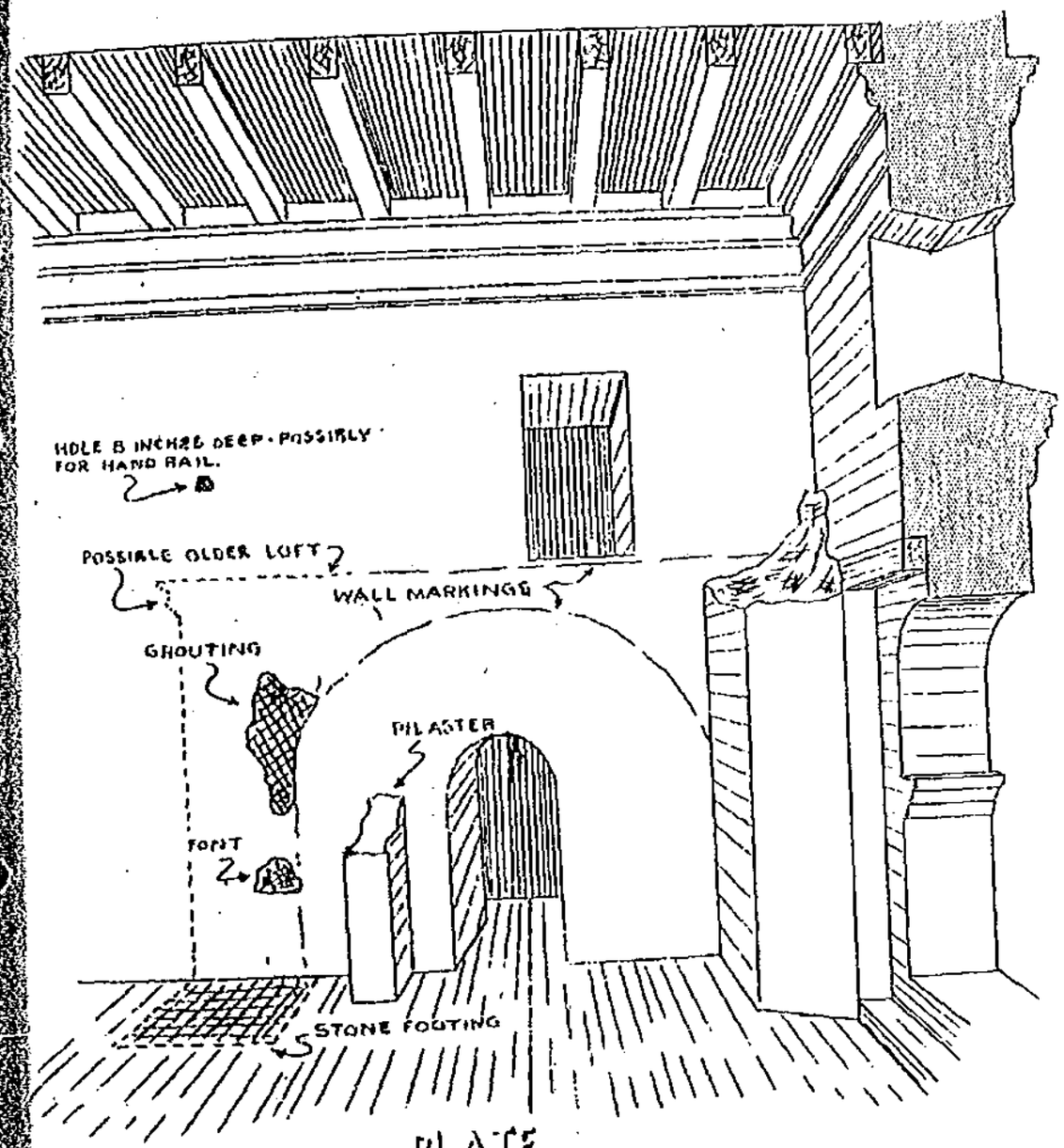


PLATE 1-PLAN.

Tov.



PLATE

EAST WALL

Tov.

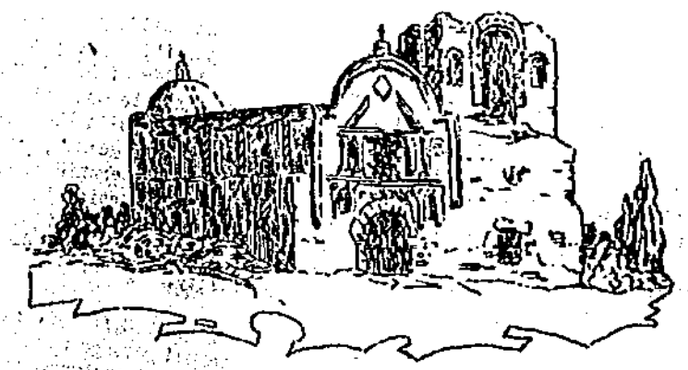
built to fit that plan; that the attempt at the groin vaulted arch failed and the padre, finding that he could not execute it because of lack of skill or funds, tore out the pilasters;left the foundations and groutings in the walls to puzzle us these hundred odd years later; gave up the groin vault entirely; moved his choir loft arch back to the right a few feet, thus decentering his Baptistery entrance; and, with a much lighter arch than was first planned, built a beamed floor in his choir loft. The pilasters of the later loft are not bonded to the walls which would check with this theory.

Another theory would be that the present walls are older than we think they are; that they are the walls which were unroofed in the raid of 1765 and re-roofed in 1781. This theory would suppose that the burning roof crashing in in 1765 bore down the groin vaulted choir loft; that in the reconstruction of 1781 they had not the means or skill to rebuild the vaulted loft and so, clearing away the debris of the old loft, they erected the new as their best effort.

This last theory in itself is a fine one, but we cannot square it with the entry in the burial record in 1822 where the transfer of the bodies of the two priests from the old church to the new, which would certainly indicate that the "new" church, which was still unfinished in 1822, could not have been the "old" church which was re-roofed in 1781.

We have asked Custodian Caywood to do some ring growth research on the headers of the various openings in the present church and see if we can get any time factor along that line of study.

In the meantime we are putting this problem of the choir loft of Tumacacori into the record on the evidence we have and leaving the question open to argument.



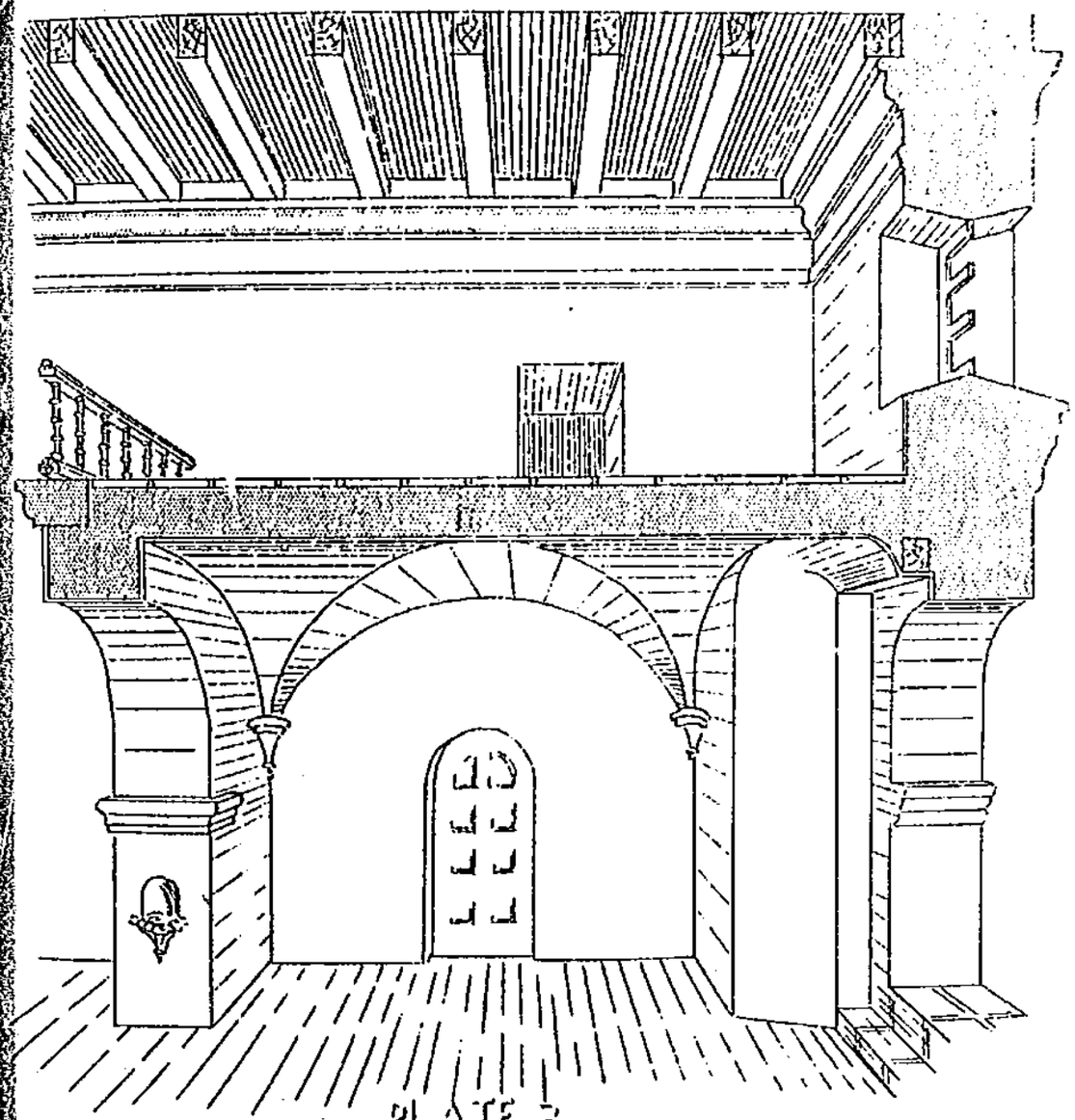


PLATE 3.
THEORETICAL GROIN VAULTED
CHOIR LOFT

Tow.

10-234

SOUTHWESTERN MONUMENTS
SPECIAL REPORT
NO 5

WAITE SANDS
GEOLOGICAL REPORT

BY
VINCENT W. VANDIVER
REG'L GEOLOG.

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

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GEOLOGICAL REPORT ON WHITE SANDS NATIONAL MONUMENT

By Vincent W. Vandiver, Regional Geologist

INTRODUCTION

The White Sands National Monument is rapidly becoming one of the prime centers of interest among the Southwestern Monuments. It is estimated that approximately 34,000 people visited the area during the past year. I was informed that Mr. Gilbert Grosvenor, editor of the National Geographic Magazine, stated during his recent visit that he had observed three of the natural wonders of the world in the course of a few days; namely, Grand Canyon, the Carlsbad Caverns, and the White Sands. The inspirational features of the sands cannot be denied and this fact together with its being the only occurrence of gypsum sand in the world of much magnitude may eventually warrant the area being given consideration as a national park.

It is due to this increased interest in the White Sands and the fact that several theories have been advanced by geologists as to the source of the gypsum that I visited the area, in an effort to relate the best geological picture possible. There is considerable geological information in the literature on the Tularosa Basin and with this data at hand combined with the field studies made there appears to be little doubt as to the source of the main portions of the gypsum comprising the sands. Since only a short time was spent at the monument the following pages are necessarily largely a compilation, however, the data assembled is in the main from the publications of the United States Geological Survey and since this type of material was available there appeared little reason for spending time duplicating field studies completed previously.

LOCATION AND EXTENT

The Tularosa Basin, of which the National Monument is a part, lies between two of the most prominent mountain ranges of New Mexico, the San Andreas mountains on the west, and the Sacramento mountains on the east. This elongated synclinal basin is approximately 150 miles in length, has a minimum width of 60 miles, and covers an area of approximately 6,000 square miles. The most spectacular feature of the area is the granular gypsum comprising the White Sands, situated some 12 miles west of Alamogordo, in south central New Mexico.

Approach to the heart of the sands is over State Highway No. 3 which extends in a northeast-southwest direction connecting the towns of Alamogordo and Las Cruces. North-south U. S. Highway No. 80-85 to Albuquerque and El Paso is available at Las Cruces. U. S. Highway No. 54-70, running in the same general direction, may be had at Alamogordo for El Paso as well as points north. The Southern Pacific at Alamogordo is the nearest

approach by rail to the White Sands.

The deposit of gypsum is about 27 miles in length from north to south and averages around 10 miles in width, the greatest width being about 15 miles. (See Plate I for aerial extent.) Over 500 square miles are covered by the gypsum sands which probably average 50 feet or more in thickness. It has been estimated (8) that the deposit contains 15,000,000,000 tons by using 60 pounds to the cubic foot of gypsum, with much of the material containing no more than 2 or 3 per cent of impurity. It is interesting to note that the gypsum sands proper occupy only about 5 per cent of the total area of the Tularosa Basin.

The White Sands National Monument was created in January, 1933, and was formally opened to the public by Mr. Tom Charles, resident custodian, in April, 1934. The area comprised in the monument is 143,145.91 acres and negotiations are now being concluded for an extension to the southeast covering 1,640 acres, including a 200-acre lake, which is to be used primarily for a migratory bird refuge. The total area will therefore be approximately 225 square miles.

Roughly 40 per cent of the total deposit of gypsum in the basin is contained within the boundaries of the reserve area. On this basis and in consideration of the above estimate for the total amount of gypsum present there are 5,200,000,000 tons of almost pure gypsum within the monument leaving an estimate of 7,800,000,000 tons outside for public exploitation as desired. The average gypsum mined yearly in the United States for the five year period 1927-1931 amounted to approximately 4,300,000 tons (14). Should all sources be closed in this country and the consumption of gypsum required for domestic purposes be taken from the White Sands outside of the National Monument it is calculated that there is a supply available to meet the needs for over 1,800 years. Botkin (5) states that if all of the gypsum mines and mills in the United States were shut down for 1,000 years, a normal supply could be obtained in the sands' area outside of the monument.

HISTORIAL

The Tularosa Basin is rich in historical interest. The coming of the Spaniards in the sixteenth century and their contacts with the Pueblos and Apaches form many exciting chapters. The main route of travel in the early days was along the Rio Grande, the valley to the west, and that the desert, because of its lack of water and Apache depredations, made a deep impression upon the early travelers is certain since it was known as the Jornada del Muerto, or "Journey of the dead." Evidence still remains of the extension of the rule and religion of the Spaniards at Manzano and Gran Quivira. Gold placers and salt found in the alkali flats were early attractions to this area. Heavy wooden wheels of ox-carts and irons with which the oxen were shod have been observed along the old trails. The first real development in the area was the establish-

ment of Fort Stanton in 1855. The range wars of the 80's and the bloody events surrounding the activities of Billy the Kid all lend much to a fascinating historical picture.

PHYSIOGRAPHY

West of the Great Plains of New Mexico and Texas is a region of isolated mountain ranges with alternating plains or broad open valleys. The Pecos and Rio Grande rivers flow through several of these valleys, but in the region between these rivers there are valleys which are entirely inclosed by higher ground, thus having no drainage outlets. The Tularosa Basin, of which the White Sands is a part, is a typical example of such an inclosed basin.

A variety of topographic features occur in this elongated basin. Probably the most prominent to the average visitor are the buttes Cerrito Tularosa, a few miles southwest of the town of Tularosa, and Tres Hermanos Peaks, near the southeast boundary of the monument. Fault scarps and innumerable shore line features are in evidence. Stream built slopes, terraces, alkali flats and an enormous exposition of dune building all contribute much to the attractions of the area to the observing person. In addition, along the northern portion of the basin are volcanoes and lava beds of intense interest and scientific importance.

Generally speaking the reserve within the boundaries of the National Monument consists of equal areas of gypsum sand dunes and alkali flats. In the southwestern portion there is an alkali lake covering six or eight square miles. The majestic peaks of the San Andreas and Sacramento Mountains, which limit the basin on the west and east respectively, rise to elevations of over 9,000 feet above sea level. The almost sheer vertical wall extending along the flanks of these mountains drops most abruptly in elevation for a distance of almost a mile to the plain level of the valley floor. The lowest altitude is in the vicinity of Lucero Lake with an elevation of around 3,000 feet above sea level.

CLIMATE

Meinzer (1) states that the climate of the Tularosa Basin is typical of the arid southwest. Generally the sky is clear and the atmosphere is dry and rare. In the main for both summer and winter the days are warm and the nights cool. Most of the rain is produced by condensation from local ascending currents of air and accordingly falls in a few heavy storms in midsummer.

The basin has a wide range of temperature, owing partly to differences of latitude, but chiefly to differences in altitude. The United States Weather Bureau reports that Alamogordo, with an elevation of 4,338 feet, had a maximum temperature over a period of nine years of 109°, a minimum temperature of 0° and an average annual temperature of

61°. These figures are in contrast to those of Cloudcroft with an elevation of 8,650 feet. Averages over a period of seven years for this point indicate a maximum of 83°, a minimum of -10° and an annual average of 43.2°.

Of considerable interest are the maximum and minimum temperatures taken in the sands area during April and July by Emerson (11) and have been recorded as follows:

Table I. Maximum and Minimum Temperatures

Dates	Position	Maximum °F.	Minimum °F.	Temp. Range °F.
April 2	Air	78	44	34
April 3	6" in Sand	56	48	8
April 4	Air	74	36	38
July 2	Air	100	58	42

As a supplement to these records comparative temperatures of sand and air were taken in both the alkali flat and the dunes on July 1 with the following results:

Table II. Temperatures in dunes and alkali flat in mid-summer

Location	Hour	Air °F.	In sun; on sand °F.	1 In. deep °F.	7 In. deep °F.
Alkali Flat	10:00 a.m.	93	108	93	77
Dunes	4:30 p.m.	99	108	99	81

Meinzer (1) summarizes the records of precipitation as follows: In the interior plain south of the lava bed the average annual precipitation is probably less than ten inches; near the margins of the plain it is approximately ten inches; in the mountain chain on the east side it increases with altitude, and near the crests of the highest ranges it exceeds 20 inches; in the mountain chain on the west side it also increases with the altitude but is on the average less than in the mountains to the east. The principal rainy season is in mid-summer, generally beginning near the close of June or in the first half of July and continuing into September. From 55 to 60 per cent of the precipitation occurs during this period.

The prevailing southwest winds are an important factor in the present location of the sands. Much has been written about the movement of the dunes in a northeast direction and one writer at least has gone so far as to estimate the date at which the gypsum sands will encroach upon the towns of Alamogordo and Tularosa. Unless one visits the area during one of their periodic dust storms it is difficult to appreciate the tremendous abrasive effects of the powerful wind currents and the enormous amounts of material carried in this manner.

VEGETATION AND ANIMAL LIFE

Studies of the vegetation of the White Sands were made in the spring and summer of 1934 by Emerson (11) and a summary of his findings are as follows:

2. Plants seem to be in the process of migrating from outside sources into the dunes with the possible exceptions of two endemics that may have originated within the area. Some species have entered only a short distance while others have migrated several miles.

2. No seedlings establish themselves except in the flats, between the moving dunes.

3. In the flats soil water is near the surface, the water table being between 2 and 3 feet deep with moist sand reaching almost to the surface.

4. Roots must absorb water from a saturated solution of calcium sulphate.

5. Even in the most luxuriant stands of plants there is a very slight concentration of nitrates and nitrites, thus raising the question of methods of nitrogen assimilation.

6. Seven species have the power to grow upward rapidly enough to survive encroaching sand. All of these produce adventitious roots when covered. At least 55 species are limited to the flats because they cannot elongate when covered.

The white color adaptation of the limited animal life of the White Sands presents an interesting story for study by the zoologist.

GEOLOGY

General

The sedimentary rocks of the Tularosa Basin consist of deposits of Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, Permian, Triassic, Cretaceous and Quaternary. Formations are present representing all ages of the Paleozoic sequence. (see Plate II). Igneous rocks are in evidence in widespread outcrops along the east flank of the San Andreas mountains and to a lesser degree along the west escarpment of the Sacramento mountains. They consist of pre-Cambrian granites and schists. Tertiary dikes and sills occur in isolated localities. Two lava flows of Quaternary age are a prominent feature in the northern part of the basin.

Cambrian

The basal formation of the Paleozoic in southern New Mexico is known as the Bliss sandstone of Upper Cambrian age. From the type locality in the Franklin mountains of Texas the formation things out and is only six feet in thickness in the northern portion of the San Andreas Mountains. In the southern portion of this range the thickness averages around 100 feet. The limited exposure in the Sacramento Mountains shows a few feet of sandstone separating the granite from the El Paso limestone above. In the main it is a gray to brown sandstone, in part quartzitic, with upper slabby members in part glauconitic. The formation is unconformable on the granite or schist and grades into the El Paso limestone above.

Ordovician

The strata of this age is composed of the El Paso limestone, of Lower Ordovician, and the Montoya limestone of Upper Ordovician age. The El Paso limestone grades downward into the Bliss sandstone but is separated from the Montoya limestone by a break in sedimentation, representing Middle Ordovician time.

The El Paso limestone forms a prominent outcrop along the east front of the San Andreas mountains, where it is 300 feet in thickness in the southern part, decreasing to around 150 feet in the northern part of the range. It is a massive gray limestone, slabby in part, and containing considerable sand in the lower portions. Fossils are scarce.

The Montoya limestone is variable in thickness due to erosion and thins out in the southern part of the Oscura Mountains. In the San Andreas it consists of two members, an upper member containing alternating thin beds of limestone and chert, from 50 to 75 feet in thickness; and a lower member of dark massive limestone around 100 feet in thickness. Locally there is present a basal deposit of sandstone. In the Sacramento Mountains, southeast of Alamogordo, the two members mentioned above have been observed. Richmond fauna (Upper Ordovician) are present throughout the upper member.

Silurian

A small part of Silurian time is represented by the Fussalman limestone containing fossils of Niagara age. It ranges upward to around 200 feet in thickness in the San Andreas range and rests with an erosional unconformity on the Montoya limestone. Generally two members are present, an upper bed of hard dark massive limestone, and a lower bed of compact fine-grained limestone.

Sedimentary formations in the Tularosa Basin and Adjoining Ridges

AGE	FORMATION	CHARACTER	THICKNESS FT
QUATERNARY	Wind blown deposit	Gypsum sands, dust and quartz sands.	0 to 50' Ave.
	Stream deposits and other valley fill.	Chiefly red clay, gypsum, sand and gravel	100-1000 +
UPPER CRETACEOUS	Vera Verde (?) formation	Sandstone and shale, coal bearing.	630
	Moncos (?) shale	Shale; some sandstone; limestone in lower part.	900
	Dakota (?) sandstone	Sandstone, massive, hard, gray to buff.	150
TRIASSIC		Red sandy shales with layers of brown sandstones and limy concretions.	340
PERMIAN*	Chupadera formation	Upper part limestone and gray sandstone; lower part gypsum, soft red sandstone, then limestone and gypsum	1200-1600
	Abo sandstone	Brown red sandstone and red sandy shales; thins towards the south	500-900
PENNSYLVANIAN	Magdalena group	Limestone with beds of shale and sandstone; several sandstone beds in lower part.	2200-2500
MISSISSIPPIAN	Lake Valley Ls.	Coarsely crystalline limestone and limy shale.	0-150
DEVONIAN	Percha shale	Gray shale	0-125
SILURIAN	Fussalman Ls.	Limestone, massive, dark above weathers white below.	0-200
ORDOVICIAN	Montoya Ls.	Massive limestone, cherty above, dark below, sandy at base.	0-200
	El Paso Ls.	Limestone; weathers light gray; slabby in part.	0-350
CAMBRIAN	BLISS Sandstone	Sandstone, massive, gray	0-125
PRE-CAMBRIAN		Granites and schists	

*The two formations of the Permian in this area comprise the Manzano Group.

Note: The stratigraphy as above indicated is from Winchester (9) with slight additions.

Devonian

A widespread deposit of black shale, known as the Percha shale, of late Devonian age, is present in southern New Mexico. Breaks in sedimentation separate it from the overlying and underlying formations. The formation consists of lower beds of fissile shales and upper beds of gray shale containing some liry beds with many fossils. These shales thin out in the northern part of the San Andreas mountains. They range in thickness upward to 125 feet.

Carboniferous System

It is the rocks of this system which we are primarily concerned since they contain thick beds of gypsum. They are widespread in this region occupying all parts of New Mexico except the higher portions of some of the uplifts, and here they have been removed by erosion.

Mississippian

The thick succession of limestones of the Magdalena group forms a prominent outcrop in the Sacramento and San Andreas Mountains. It is predominantly limestones, but interbedded sandstones and shales are present in all sections. In this area the thickness ranges upward to 2,500 feet. Locally the group may be divided into several formations, some apparently separated by unconformities, although as yet no faunal distinctions have been observed. In nearly all localities fossils occur in abundance.

Permian

The Permian is represented in the Tularosa Basin by the Manzano group comprising a thick succession with the lower member known as the Abo sandstone and the upper member represented by the Chupadera formation.

The Abo sandstone is made up of red beds of sandstone and sandy shale and ranges in thickness from 500 to 900 feet. The formation thins out in the southward extension of the Sacramento range and the Chupedera and Magdalena formations join in this direction in the vicinity of the Hueco Mountains. The Abo sandstone is apparently unconformable with the underlying Magdalena. In the western part of the state there are thin limestone beds near the base which have yielded fossils establishing the age of the formation as Permian. It is considered to be the equivalent of the Supai formation of the Grand Canyon section.

The Chupadera formation, so named from the Chupadera mesa in eastern Socorro county, is the uppermost formation of the Manzano group. It is generally separable into two members, the San Andreas limestone above and the Yeso formation below. These thick limestone beds with interbedded

sands.

Igneous Rocks

Pre-Cambrian granites may be observed in an almost continuous band along the foothills of the San Andreas Mountains. Minor outcrops of granite are present at the base of the western escarpment of the Sacramento Mountains.

Two beds of Quaternary basalt occupy the basin west of Carrizozo. Both beds form thin sheets, probably less than 100 feet in average thickness, but in the vicinity of the craters they are several hundred feet thick. The lava came from a crater in Township 6 South, Range 16 East, and flowed south for a distance of about 50 miles. The flows consist of basalt of similar appearance and like composition. They are mainly black but locally reddish or brownish. The bulk of the lava flowed some distance before solidifying, lost most of its gases, became relatively compact, though its vesicular texture near the surface, shows that it cooled before all of the gas bubbles escaped. It is likely that the lava and cones were erupted along fracture planes which had produced zones of weakness in the strata.

Meinzer (1) states that the younger lava flowed out upon the main body of valley fill (Pleistocene) and that it is clearly of less age than all except the most recently deposited parts of the fill. It was therefore erupted either in Recent time or very near the close of the Pleistocene. The older lava has been in existence several times as long as the younger but is much younger than the basin itself or the oldest valley fill. It was probably erupted late in the Pleistocene. The age of the younger basalt is at least several hundred years, but in all probability not more than a few thousand years; the age of the older basalt is probably at least a few thousand years and is perhaps several tens ofthousands of years.

Structure

The regional structure of the Tularosa Basin is probably synclinal although most of the surface is covered by sand, lava and wash with critical data available only along the margins or from scattered well records in the interior. Cross sections on Plate IV by Darton (6) illustrate the structural features in so far as they are known. A hypothetical section across the basin by Meinzer (1) is also shown on this plate. Minor anticlinal structures are no doubt present in this large syncline. The San Andreas Mountains form a huge anticlinal uplift broken on the east flank by extensive faulting. The Sacramento Mountains have likewise undergone considerable faulting but principally along the west flank. The dominant feature or the prominent western escarpment is due in the main to an anticline, faulted in its higher portions, rather than to major faulting which is in evidence along the San Andreas scarp. The primary consideration in the structure of the Tularosa Basin is that it

is a large down faulted block between the San Andreas and Sacramento Mountains which gave rise to an inclosed basin, without drainage outlet, thus forming an ideal reservoir for the concentration of saline residues and the resultant gypsum sands.

GEOLOGICAL HISTORY

The Paleozoic (formations of Cambrian to Permian inclusive) deposition was preceded by a long era of erosion in which great thicknesses of rocks were removed exposing the granites of pre-Cambrian age. Generally the region was worn down to a level country. Quartzites are present to the north and south indicating the presence of clastic beds which at one time covered the granites. This long period of erosion marks the widespread unconformity upon which the Paleozoic sequence was deposited.

Paleozoic formations of New Mexico include the lower part of a series of various kinds of sedimentary rocks which have been upturned along the flanks of the southern extension of the Rocky Mountains. They also form in some instances extensive plain and plateau areas. The close of the Paleozoic is likewise marked by a widespread unconformity, although the lithologic variation of succeeding formations is not great, there is a distinct break in faunal characteristics distinguishing these sediments from those of the overlying Mesozoic strata.

Our principal concern is with the Permian, which marks the close of the Paleozoic, since the Chupadera formation of this period contains the thick deposits of gypsum and is generally regarded as the original source of the gypsum contained in the present sand dunes.

Western Texas and southern New Mexico contain one of the greatest sections of marine Permian known in North America if not in the world. Interior shallow seas from the Gulf of Mexico entered across this region extending over western Oklahoma and most of Kansas as well. Great deltas later restricted the waters of this large embayment and in their retreat they remained longer in southern New Mexico and western Texas than in the central portion of the continent. Thus, the Permian in this region attains a maximum thickness of over 7,000 feet. The gradual retreat of the sea with its intervening advances resulted in the deposition of great thicknesses of limestones in which was laid down thick layers of salt and gypsum. Evidence prevails that the area gradually became so arid, with evaporation exceeding precipitation, resulting in a vast dead sea eventually covering the central portion of the basin. During the Permian and the period following, the Triassic, desert conditions were probably more widespread than at any other time other than the present. Salt beds extend from Kansas to New Mexico and it has been estimated that they contain 60,000 billion tons of salt and would require the evaporation of more than 22,000 cubic miles of sea water with a salinity like that of the modern ocean.

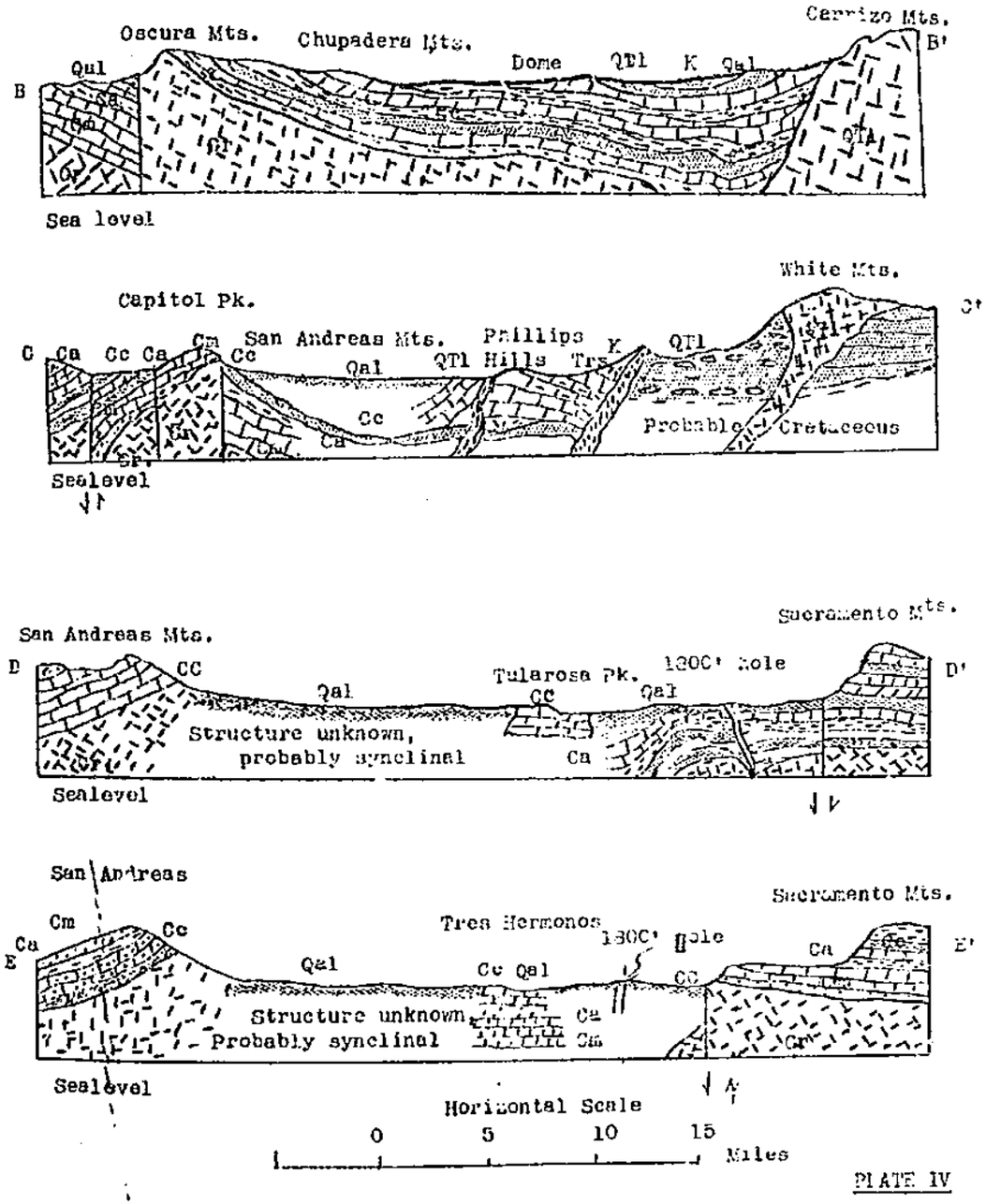

PLATE IV

As the basin was finally filled to sea level, streams converged in the low lands, depositing hundreds of feet of red mud and sands. There are occasional zones of gypsum present in the red beds which are evidence of a temporary return of marine waters and of partial evaporation at least.

It is believed that a connection was maintained with the marine waters of the Gulf through most of the permian and that additional salt waters were supplied to the lagonnal areas as evaporation proceeded in depositing the saline residues. Such a supposition is almost imperative since Twenhofel (15) states that to precipitate a ter-foot bed of gypsum over the entire extent of a basin, water to a depth of 14,000 feet would be required. It would seem very improbable that waters of a basin so deep ever reached the degree of concentration that they deposited gypsum, and that upon consideration of the immense thicknesses of gypsum and salt beds, it becomes obvious that exceptional conditions made them possible. A thickness of 1,200 feet of anhydrite in a west Texas well may be used to illustrate the time element involved in deposits of this type. The anhydrite contained banded layers apparently marking seasonal deposition and suggests that from 150,000 to 300,000 years were required to form same.

The great Appalachian Mountain chain was formed during Late Paleozoic with the culminating movements occurring during the Permian. The important points to bear in mind in connection with the history of the Permian in southern New Mexico is the existence of a shallow sea in Early Permian, the partial inclosure and breaking up of this sea into lagonnal areas which produced larged saline deposits, and finally the deposition of the red beds by streams in shallow lakes over large sections.

Permian history is of much importance to the National Park Service in the southwest. The Carlsbad Caverns have been formed in limestone of this age. Kaibab limestone of the Permian forms the rim rock at Grand Canyon. Dune sands of the Permian make up the Coconino formation as exposed in Walnut Canyon and the erosional features of the Kaibab limestone above formed ideal homes for the cliff-dwellers. Gypsum formed during this period has now come to rest, or perhaps rather to migrate, in the beautiful White Sands.

In the Tularosa Basin area sediments of the Triassic and Cretaceous of the Mesozoic era were deposited on the Permian. They consist mainly of shales and sandstones and are widely distributed in the Rocky Mountains. At or near the close of the Cretaceous the great mountain making movements of the Rockies took place. The rocks were broken and faulted and the region generally was raised above the water. The basin began to assume a more definite character. During successive periods erosion on a large scale tended to reduce the ranges to a peneplain. Great thicknesses of Mesozoic and Carboniferous strata were removed. A regional upwarp during late Cenozoic (probably Pliocene) has given

the Rockies their present height and the differential erosion of the uplifted peneplain has brought about most of their rugged relief.

Above the Cretaceous in this area are the loosely consolidated sediments of the Quaternary. Valley fill deposits over 1,000 feet in thickness have been deposited by streams, lakes and underground waters. Much gypsum was certainly carried down from the overlying formations and concentrated in the inclosed Tularosa Basin. Saline residues were thus deposited, redissolved and redeposited over and over again, even up to the present this process is going on. The most recent deposit is the gypsum sand dunes which have been formed through the action of wind on the concentrations of this material in the alkali lake area.

Fossils

Fossil bones and teeth of a mammoth are said to have been found in Section 25, Township 14 South, Range 6 East. I visited the locality but was unable to find anything but some fragmentary bones. It would probably be well to later work over the entire alkali flat and along Salt Wash in an effort to determine if important fossil remains are present. If such is the case a connection might be made with the present monument area in order to include the fossil exhibit. The intervening land so far as is known at present is worthless.

What I have termed the external molds of plants are plentiful in the White Sands. My interpretation of this process, which I am not at all sure is correct, is that the gypsum crystallized around the plant forms and adhered to the structure and became more or less hardened, the organic material of the plant decayed leaving an internal core, thus forming the external molds now visible in the sands. Samples of this material have been forwarded the Washington office. These molds as I have termed them are to be sure very recent and in fact are being formed at the present time. They will make an interesting exhibit for the future museum of the White Sands.

GYPSUM

The evidence points, according to the writer's belief, that the original gypsum and salt deposits of the Chupadera formation are derived from precipitation in bodies of water, cut off from the sea or in embayment areas extending landward, or lakes or playas, with successive replenishment by waters flowing into same and consequent evaporation. Factors are present which indicate that in most cases such substances are precipitated under arid conditions. That evaporation takes place at a powerful rate in such areas is evidenced by the fact that 23 inches of water has been taken from the alkali lake during the month of July by this process.

Saline Residues

ANALYSES OF WATERS

	LAKE		NORTH OF FLATS	
	N. W. PART (Surface)	SOUTH SIDE (10' Hole)	NEAR SURFACE	NEAR SURFACE
	%	%	%	%
Total soluble matter	9.50			
Calcium (Ca)	.07	.06		
Magnesium (Mg)	.52	.08	1.22	2.46
Sodium (Na & K)	2.29	1.88	9.88	7.62
Carbonate (CO_3)	.01	.02		
Sulfate (SO_4)	2.54	1.76	2.87	4.25
Chloride (C_1)	3.29	.94	16.82	15.78

ANALYSES OF SURFACE MATERIAL

	LAKE EDDY PROSPECT (Surface)	FLAT AT NORTH END (Surface)	(1-5 Feet)
	%	%	%
Total Soluble Matter	62.95	4.78	3.16
Calcium (Ca)	.49	.34	.12
Magnesium (Mg)	.40	.05	.03
Sodium (Na & K)	18.43	1.23	1.00
Carbonate (CO_3)	.02	.01	.01
Sulfate (SO_4)	40.27	1.27	.65
Chloride (C_1)	.60	1.72	1.35

Note: Tables are from Meinzer (1).

PLATE V

Some of the most important substances formed as saline residues are rock salt, gypsum and anhydrite. As water is evaporated the salts are precipitated and deposited. The least soluable salts are naturally precipitated first and these would include calcium carbonate and iron oxide if present. Gypsum separation follows and it is sually associated with anhydrite deposition. Sodium chloride (o. common salt) is precipitated after the gypsum and following the bitter salts of sulphates and chlorides of potassium and magnesium, which are usually among the last to separate out of solution. The latter are so soluble that they are not always deposited when salt and gypsum are formed. It has also been observed that whenever these saline residues are precipitated they are likely to be redissolved unless they are protected against solution by water. When they are preserved muds and clays often form an impervious cover which serves as a means of protection.

Twenhofel (15) states that the chief processes involved in the formation of these saline residues is the evaporation of water in which constituent materials are dissolved, although some of them, as gypsum, may be precipitated by chemical reactions without evaporation, and some occurrences have resulted from the freezing of water. In some instances they are also formed through replacement of other substances, gypsum replacing limestone probably being the most common example. Also that so far as these substances are the result of the evaporation of water they develop either through the evaporation of sea water, the waters of lakes and playas, or of waters brought to the surface by springs or capillary action.

Saline residues commonly present in the lower portions of the Tularosa Basin, or the alkali flats, are sodium chloride (common salt), sodium sulphate (glauber salt, also called "ice" and erroneously called "soda"), magnesium sulphate (epsom salt), sodium bicarbonate (baking soda), sodium carbonate (washing soda), calcium sulphate (gypsum), and calcium carbonate (limestone). Plate V on a following page taken from Meinzer (1), shows the composition of water from the narrow portion of the lake and from a ten-foot hole on the south side; also, of the surface material at the Eddy soda prospect; and similar data on waters and soil at the head of the alkali flat about 35 miles further north. There is evidently a larger ratio of chlorides to sulfates in both the waters and the surface materials at the north end of the flat than in the lower lake region. Possibly this may be accounted for by the fact that the drainage is in this direction and precipitation dies out to the south.

It is generally agreed that in humid regions soluble substances, which may be formed by the weathering of rocks, are quickly washed out of the soil passing into the drainage system and finally carried to the sea. In arid regions there is not sufficient rainfall to perform this function and in the case of an inclosed basin it would not be possible. The salts therefore remain in the soil, at times of rainfall they are dissolved into solution, and in times of dryness when water draws to

the surface, or is evaporated they are left, forming the white incrustation on the soil known as alkali, a common feature of the lower sections of the Tularosa Basin.

Varieties of Gypsum

Gypsum ($CaSO_4 \cdot 2H_2O$) occurs in several different forms. There is the amorphous or microcrystalline variety which includes anhydrite and is commonly known as rock gypsum or alabaster. This is the type that frequently occurs in thick beds. The microcrystalline variety of gypsum is known as selenite. It commonly occurs as individual crystals in clays and as veins and bands in the clay beds associated with rock gypsum. Gypsite is an earthy form of gypsum. Satinspar, a variety with fibrous structure, is commonly found in veins, but is not present in the White Sands area.

Anhydrite is an anhydrous calcium sulphate, $CaSO_4$, containing sulphur trioxide 58.8 and lime 41.2. Crystals are rare but when observed are thick tabular and of the orthorombic system. It is characterized chiefly by its cleavage which is in three directions at right angles to each other. The hardness is 3-3½ and specific gravity is 2.9.

The hydrous calcium sulphate known as selenite, $CaSO_4.2H_2O$, is composed of sulphur trioxide 46.6, lime 32.5, and water 20.9. It occurs in tabuler or diamond-shaped crystals of the Monoclinic system. There is cleavage in three directions and with a hardness of 2 it may be scratched with the finger nail. Specific gravity is 2.32. Luster is usually vitreous, sometimes silky. Ordinarily its color is white, gray; sometimes various shades of yellow, red, brown, etc., from impurities. This variety occurs along the west side of the lower alkali lake in great profusion. Various crystals were observed more than a foot in length and this probably represents the average although Talmage (6) mentions crystals reaching a maximum length exceeding four feet.

Gypsite is a massive granular earthy form of gypsum containing impurities. There is a belt of gypsite hills to the west of the White Sands proper. They appear to be old dunes that have been compacted and cemented through the action of water. Satin spar is fine and fibrous with a silky luster.

Origin of the White Sands

Sands are occasionally but rarely composed of gypsum. Deposits occur west of Duran, New Mexico, near a series of depressions or shallow lakes filled with gypsiferous materials. To the east of these lakes mounds of sand dunes occur of the same character as the White Sands. There is no known deposit of the same magnitude as the White Sands of Alamogordo, however.

Much has been written about the origin of the gypsum deposits at this locality. It is generally conceived that the original source of the gypsum is the Chupadera formations, but the question is to whether the gypsum came from the rocks as they were eroded from the ranges surrounding the basin, or if they were carried upward by waters under hydrostatic pressure from below and precipitated at the surface. From the vast quantities of gypsum that must have been washed into this basin and from various observation as processes which are at present in progress and which will be described later I am inclined to lean toward the former view, and see no reason to complicate the picture by elevating large quantities of gypsum, when a normal simple explanation is forthcoming.

It would seem well to mention some of the various opinions expressed:

Meinzer (1): The gypsum is derived from the gypsum beds in the Pennsylvanian rocks outcropping in the mountains. Since it is comparatively soluble it was brought to the low interior of the basin chiefly in solution in the surface and underground waters, and was re-deposited when these waters evaporated, either from desiccating lakes or from springs or wet areas fed from underground sources. The deposits thus formed have been altered and further transported by repeated resolution and redeposition and by wind work.

Batkin (5): According to this explanation, which differs from that heretofore given by geologists, an enormous deposit of large crystals was formed in sediments over a long period of time, the sands being a comparatively recent and rapidly formed product resulting from wind erosion and weathering of the materials of the dry lake bed. East of the lake outliers of coarse wind-blown crystals capped by vegetation show by their bedding that high dunes of this material recently existed in the region.

Talmage (6): Origin has been ascribed largely to the action of ground water bringing up gypsum in solution from beneath the valley. Field investigation shows: 1. The importance of ground water in transporting gypsum to the area where the active dunes exist has been overestimated. 2. That importance of ground water in the formation of the large selenite crystals and the importance of these crystals as the ultimate source of part of the White Sands has been underestimated. 3. Reworked by wind and weather, rather than ground water, has been directly responsible for material in the active dunes.

Russell (7): Underlying the Tularosa Basin are beds of Permian limestone and sandstone, between the layers of which are interspersed thick beds of gypsum. Boring made in recent ...

years reveals that the gypsum is hundreds of feet below the present valley floor and that water is encountered at depths of a thousand feet or less.

The nature of the sedimentary rocks above the water bearing sands is favorable to upward seepage. As the water on its upward course passes through the gypsum deposits, it dissolves that material and carries a rather full load to the surface. The limestone through which the solution passes is not readily soluble; very little in addition to the gypsum is carried by the rising water. When evaporation takes place at the surface a fairly pure crust of gypsum is deposited, which, under action of the atmosphere, crumbles to form crystalline grains.

Hills and mountains surrounding the Tularosa Basin contain gypsum, and it is evident that some of the deposit is brought from this source by surface waters that feed it to the large natural evaporation pan at the south end of the sands. Whether the source is the deeply buried beds or the visible deposits in the mountains, the processes of evaporation, crumbling and drifting with the wind are the same.

Darton (8) and Winchester (9): The gypsum has been brought to the surface by a seepage of water, probably from the underlying Chupadera beds, and deposited on the surface in crusts, which have crumbled to sand and in the course of many centuries have been piled by the wind into great dunes covering many square miles.

Richard (12): The basin thus enclosed (Tularosa Basin) has no visible outlet and as evaporation exceeded precipitation we find the waters becoming loaded with the salts above innumerated. Into this great lake was poured the waste of mountains, rocks, gravel, mud, sand, etc. Centuries later the great abyss had been filled with these sediments made up principally of the detritus of the Permian formation or Red Beds, and highly impregnated with the salts of gypsum. At the time this great lake had practically been filled there were no White Sands.... The White Sands originated from the waters of this vast lake which lies to the west... As the wind sweeps rapidly over the surface of the saturated brine waters of the lake tiny wavelets are developed at the crests of which instantaneous crystallization of the crystal gypsum takes place; that is to say, a crystal of gypsum is born and this tiny crystal is at once swept eastward by the force of the wind and ledges on the shore. Thus there is in time built upon the shore a long line of crystals which in time develop into a larger quantity and finally become a white sand

dune... In order to prove the final theory of origin a small boat was pulled out into the lake from the East shore on a fairly windy day. A canvas tarp was so arranged to catch the particles of gypsum as they were crystallized from the crests of the waves and born forth by the wind. Examination showed these to be true crystals of gypsum and of course put the origin beyond all dispute and contention. (The latter point proves material to the writer as gypsum dust is prevalent everywhere when there is a strong wind blowing in the basin. I would not be surprised to see grannies in the mechanism of a Brunton compass even though it be enclosed in a leather case upon passing through one of those storms.)

Brady (13): Describes the White Sands and region in general; associates the White Sands and dry climate with volcanic eruption. Lava is said to have diverted the assumed ancient river to another valley. Mentions Spanish legend that valley was "inhabited by prosperous people before the eruption destroyed river and brought about present desolation."

My idea as to the origin of the White Sands may be summarized as follows:

1. The Chupadera formation contains the only known source for the large quantities of gypsum now present in the Tularosa Basin.

2. Gypsum was precipitated from the evaporation of waters and deposited in thick beds in the Chupadera formation of Permian age. This process was made possible due to the prevailing arid conditions where bodies of water were cut off from the sea, probably by deltas, or in embayments extending landward, or in shallow lakes or playas, with the water supply being replenished periodically by successive advances and retreats of the sea.

3. Mountain making movements, at or near the close of the Cretaceous, with faulting and folding on a large scale, resulted in the formation of the Tularosa Basin somewhat as we see it today.

4. The Chupadera formation and overlying rocks were elevated around the margins of this Basin, thus being more susceptible to rapid erosional processes. In the Basin proper the Chupadera and overlying rocks were in a down-faulted block with several thousand feet of displacement. The Basin was probably not inclosed at this time which permitted great quantities of weathered materials to be carried away to the sea. Later movements closed the Basin and permitted no visible drainage outlet for the rock debris or saline substances carried in solution by the waters. A large lake was formed as is evidenced by the terraces which may be observed at the present time. Evaporation processes concentrated the waters and saline residues came into prominence under these ideal

conditions. The Chupadera formation was being rapidly covered by valley fill material until now it is over 1,000 feet below the valley floor in places.

5. As the shrinkage of this large lake took place great areas of the outcropping Chupadera was eroded on the margins (see sections Plate IV). The thick beds of gypsum were broken up and the material carried in solution to lower levels and deposited. At several periods at least crystals of selenite were forming on a large scale in this lake bed. Photos show the stratified gypsum laid down in this lake bed as well as the terraces containing the selenite crystals.

6. As the lake dried up and became an alkali flat, winds had an opportunity to start their work of transportation. The gypsum terraces and the selenite areas were subjected to weathering and as the material was broken up and reached the stage to be moved by the winds, the granules were carried to the east side of the lake and deposited, due to the prevailing southwest wind. The White Sands occur along the east side of the old lake bed and must have come mainly from the area once occupied by the lake. If the source is from the underlying Chupadera beds, which may barely be possible for a small percentage of the sands, then why do the sands not cover more of the basin as the Chupadera formation underlies most sections as evidenced by drill holes?

7. Various stages of this process of the formation of the sands may be observed at present. Since it can be seen I see no reason to resort to an underground source which process cannot be seen. There is a gradual gradation of materials between the old lake bed and the White Sands proper now present on the surface. Selenite crystals, gypsum terraces, coarse yellow crystals forming dunes with finer gradation eastward, intermingled with gypsite hills and some of the older dunes showing cross-bedding and now more or less cemented, and finally, the White Sands proper, free from fine silt which has been carried onward by the winds. The gradational zones mentioned are not sharply defined but overlap and intermingle and it is doubtful if they could be mapped to satisfaction without considerable time being spent in the area and even then test hole drilling would probably be necessary with considerable generalization as a final result.

8. Crystals now being precipitated in the flats forming crusts is a normal sequence since the whole area is saturated with gypsum, but it seems hardly probable that this could be a source for the large volume of gypsum sand and at the same time there must be a starting point since this feature was evidently not in progress until the dunes were well under construction and the area to the east of the old lake bed did become saturated with gypsum.

Movement of the Sand Dunes

I know of no proper records as to the rate of migration of the sand

dunes to the eastward. Now that the Park Service have made a National Monument in the area exact measurements should be made. MacDougal (4) mentions an advance of about one mile in 20 years. From local reports this estimate is much too large. At the southeast corner 10 to 20 feet per year is said to be more nearly correct. There is the possibility of correlating the rate of migration with the age of the yuccas. Richards (12) estimates that the sands will move into Alamogordo in 4097 A.D., and would reach Tularosa about 6151 A.D. I do not believe that he considered the amount of gypsiferous material remaining in the old lake bed to be transported or that the fact that the elder dunes become more or less cemented with transportation processes not so easily involved. At any rate the residents of the above mentioned towns have little to fear for some time nor need the Park Service take out protection in lands to the east in order to have White Sands for a monument in later years.

Road Building

I believe that present visitors are missing one of the most interesting features of the monument in that no road is available to proceed into the area of the old lake bed. In certain seasons travel may be made over most any section of the alkali flat. The road could easily be constructed along the west margin of the sands which would permit travel at all times. This would afford an opportunity for the public to obtain a better picture of the source of the gypsum now present in the White Sands. Mirages, a closer view of the San Andreas Mountains, etc., would lend much to the merits of such a development. These factors notwithstanding the idea that it would be pulling away from the "picnic practice" now prevalent in the scheme of things. The geological story could be related in a much more satisfactory manner after or during a visit to this area.

Tom Charles, resident custodian, is a live wire booster for the White Sands and is doing much good work for the Park Service. All possible assistance was supplied by him during my visit. Ben Daugherty and Barry Mohun, Jr., of the park staff, accompanied me on several trips and their presence was badly needed at times especially in the digging out process. Mr. Mohun, as well as Dr. Talmage, of the New Mexico School of Mines, supplied negatives for a number of the photos attached for which acknowledgement will be made later. White Sands is an area that the Park Service can justly be proud and my visit was indeed most delightful.

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SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 6

BIRD BANDING IN THE SOUTHWESTERN MONUMENTS FISCAL YEAR '36

·DEPARTMENT·OF·THE·INTERIOR·

·NATIONAL·PARK·

·SERVICE·

1936 BIRD BANDING IN SOUTHWESTERN MONUMENTS

The Director
Bureau of Biological Survey
U. S. Department of Agriculture
Washington, D. C.

Dear Mr. Director:

During the fiscal year 1936 bird banding projects in cooperation with your bureau were carried on in nine of the 25 National Monuments which are administered by this office.

Stations at Navajo National Monument, Kayenta, Arizona, and Casa Grande National Monument, Coolidge, Arizona, had existed previous to July, 1935. During the summer of 1935 personnel of other monuments were informed of the program, and seven responded by obtaining federal banding permits.

Values gained from the banding of birds in National Park Service units under our charge are threefold: (1) custodians, rangers, and naturalists become increasingly familiar with the avifauna of their region, can more efficiently answer visitor questions and prepare museum exhibits; (2) the accumulating bird records at a monument will in time assume importance to visiting scientists, and the monuments thus will become valuable "scientific sub-stations;" (3) the normal work of a cooperating government bureau, the Biological Survey, is advanced, and knowledge is accumulated concerning the somewhat incompletely studied ornithology of the Southwest.

Southwestern Monuments are somewhat understaffed and Park Service work is heavy. Bird banding is carried on as a personal hobby of the individual concerned, and most work is done while the men are off duty. Consequently, only applications from keenly interested personnel were recommended by the headquarters office for approval.

It is a very conservative statement to say that far more than three-fourths of the bird banding work in the Southwestern Monuments was done while operators were off duty. Thus, the National Park Service has gained much valuable information and improved the knowledge of several of its personnel at very little actual cost.

Headquarters aided the work as much as possible by furnishing traps, literature, mimeographed forms, etc. The Field Division of Education of the National Park Service at Berkeley, California, very kindly constructed traps with the help of Emergency Conservation Work funds.

A total of 1,547 birds of 63 species were banded at the nine stations. Seventeen of the species banded by Monument stations were not represented in the Biological Survey totals of 1935, indicating that our work is being

done in an area that needs accurate study possible only by the banding method. As these more than 1,500 birds return to monument stations from year to year, it is certain that our data will become increasingly valuable.

Brief resumes of the work at each station follow:

Bandelier National Monument

Frijoles Canyon, approximately 39 miles northwest of Santa Fe, New Mexico. Transition Zone. Altitude 5,600 feet.

Operator Mrs. Earl Jackson, wife of the custodian, banded 111 birds of 12 species. Operations were not started until September, 1935, and were handicapped at various times by lack of bands, delayed arrival of traps, etc. Natural food along the constantly-flowing Rito de los Frijoles is plentiful, and birds are attracted to traps with difficulty. Mrs. Jackson's time was limited and it was not feasible to set traps during the winter in positions across the creek on the attractive sunny side of the Canyon.

Notwithstanding these hindrances, Mrs. Jackson produced a very creditable total, and her work was characterized by extreme accuracy. It may be possible in f.y. 1937 to set up a small ECW project which will place a CCC boy at the disposal of the station operator and result in a large number of banded birds.

Casa Grande National Monument

Two miles north of Coolidge, Arizona. Lower Sonoran Zone. Altitude 1420 feet.

Operator Louis Caywood and collaborators banded 854 birds of 33 species, many of which are poorly represented in Biological Survey records. Of the 854 bands, 15 were used at Walnut Canyon and 103 at Tumacacori National Monuments. The remaining 736 were banded at Casa Grande.

Thirty-three station returns were received, including 15 interesting returns of Gambel Sparrows which had been banded in March, 1935. Work was started on an intensive study of this species, and approximately 70 colored bands were placed on resident species in an initiation of long-term studies of range and distribution, life history, sex ratio, longevity, pathology, weight, etc.

Chaco Canyon National Monument

Work at this Monument was not begun during 1936, only two Russet-backed Thrushes being banded.

Montezuma Castle National Monument

Permission was granted to Norman Jackson, son of the custodian, to band within monument boundaries. However, due to the sparadic intervals in which Mr. Jackson was able to band, the station was dismantled and the permit rescinded.

Navajo National Monument

In Betatakin Canyon near ruin of the same name, southwest of Kayenta, Arizona. Transition Zone. Altitude approximately 6,500 feet.

Milton Wetherill, alternately Trail Foreman and Temporary Ranger at this monument, during his spare time banded 61 new birds of ten species during the 1936 season. He was not at the monument during the best banding period, the winter, and has experienced difficulty keeping traps baited due to depredations of chipmunks and squirrels.

Mr. Wetherill's tent ranger station is located in Betatakin Canyon, which with Dogozoki Biko Canyon seems to afford poorer nest sites than the nearby Tsegie and Kit Sil Canyons.

Slightly increased funds have been allotted this monument for f.y. 1937, which will allow greater latitude in bird banding and other scientific work.

Pipe Spring National Monument

Four miles from small town of Moccasin, Arizona. Upper Sonoran Zone. Altitude 4,960 feet.

Operator Leonard Heaton was able to start banding in April after arrival of traps and file forms. In the two month period he made a fine showing and added 105 birds to the Southwestn Monuments total.

Heaton is proceeding very carefully with identification, and has released several individuals until positive identification was possible by means of loaned skins from various study collections.

During 1937, Pipe Spring will constitute the most northerly monument where banding is being done, and will provide an important link with Zion and Grand Canyon National Parks, Navajo, Wupatki, Walnut Canyon and other national monuments.

Tumacacori National Monument

Nineteen miles north of Nogales, Arizona, in Santa Cruz Valley. Lower Sonoran Zone. Altitude 3,250 feet.

BIRD BANDING TOTALS-FISCAL YEAR 1936-S.W. MONUMENTS

SPECIES	Bandelier	Casa Grande	Chaco Canyon	Mont. Castle	Navajo	Pipe Spring	Tumacacori	Walnut Canyon	Wupatki	Total	Banded in U.S. in1935
1.Bluebird,Chestnut-bkd								215		215	*119
2.Cardinal, Arizona		1					8			9	*1150
3.Chat, Long-tailed						2				2	*94
4.Crossbill, Bendire								17		17	0
5.Chickadee, Mountain					1			3		4	93
6.Creeper, Rocky Mountain	2									2	0
7.Dove, Inca		4								4	1
8.Dove, Western Mourning		16		2			1			17	*1397
9.Finch, House		137					2			139	3008
10.Flicker, Red-shafted	1									1	32
11.Flycatcher, Ariz.Crested		2					1			3	*24
12.Flycatcher, Vermillion							2			2	0
13.Goldfinch, Green-backed								2		2	*111
14.Grosbeak, Black-headed								1		1	276
15.Jay, Long-crested	2									2	*49
16.Jay, Woodhouse	3				6					9	9
17.Junco, Gray-headed	56				21					77	
18.Junco, Montana					5					5	
19.Junco, [illegible]					13					13	
20.Junco, Pink-sided	8									8	
21.Junco, Red-backed	10				1			43		54	
22.Junco, Shufeldt	6				8			11		25	
23.Kingbird, Arkansas							8			8	165
24.Mockingbird, Western		2					16			18	*480
25.Nuthatch, Pygmy	19							27		46	91
26.Nuthatch, Rocky Mountain	2							6		8	*447
27.Owl, Mexican Screech							1			1	0
28.Owl, Western Horned		1					2			3	*22
29.Phainopepla							4			4	5
30.Phoebe, Say		19		3			12			34	35
31.Quail, Gambel		57		10			1			68	0
32.Roadrunner		4					1			5	0

SPECIES	Bandelier	Casa Grande	Chaco Canyon	Mont. Castle	Navajo	Pipe Spring	Tumacacori	Walnut Canyon	Wupatki	Total	Banded in U.S. in 1935
33. Robin, Western								7		7	*7009
34. Sapsucker, Red-naped								4			*46
35. Sapsucker, Rocky Mountain								2		2	0
36. Shrike, White-rumped		3			1		5			9	*101
37. Siskin, Pine								1		1	148
38. Solitaire, Townsend								7	53	60	1
39. Sparrow, Gambel		414				99	1			514	*4141
40. Sparrow, Lincoln		1								1	2115
41. Sparrow, Western Lark							5			5	0
42. Sparrow, Nevada Savannah						1				1	*985
43. Sparrow, Western Vesper		1								1	*300
44. Sparrow, White-crowned		7			3					10	*4141
45. Swallow, Rough-winged		6								6	37
46. Tanager, Western								1		1	56
47. Thrasher, Bendire		5					6			11	0
48. Thrasher, Crissal		9								9	0
49. Thrasher, Palmer							2			2	0
50. Thrasher, Sage									2	2	0
51. Thrush, Russet-backed			2							2	*1333
52. Titmouse, Gray								1		1	*34
53. Towhee, Canyon							10			10	121
54. Towhee, Green-tailed		2				3	5		1	11	16
55. Towhee, Spurred	1				2					3	*658
56. Verdin							1			1	0
57. Waxwing, Cedar									1	1	*5427
58. Woodpecker, Cactus		1					1			2	0
59. Woodpecker, Gila		8								8	0
60. Woodpecker, Mearns								9		9	0
61. Woodpecker, Rky Mtn Hairy	1									1	*108
62. Wren, Baird Bewick							3			3	*72
63. Wren, Cactus		38					5			43	0
*---Group total which may include several races											
TOTAL, FISCAL YEAR 1936	111	738	2	43	61	103	103	35[illegible]	5[illegible]	1,54[illegible]	

Operator Louis Caywood's total of 103 birds of 24 species were reported in the totals for Casa Grande, but deserve special mention because this [illegible] very important station will report in the future as an independent unit.

Several species have been banded that are not usually caught in the United States, and some interesting records are bound to result. Colored bands are being used for sight observations, and considerable careful work in the banding of fledglings has been accomplished with no known casualties.

Tumacacori seems to lie on a major north-south migration route, and [illegible] in a well-watered valley with sufficient cover attracts many species.

Walnut Canyon National Monument

[illegible] east-southeast of Flagstaff, Arizona. Transition Zone. [illegible] feet.

Operator Paul Beaubien was at this monument only intermittently during [illegible] and all work perforce was done on personal time. [illegible] funds will keep [illegible] at the monument during the whole year, and on ranger status he [illegible] reasonable amount of banding during slack periods on official time.

[illegible] arrived too late in the fall of [illegible] to catch the big migrations, [illegible] drop trap at a bird bath which has been maintained at this [illegible] monument for some years, Beaubien and collaborators were [illegible] birds of 17 species---some quite rare in Biological Survey [illegible].

An additional 15 birds were banded with Casa Grande bands and are reported in the totals from that station.

[illegible] at Tupatki, Grand Canyon, the Museum of Northern Arizona, and [illegible] cooperating on specific problems will bring some interesting [illegible] in the future, it is believed.

[illegible] National Monument

[illegible] miles northwest of Flagstaff, Arizona. Upper Sonoran Zone, [illegible] feet.

Pressure of other work prevented much bird banding activity by Operator [illegible] until late in the spring of f.y. 1936. A total of 57 birds of [illegible] species were banded. Indicative of possible valuable results in the [illegible] were the 53 Townsend Solitaires banded---only one of this species [illegible] in the United States last year.

[illegible] and his wife, Mrs. Sally Brewer, are capable observers and with

and Michener water traps, all manufactured by the National Park Service Museum Laboratores at Berkeley, California, under E.C.W. funds.

Fast made a fine quail trap, drop traps, gathering cages, etc. A house trap was constructed by King.

Feeding and Trap Stands: To eliminate rodent damage, two pedestal feeding stations were made by King. These each accommodate a Government Sparrow Trap and a Potter Trap.

Files: As birds are banded, entries are made in pencil on a mimeographed form, prepared especially for the purpose. When a sheet of about 50 entries is filled, its contents are then transferred to the triplicate file system in India ink.

The filing system used at the Grand Canyon National Park station of Edwin McKee was adopted and found very satisfactory. Each new band issued is noted in three [illegible] card files: (a) by Band Number; (b) by Date; and (c) by Species. Returns also are entered in all three files. Repeats, however, appear only on the individual Band Number Cards.

Two additional files are kept: (1) Key to Colored Bands; and (2) Matings and Genealogical Notes.

An observation file is also kept on which entries are made on species cards by dates. Unusual observations not necessarily connected with banding are noted down. This file supplements the others.

King kept files current, with the assistance of Fast during the months of February and March, and of Caywood on several occasions.

Other Equipment: Included usual series of Biological Survey numbered bands, celluloid bands in five colors, especially prepared banding pliers, butterfly nets for capturing roosting finches at night, flashlights, gathering cages, etc.

The Southwestern Monuments Library, rapidly accumulating a full set of reference books on western ornithology, proved of indispensable help.

TIME SPENT ON PROJECT

Due to pressure of other Park Service work, little official time can be allotted to bird banding. Operators at the monuments band rather as a personal hobby than as an official duty and try to perform as much of the work as possible during their own time. Their records, methods, etc., however, are considered government business and are subject to inspection at any time.

King spent a little more government time on the project than he desired,

their experience of working as collaborators with the Museum of Northern Arizona, will produce excellent results next year.

Respectfully submitted,

Dale S. King, Operator #5310
Junior Park Naturalist

REPORT OF BIRD BANDING ACTIVITIES FOR FISCAL YEAR 1936
CASA GRANDE NATIONAL MONUMENT
LOUIS R. CAYWOOD, OPERATOR #5128

PERSONNEL OF STATION

Receipt of bird banding permit #5128 allowed banding activities to commence March 14, 1935. Operator Louis R. Caywood, then park ranger at Casa Grande National Monument, and Dale S. King, headquarters junior park naturalist, carried on the work until the middle of July when Caywood was transferred to naturalist rating and left Casa Grande for work at other monuments.

King and Ranger Charlie Steen then cooperated in maintaining the station, Caywood resuming the work intermittently as he returned to Casa Grande between field trips.

The station fortunately enlisted the services of John E. Fast, a very valuable collaborator, who established a sub-station at Vah-Ki Inn, his winter home a half mile south of the Museum, and banded from February 3 to March 24, 1936. Mr. Fast proved a very accurate observer, and succeeded in banding more than 40 percent of the total birds banded at the station.

As various men visited headquarters, they were given instruction and practical experience which will aid them in establishing and maintaining their own stations. These included Charlie R. Steen, now traveling junior naturalist, Southwestern Monuments; John E. Fast, already mentioned; J. Donald Erskine, ranger, Casa Grande National Monument; Leonard Heaton, custodian, Pipe Spring National Monument.

March 17, 1936, Caywood went to Tumacacori National Monument, Arizona, as custodian and established a station there. Banding at Tumacacori is necessarily reported here as if it were a sub-station, although it will issue individual reports in the future.

Casa Grande work during the reminder of the year was done under the permit to King, #5310.

EQUIPMENT OF STATION

Traps: Government Sparrow, Potter (two compartment), Baldwin woodpecker,

chiefly to insure establishment of the several new stations at the monuments on a correct and efficient basis. As they run smoothly in the future, this expenditure of government time will lessen. He managed, however, to accomplish the bulk of recording in evenings on his own time.

File forms were mimeographed by King at almost no expense to the government. Operators of the station feel that the National Park Service has amassed a great amount of potentially valuable information concerning a worth while project in an extremely economical way.

STATION ACTIVITIES

(Note: The first 34 birds banded were reported too late to be inclu in published f.y. 1935 summaries, and will be included in this discussion. Activity started March 14, 1935, was hindered considerably by lack of bands during the summer and late fall of 1935. Banding was slowed or stopped several times by departure of operators to field.)

Number of Captures

854	bands placed on new birds of 53 species, some of which occur rarely in Biological Survey reports
33	returns
835	repeats
1,722	total captures

That the station is operating in a not-too-well-known area is shown by the following table, taken from information in "Bird Banding Notes":

Species	Banded in U.S. in 1935	Banded by Casa Grande in 1936
Arizona Cardinal	0	9
Inca Dove	1	4
Gambel Quail	0	58
Say Phoebe	35	31
Roadrunner	0	5
Rough-winged Swallow	37	5
Bendire Thrasher	0	5
Crissal Thrasher	0	8
Cactus Woodpecker	0	2
Gila Woodpecker	0	8
Cactus Wren	0	43

Approximately 70 colored bands, received relatively recently, have been used for sight observations and will bring valuable data.

Returns

A total of 33 returns were received during the period.

(A) Of these, nine were of birds probably resident, but uncaptured (one each of House Finch, Say Phoebe, and Crissal Thrasher; six Cactus Wrens).

(B) Three roosting House Finches were killed when netted at night before operators had acquired necessary skill and knowledge of technique.

(C) Six accidental deaths.

(a) Two Gambel Quail: one apparently overheated by 55 (possible maximum) minute stay in trap in early spring. Stopped trapping quail immediately and have had no further trouble. The other entered trap at dusk and was killed by cat before operator made usual rounds at dark.

(b) One Cactus Wren broke neck after entering screen porch. No fault of operator.

(c) Two Gambel Sparrows died in trap due to unknown cause. Perhaps chick feed had soured, so trap was cleaned thoroughly. Of more than 1,600 captured birds, this was the only such instance.

(d) One Gambel Sparrow killed by Shrike. Shrike was captured and released at distance.

(D) Fifteen bona fide returns of Gambel Sparrows

Of 31 Gambel Sparrows (Zonotrichia leucophrys gambelii) banded near the Museum between March 14 and April 1, 1935, the remarkably high percentage of 15 were re-captured, or "returned" during the following winter of 1935-36.

Seven of the 15 were banded as immature. All returned to the same location as adults. Of these, four never repeated after their return. Another repeated twice during the month of November. Another repeated twice during the month of December. The seventh one arrived November 16 and stayed until March 21, repeating five times.

Eight of the 15 were banded as adults. One returned February 4 not to the Museum but to Vah-Ki Inn, half mile south. Upon being released at the Museum, the bird made its way to Vah-Ki in 39 hours, repeated three times until February 23. Three were captured during less than two-week periods after their returns. One was captured during a three-week period after returning. Two stayed almost four months. One stayed three months.

No tenable conclusions can be drawn on data including only 15 returns, yet the following tendencies seem to appear.

(1) A remarkably high proportion (almost 50 percent) of the Gambels banded returned to the very same restricted locality where they had been banded. Very little tendency to wander, and when once established in another territory (cf. the Vah-Ki case) return to that locality with the

least possible delay.

(2) Gambels in their first year of maturity return to the place where they spent the winter when immature, but tend to move on to another location or other locations.

(3) Gambels in the second year (or older) of their maturity tend to return to the same territory occupied before, and remain there all winter.

Some very interesting results should emanate next winter from the trapping of the more than 400 gambels now banded.

Mr. Fast started a special study of Gambels, and hopes to continue it the next migration season. Quoting from his report in the Supplement to the Southwestern Monuments Monthly Report for February, 1935, page 126:

> ".....I thought it would be interesting to test still further their homing instinct. I began to collect birds in lots of five in small transfer cages, taking as many full lots of five as I could gather each day before noon. I then released them, five at a time, along the road to Phoenix: five the first mile, five the second mile, five the third mile, etc., up to ten miles. Newly banded birds, repeats, adults, immatures, were all the same to me except that a bird sent on this mission and again caught was excused from further service. I released them all before noon to give them the best chance possible.
>
> "The Phoenix road is toward the northwest. Authorities state that Gambel Sparrows migrate northwest and spend the summer in the territory from Montana to Oregon, and north through western Canada and as far as Alaska, so that the sparrows might be expected to say to themselves, 'Well, we thumbed a ride this far anyway.' But--no--back they came...The record of birds which flew back to Vah-Ki Inn is as follows:
>
> | | |
> |---|---|
> | one mile---------five | six miles------one |
> | two miles--------one | seven miles----one |
> | three miles------two | eight miles----none |
> | four miles-------one | nine miles-----one |
> | five miles-------none | ten miles------one |
>
> "It may be expected that more are back, but are too smart to enter traps again. Migration takes place in about six or eight weeks.....All of these returning birds practically have to fly over the traps at Casa Grande Museum, yet none have been taken there....."

OBJECTIVES NOW CONTEMPLATED

Gambel Sparrows

Mr. Fast plans to return to Vah-Ki Inn next winter for the entire Gambel migration period and carry on intensive work in that species. If this is not possible, operators of the Casa Grande station will do as much as they can on the project. Further and more complete study will be made of territory, longevity, mortality, and as many other problems as seem feasible and productive.

Gambel Quail

Forty-five quail have now been banded with colored bands so that individuals can be recognized at some distance. Others will be banded similarly as captured. Utilizing advice of David M. Gorsuch, authority on this species, the station is embarking on an extended investigation including problems of territory, dispersal, family groups, mating activities, longevity, population, etc.

Nine probable nesting pairs have been recorded this spring and attempts will be made in the fall to capture the hundred or so quail on the monument by family groups.

Cactus Wrens

Thirteen are now banded with colored bands, and others will be so marked in the near future. Fledglings are being banded in careful fashion, and the same course of study is planned for this species as for the quail.

Colored Bands

These are also being used on other species resident for the greater part of the year, and will allow us to make more observations: Cardinals, Inco Doves, Flycatchers, Phoebes, Western Mockingbirds, Roadrunners, Shrikes, Thrashers, Woodpeckers, etc.

(Dale S. King)

TUMACACORI NATIONAL MONUMENT

Mr. Dan Clarke, a University of Arizona Agricultural student, knows the birds of this region and has been helping me band with a sub-station at Arivaca.

Banding has been more interesting here than at any other place I have banded yet because of the great variety of birds to be captured. May species, however, do not come to traps and therefore cannot be banded unless the young are caught while still in the nest. Care has been taken to band only those too young to fly from the nest when banded. In this way they grow up and the parents teach them to fly when they are ready.

If birds are banded when they are just about to leave the nest, they may fly off and become the prey of some predator. No casualties are known to occur from banding nestlings. One casualty did occur when a Canyon Towhee, unbanded, suffered from sunstroke by being in a trap in the sun for less than an hour. All traps have since been provided with shade and no similar occurrence has happened.

Banding so far south there are many new species caught which are not usually banded in the United States. By next year a sufficient number of birds will have been banded to be able to obtain some interesting records. Four cactus wrens have been banded with colored bands. As soon as more colored bands are available I will begin the banding of Cardinals with them in order to make observations.

(LOUIS R. CAYWOOD)

BANDELIER NATIONAL MONUMENT

The birds banded during this period are as follows:

Rocky Mountain Creeper	2
Pygmy Nuthatch	19
Rocky Mountain Nuthatch	2
Rocky Mountain Hairy Woodpecker	1
Red-Backed Junco	10
Pink-Sided Junco	8
Shufeldt Junco	6
Grey-Headed Junco	56
Spurred Towhee	1
Long Crested Jay	2
Woodhouse Jay	3
Red Shafted Flicker	1
Total	111

The traps used were: (1) Higgins Trap, modified to have one door, and to close with a pull string and trigger; (2) Two Government Sparrow Traps, the one on the ground proving better than the one set on a table; (3) A 2-celled Potter Trap, baited with suet, which especially attracted Nuthatches and Creepers; and (4) a Baldwin Woodpecker trap, baited with suet. This last attracted only one Woodpecker. The Nuthatches fed there regularly, but seldom spring it, and when they did, could worm out.

In the three first traps Chick Chow was used for bait, with occasional bread crumbs. Suet was used in the Potter and Baldwin traps.

(MRS. EARL JACKSON)

NAVAJO NATIONAL MONUMENT

I have listed the birds banded under two headings; one, that which has been reported to the Biological Survey; second, birds banded this

year and which have not been reported to the Biological Survey.

I miss the best banding up here which is winter as the ground feeding birds come in late in the fall and leave early in the spring. The canyon furnishes both feed and shelter. Be-ta-ta-kin Canyon is not ideal place (or so it seems) for nesting. It is good feeding ground and furnishes good shelter. The resident birds nest here, also a few of the summer birds. I have noticed more nests, also young which have left the nest, in the Tsegie and Kaet Zeel Canyons, than in Be-ta-ta-kin and Dogozshi Biko Canyons.

Last year found nests of, Woodhouse Jay, Canyon Wren, Bush-tit, White-throated Swift, Mountain Chickadee and Ravin. This year Canyon Wren, Long-crested Jay and two nests started by Bewick Wren. (Note on Long-crested Jay in May, 1936, report.)

My big problem here is with chipmunks and squirrels. (try and keep feed in the traps.).

(MILTON WETHERILL)

PIPE SPRING NATIONAL MONUMENT

Attached you will find records of the birds banded at Pipe Spring National Monument during the months of April, May, and June.

I surely have had lots of fun watching the birds come for the feed and learning of their habits, as well as the new birds that come around.

The past two weeks I have not been doing anything about trapping. One reason is that the CCC boys have been bothering the traps and birds, and the other is that I have been busy at other things and could not get around as often as I should; so have brought all my traps in.

I have discovered five nests of House Finches in a clump of trees not far from the Fort.

(LEONARD HEATON)

WALNUT CANYON NATIONAL MONUMENT

During the period covered, the station was operated intermittently by four different rangers-in-charge. With a new fiscal year at hand, it appears that one man will be stationed here permanently, and that more frequent and regular observations shall be made. The past season's work has contributed little beyond the banding of birds, but more serious research is contemplated.

(PAUL BEAUBIEN)

SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 7

NAVAJO

WALNUT CANYON

GEOLOGICAL REPORT

GEOLOGICAL REPORT

BY

V. W. VANDIVER

REG'L. GEOLOG.

DEPARTMENT OF THE INTERIOR

NATIONAL PARK

SERVICE

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WALNUT CANYON GEOLOGICAL REPORT

By Vincent W. Vandiver, Regional Geologist

INTRODUCTION

Walnut Canyon National Monument was reserved by the Government with the idea of the preservation of the numerous cliff dwellings which occur in this area. The geological features of the area are most interesting, however, and for those who will take the time to consider the various processes which contributed to the formation of this canyon, they will find that in miniature much the same factors are involved as those which resulted in the formation of the Grand Canyon of the Colorado River. I shall endeavor to relate in this report how these geological processes have played such an important part in the carving of the landscape in Walnut Canyon which resulted in an ideal location for the establishment of the homes of the Pueblo cliff-dwellers.

LOCATION

Walnut Canyon National Monument is located about 10 miles southeast of Flagstaff, Arizona, on a loop road connecting with U. S. Highway 66. The presence of walnut trees along the floor of the canyon has supplied its name. The reserve was created as a National Monument in 1915 although it is understood that the area was under the supervision of the Forest Service from 1906. It contains an area of 960 acres. There are of course many ruins in the Southwest of ancient pueblo peoples however there are relatively few cliff dwellings of this type. They are most accessible to large numbers of tourists due to the proximity to one of the main routes of transcontinental travel through this region.

ARCHEOLOGY

Dr. Harold S. Colton (1), of the Museum of Northern Arizona, states that the cliff dwellings in Walnut Canyon have been dated by the tree ring method indicating that they were occupied by pueblo Indians from around 900 to 1300 A.D. There may be some significance to the fact that these dwellings were being occupied shortly after the last eruption of Sunset Crater, situated some twelve miles to north, and whose last activity has also been estimated by the tree ring method as having taken place around 875 A. D. There are present ruins of some 300 rooms scattered along both sides of Walnut Canyon and it is easy to conceive of upwards to 1000 people living in this settlement. The area was visited by James Stevenson of the Smithsonian Institution in 1883 and he made the following statement: "The doors are large and extend from the ground up to a sufficient height to admit a man without stooping. The rooms are large and the walls are two to four feet thick. The fireplaces are in one corner of the room on an

elevated rock, and the smoke can only escape through the door. The masonry compares favorably with the construction of the best villages in Canyon de Chelly. Many objects of interest were found in the debris around and in these houses. Matting, sandals, spindle whorls, and stone implements of various kinds abound." During the interval from the time of Mr. Stevenson's visit and the taking over the area by the Forest Service there was much vandalism. Practically all of the objects left by the pueblos were removed and in searching for these materials many of the cliff dwellings were broken down and more or less destroyed. As the result of this vandalism it is doubtful if the detailed story of the peoples of Walnut Canyon will ever be known.

Dr. Colton considers that the people who built these cliff dwellings were probably the ancestors of those who constructed Elden Pueblo and many other sites near Flagstaff. This supposition is arrived at from the similarity of the potsherds and flattened skulls which have been recovered from the various ruins.

The dwellings in Walnut Canyon were constructed under overhanging ledges of limestone two hundred feet or more above the stream bed. Not only were their homes built along the recesses in the side of the canyon wall but retreats were also made on at least five "islands" of promontories in the canyon which served as fortresses as a means of protection against invaders. A trail is in evidence to the right of the present entrance trail to the monument which is believed to have been the route taken to obtain water from the stream or pools in the canyon. Little water now reaches the stream channel to fill the pools due to the recent construction of the Lake Mary dam. During dry periods it is also conceived that water may have been obtained by digging pits in the sand along the floor of the canyon. The remains of broken stone hoes, etc., have been discovered along the flats of the rim areas, northeast of the village, and it is here that the pueblos probably cultivated their meager crops. Another factor which no doubt influenced these peoples to select Walnut Canyon as a desirable place to live is the presence of ledges and recesses especially in the walls along the north side of the canyon which formed a means of protection against the climatic conditions of the severe winters. The presence of water supply nearby and satisfactory soil for cultivation along the rim as well as the "islands" in the canyon which were used as forts were likewise desirable features.

GEOLOGY

The oldest rocks of the general vicinity of Walnut Canyon belong to the Redwall limestone formation of the Mississippian, along the northeast flanks of Elden Mountain, where uplifted portions of the sedimentary section are exposed by this great laccolith. Above the Redwall is the river flood plain deposit, consisting of sandstones and shales, and containing tracks of land animals and impressions of fern-like plants, which has been termed the Supai formation of Permian age. Next above the Supai is the

cross-bedded Coconino sandstone and followed in order by the Kaibab limestone, both of Permian age. It is the two latter formations with which we are most concerned since they make up the sedimentary section of rocks exposed in Walnut Canyon.

Briefly the geologic history of the area may be described by stating that following the deposition of the Kaibab limestone the sea retreated as the region uplifted slightly with the sedimentary rock remaining practically horizontal apparently subjecting the formation to erosion long enough to produce a youthful topography. Upon this surface was deposited the shales and sandstones of the Moenkopi. A great thickness of varicolored shales and sandstones were then deposited in a large basin by rivers and shallow water lakes. These continental deposits make up the Chinle formation. They contain a land fauna and the remarkable deposits of silicified wood at the Petrified Forest. They supply most of the beautiful coloring to the Painted Desert area and are classed as the uppermost Triassic formation in this region. While these beds form the last record of sedimentation in this territory it is known from a study of the stratigraphy of the surrounding country that great thicknesses of Jurassic, Cretaceous and perhaps Eocene rocks were once present but have all now been removed by erosion.

COCONINO SANDSTONE

Below the Kaibab limestone which forms the rim rock at Walnut Canyon, there is the light colored, highly cross bedded sandstone, which has been designated as the Coconino sandstone from its type locality at the Grand Canyon. The contact between the two formations is readily observed along the canyon walls. Located between formations of Permian age, as determined by fossil remains, the Coconino is likewise referred to the Permian Epoch. A closer determination of the age of the Coconino is made as Middle Permian in view of the grading contact with the underlying Hermit shale in the Grand Canyon, whose age has been found to be upper Lower Permian from the fossil flora secured.

The Coconino sandstone occupies a large area in northern Arizona, north of the southern limits of the Colorado Plateau. While much of this region is capped by the Kaibab limestone, the presence of the Coconino is certain from the many exposures in the canyon walls throughout the province. From a thickness of 1000 feet at Pine the formation thins out to zero along the Utah boundary. It also thins in a northwest direction towards the Nevada boundary where it is only a few feet thick whereas there is over 600 feet of section in the vicinity of Holbrook. From samples taken by Mr. Edwin McKee (2) the sand grains are predominantly medium coarse grained along the southern limits of the formation and grade into much finer materials to the north. The source of the material is therefore concluded to be from the south, in a barrier believed to have existed during most of earlier Paleozoic time, which extended through central Arizona and is known as Mazatzal land. Geologists generally consider that there is

sufficient evidence to conclude that the sand grains comprising the Coconino formation were in the main transported by the winds and deposited in the form of sand dunes. The lack of pebbles seems to point towards the wind as the major agent of transportation. The wedge-shaped cross bedded units of this formation are inclined in many directions, a feature not widely produced by the action of water. The only definite fossils thus far discovered in these sandstones are the footprints of amphibians or reptiles and trails made by annelid worms. The fossil evidence available also tends to support the theory of eolian origin of the formation.

The Coconino has supplied its portion of the natural features necessary in the making of Walnut Canyon an ideal site for the cliff dweller. In the valley south of Elden Mountain there are some large sink holes, known as the Bottomless Pits. They form the entrance to caves in the Kaibab limestone, which have been dissolved out by the action of ground waters on the limestone, as they flowed underground along joints and fissures to outlets in the lower levels of Walnut Canyon. The more or less porous Coconino sandstone was favorable to the seepage of this additional water into the canyon. The normal weathering of the Coconino caused much sand to be deposited in the canyon. This condition may in some instances have caused the formation of pools of water just beneath the surface and permitted the pueblo Indians to dig for water during periods of dryness. Then, too, as the canyon was being carved the Coconino was susceptible to certain straightening of the channel and during this process the old meanders of the stream were abandoned and "cut-offs" were formed. These "islands" permitted the Indians to build homes in fortress fashion in the central portions of the canyon and gave them an excellent means of protection.

KAIBAB LIMESTONE

Overlying the Coconino Sandstone throughout large sections of northern Arizona, except in the east near Holbrook, is the Kaibab limestone. It forms the upper portions of the walls of Walnut Canyon and Grand Canyon as well and caps most of the high plateau of the north-central part of the state. It is composed of grey, sandy limestone, with many horizons filled with chert, also massive layers of limestone interspersed with less resistant beds of shaly sandstone. The lithology of the Kaibab limestone with the constant variation of hard and soft members, the soft weathering away leaving the more competent beds to form overhanging ledges, has resulted in a natural habitat for the cliff dweller in this canyon.

The Kaibab limestone is quite variable in thickness, ranging from upwards to 1000 feet in the Virgin River valley to 600 feet on the Rim of Grand Canyon, and from 300 feet in the vicinity of Flagstaff to zero just east of Holbrook. Mr. Edwin McKee, Park Naturalist at Grand Canyon National Park, has developed some new and interesting details concerning this formation and the results of his study will be published in the near future. At Walnut Canyon the Kaibab is quite fossiliferous. Many marine fossils of brachiopods such as Productus and Spirifers may be observed. In some in-

stances the silica nodules and concretions enclose fossils sponges. The various types of fossils collected of which there are some 80 species indicate that the limestone is of shallow water marine origin. Since the limestone was deposited below sea level and now has an elevation of approximately 7,000 feet above sea level there is every reason to believe that the region has been uplifted on a large scale. It will be noted along the walls of the canyon that the contact of the limestone with the underlying Coconino is practically horizontal and it is therefore assumed that the Kaibab sea advanced rapidly at the close of Coconino time since there is no evidence of erosion of importance along this line of contact.

An important point to consider with respect to the Kaibab formation and the cliff dwellers in this canyon is the presence of softer members of sandy limestone interspersed in the section with the more resistant or massive limestone beds. This condition during the process of the carving of the canyon and the normal weathering processes gave rise to ragged, vertical cliffs, with recessed grooves in the walls which finally formed the homes of the pueblo Indians. The ledges may have been formed in part by the action of the stream on the softer beds when it was cutting away at much higher levels, but the process may be explained in most instances I believe, by the normal agencies of differential weathering.

STRUCTURE

Since the structural details would involve a rather lengthy report it may suffice to say briefly that they include upward movements at the close of the Permian and profound uplifting during the Tertiary. Generally speaking the uplifts have caused greater displacements of the rock strata than the faults, especially in the southern portion of the Colorado Plateau area. The exact time of the uplift which resulted in the canyon cycle of erosion to form the Grand Canyon, Walnut Canyon, and many other canyons in this region is still the subject of considerable difference of opinion.

As regards to Walnut Canyon in particular, during one of the later periods of uplift, the rock strata were broken forming what has been termed the Anderson Mesa fault. This fracture in the earth's surface represents a displacement of around 300 feet, strikes N 65° W, with the uplifted block on the northeast side. The fault no doubt partially dammed the stream but since the uplift was so slow the stream was able to maintain its channel and thereby with the additional gradient and power supplied the cutting tool gained sufficient force to carve Walnut Canyon. Dr. Colton has referred to these clefts as being actually sawed, with the body of the saw composed of the water, the teeth made up by the boulders, pebbles and sand grains, and the energy being supplied by gravity. Much the same factors were necessary in the cutting of the Grand Canyon of the Colorado River. Minor North-south faulting along Walnut creek has probably been responsible for some of the zig-zag courses which the stream followed. The stream followed these breaks or cross-faults as a line of least resistance in the softer broken rocks before returning to its normal course. As cut-offs

were formed and the old meanders abandoned the central "islands" were carved out.

SUMMARY

It is thought that the following points may prove of interest to the visitors without boring them with too much geological detail:

I. Walnut Canyon may be termed a Grand Canyon in miniature in which a broad regional uplift supplied the stream with the necessary power to carve the gorge.

II. The stream working through zones of weakness along minor north-south faults which cross the canyon, developed many meanders or goose necks, and when later these were carved through, cut-offs forming "islands" remained which the pueblos have utilized as fortresses.

III. Ledges in the Kaibab limestone were formed by the differential weathering of the hard and soft members. The massive resistant limestone beds for the ledge which served as the roof and floor and the weaker sandy limestones eroded more rapidly to form the recesses in which the cliff dwellings were constructed.

IV. The contact between the Kaibab and the Coconino seems a worth while feature to point out as well as the nature of the Coconino sandstone with typical characteristics of a wind blown dune deposit.

V. The marine fossils in the Kaibab limestone should prove of interest as they clearly demonstrate the uplift that has taken place in the general area. These beds are now some 7,000 feet above sea level.

INFORMATIONAL SIGNS

The following informational signs are recommended:

I: WALNUT CANYON

The Canyon was formed as the result of a gradual uplift of the region with the stream being able to maintain its course. The additional power supplied the stream enabled it to saw out the gorge that we now see.

II: KAIBAB LIMESTONE

A shallow water limestone deposited in the sea and containing many remains of marine fossils.

III: COCONINO SANDSTONE
A wind blown dune deposit containing footprints and trails of land animals.

IV: LEDGES AND GROOVES
The ledges make up the more massive and resistant members of the Kaibab limestone. The grooves or recesses consist of the weaker beds which contain more sand in the limestone and are more easily eroded. This is the result of normal differential weathering.

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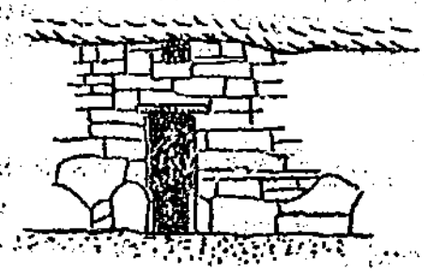

SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 8

NAVAJO
GEOLOGICAL REPORT

BY
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DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

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GEOLOGY OF NAVAJO NATIONAL MONUMENT

By Vincent W. Vandiver, Reg. Geologist

INTRODUCTION

The purpose of my trip to the Navajo National Monument was to ascertain the geological features in the vicinity of the ruins in order to prepare a formal report on the area. The Monument was reserved on the basis of the archeological interest. It is considered important however that the Park Service staff be informed on the geological aspects since numerous visitors ask to be advised on these questions and since such features have had a direct bearing on the presence of the Pueblo cliff dwellers in the area.

LOCATION

Navajo National Monument is situated in the northwestern part of the Navajo Indian Reservation, in northeastern Arizona. It is composed of three units, - Betatakin Ruin, Keet Seel Ruin and Inscription House Ruin. These areas comprise a total of 360 acres and were reserved by the Government in 1909 and 1912 as a means of preservation of some of the most important remains of Pueblo cliff-dwellings thus far discovered. The maximum distance between the three units of the Monument is about 20 miles although this distance by trail or road due to the necessity of circuitous routes is much farther.

Betatakin Ruins and Keet Seel Ruins may be approached from the southwest from Shonto and from the east via Kayenta. The road leads to the top of the mesa above Betatakin and a trail for horse trips has been constructed into the canyon, distance of about a mile, to this point. A rough horse trail is available to Keet Seel from Betatakin which is approximately eight miles in length. The route to Inscription House Ruin turns north along the Rainbow Natural Bridge road about midway between Tuba City and Kayenta. Travel may then be made by car westward for a distance of about two miles from the Inscription House trading Post at which point the rim of Navajo Canyon is reached. A horse trail has been constructed into the canyon and the ruins are located about four miles distant from the rim.

Mr. John Wetherill of Kayenta, Arizona, is custodian for the Monument. Mr. Milton Wetherill is the acting ranger in charge and is stationed at the Betatakin Ruin.

CLIMATE

The climate of this section of the Navajo country is arid. The rainfall average for eleven years to 1927 at Kayenta, with an elevation of 5,800 feet, amounted to 8.86 inches per year. The minimum temperature

during this period was -18° F. with a maximum of 104° F. The average annual range at this point is between -8° F. and 101° F.

HISTORY

There are over three hundred cliff-dwelling ruins in the Tsegie Canyon drainage system north of Marsh Pass and while I have visited only a few of them, besides those included in the Monument, it is understood that they are all constructed in alcoves of the Navajo sandstone. There are times when a geologist may map outcrop of a formation from the surface vegetation and here from the association of the number of ruins with the Navajo formation it would seem almost possible to use this criterion.

Betatakin

This ruin is located in a magnificent arch of Navajo sandstone, on the west side of Tsegie Canyon, about one and one-half miles below the junction with Dogoszhe Beco Canyon. Betatakin was so named from the Navajos which means "Side Hill House." The enormous archway in which the cliff-dwellings were constructed is 425 feet in height to the crown, has a span of 370 feet, and reaches a maximum depth of 135 feet. It is difficult to realize the proportions of the arch or window until one has stood in its recesses and looked outward across the canyon. The great Rainbow Natural Bridge could be placed inside of the archway with room to spare. The dwellings consist of some 135 rooms and they rank fourth in size of those discovered thus far. From tree ring data it has been discovered that the ruins were inhabited from 1242 to 1277 A. D. One of the best springs in the country flows out of the sandstone cliff at the base of the arch with a flow of one and one-half gallons per minute. Betatakin was first known in 1907. In 1909 Mr. John Wetherill conducted Professor Byron Cummings to the site just prior to the First Rainbow Bridge expedition. In 1917 Mr. Neil Judd cleaned and repaired certain portions of the Betatakin ruins.

Keet Seel

This ruin derived its name from the Navajo term Keet Seel or "Broken Pottery" and it is located in the canyon of the same name, some eight miles by trail above the Betatakin ruins. It contains 152 rooms and is the second largest Pueblo cliff-dwelling known and ranks second to the largest ruins located at Mesa Verde National Park. Discovery was made by Richard Wetherill in 1894 who was accompanied by Mr. Charles Mason. They revisited the site in 1897. Some restoration and cleaning was carried on with CWA funds in 1934. The dwellings are indeed spectacular and one would not need to be an archeologist to enjoy spending considerable time at the site. They are also located in a huge archway in the Navajo sandstone. Slabs of Kayenta sandstone were carried from some distance below in Keet Seel Canyon for certain parts of their

construction. The site was inhabited by Pueblos from 1116 to 1284 A.D. and it is considered that these peoples together with those of Betatakin migrated to Canyon del Muerto (Canyon de Chelly) because of drought conditions.

Inscription House

These ruins, located in Navajo Canyon, were named from a dim carving on the wall which has been interpreted to read "Carlos Arnais 1661". A party headed by Professor Byron Cummings discovered the ruins and the inscription several years ago. The dwellings are located more than 150 feet up on the side of a cliff of Navajo sandstone and the inhabitants were well protected. A rather large cave is present on one side. Some protection must have been desirable as other sites might have been selected which would have been more accessible. Occupation was during the Pueblo III interval. Some water is in evidence in the stream bed of the canyon which is probably fed by springs. No doubt some water could be developed in the canyon from seeps.

Besides the above mentioned ruins which have been included in the Navajo National Monument there are many others of importance in this area some of which are Swallows Nest, Rope House, Platform House, Bubbling Spring, Turkey Cave, Turkey House, Ladder House, Bat Woman, Twin Caves, Horn Basket and Spruce Tree House. They contain from 20 to 30 rooms.

GEOLOGY

The three units of the Navajo National Monument are all located in the lower part of the Navajo sandstone formation. This massive wind blown deposit outcrops over wide areas to the northwest of Black Mesa and forms the uppermost member of the Glen Canyon group, generally recognized to be Jurassic in age. As yet no fossils have been found in the Navajo sandstone to definitely establish its age so that it should be kept in mind that this classification is tentative. The sedimentary rocks involved in the three units of the Monument and vicinity are composed of Pleistocene or Recent Lake Beds; Navajo sandstone, Kayenta formation, and Wingate sandstone of the Glen Canyon group, Jurassic (?) in age; and the Chinle formation of the Upper Triassic. A stratigraphic section indicating additional details of the above mentioned formations is included on page following.

PLEISTOCENE TO RECENT

In recent years, possibly not more than 25 years ago, Marsh Pass as well as Tsegie ("Lakes in the Canyon") Canyon contained swamps and lakes which have since been drained by a deep arroyo. Overgrazing is generally conceived as being responsible for this new erosion cycle. There is much evidence of an extensive series of lakes in both Tsegie

STRATIGRAPHIC SECTION, NAVAJO NATIONAL MONUMENT

AGE	FORMATION	THICKNESS (FEET) REGIONAL	THICKNESS (FEET) LOCAL	CHARACTER OF ROCKS
RECENT TO PLEISTOCENE	LAKE BEDS		0 TO 60	Sands and gravels deposited in an old lake bed or series of lake beds which once occupied Tsegie Canyon. Several different periods may be recognized. Plant remains and several varieties of fresh water shells are present.
JURASSIC (?)	GLEN CANYON GROUP — NAVAJO SANDSTONES	400 to 1100	900	Massive buff to grey sandstone, with spectacular cross-bedding and well developed jointing. contains local limestone lenses. Weathers various shades to brown and red. Prominent cliff maker. No determinable fossils have been discovered. Of a total of over 300 ruins in Tsegie Canyon drainage system all are in this formation. The Navajo Monument ruins occur near the base. Widespread tangential cross-bedding has made possible the huge development of arches, alcoves and cavos.
	GLEN CANYON GROUP — KAYENTA FORMATION	0 to 225	0 to 225	Uniformly bedded, red to buff sandstone, with interbedded shale. Weathers a grey vermillion. More slope forming than Navajo sandstone. No fossils have been found although dinosaur tracks have been located to the north of this area.
	GLEN CANYON GROUP — WINGATE SANDSTONE	30 to 450	150 to 260	Buff cross-bedded sandstone which forms vertical cliffs. Cross-bedding not so highly developed perhaps as in the Navajo sandstone. Weathers deep red to black. Unfossiliferous although dinosaur tracks reported.
UPPER TRIASSIC	CHINLE FORMATION	0 to 1182	0 to 70	Variegated shale which contains silicified wood. Exposed in the lower parts of Tsegie Canyon. Supplies much of the paint in the Painted Desert area.

and Keet Seel Canyons. Sands, gravels and clays have been deposited in regular beds up to 60 feet or more in thickness. The trail leading from Betatakin to Keet Seel shows a remarkable development of this formation. The remains of plants and pollen together with the presence of fresh water shells buried in these beds has led geologists to believe that lakes were depositing their sediments from the Pleistocene to Recent times. Several different stages of development or cycles may be observed in sections of the Lake Beds where the present drainage system has unfolded excellent exposures. These beds usually cover the Wingate sandstone in the lower portions of the canyon although in some instances it is the Chinle formation that is obscured.

JURASSIC (?) - GLEN CANYON GROUP

Navajo Sandstone

The uppermost member of the Glen Canyon Group in this area is the Navajo sandstone formation. This formation contains the three units of Navajo National Monument and it is stated that there are some 300 other cliff-dwellings in the Tsegie Canyon drainage system which are also found in the Navajo. A superb display of cross-bedding with tangential planes a conspicuous feature and the almost total lack of horizontal bedding characterizes the formation. It is composed of sub-angular to rounted grains of quartz of medium size, which are rather loosely cemented by calcium carbonate. On fresh surfaces the color is buff to grey and upon weathering various shades of red and brown stand out. The coloring has not been so spectacularly applied to the Navajo in this area as in the Virgin River Canyon at Zion National Park. Box canyons and huge dome have been carved in this sandstone until passage on foot is treacherous and in many instances impossible. Rainbow Bridge and several other natural bridges in the area have been carved from the Navajo formation.

The Navajo sandstone is generally recognized to be of eolian origin. The presence of horizontal bedding and the presence of cross-bedding on an enormous scale, together with the absence of silt and almost total absence of fossils tend to support this theory. There are thin lenses of limestone in the Navajo Monument area, especially in Navajo Canyon, indicating that at least some of the sediments were deposited by water. Efforts were made to locate fossils in these limestone lenses but no success was had. Brady (6) describes a small theropod which was discovered about two and one-half miles east of the Inscription House Ledge in the Navajo sandstone. The possible remains of a small dinosaur in this formation were found above Turkey Cave. The bones were located about 750 feet above the base of the sandstone in a sandy shale lense and it is stated by C. Camp of the University of California that they "show evidence of belonging to a different group from any dinosaur yet discovered." A few bone fragments are in evidence just below Keet Seel ruin but these are considered to be too fragmentary to serve for identification purposes. No fossils have been discovered thus far to actually determine the age of the sandstone.

Baker (3) states that the Navajo sandstone thickens towards the west and is believed to include all of the massive Jurassic sandstone that crops out in northern Arizona and southern Utah west of a line through Less Ferry, Arizona. He also states that the source of the sediments is not definitely known but concludes from the westward thickening of the formation that the source presumably lay in this direction.

Gregory (1) describes the factors involved in the formation of the arches and alcoves in which the cliff-dweller constructed his home in excellent fashion and the following is quoted from his paper, - "The sandstone cliffs in this region are beautifully sculptured; buttresses and recesses are common, overhanging walls are characteristic, and the wide open mouths of niches and caves perched high on the canyon walls are conspicuous. These cavities, protected from the rain, from the glaring heat of the sun, and from suffocating sandstorms, were widely utilized by the ancient inhabitants as building sites - rock shelters or cavate dwellings, as the terms are used by the archeologists. The structure of these beds is favorable for the production of rock shelters. The rock composing them is porous, elaborately cross-bedded, and traversed by joint planes set far apart. The curved laminae of the cross-bedded strata, 1 inch to several feet thick, are held together by weak cement that is easily removed by percolating water. Slight undermining along zones of the more impervious rock permits the overlying laminae to fall in response to gravity. They drop to the floor as a unit or in separate slabs; the crushed fragments, with cement already removed from the spherical grains, rapidly disintegrate and make their way to the mouth of the cave. As the process continues shell after shell is removed and the arched roof cave is sunk farther and farther into the face of the cliff, until building sites 200 to 3,000 square feet in area are prepared for the cliff-dweller. All stages of the work are represented. In some caves shells of partly detached rock bridge the entrance; in others blocks on the point of falling extend downward from the roof, and the floor is piled high with fragments that crumble under the blow of the hammer; still others are free of debris, and the rock of the roof and sides is firm. The work of ground water is forming these rock shelters is evident. Some of the caves are dry or streaked with moist alkali "bloom"; in others water oozes continuously from the wall over a wide area marked by moss and ferns; many caves contain perennial springs whose outlet is definitely localized. The conditions that permit the formation of rock shelters in massive beds of sandstone--namely, tangential cross-bedding and porosity in rock of uniform composition--also favor the production of windows and natural bridges."

Kayenta Formation

The Kayenta formation in the vicinity of Navajo National Monument varies from 0 to 125 feet thick whereas regionally it is almost twice this thickness. It is uniform to irregularly bedded and consists mainly of sandstone with some interbedded shale and in some instances limestone and conglomerate. The character of the bedding is the main criterion

highly cross-bedded sandstones above and below.

Note: Two such signs needed for Betatakin area and Keet Seel trail.

III: WINGATE SANDSTONE
JURASSIC (?) AGE

The uniform texture, large scale cross-bedding and lack of fossils strongly suggest that these sandstones were deposited by the wind in the form of dunes.

IV: CHINLE FORMATION
UPPER TRIASSIC IN AGE

These variegated shales contain shells, reptilian remains, and silicified wood which have established their age. They are fresh water forms and the formation is considered to be of continental origin. Ask the Ranger to show you Petrified Wood from these beds.

Note: One sign needed to be placed along the Keet Seel trail.

V: LAKE BEDS
PLEISTOCENE TO RECENT IN AGE

Sands, gravels and clays deposited in old lake beds which once occupied this valley. Plant remains and fresh water shells are found in abundance and the Ranger will point these out to you if you wish.

Note: One sign required to be posted along the Keet Seel trail.

CONCLUSIONS

Navajo National Monument is a most interesting area. While I am not familiar with the fundamental archeological factors the ruins were just as spectacular to me as some of those contained at Mesa Verde National Park. It is surprising that so few people living in northern Arizona know of the importance and inspirational character of this Monument. The Park Service is indeed fortunate in having Milton Wetherill on duty as Acting Ranger at Betatakin. He was most helpful to me during my recent trip and is greatly interested in a ll of the different angles of the Monument. He has made a study of the plants and is now working on the birds and animals.

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SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 9

TUMACACORI ALCOVES OR TRANSEPTS

BY

J. H. TOVREA

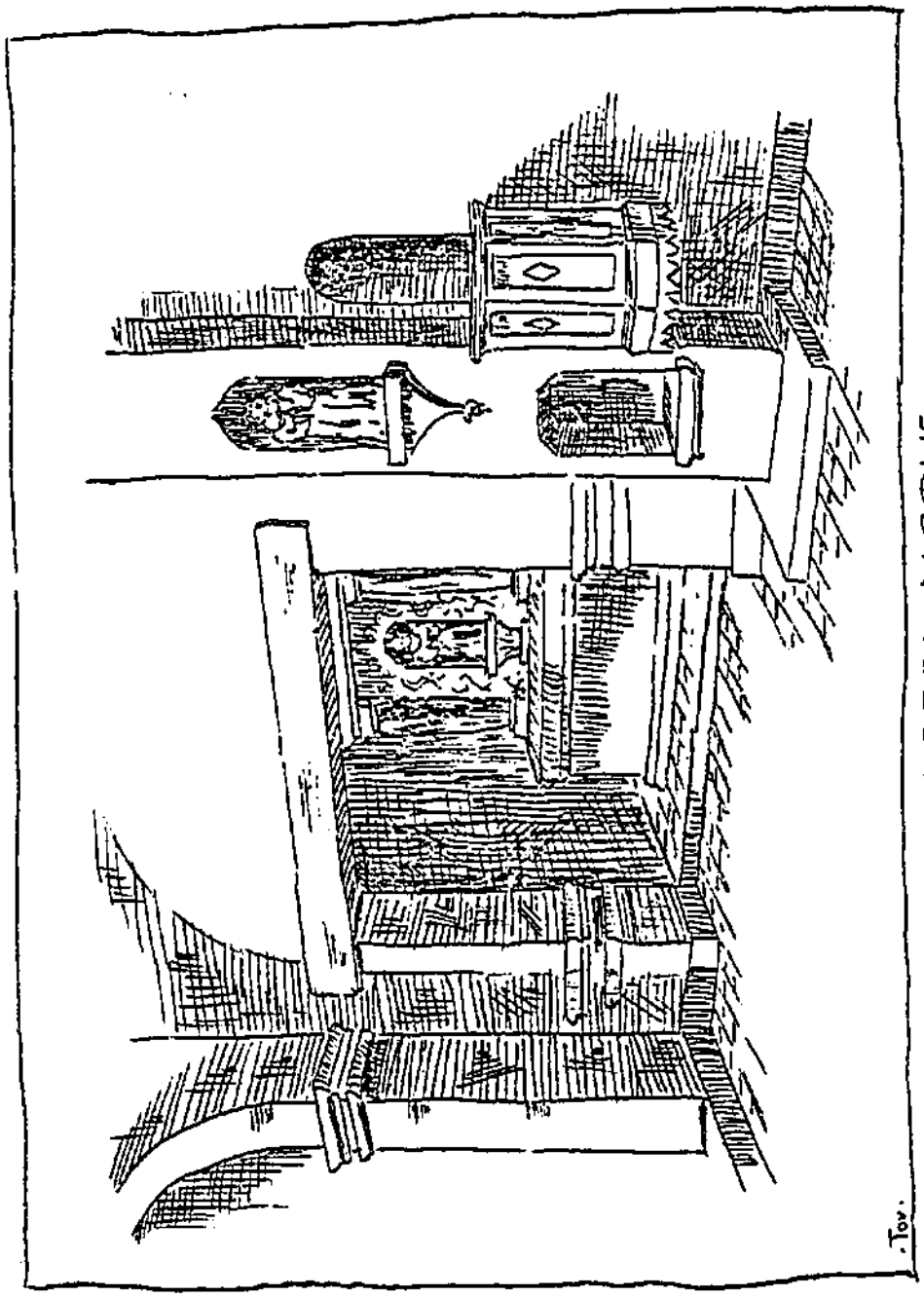
AND

FRANK PINKLEY

·DEPARTMENT·OF·THE·INTERIOR·

·NATIONAL·PARK·

·SERVICE·



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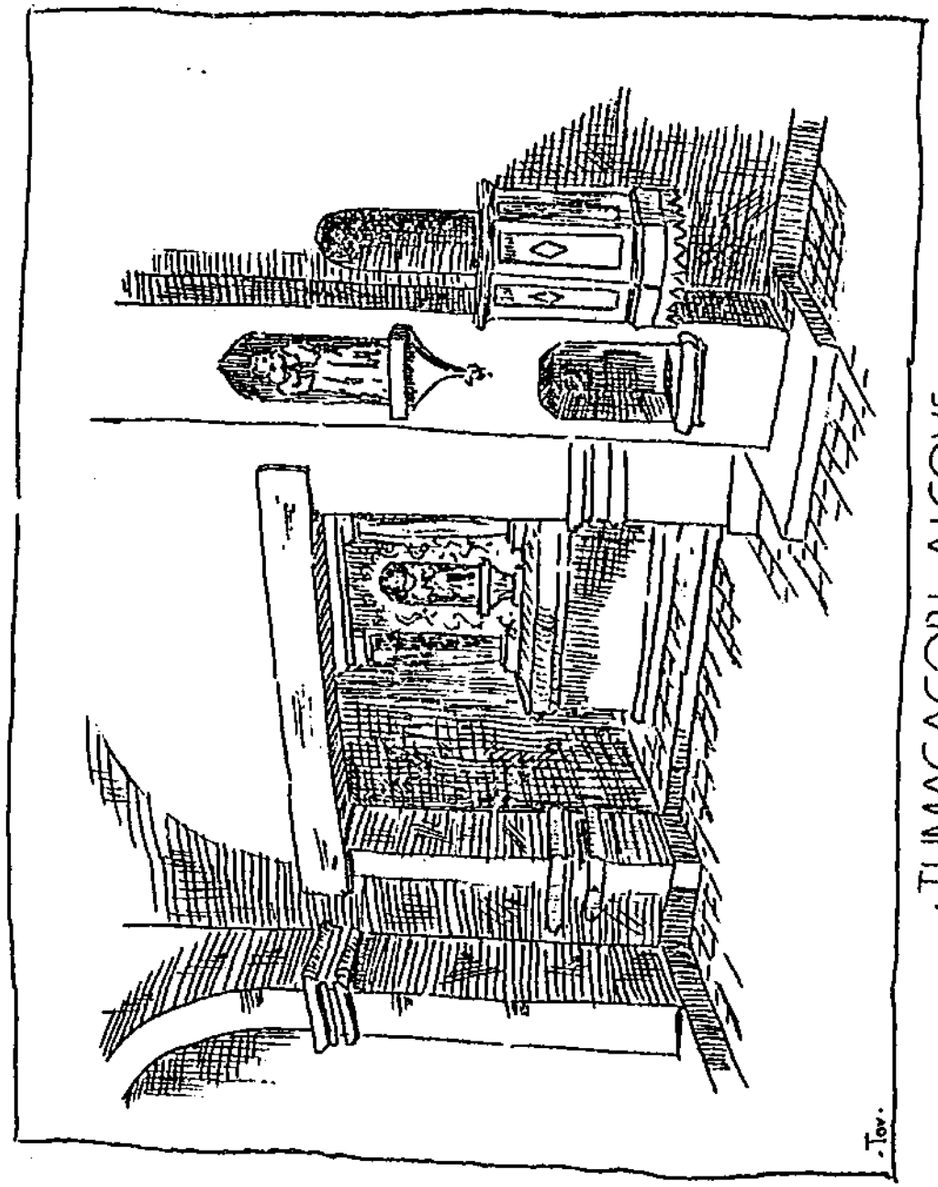

·TUMACACORI·ALCOVE·

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TUMACACORI ALCOVES OR TRANSEPTS

By J. H. Tovrea and Frank Pinkley.

For many years we puzzled over certain non-bonded wall joints in the nave of the Tumacacori church. It might be well to put the problem down here and let others see if they can add to our information or develop any new theories.

Tumacacori was abandoned about a century ago. The beamed roof of the nave fell into ruin, partly due to vandalism and partly due to weathering. The interior walls of the nave were thus left open to the elements for several generations and the interior plaster broke away in large patches revealing the construction of the wall.

Not quite half way down the lenghh of the nave from the entrance doorway are two pilasters, one against each wall, running the full height of nave. Just in front of these pilasters some three feet the plaster being broken away exposes an unbonded joint in the wall which runs up about seven feet from the floor before the adobe bricks begin to bond across. About twelve feet farther along the walls we find another of these unbonded joints in each wall running to the same height before the adobes begin to bond across.

As we walk up the nave from the entrance doorway, just before we come to the pilaster on the right, the broken plaster shows, at a point several feet above the floor of the church, what appears to have been an entrance, window, or opening of some kind into the wall, which has afterward been filled with adobe bricks. Only the bottom of this supposed entrance or opening is visible, the plaster just above still clinging to the wall and preventing one from seeing whether or not the top of the opening might have had a wooden header or adobe arch.

The above were all the facts we had for some years and upon them we built many theories. One of the best of these theories was that the Padres had designed this church to have a cruciform plan; that the unbonded lines in the adobe walls marked the width of the openings into the transepts and that the opening or entrance in front of and near the east pilaster was the opening into the pulpit. We presumed that something had happened to make a change in the plan; that after the walls had been built some six or eight feet high the idea of constructing transepts was abandoned; that the workmen were ordered to fill up the transept openings and brick up the entry way which they had partly constructed leading from the east transept up through the wall into the pulpit which would have stood in the nave of the church.

This theory, given above, would account for the non-bonded joints in the walls of the nave and for the making of the so-called "pulpit entrance" which was then filled up and plastered over. It would also account for

the bonding over of the adobes above the joints in the walls. The whole thing was just a change of plan while the church walls were under construction.

One time when Mr. George L. Boundey was Custodian of the Tumacacori National Monument, in doing some clean-up work and re-grading along the west side of the mission, he exposed the foundation of the supposed west transept. He opened it up and we looked it over and he then closed it up again.

One startling thing about this foundation, which developed in this examination, was that there were a few inches of the original wall still standing above the rock foundation and those few inches of the adobe wall CARRIED THE ORIGINAL STUCCO PLASTER WITH THE CHARACTERISTIC RED AND BLACK DECORATION SUCH AS THE WHOLE LOWER SECTION OF THE CHURCH ONCE CARRIED.

It does not appear reasonable to us that they would put the plaster on the inside or the stucco on the outside of a partly built wall. As we view it, then, the importance of this bit of stucco on the outside of this wall was to prove beyond reasonable doubt that this transept or alcove had once been completed; in other words our theory of a change of plan during construction and an abandonment of this part of the structure before it was completed would not fit this fact of the stuccoed exterior face of the wall.

The study of a sister mission across the border, San Ignacio de Caborica, shows a plan somewhat similar to Tumacacori with two alcoves opening off the nave. The walls of these alcoves do not extend as high as the church walls and the alcoves have flat roofs. The east alcove has a pulpit entrance starting upward from the floor of the alcove, turning to the right and coming up through the wall of the nave, opening into the pulpit several feet above the floor of the church. Here we have in actual use precisely the same arrangement which we thought had been in effect at Tumacacori. The alcoves at San Ignacio each have an alter at the back and we think the same arrangement would have been effected at Tumacacori.

We are now of the opinion that these two alcoves or transepts at Tumacacori were at one time completed and in use; that in a later reconstruction period the walls of the nave at these points were torn down to a point some eight feet above the ground, the alcove or transept walls were removed down to ground level, the former entrance opening into the alcoves or transepts were bricked up and the walls of the nave were then carried back up to roof height. This would also entail closing up the pulpit entrance and the present pulpit entrance was then cut through farther along toward the rear of the church. It is also possible that the present sacristy was constructed at the time of this reconstruction and the present arch erected between the nave and the sanctuary, but these are problems which are outside the scope of this paper and will be treated later.

As the facts now stand it seems probable to us that the nave walls of the present church might have been built before 1760. At that time those alcoves or transepts were complete and were in use. We have some reports of the church being attacked and at least partially destroyed by the Apaches in the 1760's and at this time the roofs of the nave and these transepts or alcoves were probably destroyed by fire and the walls left open to the elements. Nothing seems to have been done until 1781 when we have a notation on the church had been rebuilt or restored and was again in use. We think it is entirely probable that it was in this reconstruction of 1781 the decision was made to abandon these side structures, because of their ruinous condition, possibly because the fire had destroyed the lintel beams which may have carried the walls across the openings, or because they had been too badly desecrated to be used again, and so the present arrangement of the interior of the church dates from about 1781.

Attention should be called, at this point, to the fact that the four large altars in the nave of the present church are not bonded into the nave walls. The plaster of the nave walls runs unbroken behind the altars. Now, since the extensive reconstruction as set out above would probably entail a replastering of the interior walls of the nave, we might suppose the present altars in the nave to date from 1781 or later.

This would fit well into our theory for with the high altar in the sanctuary and the two side altars in the alcoves or transepts, no others would be needed, whereas, upon the abandonment of the alcoves or transepts the Padre might decide to relieve the plainness of the nave by introducing the present altars.

We present this study of the problem of the alcoves at Tumacacori for better heads than ours to puzzle over and to point out to the research men who are now working over the ancient records the need of looking carefully through all the reports around 1781 to see if any documentary evidence can be found which will corroborate these guesses of ours as to a reconstruction and if there was one just how extensive it was.

SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 10

REPAIR AND RESTORATION OF TUMACACORI 1921

BY

FRANK PINKLEY

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPAIR AND RESTORATION OF TUMACACORI—1921

By Frank Pinkley,

(Ed. Note: While going through the old files the other day on some other matter we ran into the old report of the work done on the Tumacacori Mission in 1921. The original of this report was filed with the Washington office, but in reading it over we thought it was of sufficient general importance and has enough historical value to incorporate it here.)

Early in the year it was decided to restore the roof over the nave of the church and arrangements went forward so that the work started the latter part of April.

Our fund for the protection of national monuments being so small as to preclude the allotment of an amount sufficient to complete this work, and there being no way of putting half a roof on this year and another half later on, recourse was had to local aid.

Too much credit cannot be given to the local organizations who contributed funds for this work. The National Park Service allotted $000; the Knights of Columbus of Tucson gave $100; The Arizona Archeological and Historical Society gave $160; the Chamber of Commerce of Nogales gave $600; and the Knights of Columbus of Phoenix gave $100; making a total of $1,760 on hand when the work started. In July and August further allotments of $395 were made from Service funds, so the total amount expended came to $2,155.

The roof was partly a restoration and in part a modern weather-proof construction. Special sizes of bricks were manufactured and burned and with them the badly eroded walls were carried up to their original height. This included raising the front wall ten or twelve feet in the restoration of a semi-circular pediment which originally formed the upper part of the facade.

Logs were brought out of the mountains, hand hewn, stained to give the appearance of age, and put in the places of the old beams. Ocotillos were brought in from the desert, cut to fit, and placed on top of these beams, forming the ceiling.

Viewed from the interior of the church, the roof is a perfect restoration. A complete restoration would not, however, have been so satisfactory from the weatherproofing standpoint, so above this restored portion we built a modern roof, from which the drainage is cared for through the restored downspouts of the old construction. This modern roof does not show from below, being hidden by the parapet walls of the nave, which extend above the roof line.

Aside from work on the roof, the tower stairs, running from the ground level to the bell arches in the third story, were entirely restored, they having been dug out long ago by treasure hunting vandals.

Many other smaller places too numerous to mention were patched and filled wherever it was considered necessary to strengthen walls or remove traces of vandalism.

General Conditions

It must be remembered that the Tumacacori Mission is 18 miles from the nearest town and that, although we had a good motor road to Nogales, railroad shipments were out of the question.

The amount of work to be done precluded the use of labor-saving machinery as the expense of buying or renting it and bringing it out would have more than offset the saving gained by using it.

We were thus forced by circumstances to do the thing which our logic suggested; follow as nearly as possible the methods of the builders in making our repairs. This line of reasoning applied to the men to be used in the work as well as to the methods.

We had the choice of bringing high priced workmen out from town and boarding them in a camp, or of using the workmen of the locality who could live at home while the work was going on. We chose the latter course for several reasons, and while there were times when we were discouraged and thought maybe we had not made the wisest choice, we were at least wise enough not to change horses in the middle of the stream, but carried through the original plan to the end of the work.

The high-priced expert workman would have meant a heavy pay roll over a short period of time and our funds were not arranged so that we could secure them so freely as that would demand. That part of the money contributed by bodies outside our Service could not be obtained on short notice in every case, so it was considered wise to proceed with the work by easy stages rather than to crowd it to a quick conclusion.

Another objection to rushing work of this kind lies in the need of time to note and digest the many points which come up as the work proceeds. Haste would cause many problems to be slurred over, wrong solutions applied to others, and a general tangling of affairs, due to the fact that we were under a heavy daily expense and could not hold up the men to obtain the right solution.

Another factor with us was that the expert workman, be he brick man, cement man, plasterer or carpenter, is not inclined to brook much interference with his methods and more or less friction will be started when one tries to experiment and adapt present day methods to hundred-year-old results.

By using local workmen we reduced our amount of work done per day about

20% as compared with the same number of expert workmen; but since our cost per day was reduced about 50%, the net result was a gain, the amount of extra time used in making the repairs not being a serious factor.

I was unable to be on the ground all the time when the work was going on and this was a decided disadvantage. My other duties kept me going back and forth and it was only the last five or six weeks of the work that I was able to be with the boys practically all the time. Questions arise from day to day which need the decision of some person who knows the causes, history, and environment which led to the construction of these walls. In some of these cases, unless the leader is present, the men must choose between delaying the work for a decision or making a guess which may be the wrong one.

We experienced the usual troubles which a Government man on a small job in a semi-isolated position like this will generally find. Since it was a Government job we were expected to pay high wages and be generally generous and easy. The hardest single phase of running a small Government job is in meeting the payroll. So far as possible local funds were used for this purpose so we could draw checks on local banks and pay off Saturday night or Sunday morning for the week just closed; but toward the end, we had to put the men on the Government payroll, which meant a two or three weeks' delay in getting the pay checks. This caused a good bit of dissatisfaction as these men live from hand to mouth and had no means of bridging this gap and feeding their families unless, as in one or two cases, temporary loans were arranged.

The summer rains caused some trouble although they did no serious damage other than flood our storage room in one case and slack two or three sacks of lime for us, and wet and spoil some cement on its way out from town in another.

There is no intention here to point out only those general conditions which were not favorable to us. Many things worked together for our good, but it is human nature to note and remember those things which cause delay and trouble.

We had, as has been stated, a splendid wagon road from Nogales to the mission over which we could bring in material and supplies regardless of the weather. The matter of drayage over this road developed a peculiar twist which puzzled me for some time before I settled on its cause. It was only 18 miles to town, and a man with a two-horse team could have made the round trip in a day, bringing out a 2000-pound load, but I could never get it done that way. The freighter, a Mexican, would hook up a four-horse outfit, drive down to town the latter part of one day, stay overnight and come home the next day with the load. He thus put in two long half days rather than one long day. It took me some time to figure out that a generation or so ago, when this freighter was

a young man, the roads in that part of the country were none too good and this trip from the mission to town and back was too much to be made in a single day or with less than a four-horse outfit. This man's mind has not changed with the changed conditions and he still thinks that it is the proper way to get a load from town and far be it from him to depart from the ways of his fathers! Since I was paying for the drayage by the hundred pounds, I didn't consider it worth while to try to uproot this local belief in the old customs in this particular case, so the freighter had his way and used all the time and horses he wanted.

The Bricks

In the restoration of the walls we were to use two classes of bricks; the adobe and the burned brick.

The adobes presented no particular problem excepting that the Mission adobe is much longer and thinner than the common size in use today, being 11½ inches wide, 25½ inches long and 2¼ inches thick.

The adobe is a sun-dried brick in common use all through the Southwest for building purposes and perhaps a little description of the method of its making might be interesting. Fortunately we had water near at hand in a little ditch about a hundred yards east of the Mission, which, by the way, must be running on almost the exact line as the one the padres used during the ancient days to irrigate their garden and field. The boys dug a pit a few feet to one side of this ditch, removing and discarding the surface dirt as not fit for adobes. The surface soil at this point had been built up a couple of feet in the last century and it was only after going through this accumulation of past generations that the men pronounced the material good 'dobe dirt. About a wagon load of this dirt was then loosened up in the pit and worked over with the shovels until it was fairly well pulverized. Stones and sticks of any size were picked out during this working. Water was then led from the irrigation ditch by a small trench and allowed to run into the pit while the dirt was turned with the shovels until the boys had constructed a magnificent mud pie. The water was then shut off and some refuse straw was worked into the mud. This straw was to bind the mud together when it was dry and to help absorb the rain when it falls on the face of the brick after it is placed in the wall. The men at this stage prefer to work barefooted with their trousers rolled up above the knees and it is a real athletic exercise to mix a wagon load or so of mud while standing on such insecure footing.

When the mixing is finished, one man in the pit shovels the mud up into a wheelbarrow and a second man wheels it away to the moulding ground. This is a level piece of ground which has been raked and dragged flat with a board. The moulder has his mould ready on the ground and the barrow man wheels his barrow up and empties it directly into the mould which is simply a frame without top or bottom having three

or four compartments the size of the prospective adobes. The moulder then gets down on his knees and rams the mud into the frames with his hands until all the frames are full, when he 'strikes' them by raking the surplus mud off at the level of the top of the frames. The two men then pull the frame up, leaving the newly moulded bricks, like so many cakes of black jelly, lying on the ground. While the barrow man goes back after another load of mud the moulder washes his frame off in a bucket of water and lays it out on the ground ready for the next load.

A couple of days after moulding the bricks are dry enough on top to turn up on their edge. Another two or three days and they are dry enough to stack, or, if they are wanted for immediate use, to be hauled to the job and placed in the wall.

This method of manufacture leaves finger and hand prints on the bricks which dry and become lasting impressions, so that the sign manual of our boys went into the walls in the bricks they made. In tearing some of the top material off the walls to start the reconstruction we often saw these handprints left there by the people who laid the bricks more than a century ago. In one case we found a perfectly preserved cockleburr in a brick when we broke it in two, and in another a little blue bead which had probably once been part of a necklace around some dusky throat.

The burned bricks caused us quite a bit of worry before we finally arranged for a supply of them. Seven sizes of burned bricks have so far been identified in the walls of the mission and I would hesitate to say that these were all that were used.

The most interesting size to us, because it was the hardest to manufacture and to lay, was the one we called indifferently the cornice or moulding brick. It is represented by Figure 1, Plate I, is 22 inches long over its greatest length, 13½ inches wide at its greatest width, and is 3 inches thick. In other words it is the size of seven or eight of our common bricks of present day manufacture. One end of this brick is moulded in a scroll shape and a line of the bricks, standing side by side with this scroll end projecting over the wall, forms the cornice.

When we went to a brick man in Nogales and asked him to quote us a price on 1500 of these bricks, he said they couldn't be made; that they were so big that they would not hold together through the drying and burning processes but would crack and go to pieces. When we pointed out that they had been made by the padres out at the mission, he said maybe they could make them but he would hesitate to do so with the soil he had at Nogales. We finally persuaded him to say he would try 1500 of them at 10 cents each. We were not satisfied with this deal but kept looking for some one who would come out to the mission and burn the bricks right on the ground, for the wagon haul of 18 miles out from Nogales, no matter how good the road, meant a heavy loss in breakage.

At last we were able to find a Mexican by the name of Lopez who had had experience in building kilns and burning bricks, who agreed to come out and build us a kiln if we would make up a total of 6,000 bricks. We decided we needed two other sizes besides the cornice bricks to make the proper restorations and, while we would not need as many as 6,000 bricks for this present work, it would be no loss to have some bricks left on hand for future repair and restoration work. The other two sizes decided upon were the wedge shape and the 8 by 16.

The wedge shape brick shown at Figure 2, Plate I, gave us considerable cause for study and it was the better part of two months before we finally decided upon the reason for its shape. Architects, engineers, and contractors, all declared it was built for an arch brick, but all the arches in Tumacacori are built of the plain mission adobes. The wedge shape brick was found too in places where its shape could not be accounted for. It was used on the shoulder or offset of the outside walls, in the pediment on top of the front wall, and one or two other places where the 8 by 16 brick would have given more satisfaction.

The explanation finally arrived at was that it was a dome brick put to a secondary use in all the places we had been finding it. Upon this theory we experimented and found that the bricks laid flat, side by side, with the small end of the wedge pointing inward, formed a circle about seven feet in diameter. Smaller or larger circles could be made by making the cracks between the bricks wedge shaped, at the outer side for smaller circles and at the inner side for larger circles, so that a dome of any size could be started and gradually drawn in at the top without using false work underneath to support it during construction.

This explanation of these bricks checks out with a historical note in Bancroft's Arizona and New Mexico, (Page 385, footnote) where he says: "In 1822 a new church was in process of construction or extension, but work was for a time suspended on account of trouble about the pay for 4,000 head of cattle that Padre Estolric had sold to obtain funds."

Padre Liberos, who was in charge of the Tumacacori Mission from 1822 to 1824 was delayed in his work by lack of funds. He had used up all his standard sizes of bricks in the walls and could not get the necessary funds to burn another kiln. In this extremity he realized that the first thing to consider was protection, and to get protection from the weather for his exposed walls and offsets, he decided to use up the wedge shaped bricks which had been made for the domes over the bell tower and mortuary chamber. He expected, as soon as his funds were available, to go on and burn another kiln of bricks in which he would include another supply of dome bricks, and finish his church, but the church was abandoned before the work was completed.

PLATE I – Brick Sizes Used at Tumacacori

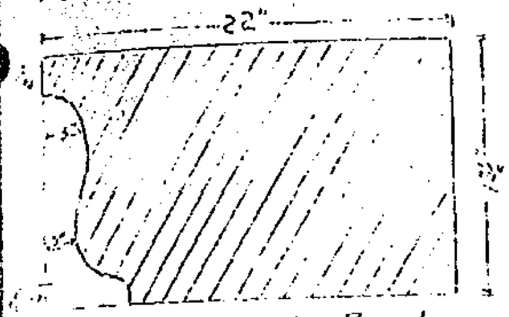


Fig 1 - Cornice Brick 5" Thick

Fig 2 - Wedge Shape Brick 3" Thick

Fig 3 - The 8 × 16 3" Thick

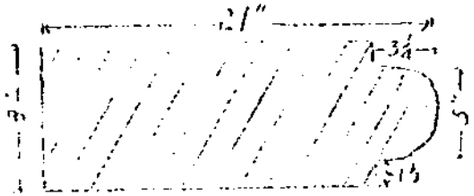
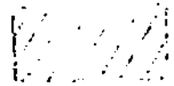


Fig 4 - Tower Moulding Brick 3" Thick



Present Commercial Brick

Fig 5 - Moulding Brick 1½" Thick

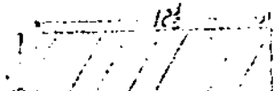


Fig 6 - Floor Brick 2¼" Thick

Fig 7 - Done Step Brick 2¼" Thick

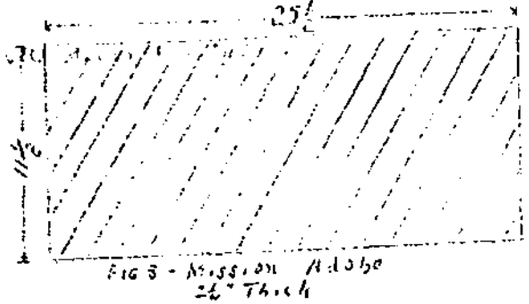
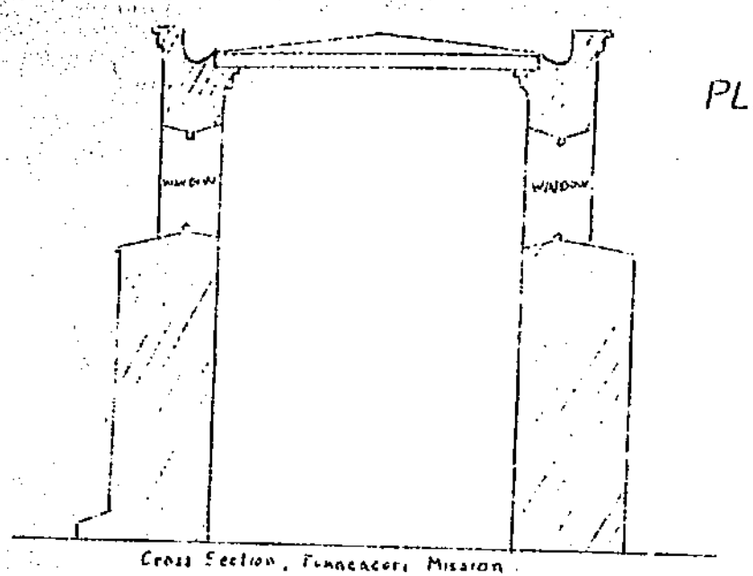
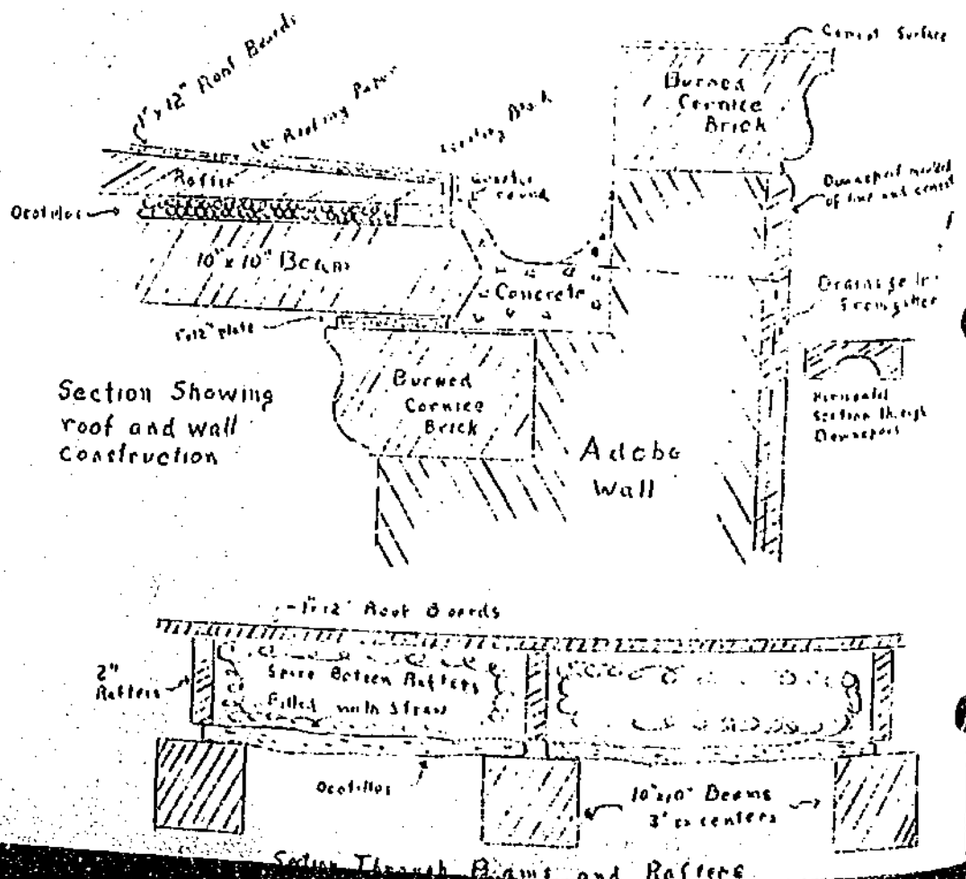


Fig 8 - Mission Adobe 2½" Thick

PLATE II



Cross Section, Tumacacori Mission



We arrived at this solution of the problem of the wedge shaped brack too late to keep us from burning a supply of them, so while it was not really necessary, we restored the wedge shaped brick where we found it had been used with the exception of the pediment at the top of the front wall where we considered the 8 by 16 size stronger for the purpose.

A few words of explanation may be in order about the other sizes of the burned bricks.

Figure 4, is a special moulding brick used in the bell tower, the half round projection forming the moulding which can be seen near the corners of the tower, and the frame which can be seen around the bell arches, are made of this brick. Figure 5, is a thin square brick. A line of these bricks was left projecting a t the spring of the arches, just under the bell beams, in the bell tower. They proje t a little over an inch and were to be covered with plaster, forming a neck mould at the spring line of the arch.

Figure 6 shows what seems to have been intended primarily for a floor brick, although it has been found in one case, at least, in a wall, and in another as a capping for a bench. Figure 7 is the dome step brick. Photographs show a series of 12 steps leading up to the cupola on top of the sanctuary dome. These were for the practical purpose of getting up to the cupola to make repairs should the occasion arise, and for the artistic purpose of breaking the monotonous line of the dome. For a long time I thought these bricks were simply cut to shape out of the 8 by 16 size, but upon close examination they prove to be special diamond shaped bricks made for this particular purpose; only twelve of them were ever used!

The methods used in mixing and moulding the burned bricks did not differ essentially from those described above used in making the adobe bricks. We had to experiment with various amounts of sand and finally mix in a little straw to keep the large cornice bricks from cracking while drying.

After the bricks were well dried they were built into a kiln and burned, nine or ten cords of wood being used in the burning. Their quality, we found when we came to using them, was not so good as the old bricks of the padres. I think this was partly due to the burning; that they would have been better if we had burned them longer, and partly due to the fact that the material we had to use was more or less mixed with the loan of a century's use of the surrounding soil, probably reducing the clay content of our brick as against those of the padres, However they served the purpose for which they were designed and cost us less than they would if we had bought them in Nogales, aside from the saving of the drayage in transporting them and the loss in breakage.

The Timbers

Feeling pretty well satisfied that we had conquered the question of bricks herewith to bring our walls up to the proper height, we next began to consider where we were going to get the timbers for the roof which was to cover the nave. The original roof was of pine timbers brought from the Santa Rita Mountains, at the nearest point about 20 miles away to the east across the Santa Cruz River.

I went over and looked out the country on the side of the mountains nearest to us, going up the White House Canyon as far as it was navigable for a Ford, and going into consultation with a Mexican up there who had lived in those parts about thirty years. He assured me that the timbers could not be brought out that way. There were some large enough for our purpose up near Old Baldy, but it would be a question of snaking them two or three miles over canyons and washes to a point where our wagons could get to them. Before this I had sent a Mexican over who had spent a day and a half looking out the country and he had come to the same conclusion. I believe we looked over the ground where the padres got their pine timber, but all the large trees have been cut out of that part of the mountains in the last two or three generations.

Balked on this line, we had recourse to some Mexicans who had mined around on the south and southeast slopes of the Santa Ritas and assured me we could get trees of the size we wanted around there. This meant a matter of snaking the trees from the point of cutting some distance to the wagons; a wagon haul of about 12 miles down to the railroad; a rail haul of about 30 miles around to Tubac station; and then bringing them across the sandy Santa Cruz River to the mission on wagons. All this was finally done and we landed 20 sticks of timber eighteen feet six inches long, with an average diameter of about fourteen inches, on the ground.

We could, of course, have purchased timbers of the size we wanted at the lumber yard in Nogales; but there is a certain amount of sentiment to be taken into consideration in work of this kind, and I wanted, as far as we reasonably could, to use the materials and methods of the original builders.

I am sure the original timbers were pine because I have talked with two different men who claim to have seen the mission when a few of the rafters were yet in place and both men agreed they were pine. Not satisfied with this, we traced down a story to the effect that some of the timbers were taken out of the roof by Mr. King in the 60's or 70's and built into a house across the river. We found that the railroad, in building from Tucson to Nogales several years ago had condemned the land this house stood on for a right-of-way, destroyed the house, but had left one timber lying along the right-of-way. This timber laid there until a couple of weeks before we got interested in it when a clean-up gang of

section men set fire to the weeds and grass on the right-of-way at that point and burned the timber. We were still able to get our evidence however for, although we lost the pleasure of being able to restore an original timber to the roof, we were able to tell by an unburned portion of one end that it was pine, to get the approximate size of the rafters, and, by measuring the ashes on the ground, to get its length, which checked with the width of the nave of the church.

After getting our timbers on the ground we had our work cut out, so to speak, to get them hewn square and get them up on top of the 24-foot walls of the nave. We were all new to this work but by this time we were getting the habit of developing our own methods as the various needs arose so we got an axe and an adze and experimented until we were able to square up timbers which are passing inspection today by hundreds of visitors as a first-class job.

One day as I was squaring one of the pine timbers with an adze and thinking how, just about a hundred years ago, on this same plot of ground, a priest with his robe tucked out of the way was swinging a similar adze on another pine log from these same mountains, I was called back into the present by the drone of an airplane and, leaning a few minutes on the handle of my adze, I watched the silver glint of the sun on the wings of the plane as the man on fire patrol over the Santa Rita Forest Reserve went off duty and flew home to Nogales, making the 18 miles from our place to town, which would have cost Padre Liberos a weary half day, in about 10 minutes.

We spoke often while we were at work of what the padres would think could they revisit today these scenes of their labors.

When the timbers were squared cut we devised our own tackle methods for getting them on top of the walls and succeeded in a couple of days' hard work in lifting them up safely without damaging the walls or breaking any heads. Here they looked entirely too new and white, so we decided to darken them a little to give them the appearance of age. We experimented with some crude oil diluted with kerosene and after painting and repainting some sample beams two or three times, attained what we considered the proper shade and went over all of them. The proper shade was largely a matter of guess-work for we were using the stain in the open air and bright sunlight and it would be seen against the semi-dark ceiling of the roof from the interior of the church, so we had to make it several shades lighter than we expected it to look later on. We were very fortunate in hitting upon the correct shade, and many visitors, looking at the roof now upon entering the church, think the beams are the original ones and are a hundred or so years old.

The Ocotillos

The construction used in the original roof was to set the main

beams about three feet on centers and then crosswise over them put on a layer of ocotillo stems, ribs of the sahuaro cactus, or small brush. On top of this second layer was a layer of grass and above this, either dirt, with a lime surfacing in which bits of bricks were bedded to give strength, or the lime may have been put on the grass without the intervening dirt. By a process of elimination we decided the padres must have used the ocotillo stems. The sahuaro cactus does not grow in the vicinity of the mission and the ocotillo stems would have been much better for the purpose than the more crooked mesquite or the small reeds or brush which might be found along the river.

The ocotillo is confused by the average desert visitor with the cactus family, but it belongs to a very small family of its own, Fouquieriaceae, having only one genus and a very few species. Armstrong in "Western Wild Flowers", gives the following description:

> "A magnificent desert shrub, when in full bloom, but strangely forbidding in aspect in spite of its beauty. Its many stiff stems, from six to twenty feet tall, entirely without branches, stand up stiffly from the root, like a bunch of wands, and are armed their whole length with terrible thorns, which in the spring are masked with beautiful foliage, like little apple leaves. From the tip of each wand, springs a glorious cluster, from six to ten inches long, and crowded closely together, suggesting a flame and waving to and fro in the wind with a startling effect against the pale desert sand. When the flowers and leaves are gone, the clumps of dry, thorny sticks look quite dead and it is hard to believe that they were so splendid early in the season."

Having decided to use the ocotillos to cover our beams, we began looking for an available supply and seeing what they would cost us. They grew rather sparsely on our side of the river and were back up on a mesa where we could not get to them easily with the wagons, so we decided to bring them over from the other side. This we found to be quite a little job, and before we had brought over as many as we needed, the river got up and cut us off from that supply and we were forced to get the remainder on our side. It was fortunate that we only needed part of a wagon load to complete the work, for it took two or three days persuasion to get the Mexican to go out and gather them on the rough mesa.

Other Materials

Sand was obtainable in two or three washes a short haul from our work, and toward the end of the job an obliging young cloudburst washed down a plentiful supply about thirty yards from our mixing box.

Lime and cement were purchased in Nogales as was lumber, roofing peper, and like materials. We found we could not make a straight lime mortar which was strong enough to suit us, so we put cement enough in to make it the strength we wanted.

The Need of Protection

Having explained the sources of our materials, we are now prepared to take up the need of protection and the work itself.

The need of protection, and the primary cause of the restoration done in this work was protection, was very great. Destruction at the Tumacacori Mission has occurred from two main sources; the elements; and treasure seeking vandals.

A century of storm and sun had disintegrated surface in many places and eaten into the adobe walls. Settling cracks occurred in some places, due I think rather to the weight of the walls than to any earthquake, such as destroyed the towers of Cocospera in 1887 or 1887. The tops of the walls of the nave had worn down two to four feet and in some places we had to cut another foot or two off to get down to a solid footing so we could begin to build up the new wall.

The Treasure

Almost all the vandalism can be traced to the treasure hunters. For generations tales of buried treasure have hung around the Tumacacori Mission. If one is to believe all these tales, the padres spent all their time in mining and reducing immense amounts of gold and silver and the church was rich beyond computation.

Most of the vandalism has been done, not on any system but on 'hunches.' A scoundrel with a pick and shovel seems to have felt free to walk into the church any day and dig here, there and yonder without rhyme or reason. It never seemed to dawn on his dull brain that if the padres were hard-pressed and decided to abandon the mission in haste, they would hardly try to secrete any valuables by tearing up a perfectly good cement church floor where the soft earth and broken material would be sure to tell the tale to the first visitor, when they could go out into the garden and dig a hole in the freshly turned earth where a newly covered hole would merge into the rest of the soil and would not be noticed twelve hours after the work was completed.

One school of treasure seekers are trying to use some system in their work, but, so far at least, have not attained any success. In my work as custodian of the Tumacacori I have happened upon four copies of a document in the hands of different treasure hunters, from which they were constructing charts with which they were expecting to find the mines and treasure of the padres.

While it is not exactly germane to our subject of the repair and restoration of the Tumacacori Mission, a copy of this manuscript might be of interest, and I will insert a fairly accurate translation here, leaving the distances blank at the request of the person who allowed me to transcribe this copy.

The Manuscript

"One document which dates of the years 1558 to 1668. It expresses as follows:

"The mine which is called 'Virgin of Guadalupe' close to Tumacacori, it will be found at -- leagues, measured from the great door of the church to the south, and from the waters of San Ramon measured to the left---varas to the north. About --- varas before arriving at the mine is a black rock engraved with a chisel. On the rock you will red the inscription $\frac{CC\ D}{T\ D}$ and --- varas from the cross you will find the treasure and that is what the letters signify.

"At --- varas after you pass the black rock you will find a small monument in the direction of southwest. It is two peaks which were demolished by powder and fell over the mine in great masses. Without more testimony than the powder put in the cliff the place was abolished forever so people could pass over it and it would never be seen.

"In a certain place exists one square of --- varas in a square inside and outside the mine and the treasure is in the middle of the square. In the mouth of the mine there is silver and gold and white silver. The gold was brought from the mountain of Guachapa close to Tubac. The silver consists of 2050 bars smelted together with 905 of virgin silver. The whole amounts to the value of about 50,000,000 (pesos?).

"Ahead in the same direction to the south at --- leagues from the mine of Guadalupe there is a passway which is called 'Deep Water.' It has at the south, by the road of the passway, a canyon which opens out at the town of Santa Cruz. The mine will be found when you get in the pass. Below the said pass way are 12 arrastas and 12 patios. There is one tunnel of 30 varas which has the name 'Purissima Conception' engraved with a chisel. A tunnel runs to the north and about 20 varas ahead there is another tunnel, small about 100 varas, and it runs to the west. The ore is yellow. It runs 1/2 silver and 1/5 part gold.

"At --- varas there is a mine in the direction of north. You will find in this native silver from one pound to at least 5 arrobas, the greatest. This mine will be found covered or hidden by a copper door; it has enormous iron bars, everlasting. The copper was brought from the neighborhood of the mountain of Guachapa in the neighborhood of Tubac, smelted in Tumacacori and was taken with oxen to the mine in the years 1558 to 1658.

"From the mine 'Purissima Conception' to the mountain of Our Lady of Guadalupe there are --- leagues and half way on the road in the same direction there is another mine. It will be found by the name of 'Opata'. It has a tunnel 400 varas long and it runs to the south. The metal of this mine has a lime contact, and about 300 varas from the mouth of the mine there are some inscriptions and furthermore there is a long black mesa from the side where the sun rises and sets. Follow a deep canyon to a rock slide. You will see one inscription made by a bar. Here is a hole 1/2 vara deep and it will last forever. Opposite, to the south of the canyon, you can see the mark of the gold. At the side of the canyon to the north of the mark we have --- leagues from mine Opata to Tumacacori. The mark is to the west.

"On the other side of the mountain you will find the mine of Our Lady of Guadalupe. You will find the letters engraved "P. L. R. 12 Dec. 1508". This mine was found by chance and all her interests remain in charge of Tumacacori. In this mine will be found a copper box. It has a key hanging on one corner. There is a set screw which you open and then there is a rod which you pull out and open the box. There will be all the maps and the great treasure.

"If any one by chance will have the great fortune to find one of the mines he shall be obliged for the good of his soul to give 10% to the mother church.

"In the year 1658 belonging to Tumacacori was a mine by the name of San Pedro which you will find --- leagues from the mine Isabelle. The river is to the north --- leagues and the mine is close to some black rock at the point of the mountains. From this point a trail goes to the mine San Pedro, in a line with a line of the mountains at a point of the bar. The mine is --- leagues from the side door of the church to the west and when the sun rises it is directly in the mouth of the mine, and from this mine you can see the town of Arivaca.

"From the Virgin Guadalupe it is --- leagues to the mine San Pedro. There is a landslide of about 1/2 vara from the top to the bottom of the canyon. There is a trail that descends from the mine San Pedro. It comes down to the Virgin Guadalupe in the direction of the south to the mine of San Ramon. The eyes will be engraved in one rock. In the mine of San Pedro will be found enormous slabs of virgin silver, two deposits of virgin silver. There is a wooden door. To the west there is a landslide and in it there is a deposit, and to the east there are others, and at a certain place there are three deposits containing all pure virgin silver.

"And notice is given that any person who finds this mine will be obliged to give to the mother church 10% and repair this church, and the Lord will bless his soul."

(The following notice is appended to the copy of one document which I saw.)

"Notice: The original of this document was in the archives of the parish of Magdalena, Sonora, and from there it was taken by a priest to the museum of Paris."

It will be noticed at once that the dates of 1558 to 1658 given in this document are entirely too early. Tubac, Tumacacori, Arivaca, and several of the names given here, do not appear in history until after Kino's first visit in 1691.

Yet the internal evidence points to the fact that all the copies of this manuscript which I have seen came from some master document. On the face of it it looks like a hoax, yet I know two or three people who believe earnestly that it is an honest document and points the way to real mines and treasure.

The local population felt quite sure we were treasure hunting when we ran some experimental trenches in the odd hours after quitting time in the evenings. The main object of this trenching was to establish, if we could, the location of the older church. We failed in this, but we did pick up a few interesting points in the plan of the quadrangle so the work was not wasted. The trenches were filled up when we were through with our examination, as to leave them open to the elements was simply to invite further destruction. We have two pits still open on an unfinished trail which we hope will uncover one of the bells.

The Lost Bells

That the Tumacacori Mission had a bell in each of the four arches

of its bell tower can be seen by an examination of the tower today. It must be remembered that in these missions the bells were not mounted to swing as are our church bells of the present time, but the bell was hung in a stationary position and the rope was attached to the clapper, so the bell was really tolled instead of being rung. A great beam of oak brought out of the Tumacacori Mountains west of the Mission, is still bedded in the walls of the tower at the top of each of the bell arches. The beam in the south arch shows the marks made in it by the rawhide rope by which the bell was hung. Since this was the front arch, and the bell hanging here would be the one most often seen from below, it is reasonable to believe that the largest bell hung in this arch. The person ringing the bells would have stood almost under this south bell, making the pull of the rope here slightly different from the others, probably imparting a slight swaying motion to the bell, which has caused the rope to chafe the beam. A bell hung in the east arch as is proven by the marks left by its ringing rope. The piers of the tower are so large that the rope running from the clapper of the east bell to the place where the ringer would stand in the south arch, cut into the corners of the piers between these two arches, so that today you can see six or eight deep marks, some of them almost a hand's breadth deep, which the rawhide rope cut into the bricks in sawing back and forth whenever this bell was rung. The same marks can be seen where the rope from the bell in the west arch cut into the corners of the southwest pier of the tower. If the bell in the north arch had always been rung by pulling its rope from the south arch, we might now have no evidence of its existence; but for some reason the ringers sometimes pulled its rope over through the west arch, probably while standing on the roof near that arch, and so the rope left its story on the northwest pier of the tower. It may be taken then as a fact that at one time four bells hung in the four arches of the tower.

Legend has it that, shortly after the abandonment of the mission, the bells were buried by the Indian neophytes to prevent their destruction or removal. I am inclined to believe this legend is based on facts. The bells were so heavy that their transfer further south would have been more or less of a problem; they were not needed further south either, for, owing to political disturbances in the period of 1820-1830, the church was having a hard time holding its own without expanding and building new churches which would need new bells; and I think the padres expected, when conditions grew more favorable, to return and re-establish the mission at Tumacacori. The legend was strengthened some years ago when a Mexican or Indian man turned up in Tucson with two bell clappers which he claimed belonged to the bells of Tumacacori. The people connected with the university made up a small purse and purchased them from the man and they are at present in the university museum. They have every appearance of being hand hammered and are crudely shaped. The man claimed that he had dug these up, knowing from the story which had been handed down through his family where they were buried. For some

reason, according to this man, the bells and clappers were not buried together, but if the family story was true, then he knew where the bells were.

He was offered a further sum if he would bring in the bells, but he reported afterward that either the story was wrong or he used the wrong landmarks, or some one else had removed the bells, for they were not where he had dug for them and he was unable to locate them.

One day, while we were at work on the repair of the mission, an old Mexican who had been born and raised at Tubac, which is about 3 miles away, came over to smoke and talk awhile and incidentally asked why, since we were fixing the mission up, we didn't hang one of the bells in the arches. Upon our explaining that, like the immortal Barkis, we were "willing" but did not know where the bells were, he said he knew where one of them was. He then went on to say that he had known from boyhood by the local tales, where the bell was buried, but had not dug for it until about 35 years ago when a rumor became current that it had been removed. Upon this, he and another man came down to the mission and sunk a pit about eight feet deep where the bell was supposed to be located, and found it. Having proved that it was still there, and having no reason to remove it, they filled the pit up "And," he very logically concluded, "if no one else has taken it away I suppose it is there yet." He said it was at the foot of the bell tower about three feet out from the wall and he would show us the exact spot some time when no one was around. Upon this offer I told him that if what he said proved to be true I would raise a fund of $25 to repay him for his care in keeping the secret and delivering it to us.

On the strength of this story we sunk a pit about four feet square and eight feet deep on a spot he pointed out, but the dirt we took out had not the appearance of having been turned before and there was no bell at the bottom of the pit. We then set over about eight feet to the west and started another hole, thinking we would go down on this, run a drift between the bottom of the two pits and explore a little from the sides of both of them before we gave up. So far we have not had time to do this and I am unable at this time to either prove or disprove the old man's tale. This trenching was all done at odd hours and toward the end of the repair work I was working ten or more hours a day on the mission and had no extra time for this bell hunt. We did develop a lead which had us excited for a while. In the second pit, when I had gone down a foot or so, I uncovered a rotted stick standing vertically and axe marks on it proved it was not an old root of some bush which had grown there. The ground, too, had undoubtedly been turned once before. "Ah!" we cried, "the old man, when he found the bell, left a marker which he has forgotten to speak of." Needless to say, we worked quite earnestly after this and were soon down to a depth of about four feet when the shovel grated on a metal object!

It proved to be an old bucket.

I know now that a couple of the Alegria boys had prospected for this bell in that pit about 16 years ago, but, becoming discouraged, had laid this joke which took so long to come to light. It was a good joke on us. However, they had stopped at a depth of four or five feet and the old man was quite sure his pit was over his head when his shovel touched the bell. So this old prospect hole didn't go deep enough to prove that the bell is not there.

The Pilar

A very heavy rain during the rainy season sent a large amount of water down past the mission and the erosion caused by this exposed a brick wall about 21 feet south of the southeast corner of the bell tower.

We examined this wall with some trenches and found it was built of the 6 x 12 burned bricks (see Fig. 6, Plate I), was about 12 feet long and turned south at both ends but, owing to its badly broken condition after it turned the corners, we gave it up. The wall which we developed was beautifully finished on the south side with a hard plaster resembling cement, and the floor, which we found about two and a half feet lower than the entrance threshold of the door of the church, was finished with the same material.

We decided this could not be the wall of a house because it was of burned brick and no other house on the grounds has brick walls; the floor of this structure was too low to have been on the ground level and not low enough to have been part of an underground room; and a house here would have destroyed the view of the facade of the church as one approached from the south. We pitched upon the explanation that this was a reservoir in which water could be stored. A day or two later a Mexican who had been born and had lived all his life near the mission happened along and confirmed our supposition. He said he remembered when he was a small boy he had visited the mission many times and at that time two of these reservoirs, which the Mexicans call a pilar, were in evidence. They occupied the plaza just in front of the church, were not very far apart, and between them was the evidence of a round well which had been lined with burned brick. We never got time to check this story up with trenches, but I believe it is substantially correct. It is to be hoped that we will at some time later be able to uncover and reconstruct this portion of the plaza, as it will make a pleasing foreground to the pictures of the facade of the church.

The Bench

At another time we opened a trench at a point about 14 feet north and 25 feet east of the southeast corner of the tower. It must be remembered that a row of rooms ran east from the tower, and this point

we opened was the junction of a wall running north from the back, or north side of this row of rooms. We afterward found that the wall running north was the east wall of a row of rooms, so this corner which we went down on was a corner of the quadrangle.

Along the walls forming this corner we found a bench or seat formed of adobe bricks built up some 10 inches and then capped with the 6 x 12 burned bricks and then finished off with a beautiful hard, red plaster. On the floor level we found a floor of the 6x 12 burned brick, several square feet of which was still in good condition.

Here again we were unable to continue our work and make a thorough examination, but I am sure this was part of a seat which ran along the house walls on the inner side of the quadrangle, and on this very part which we were examining Padre Liberos may have sat down to rest after a weary day spent with his neophytes in the village and field and garden, and watched the unpacking of a newly arrived pack train from far to the south bringing in material and supplies which he needed so badly to continue his work. The brick floor at the foot of the bench is a part of the corridor floor and one looked across it, through the sweeping arches into the sunshine of the quadrangle and felt that here was a mass of buildings, built at an immense expense of time and labor, but fit to endure for centuries. Little did he think as he listened to the clatter and jingle of the harness and the chatter of the Mexican and Indian attendants, that a scant hundred years later we would be opening trenches here in the debris of his walls in an attempt to discover the use of the various buildings!

Assembling the Materials

The actual work of rebuilding the walls and restoring the roof went along very slowly. The walls were so thick that it took a surprising amount of time and material to make such of a showing. At first we tried out the method of carrying all material up by hand, but this consumed so much time that we afterward put in a rope and pulley. We had to work out a special method of handling the cornice brick when we came to that point in the construction. It will be seen by a study of the cross-section sketch of the nave given in Plate II, that a row of these bricks come just under the roof beams on the inside of the church.

These cornice bricks, you will remember, were about 13 x 22 inches in size. We found that the simple method of laying the brick flat, covering it with mortar and then turning it up into place, would not work at all. The common run of mortar was too stiff to work down between the bricks if we stood them in position and then tried to fill the cracks. We next mixed the mortar to the consistency of a thin slop and tried pouring it between the bricks after they were set in position. Being so thin, the mortar promptly ran out of the crack at both ends of

the brick. We finally found that two men could work best on this job. The mason would set up the fresh brick at the proper distance. The helper then held a board over the crack at the back end and a special mould cut to fit the front curve, over the front end of the crack, while the mason upset half a bucket of mortar into the crack. In less than half a minute the mortar was set enough to allow the boards to be removed and the process could be repeated on the next brick. Since each of the bricks had to be lifted, carried, set and lined up, separately, it will be readily understood that a good bit of time was consumed in laying these cornices.

After laying the inner cornice, we stopped the brick work two or three days until we could get the beams up on the walls. These beams do not rest directly upon the brick cornice but upon some one inch board plates we put upon top of the bricks. Our idea in this was that if a beam warped or twisted after being laid, these plates would distribute any strain from falling directly on the noses of the cornice bricks and breaking them off.

The beams were unequal in size, running from about nine to about twelve inches square. The problem raised by this was whether we were to let the bottoms of the beams remain even and let the unevenness all fall along the top line of the beams, or whether to cut some sockets for the large beams and distribute the unevenness between the top and bottom lines. We decided on the first method and it proved very satisfactory. The bottoms of the beams fall evenly along the line of the noses of the brick cornice or moulding and the irregularities of the tops are not noticeable because there is no regular or even line there to force a comparison.

We did another good stroke in the distribution of these beams when we began at the entrance end of the nave with the smallest and ended at the sanctuary end with the largest, grading them larger and larger as we went forward.

The idea in doing this was that the visitor will almost invariably examine the roof construction as soon as he enters the church and will not pay attention to its details afterward. Now the nave is 73 feet long and this method of putting the larger beams at the far end makes all of them appear about the same size, while if we had put in any small beams toward the front of the nave, at that distance they would have had a sort of pipe-stem effect.

We had decided as soon as we hewed the beams out that they looked entirely too fresh and new for our purpose, so we looked around for some method of aging them in the wood, so to speak. For this purpose we used common crude oil, cutting it to the shade we desired with kerosene. We did not dare apply this stain until the beams were up on the wall because it did not dry very fast and we were afraid the handling

and the hoisting tackle might leave marks on them. After the beams were on the wall and before we had built the bricks in between them to hold them solidly in place, we applied the stain. The work of this was not hard, being simply a matter of brushing the stain on with long handled brushes, rolling the beam a quarter turn at a time until we had covered all four sides; but the mental strain of deciding out in the bright white sunlight under an Arizona sky what shade to apply to give the best result in the semi-dark interior of the church under the completed roof, nearly wrecked our force. We worked one beam over three times before we thought we had the shade and then after painting four or five beams that shade, decided to darken it a little. The boys considered this 'piddling' all foolishness, but the result when the roof was completed is fine.

We set these beams three feet apart on centers. We did not need such heavy beams nor need them so close together to support the weight we had to carry, but at this point the roof is a restoration of the original which did carry heavy construction above it.

Having the beams stained and finally bedded down, we next set the roof rafters above them. The roof must have a pitch as low as we could give it and get drainage, for it must not show over the low parapets of the side walls of the nave. To get this result we used 2 x 12 timber laid on edge sawing them to a ten inch fall in a nine foot run. One of these rafters was set on top of each beam, and, since the tops of the beams were uneven, each in itself as well as with its next neighbor, it cost us two or three days' work to get the rafters lined up.

Having our beams and rafters in position, we were then ready to lay our ocotillos. These had been cut into fairly straight sticks 38 inches long, and were laid from one beam to the next on top of the beams between the 2 x 12 rafters. We did not lay these ocotillos straight with the longer axis of the nave, but laid those in the first row, that is between the first beams, slanting to the right, the next row slanting to the left, and so on. Viewed from the floor of the church, this gives a pleasing effect, and we have good precedent in that several of the old churches are so roofed.

The intention was to use the ocotillos alone for this ceiling effect, but when we came to put them in, we found that if we laid them two layers deep, as we had decided to do, one might, in places, still be able to see up between them and discover the modern board roof we were going to put on the rafters above. This caused us some worry but we solved the difficulty by going out to one of the neighbors and buying a ton of hay which we put on top of the ocotillos. Some showers came along at an opportune time and settled this hay down close before we put the roof on, so the reconstruction from the under side of the roof is perfect.

Finishing the roof was simply a matter of nailing 1 x 12 boards on on the rafters and covering them with a good grade of roofing paper.

While we were working with the beams and ocotillos, the walls of the nave had been brought up to the original height and the parapets had been finished off with a course of cornice brick. The top of this parapet was flushed over with a mixture of lime and cement to prevent erosion and this was carried down the back of the parapet to the gutter.

The cornice brick around the sanctuary walls, which are still in place, were tilted outward so that the rain drains off over the nose of the bricks and follows the face of the cornice down, causing erosion of the wall just under the cornice. We were careful to drain our parapet walls to the inside so that the rain will not run outward over the nose of the bricks but back and down the parapet into the gutter.

The gutters were made of a rubble of lime, cement and rocks. This was poured into place and shaped with trowels and a half round wooden float which we made for the purpose. We took great care to make the joint between the wooden roof construction and the cement gutters absolutely water tight. For this purpose we used a special plastic roof cement which is laid with a trowel. We used this plastic cement under the roofing paper, on top of the paper, and on top of a piece of quarter round moulding which we nailed into the angle where the paper and cement meet. I think the roof will leak any other place before it leaks at that joint.

As is stated on page 10 the roof drainage was handled by means of 18 downspouts. Nine of these took care of the water from the roof of the nave, five on the west side and four on the east side. These drains were all in bad condition and we had to repair what was left of them as well as extend them up over the new wall which we had built. They were originally made of lime but we used cement for restoring them. The water comes into these drains from the bottom of the gutter by means of openings just under the cornice of the parapet as is shown in the detailed drawing of the roof and parapet construction in Plate II.

In repairing these drains we opened the debris lying against the base of the west wall of the church to get at the foot of them and found a rock abutment wall running along the base of the church wall. The drains ran down to this and the water must have run on over this abutment wall and made its own path away from the church as we could find no signs of open drains on the original ground level. The rock abutment is not an integral part of the church wall but has been built after the church wall was completed and plastered. It is carried back along the west side of the church and the north and west sides of the cemetery. Evidently, since the west is the high side of the building, the water coming down off the mesa has given the padres some concern for fear it would wash the walls on that side and they have taken this means to

protect their construction.

Rebuilding the pediment was the most interesting single piece of work we did. The pediment was broken off at the line of the lintel which crosses the facade over the choir loft window. We had two pictures to work from which were taken before the fall of the original pediment. One of these was a direct front view and the other was taken from a point about 200 feet southwest of the building. These views are published in a recent book on Mission Architecture by Mr. Duell, as having been taken in 1880, but this is a mistake. The pictures were taken by W. George Roskruge, of Tucson, on July 3, 1889. I was glad to get this point cleared up very recently, for two interior pictures taken at the same time, show no beams over the nave. Now two men have assured me they saw some of the roof beams in position, one in 1882 and the other in 1886 or 1887. If the Roskruge pictures had been taken in 1880 they would have proved the men to be in error, but since they were taken in 1889, not only does the evidence of the two visitors stand, but we can date the fall or removal of the last beams of the roof of the nave between 1886 and 1889.

We were able to locate the footings of the gables which are attached to the face of the pediment quite accurately by the brick sockets which still remained in the lime plaster on top of the lintel. The diamond-shaped figure above the ends of these gables is in its proper place but we will not know until next July, when we can compare the shadows of the real diamond with the one in the picture, whether or not it projects far enough from the wall. If we find it is not far enough out, we can build it up with plaster.

To get the curve line of the pediment I sat at the point where the Roskruge picture was taken and had the boys experiment with different lengths of sticks, swinging them in the plane of the proposed pediment and using the center of the line across the shoulders of the facade as the center of the pediment, until the end of the stick covered the proper bricks on the tower in the background. We then used this stick as a radius in building the pediment.

The ball on top of the pediment, which carries a cross, is partly original. In the excavations a couple of years ago, when we cleaned the debris out of the nave of the church, we found about a quarter of this ball. It had a socket running from top to bottom, and when I saw it I remembered a plate in Rinton's Handbook to Arizona, 1878, made from an artist's drawing, which showed a cross mounted in a ball on top of the facade. So this portion of the ball is again resting in its original place.

Minor Repairs

The stairs in the tower, described on page 9, are completely a

restoration of ours. Vandals had not only torn out the old steps, but had dug several wagon loads of material out and thrown it back into the baptistery. Evidently they thought the treasure was buried under the steps.

We made no attempt to put these steps in with accurate workmanship. The effect we were striving for was the old stairs after some use and a hundred years of abandonment but without the touch of a vandal pick. That we succeeded pretty well is shown by the fact that more than half the visitors who had not seen the mission before we started our work, thought the steps were the original ones, two weeks after we had completed them.

A large hole in the back wall of the sanctuary was closed up. Many visitors thought this hole was originally a window. I knew it was not for it showed no marks of lintels to support the wall over the opening, and, although the padres were sometimes faulty in their construction, they would not put an opening in the back wall of the church directly over the high altar where it would make a glare of light to blind the eyes of the neophytes in the nave as they tried to see the ceremonies in the sanctuary. The Mexican who had visited the mission in the 80's told me there was a niche for a statue there over the high altar, and I am inclined to think his memory is correct. Vandals probably dug through the wall back of the niche looking for treasure.

The lighting of the sanctuary was wonderfully improved by closing this hole. I had many times tried to imagine what the interior would look like with a roof over the nave and this hole in the sanctuary wall stopped, but the effect was better than I had imagined.

There are five windows in the nave of the church, two on each side and one in the choir loft over the entrance. These windows light a space 17 feet wide by 73 feet long. There are two windows in the sanctuary which light a space 17 feet square. It will be seen at once, then, that the sanctuary is better lighted than the nave, and this is as it should be. Furthermore, the sanctuary windows, being higher up in the walls, give a sort of overhead lighting which must have brought out the decorations on and around the high altar. The quiet, the restfulness, the coolness, and the softened light of the nave, tended to center the attention down through the great arch, to the high altar in the sanctuary.

Tumacacori is not the most spectacular mission in this chain which Padre Kino founded, but its interior was well designed and very effective.

CONCLUSION

I wish to say in conclusion that the repair and restoration work at the Tumacacori Mission is by no means finished. The work will be

carried on as funds permit until we have this monument in condition to stand the erosion of the elements without serious deterioration. It is to be hoped that before many years we will be able to keep a custodian in charge under full pay, who can live at the monument and prevent vandalism and give the information to visitors which they desire so much.

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MUSEUM CIRCULATION By Frank Pinkley, Supt.

Because our proposed museum at Tumacacori National Monument is a comparatively small one, and because we have some individual problems in that installation, we have had some very interesting discussions regarding the plan. The building is planned around a patio and we want to open the rooms out into the loggia so that visitors will go into a room, turn to the right, go anti-clockwise around the room and come out by the door by which they entered, go along the loggia to the next room and repeat the process there. The other method is to open the rooms one into the other in series by connecting doorways. We do not like this method so well because few visitors will circle a room which has an outlet at the far end. We have argued that the visitors will enter room 1, turn to the right, go down the right hand wall to the far end, and will then go through the doorway into room 2. Since, in an archaeological or historical museum the material on display must be presented in some sequence from case to case, wall to wall, and room to room, it is pretty clear that this trick of passing down the right hand side of your rooms and leaving the left side unnoticed is going to wreck your chances of getting your material examined in the sequence in which you had planned.

I wish here to quote from pages 105-06-07 and 108 of Problems of Installation in Museums of Art, by Arthur H. Molton, Instructor in Psychology in Yale University. This is one of the Publications of The American Association of Museums, New Series No. 14, Washington, D. C., 1935.

> "As previously mentioned, we have records of the exact routes taken by the visitors in going through the Flemish-Dutch gallery. In Figure 21 we have shown the types of routes taken by those visitors who turned to the right on entering the gallery, and the frequency of occurrence of each type. In Figure 22 we have given a similar schematic presentation of the routes of the visitors who turned to the left on entering the gallery. In both instances the representation is of the records of Sunday and week day visitors observed during the first installation of the paintings, and all proportions are based on the total number of visitors observed, regardless of the direction of the first turn.

SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 11

KINO MISSION RECORDS

RESEARCH & TRANSLATION
BY ROBERT H. ROSE

THE DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

BANCROFT LIBRARY RESEARCH

By R. H. Rose

INTRODUCTION

In the following pages will be found translations from a number of original documents on the history of the missions of Pimeria Alta. Cocospera, Magdalena, San Ignacio and Imuris are taken up in this report while in subsequent numbers other missions are to be treated. For the most part this material consists of extracts from baptism, marriage and burial records. In extracting from these documents items along the following lines have been taken:

a. Names of various priests officiating in baptisms, marriages and burial services as gathered from their signatures of testimony.
b. Dates of the baptisms, marriages and burials with the number of such officiated at for the various years shown.
c. Notes occurring at various places among the records which might contribute to a knowledge of events in mission history.
d. Copy of Padre Eusebio Francisco Kino's burial notice as recorded by Father Joseph Agustin de Campos, then the minister of San Ignacio. This is followed by a translation from Bolton's "Rim of Christendom."

It is not easy to predict the value of (a) and (b) above but it is believed that these items will have present and future value in completing the record for some of the missions where the record is scant or blank. In the case of Cocospera records continuing to March, 1830, have been found which prove this mission was a going institution until at least as late as that year. Listing the number of burials, baptisms, marriages, etc., for various years may prove of extreme value in determining the degree of prosperity in their work enjoyed by padres during some years contrasted with the scant harvest at times.

To scholars of mission history my method in at least one instance may appear bold and perhaps a little rash. I speak here of my listing of names of officiating priests. I have copied them as nearly accurate as I could make them out from the records. Thus, some of the names will be incorrectly spelled while a few may be so far from correct as to make them practically unrecognizable to one familiar with them. However, it was believed that the procedure was justified because in this way many new names of officiating priests may be brought to light which would not otherwise have been known. Most of the names I have been able to check while many others are so nearly correct as to make possible easy later verification. Several factors made correct copying impossible in some instances; these documents were in script and usually written in a very scrawly style and in Spanish, of course; the records were often faded and fragmentary; and in Pinart's summary often he was unable to determine the exact spelling of names; while lastly, errors probably crept into my copying of Pinart's records.

LIST OF PRIESTS OFFICIATING AND OTHER NOTES OF INTEREST TAKEN FROM THE ORIGINAL BURIAL, BAPTISMAL AND MARRIAGE RECORD BOOKS OF THE MISSIONS OF PIMERIA ALTA.

COCOSPERA

"Libro de Entierros, 1822-1836": (Book of Burials)

The first page of this record of burials contains a notice signed by Fr. Francisco Nuñez and Fr. Ramon Libetz who had the power of inspecting the records of the missions. These men seem to have been the Deputy Prefect and the Secretary, respectively. In this notice they are certifying that on April 20, 1822, the old burial book is being officially terminated and placed in the archives while this new book is officially begun. Fr. Francisco Solano Garcia is "Mitro. de esta Mision de Santiago de Cocospera" - Minister of Cocospera Mission - at the time of entry of the aforementioned notice.

A little further, Fr. Francisco Solano Garcia makes an entry which translated states that "In this book are set down the entries of the deceased people of this town of Santiago de Cocospera beginning the 9th of August of 1822." In my notes I have copied in the Spanish many of these burial records in full particularly those of the critical years around 1827-1829 and those of 1835 and 1836 terminating this book. Not all of these will be quoted in the extracts to follow but the dates and the padres officiating will be listed.

Fr. Francisco Solano Garcia:

1. Mentioned in the notice of April 20, 1822, with which this Book of Burials is officially opened.
2. Mentioned in his own notice of August 9, 1822.
3. Garcia then signs burial records dated as follows:
   a. Aug. 12, Sept. 2, Sept. 5, and Nov. 19 of the year of 1822.
   b. A very dim entry which appears to be dated in the year 1823.
   c. January 20, Feb. 3, 5; May 30; June 14; Sept. 4; and Oct. 5 of the year 1824.
   d. March 19, Aug. 25; Sept. 2, 23, 24, and 29; October 21, 26; November 3, and 12 of the year 1825.
   e. January 4; April 2, 5, 10, 12, 12, 13, 16, 2, 22 and 22; May 15; July 24; 29; October 5, of the year 1826.
   f. July 18, Aug. 1; Sept. 14; of the year 1827.

Fr. Jose Ma. Perez Llera (sp.?)

A. September of the year 1827. His rank in relation to Cocospera is not indicated in the text of the burial record of this date.

Fr. Rafl. Diaz:

a. November 12, 1829 Dias signs an entry referring to the unsettled conditions in the administration of the churches and points out that a number of people died to whom the sacrament could not be administered. Year 1829.
b. September 20, 1830.
c. May 26; Nov. 15; Dec. 2 and 25, year of 1831.
d. Dec. 8, 20, year of 1832.
e. May 1 and Aug. 10, year of 1833.
f. April 30 and September 20, year of 1834.
g. June 10, August 12, 20; September 2; and October 6, year of 1835.
h. March 2, year of 1836.

The March 2, 1836, entry is the last one in "Libro de Entierros" for Mision de Santiago de Cocospera. This entry ends about the middle of the page. Had entries continued after March 2, 1836, it seems that they would have immediately followed the entry of this date. Hence there is likely considerable significance in the fact that March 2 is the last date entered though there was room for more. It would appear, therefore, that Cocospera Mission was a going institution as late as the spring of 1836. See later summary of Cocospera Baptismal records.

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COCOSPERA

Libro de Bautismos, 1822 - 1836: (Book of Baptisms)

On the opening page of this book is a notice which states that "In this book are recorded that portion of baptisms of the Indians of this Mission of Santiago de Cocospera which begins on April 21, 1822." The list of padres officiating at these baptisms as noted from their signatures to the records, follows:

Fr. Franco. Solano Garcia:

1. April 21; May 17; September 4, 18, 18; October 7, 12; December 8; year of 1822.
2. January 31; March 29, 29; April 22; June 26; October 11; November 27, 29, and 29; year of 1823.
3. January 8; April 17; August 21; and September 29; year of 1824.
4. January 21; February 18; May 5; year of 1825.

5. Feb. 10; April 5, 4, 17; and October 15, year of 1826.
6. July 24; October 23; November 30; and December 23; year of 1827.
7. March 23, 1828. This is the last Garcia entry in this book as "Minister of this Mission" (Cocospera); year 1828.

Fr. Jose Ma. Perez Llera: ("Mntro. de esta Mision")

1. Nov. 6, year of 1828.
2. January 23, 27 and 27; and September 21, year of 1829.

Fr. Rafl. Diaz:

1. Obscure date, year of 1828 (ends in "re" and is Sept-Dec. some time).
2. July 23, year of 1829.
3. February 17, 18; May 2; October 28; and December 14, all year of 1830.
4. January 30; April 27; June 22; and December 3, year of 1831.
5. January 13; June 15; and December 9, year of 1832.
6. January 1; March 7 and 6; April 12; July 3, year of 1833.
7. Obliterated date; March 10, both in year of 1834.
8. February 15, 15; and April 2, year of 1835.
9. January 1, 1836.

This last entry, like others, is signed by Diaz as Minister of the Mission. These baptismal records end about two-thirds of the way down the page with plenty of room for further entries. This seems quite significant and probably means that had Cocospera been a going institution after early 1836, surely the baptismal records would have been entered, finishing out the page.

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SAN IGNACIO

"Libro de Casamientos, 1697 - 1737: (Book of Marriages)

Campos signs his name either as "Joseph A. Agustin de Campos", or simply as "Agustin de Campos". He designates himself as Minister of the Mission "por Su Magd".

Agustin de Campos:

1. Seven records; February; April 16; July 30; and remainder obscured. Year of 1713.
2. January 8, year of 1714.
3. See later entry for year of 1715.
4. August 30, year of 1716.
5. Space for 1717 entries but only entry is "Año de 1717".

6. October 23, year of 1718.
7. Two on July 22; two on December 24; all for the year 1719.
8. May 19, year of 1715.
   a. An item for 1715, exact date obscured, calls attention to the "Visitado" who visited the mission, inspected the records, and entered his name in the book of baptisms. Date 1715; exact date obscured. Name appears as Felix de Villatrese (?).
9. Six, all on February 16, year of 1721.
10. Four, February 22; February 22; July 10; 1722 and obscured date.
11. Eight Campos entries. Specific dates noted are March 23, 28; April 14; Oct. 17; and Dec. 26; year of 1723.
12. Four; specific dates noted, Nov. 3 and 4; and Dec. 14, year of 1724.
    a. Very same sheet begins about the middle of the page with entries for 1733.
13. One Campos wedding entry for July 30, year of 1735; another 1735 Campos entry noted.

Marquiam: (Probably Father Marquina, rector on the Yaqui - See Bolton's Rim of Christendom, Pages 135, 202, 203)

1. Aug. 1; Aug. 1; year of 1722.
   a. No rank indicated.

Gallardi:

1. Dec. 29, year of 1722
   a. No rank indicated and no further identification found.

Phelipe Segesser: ("Felipe" by Bolton)

Here, again, it is well to mention that year of 1733 entries signed by Segesser start on the same page as the 1724 entries signed by Campos. Thus, entries for 1725-1732, inclusive, are lacking in the San Ignacio Book of Marriages. It will be of interest to check from historical sources on events during this interval.

1. Total about 13 entries for 1733 by Segesser. Sheets lose their continuity and therefore there were probably many more. January 2, 6, and one obliterated January date; April 13, 13, 14, 20, and 20; June 29; July 12 and July 12, are specific dates noted. There were surely some August-December entries but due to missing sheets in the record these cannot be determined. Year of 1733.

IGNACIO Keller: (Father Ignacio Xavier Koller)

1. August 2, and illegible date, and four more later, all for the year of 1735.
2. No transition entry "1736" noted.

Gaspar Stiger: (Father Gaspar "Steiger" - Bolton - P. 594)

1. Aug. 31; Jan. 10; Feb. 26; Mar. 22; April 22; Aug. 31, and other obscure dates, twelve in all, and all for year of 1737 except possibly the first one (Aug. 31) listed.

End of "Libro de Casamientos" for San Ignacio.

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SAN IGNACIO

"Padron San Ignacio - 1768 (Census)

This census of San Igancio was made June 25, 1768. The total census shows 158 souls. These are listed as to family heads, orphans, pimas, papagos, etc. Following the census there is an entry which refers to a family of four transferring on August 17, 1768, to San Pedro y San Pablo de Tubatama and later returning to San Ignacio where Gaspar Stiger was officiating minister. Ill treatment at Tubatama was the reason given for the return.

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SAN IGNACIO

Following is a summary of a list of officiating San Ignacio priests compiled by Alphonse Pinart: The list includes the period 1687 - 1814. San Ignacio had San Joseph de Himuri and Santa Maria Magdalena as visitas. It also included the town and mining camp of Santa Ana. (Pinart's notes presented herewith have been translated from the Spanish).

Fr. Mathias Gallo:

1. Gallo appears as minister up to the 11th of April, 1778. Pinart was unable to ascertain from what earlier date.

Fr. Francisco Zuniga: (Minister for His Majesty)

1. Signatures seen for June 4 and July 4, year of 1778.
2. They begin to be seen again on January 15, 1779, up to Feb. 17, 1780. Pinart says the book was fragmentary at this point.

Fr. Balthasar Carrillo:

1. "With the permission of the proprietory minister by commission, he was officiating from August 11, 1773, up to Dec. 26, 1776.

Under year of 1814 Pinart states that: "May 18 for the Mission of San Igancio there is a certificate signed Fr. Francisco Fontbona, by the Secretary who says that the Right Rev. Prefect (Fr. Juan Bautista de Cevallos) of these missions (College of Sta. Cruz of Queretaro) had been here in person and directed that in th baptismal book there should be separately placed those of the Indians and those of the residents."

Joseph Agustin de Campos - Entre. (Minister of the Gospel for his Majesty, Jesuit)

"The following document appears in the 1st page of the book of burials. Begun on January 19, 1697, under the signature of said P. Campos; "Book of burials of this town of San Ignacio -?- of Pimeria, in which are also entered those of the town of San Joseph de Himuri.

"Himuri; 'I, having entered this mission in the year 1693, the 2nd day of October, there followed the uprising of the nation in the year 1695. And all the papers of administration were lost w[illegible] they burned my things and my poor shelter. This is the reason for all that which I administered not being recorded.

"'And years later in a (illegible word) on account of the houses being like those of a pauper, other papers and writings were once more lost and badly treated. I mention it for the possibility of correction that we may be able to supply in the order of things'".

Pinart thus concludes as follows: "So we see that said Padre Campos began steadily the charge of minister of the mission in 1693. Even on November 1, 1731, there are still seen burial notices from his hand, although the last signature is on July 4 of another year. Furthermore, it appears that in January, 1732, he was still living in the Mission.

"There is a baptismal book in which many pages are missing at the front and back parts. The signatures of Padre Campos are seen in it from October, 1723, to March 23, 1735. (Due to a long siege of illness, in 1731 (Nov.), they placed as a companion to him Padre Segesser who was with him until March 7, 1733. According to this same (document), Campos did the recording at the departure of Segesser."

Phelipe Segesser: (Segesser--Jesuit) (Felipe)

1. "It appears that he was the clergyman or curate of the town, as in the burial book there appear entries in his handwriting and signature from November 8, 1731, up to May 4, 1733.

2. "In the baptismal book they are seen From Nov. 3, 1731, up to March 7, 1733. There is a note of July 13, 1733, by Padre Ministro Campos which says that due to a very long illness which he suffered, they lent him as a companion for the administration of the Mission, Padre Segesser, a Swiss, native of Lucerne, and he kept all these (records) and those of the other books mentioned."

3. For August 10, 1702, we see an entry by Pinart referring to "Fr. Franco. Gonzalvo, Minister of San Francisco Xavior del Bac". It is a burial notice of this Padre. There is a recent penciled notation here to the effect that Gonzalvo was not minister of San Xavier del Bac but that he merely came from a trip there. The entry goes on to say: "The Padre Augustin de Campos attests that on said day at about 4, after all sacraments being received by said Padre Gonsalvo, Valencian of 29 years of age, (he) died. He came from Spain together with this same Padre Campos. He became ill at San Ignacio in the house of Campos. He died of a cold, and in his right mind. He was buried in the presbytery (chancel) of the Church right near the Evangel (Evan.^{o}).

"September 19, 1725: The Bishop of the Diocese and his Secretary Ber. Diego Gonzalez, visited the town and examined its ecclasiastical books and found them in good order."

"Jan. 2, 1732: The curate, Phelipe Segesser, buried Ambrosio, Padre Agustin's horticulturist (gardener); that a bewitcher had killed him with his deviltries as he himself confessed afterwards when he had been caught."

"Jan. 9, 1732: "Cap^{n} (probably capellan, or chaplain) Don Juan Manuel Zelaya died today -- one who was married -- buried on the 10th."

"Dec. 19, 1737: The most illustrious Sr. Dr. Don Martin de Slizacochas, Bishop of Durango, realm of Nueva Vizcaya, and of His Majesty's Council, visited, inspected the books, and approved them."

Gaspar Stiger: (Gaspar Steiger)

1. Gaspar Stiger, curate, Minister of the Gospel for H.M.; his signatures appear from May 4, 1736, up to June 27, 1756 (he was probably a Jesuit (Pinart)).

2. His signatures are seen again from Nov.,1758, up to April 25, 1760. (In the book of burials.) (In the baptismal book his last signature is September 26, 1761).

3. He died on April 24, 1762 (it is seen two pages further). It appears that he was on a visit in San Ignacio and officiated in some baptisms on Dec. 30, 1733. (In the baptismal book in a memo we observe intervals in which other padres officiated owing

to the indispositions of Stiger which are explained in the certificate of his death and burial."

Joseph Och: Curate, Jesuit. (Father Joseph Och: - Bolton, P. 594.

1. His signature appears at the foot of several burial notices. (He was probably a Jesuit), from January 21, 1757, up to October 27, 1758.

2. In the baptismal book they are seen from Dec. 5, 1756, up to Dec. 20, 1758.

Jesus Franco. Pauer: Curate for H.M. (Jesuit)

1. His signatures begin from May 1, 1760 (continuing) up to Feb. 15, 1767. He was visiting on May 31, 1751; July 30, 1752, up to Dec. 28; also on the 4th, 6th, and 9th of Dec., 1753; 14th and 15th of April, 1754.

2. In the same book of baptisms they appear from Jan. 1, 1760 on, entitling himself the "Minister of the Gospel for His Majesty". continued in San Ignacio in October, 1761, and on August 25, 1762, up to March 12, 1767.

Padre Joseph Hoffenrichter: (Jesuit)

1. Luis Vivas attests: - "Rector of these missions of Pimeria that on said day (March 7?, 1762) died the above mentioned Padre in this (town) of San Ignacio; native of Wildstein in.....Bohemia, born on January 10, 1729, entered the Jesuit Order (Compania de Jesus) in 1754; came to these Pimerian Missions in 1761; he administered the Mission of Ati in the west where he became ill with fever and having suffered with other undetermined ills he came to this Mission to seek alleviation which he could in no manner give himself - Minister of pure conscience and exemplary life, was in righteousness on the most direct road to rejoice in his God.

"Buried in the Church of the Mission near by the Epistle (right) side of the Altar. ("Enterrado en la iglesia de la Mision al lado de la Epistola").

P. Gaspar Stiger: (Jesuit Minister of said Mission) (Gaspar Steiger) (Note that this is second entry for Stiger by Pinart)

1. April 24, 1762, San Ignacio: He (Stiger) died on said day receiving all of the Sacraments about 2:00 P.M. Swiss by birth of the Diocese of Constance, he was born October 21, 1695; Secular cleric, was ordained as priest in 1719 on the Pentecostal

Sabbath (Whitsuntide). After being a curate for one year in his fatherland, he entered the Jesuit Order on October 9, 1725; upon his petition he went to the missions of the Indies in 1729; Aug. 1 appointed by the Superiors to the Mission of Carichigui in 1731 at the instance of the Most Illustrious Sr. Don Martin de Slizacochea (?), Bishop of Durango he was named the Vicar General (Provisar) to this new realm of Christianity of Upper Pimeria and the new mission of San Xavier del Bac "in which envious of the fact that the glory of God and the faith of Jesus Christ was advancing, the Devil harassed (?) the Indians with witchcraft that they should kill him, which they tried to do on three occesions and it would have been accomplished (save for the providence of God through Padre Agustin de Campos and although free from enchantment Stiger remained suffering all of his life and the three evildoers had a hapless end, the Devil carrying one off, another suddenly fell dead and the third was killed by his own relatives.

2. "In the year 1736 he entered obediently this Mission of San Ignacio which he found almost depopulated by the continual epidemics and highly dynamic fevers, but with all-encompassing charity he resettled the three towns with Papagos------having found 10 families upon his arrival, he saw (later) more than 100 families."

3. He was buried next to the super altar of the high altar just by the Evangelio. (The foregoing is attested to by the Minister of the Gospel, Francisco Paueim Jesuit).

Ber. Joseph Nicolas de Mesa:

1. His signatures appear from Nov. 22, 1767, to April 13, 1768.

Pinart next lists an entry for December 24, 1767, which is a burial notice for the infant daughter of the Captain Dn. Juan Thomas de Beldarrain.

2. On April 13, 1768, Ber. Joseph Nicolas de Mesa makes an entry about the death of some girl children who were deceased without confession during the absence of the R. R. P. P. (probably the officiating priest). Mesa goes on to say that at this time unruly Indians attacked the town and killed two people who were buried without confession, in the church.

Fr. Diego Martin Garcia:

1. His signatures are seen (by Pinart) from May 31, 1768, up until January 23 of 1772.

Fr. Fco. Sanchez Zuniga, Minister:

1. His first signature appears on January 23, 1772, up until March 28, 1780.

Fr. Antº. Ramos:

1. Officiated in this mission October 4 and November 9 of 1773.

M. R. P. Fr. Manuel Carrasco: (Dated San Ignacio, March 2, 1776)

1. "Certif. Fr. Fco. Zuniga (that) the Padre Carrasco died in that (obliterated word) about 3:00 p.m. in the town of Magdalena. He was minister of Tubatama; he was buried in the Chapel of San Xavier just by the Epistle (side of the chancel). He received all the sacraments with exemplary devotion."

Fr. Pedro Arriquibar: (Mntro. de doctº. p. Smd)

1. His signatures are seen from April 16, 1780, up to the end of 1787 in which year this burial book ends.

Luis Mª. Gallardi: (Jesuit)

1. With permission of the proprietary Padre he officiated at a baptism on August 4, 1725; Feb. 7, and April 14 and August 5, 1727, are also seen. ("Con permiso del P. Mntro. propietario oficio en un bautismo 4 de Agtº. 1725, 7 de Feb. y 14 de Abril y 5 de Agosto 1727 se ven tambien").

Inspection by Bishop of Durango:

"1725, September 17: Realm of Sn. Antº. de Motepore. The Bishop of Durango, Dr. Don Benito Crespo, of the order of Santiago and of the Council of H. M. being in said Realm examined the books of the Mission of Sn. Ignº. presented to him by the Padre Joseph Agn. de Campos which he found in order. The Bishop was pleased to express to him in sincere manner his appreciation of the services which he had given in his ministry adding his apostolic seal his said certificate is signed by the said bishop, and by the Inspector- Secretary (de visita) Don Diego Gonzalez Perianez."

Ign. Xavier Keller: (Jesuit Padre)

1. His signatures appear in the baptismal book from Oct. 6, 1732, up to April 10, 1735, and Oct. 24, 1741 - May 29, 1742. He styles himself the Minister of the Gospel of S. M. of the Pimas.

Miguel Capotillo: (P. Jesuita)

1. On July 26, 1734, he officiated here at a baptism.

Joseph Foral: (Clergyman)

1. With the permission of the Minister he officiated here at a baptism October 13, 1736.

Jacob Sedelmaier: (Jesuit Clergyman) (Sedelmayr *Bolton P. 435)

1. Officiated today at a baptism, Jan. 3, 1737; another time on Feb. 12, 1738 - May 7, 1739.

Joseph Xavier (or Savier) de Molina:

1. Jesuit Minister of the Gospel in the Dolores officiated in San Ignacio on July 22, 1737. He titles himself "Vicario Gen. (Vicar-General) on Nov. 1740. He officiates at other times on May 12, 1742, and February 3, 1745.

Bishop of Durango Inspection:

1. San Ignacio, Dec. 19, 1737. On this day Martin, Bishop of Durango and his Secretary of Government and Inspection Dn. Pedro de Bohenique(?), were in the Mission. After having inspected the books, sacred vestments and all of the rest (of the equipment) and having found them in perfect order the Bishop praised highly the merit and apostolic seal of the Padre Gaspar Stiger.

Alexandro Baruani(?):

1. On April 17, 1740, he officiated at Several burials.

Lorenzo Ign. Gutierrez: (Matro. por S. Magd.)

1. His signatures and handwriting are seen in the baptismal book from Nov. 28, 1740, up until October 11, 1741.

Barthelemo Saenz: Jesuit

1. He officiated here at Baptisms on May 24 and On June 5, 1749.

Miguel de la Vega: (Clergyman)

1. Officiated at a baptism April 17, 1750.

Luis Vivas: Jesuit

1. On the 18th and 24th of March; and the 12th of May; 7th and 8th of October, 1753, he officiated at some baptisms with permission (con licencia) of the Minister; also on April 1, 8, 9, and 13, 1754.

Alonso Espinosa: (Clergyman)

1. His signatures a re seen from April 24 to July 14, 1754; again on Dec. 23, 24, 25, 1754; Feb. 11, 18, 1755; and from Feb. 25 to April 15, 1755.

Antonio Ma. Bentz: (Jesuit)

1. He officiated at a baptism on July 8 and 31, 1756; Aug. 1, Nov. 14, 1756.

Franco. Gutierrez:

1. Officiated at Several baptisms from Sept. 21 to Oct. 3, 1756. One on April 5, 1757.

Juan Anto. Zedano:

1. Officiated at a baptism Sept. 18, 1756.

Franco. Alava: (Jesuit)

1. Officiated at a baptism Nov. 21, 1756. Several in April, 1757.

Bernardo Middendorff: (Jesuit)

1. Officiated at Several baptisms October 31, 1756; again Dec. 6, 1758.

Ign. P. Jefferson: (Jesuit)

1. Officiated at a baptism Dec. 4, 1756.

Miguel Gerstner (Jesuit)

1. Officiated at a baptism Dec. 8, 1756, and January 2, 1757.

Inspection of San Ignacio:

1. November 13, 1761: Today the Padre Ignacio Lizafsvair (Pinart says, "tal vez la alta letra es n-- perhaps the tall letter is n-) of the Jesuit Order (Compania de Jesus), Inspector General

of the Missions of this Province of New Spain and Ecclesiastical Inspector-General of said missions pertaining to the Bishopric of Durango for its present Most Illustrious Sr. Bishop Dr. Dn. Pedro Tamarron - and Romeral of the Council of H. M., inspected this Mission, its sacred vestments (ornaments), book, etc. This document is incomplete - and from here, on, the rest of the pages of the book are missing.

(End of Pinart Summary)

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MAGDALENA

Magdalena was a visita of San Ignacio and for that reason it is important that summarization of its burial, baptismal and marriage records be considered with those of its governing mission.

Libro de Entierros: - Magdalena - 1702-1816; part 1820-1824; (Book of Burials).

Agn. de Campos:

1. In 1702, range Sept. 3 to Dec. 14, he officiates at 10 burials.
2. In 1703, range March 3 to Nov. 21, he officiates at 39 burials.
3. For years of 1704, 1705 and 1706 the year entries are seen but there appear no burial records.
4. In 1707, March 22, Campos makes a burial entry but it is unsigned.
5. In 1708, July 17 and 19, two burials.
6. In 1709 to 1716, inclusive, no year entries nor burials are seen.
7. In August, 1719, one burial entry, apparently by Campos.
8. Five entries a ll show Campos officiating, year 1720
   a. The first of the entries says in effect that on January 20, 1720, a certain Felipe was buried beside the ones who in 1695 destroyed the towns they themselves had built up.

Notice that here we find entries for the period 1709 to 1716 which were missing from their proper place in the series.

9. In 1709, range Aug. 27-Nov. 30, Campos officiates for 21 burials. They are unsigned but are in Campos' writing.

10. In 1710, Jan. 1, Feb. 2, and Aug. 5, and other dates obscure, Campos officiates at eight burials.

11. In 1711, March 15; Kino burial notice; the only entry for the year. Campos officiates. (See copy of original record on Plate II of this Supplement).

Año 1711 =

En quinze de Marco poco antes de media noche Rezo
uidos los S.tos Sacram.tos Rlurio con Grande sosiego y edificaz.on
en esta casa y Pueblo de S.ta M.a Mag.na el P. Eusebio Fran.co Quino
de hedad de setenta años Mis.e cosi Veinte y quatro de

Padre Eusebio Fran.co Kino =

Nra S.a de los Dolores fundada por el mismo
Pe. el q.al trauajo Incansable m.te en continuas pere
grinaziones y Reduz.on de toda esta Pim.a descu
brio la casa Grande, Rios de Gila y Colorado y las
naziones Cocomaricopa y Chumas y los Quicamaopa
de la Ysla y descansando en el S.or esta enterrado
en esta Capilla de S.n Fran.co Xauier al lado del
[illegible] da y [illegible] a silla en Ataur

Padre: Eusebio Fran.co Kino =

Nra. Sa. de los Dolores fundada por el mismo
Pe. Ygl.al trauajo Incansablem.te en continuas pere
grinaziones y Reduz.on de toda esta Pim.a descu
brio la casa Grande, Rios de Gila y Colorado y las
naziones Cocomaricopa y Chumas y los Quicamaopa
de la Ysla y descansando en el S.or esta enterrado
en esta Capilla de S.n Fran.co Xauier al lado del
Euangelio donde caen la seg.da y terz.a silla en Atauir
fue de naz.on Aleman de la prou.a a que perteneze la
Babiera hauiendo sido antes de entrar en la Pi
meria misionero y Cosmografo en la California
en tiempo del Almirante D. Ysidro de Ocondo

Agustin de Campos

PLATE II

(Bolton's Translation of the Kino burial, taken from "Rim of Christendom")

"'THE YEAR 1711

"'Padre Eusebio Franco. Kino.--On the fifteenth of March, a little after midnight, Father Eusebio Francisco Kino died with great peace and edification in this house and pueblo of Santa Magdalena at the age of seventy years, having been for nearly twenty-four years missionary of Nuestra Señora de los Dolores, which he himself founded. He worked tirelessly in continuous pregrinations and in the reduction of all this Pimeria. He discovered the Casa Grande, the rivers Jila and Colorado, the Cocomaricopa and Suma nations, and the Quicimaspa of the Island. And now, resting in the Lord, he is buried in a coffin in this chapel of San Francisco Xavier on the Gospel side where fall the second and third choir seats. He was German by nationality and of the province to which Bavaria belongs, before he entered the Pimeria having been missionary and cosmographer in California, in the time of Admiral Don Ysidro de Otondo.

AGUSTIN DE CAMPOS (rubric)!"

Note:

The above translation reads ".....a little after midnight....." whereas the original burial entry reads ".....poco antes de media noche," which would be ".....a little before midnight....."

It is interesting to note that Campos spells the name of the famous padre as "Quino" in the first few lines of his entry whereas in the margin we see the familiar "Kino".

A further observation of interest is the fact that Campos says Kino was of German nationality whereas it is now generally accepted that he was born in Italy but was educated and had taught in Germany.

13. January 1712 contains lengthy entry of burial by Campos.
    a. January to December 16, fifteen more Campos entries.

14. January 5 to December 29, 1713, Campos writing, showing he officiated at 24 burials.

15. February 7 to July 9, 1714, four officiations by Campos signing himself Minister of the Gospel for H.M.

16. July 1 to Nov. 18, 1715, show 11 Campos entries with an additional Nov. 1 audit entry.

17. Feb. 9 to Dec. 7, 1716, Campos officiates for six burials.

Fr. Diego Martin Garcia: (Min. Por S. Magd.)

1. June 27 and October 19, 1768; two Garcia entries. It is interesting to note that these are numbered "1 & 2" showing that they are the first two entries after the change in administration.

2. Jan. 17 - Nov. 27, 1769, ten entries, numbered 3-12, by Garcia.

3. Jan. 3 - Nov. 9, 1770, twenty-six; #39-50; Garcia.

4. Feb. 21 - Dec. 10, 1771, twelve; #39-50; Garcia.

5. Jan. 5, 1772; one Garcia entry. See immediately below for further 1772 entries.

Fr. Franco. (fhz?) Zuniga: (Rank not given.) (or Zunida?)

1. Sept. 17 and Oct. 20, 1772; two entries.
2. April 23 - Nov. 7, 1773; four entries.

Fr. Manuel Carra[illegible]o: (Mno. por Su. Magd.)

1. Jan. 13 - June 25; and one later in 1774 too dim to read; five entries in all by Carrasco.

Apparently no 1775 entry:

1. Record #62 is the last one for 1774 while #63 is first entry for 1776.

Entries for 1776:

1. Seven entries, Mar. 22 - Aug. 28, by Fr. Franco. Zunida (or Zuniger)

Note: (Pedro Font)

"Note that on this 16th day of November of 1776 at 8 (o'clock) in the morning, the enemy - Pimas and Seris-fell upon this town, Santa Maria de Magdalena; they killed the girl of the aforegoing entry, ...they stole the sacred (word out) ornaments (or vestments); they outraged the church and sacred images; and finally carrying off (blurred words).....leaving the town and house of the Padre destitute and that it may be recorded it is signed by Fr. Pedro Font."

(The above is only an approximate translation due to fading and obscure words.)

P. Franco. Zuniga: (or Zunida)

1. In 1777; two entries, June 19 and July 27.
2. In 1778; two entries of May 18 and June 13.
3. See below for two 1778 entries by Fr. Mathias Gallo.
4. In 1779, June 2; one lone entry styling himself "Mntro de la Mision".

Fr. Mathias Gallo:

1. In 1778; May 24 and May 28 entries. (See 3 above).

Fr. Pedro de Arriquibas: (Mntro. de Docta. P.S.M.)

1. In 1780; July 3 and Aug. 13; two. Arriquibas styles himself "Minister of the Gospel for his Majesty."

2. In 1781; Feb. 15 - Nov. 17; fifteen.

3. In 1782; Feb. 11; one only.
4. In 1783; six but dates too obscure to read.
5. In 1784; one in June.
6. In 1785; one on March 29.
7. In 1786; five from May 14 to 26th day of undetermined month.
8. In 1787; one on Jan. 15.
9. In 1788; one on June 20.
10. In 1789; three, two of which are Jan. 18 and Oct. 11.
11. In 1790; two; Aug. 30 and Sept. 2.
12. In 1791; entirely missing since from 1790 and 1792 entries begin without interruption on the same page.
13. In 1792; one on November 6.
14. In 1793; one on Jan. 7.
15. In 1794; ten between Jan. 10 and Nov. 30. Arriguibas styles himself "M.P.S.M." - Minister for His Majesty.
16. In 1795; entries lacking. On the same page entries continue uninterrupted from 1794 to 1796. "Año de 1795" appears but space for entries is blank.

Fr. Franco. Cobas: (Mnro de la Mision) - Minister of the Mission.

1. In 1796; three between Jan. 10 and Dec. 8.
2. In 1797; two, for Nov. 15 and Dec. 2.
3. In 1798; two for Jan. 27 and June 2.
4. In 1799; six for May 28; Aug. 23 and 27; Sept. 7; Sept. 15 and Oct. 17. Cobas styles himself "Minister of the Mission".

Fr. Joseph Perez: (Mnro) - Minister

1. In 1799; April 7; June 27 and July 15; Aug. 27; Sept. 9 and Sept. 9. Total, six. Perez styles himself simply "Minister".

2. In 1800; one of undetermined date. Minister.
3. In 1801; five between Mar. 1 and Dec. 6.
4. In 1802; four between June 8 and Oct. 20.
5. In 1803; two for Feb. 3 and Aug. 27.
6. In 1804; four between Jan. 31 and Oct. 3.
7. In 1805; three for May 9, 15 and 22.
8. Perez signs none for 1806.
9. In 1807; four between Feb. 22 and Oct. 20.
10. In 1808; two for Mar. 12 and May 8.
11. In 1809; four between Mar. 28 and Sept. 9.
12. In 1810; six between Feb. 20 and Oct. 24.
13. In 1811; four between Feb. 14 and Dec. 26.
14. In 1812; two for Sept. 8 & 18.
15. In 1813; five between January 28 and February 14.
16. In 1814; four between Jan. 13 and Sept. 20; and one for Oct. 11.
17. In 1815; no Perez entries.
18. In 1816; one July 25 and two for Apr. 30 and May 4 and 12 in Aug.
19. In 1817; 1818 and 1819 entries missing.

Frr. Juan Gonzalez: (No title given)

1. In 1805, one May 26 entry.
2. In 1806; one June 6 entry.

Fray Josef Gomez: (No title given)

1. In 1806; one Sept. 14 entry.

Fr. Pedro Ruiz: (No title given)

1. In 1813; one Sept. 7.
2. In 1814; four between Sept. 24 and Dec. 21.
3. In 1815; 31 between Feb. 8 and Oct. 6.
4. Many of the 1816 entries mutilated or faded and it is barely possible that Ruiz officiated for some of the burials missing.

Fr. Saturino Anzeta (Nearly a s can be made out)

1. In 1815; four between Dec. 7 and Dec. 22.

Fr. Miguel Montes:

1. In 1816; approximately 75 entries Feb. 3 to Oct. 23, with most of them falling in August. The series runs to #289 on Oct. 23, at bottom of page, by Montes, then begins with No. 1 in entirely different handwriting on the following page.
2. In 1821; one Oct. 12 by Montes.
3. In 1824; Nov. 22, 21 and Aug. 1, three.

Fr. Mariano Llobet: (No official title given)

1. In 1816; one Oct. 2.
2. In 1821; two Nov. 3 entries.
3. In 1822; four for Jan. 27; Sept. 23 and Oct 17. 17.
4. In 1823; one for Mar. 1.

Fr. Juan Bta. Estebric: (Estebric as nearly as can be determined)

1. In 1820, four from Oct. 10 to Nov. 25. Record incomplete and obscure. These records are divided between Magdalena and San Ignacio.

Fr. Juan Nuñez: (No official title given)

1. In 1822; three on June 26, Aug. 9 & 19.

The year 1824 ends these records as nearly as can be determined. For 1824, Fr. Miguel Montes signs two entries and writes the third one. However, very dimly beneath the clearly written Montes third entry the name "Fr. Franco. Nuñez" can be seen. It looks as if perhaps the sheets had earlier Nuñez entries on them, then later got wet almost entirely fading out the writing. The sheets then were apparently used later by Montes for his entries. Thus, perhaps earlier Nuñez entries occur on the same reused sheets.

End of Magdalena "Libro de Entierros" 1702 - 1816; part 1820-1824.

o

MAGDALENA

"Libro de Casamientos": Pt. 1822-1825. (Book of Marriages)

Attention is again called to the fact that Magdalena was a visita of San Ignacio. These dates together with padres officiating should be considered in connection with the Magdalena burial records just preceding this "Libro de Casamientos" and those records for San Ignacio; these pages of the Marriage Book are incomplete because it is noted that a record ends at the top of the first page and the first complete record is dated July 29.

Fr. Franco. Nunez: (Comizo. Profecto. de estas....Las Misiones")

1. In 1822, incomplete record shows three entries for July 29, Aug. 19 and September 2. The title above is found in the texts of entries themselves.
2. For 1823: - No spaces and no entries of any kind. The marginal numbering continues from 54 to 55 in passing from 1822 to 1824.

3. In 1824; fifteen entries dated From June 10 to Dec. 1. All are over Nuñez's signatures but the entries themselves are in writing obviously not that of Nuñez. Perhaps the original Nuñez entries were becoming faded and some kind soul rewrote the texts to prevent total loss of the record.

4. In 1825; Jan. 8 to 19; seven Nuñez entries. He again styles himself "Comisario Profto. de estas Misiones".

Fr. Miguel Montes: (Pred. Agco. por encargo)

1. In 1825; one entry for Feb. 7.

Fr. Juan Vano: (No title given)

1. In 1825; eight entries, June 2 - July 24.

End of Magdalena "Libro de Casamientos"; pt. 1822-1825.

SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO 12

KINO MISSION RECORDS

RESEARCH & TRANSLATION
BY ROBERT H ROSE

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

BANCROFT LIBRARY RESEARCH

By Robert H. Rose.

INTRODUCTION

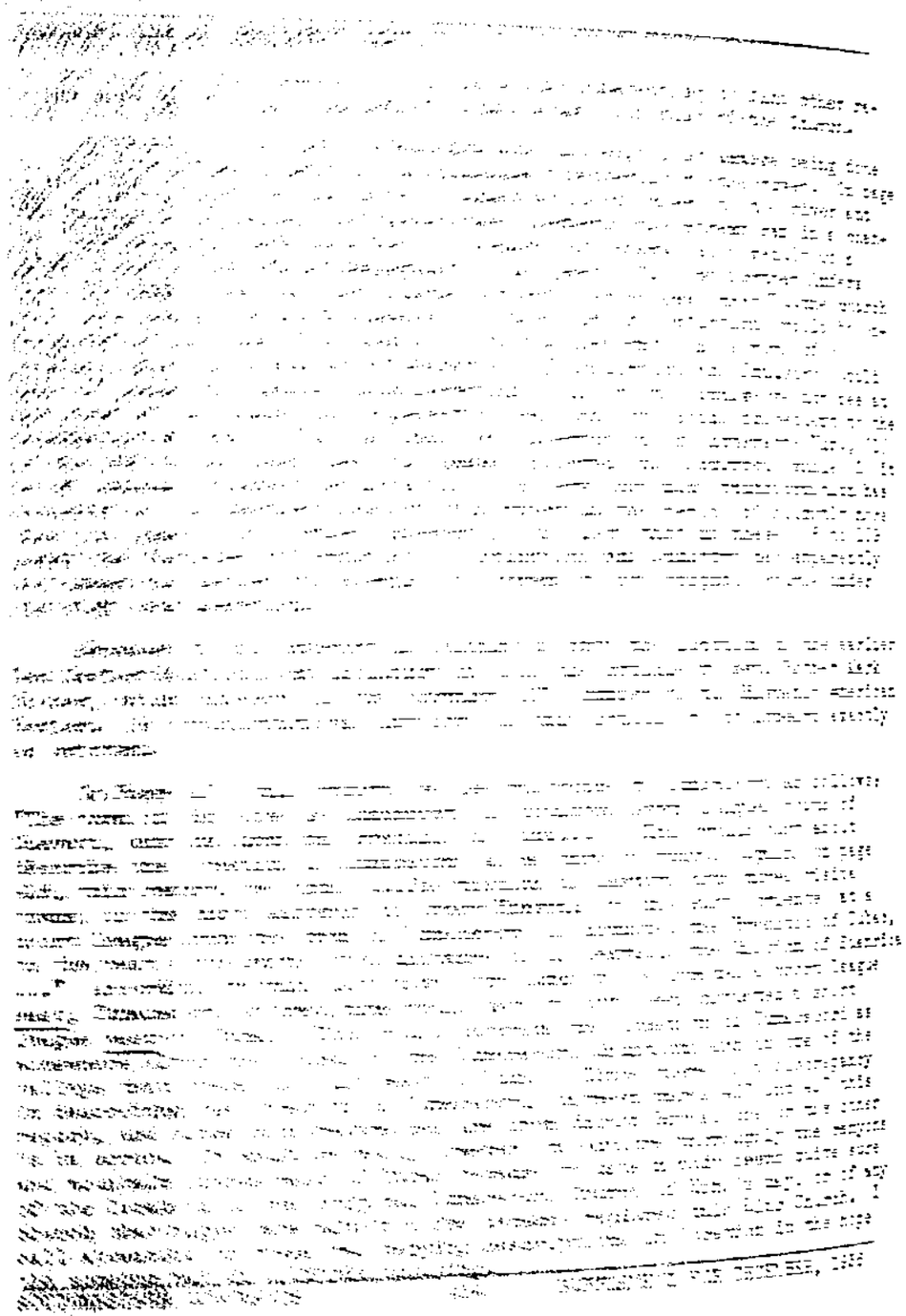
The November Supplement contained the first of a series of Special Reports covering research done at Bancroft Library, University of California, on original records of the Missions of Pimeria Alta. This first report dealt chiefly with names of priests officiating at various missions with dates and such historical notes as could be found. Important among the material contained in this report is a mimeographed reproduction of the Padre Kino Burial Record taken from "Libro de Entierros" of Santa Maria Magdalena.

There is sufficient additional material for another one or two Special Reports on historical notes, padres officiating, etc., which has been practically worked into shape for publication. However, in order to vary the subject material as the reports appear, the second Special Report (#12) has been organized about the official reports of Bishop de los Reyes as the material of central interest. Most of the following pages are taken up with translations from Bishop Reyes' reports.

These reports have been known to students of Southwestern history for quite some time and passages from many of them have been cited by various historians. It was thought, however, that translations of the complete reports on those missions of interest to us would be very worth while because having these complete translations in hand during trips among these missions makes possible minute checking up on historically important details.

Perhaps first in importance among historical items this month is the reference, page 427 this report, to the building of a church at Cocospera. Noted here we find "...in the visita of Santiago de Cocospera where the missionary lives at the present time, and where there is being constructed the church..." The writer visited Cocospera in October 1935 with the NPS survey party. At this time it was noted that the present beautiful structure is the ruin of an enlarged and remodeled earlier mission structure. The earlier structure reveals itself as an adobe building with plastered and decorated interior walls. It seems that this adobe church is the building that was under construction in the early 1770's when Bishop Reyes is writing. The extension in front and rear of this adobe church together with the remodling of the interior, done in burned brick and plaster, were probably accomplished in the very late 18th or early 19th century. No specific reference was found on this point.

A second item of great interest is found on page 431, this report. In the report of the Scientific Commission to Puerto Libertad we find reference to the fact that construction on Caborca Mission was started in 1803 and completed in 1810. Since Fr. D. Tomas Robinson, Chief of the Scientific Commission, is writing of an expedition made in 1861, this would place the construction of Caborca Mission some 50 to 60 years prior



CUCURPE

Reyes - July 6, 1772 (Los Santos Reyes de Curcurpe) P.749-
Pimeria Baja (Lower Pimeria)

The Mission of Cucurpe is the last and most northerly of these which are commonly called Lower Pimeria and the province of Sonora. At the present time it is reduced to a lone (sole) visita town, due to the other town's, named San Juan Bautista de Saracache, having been abandoned by order of the governor of the provinces. The soil of this abandoned town is very advantageous and the most rich in minerals of the province; in the year 78 (Is this an error and should it be 1768 and not 1678?) some gold and silver mines were being worked, and it was peopled with nine storekeeper's shops, and one hundred and thirty-seven families of Spaniards and "gente de razon." Of Indians native to the town it is evident according to the censuses: that before (the town's) becoming a mining camp there were forty-eight families; but at the time of the abandonment in the year 70 there were left only five families who congregated in the visita town of this mission of Cucurpe. All the land of this mission is continuous, broken, hilly country and ravines barren of trees for building (purposes) and of small valleys and level lands ("planes") for tilling and sowing. To the East at a distance of fifteen and twenty leagues this mission borders upon the towns and missions of Banauchi and Arispe, belonging to the Valle de Sonora. To the west all is deserted land up to the California Gulf thirty leagues distant more or less. To the south fourteen leagues (away) is situated the preceding mission of Opodepe, and fifteen leagues to the northwest (is) the mission of San Ignacio of Upper Pimeria.

DELORES: 750 -

In order that one may understand the actual state of Cucurpe Mission, it is necessary to mention, that four leagues north of the town of Cucurpe, is found situated a small farm of Spaniards and "people of reason" - who say they bought, or had given to them, all the land occupied by the towns and the old Mission of Delores which Padre Eusebio Kino administered for many years, and (which) served as a yardstick (model) and base for settling and establishing the missions of Upper Pimeria. This ancient mission is the one which is now called (the) town of Delores, whose fertile and extensive lands are divided up among farmers, who for the cultivation of their farms, (and) help with their cattle, admit and give a share to as many evil-doers and vagabonds as care to accommodate themselves. Of "Hiaquis" (probably Yaqui) Indians, alone, the missionaries of Cucurpe have counted sometimes thirty-five families who were publicly regarded as married, almost all being Indians fugitive from their villages and thieves and whomen unfaithful to their husbands; with this liberty some deviltries increase notedly in this town of Delores, where there is no longer a church nor a minister, as this missionary of Cucurpe administers to them, without the least bit of interest, the holy Sacraments and performs the offices and burial services (interments) when, they bring the dead, in order to bury them in lands of the mission. This disinterest is common (general)

and notorious with all of the missionaries of the college of Santa Cruz with the Spaniards and "people of reason" who live in the missions, in mining camps and farms (which), although they may be very distant, always when they are called help quickly; and if some died without the holy sacraments it was because they did not give notice in time, or because they did not want to enjoin in the known risk and danger of those frontiers and enemy lands. The missionaries do not find reason to obligate the Indians of the mission to accompany them. They serve in this continual and painful administration of the towns, farms of the Spaniards and "people of reason", and for (the occasions) when these die, only the Indians serve as pall-bearers, to dig the graves, and set the tapes in order to bury them; and, finally, it appears to be against reason and justice, these Spaniards' and peoples neither serving nor supplying with the least thing for the construction and maintenance of the churches of the missions. They solicit and desire to be the only ones to have the right of burials, (and) reserved (designated) sepulchers within the temple, and that the Indians of the town should be buried in the strums or cemetaries; but the Indians have to do all this and the missionary has to conform, if he does not wish that they should slander him with the accusations and complaints which these residents (neighbors) of Delores have made several times against the missionary of Cucurpe, writing to the governor of the provinces "that the Padre-missionary wishes to order all that which is the royal jurisdiction; that he offers resistance to the decisions of the governor and orders of the King; that he is the enemy of the Spaniards and of "people of reason" and other tales which they have skillfully fabricated and (which they) know are listened to with pleasure.

CUCURPE - Cont. P. 751

The town of Cucurpe is situated on a highland or plateau hard by a stream which in rainy season runs turbulently. It is entirely surrounded by mountains and high, useless, barren hillocks, and only on the northern side does it have a narrow valley with good lands where the Indians cultivate, and work their individual plots of wheat, corn, chickpea and other seeds; but they are (involved) in continual disputes with the residents of the neighboring town of Delores, who aspire to and say that the limits of their town will be extended very near to the plots of the Indians of Cucurpe. The Padre Nicolas de Perera, Jesuit missionary, in behalf of the Indians, bought for the sum of six hundred pesos the lands of a ranch which were in between the farms of the Indians and the lands of Delores; in their claims (pretensions) and contentions with the Indians of Cucurpe, this means had not been sufficient to curb those of Deloros. Those of Cucurpe are of the Eudebe and Opata nations, similar in tendencies and customs to their neighbors and relatives of the preceding Mission of Opodepe. The church of the town is ornamented inside with two tiny collaterals and four altars with various paintings or several (pictures) and (lienzos) linen hangings with their borders gilded. The structure of earth has roofs of good wood and straw, and the sacristry has four

chalices, a custodia, a large drinking cup, a high cross, processional candleholders, an incensory, a holywater pot, four candlesticks, and a lamp, with other little adornments all made of silver, vestments (ornamentos) of all kinds and colors, with (the) decorations sufficient for altar and divine worship. The house of the Padre-Missionary forms an inner patio (court) with the church; (he) has an ample and adequate dwelling, and corresponding offices; the structure of earth, and although it is new, ruin is threatening some (of the) dwellings and offices. The settlement of Indians appears to make a plaza with the church and missionary's house; some have constructed their houses of adobes, but very squatty, and so little elevated that they do not attain the average height of a man; they are generally very poor in furniture and temporal goods. The most diligent and energetic ones have yokes of oxen. During these last years they have been spoiled by wandering over sandbanks neglecting to plant or cultivate their plots, for which they have suffered many needs and hungers. Owing to the shifting about of the Indians, the women are the ones who work in their individual plantings, but due to this method, although it meets the necessity, there arise great ills and injuries because being a frontier of enemies, these are able to kill and steal at will, and the Indians continuing in their disordered liberty there is no one to till the soil and defend the town, and it will be necessary to abandon it to the enemies. By the census which I have now there must be seventy-three families, four widowers and nineteen widows, twelve orphans, and the (total) number of souls is two hundred eighty-six; almost all understand and speak the Spanish language, and these who are willing to attend (the teaching of) the catechism are fairly well educated. The communal properties (temporalities) of the Indians are five hundred head of sheep, sixteen (head) of cattle, nine horses and mules, some ranches or small farms where they say there are wild cattle (being) raised belonging communally to the mission. They sow a plot of wheat, corn and other seeds and an orchard of trees adjoining the house of the Padre-Missionary; some Spaniards live in this town and many families of those who are called "people of reason" ("gente de razon") and in some years the number of these is greater than that of the Indians of the town.

TUAPE (San Miguel de Tuape) 752.6

The town of visit San Miguel de Tuape is situated on the flat top of a hill above the arroyo, seven miles south of the preceding town of Cucurpe. The next year of seventy, a terrific freshet of the river carried away all the lands and orchards of the natives of this town, so that at present there are none, nor does this town have lands for tilling and sowing within a distance of two or three leagues; they are of the Eudebe and Opata nations, speak their own language and very few understand the Spanish; generally, they are ill-inclined, idle and disobedient to the counsels and corrections of the Padre-Missionary. The children and some (of the) old people know the catechism and principal tenants of our holy religion, but the rest, because they are not willing to attend the teaching of the catechism, are ignorant of the necessary

(knowledge) with the (consequent) necessity of a medium in order to be able to save themselves. Almost all live needily, hungry, (starved) and naked. The church is large, the construction is of adobes (unburnt sun-dried bricks) roofed with straw and earth. Inside (it is) ornamented with two collaterals of linen, their borders gilded. The sacristry with two chalices, and a silver case; five chasubles, a white prist's gown, an amice, and other ornaments of altar and divine worship all very old and almost unserviceable. The house of the Padre-Missionary was ruined completely this next year of seventy. The town of the Indians composed of scattered huts and tiny houses of adobes is situated in the flat top of the aforesaid hill. By the census which I have now there must be forty-eight families, three widowers, twelve widows, and the (total) number of souls is two hundred twenty-eight. The properties (temporalities) or goods which are communal, are seventy head of cattle, a small planted field of wheat, corn, and an orchard of trees, whose fruits, although it is said they are for the Padre-Missionary, belong in common to the whole town. This is the present day state of the Indians and missions without any omission of any information for personal and material reason.

GUEVAVI

Documentos para la Historia de Mexico

Page 582: - F 1203 - D63-3 Ser. X

From Guevavi we took Southward along the las Bolas Road towards the missions which remain (falten) and it is through a ridge of mountains whose pass is about ten leagues from Guevavi towards the south; and from Bolas we arrived two leagues farther to Agua Caliente, the old capitol, but at present very small, because of having been destroyed and having had killed a number of its residents in the uprising. (That) from here to Sario, (head) headquarters of the Mission of this name, with protection of Nestra Señora de los Dolores, along a southeasterly direction, five leagues through the town of Bussani, visita and station of this mission, two leagues distant from its headquarters, which is located at 31 degrees 56 minutes of latitude and 262 degrees 56 minutes of longitude. The Padre Miguel Gersmer works there (in the mission); he has three visita towns, the one which we already saw from Bussani; another about a half a league from the capitol, Agua Caliente, to the northeast; and the third located at two leagues to the east. In Sario the uprisen (Indians) killed sixteen people consisting of eight Spanish men and the remainder women and children on the night of November 20 of 751 (1751), and the Padre-Missionary on information which he had received succeeded in leaving a half hour before they searched for him at Tubatama, seven leagues away to the south, which is the headquarters of the Mission which follows.

Tumacacori - (F 1203 - D63) _
(3 Ser x)

Page 583: "Doc. para de la Hist. de Mex. Chapter VII & IV
Reyes in 1764

"Here we have to travel another thirty leagues south, to the royal Presidio of Tubac, where we will be able to rest and, in the afternoon, to move on to Tumacacori and Calabasas, two other towns of Guevavi, on the "Gussadoo Pima" or "agua grande" which is the principal part and is found in 32° 28' latitude and 262° 12' of longitude. Its missionary (is) the Padre Custodio Ximeno. (It or he) has three terms of visit ich we already saw from the road, Bonestac, Calabasas and Tumacacori. The first is ten leagues distant to the northeast; the second four to the north and the third seven to the northwest; about one league from the Presidio (is) the fourth which it has, and it was called "Arivaca"; together with its locality the Pimas lovastited it in the year 751 (1751), and it used to be about twelve leagues from the headquarters. There is a gold mine near to this town and several silver mines, and they are worked at the present time."

(This note on Tumacacori by Pinart is translated from the French and is placed here for comparison purposes.

Tumacacori: F 811 P 64 "Voyage Dans L'Arizona"
by Alphonse Pinart.
Excerpt from the Bulletin of the Geographic Society
Paris - March 1877. (translated from the French.)

Page 14 -

Having concluded my observations at the Casa (Casa Grande), I left Mr. Walker on the 18th of February (1876) and arrived at Tucson, the capitol of the territory of Arizona, on the morning of the 19th. Tucson does not present anything remarkable, if it were not that it is the first town built by the Spaniards in Upper Pimeria and owes its existence to a mission where the ruins, are seen still on the left side of the town. This one here (Celle-ci) is built American style and preserves all the originality of this population. After Tucson I visited the Mission of San Xavier del Bac where there is found a magnificent church still in good condition and built by the Jesuit missionaries during the course of the last century. It is also at San Xavier that there is found the principal village of the Papago Indians, allied to the Pimas and speaking their language. I took the direction to the south from there, attempting to penetrate into Sonora and visit the two ancient missions in ruins at Tubac and Tumacacori: I arrived near to the Sonoran town of Santa Cruz, but there difficulties presented themselves, and by reason of revolutions which were desolating this unfortunate country, I had to retrace my steps.

(Has desc. Casa Grande also)

TUBUTAMA

Page 583 "Documentos para de Historia de Mexico."

1. Its missionary is the Padre Luis Vivas, (who) has a visita town two leagues to the Southwest. Another four leagues farther in the same direction, comes the town of Ati, headquarters of this mission.....Due to the death of its Padre-Missionary Jose Hafenrichter, he administers this mission pending the arrival of a successor from Mexico. Padre Luis Vivas administers it with its visita Uquitoa three leagues away in this same direction; as also Piterin administers to the extent of his ability the Mission of San Miguel de Sonostac, where the Pimas killed, in the year already cited, Padre Enrique Ruen. Near Uquitoa there used to be a silver mining town in which on the night before the 21st day of November 757 (1757) the besiegers cruelly put to death Bomesario and some other Spaniards.....

...,Padre Antonio Maria Beroz cultivates this mission (Caborca).... with its two visita towns Pitic which we saw, and Bissani eight leagues further to the southwest (the direction of nearly this whole river) and about twenty leagues from the ocean....

In Caborca there had died at the hands of the besieging Pimas two Padres of the Jesuit order, in the year of 1694, the Venerable Padre Fr. Javier Saeta; and in 1751, on the 21st of November Padre Tomas Tello; at the same time they cruelly put to death Padre Enrique Ruen in San Miguel de Sonostac, about fifty leagues to the northwest of Caborca.

OPODEPE

(Mission de Nuestra Señora de la Asuncion de Opodepe)
746 - Doc. Para de la Hist. de Mex. 3d Ser.

The mission of Opodepe with a visita town is situated on the banks of a stream which runs north (and) south between hills and has small plots of level ground for tilling and sowing; to the east, fifteen or sixteen leagues distant are situated the towns and mission of Aconchi; to the east, at a distance of eight leagues, is situated the ruined and destroyed mission of Populo where the Seris used to live stably prior to their rebellion and uprising of the year 40 (1740); to the south, at a distance of twenty leagues, is situated the mission of Ures, and fourteen leagues to the north, the towns and mission of Cucurpe, and on account of the Seris having revealed themselves, the Synod of the mission of Populo determined and assigned that there should be established a missionary in this one of Opodepe, with its visita town.

The town of Opodepe is situated on the mesa of a hill adjoining the stream which runs narrowly encased (encajonado) between a nearby mountain to the west, and the "plan" (Table land) on which the town is situated;

all the neighboring land is barren and has no level ground for tilling and sowing. The good lands which are somewhat distant in a northerly direction, have been taken and appropriated to themselves by twelve or thirteen families of people of reason, who are established in a ranch which is commonly called El Realito; at a short league from this town of Opodepe to the south at two and three leagues there are some level lands adjoining the stream with good soil, where the Indians go to sow their individual plots of wheat, corn and other seeds; in the environs of the town and on shores of the stream some Indians have their tiny orchards with figs, peaches, quinces, pomegranates, and other trees and fruits; the church of this town is being constructed of adobes (white) at the present time a bower with vestibules (porches) of the house of the Padre-Missionary serves as a church. This (the house) is composed of a patio and two inconvenient (uncomfortable) dwellings of which one serves as a sacristry. The adornments and service of altar and divine worship are two chalices, a high cross, processional candle holders, incensory, a lamp, "anetre", and an all silver baptismal case, three new vestments of galloned (braided, trimmed) cloth., with some other ordinary ones of all kinds and colors. The Indian village is situated on the "plan" of the same hill, its houses badly disposed (placed) and embowered. The Indians say that they are of the Eudebe and Yaqui nations, but in reality they are a deviation and composite (mixture) of Spaniards, (mulatos) natives (coyotes) and other breeds. These crossbreeds, which almost all who are registered (included in the census) in the town are, wish to be Indians, so that the priest of the locality should not ask and collect his dues and prequisitos, so that the Padre-Missionary should administer, should aid and rescue them in their needs; but they do not wish to be commanded and governed like Indians, nor do they obey the corrections and counsels of the Padre-Missionary; from this original cause there result many ills and gravest disturbances; it is impossible to instruct and indoctrinate them as they require (need); they are of a lively temperament, generally understand and speak the castillian tongue, and solicit clothes to dress themselves with but they are very poor in earthly (temporal) goods; they do not have furniture and their possessions reduce themselves to the small town plots which they harvest and sell immediately or barter for cloth (dry goods) to dress themselves in, and they are always in need of maintaining themselves on the communal goods of the town, or living wondering and (searching) looking for gold in the placers. In the spiritual realm, they generally are ignorant of Christian doctrine and of the principal mysteries so that of necessity they must know (or be instructed in) of a medium in order to save themselves; they have gotten into the habit during these last years of many vices, principally of inebriation, because of the neighbors' and people of "razon's" having instructed them and shown them the method of making (concocting, composing) mescal and rum (chinquirito) from lees of sugar and other drinks which previously the Indians of all these missions were ignorant of, and because this vice and license the missionaries have pitiful experiences. By the census which I have now there must be seventy families, twelve widowers, eight widows, fifteen orphans, and the (total) number of souls two hundred

fifty-seven. The communal properties (temporalities) are a ranch (farm) or plot of land where it is said there are some cattle being raised, thirty or forty head of sheep, six or seven teams of oxen (Yuntas-yokes de bueyes - bulls), fifteen or twenty cows and ten or twelve beasts (probably of burden; i.e. horses, mules, donkeys), a fruit tree arbor (orchard, garden) adjoining the house of the Padre-Missionary, and a small plot which they cultivate communally of wheat, corn, kidney bean, "lanteja" and chickpea (garbanzo); the Spaniards, mulatos and other breeds established in this town are many, and seemingly will be (number) more than thirty families.

748.5 -

The town of visit of Nuestra Señora del Rosario de Nacameri, seven leagues to the south of the preceeding one of Opodepe, is situated on a high land next to the river. To the west (it) is surrounded by high hills and mountains barren of trees for construction (purposes). Between east and south this town has an extensive valley with (of) good land for tilling and sowing. The nearest and best have been appropriated by many (Span. I presume) residents and people of "razon" who are established in this town, and the Indians sow little (land) or none, and in truth they are not to blame, because they are a very small number of families. The native Indians of this town which according to the census appear to have twelve families, are the only ones who have to bear the burden of attending and serving in what is necessary to the Padre-Missionary; of keeping up the communal houses; serving and giving escort to the (continual) mail couriers (possibly passengers of the mails) in order to deliver to their destinations the letters of the royal service and private ones; and, finally, of many other burdens to which the Indians who are of the mission, alone are obligated; and although there are Indians of other missions or gentiles of the frontier nations who serve in the capacity of slaves to the Spaniards and "people of reason" this is the cause which moves the nations of some towns to press (insist on) and beg the sacking of (the) mission rule because as they are simple (souls) it appears to them that by this means they will see themselves free from these burdens and (mis) treatments like the"people of reason". In this town the church and the house of the Padre Missionary are completely ruined. In order to celebrate the holy sacrifice of mass and to administer the holy sacraments, there is a chalice, an incensory, and an all silver (probably baptismal) case; there are three vestments of various colors, with other adornments, very old and almost unserviceable. By the census which I have now there must be 12 families, two widowers, a widow, and the (total) number of souls thirty-four; they are of the lower Pima nation; they talk their native tongue and some understand the Spanish tongue. All are very poor in furniture and (temporal) earthly goods, and some are very ignorant and backward in the catechism and Christian Doctrine. The communal properties are three or four hundred sheep which belong to Opodepe and there are in this town due to the goodly size of the pastures, three or four teams of oxen, and the fruits (harvest crops) of a small plot of wheat,

corn and other seeds. There live in this town more than fifty families of Spaniards and "gente de razon."

SAN XAVIER DEL BAC F 1203 D63 36 Ser. X

(1) "Documentos ... Historia de Mexico "FrAnt°. de los Reyes - July c, 1772.

Page 766 #15

"The town of San Xavier del Bac is situated on a plain, abounding in water and good lands, where the Indians sow some small plots of wheat, corn and other seeds; the church is of moderate capacity ornamented with two collaterals of linen with their gilded borders. There are the (sacristy) vestry with four chalices, two of them unserviceable, a custodia, an incensory (a thurible), an extra conventual dish, and some all-silver mass wine vessels, four vestments of various colors, with other adornments of altar and divine worship, all very poor. By the census which I have now there must be forty-eight families, seven widowers, twelve widows, twenty-six orphans and the total number of souls is two hundred and seventy.

"The visita town of San Jose del Tucson is situated six leagues north of San Xavier. It has neither church nor a house for the missionary. Because of the fertility of the soil, a large number of Christian and Gentile Indians are united and congregated in the form of a town. It has not been possible to make a census, but it stands to judgment (reason) that the heads of families are more than two hundred."

Pimeria Alta (Upper Pimeria): Reyes - 1772

#15 P. 754 - Doc. para de la Hist. de Mex. - 3d Ser.

Speaking of the missions of Pimeria Alta, Reyes says: (754) 754.9 "The churches and dwellings of the missionaries are all constructed of adobes, roofed with timbers, straw and earth. The towns adjoin the churches, but are composed of scattered huts and poorly made native dwellings. Some Indians, in order to please the missionaries, build some houses of adobes, roofed with straw and earth; they plant very little; and in order to cultivate and benefit by their individual plots it is necessary that the Padre Missionary provide them with seeds, axes, hoes and all that is necessary, and if these are lacking (755.2) there is no planting.

"755.8 In the first survey (perhaps a report) it is observed that these missions, towns, and presidios of Upper Pimeria, are situated almost on the same parallel between 31 and 32 degrees north latitude, but it is necessary to note that the three missions of San Xavier del Bac, Guevavi and Suamrica, which occupy the most easterly land are higher

(either in north latitude or altitude?) than the five remaining ones situated to the west; and in order to proceed with clarity I shall arrange the description in the following manner:

(San Xavier - Guevavi, etc.)

PITIQUITO - (San Antonio del Pitiquin)

P. 765 - Reyes.

The visita town of San Antonio del Pitiquin, two leagues east of Caborca, has neither church nor missionary house. By the census which I have now there must be 75 families, 8 widowers, 11 widows, and the (total) number of souls 370.

The visita of San Juan Del Bisanig, six leagues west of Caborca, has a church and a house for the missionary, but is devoid of ornaments and furniture. The Indians, although they have good lands, plant little or nothing, and have a great predilection for fishing in the estuaries (inlets) and shores of the sea, eight or ten leagues distant. By the census which I have now there are sixty-three families, 11 widowers, eight widows, six orphans and the (total) number of souls 271. In this mission and the towns there have recently recongregated some families of rebels who were reduced in this last campaign; and by the letters of the padre missionaries it is known that at the beginning of this year of 72 some of these rebels were deserting and running off to the hills (cerros).

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The river Gila runs from east to west directly opposite these towns of Pimeria, until it empties into the famous Colorado River which runs its course from the north, and united, these two rivers form a bow deflecting to the south, emptying their waters into the upper part of the Gulf of California. In the area of land which the missions bound, together with the two cited rivers and the sea of California, there are found settled the Sobaipuris Indians, the Papagos, the Yumas, the Guaicamas, and the Cocomaricopas, and all gentle; and they have manifested great love for the missionaries, especially for Padre Garves (Garcés?) missionary of San Xavier del Bac who has visited them often; and they have requested (him) that he should come to live with them and bring other poor Padres, similar to Padre Garves, towards whom they had attained a great inclination and affection. Of all these nations or factions the one of the Papagos who are settled at short distances to the north of the missions, is the most numerous. These Papagos, part gentile and part Christian, speak the same language as the Pima Indians; from the towns and with the proper arrangements, the Padre Missionaries can gather them and reestablish and augment the missions of Upper Pimeria whose present day state (or poor condition) remains annotated clearly and truthfully.

1. Mexico, July sixth, seventeen twenty-two - Fr. Antonio de los Reyes

Note:

2. This reverend father was then the first Bishop of Sonora

(1 & 2 above apply to the accounts of all of the missions copied thus far. Cucurpe is in another section)

TUBUTAMA

Page 76 - 4th Ser. Doc. Hist. Mex.

Reply

Which Padre Jacobo Sedelmair gave to the charges which the Padre Inspector General made against him.

"I entered as missionary in Tubutama in the year 1736; and in the twelve towns which were entrusted to my administration I did not find a single decent church or cemetery, and the majority of the towns were without houses, with few people present; and so it is true that taking the people out of their mountains (wilds) and gathering them together, I made them build in each of the seven main towns a church, construct and fence the cemeteries, and in eight towns I built a house for my subsistence, while all the time, not staying in one place, I went visiting these towns for their administration and for the teaching of the catechism which they need so much. These churches, cemeteries, and house, I built, constantly changing the Pueblos (crews of workmen) for the work; and with the roaming Papago Indians, gypsies and good for nothings who came down to work gladly, who ordinarily seemed so hungry as to appear as skeletons, and at the end of five or six weeks some of them returned to their lands fat, and others came. In this construction work their manner of work was: to gather between eight and nine o'clock and to quit about four; those who dig the ground do it seated; they carry two baskets of mud in their hands; they sit down to rest, and the same with the others; but something was accomplished with them, because of their being many. This construction work was done during the most leisure times, and when the Indians were not busy with their corn crops."

79.3 - "I now refer to the land situation; I say, and it is the truth, that since I gathered so many Indians at Tubutama, following my instructions in the harvests, I was assigning the Indians the best lands or very good ones near the town with all its conveniences, under the (irrigation) channel of the church, and above a table land -- I was lending to them very often, and to others, the axes with which to open up (new) lands, never (not) occupying them with other things at those times; so that the town of Tubutama, by my direction and benefaction was seen (very)

much improved even in the dry farming (temporal) of the Indians; and other pieces of land, in this area, they always sowed them for themselves in addition to their own lands, of which I am not in charge, which doesn't worry me since I had not taken them away from them piece by piece, neither good nor bad; and I say that in order to liquidate this (situation) I would have to go to Tubutama to see the strips (of land) which they say were theirs and which I took from them: I say, in particular, of the Indian Ciprian that he is not (a native) of Tubutama but that I converted him to Tubutama together with his village which was of about sixty heads (of people) whose children and adults I baptized; as if for myself I built at my cost in the town a decent house of adobe, beams and flat roof, enabling them of his village to sow, and assigned them land; and thus do not know what lands Ciprian had in Tubutama which I took away from him. I have taken nothing from him; considered and reconsidered I say so, that the Indians have the habit of saying that lands loaned to them and then taken back by the original owner have been taken away from them. But even so Ciprian is not in the right, because if I had taken back from him a piece, I always loaned him another, just as I made loans to so many others; and how come this same Ciprian found so much new land to cultivate, according to what I've now found out in Pimeria, and before he had not done so?

GUEVAVI

(Los Santos Angeles de Guevavi)

Page 757 - Doc. para la Hist. de Mex. (3 Ser.) July 6, 1772.

The mission of Guevavi with three visita towns, is the most easterly of Upper Pimeria; to the east (oriente) at a short league from the town of Tumacacori is situated the Presidio of Tubac; to the west (occidente) at a distance of twelve leagues, the Mission of Suamrica - to the south at twelve and fifteen leagues the missions of the Valley of Sonora, and to the north the preceding mission of San Javier.

The town of Guevavi is situated on level and fertile land, adjoining a stream with good lands, where the Irdians cultivate their individual plots of wheat, corn and other seeds, and a small communally sown plot. The church is interially ornamented with two altars and a tiny collateral of linen with gilded frames; the vestry with three chalices, two conventual dishes, and mass wine vessels. There are also a custodia, a large cup (drinking vessel or ciborium), a thurible, an incensory, an all-silver case, vestments of all kinds and colors with other adornments of altar and divine worship. By the census which I have now there must be nineteen families, five widowers, seven widows, twelve orphans and the total number of souls is 86.

The town of San Cayetano de Calabazas is situated two leagues east

(oriente) of Guevavi on a plain with good lands, but it [illegible] it little or not at all. There is neither church nor a house for the missionary. By the census which I have now there must be seventeen families, four widowers, seven widows, and the (total) number of souls is 64.

The town of San Ignacio of Soroitac is situated in a valley [illegible] by mountains, six leagues east (oriente) of Guevavi and two from the preceding town of Calabazas. The lands are many and good ones for tilling, but the Indians cultivate them very little. The church and house of the Padre-Missionary has no adorned ornaments nor any furniture, when the Padre comes to this town and the other visitas to administer (them) he brings along all the necessities from the town of Guevavi. By the census which I have now there must be 18 families, 2? widowers and [illegible] 12 widows, and the total number of souls is 94.

Tumacacori: Page 758

The town of San Jose de Tumacacori is situated seven leagues south (al sur) of Guevavi, and one from the Presidio of Tubac, on a plain and with good lands. In this town there is a church and a house for the padre-missionary, but they are nude of ornaments or furniture. By the census which I have now there must be 22 families, 1? widowers, [illegible] hans, and the total number of souls is 93.

Suamca (Santa Maria de Suamca)

Page 758:

This mission and town of Suamca was attacked by Apache [illegible] in the following year of sixty-eight. They burned the church and [illegible] of the mission and reduced them all to blood and fire. By the aid of the savages the Padre-Missionary was saved, who, gathering [illegible] women and children, took refuge and gathered in the visita town of Santiago de Cocospera where the missionary lives at the present time, and where there is being constructed the church; but the soil of this town is infertile and there is a lack of water, due to which the Missionary and the Indians native to Suamca have made repeated [illegible] tions to reestablish their ruined town which used to stand in a [illegible] valley with good lands for tilling and planting, five leagues [illegible] the Presidio of Terrenate. This is the present situation of the mission of Santa Maria de Suamca whose natives, united with those of the [illegible] town comprise the number of 30 families, five widowers, 20 widows, and the total number of souls is 110.

Note: In the above account we find the following:

"....in the visita of Santiago de Cocospera where the missionary lives at the present time, and where there is being constructed the church....."

On the occasion of visiting Cocospera Mission in October, 1935, it was noted that the present structure is the result of remodling and extension of an earlier adobe mission building. The plaster could be discerned on the inner walls of adobe. Apparently at some later time burned brick and adobe were used to remodel the interior of the adobe church and extend it on the front and on the Sanctuary end.

Judging from the fact that other mission structures like Caborca, San Xavier and Tumacacori are early 19th century structures, the remodeled and extended mission at Cocospera also probably dates from the early 1800's. If this is the case then the church referred to above as being under construction in 1770 at the time Bishop Reyes is writing, was the earlier adobe church.

San Ignacio (San Ignacio de Caburica)

Reyes - 1772 (Doc. para la Hist. de Mex.) 3d Ser. - F 1203 D 63 X

Page 759

The Mission of San Ignacio with two visita towns is situated in a spacious flat lowland surrounded by high mountains; hard by the towns there runs a stream which offers easy irrigation for the many and good lands of these towns. To the east of this mission at a distance of 12 leagues is situated the town of Cocospera of the ruined mission of Santa Maria of Suamrica. To the west with some deflection to the south at a distance of five leagues are congregated some Spaniards and "Gente de Razon" in a small farm or stock raising ranch of cattle and horses which is commonly called the Santa Ana Camp, without a church or minister of the gospel. To the south with some deflection to the east is the mission of Cucurpe, fifteen leagues distant, and to the north the gentile nations and all the known land up to the river Gila.

The town of San Ignacio is situated on highlands surrounded on the north by high mountains. The Indians cultivate their individual plots and also communally plant corn, wheat, beans and other seeds. The church is interiorly adorned with three tiny collaterals. The sacristry has four chalices, four candlesticks, a custodia, a lamp, an incensory (censer) a wafer cup, and an all silver baptismal case, vestments of all sorts and colors with other adornments sufficient for the altar and divine worship. The house of the Padre-Missionary adjoins the church, but there were ruined during the next (proximo) year of 770 (1770) several dwellings and offices adjoining the church. The house of the Padre-Missionary has a large orchard with many choice quince trees, peach trees, and pomegranates, and due to the lack of cultivation there has been lost a good vineyard. By the census which I have now there must be 36 families, four widowers, seven widows, 15 orphans, and the total number of souls is 148.

Imuris - Reyes - [illegible]

The town of San Jose de Imuri [illegible] San Ignacio is surrounded on the west and north by [illegible] enjoys good lands, but the Indians work [illegible] vating them.

The church and the house of the missionary [illegible] ornaments of the altar and divine worship [illegible] three chasubles, two white priest's [illegible] ments, everything old and almost useless. [illegible] there must be seven families, six widowers, [illegible] number of souls is 38.

Tubutama

([illegible])

Reyes - "Doc. para la Hist. de Mex. - July [illegible]"

Page 762

The mission of Tubutama with a visita town is situated to the west with some deflection northward from the preceding one of Sario; eight leagues distant to the south lies the abandoned [illegible] of lower Pimeria; and the Papagos and other gentile nations are to the north up to the Colorado and Gila Rivers, about seventy or eighty leagues distant from this mission.

The town of Tubutama is situated in a spacious flat lowland of good and fertile soil where some Indians cultivate their individual plots and plant communally, wheat, corn, beans, and other seeds. The house of the Padre-Missionary is tidy and roomy, with an adjoining orchard of quince, pomegranates, peaches and other trees. The church is fully ornamented with two altars of linens with their borders gilded, with a tiny collateral in view (de perspectiva). The sacristry has three chalices, a custodia, a high cross, processional candlesticks, a [illegible], three extra conventual dishes with their mass-wine vessels made entirely of silver, vestments of all kinds and colors, with other rare adornments for the altar and divine worship. By the census which I have now there must be forty-five families, twelve widowers, six widows, [illegible] orphans, and the total number of souls is [illegible].

Santa Teresa - Reyes 1772

The visita town Santa Teresa, two leagues east of Tubutama, has a tiny church denuded of ornaments and adornments, and a small Padre-Missionary's house. By the census which I have now there must be 13 families, seven widowers, two widows, and the total number of souls is 52.

Ati

(Mission de San Francisco Ati). Reyes - 1772 - July 6th.

The mission of Ati with a visita town is situated in a valley six or seven leagues long and two or three leagues wide, surrounded by high mountains and a stream with good and abundant waters. To the east with some deflection northward is situated the preceding mission of Tubutama four leagues away, and seven leagues to the west with some deflection southward is the Presidio of Altar.

The town of Ati could be the most prosperous and fertile settlement of Upper Pimeria, but at the present time it is reduced to that which the Indians wish to plant, which is little or nothing, individually (en particular) or communally. The church is a tiny chapel without ornaments. The sacred vestments of the sacristry are a chalice of silver, an incensory (censer) of copper, three old chasubles, a white priest's gown, an amice, and other vestments of altar and divine worship, almost useless. By the census which I have now there must be 36 families, seven widowers, two widows, 15 orphans, and the total number of souls is one hundred and thirty-seven.

The visita town of San Antonio de Oquitoa (Huquitca), five leagues distant to the west of Ati, does not have either a church or a dwelling for the missionary. By the census which I have now there must be 23 families, nine widowers, five widows, ten orphans and the total number of souls is 106.

Sario

(Mission de N.S. de los Dolores del Sario) - Reyes

The town of Santa Maria Magdalena is situated two leagues west of San Ignacio and three from the aforementioned camp of Santa Ana. The house of the Padre Missionary is entirely ruined. The church is large, but almost ruined and only a chapel of San Francisco Javier has decent adornments. There are the sacristry with a chalice and a silver baptismal case, three chasubles, a white priest's gown, two amices, an incensory and two copper candlesticks, with other adornments of altar and divine worship very poor and almost useless. The native Indians of this town, although they enjoy good lands, plant them little or not at all. By the census which I have now there must be 19 families, five widowers, one widow, six orphans, and the total number of souls is 86.

This mission is reduced at the present time to a single visita town, because of the two towns of la Arizona and Busani having been abandoned in the following year of sixty-six, because they were continually being attacked by the ferocious Apaches, whose natives gathered in the two towns which exist at present. To the east at a distance of twenty leagues is situated the preceding mission of San Ignacio, and eight leagues west

of Tubutama; to the south the abandoned land of Lower Pimeria, and to the north the villages of heathen Indians and other gentiles who populate all the known land up to the river Gila.

The town of Sario is situated in a valley encircled by high mountains. Hard by the town runs a stream to the many and good lands of this mission. Some Indians cultivate their individual plots and also plant communally wheat, corn and other seeds. The church is interiorly ornamented with a collateral of linens, with its frame (borders) gilded. There are the high cross and an all silver baptismal case, vestments of all kinds and colors with a scarcity of other ornaments for the altar and divine worship. By the census which I have now there must be 32 families, 15 widowers, four widows, 12 orphans, and the total number of souls is 136.

The visita town of San Jose de Aquimuri two leagues southwest of Sario, has neither a church nor a house for the missionary. By the census which I have now there must be 14 families, five widowers, two widows, and the total number of souls is 58.

Caborca and Pitiquito

"Geografica y Estadistica" Vol. 10 (F 1201; S 62 a V 10)

A. "Account of Puerto de la Libertad"

In the Altar District (by the Scientific Commission to Port Libertad)

Page 273.

1. Pitiquito: This town is 24, 17-100 leagues distant from the port of Libertad along a good wagon road (observe the chart): it is situated one and a half leagues below the confluence of the San Ignacio and Altar Rivers, and is one of the greatest agricultural localities that this district contains. The town, which contains 1,800 inhabitants, extends about 750 meters from east to west by 100 from north to south; it has a good church and excellent farming lands located lengthwise along the river lowland with dimensions of one and a quarter leagues by three-quarters of a league in width. There are harvested superabundantly corn and beans; about 6000 fanegas of wheat; and its settlers (Span.) who also apply themselves to the raising of cattle possess more than 2,000 head.

2. Caborca - p. 273

"This town, distant 24,22-100 leagues from the port of Libertad along a good road is found situated on the lowland of the river Altar after it has formed the San Ignacio, and it is the second of the district in agriculture and the first in mining, for in the mountains which surround

it (Caborca) most of the mines are found there which the ancients (old explorers probably) used to work and four which are actually being worked. It contains a population of 600 souls; its farm lands which extend one league from east to west by a quarter of a league from north to south produce annually 6000 fanegas of wheat; plenty of corn, some beans, cane, etc. There are about 6000 head of cattle and horses raised on the surrounding farms and ranches, principally on the Calera Ranch belonging to D. Diomsio Gonzales. It has the best church in Sonora which the Jesuit Missionaries began to build in 1803 and which w as completed in the year 1810. The farming of this town could be increased considerably and at very little cost, by changing the course of the river to the old channel which it had before, because in the old channel are to be found deep holes full of water which its current carries under neath the sand by which they are covered, and which formerly used to serve not only to irrigate some lands of Caborca but also those of Bisani which are extensive and of good fertility. The great flood of the river happening as a result of the rains of the year 1828, made it change the east to west course which it formerly had diverting it almost into the first houses of the town towards the south; the church with this change being the nearest to the point of deviation, would be endangered in some new flood, and it would be desirable that as a work of public welfare, the Minister of Promotion, Colonization and Industry, would take it under his high (exalted) consideration.

Notes (R.H.R.)
Commission
1. Formed during administration of Fr. Don Ignacio Pesqueira of Sonora.
2. Fr. D. Tomas Robinson - Chief of the Scientific Commission.
3. Done in 1861.
4. "Jesuit Missionaries" an error; must have been Franciscan.

(Vol. 10 - "De Geografica y Estadistica")
F 1201 - Sqr Co. Vol. 10

a. Page 673 contains material on Nuestra Señora de Loreto.

Caborca: F 1245 V 43

R. Velasco Ceballas: - Will the United States possess itself (take possession) of Lower California?" Pub. Mex. - 1911.

The Crabb Filibuster: - page 12.

The seed of the filibusterers Long, Edwards, Walker, continued giving its fruits. In the year 1857 it produced Henry Crabe who boldly penetrated into the State of Sonora.

The Sonorans, in gallant proof of their love of their native land and of bravery, attacked Crabe in the little town of Caborca, surrounded him, defeated him and knocked him to smithereons. Of the hundred and sixteen

men who composed the filibustering company, one hundred and fifteen died at the hand of the defenders. The remaining one, after having him in their power, they granted his life so that he could return to the United States to tell of the disaster.

Guevavi
"Documentos para la Historia de Mexico"
Series 1 Vol. 1

In "Informe a su escelencia por el Padre Miguel Quijano" the following excerpts are found:

P. 45. "The history of the prisoners of Guevavi, the account of their witnesses who were present and knew very well that which occurred; D. Jose Antonio Ortiz, D. Joaquin de Cazares and Jose Romero and another; those who affirm that it is untrue that they were to blame for the lance thrusts which they (the prisoners) wish to represent; that what happened was that having known in Arlac, whither Padre Garrucho had gone to give a confession, they had stolen from his mission a drove of horses. An Indian, offering himself to find the theft and the robbers, the Padre had said to the governor Lorenzo, to the Captain and to the Mayor of Arlac, that they, guided by the Indian who was offering himself to find the theft, should go in (search) hunt of the thieves, and finding them with the plunder, should bring them to Guevavi....."

Mission San Xavier del Bac, Tucson, Arizona. F. 190

Vol XVI; Feb. 1936; No. 1; page 91.

By Rev. Mark Bucher, O. F. M.

"Who built the present Mission San Xavier del Bac, has of late been a mooted question. Two assertions have been made. The first was that the structure was the work of the Jesuit missionaries. Later, when certain architectural features, distinctly Franciscan (eg. the Franciscan coat of arms on the facade), were pointed out, it was asserted that the mission was begun by the Jesuits and completed by the Franciscans. The purpose of this paper is to show that still greater modification must be made to the original assertions, for the mission was entirely the work of the Franciscans.

While I was staying at the Old Mission of San Xavier near Tucson, several questions gave me great concern. Why was the name Bac or Baac (meaning "where water comes out of the earth") given to this Indian village, when there is not even a traditional water spring nearby, and the river is over a mile away? How could the Jesuit missionaries, who followed Kino in the first half of the eighteenth century, complain in their reports that the mission was located in a swampy place, frequently inundated by the river, when the present mission site and the village lie on

ground several hundred feet above the river bed? Again, how could H. E. Bolton of the University of California imply that Grotto Hill was about a "quarter of a league" distant from the mission, when they are next door neighbors? Finally, how could the Jesuit missionary, Kino, enter in his diary the observation that water would flow into each room of the completed mission buildings, for which he had laid the foundation that day, when even now, no water can be led to the lowest point in the present buildings, even after the government has built a dam several miles up the river?

In order to solve these puzzles, I began to interview the Indians in the village of Bac, as well as the old inhabitants of Tucson, to learn, especially from the former, their traditions concerning the mission. According to these, Bac, the Indian name for the village, had reference to the Santa Cruz River, which is mostly a subterranean stream, but here and there emerges to the surface and flows like a normal river. One of the places, where the river flowed above ground, was about two miles northeast of the present village of Bac. However, I was informed that this village had not always been located at its present site, but lay to the northeast, on the left bank of the river. Hence origimated the name "Bac". The first query was, therefore, readily answered.

The solution of the first question furnished a key to the remaining queries. Aided by what I had gathered in lengthy talks with the Indians and almost equally long conversations with old Mexican families in Tucson, and assisted by Father Bonaventure Oblasser, O. F.M., an Indian missionary among the Papagos, I set out to locate the place, if possible, where the village once lay, and with this, the conjectural spot of Kino's church. From different sources, I had learned that until the close of the previous Century, there could be seen in a field lying to the north of the present village adobe walls ranging in height from three to nine feet. That these walls were the remains of Kino's Church, no person would even remotely maintain, since the missionary himself tells us that he used tezontle rock for foundation, while these ruins, to all appearances, were adobe. Appearances were deceitful in this instance, for the adobe, as investigation proved, had been laid upon a tezontle foundation, and had washed down on both sides and completely enveloped the foundation stones. This was brought to light by the plowing up of that whole section by a land company, which was unaware of what it was doing (in an historical sense). On finding these stones, the workmen carried them to the southern boundary of the field, as was learned from one of the men who had worked on the project. Here these stones lay, hidden for the most part by mesquite and ironwood, until in one of my exploration trips I happened to stumble over them. On digging nearby, I found fragments of pottery lying in great profusion all around. On another occasion I found a wide ditch now only faintly traceable and running down to the river bed. At the jagged edge is the cliff. Upon digging in the sand, I uncovered what looked like the remains of a dam. Likewise, where the water had washed broader and deeper, human bones could be seen.

These discoveries pointed to the evident conclusions that the old village of Bac or Banc had been located here; and that [illegible] place where Father Kino had laid his foundation stones of [illegible], says in his diary under April 28, 1700:

> "On the twenty-eighth we began the foundation of a [illegible] and capacious church and the house of San Xavier [illegible], the many people working with much pleasure and zeal, [illegible] digging for the foundations, others in hauling many [illegible] stones of tezontle from a little hill which was about [illegible] of a league away. For the mortar of these foundations [illegible] not necessary to haul water because by means of irrigation ditches, we very easily conducted the water where we [illegible]. And that house with its great court and garden [illegible] able to have throughout the year all the water to [illegible] ning to any place or work-room one may please....."

As one stands in that field which was the original [illegible] up to the south, a short mile distant, the hill from [illegible] rock was hauled, and where even today, that same variety [illegible] found in abundance, while on Grotto Hill, there is [illegible] on it or in it.

These discoveries satisfactorily solved in various [illegible] now when the river, swollen by heavy summer rains, [illegible] this section is still inundated and still suffers [illegible] despite money appropriations by the Federal Government. [illegible] buildings were finished, water could be led "very easily" [illegible] for it ran naturally down hill. Finally, Dr. Bolton, [illegible] was unacquainted with the topography of Bac and that [illegible] cept my findings.

Rev. Carl Bader, [illegible]

Santa Barbara, California.

* * * * * * * * * * * * * * * * * * * *

KISHMUS PARTY

By Sallie Pierce Brewer

The Navahos gathered at the big "show" hogan for the Christmas party this year---thirty-six of them, by a fairly accurate check-up.

Four days before the 16th we had gotten the fir tree from the Peaks; two days before we had gotten the presents in Flagstaff; and the day before and day of the party we had cooked, wrapped presents, and trimmed the tree. At one time on the afternoon of the 16th I counted seven pots on the stove in the cook shack, not including a washtub full of beans which two Navaho boys had just carried over to the hogan; the other pots were full of rice and dried fruit.

Our friends of Wupatki Basin were all there of course; Nezca Yazzie and his family had made a 25-mile wagon trip from above Grand Falls, arriving a day ahead of time; seven of the Bela Cody family came almost as far; a nephew of Clyde's rode down from Gray Mountain (Coconino Point) with sacks of pinons and greetings from some of the Peshlacais up there; the inevitable modern touch was added when two Navahos arrived in a car--they had come for Nanil Cady, the medicine man, to sing the next day at their hogan--and had come in time for the feast.

Jimmie and I were awakened about sunup the morning of the party day by Nezca Yazzie and family coming in to sit on the benches and wait for us to get up; it appeared that since he had come a day early he thought it was high time the party started--we had asked them to come, here it was sunup, and they had no flour or sugar! We realized how lax we were being in our duties as host and, as soon as we could persuade them to leave, got up and about the business of providing food.

Clyde and Sarah were the next arrivals, and set to helping us immediately; Clyde marshaling the boys to carry food and Sarah producing enough pots to cook with. With the gathering of the rest of the guests in the late afternoon I was asked for tissue paper and cards and they wrapped their presents to us; I stood discretely to one side and wrote "Jimmie from Katherine" and "Sallie from Clyde" on cards as they brought them to me.

That important business being over everyone adjourned to the hogan; after the tree was trimmed (with Hendron and Clyde throwing tinsel and snow with a will) we ate. And we really ate; besides the beans, rice, and fruit, we had tomatoes, and mutton, and bread and coffee. And I think we had enough, because the men left the bowls half full when they leaned back to smoke the cigars Jimmie passed, and that's the first time I've seen Navaho men fail to eat all that was put before them!

Before we went out to the tree the Brandeis came--they are long-time friends of the Peshlacais--and brought a crate of oranges and candy. They were passed after distributing our presents; then came the opening of the big box of clothes (contributions from whoever would contribute). Clyde

Wupatki — the excavation of Room 7

J. W. Brewer, Jr. & Erik K. Reed

Jan. 1937

917.8

917.8

January 15, 1937.

Mr. Frank Pinkley, Superintendent,
Southwestern National Monuments,
Coolidge, Arizona.

Dear Mr. Pinkley:

I am herewith submitting a report of the excavation of Room 7 at Wupatki National Monument.

In chronological order, the notes of Dr. J. W. Fewkes, Mr. A. T. Williamson, C.W.A., 1933-4, Mr. Erik Reed, 1936, and Mr. J. W. Brewer, Jr., 1936, are included.

Acknowledgment is made to Mr. Volney H. Jones of the University of Michigan, Mr. George Millett of the Museum of Los Angeles, and Mr. L. L. Hargrave of the Museum of Northern Arizona for their identification of material found in the excavation.

Respectfully submitted,

J. W. Brewer, Jr.

J. W. Brewer, Jr.

916

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MAP SHOWING MUSEUM OF NORTHERN ARIZONA ROOM DESIGNATION

SKETCH OF THE EAST WALL, ROOM 7

SKETCH OF THE NORTH WALL, ROOM 7

BURIAL PLANS

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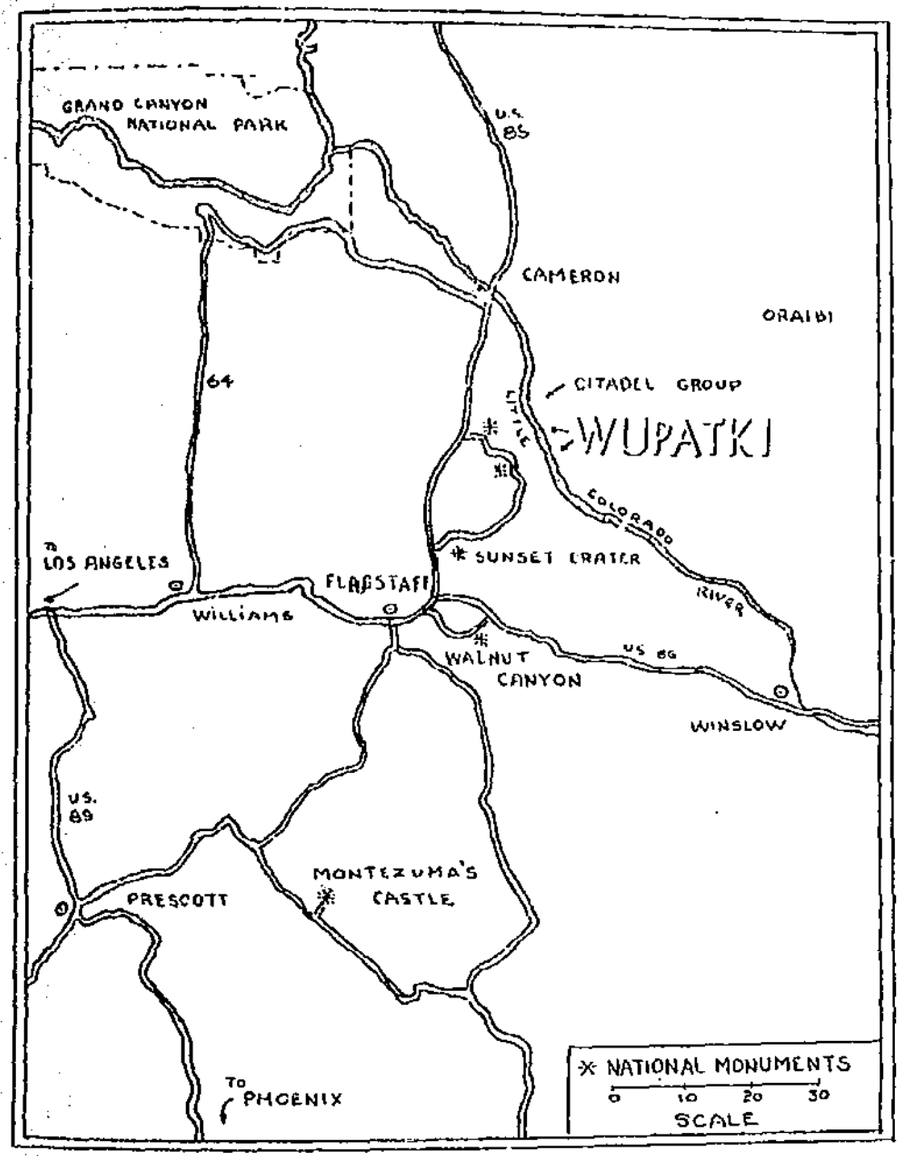
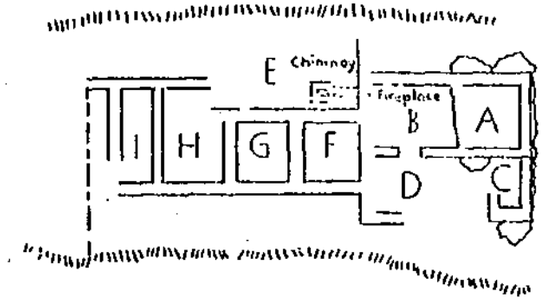


VICINITY MAP.

WUPATKI NATIONAL MONUMENT LIES 38 MILES NORTH-EAST OF FLAGSTAFF, ARIZONA.

WUPATKI
THE EXCAVATION OF ROOM 7

By James W. Brewer, Jr., and Erik K. Reed



Fewkes' Figure 8

REVIEW OF PREVIOUS WORK IN ROOM 7 AT

WUPATKI NATIONAL MONUMENT

Assembled by J. W. Brewer, Jr.

****

J. W. Fewkes (22nd Annual Report, Bureau of American Ethnology)

Notes of the Summer of 1986

Room E (Room 7*) has two stories, and the floor beams and rafters are still in place but buried under debris. A high wall extends from the eastern wall of Room E, crossing a depression in the cliff which is bridged by logs serving as a foundation. - - - - - -

The rooms of the second section (North Unit) (Fig. 8), several of which are well preserved, are lower than those of the first section, (South Unit) and the detritus has covered the base so completely that the mesa is inconspicuous. - - - - - - - -

Room A (Room 1) is nearly square and is built on two rectangular rocks, the top of which forms the floor. One of the rocks forms a side of the lower story of the adjoining Room B (Room 4), which is in the best

* Present designation.

condition of any in this section. The walls of this room are well preserved and it was occupied as a habitation by a herder a few winters ago.* There is a lateral doorway through the wall on one side (east), and in one corner (southwest) is a fireplace communicating with a chimney, which will be later described. - - - - - -

A chimney like structure is one of the most conspicuous objects in this part of the ruin. It rises from the mass of debris covering Room E (Room 7) and communicates with the fireplace in Room B (Room 4), but a vertical line from its top is 7 feet 10 inches from the nearest wall of the room in which the fireplace is situated. Whether this chimney is aboriginal or not, or whether it is a chimney at all are open questions.

Excepting its state of preservation and fine masonry, no evidence was found that it is of more recent date than the walls of the rooms. If it is an aboriginal chimney, which is doubtful, the structure is unique. It may be a ventilator, comparable with the chimney like structures described by Mindeleff in the kivas of Canyon de Chelly.

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* During later excavation of Room 4, in 1933, a San Francisco newspaper with the date of 1889 was found on the floor.

****

A. Tenbroeck Williamson (Report of CWA Excavation in 1933-34)

(True Copy)

Room 7

A.T.W.---693

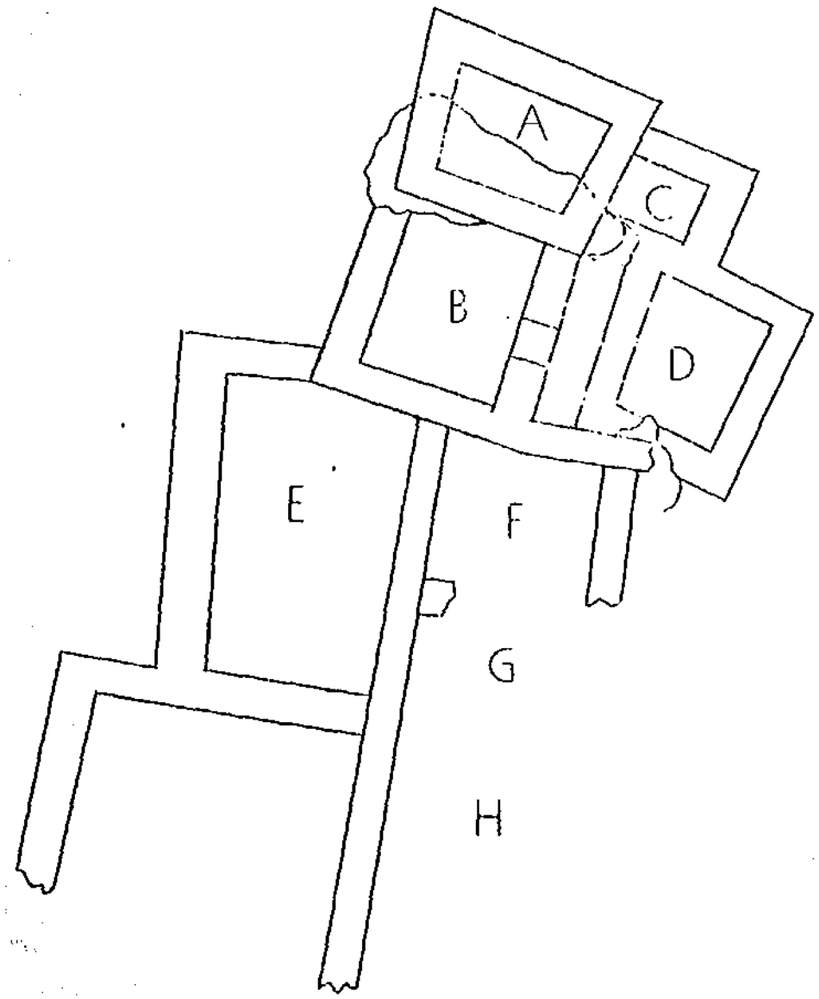
The upper fill of fallen wall was removed from Room 7. Because the allotted quota of laborers was not maintained, it was impossible to complete the excavation of this room. Of importance was the proof, since there was no tying into the wall, that the chimney in this room was not aboriginal. This is counter to a belief of Dr. Fewkes. Three beam holes in the east wall indicate a E-W direction for the roof beams.

Artifacts recovered from Room 7:

Ladle handle - Baby-in cradle-type
Fragment cotton cloth (2)
Bone implement fragment (3)
Glycymeris fragment, incised.

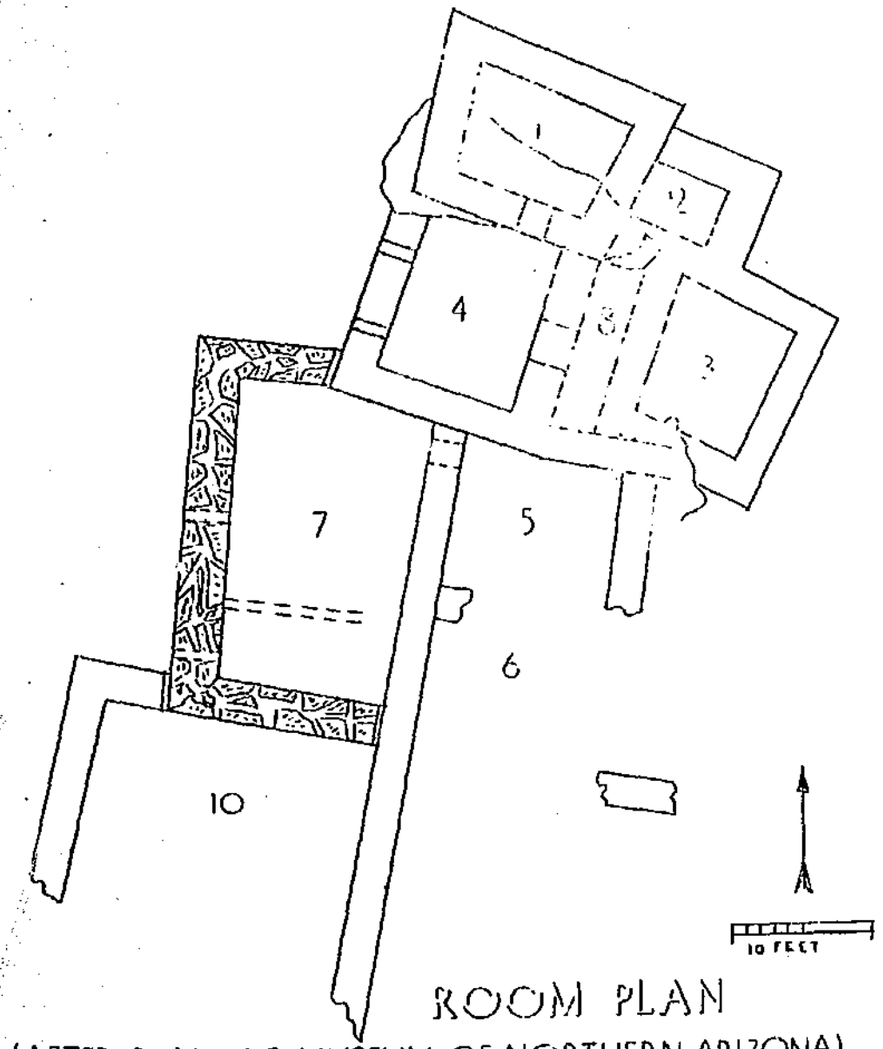
Photographs in association with Room 7:

405.87
405.111



ROOM DESIGNATION AFTER FEWKES

THE NORTH UNIT
WUPATKI



ROOM PLAN
(AFTER PLAN OF MUSEUM OF NORTHERN ARIZONA)

Reprinted from Southwestern Monuments Monthly Report for March, 1936, page 162, by J. W. Brewer, Jr.,

430 Archeology, History

From partially excavated Room 7. A larger than average, much broken pot washed out. I collected the pieces and put them together on a slack Sunday afternoon. The olla is of coarse paste, rough smudged exterior; interesting is a row of 3/4 inch coiled rosettes just below the neck.

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EXCAVATION 1936

BY E.K.REED

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1. Introduction:

The main ruin at Wupatki National Monument is a large masonry pueblo on a spur of rock below the edge of Woodhouse Mesa overlooking the valley of the Little Colorado. The major portion of the site was excavated and restored by a CWA project, directed by the Museum of Northern Arizona; it is planned to leave part of the rest unexcavated indefinitely. For some time, however, Room 7, from which some of the upper fill had been removed by the CWA, on the side of the lower (northern) portion of Wupatki, had been washing out badly and it was feared that sherds of restorable vessels were being lost.

Accordingly the Regional Assistant Archaeologist spent the period of October 13 to November 3, 1936, at Wupatki National Monument excavating Room 7. Ordinarily eighteen man-days would not be required for the excavation of a room 20' x 12' with average depth of fill about 2½', but, mainly because of the abundance of sherds, all of which I want to recover with as little breakage as possible, the work was done very slowly and painstakingly. Five burials were encountered; fifty-nine listed specimens and a number of uncatalogued ones were found; a number of interesting architectural details were worked out and studied. These are discussed in detail below.

Reluctantly, I left the job unfinished, because of the pressure of other matters, when it became evident -- upon entering the trash pit at the south end of the room -- that considerably more time would be required. On the one hand, I left the room in passable condition, the trash pit cleared and levelled to a slightly deeper level than that of the floor,

so that washing out will do little damage; on the other hand, custodian James W. Brewer, Jr., is sure he can find time to finish up the job (there is no doubt at all of his ability to do the work properly - he was field supervisor in general charge of the CWA work here and is a Research Associate of the Museum of Northern Arizona). Incidentally, I wish to express here my appreciation of Mr. Brewer's help throughout my work.

The artifacts and burials found in Room 7 were given serial numbers following the system of the Museum of Northern Arizona and continuing their Wupatki catalog. The majority of the cultural material recovered will be turned over to the said Museum for safe-keeping and for study (the specimens recovered by the CWA here are also in the custody of the Museum). These, and the CWA collections, will be returned to Wupatki for exhibit whenever a museum is arranged there. Dr. Colton and Mr. Hargrave of the Museum are publishing a general study on the Pueblo III period shortly, and plan to publish on Wupatki - primarily the CWA excavations - eventually; they have always cooperated with the Park Service to the fullest extent, and everything found at Wupatki should be placed at their disposal.

Burials 38 and 42 were not preservable at all; burial 41 is not yet excavated; burials 39 and 40 were cleared and left in place, and it is my opinion that they should be shellacked and the pits covered with some sort of lid and left permanently undisturbed as insitu exhibits. I am content to leave the disposal of burial 41, and any further burials found by him, up to Mr. Brewer.

Insitu exhibition of burials (of other phenomena, for that matter) in Room 7 is particularly to the point if Room 7 is utilized for a museum room as has been suggested. I heartily support this idea; the room can be made into a very suitable small museum, with no vast expense. If this is done, I suggest that a large skylight, or pair of skylights, be incorporated in the roof, rather than making unsuitably large window in the west wall; that the entrance be placed at the northeast corner of the room (i.e., using the present (original door); that the outward-leaning section of the north wall be left sprung and simply finished up - there is no likelihood of its collapsing; that on the other hand the wall in the northeast corner be restored (to use the old door as the entrance); that the floor be of 'dobe plaster as it is now and has always been.

2. Method of Excavation:

Room 7 was filled to an average depth of about two and a half feet above the floor (some of the fill had previously been removed by CWA crew directed by Ten Broeck Williamson) with sand and adobe, largely fallen roof and wall material, containing lenses, layers, and pockets of ash and charcoal, and containing a great quantity of sherds. Due to the amount of sherds and the possibility of restorable vessels, practically all the fill was first trowelled down, and then shovelled out, being thrown across

the trail on the west side of the ruin to fill in depressions there.

The excavation was conducted systematically, by dividing the fill into horizontal and vertical sections of varying size. The fill sloped sharply from north to south, so the uppermost layer was taken at first arbitrarily to the lowest point on the then surface; later it appeared that this was nearly down to the uneven level of the fallen ceiling, so this latter was taken as the division point between layers 1 (upper fill, above the fallen roof) and 2 (fill between the fallen roof and the floor). Layer 3 is subfloor trash. The horizontal divisions within each layer were arbitrary and of varying size according to conditions and convenience; they are designated by alphabetical letters. They do not necessarily correspond from layer to layer. Thus, block 1 A is the fill above the fallen ceiling in the entire south half of the room (this block was extended so much because of its extreme shallowness); block 2 A is only four feet square in the southwest corner (between the ceiling and the floor); block 3 A is the entire trash pit in the south end of the room, since this area constitutes a unit as against the presumably much earlier subfloor trash. (It is also possible that the trash pit is really subfloor trash, the floor having for some reason disintegrated over the south end of the room. Light will be thrown on this by Mr. Hargrave's study, by comparison of artifacts from 3 A and 3 B (subfloor trash)). Material from sections 1M and 1E belong actually with layer 2, since these blocks were almost entirely behind (under, in effect) the upturned northeast corner of the fallen ceiling. The small section of wall north of the door in the east wall fell before the roof did, obviously, and a certain amount of soil washed and/or blew in among these rocks, also before the fall of the ceiling; any cultural material therein belongs temporarily, though not literally spatially, between the ceiling and the floor.

Layer 1 was removed down to the fallen ceiling (most of blocks 1E and 1M being left untouched accordingly), and the latter was cleared off and photographed; then layer 2 was removed and the floor cleared. The small pits in the floor were investigated and infant burials found in most of them. One burial, No. 41, over which the floor had been replaced, was not worked on, and excavation of the trash pit was carried down only to floor level. These two things are being worked on by Custodian Brewer, who informs me that he has already found a very fine burial in the trash-pit (area 3 A).

3. Architectural Features:

The floor of Room 7 is of adobe plaster, in good condition; it has been replastered once. The replastering is one inch thick; there is no refuse fill between the floors, so no break in occupation is indicated.

The walls are of small slabs of Moencopi limestone and evidently were plastered completely with adobe during occupation. Some of this wall plaster is preserved quite well in the northeast corner of the room

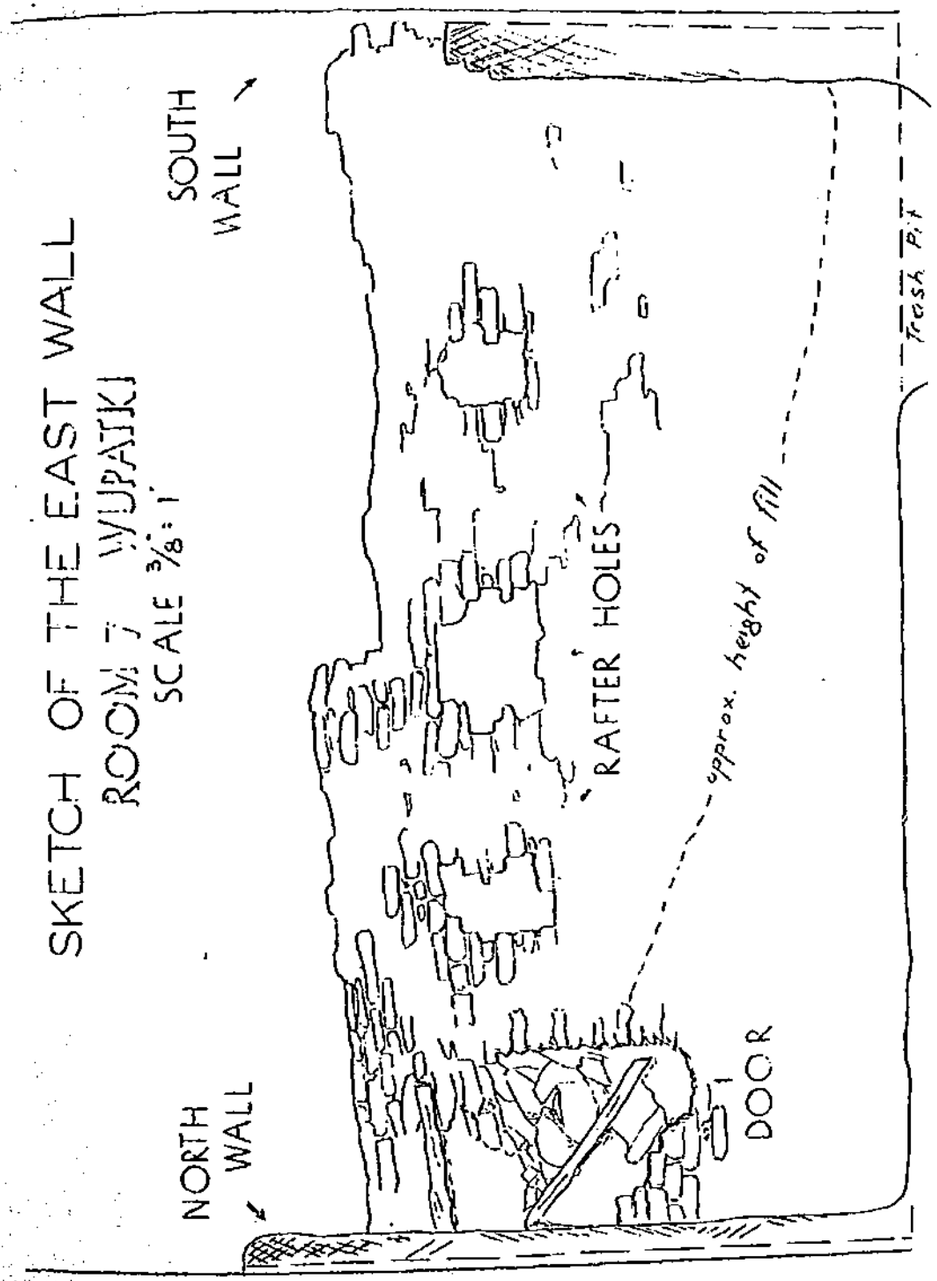
(protected by the fallen rock and consequent early accumulations of soil).

The ceiling evidently fell in all at once, atop the rock-fall in the northeast corner and atop about 9' (in the north end) to 3" (in the south end) of mostly windblown (?) refuse fill. Impressions of rafters (running north-south, poles about 3" in diameter), in some cases still containing decayed fragments of the poles themselves, and of small sticks, brush, and grass (mainly running east-west approximately), with remnants of the grass itself, were clearly observable in the north end upper side of the ceiling. In other words, what is referred to herein as the ceiling is only a part of it - the underneath, or inside, plaster. (A major portion, accordingly, of the fill above the ceiling, layer 1, is the adobe and earth which were piled on top of the timber and brush that constituted the basis of the roof. As a matter of fact, the two metates which do found, and perhaps some of the pottery - restorable plainware jars especially in -- layer 1 were probably on the roof when (and before) it collapsed). The three transverse (east-west) rafters, did not appear in the fallen ceiling itself; but three beam holes in the east wall attest their former presence. The center one of these, in the middle of the wall, is now 1'6" by 2'3" and presumably the central rafter was a log about 16" to 18" in diameter. This would have been the primary support of the roof. The other two beam-holes are spaced about halfway from the central one to the north and south walls and contained rafters not over 10" in diameter. The three-inch north-south poles were laid across these three main supports which were firmly held in the walls and brush, grass, adobe and earth, piled successively atop them.

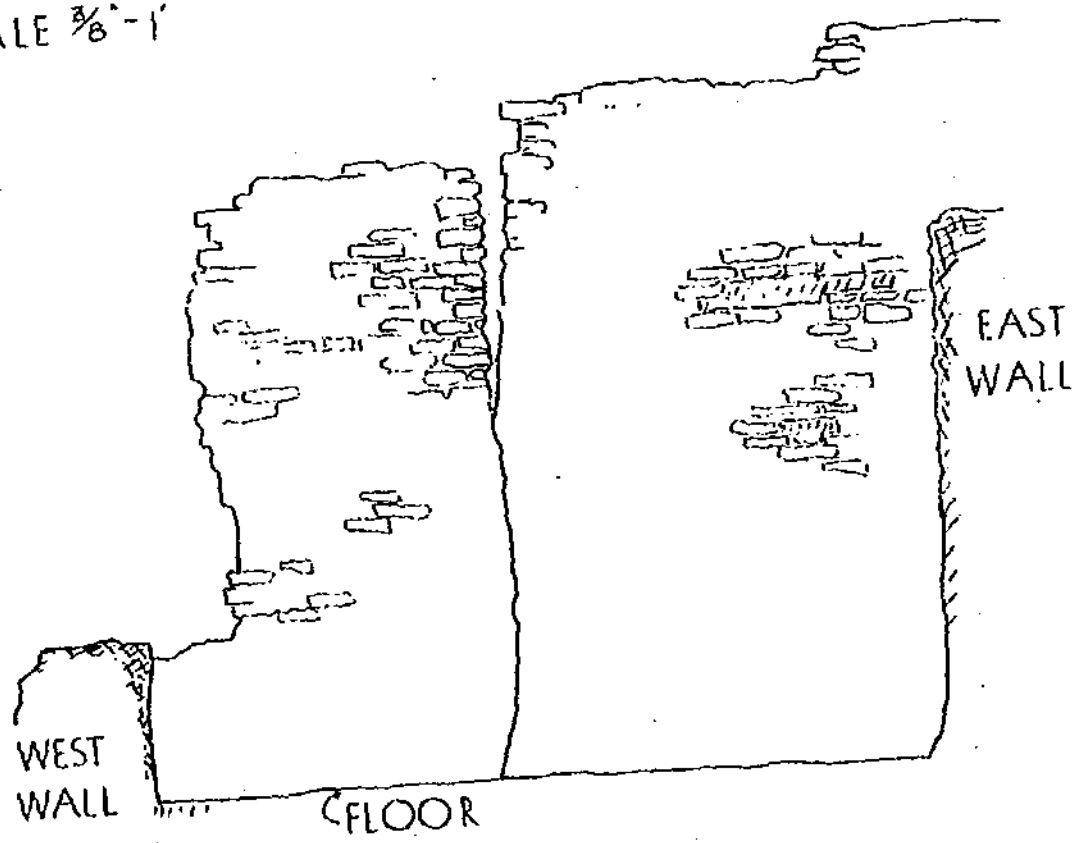
These three-beam-holes extend down to one and the same course of masonry, so that these are the original lower limits, at 6'6" to 6'10" above floor level. The present upper borders of the rafter holes are 7'10" to 8'1" above the floor, which is about a foot above what appears to have been the top of the door in this wall. There can be no question but that the fallen ceiling which we have been discussing is the one which was supported by these three beams, as on the one hand there is no trace of any fallen ceiling between it and the floor and on the other hand there are no rafter holes whatever between those three and the floor. Accordingly, then, the ceiling was approximately 8' above the floor; forming a room unusually large vertically as well as horizontally.

There is no indication and no likelihood of any door except the one in the north end of the east wall, which is mostly gone, rising at present only about 30" above floor level. There is nothing suggesting any opening in what is left.

The door in the north end of the east wall extended vertically from 4' above the floor to 7' above the floor. Presumably a short ladder was set against its sill. This peculiarity of one small door so far above the floor, may have been for defensive reasons; more probably it is simply because the floor level in the adjoining room (unexcavated) into which it



SKETCH OF THE NORTH WALL
ROOM 7 WUPATKI
SCALE 3/8" - 1'



opens is presumably higher--not necessarily a full four feet higher--than that of Room 7. The door is about 20" wide, set out about 16" from the corner. (Those measurements are given as approximate because the section of wall between the door and the north wall, and the east part of the wall above the door, have collapsed.) The fallen lintel is still in the doorway, extending diagonally across it (and across where the fallen section of wall stood); above it are displaced stones it previously supported.

A ventilator extends through the west wall close to its south end just below floor level. A similar ventilator, filled in with building stones, occurs in the west wall near its center just at (that is, extending up from) floor level. It is quite possible that this ventilator was used at first, was blocked when the replastering took place. Why, I have no idea.

Several pits in the floor appeared when it was cleared off. The most striking of these was the large trash pit across the south end of the room, constituting 3 A. This is being worked out by Mr. Brewer. The others turned out to be burials (discussed below) or simply disintegrated places in the floor. A weak part of the floor just north of the center of the room contained a pocket of ash; this resembled a burnt post more than a firepit. I found neither definite postholes nor a definite firepit. These, at least the firepit, may perhaps be found by Mr. Brewer. It is to be expected that further pits will appear in the lower floor level when the replastering is removed. Very possibly weak places in the upper floor are due to such pits. A clay-lined pit in the northwest corner of the room, 1'2" in diameter and 4" deep, contained a shattered polychrome bowl.

Late chronological position of Room 7 is amply evidenced by the curving-out of the base of those of its walls which are parts also of other rooms; clearly the east and south walls and part of the north wall were built as exterior walls, and Room 7 added later by extending the north wall and constructing a west wall. This is particularly definite and clear in the north wall, where the added section was not tied in with the already existing part and has leaned out away from it.

4. Burials;

Five inhumations were encountered; two of these were completely removed; two cleared but left in place; one has not yet been worked on. They were assigned numbers beginning with 38, in continuation of the Museum of Northern Arizona series of Wupatki burials. All four of the excavated burials were children; two flexed, one extended, one extended and twisted or semiflexed. All four were in pits cut through the floor beside one or another wall, and the floor was not replaced over them. Possibly these four children died at the time of, or shortly after, the abandonment of the room. The unexcavated burial is evidently in another pit under the floor; but the floor was replaced over it. (Perhaps only the upper floor or replastering). Two burials were not accompanied by grave-goods; two had as offerings two small pottery vessels each, a jar and a bowl in each

case. In one of these a twilled yucca mat was spread under the pots and above the skeleton. The other was covered with thin slabs of stone.

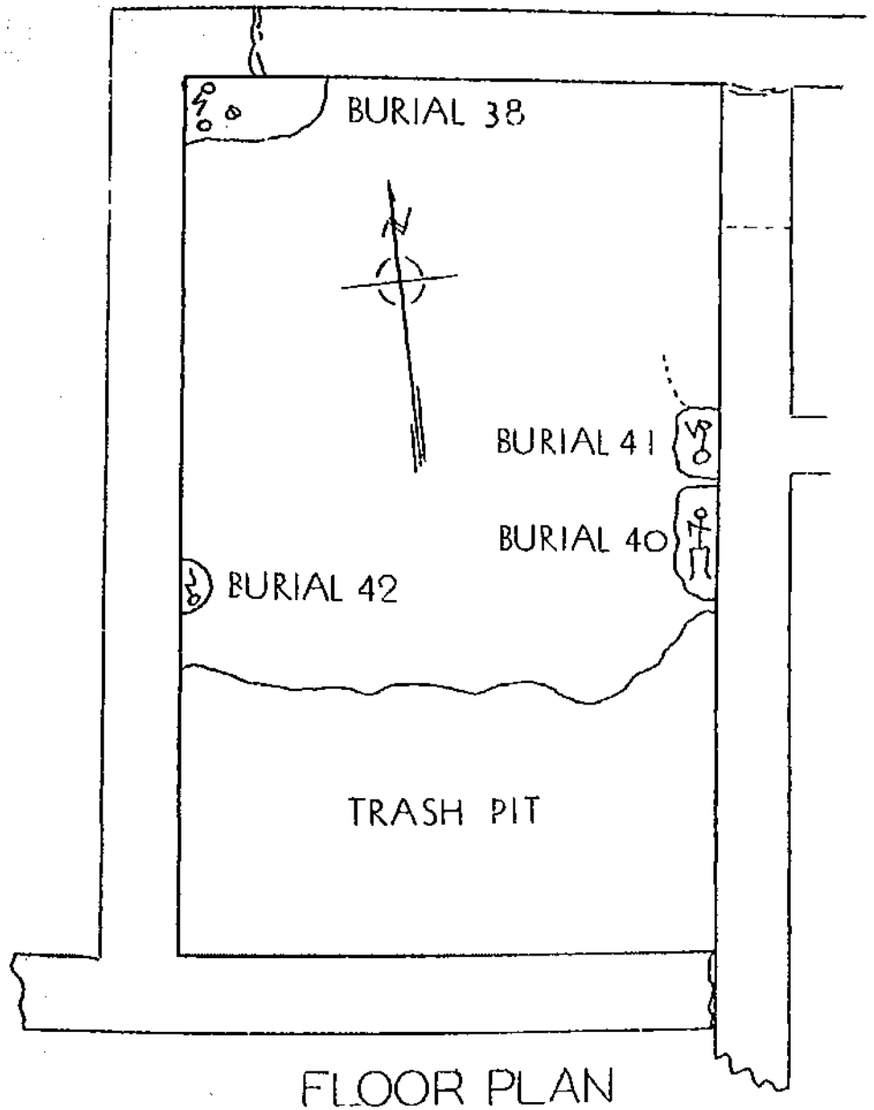
Thirteen complete or restorable pottery vessels are listed in the catalog; in addition there are, probably restorable, several polychrome bowls and a number of redware and plainware jars which were not catalogued because they had not been completely sorted out and worked on. In addition there are the following minor ceramic objects: clay figurine leg with a eleven-toed; two ladle-handles, two pottery disks (spindle-whorls--flat sherds worked down to an approximately circular shape and to a diameter of about an inch and a half), one perforated black-on-white, one unpierced corrugated.

Of the thirteen pottery vessels, only two are jars; both of these are small (one, black-on-white, 4½" by 4½", the other, corrugated, 4½" in diameter and 3" high) and both were found with child burials. The black-on-white jar would well be termed a pitcher; narrow orifice (to-wit, 2½"), and a single large vertical handle. The other, is a small flat indented corrugated vessel without handles. The uncatalogued redware jars are large ollas.

Five black-on-white bowls and six redware bowls are listed. One of the former is particularly interesting, a variation that neither I, nor any archaeologist I've talked with since finding it, had previously observed or heard of: After the bowl was dry, but before firing, a layer of coils was added around the exterior, and not indented or thumb-marked ("corrugated"). One of the black-on-white specimens was originally a large bowl; part of the rim broke off, presumably, and the vessel was ground down to form an almost flat plate. Another black/white plate, incomplete, was found--this one deliberately and originally a flat plate (a typical shape in the Pueblo area). This object is also of interest in that it is decorated on both sides; ordinary Flagstaff-type designs on the top of interior, hatched bands on the bottom or exterior. Another black/white bowl is slightly unusual in its sparsity of design---a succession of long, narrow horizontal triangles around the interior of the rim; nothing more. The fifth is surprisingly, quite average---a typical and fairly good large Kayenta black-on-white bowl.

All the redware vessels have black interiors, varyingly well polished. The three large (about 9" diameter) bowls are smudged also on the outside. One small (2/8" diameter) redware bowl was with one burial, another slightly larger with another. The latter has an interesting detail---it is crimped at two points on the rim, forming a corner or, so to speak, a spout. Finally, one is not only a small black-interior redware bowl with thumbnail marks on the exterior suggesting the Plains, it is an effigy type of Mohican, or Mexican, affinity carried on the back of a quadruped.

The polychrome bowls are of at least two, perhaps three, varieties, all on an orange base. One vessel has a black/orange interior and a



FLOOR PLAN
ROOM 7 WUPATKI

SCALE 2 FEET

mammals, deer), ten artifacts of bone were found. Five were typical bone awls of mammal bones (mostly deer metatarsals), three were small needles, of rodent or bird bones, one of which is eyed, one is a "bodkin" ---a large needle with a slightly hooked end; one a variety of awl with a deep groove from front to back across the proximal epiphysic.

9. Objects of Perishable Material:

Squash seeds and small corn-cobs constituted the only remnants found of vegetal foods. A number of fragments of wood, and wood charcoal, of varying size were recovered; those which were in fairly good condition were saved in the hope that they might prove of use in dendrochronological determinations. Unfortunately only a few look like pine (the only wood utilizable in tree-ring dating).

Remnants of textiles of various types in varying condition were recovered. An almost complete cast (both upper and lower impressions) of a coiled basket about 10" in diameter, with only the merest traces of the basket itself, was just above the fallen ceiling. A roughly twilled yucca sandal, two smaller fragments of sandals, an irregular fragment of tightly woven thin cloth, and one end of a sandal-pad or belt woven of coarse cotton (?) yarn, with two longitudinal dark stripes, were recovered from the trash pit. Also, small fragments of well-knit textile, perhaps of cotton, were found with burial 39, curved pieces suggesting leggings or armlets. A mat accompanied burial 38; or narrow-leaf yucca leaves twilled one over-two under. A few other much smaller fragments of yucca matting were encountered.

No wooden artifacts were found; one cane cigaret was turned up in the trash pit.

CATALOG OF SPECIMENS

NA 406 R 7 A-8 Vesicular basalt mortar 3" in diameter in SE corner of 1E at depth from surface 4".
-9 Shell tinkler from 1 B
-10 Redware ladle handle from 1b
-11 White chalcedony (?) projectile point 1¼" long with concave base and pair of small side notches from depth about 2-" from surface in 1 a
-12 Bone awl from 1 a, of deer (?) ulna
-13 Bone awl from 1 a, Epiphysic gone (not worked off)
-14 Bone awl from 1 a, perfect, of deer (?) metatarsal
-15 Piece of glycymeris shell bracelet from 1 b
-16 Bezel of shell bracelet, from 1 a
-17 Leg (cloven foot) of pottery figurine, 1 a
-18 Incomplete shell bracelet 1 d
-19 Vesicular-lava cylindrical pebble 1 d
-20 Broken small bone awl, 1 h

NA 406 R7 A-21 Pendant of red igneous stone, large longitudinal perforation, one side flat, rest of circumference bulging 1" long, from SW corner of 1 c, dept from surface 1'8"
-22 Piece of shell bracelet from 1 j.
-23 Shell tinkler, 1 a
-24 Stone hoe blade, 1 a
-25 Stone hoe blade, 1 a
-26 Blackware bowl 3½" in diameter, exterior thumbnail-marked, supported on quadrupedal effigy of which head and tail gone. Much of rim gone in SE corner of 1 b at depth 1'9".
-27 Black/white bowl bottom worked down to a plate, complete. Diameter 6½". In layers (2 and (3 in 1 g
-28 b/w bowl 6" in diameter with layer of coils added around exterior after bowl dried but before firing. In NW ¼ of 1 d at depth 18" and in 1 g (2 and (3, almost complete.
-29 Black- (fairly well polished)- interior redware bowl 9½" in diameter, about one-third missing, in SW¼ of 1 h at depth 1'6".
-30 b/w bowl--about half present, in two large sherds; small design, repeated around rim only. In SE corner of 1 d at depth 8" and in NW¼ of 1 d at depth 15" from surface (actual diff. in depth circa 10").
-31 Large b/w bowl, fairly well made, mesquite bar type of design not especially well drawn; about a third present (in 1 b at depth 12" to 18")
-32 Fragments of inner and outer impressions of a basket cast (in 1 a at 10'9" due North (magnetic N)) from SE corner of room 10" in diameter; ordinary coiled with 4½ coils to the inch, 16 stitches to the coil, foundation unascertainable, hemispherical.
-33 Large flat-bottomed black (not especially polished) interior bowl (in center of 1 h at depth from surface ca. 2'--about same absolute level as A26 and A20) over half present.
-34 Large blackware bowl of A29 and A33; in poor condition; over half present. (at depth 10" in 1j).

* A ladle handle (b/w) in 1 g or h sherds
** Two or three vesicular-lava cylindrical pebbles in 1 a shera..

NA 405 R7 B-1 Half of perforated pottery, b/w, disc-2d
-2 Unperforated pottery, corrugated, disc--2d
-3 Half of perforated thin stone disc--2m
-4 Bone awl; perfect; epiphysis worked off--2d
-5 Vesicular lava cylindrical pebble (within 3" of floor in 2m)

mammals, deer), ten artifacts of bone were found. Five were typical bone awls of mammal bones (mostly deer metatarsals), three were small needles, of rodent or bird bones, one of which is eyed, one is a "bodkin" ---a large needle with a slightly hooked end; one a variety of awl with a deep groove from front to back across the proximal epiphysic.

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-5 Vesicular lava cylindrical pebble (within 3" of floor in 2m)

NA 405 R7 B-6 Tinc (diameter 1", height ½") sub-hemispherical diorite (?) mortar (just above floor at conj. of 2a, b, c, f).
-7 Broken shell tinkler-- 2m
-8 Olivella bead from S end of 2j, depth CA 4" above floor.
-9 Fragment ca 3" by 2" of tightly woven cloth-- 3a
-10 Piece of shell tinkler (within 5" of floor in 2j)
-11 Obsidian arrowpoint; base broken off (3" above floor in NE corner 2f)
-12 Part (probably about half) of a subrectangular flat low-walled vesicular basalt "mortar"; 4" across short side; 1½" high (in N end of 2j, about 5" above the floor)
-13 Vesicular lava cylindrical pebble-- 2f
-14 Vesicular lava cylindrical pebble-- 2f
-15 Piece of shell (not glycymeris, larger) bracelet 3a.
-16 Stone keg-shaped object 7/8" high; deep transverse groove in one side-- 3a
-17 Bone tool with deep notch in proximal end-- 3a
-18 Cane cigaret-- 3a
-19 Bone needle--3a--epiphysis worked off; perfect
-20 Bone needle--3a--epiphysis left on; perfect
-21 Bone needle--3a--eyed; end broken off at eye
-22 Bone bodkin (hooked end)--3a
-23 b/w (of Dogeszhi) plate; about 6½" in diameter and about 1½" high; about 1/3 percent; decorated on both sides--two hatched bands on exterior; solid motifs and thick lines around interior with Maltese cross in middle (6" above floor in 2m)
-24 Sandal of twilled yucca-- 3a
-25 Sandal fragment-- 3a
-26 Sandal fragment-- 3a
-27 Woven sandal pad or bolt end of very coarse thread (cotton ?); two longitudinal dark stripes; 3" wide 3a

NA 405 R7 B36-
-1 b/w pitcher; one large flat vertical handle; diameter 4½"; height 4½"; diameter of mouth including rim 2½"
-2 Small redware bowl, polished black interior, 2-7/8" diameter including rim; height 1-3/4"
B40-1 Tiny shell bead (a ground down olivella) in fill of pit above skeleton
-2 Corrugated small handle--less jar; 4½" in diameter; 3" high; diameter of mouth 3-1/8"
-3 Redware (polished black interior) bowl; 5" in diameter; 2-3/8" high; with two crimps in edge forming a spout.

Polychrome bowls not catalogued; uncertain as to how many are restorable.

A number of evidently restorable plainware jars among the sherds. Manos, metates, hammerstones, flint chips, and cores not catalogued.

Four metates: the thickest, from surface above le, two metates in le, 3" apart, one face up at depth 15", one face down at depth 20"; at 1e" from SE corner of room and 15'2" from SW corner a metate in ill at depth ca 4' from surface, on 1½' above floor, just to west of stack of fallen rock; thinnest and least used one, no definite trough.

Condensed Burial Notes

Burial 38: A very small baby, flexed on left side, head to north-northeast in large grave (floor not replaced) in the northwest corner of the room. The skeleton itself closely tucked up in the corner in a pocket of cinders. A yucca mat spread flat across the grave, corner turned up against west wall extending above floor level. A black-on-white pitcher and a very small redware bowl set on the mat.

Burial 39: Child about four years old, flexed on left side, head to south, in pit 1'3½" in diameter, at the east wall 8' from north end, floor not replaced. Uppermost point of skull (right parietal) only ½" below level of floor. No offerings--traces of a closely woven textile. Note peculiarity; skull and rib cage empty, but not collapsed.

Burial 40: Small baby, extended with head to north, in pit 2'4" by 1'1" along east wall just south (4½" from) #39, floor not replaced. Face up. Arms semiflexed--right pulled back and up, left pulled under torse, skull about 9" below floor level. A redware bowl and a small corrugated jar on the floor of the pit, the bowl near the left foot and the jar near the right knee. A small shell bead in the fill. Covered with four thin slabs of stone set on ledge in grave at about 4" below floor. Left insitu.

Burial 41: Unexcavated. Just north of 39 against the east wall--skull of 41 one and one-half inches from right insehium of 39.

Burial 42: Tiny baby in circular pit, less well-defined and shallower than foregoing, 8" in diameter against west wall 12' south of north end. Head of cast, foot to northwest, no offerings. In poor condition, removed.

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The following is a laboratory report by Mr. Volney H. Jones:

NPS/NA 405 R7 B.9

A fragment of a textile of plain plaiting (under-one, over-one) weave. It is rather closely wover with about 14 threads per centimeter in one direction and about 8 threads per centimeter in the other. The threads are single strand and spun in a counter-clockwise direction.

A larger two-strand cord is worked into one edge of the textile. The manner in which it is engaged does not conform to the usual pattern of edge binding. It appears to be a repair rather than part of the original weaving.

Bits of material from threads of each direction and from the heavier cord on the edge were examined and were found to be of undyed cotton, Gossypium sp. The species is likely Gossypium hopi.

NPS/NA 405 R7 B.27

A fragment of a textile of twilled weave. The borders and a center portion are undyed. Two broad stripes are dyed brown.

The fragment is 7.8 cm. in the shortest dimension and about 18 cm. at the longest point in the other--but is incomplete. The material is cotton and the individual threads are single strand, twisted counter-clockwise.

The weave is basically a twilled weave with the unit over-two, under-two. The pattern is a diagonal one, and by varying the grouping of the warp elements passed over and under, the diagonals zig-zag back and forth across the fabric. This is further complicated by breaks in the pattern caused by what appears to be imperfections in the weave.

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FURTHER EXCAVATION

BY J.W.BREWER, JR

When Mr. Erik Reed was detailed to Chaco Canyon National Monument, the excavation of Room 7 at Wupatki was continued from November 8 by the writer.

At this time the fourteen feet and seven inches north of an irregular E-W partition had been cleared to the 'A' floor level. This was the last occupied first story floor level in this room.

In the west wall there is a ventilator 1' 3" from the south wall (inside). Since the top of this vent is located 11" below the A floor level, its use could be determined only through further excavation of the trash pile south of the partition.

Excavation of the Trash Pit

The south five feet of this room appears to be a trash dump separated from the north part of the room by a wall of vertical and horizontal sandstone slabs; this wall, partly destroyed, once extended downward to a depth of 2' 3", from the level of floor A to undisturbed shale. (The sandstone shelf noted in the north end of the room (Reed) does not continue south of the partition.)

Removing the trash in arbitrary six-inch layers, a small cyst (12" N-S by 13" E-W by 15" deep) was found 24" from the south wall (inside). The east wall of Room 7 is the east side of the cyst. The upper fill in the cyst was similar to that found throughout the pit (ash, bones, sherds, sticks, and stones). At a depth of ten inches and against the north side the edge of a coiled basket, or tray, was found (Catalog No. 405.R7D.1). The bottom one inch of the cyst was entirely covered with partly burned clumps of grass.

Against the north side (outside) of the cyst is a vertical stone slab that forms the south side of Burial 43.

In the trash pit a small block of hardened level occurs at a depth of one foot, seven inches in the SE corner. At the same level another block of hard packed clay appears against the partition of the EW center. Angling toward the ventilator from this block are three vertical and then two horizontal sandstone slabs. On top of the hardened level and flush on the first vertical slab, rests a nearly horizontal stone that suggests the remains of a covered channel ventilator. (Sub-floor channel ventilators have been noted in Rooms 46 (Hargrave) and 43 (Van Valkenburgh)).

I believe that after the room was abandoned the south end was used as a trash dump, and that stones once used in the wall (partition) and in the vent channel (?) were later used to construct the cyst and Burial 43.

Artifacts found in the trash pit are as follows:

405 R7D.2	Cane tube
.3	Cane tube
.4	Fire drill
.5	Fire hearth

Burial 41

The excavation of Burial 39 revealed a skull bone on the north side of the cyst 10" below floor level B.

This was thought to be a north-south burial until a test hole 8" to the north of Burial 39 and through three floor levels produced no supporting evidence.

Working this test hole to the south at a depth of 10" no bones were encountered, until the edge of Burial 39 was reached, revealing that the evidence upon which Burial 41 had been based was only a fragment of skull (a complete parietal bone).

Suspecting more of this burial might be found at a greater depth, Burial 39 was removed. One inch below the bottom of this cyst another parietal (right) bone was found and, with the removal of that inch of fill the parietal bone was seen to be resting on a frontal and upper jaw bone. On the same level and against the wall the occipital bone was found. All of the skull bones mentioned above apparently belonged to one individual.

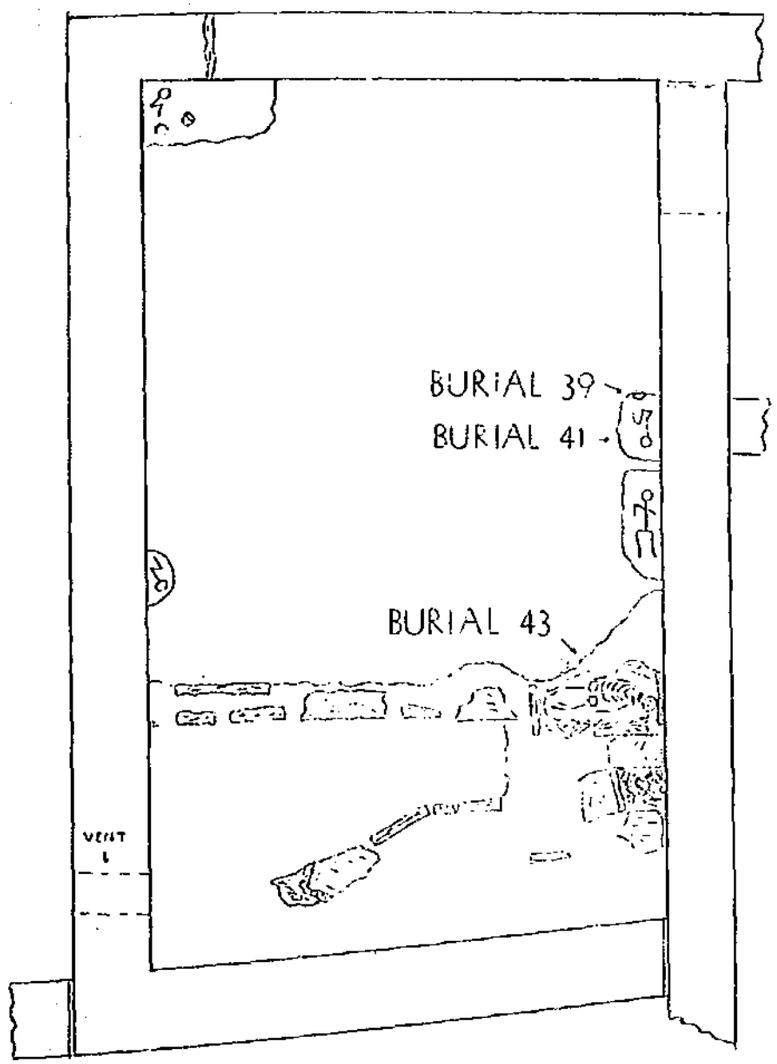
No other bones or offerings were recovered in this burial, which appears to have been the re-burial of a youth's skull.

Burial 43

Burial 43 is that of a seven (?) year old child. It lies at right angles to the east wall and parallels the disrupted partition on the south (fourteen feet from the north wall). The north side of the burial is the space formerly occupied by the E-W partition; at the east (head) end a vertical slab leans on the east wall of Room 7; at the west (foot) end and south side are also vertically placed slabs. Eight inches from the west end a three-inch pine beam once spanned the burial, supported by one of the vertical slabs on the south and inserted into a hole hollowed on the north side. The purpose of this beam was to support a stone lid or cover for the burial; this stone cover was found over the west end of the burial, still resting on the beam except on the north end where the beam was rotted and fallen. (Catalog No. of beam: F.405 R7.5).

The bottom of the cyst is one foot, nine inches below the B floor level; the cyst is one foot, three and one-half inches wide and two feet, nine inches long.

The child was wrapped (or dressed) in a cotton fabric and placed on a mat, which in turn had been placed on a thin layer of cinder in the bottom of the cyst. The arms and legs were extended and the head tipped slightly forward, because of the inadequate size of the cyst. The child was then covered with a mat upon which burial offerings were placed as follows: A pair of nested bowls--a black on white jar (Cat. No. 405 B43.3) inside a corrugated redware bowl (Cat. No. 405 B43.2)--placed three inches to the right of the neck. A single black on white jar (Cat. No. 405 B43.1) placed slightly above and to the right of the hips on a coiled basket or plaque (preserved only directly under the jar). Above the right knee a Flagstaff Red bowl (Cat. No. 405 B43.5) was nested into a black and white bowl (Cat. No. 405 B43.4). Between the knees a small black on white cup (Cat. No. 405 B43.6) was nested into a slightly larger black on white cup (Cat. No. 405 B43.7). A Glycymeris shell bracelet (Cat. No. 405 B43.9)



ROOM 7 WUPATKI

SCALE

was intact around the left humerus. Scattered (possibly by rodents) throughout the cyst were 86 small bivalve shells and 48 olivella shells (Cat. No. 405 B43.8). They were most numerous about the neck and eight of the olivellas were lying together under the skull, longitudinally parallel with the perforated end toward the head of the burial. About the right wrist were found seven olivella shells ground off on both ends, probably a bracelet (Cat. No. 405 B43.10). (Beam F.405 R7.5 complacent, McGregor)

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CATALOGUE

Burial 43

NPS
NA405 B43.1 B/W jar with vertical handle Diam. 4" Ht. 3"

.2 Undescribed corrugated bowl with white exterior decoration Diam. 6½" Ht. 3"

.3 B/W jar with vertical handle Diam. 4-3/4 " Ht. 4½

.4 B/W bowl with horizontal handle Diam. 7-5/8" Ht. 4"

.5 Flagstaff Red bowl Diam. 4½" Ht. 3"

.6 B/W cup with horizontal handle Diam. 3-5/8" Ht. 2"

.7 B/W cup with vertical handle Diam. 4-3/8" Ht. 2½" (unfinished cross hatchure on exterior)

.8 Shell necklace (Glycymeris and olivella bacteria)

.9 Glycymeris bracelet (?)

.10 Bead bracelet (olivella)

NPS
F405 R7.5 Beam specimen (complacent; McGregor)

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Disposition of Backdirt

The back dirt from Room 7 was used to fill a depression in the trail along the outside of the west wall of Room 18 and the south half of Room 7, and a hole left by CWA five feet west of Room 7. To get a trail across this hole, a "dry masonry" wall had been constructed 4½ feet west of the west wall of Room 7. This wall has also been covered with back dirt.

A trench in Room 18 was also filled to help eliminate a pocket that compelled surface water to seep into the room. This is another unexcavated, unrestored room that probably contains as much valuable information and as many artifacts as Room 7.

Recommendations

In view of the several unexcavated floor levels known to exist in Room 7 and the occurrence of burials in that room below floor level, further investigation of the lower floors might be advisable.

I recommend the reconstruction of Room 7 and the replacing, under glass, of all the burials with their artifacts.

The door into Room 5 should be sealed and a new one built into the west wall as it is restored. The north, south, and east walls are now standing at sufficient height to support a roof.

In addition to the burials this room is large enough to accommodate at least four museum cases and several wall charts, etc.

In reconstruction of the roof two 3' square skylites should be provided toward the eastern half of the roof. This would permit light for display of B 43. Two windows in the west wall would also help lighten the room.

A thorough study should be made of the pottery.

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Technical identifications of artifacts recovered.

Shell material was identified by Mr. George Willett of the Museum of Los Angeles as follows:

NPS/NA405 R7.23 - Conus comptus gld. (?)
NPS/NA405 R7.15 - ? ?
NPS/NA405 B43.8 - Olivella Bacteria (Little Olive)
NPS/NA405 B43.9 - Glycymeris
Miscellaneous (1.) - Cardium elatum (Giant Cockle)

"The material probably comes from the Gulf of California." (Comstock)

The laboratory report of Dr. Volney H. Jones of the University of Michigan follows:

Report No. [illegible]

Date of receipt of material	November 23, 1936.
Received from	National Park Service, Wupatki [illegible] per J. W. Brower
Collected by	Brewer?
Where collected	Wupatki Monument, Arizona
Name of site	Wupatki
Other circumstances	From Room No. 7, Wupatki. Tree-ring date 1168 A.D.

Description
Original No.
Laboratory No. 1273. A fragment of loosely woven textile [illegible] 5 threads to the centimeter in each [illegible]. The threads running in one direction are [illegible] what larger diameter than those in the [illegible] direction. As there is nowhere a selvage [illegible] it is impossible to determine which is [illegible] which is waft. The weave is a simple [illegible] under-one or plain weave. It is probably [illegible] not necessarily loom woven.

The material is cotton, very likely Hopi [illegible] (Gossypium hopi) as this species seems to [illegible] the only one grown in the region in [illegible] times. There is no evidence that the [illegible] been dyed.

Lab. Report No. 1274 Four fragments of shells which seem to be [illegible] (lagenaria vulgaris). It is difficult to [illegible] guish the gourds, squashes, and pumpkins [illegible] alone as the stems and seeds are the [illegible] which they are usually determined. [illegible] stem scar on one of the fragments leaves [illegible] doubt as to the identity in this case.

Gourds were commonly used in the Southwest, [illegible] elsewhere as well, in the manufacture of [illegible] containers, dippers, etc. The Hopi [illegible] have four different shapes of gourds, [illegible] rately named and grown for a special [illegible]

Lab. Report No. 1275. A corn cob about 7.5 cm. in length and 2 cm. in diameter. It formerly had eight rows of kernels, and shows the elliptical cross-section characteristic of Southwestern corn. This cob is somewhat smaller than that of the corn commonly grown today in the Southwest but is not otherwise unusual in any way. It appears to have been of flour type.

It is interesting to note that the kernels were removed in the green, or roasting-ear state, as evidenced by the bases of the kernels still adhering to the cob. It had probably been steamed or roasted before eating, but does not show any effects of scorching in the process.

Lab. Report No. 1276. An ear-stalk of corn of average size and appearance. It is not possible to distinguish the type of corn from which it came.

Lab. Report No. 1277. One half of shell of a walnut, 18 mm. in diameter, none of the kernel now present.

Walnuts grow in the canyons of southern New Mexico and southern and central Arizona. These were formerly considered to be all of one species, Juglans rupestris, but have since divided. The westermost which has a larger nut and differs in other respects is now considered as a separate variety (Juglans rupestris var. major) by some authors and as a separate species (Juglans major) by others. Juglans rupestries extends only into the southeastern corner of New Mexico, while Juglans major occurs across southern New Mexico and Arizona extending in central Arizona almost as far north as Flagstaff. Wupatki appears to be somewhat north of its range but it is not impossible that it occurs in sheltered canyons nearby.

The diameter of the nut of Juglans rupestris is given as 15-20 mm. and that of Juglans major as 20-35 mm. but there is some overlapping. Since the present specimen is 18 mm. in diameter it more nearly resembles Juglans rupestris in size, but if it is of this species it has been carried considerably out of its range. We are more inclined to believe that it is a small specimen of Juglans major from nearby.

These western walnuts which are so small as to offer only a negligible source of food were, however, some-

times eaten by Indians. They were also carried considerably out of their range for use as ornaments. They have been found at both Aztec and Pueblo Bonito with holes drilled in them for suspension and one from Bonito was decorated with turquoise inlay. There is no indication that the present specimen had been brought to Wupatki for any purpose other than as food or as a curiosity.

Lab. Report No. 1278. Four tubular reed pipes and one segment of reed of much smaller diameter. These may be described as follows:

a. One pipe 4 cm. in length and 1.5 cm. in diameter. The internode has been punctured. No material remains in the pipe but there is evidence of burning.

b. One pipe 5 cm. in length and 1.6 cm. in diameter. The internode has been punctured and there is evidence of burning. There is no material in the pipe.

c. One pipe 3.5 cm. in length and 1.2 cm. in diameter. The internode has been punctured and there is evidence of burning. Some partly burned material remains in the pipe.

d. One pipe, now broken, but formerly about 4.5 cm. in length and 1.4 cm. in diameter. The internode had been punctured and there is evidence of burning. Some partly burned material came from the pipe.

e. A segment of reed 6.5 cm. in length and .8 cm. in diameter. Appearing to have not been fashioned as a pipe but possibly waste material from pipe manufacture.

These pipes are of the type commonly called "ceremonial cigarettes" in the Southwest. Such pipes seem to have been used both in ceremonial smoking and as offerings. The present lot are of the customary material, Reed Grass (Phragmites communis) and in general are similar to others which we have seen in being composed a node and parts of two adjacent internodes.

These differ in several respects from reed pipes from the Gila region examined by us and by Mr. Charlie

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times eaten by Indians. They were also carried considerably out of their range for use as ornaments. They have been found at both Aztec and Pueblo Bonito with holes drilled in them for suspension and one from Bonito was decorated with turquoise inlay. There is no indication that the present specimen had been brought to Wupatki for any purpose other than as food or as a curiosity.

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These differ in several respects from reed pipes from the Gila region examined by us and by Mr. Charlie

Steen. (See; Steen, Charlie R., Ceremonial Cigarettes, Southwestern Monuments, Monthly Report, Oct. 1935, Supplement pp. 287-292). Only about one-third of those from the Gila region had the node punctured while it is punctured in all of the present specimens. All of the present specimens show signs of burning while few of those from the Gila had been burned. None of the present specimens have any wrapping or ornamentation while this was common among those from the Gila.

The material in the pipes from the Gila region examined by us was crushed tobacco leaves held in place by a plug of thin folded inner bark of creosote bush. The material found in two of the present specimens is definitely not of the same material and arrangement. The material is of small half cylinders of bark as taken from some stem or root, apparently from some woody plant. It bears no resemblance to either tobacco or creosote bush. The material seems uniform and there was no plug to hold it. We have so far been unable to identify this bark.

The pipes from the Gila region seem in most cases to have been for offerings rather than for smoking, but these from Wupatki apparently were designed and used for smoking. Fewkes has reported having observed the ceremonial smoking of reed pipes by the Hopi.

Lab. Report No. 1279. A cocoon of some insect of the order Lepidoptera, probably that of a butterfly. Identified by Professor F. M. Gaige, Curator of Insect Division, Museum of Zoology, University of Michigan Museums.

Lab. Report No. 1280. Badly disintegrated strips and wads of strips of leaves of Yucca, apparently of Yucca baccata. Some of the strips are twisted and knotted seeming to have been used as thongs.

Lab. Report No.1281. A pod of the plant commonly called Devil's Horns or Unicorn Plant, Martynia sp.

A number of species of this genus occur in the Lower Sonoran zone of southern Arizona and southward. Only a single species occurs in the Upper Sonoran zone in the vicinity of Wupatki, this is Martynia louisiana. the specimen is doubtless of this species.

Among the Apache, Papago, and Yaqui the seeds of these

plants are eaten. Fiber from the pods enters into the ornamentation of the baskets of the Papago and Pima. The purpose of the present specimen evidently was not for food as the seeds are still present. Also there is no evidence that the fiber was removed for basketry and indeed there is no record of Martynia fiber having been used thus except in the Gila region. Hough has reported the ceremonial use of Martynia louisiana in the soyaluna paho of the Hopi. Possibly some such use may account for the presence of the specimen at Wupatki.

This is the first archaeological specimen of Martynia which has come to our attention.

Lab. Report No. 1282. Two beans and several fragments of bean pods. In size, shape and other characteristics these strongly suggest Lima beans (Phaseolus lunatus) and we have no doubt that they are of this species.

Lima beans are of Central or South American origin and have been found in archaeological sites in Peru. They have been collected from various tribes of North American Indians and their aboriginal cultivation in North America apparently has never been questioned. However, much to our surprise a hasty examination of our files and of archaeological literature reveals no previous archaeological Lima beans in North America. If a more careful survey fails to show any such evidence these specimens will assume great significance and importance. Kidney beans (Phaseolus vulgaris) are quite common in archaeological sites in the Southwest and other parts of North America.

Lab. Report No. 1283. Portion of stem, two seeds, and several fragments of shells of pumpkin. The stem and seeds are of Cucurbita moschata and the shells appear to be of the same species but exhibit no definite diagnostic characters. Cucurbita moschata is common in archaeological sites in the Southwest. A variety of Striped Cushaw pumpkin of this species was widely cultivated throughout the Southwest and has persisted to the present.

Lab. Report No. 1284. Tube and trap-door of the nest of a trap-door spider. Identified by Professor F. M. Gaige, Curator of the Insect Division, Museum of Zoology, University of Michigan Museums.

LAb. Report No. 1285. Basal portion of a yucca leaf, seeming to be of the

narrow leafed yucca, yucca glauca. No suggestion as to its purpose is offered.

Lab. Report No. 1866. A disintegrated and broken cotton boll. This checks well in size and other characteristics with bolls of Hopi cotton, Gosypium hopi in our collections and doubtless is of this species which seems to have been the only species grown in the Southwest in aboriginal times.

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Conclusion

The writer agrees with Mr. Reed that Room 7 was apparently abandoned in the latter days of the prehistoric occupation of Wupatki.

The south wall of Room 4 is abutted by the west wall of contiguous Room 5 and 6 at an almost right angle (see Room Plan). Taking advantage of this much construction, the builders of Room 7 made an extension of 4 feet, 4 inches to the already existing 6 feet, 2 inches of south wall of Room 4, thus forming the north wall of Room 7. The west walls of Rooms 5 and 6, of course, were the east wall of the newer Room 7. Constructing the south and west walls for Room 7 the northwest and southwest corners were tied, while the east end of the south wall abutts the west wall of Room 6 as the added portion of the north walls abutts Room 4. The presence of these two tied corners is unusual, "ties" are almost unknown in the earlier rooms of the Pueblo.

The only door in evidence in Room 7 is in the east wall, 4 feet, 8 inches above the floor level! I believe this unnatural height of the door entered on the second floor level of Room 5 (unexcavated). The chinking with small stones, to bring the sides up evenly, indicates the restoring of a wall through which an opening for the door had been made. A beam specimen taken from the fill in this door (possibly a fallen lintel) dates 1166 (McGregor), with the outside ring present.

Some of the pottery types found in the fill of room 7 are of the latest types found at Wupatki (Hargrave). Of the decorated wares, polychrome sherds are as much in evidence as black-on-whites.

Sherds from a "Little Colorado" type vessel appearing to have a small glazed panel were forwarded to Mr. F. G. Hawley of the Inspiration Copper Company, who tells us the following: "By dissolving off a considerable amount of the paint in a mixture of nitric and hydrofluoric acid and concentrating this in a platinum dish I was able to get very good tests for both copper and lead by the electrolytic method. Apparently more copper than lead but very distinct tests for both."

Of special interest are the four infant and two youth burials in this room.

In some localities it was the custom to bury infants inside of pueblo rooms, while the adults were buried outside. Haury shows us that at Canyon Creek Ruin (Medallion Paper #14, 1934):

> "Forty burials were found during the excavations. Infants, and in rare cases adults, were buried below the floors of rooms. Adults and youth were placed on two artificially constructed terraces on the talus slope below the west end of the house."

Such a practice is not indicated at Wupatki. Of the 26 human burials excavated at Wupatki (not including Room 7) 18 were inside burials. Of these 18, ten were adult. On the other hand, of the eight outside burials three were children. This indicates that Wupatkians did not observe the custom of the Canyon Creekers, or of the modern Hopis.

The answer to why so many children, and no adults, were buried here in Room 7 seems to be only that so many children died.

Bearing in mind that all four of these infant burial pits were definitely cut through the last occupied first story floor level in Room 7, and assuming this indicates a high rate of infant mortality, let's turn to Dr. H. S. Colton's excellent paper "The Rise and Fall of the Prehistoric Population of Northern Arizona." (Science, October 16, 1936)

> "Haury has shown us that droughts were sometimes so bad that there were considerable migrations of peoples, and there is no doubt that persons in early days were subject to deficiency diseases. Droughts no doubt lead to starvation, disease, migration and to wars, but droughts were probably on the long run not much worse in the years after 1100 than in the eight hundred years that preceded. The tree ring specialist can see no real difference in rainfall. As you will see later, the big decline in population began long before the 23-year drought, the great drought that ended in 1300, which certainly was a major catastrophe in pueblo history. ---------
>
> "Lack of vitamins would hardly be a serious factor in causing deficiency diseases. But there is a neglected factor leading to a population decrease which seems very much stronger than any of these. This factor might be summed up in the words 'bad sanitation'. ----

"After 1100 the people changed their habits and constructed masonry structures with flat roofs in which several families dwelt in closely contiguous rooms. It marked a change from rural conditions to urban--a change from a family or a small group of families living in detached one-roomed houses placed near their farm plot, to a condition of many families living in multi-storied apartment houses and walking some distance to reach their fields. I want to stress the fact that the change occurred in northern Arizona about 1100 A.D. The statement may not apply to the area east of the Chinle Valley and certainly does not apply at all to New Mexico or Colorado.-------

"The pueblo family lives in crowded quarters. Families live close together, and the excreta are deposited in the narrow plazas, streets, middens, and passages near the houses. Were it not for the arid climate, conditions would be impossible. ----------

"The infant mortality of the Hopi children under two years of age after the summer rainy season is very great. ----- In 1934 nearly all the children under two years of age died of infantile dysentery at Shungopavi and also at First Mesa. --------

"Our studies show us that the population of northern Arizona increased seven fold between 600 A.D. and 1100 A.D. This was possible by the introduction of agriculture, together with the custom of families living in isolated houses.

"During the next eight hundred years, when urban communities such as Wupatki grew up, the population decreased. This decrease was equal to the previous gain. We do not have to postulate nomads, we do not have to postulate drought. The mere fact that people lived in crowded tenements under bad sanitary conditions, and so could not raise their children is a sufficient explanation to account for a loss of population." (The underscoring of "could not raise their children" is mine.)

On the evidence presented in Room 7 Wupatkians "could not raise their children" at that time.

Assuming Room 7 was constructed about 1108, used as a living room abandoned and used for a burial ground, the evidence found in this room might contribute to the answer to "Why was Wupatki abandoned?"

The latest tree-ring date yet obtained at Wupatki is 1205 A. D.

(National Geographic Society, Pueblo Bonito Series IV, Dr. A. E. Douglass, 1935) indicating that toward the latter years of Wupatki occupation a high rate of infant mortality may have led the inhabitants to abandon the Pueblo.

Cottonwood charcoal found on the floor and in the trash pit greatly predominates pine.

Possibly this fact supports Dr. Douglass' theory of receding pine forest on Woodhouse Mesa one half mile south of the Pueblo.

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SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO 14

PIPE SPRING

BY
VINCENT W. VANDIVER
·REG'L GEOLOG.·

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

PIPE SPRING NATIONAL MONUMENT

By Vincent W. Vandiver, Associate Regional Geologist

Introduction

Pipe Springs as a National Monument owes its existence to important historical factors in connection with the early Mormon pioneers and their struggles with the Indians of Southern Utah and Northern Arizona. It will be my endeavor in the following pages to relate something as to the geologic history of the general area of the Monument. In the immediate vicinity of Pipe Springs the geology is not particularly exciting; however, one of the prize stratigraphic sections of America, if not in the world, extends from the Colorado River on the south, through the general area of the Monument, and on northward into Utah to the Markagunt Plateau. Rocks from the Archean to the Eocene may be observed in this space of around one hundred miles and very few periods fail to be represented. This great columnar section, comprising some 12,000 feet of sediments, has been made visible to us through the regional uplift of the area, the raising of beds which were at one time below sea leavel to a height of almost two miles above sea level, with consequent carving of great canyons and the formation of the step-like higher plateaus proceeding northward into Utah, thereby unfolding the geologic history in open-book fashion.

I first visited Pipe Springs in October, 1935, and have since made official visits to the area in company with Dr. Charles N. Gould, Regional Geologist, and in the latter part of 1936 several trips with Dr. Herbert E. Gregory of the United States Geological Survey. Many of the observations discussed in this report have been reviewed with these geologists. The maps included in this report are from published data of the United States with minor alterations of the fault lines between Pipe Springs and Moccasin Springs, the latter in accordance with our interpretation. The area is one which grows in interest with successive visits and after one has seen all there is to be seen he returns and finds that there is "plenty new under the sun".

Location

Pipe Springs National Monument is situated in northeastern Mohave County, northwestern Arizona, in the famous Arizona "strip", bounded by the Utah state line on the north and the Grand Canyon of the Colorado on the south. The Monument contains only 40 acres in the SW¼ of Section 17; Township 40 North; and Range 4 West. It is about 10 miles south of the Utah line. President Warren G. Harding established the area as a National Monument by Presidential proclamation on May 31, 1923, placing same under the administration of the National Park Service. Reservation was made primarily to protect an old stone fort and springs which have had an important bearing on the history of the early Mormon settlers in this desert region and their troubles with the Indians.

The sketch map on the following page shows the general geographic relationships. Travel from the main U. S. Highway No. 66 through northern Arizona and New Mexico is made to Pipe Springs via U. S. Highway No. 89 by way of Cameron, Lee's Ferry, Jacob's Lake and Fredonia. At the latter point one leaves the gravel road and travels southwest, on a graded road, a distance of 15 miles to the Monument. If proceeding into Utah one may travel northwest from Pipe Springs and enter Zion Canyon National Park from the south or return to Fredonia and U. S. Highway 89 for those travelling south. For those driving south from Fredonia there is a sign which calls attention to the fact that the next town (Flagstaff) is 200 miles distant. This is no doubt somewhat disconcerting to motorists during the summer months, especially those with slick casings on their cars.

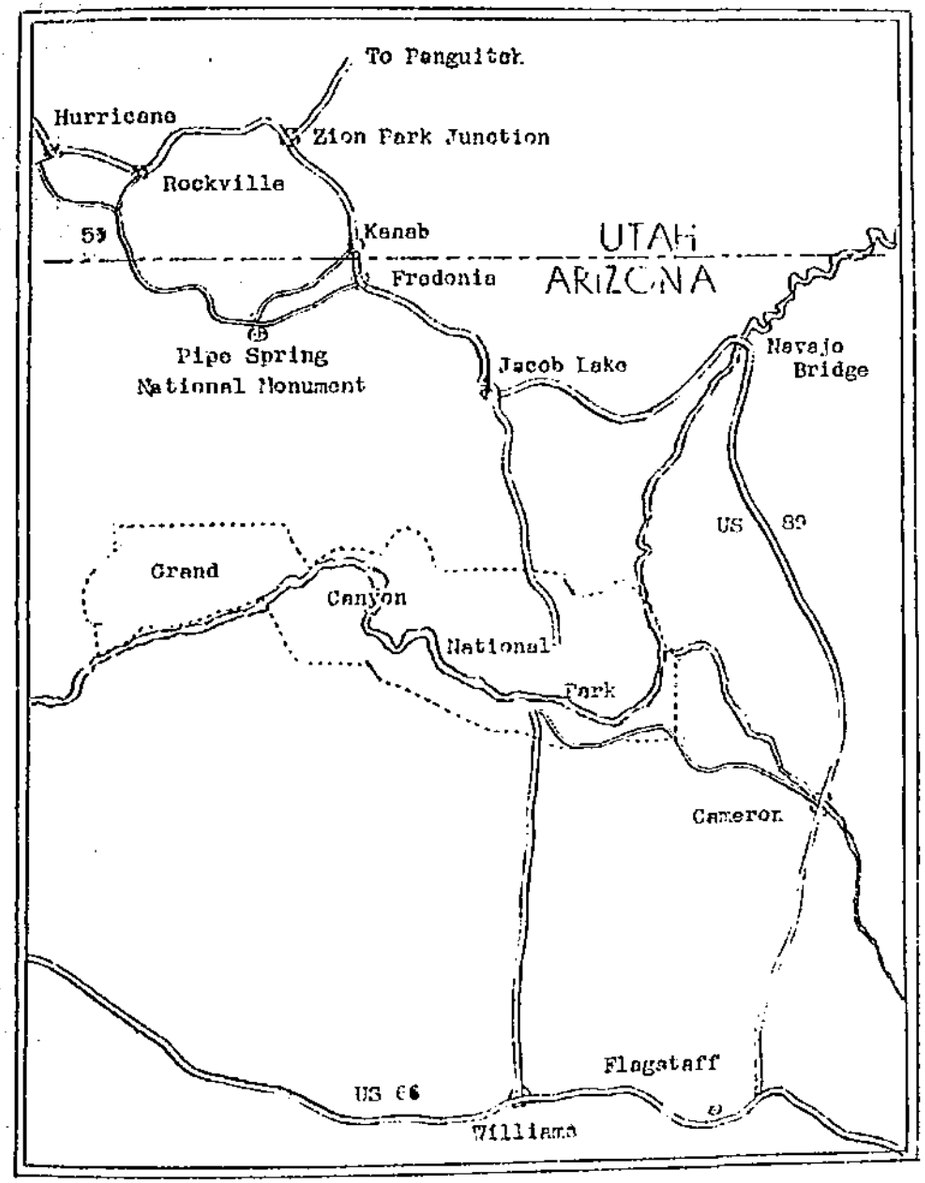
Mr. Leonard Heaton is acting custodian for the Monument. He makes his headquarters at Pipe Springs and resides with his family at Moccasin Springs a few miles north. The Heatons have lived in this section for about half a century. The acting custodian, from his contacts with members of a large family and from his extensive travels in the section, is ideally situated as the Park Service representative.

HISTORY

Pipe Springs

This region is indeed rich in historical interest. Much of the following data has been obtained from Dr. Herbert E. Gregory (1) and Mr. Leonard Heaton (2-3). The Pueblo Indians attained their peak of culture in the Southwest around 1100 A.D. Cardenas, the Spanish explorer, discovered the Grand Canyon in 1540 and at this time found roving bands of Indians (Navajos ?) on the Coconino Plateau. There were several expeditions into the region during the next three hundred years when efforts were made to establish satisfactory business relations with the Indians. Hunting bands of Navajos, Utes, and Piutes seemed to be in evidence everywhere. "Zion" or Salt Lake City, as it is now known, was founded in 1847 by Brigham Young, President of the Morman Church. Soon thereafter parties were dispatched southward across the High Plateaus to select sites where water and suitable agricultural lands favored the establishment of settlements.

It was in 1856 that the first white man visited Pipe Springs. This party was sent out by the Morman Church with instructions to explore the country lying in and around the Colorado River and to endeavor to make peace with the Indians living in the vicinity. The group was headed by Jacob Hamblin. The Monument received its name through a wager made by William Hamblin (Gunlock Bill) and another member of the party who challenged him to shoot through a silk handkerchief at a distance of fifty steps. The handkerchief was hung by its upper edge only and of course remained unpunctured. Accordingly Hamblin, vexed by the joke, dared



VICINITY MAP

PIPE SPRING NATIONAL MONUMENT, ARIZ.

Amon Tenney to place his pipe on a rock near the spring which was at some distance, so that the mouth of the bowl faced the party. Hamblin wagered that he could shoot the bottom out of the bowl without touching the rim, which he promptly did, and thus the name Pipe Springs.

According to available records Dr. James M. Whitmore and his brother-in-law, Robert McIntire, made the first settlement at Pipe Springs in 1863. They were mainly interested in the cattle business and lived in a dugout near the present fort. The Navajo Indians were raiding the settlements in this section during 1866-1867 with the result that many of the weaker establishments had to be abandoned. In January, 1866, the Indians stole the livestock that the Whitmores had near the spring. As the rightful owners followed the trail they were killed by the Indians at a point about four miles away. The eight-year old son of Whitmore was left at the springs and he later caused the report of the slaying to reach Captain James Andrews of the State Militia. Six Indians, later found to be innocent, were killed for the crime.

The springs and adjoining lands were purchased from the Whitmore Estate by the Morman Church. Bishop Anson P. Winsor was sent out in 1868 to build a fort and to care for the tithing cattle in the interest of the Church. He constructed temporary two room quarters northeast of the spring which were restored in 1925. A second two-room house was constructed west of the spring, facing south, which commanded a broad view of Antelope valley. These structures were to be used as living quarters during the process of construction of the fort. The latter building was restored in 1929.

In the fall of 1869 a crew of thirty to forty men started to work on the fort. The plans called for two two-room buildings facing each other across a court. The buildings were to have two stores. The court was to be closed off at each end with massive swinging gates. Red sandstones (of the Chinle formation) was obtained from nearby quarries and used in construction. Some of the doors and windows were shipped from Salt Lake City. Most of the lime used for mortar was hauled in wagons from Pocketville or Virgin City, Utah. Much of the lumber had to be cut and hauled for a distance of from forty to fifty miles. The construction of the fort was completed in 1870. The buildings were so located that the spring flowed up into the courtyard and in this way they were always supplied with water.

Soon after completion two of the rooms in the fort were utilized as a cheese factory. The Winsors shipped most of the dairy products to St. George, Utah, where a Morman temple was under construction. Beef steers were driven at frequent intervals to this point and in the spring and fall to Salt Lake City.

In 1871 the Deseret Telegraph Company's line was extended to Pipe Springs with Miss Lucila Stewart as operator. This was the first telegraph

line into Arizona. As the Indians were giving no trouble at the time Miss Stewart was transferred in a few months to Kanab, Utah, where she handled much of the business of Major Powell's party, who were conducting exploration work in the surrounding country. Bishop Winsor moved to St. George in 1875 and sold his interests to private parties for a cattle ranch.

The Arizona "strip" country was noted at this time for its excellent grazing lands. Cattle fattened with little effort on the part of the ranchmen. Thousands of head were rounded up each year and driven to market with the result that many comparatively wealthy families became established in the vicinity. Drives were started periodically from Pipe Springs and nearby points to the railroad. Profits proved too much for the settlers, however, and now the whole of the Arizona "strip" country has been overgrazed until little vegetation remains. The Soil Conservation Service are now making every effort to return these lands to their original state.

Moccasin Springs

This series of springs, situated about five miles north of Pipe Springs, was first claimed by white man in 1865. The name Moccasin was derived, it is said, from an Indian moccasin which was found near the spring by early settlers. In the spring of this year a man appeared at Cannon ranch and informed William Maxwell that he was going to take up a ranch at Moccasin, whereupon Maxwell sent his eldest son over to Moccasin to claim the place, and later sold it to the stranger for $200. This man built the first cabin and lived at the springs for eight years. The property then changed hands several times until purchased by Allen and Webb, who later became members of the Morman United Order, of Orderville, Utah, at which time their holdings were turned over to the Order. The five Heaton brothers were working the ranch at the time of the abandonment of the Order and received same when the lands were split up. Johnathan Heaton purchased his brothers' interests and Moccasin Springs has been the property of his sons since about 1893 up to the present time. Today there are several nice homes, orchards, etc., making it a beauty spot in the desert.

Kaibab Indian Reservation

When the United Order, of the Morman Church, was in operation throughout this area many Piute Indians were brought in to assist in farming the lands. Each Indian was given ten acres of land and the group received their portion of the water from the springs. They likewise had foremen to teach them the art of farming. In 1908 the Government established the Kaibab Indian Reservation which consisted of a tract of land about 18 miles in length and 12 miles in width and extending to the Utah State line. At this time there were about 120 Indians belonging on the reservation, whereas today there are only half this

number. Their headquarters are located about midway between Pipe Springs and Moccasin Springs. This is where they have their homes, schools, etc. Although the Indians now receive one-third of the water from Moccasin Springs their principal interest seems to be in the raising of livestock rather than farming.

GEOGRAPHY

Topography

Pipe Springs is located in the southwestern sector of the Colorado Plateau, which is characterized by high block plateaus being bisected by the mighty canyon of the Colorado River. These uplifted plateaus are outlined by prominent fault scarps trending generally in a north-south direction. The escarpments in this region trend east and west in the main, while the canyons, with the exception of that of the Colorado River, are carved in a north-south direction through the High Plateaus. Dr. H. E. Gregory states the following (1) "The highlands are plateaus, tables, benches or steps rather than mountains, hills or domes, and the streamways are canyons -- narrow or wide, deep or shallow -- rather than river flats, bottoms, swales, or meadow lands. The canyons and plateaus alike are developed on a stupendous scale, and for the region as a whole 'the canyon lands' and 'the plateau country' are equally appropriate terms". Drainage in this area is southward to the Colorado River. Pipe Springs is approximately 5,000 feet above sea level. The Kaibab Plateau to the south and the Markagunt Plateau to the north reach elevations of over 9,000 feet.

CLIMATE

The climate of the plateau country ranges according to altitude from semitropical to temperate. For areas with the general altitude of Pipe Springs (5000 feet) the summers are hot and the winters somewhat severe. The average annual rainfall for Kanab, Utah, about twenty miles northeast and with practically the same elevation, is 12.68 inches. At this point for over a period of years the highest temperature recorded was 105° and a low of -15°. The highest and lowest monthly mean temperature being 67.2° and 33.4° respectively.

Vegetation

The collection of the following list of plants from the Monument was collected by Leonard Heaton, Acting Custodian, and they were named and identified by Jack Whitehead, Boyce Thompson Aboretum, Superior, Arizona. They are included in this report not because of any special connection but as a matter of record only.

Salmon Globe Mallw ..... Malvaceae - sphaeralcea anibigua, A. Gray
Mariposa tulip ..... Liliaceae - Calochortus flexuosus, S. Wats.

Minute California Poppy...	Papaoraceae- Eschelita Minutifolia, Sluats.
Buffalo Guard.....	Cucurbita foetxi dissima, H. B. K.
Russian Thistle.....	Chenopodiaceae- Salsola Pestifer, A. Nels.
Broomrape.....	Crobanchiiaceae- Orobanche ludouiciana, Nut.
Arizona Four O'clock.....	Nyctaginiaceae- Cueniocalidion multiflorum, Torr.
Tansy Mustard.....	Brassicaceae Sophia pinnata, Walt. Howell.
Bee Weed-Yellow Cleome....	Capparidaceae- Cleome lutea, Kuoker.
Desert Trumpet.....	Polygonaceae- Eriogonum niflatum, Tarrey.
Plantain.....	Plantogiuaceae- Plantago Major L.
Narrow Leaved Goosfoot....	Chenopodiaceae- Chenopodium leptophyllum, Nutt.
Fluff Grass.....	Gramineae- Triodia pluchella, H. B. K.
Six Weeks Grama Grass.....	Graminoae- Buteloua Barbata, Leg.
Ivy leaved Ground Cherry..	Solanaceae- Physalis hederaeplin, Noes.
Scrub Oak.....	Fragaceae- Quercus ?
Bird Beak.....	Scrophulariaceae- Cordylantus neuinii, Grey.
Saltbrush.....	Chenopediaceae- Artiplex cuneata, A. Nels.
Jimpson Weed.....	Solanaceae- Datura Metaloides, D. C.
Knotweed.....	Polygonaceae- Polygonuni Mulhenbergii, Wats.
Common Horhound.....	Labintae- Marrubium uulcare L.
Crowbeard.....	Compositae- Verbesina encelioides-exuuriculata Red and Green
Sunflowers.....	Compositae- Helianthus aridus, Rydb.
Cocklebur.....	Compositae- Xanthium Commune, Britton.
Annual Bur-sage.....	Compositae- Franseria Acanthicarpa, Hook, Cav.
Horseweed.....	Compositae- Ergeron Canadensis, L.
Wild Lettuce.....	Compositae- Lactuca Scariola Integrata, Grant
Snakeweed.....	Compositae- Gutierrezia Lucida, Greene.
Creak Senecio.....	Compositae- Se necic douglasi, L.
Aster.....	Compositae- ?

In addition to the above Mr. Heaton states that there are about 100 more plants which have not been named or classified. Some of the most important are greasewood, rabbitbush, sagebrush, cactus, and a lot of grasses. Some of the more common trees are cedar, pinon pine, American elm, locust, ailanthus, silverleaf cottonwood, lombardy poplar, and willow.

Fauna

Mr. Heaton has likewise supplied the following list of birds, animals, and reptiles for the Monument:

Birds		Animals	Reptiles
Quail	Hawks	Jack Rabbits	Desert Rattle Snake
Robin	Eagles	Cottontail Rabbits	Bull, Blow or Gopher Snake.
Crows	Ducks	Coyote	
Killdeer	Cranes	Civit Cat	King Snake
Blackbirds	Gamble Sparrow	Ringtail Cat	Red Racer
Song Sparrow	Herons	Grey Squirrel	at least five kinds of lizards.

Birds (Cont.)

English Sparrow
Pinon Jays
Woodpeckers
Oriole
Goldfinch
Humming Birds
Flycatchers
Wrens
Sandpipers

Animals (cont.)

Striped Chipmunk
Brown Chipmunk
Longtail Rat
Wood or Pack Rats
Mice
Porcupines
Badger

GEOLOGY

Stratigraphy

The sedimentary rocks of this area, which outcrop over broad portions of the Colorado Plateaus, are composed of the Moenkopi formation, the Shinarump conglomerate, and Chinle shales of the Triassic; the Wingate sandstone, Kayenta formation and the Navajo sandstone all of the Glen Canyon Group, Jurassic (?) in age; and northward into Utah the Carmel and Morrison formations of the Marine Jurassic, underlying a thick series of Cretaceous and Tertiary rocks. Looking southeast from Pipe Springs across the broad valley one may see the north flank of the Kaibab monocline, the surface being made up of Kaibab limestone, Permian in age. The Kaibab limestone forms the rim on both sides of the Grand Canyon.

Looking southwest from Pipe Springs the Mount Trumbull volcanic field is visible. These lavas were erupted during Tertiary times and comprise one of the major volcanic fields of the region. The view northward from the Kaibab Plateau, just before going down into the valley after leaving Jacob's Lake is one of the most impressive panoramas of the region. From this point the Vermilion Cliffs, the White Cliffs, and even the Pink Cliffs, which form the steplike High Plateaus of southern Utah, are visible on clear days.

The sequence of geologic formations is indicated in the stratigraphic table on the following page; however, each will be described briefly here.

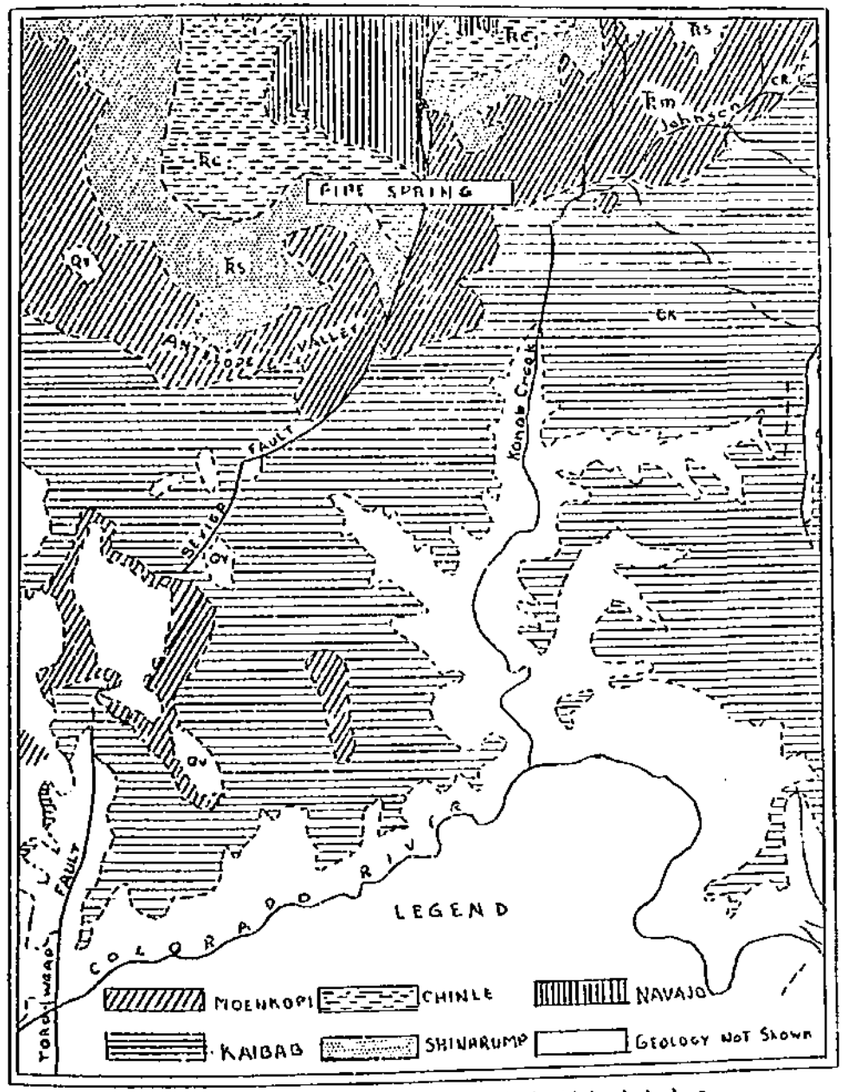
Kaibab Limestone

This gray to buff limestone comprises the basal formation of the plateaus to the north and south of Pipe Springs and forms the uppermost cliffs on both sides of the Grand Canyon. It is a sandy limestone with considerable chert and gypsum in some localities near the base. The formation is quite fossiliferous, with some 80 species of sponges, corals, shells and sharks teeth having been described to attest to its marine character. The Kaibab limestone is observed south and west of Pipe Springs.

GENERALIZED STRATIGRAPHIC SECTION FOR THE REGION AROUND PIPE SPRINGS NATIONAL MONUMENT

ERA	PERIOD	FORMATION	THICKNESS (FEET)	CHARACTER
TERTIARY	EOCENE	Wasatch	400-1500	Highly colored beds of limestone, shale and sandstone with basal conglomerate. "Pink Cliffs" of Bryce Canyon National Park and Cedar Breaks National Monument.
		Unconformity		
	CRETACEOUS	Kaiparowits	3500 plus	Bluish drab sandstone and sandy shale.
		Wahweap		Yellowish-grey massive sandstone with sandy shale.
		Straight Cliffs		Yellow to brown, irregularly bedded sandstone with some coal.
		Tropic		Bluish drab argillaceous to sandy shale.
		Dakota		Yellow to white sandstone conglomeratic in part. Thin coal beds and petrified wood in places.
		Unconformity		
	JURASSIC	Undifferentiated and Carmel Limestone	500 ±	Pinkish gypsiferous sands overlain by massive gypsum, thin limestone and sandy shales. Hard grey fossiliferous limestone.
MESOZOIC	JURASSIC(?)	Navajo	2000 ±	Huge piles of sandstone with cross-bedding on an enormous scale. At Kanab Canyon this group is divisible into three formations however at Pipe Springs the Navajo rests on the Chinle.
		Kayenta		
		Wingate		
		Unconformity		
	UPPER TRIASSIC	Chinle	400-1000	Variegated marls, sandstones and thin cherty limestone conglomerates. Shales included with Bentonite in places. Petrified wood and reptilian remains are abundant.
	UPPER (?) Triassic	Shinarump	100 ±	Conglomerate and coarse sandstone with fragments of fossil wood.
		Unconformity		
	LOWER TRIASSIC	Moenkopi	400-1775	Red-brown, grey, white and yellow gypsiferous sandy shales with interbedded layers of yellow limestone in lower part and conglomerate at the base. Thickens westward accompanied by change from arid terrestrial deposits to marine beds.
		Unconformity		
PALEOZOIC	PERMIAN	Kaibab	200-1000	Grey to buff cherty sandy limestone with interbedded sandstone and gypsum in places. Contains a marine fauna consisting of some eighty species.

Note: Mainly from USGS Publications.



GEOLOGIC SKETCH MAP

PIPE SPRING NATIONAL MONUMENT, ARIZ.

Moenkopi Formation

Unconformably overlying the series of marine limestones is the chocolate brown, grey, white and yellow sandy shales with interbedded layers of limestones in the lower part and a conglomerate member at the base. This group comprising the Moenkopi formation thickens towards the west and the arid terrestrial deposits merge in this direction into marine sediments containing fossils. One of the best sections for the Moenkopi formation may be had at Virgin City, Utah, about forty miles northwest of Pipe Springs, where 1775 feet of section have been measured. The escarpment to the east of Pipe Springs, on the upthrown side of the Sevier fault, is made up of beds belonging to the Moenkopi formation.

Shinarump Conglomerate

The Shinarump is more resistant than the overlying and underlying shales and sandstones and it therefore forms a cap rock, being persistently a cliff-maker, throughout large sections of this region. It is made up of conglomerates and coarse sandstones and is unconformable with the Moenkopi formation below. It rarely exceeds 100 feet in thickness and usually contains fragments of petrified wood in abundance. In some localities the chert pebbles in the conglomerate have been found to contain "Kaibab" fossils.

Chinle Formation

A thick series of shales, sandstones, and thin conglomerates conformably overlie the Shinarump conglomerate and have been designated as the Chinle formation. This series of sandy marls forms one of the most picturesque series of rocks in the region. Because of the great variation of color in brief vertical and horizontal distances together with the vividness of same in various shades of light they are usually referred to as the "Painted Desert". Strictly speaking, however, the "Painted Desert" is generally understood to extend from the vicinity of the Petrified Forest National Monument in a northwest direction to the vicinity of Cameron, Arizona. From the character of rocks now making up the Chinle and the fossil remains thus far discovered we know that the material was deposited by shifting streams and in great shallow bodies of water. At intervals there were great outbursts of volcanic ash from areas of intense activity. This ash was carried to great distances by the wind and is now found intermingled with the beds making up the Chinle. The ash, which is known as bentonite, contributes much to the colors of the formation. A distinctive feature of these rocks is the almost universal presence of petrified wood. The wood is so plentiful in places that they have been termed "forests". Important remains of fossil reptiles and amphibians have been found in these beds.

The old fort at Pipe Springs is constructed from sandstone beds of the Chinle and the fort rests on beds belonging to this formation.

Wingate and Kayenta Formations

The Wingate and Kayenta formations are not exposed at Pipe Springs. They are included in the stratigraphic section since they occur just north of the Utah line. The Wingate is a highly cross-bedded wind-blown sand deposit which cannot be distinguished from the Navajo sandstone unless the intervening Kayenta formation is present. The Kayenta formation is a uniformly bedded calcareous shale deposit with some sandy shales and thin limestone beds.

Navajo Sandstone

The Navajo sandstone like the Chinle formations is most interesting from the point of view of color but it is mainly known to geologists due to its extreme thickness and the variety of architectural festures. Zion Canyon is carved in the Navajo sandstone. At Pipe Springs it may be observed just above the slope of Chinle shales. The Navajo is composed of quartz grains, imperfectly rounded, and held together by a weak cement of calcite and iron oxide. Its various shades of color is due in the main to type and amount of cement. Its principal characteristic is the presence of cross-bedding on a hugh scale. Curved vertical laminae have in many places resulted in the formation of great recesses, caves, and alcoves wherein the Pueblo cliff-dweller found shelter. No distinctive fossils have been found in the Navajo and as the result its age may only be conjectured on a lithologic basis as Jurassic (?). At Zion Park the formation is over 2000 feet in thickness.

The formations for the general area are all indicated on the stratigraphic table. Those above the Navajo do not occur at Pipe Springs or the immediate vicinity and it is not considered important to discuss them at this time.

Structure

The important structural features of this section of the Colorado Plateau in east-west profile are the Hurricane and Sevier faults which have a general north-south trend and cut the plateaus into great blocks. A section of the wall of the famous Hurricane fault remains and is crossed by the Zion Park and Toquerville highway at the Hurricane Cliffs. Although there is some folding present in the area between the faults the strata is generally undisturbed with dips in the main of less than 2°. Regional uplift and differential erosion have contributed mainly to the present land features.

Sevier Fault

The Sevier Fault has been traced from the High Plateaus in Central Utah in a southwestward direction for a distance of over 200 miles to Mt. Trumbull and it probably continues across the Grand Canyon of the

Colorado as the Toroweap fault. The fault cuts south through the broad valley which extends northward from Pipe Springs where a displacement of 800 to 1000 feet may be noted with the upthrown side to the east. The uplift along the Sevier fault at Mt. Carmel in Utah has brought the Cretaceous rocks in contact with Navajo sandstones of the Jurassic (?) indicating a vertical displacement of about 2000 feet. The Sevier fault may best be seen at Pipe Springs by travelling northward on the road to Moccasin to a point in the vicinity of where the above mentioned photo was taken.

Pipe Springs

Pipe Springs, Moccasin Springs and the other springs and seeps in the zone to the west of the fault owe their existence to the presence of the Sevier fault. The beds are dipping a few degrees in a northeast direction into the fault. While the rainfall is slight, amounting to less than 13 inches annually, the Navajo sandstone forms a tremendous catchment area and a considerable portion of this water percolates downward as ground water until the Chinle shales are reached. At this horizon it follows the dip until the fault zone is reached where another barrier is formed by the Moenkopi shales and sandstones. As the water is piled up along this zone it is forced to the surface under hydrostatic head. Pipe Springs has a capacity of some 65,000 gallons per day and the Moccasin Spring is some three or four times its size.

Geologic Signs

No signs are recommended for Pipe Springs since the area within the Monument is so small and the prime geological features are more regional in character, making it difficult to develop them from this point. We have in mind the construction of a wayside shrine for Lee's Ferry Bridge to take in the area from the Grand Canyon to Bryce Canyon in Utah in a geologic section. Pipe Springs and its relative position will be shown on this panorama. It is also considered by the writer that a similar shrine should be erected on the Kaibab Plateau, on the road north from Jacob's Lake, and immediately before one starts dropping down into the valley. Most visitors stop and stare at this marvelous landscape and the features should be pointed out to them as practically all of the tourists are plying between the parks. Pipe Springs could well be brought into this picture. A generalized cross-section from the north rim of the Grand Canyon to Zion National Park through the Pipe Springs area on a large scale is to be drawn and placed on the wall of the old fort at Pipe Springs for the benefit of the visitors who are interested.

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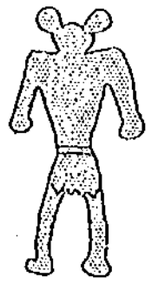

SOUTHWESTERN MONUMENTS
SPECIAL REPORT
No. 15

EXCAVATIONS AT TUMACACORI
1934

BY
PAUL BEAUBIEN

·DEPARTMENT·OF·THE·INTERIOR·
·NATIONAL·PARK·
·SERVICE·

San José de Tumacacori

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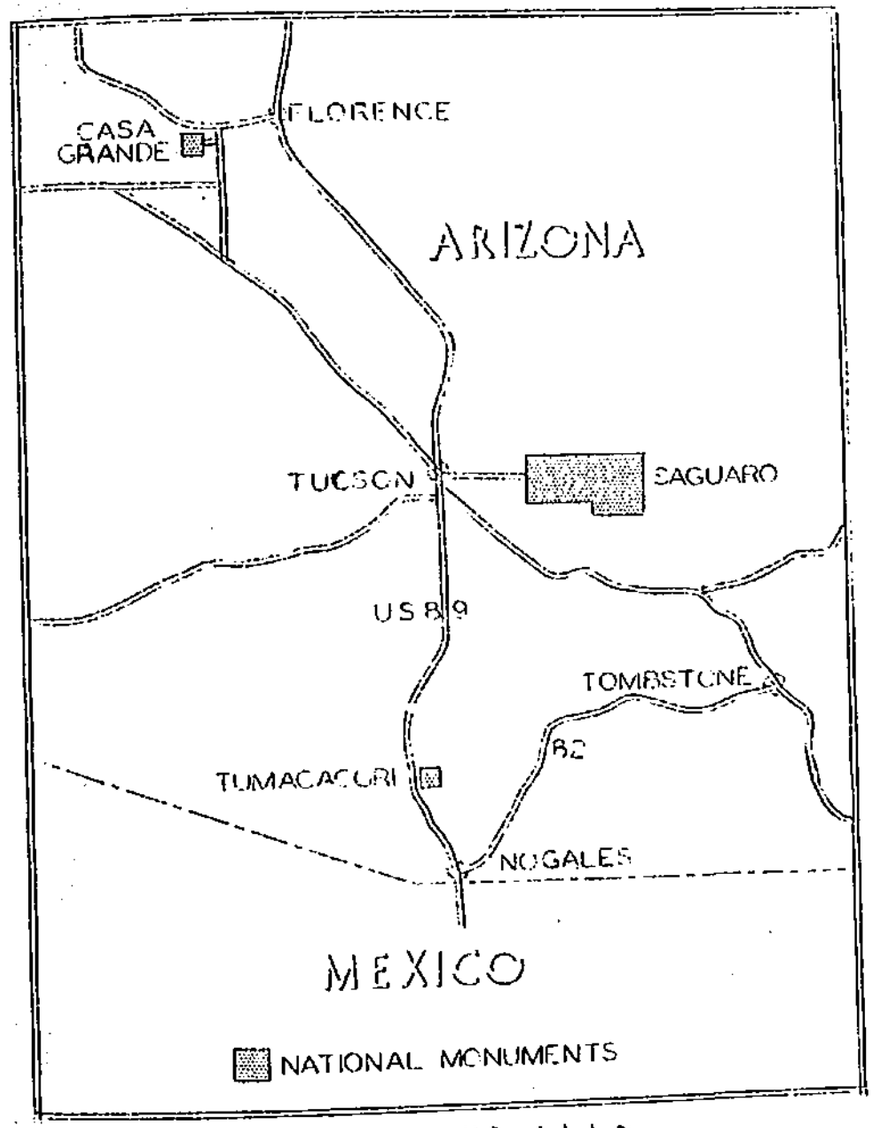

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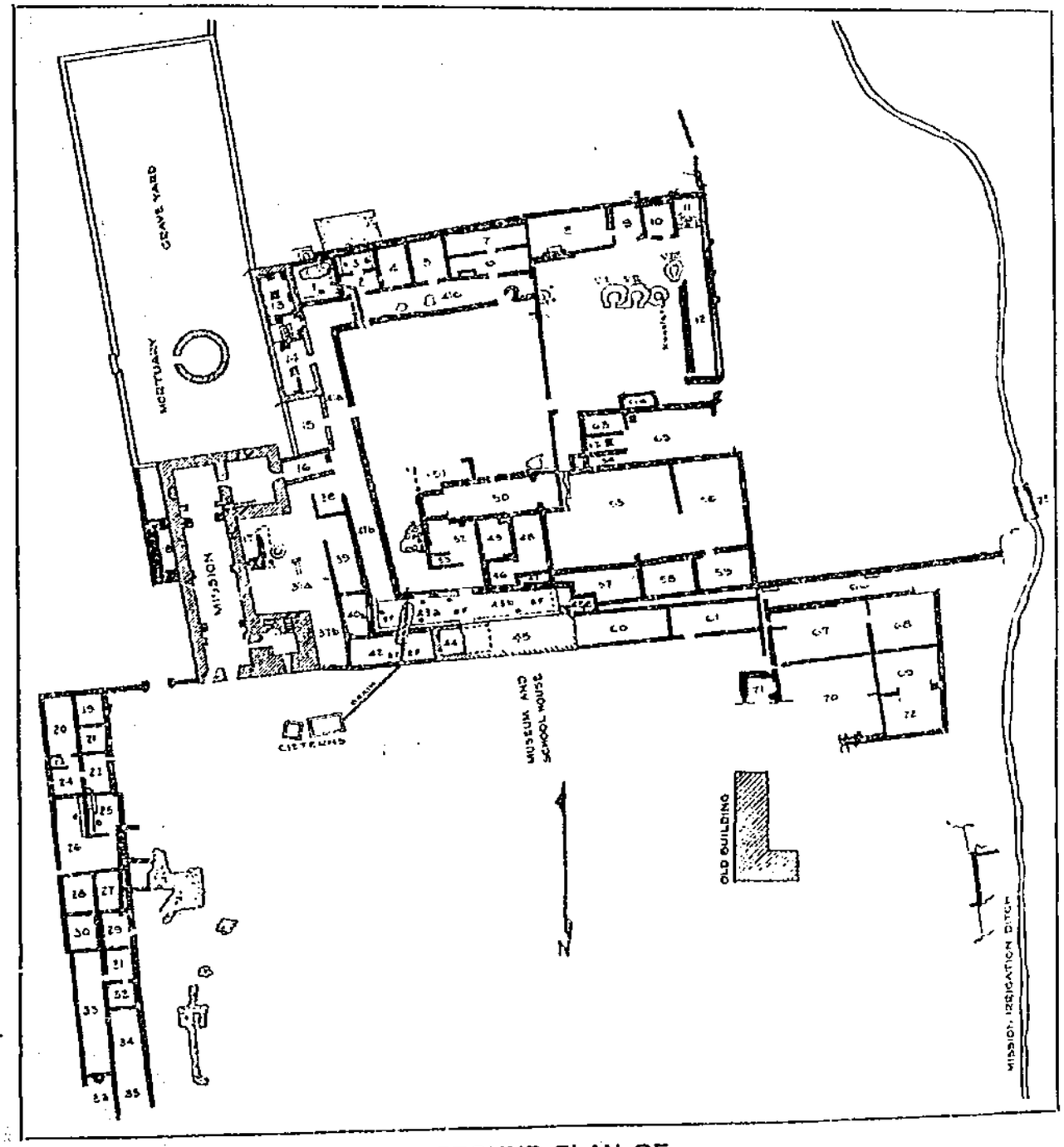


GROUND PLAN OF
TUMACACORI MISSION
1934

EXCAVATIONS AT TUMACACORI-1934

By Paul Beaubien

(Ed. Note: Father Victor R. Stoner, an authority on the Kino Chain of Missions, has checked this report and made some date corrections. Some of the dates reported by Beaubien in quoting Rensch conflict with those that Father Stoner has found on his research work, and where such conflict occure Father Stoner's corrections will be shown in parenthesis.)

INTRODUCTION

On December 15, 1934, I arrived at Tumacacori National Monument, Arizona, to take charge of an FERA project instituted to uncover certain ruined buildings adjacent to the present mission. The wall and special features such as benches, furnaces, etc., were to be mapped by National Park Service engineers, after which the soil was to be replaced as found. Such maps would be of significance in the formulation of possible future landscaping or partial restoration plans. Moreover, it was hoped that some of the blurred chapters of Tumacacori's history would become more legible.

Men from the immediate vicinity were detailed to the project by Mr. J. R. Collie, project manager of the welfare board, Santa Cruz County. Mr. Collie cooperated with me to the fullest extent within his power, but due to the varying number of people in need of relief and the unpredictable amount of money available for any definite period, there was great variation in the number of workers reporting for the usual work period of three days. The number of men per shift varied from two to thirty-five, while the days per month varied from one to ten. Altogether 919 man-days were employed in excavation and backfilling before the men were taken from my charge on March 27, 1935.

Several dozen rooms were partially excavated, and the field notes, plus photographs, form the major portion of this report. The maps, produced by the engineers, are the most valuable contribution to the knowledge of the site.

This report has to do only with my work at Tumacacori and no attempt is being made to write the complete story of the mission. However, a brief summary of the known history, gleaned from "Chronology for Tumacacori National Monument" by H. E. Rensch, will be given by way of introduction.

Tumacacori was the place name of a Sobaipuri (a Pima-speaking group) Indian village, situated in the Santa Cruz valley during prehistoric times. The Santa Cruz flows northward near the eastern edge of Pimeria Alta (the land of the Upper Pimas). Broadly speaking, Pimeria Alta was bounded on the north by the Gila River, on the west by the Gulf of California and the Colorado River, on the south by the

Altar River, and on the east by the San Pedro River. Tumacacori entered the pages of history when a delegation of headmen from the Santa Cruz valley intercepted two Jesuit Fathers, Kino and Salvatierra, at Tububabi and persuaded them to visit their villages, January, 1691. The headmen hoped the Fathers would establish missions among their people.

1691 - The two Fathers visited the Santa Cruz Valley, and the first Christian services to be held in what is now southern Arizona, took place at Tumacacori in January. (There had been missions among the Hopi Indians of northern Arizona from 1629 to 1680. B.A.E. Bull. 30, Vol. I, page 561.)

1695 - A ranch was established at Tumacacori (now San Cayetano de Tumacacori) with the livestock from Caborca where an Indian uprising had resulted in the death of a priest.

1701 - "On the night of April 12th, Kino and Kange slept in the adobe house at Tumacacori, which had been erected for the missionary that the natives were awaiting to come to live among them." (Evidently there was no building of Spanish origin there in the 17th Century). Later in the summer, a newly arrived missionary, Father Juan de San Martin, took charge of Tumacacori, Guebavi and Baccancos. A house and a church were erected at Guebavi (the central rancheria), and the two visitas, Tumacacori and Baccancos, received periodic visits from the Father. A building was begun at Tumacacori.

1702 - Father San Martin departed, and that part of Pimeria Alta now known as Arizona was without a resident missionary for thirty years.

1732 - Another missionary arrived to take charge of Guebavi and its visitas, but died within a year.

1736 to 1767 - In 1736 (Bancroft says 1737, Arizona and New Mexico, Page 12 - V.R.S.), a very rich silver mine, Boles de Plata, was discovered to the southwest of Tumacacori and many miners, followed by settlers, entered that part of Pimeria Alta. One record suggests that some seventy Spanish settlements were established during the next decade. By 1750, another priest was at Guebavi. Then,except for short periods during Indian trouble, there seems to have been a resident priest at Guebavi who made periodic trips to Tumacacori, until the Spanish monarch ordered all Jesuits from his possessions in 1767.

(From the Jesuit records reported by Rensch, there was never a resident priest at Tumacacori. The only mention of a Spanish building was that one was begun in 1701, just one year before the abandonment of all Arizona missions for thirty years.) (Not true; Kino did not die until 1711. This was during his busiest time. V.R.S.)

1758 to 1784 - After the expulsion of the Jesuits there was a short

period of neglect*, but thirteen Franciscan Fathers arrived in Pimeria Alta, 1768. One took charge of Guebavi and its visitas, including San Jose de Tumacacori. (With the advent of the Franciscans, San Cayetano de Tumacacori became San Jose de Tumacacori.) (* Not true; Franciscans came as Jesuits left.V.R.S.)

The early years of the Franciscans were years of trouble with the Apaches to the north, and the Seris to the west. One record states the Church was burned at Tumacacori in 1769. (Probably there had been a Jesuit church there.)

1784 to 1822 - "By 1784, the Indians seemed largely to have abandoned Guebavi, the prey of so many Apache attacks. The mission was moved to Tumacacori." (The period of Tumacacori's real importance dates from 1784.)

Eventually, the Apaches were checked and most of the missions began to flourish. One historian calls the period from 1785 to 1815 the golden period of missions and settlement in Pimeria Alta. "Certainly the Apaches were kept in better control than the period before or after, Settlement was encouraged. Commerce thrived and mining revived. It seems that most of the extant missions date from this period."

1821 and 1822 - Mexico was declared a republic, and Spain withdrew all financial support to the missions. One record states that Tumacacori was burned by the Apaches at this time, and no attempt was made to rehabilitate it.

1827 - The last of the Spanish missionaries left Arizona (from San Xavier). After the departure of the Fathers there were always a few natives in the vicinity. And soon the history of Tumacacori is reported by American travelers.

1849 - Thousands of gold seekers passed by Tumacacori, and a few have left diaries mentioning the site. From 1851 to 1855, the United States Boundary Commission visited the region and described Tubac, Tumacacori, etc., in their reports.

1852 - A French colony from San Francisco settled in the Santa Cruz valley.

1856 - There were more than 500 inhabitants (largely Mexicans) at Tubac, brought there because of revived mining activities. There were 150 silver mines within a radius of 25 miles.

1857 - Emory reports a small settlement of Germans at Tumacacori .

1861 - With the outbreak of the Civil War the Army abandoned Arizona and the Apaches were free to go on the rampage. Tubac and the various

American ranches along the Santa Cruz were abandoned for the most part.

1862 and 1863 - The California Volunteers arrived and brought about a semblance of order.

The above outline was abstracted from Mr. Rensch's paper. Of course there have been many changes since 1864. Native families have occupied some of the buildings up to, and after, the time the mission was set aside as a national monument. Papago Indians consider it sacred ground and have buried their dead there within recent years. A few individuals have restored portions of the ruins. Others, believing the Jesuits left buried treasure, have vandalized the place. Every room excavated exhibited the results of vicious pot-hunting.

Some of the destruction was of recent origin. Not once, but time after time. tin cans with labels unrotted, celluloid combs, and other modern artifacts were found in the deepest part of the excavation. And if any artifacts were found in undisturbed soil, I was not aware of it. In fact, only a few objects of material culture interesting enough to be placed in a museum were found and because of the disturbed condition of the soil, none could be used to classify a room as to use, or suggest a period of occupation. This absence of worth while artifacts is another testimonial of the thoroughness of the pot-hunter.

In addition to rumors of buried treasure another cause of vandalism was the amount of building material available to the surrounding farmers. I was told by the laborers that there were few buildings in the vicinity, constructed before the arrival of a permanent custodian, which did not contain some burned brick from Tumacacori.

METHOD OF EXCAVATION

The outline of work demanded some deviation from principles usually employed in work of this nature. First, the dirt from the excavations was to be replaced as soon as the uncovered structures were surveyed by the engineers. As the engineers could come only irregularly, the disposal of dirt was a major problem. Usually when the dirt piled too high, the scene of activity was shifted to another portion of the ruin. Thus, the excavation for any group of rooms progressed at sporadic intervals, presenting a chaotic appearance to some five thousand visitors.

Because of the visitors' interest, special paths were constructed through the "dig" for their benefit.

Normally, when excavating rooms, a two or three foot trench, width being dependent on depth, was cut along each side of a wall, leaving an "island" of undisturbed soil in the center of each room. This arrangement did not lend itself to the taking of comprehensive photographs but it did lessen the amount of earth to be moved twice. Also, the "island"

of undisturbed soil in the center of each room. This arrangement did not lend itself to the taking of comprehensive photographs but it did lessen the amount of earth to be moved twice. Also, the "island" served as a witness that no cross walls, floor levels, or fallen ceilings were overlooked. In some instances, a room was entirely cleaned when special conditions, such as unusual type of floor, abundance of artifacts, etc., indicated that a complete clearance might prove profitable.

A limiting factor was that no remnant of wall or floor was to be damaged. Thus, the only chance to exploit undisturbed stratification was eliminated. Some floors were pierced by treasure hunting holes but always these floors had already been undermined as far as possible from the hole.

EXCAVATION ABOUT THE PRESENT MISSION

Because the present mission is the central structure from which all others must be located, it seems advisable to begin a description of the excavation there. At the outset, no work inside was contemplated but a series of unforeseen factors developed which led to some investigation. First, the Franciscan Order wished to have the bodies of two priests exhumed from the sanctuary for removal to San Xavier; second, walls of Rooms 17 and 18 were encountered outside the mission and, possibly, could have continued under it; and theird, rainy days dictated a choice either of working under a roof or sending the men home with wages unearned.

The two fathers to be removed were Fathers Belthazar Carrillo and Narciso Gutierrez. In 1784, Carrillo was in charge at Guebavi, and moved with the mission to Tumacacori. He died in 1795. Gutierrez, who succeeded him, died December 13, 1821. Mr. Frank Pinkley has a copy of a burial record which states the bodies of the two priests were taken from an old church and buried in a new, December 13, 1822.

On December 31, 1934, a party from the headquarters of the Southwestern Monuments, with Father Vincent of San Xavier, arrived to move the bodies again. On their arrival, I sent for one of the FERA laborers, Augustine Cardial, who has witnessed some of the vandalism at the Monument. According to Cardial, a party, headed by the superintendent of a mine in Mexico, had dug a treasure hunting hole, fifteen feet deep, where Carrillo and Gutierrez were said to have been buried. The party had found the bones of two adults. When refilling, all the bones were tossed back into the hole, except one skull kept for a souvenir. Cardial's story was supported by all evidence unearthed

In Father Vincent's presence, a six-foot hole was dug and no bones were found, but another try was made a few days later. At a depth of seven and a half feet, the jumbled parts of two adult skeletons were found, associated with pieces of plaster, bricks, and other debris typical of treasure hunting holes. I removed the four femurs, three of

which were the only long bones unbroken, the fragments of one skull, and about half the smaller bones. Then having something else to do, I let two laborers remove the other bones. No pieces of coffin or cloth were found. Of course, the treasure hunters would have taken any beads, crucifix, or coffin ornaments.

The bones were darker in color and much more fragile than any others found in the church. Also large mastoidian processes on the one skull indicated it was a male. I sincerely believe they were the bones of the two Fathers thrown back in a treasure hunting hole.

The bones were reburied at San Xavier, February, 1935.

ROOM 18

Inside dimensions: 18' 9" long, 5' 6" wide at north end, and 5' 9" wide at south end. Average width of wall: 5' 11". Had been coated, both inside and out, with a thick layer of lime plaster in which were imbedded handfuls of red crushed brick at irregular intervals. The horizontal intervals varied in the bottom row from 6" to 3', but 1' 3" was common. Two, three, and sometimes four horizontal rows of spots were still visible.

However, enough was present clearly to distinguish it from the later type to be seen on the mission and graveyard walls. In this latter type, the spots are imbedded at regular intervals closer together, besides being composed of a different colored material. The spots on the later walls are composed of crushed, over-fired bricks, mostly black and brown in color. The addition of darker colors presents more contrast in a white wall.

The top of the south, west and north walls approach the present ground level. No adobe bricks remained in place; the wall or foundation being composed of large river boulders set in adobe mud. This foundation averages five feet in height, and is found under all walls of the mission except the baptistry and two gaps along the nave which were the entrances to Rooms 17 and 18.

No constructed floor was present but the lower edge of plaster inside indicated the approximate level.

The entrance to Room 18 was indicated by two vertical, non-bonded cracks on the inside of the mission, extending about 8' 6" above floor level. The adobe wall between these cracks did not rest on a heavy stone foundation as did the walls on either side. It is impossible to say whether this opening was once surmounted by an adobe arch or by a wooden lintel.

Just north of Room 18 is an enclosure, the west wall of which is marked only by a light foundation from 1' 9" to 2' 0" wide. When first

discovered, I believed this foundation marked where the graveyard wall once extended to Room 18 before Room 18 was abandoned. However, inclusions of broken, burned brick and chunks of lime plaster may indicate more recent construction. Foundations containing such debris, elsewhere on the Monument, seemed to date since abandonment by the Spaniards. The south end of this foundation was butted against the corner of Room 18 after Room 18 had been plastered.

(Note: Frank Pinkley and J. H. Tovrea, in the monthly report of the Southwestern Monuments, August, 1936, page 123, state the following in regard to the foundation of Room 18: "One startling thing about this foundation, which developed on examination, (when excavated at an earlier time by Geo. Boundoy) was that there were a few inches of the adobe wall still standing above the rock foundation and these few inches of the adobe wall CARRIED THE ORIGINAL STUCCO PLASTER WITH THE CHARACTERISTIC RED AND BLACK DECORATION SUCH AS THE WHOLE LOWER SECTION OF THE CHURCH ONCE CARRIED." I saw no black decoration, nor were the decorative spots arranged on Room 18 as they are on the mission proper. However, at the time of the later excavation there was no adobe wall present on the five foot stone foundation which served as the lower part of the wall.)

ROOM 17

Almost a counterpart of Room 18, but slightly larger. The north end of the east wall had been destroyed, either by treasure hunters or by the recent repair work to the mission proper, but I believe the south wall of the sacristy was the north wall of this room. The east wall and especially the southeast corner were damaged greatly by metallurgical operations since the room was abandoned.

Here and there a few square inches of plaster hung to the inner surfaces of the south and east walls, but no red spots were seen. Considering the limited amount of plaster remaining, the absence of spots was not surprising even if this room had been plastered in a similar fashion to Room 18.

The entrance to this room was similar to that of Room 18.

NAVE OF MISSION

Found four lime plaster-river boulder structures which may have been altar or pilaster foundations. The northwest one had been disturbed somewhat. The boulders of the northeast one were found loose in the soil with fragments of lime plaster still adhering to their surfaces. The tops of the south pair were flush with the latest constructed floor, and all four had been about two feet in depth.

The purpose of these foundations is unknown, but I do not believe they were fragments of old walls (J. H. Tovrea, Monthly Report of the Southwestern Monuments, January, 1935). No wall foundations set in lime plaster were found at Tumacacori. Also, it would be an unusual coincidence to have similar sections of two walls exhibit missing segments of equal length at the same relative position. Further, the only other wall of approximate width was the south wall of Room 12 more than 200 feet away. Again, the north pair had been disturbed somewhat by treasure hunters, but the south pair were symmetrically rectangular.

A purpose for the south pair (as supports for a choir loft) is logically presented by Frank Pinkley and J. H. Tovrea in the monthly report of the Southwestern Monuments, May, 1936, pages 375 to 379.

A burial of a young girl was found between the restored altar and the southwest foundation. The grave had been lined with burned brick and boulders, presumably from nearby. Two or three of the brick carried lime putty (I use the word putty instead of plaster to denote the absence of sand). One of these bricks exhibited grooved decoration, and may indicate the character of the original surface of the side altars.

An unusual feature, of unsuspected significance at time of finding, was discovered at the northeast corner of nave. Here the foundation projected into the room about eight inches, just below the old floor level. Later it was found that this offset carried from the disturbed boulder-line plaster structure to the northeast corner of the sanctuary, while in the sacristy, the thick adobe wall overhung the foundation a corresponding distance. Evidently, the adobe wall was laid about eight inches too far east for the foundation.

SANCTUARY

The specialized plaster as on Room 18 was found low down on the west wall, and the west half of the north wall. In the southwest corner, this plaster ran behind the pilaster which supports the west half of the arch between sanctuary and nave. It is certain that this pilaster was erected after the wall had once been plastered. The lower edge of this plaster was 3.3 feet below the latest constructed floor level of the sanctuary, and 0.4 feet below the lower plaster line of Room 18. The latest floor level of the sanctuary was 2.8 feet above the latest floor level of nave.

A semi-cone-shaped lump of lime putty reenforced with brick was found underneath the statue niche of the west wall. The surface bore some red and green paint, and was modeled with a curvilinear design. I believe it to be the ledge which projected from the niche. As it carried a more elaborate design than the ledges of the nave, it was a welcome find. It could be restored to place with dowels and plaster of paris.

In the northeast corner, two pieces of lime putty decoration were

found. Their surface had been painted brown and then covered with some sort of gilt. Their original part in the decorative scheme can only be guessed.

SACRISTY

Because of many rumors of an underground passage leading from this room, more dirt was moved than was really practical. The north two-fifths was excavated to a depth of ten feet without finding any trace of a tunnel. The top eight or nine feet had been disturbed by treasure hunters but the test hole extended at least a foot into undisturbed gravel. Here again the specialized plaster of Rooms 18 and 19 was found below the present floor level. Only a thin strip remained on the north wall at the old floor line, but there were two red spots of crushed brick in the west half and two to the east.

One of my first theories in regard to this plaster was that the crushed brick was inserted in a first coat of plaster to hold a second layer. I abandoned this theory for several reasons. The nave, sanctuary, and sacristy have had two coats of thick lime plaster and, with large areas of the under coat exposed, there is no crushed brick in evidence. Another point is that the imbedded pieces of brick are troweled smooth with the surface instead of projecting slightly as would be desired were they to serve as structural features. Again, the pieces are arranged in groups instead of being scattered to do the most good as a tie. To my mind the red brick insertions can be classified only as ornamentation -- the forerunner of the later type of brown and black decoration to be seen in the walls of the present mission.

The finding of the same specialized plaster in Room 18, the sanctuary, and the sacristy indicates they were in use at the same time. That Rooms 18 and 17 were plastered seems proof enough that they were completed and in use.

It now seems the present mission has been remodeled; Rooms 17 and 18 abandoned, and the floor of the sanctuary raised 2.8 feet. The plaster behind the pilaster in the sanctuary indicates the present dome was not built at first because the pilaster supports the arch which in turn supports the south side of dome. So the roof was changed also. Perhaps it was raised because the floor below was raised. As no plaster is to be seen behind the pilasters higher on the walls and as none of the specialized plaster is to be found except at floor level, it appears the remodeling took place after a period of neglect when rainy weather had an opportunity to remove it. A long period of neglect with some wall erosion would explain why the upper margins of the entrances to the side rooms are not in evidence, since, here and there, the walls would have to be resurfaced, especially around an opening. It is doubtful that such a thick wall would have been supported by a wooden lintel for a distance of 13', but it is possible. If by any chance the lintel was burned, all

the wall between the door jambs would have to be rebuilt from the ground up.

According to a burial record, Father Gutierrez, who died in (December 13, R.R.S.) 1621, was taken from an old church and reburied in a new one, (Frank Pinkley, Mission of San Jose de Tumacacori, Page 7, (December 13, R.R.S.) 1622. This would allow two years for the completion and subsequent rebuilding of the present mission.

PATIO

Just east of the mission was a patio with the walls of some of the surrounding rooms still above ground. This area was termed a hollow square in 1850 by Prof. W. Wrightson, whose description follows:

> "The church is an adobe building plastered with cement and coped with burnt brick..... Adjecent to the church, in the form of a hollow square, were the residences of the priests, containing spacious and airy rooms, with every evidence of comfort and refinement, while surrounding these in the interior, was an arched colonnade, forming a shady walk around the whole inclosure. To the east of this square of sumptious residences was an oblong building, where the metallurgical operations were carried on. Here are still the remains of furnaces and quantities of slag, attesting the purpose for which this was formerly used; and further still to the east was the garden, including about five acres and surrounded by a cabone wall. The acequia passed through this, and here are the remains of a bathing place and a washing vat. There are also fruit trees and vines still growing..... To the south of the mission building, and fronting the church, was laid out a large plaza, which was surrounded by peon houses, thus forming a respectable village."

To the best of my knowledge, the above is the most accurate of any early description.

ROOMS 13 AND 14

At the northwest corner of the patio are the walls of a one-time two story building. The ground floor was divided into two rooms by a stairway, but there is no evidence of a partition in the upper story. The west wall of this building, which serves in part for the east boundary of the graveyard, is withstanding erosion better than the other walls because of the plaster covering on the west surface.

The floor level of the upper story is well marked by the holes which held the supporting beams. Except for a few large beams near the stairway, where part in the original structure must be guessed, the beams averaged

6½" in diameter, while varying from 5" to 8". The horizontal distance from center to center of beams averaged 15-9/10". One large beam projecting from south wall along the east side was probably inserted after the building was finished, to give additional support to the east end of the floor beams. The north end of this log is missing.

The stairway was of adobe bricks, with stone capped treads. Some of the large flat stones, 2" to 5" thick and sometimes 3' long, were topped with lime plaster about one inch thick. I believe the whole stairway had once been plastered.

At the foot of the stairway was a small vertibule with a doorway, 4' 3" wide, leading to the patio. Possibly this was the only doorway when the structure was first completed. Laborers on the project said they could remember when two families inhabited this building. Undoubtedly some changes may be attributed to these later occupants. Speaking in general, an inclosure at Tumacacori rarely had more doors than were absolutely necessary. The entrance midway in the east wall of Room 14 was unnecessary until the room was separated from the central doorway by the short length of walls between the two pilasters at the foot of the stairway. This light wall of unplastered adobe bricks exhibits a different character than other walls of building. It is laid on a plaster floor and butts against plastered pilasters. The adobes are lighter in color and, quite noticeably, contain few pebbles. The location of the doorway in question would weaken the wall where the second story beams were supported and apparently there was something heavy to support with nine (one was omitted from the map) pilasters and two heavy pillars on the ground floor.

An old description by Powell, 1849, (recopied from Rensch's "Chronology for Tumacacori National Monument") refers to this building: "....East of the church there was a large square yard, on the west side of which, passing under some solid arches, we came to a flight of steps leading to a granary, etc. It is a very large establishment and the monks and priests had every accommodation to make life comfortable....." As the stairway here was the only flight of steps encountered outside the mission, and the solid arches could refer to a cloister (the arched colonnade of Prof. Wrightson) along the west side of patio, it seems that Powell thought the second story to be a granary. On what characteristics he based his opinion, I do not know. Perhaps, if he had visited the place in 1820, he might have identified it as something else.

The pillar of Room 14 proved interesting. Observing some plaster on one of the inner adobe bricks, I removed the top layer of adobes and decided they had been appropriated from at least three old walls on the Monument. Three types of plaster were represented on inner surfaces of bricks of the top two courses; one type, 3/4 inch thick, which had been applied with a trowel; a thin white wash on another; and a white wash

topped with red stain on a third.

On the floor between this pillar and the pilaster to the south was a streak, 1' 8" wide, of roughened plaster, indicating a former wall. There is no evidence of a wall butting against the pilasters, however. The pilaster at the south end of Room 14 leans to the side several degrees but was plastered the same time as the wall.

An interesting feature of Room 13 was the bench along the east side. The bench was 1' 5" high, 2' 2" wide at south end and 2' 5" wide at north end. On top the bench in front of the north pilaster, was a circular depression, about 8" deep, which would serve very well for holding an olla upright. The bench was in a fair state of preservation with much of the plaster covering intact.

The batter along the west wall of this building was 8" wide at the north end of Room 15, and decreased in width gradually until it disappeared just short of the south wall of Room 14. From the floor it rose vertically 1.2 feet then sloped into wall 2.8 feet above floor level. Where small areas of plaster were missing, the batter was composed of small boulders set in adobe mud. At a few other places on the Monument this sort of construction was resorted to in order to save a wall weathering away at ground level. Whether the inside of this building was ever in need of such repair is doubtful.

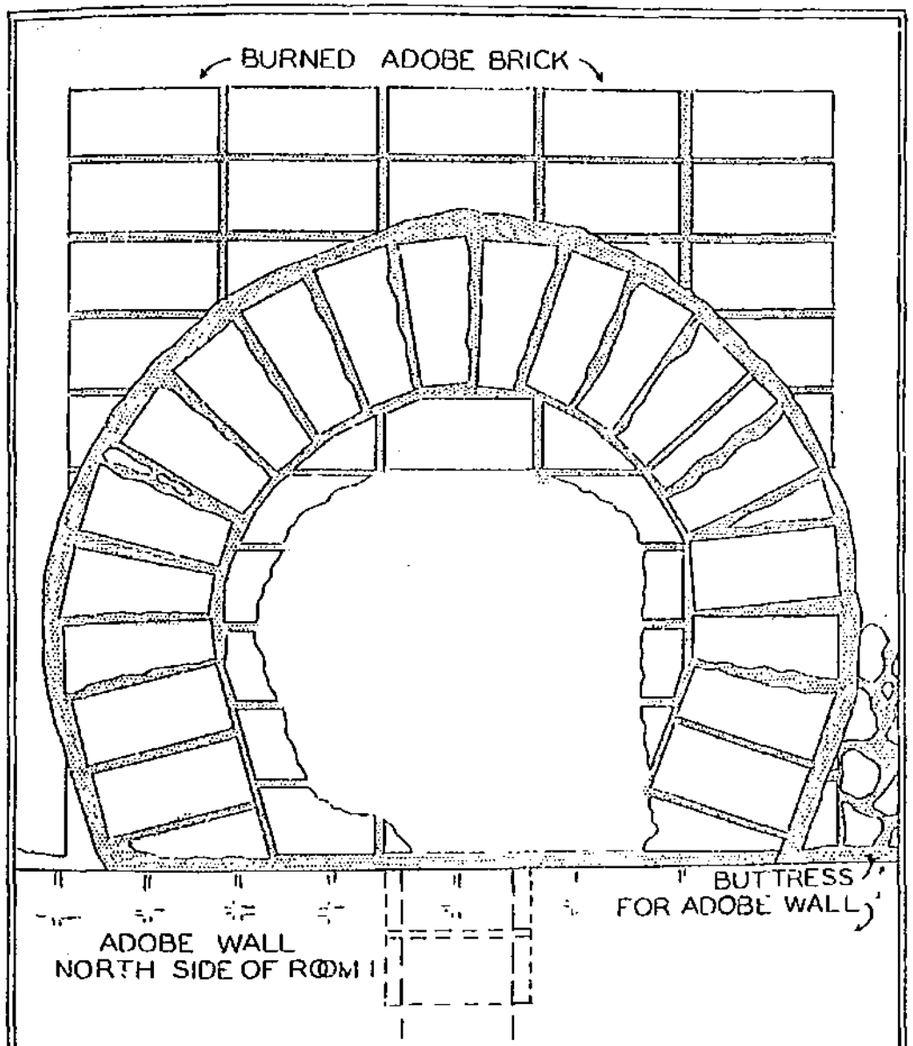
There were two small apertures in the west wall of this building. They were rectangular in shape, and about twice as large inside as out. I do not have their measurements but they could easily be measured on from the prepared side of wall.

The short length of wall between the two pilasters just north of entrance was indicated only by the course of fired brick lying loosely on the plaster floor. It is doubtful that a true wall was ever there.

A distinctive feature of this building was the character of the adobe bricks employed in the walls. They were light gray in color, and contained more small pebbles than any others thought to be of Spanish origin. However, the plaster on the outside of west wall is undoubtedly of Spanish date.

The inside plaster of this building was crudely applied - was much more similar that any other plaster I found. This supports that part which was reconstructed after the early quarter of the 19th century.

The difference of adobe added in distinguishing the east wall of Room 15 from the west wall of Room 14.



DETAILED BAKE OVEN PLAN

SCALE 1"-1'-0"

SEE PAGE 195

ROOM 1

In the west wall were two recesses; marks at their margins indicated their use as cupboards. Both were 3' square, 1' deep, and 4' 5" above floor level. However, the north one had once reached to floor level, and had been filled in afterward. It is quite probable that the north one was a door and the south one a window before Room 13 was constructed.

In the north wall were two openings lined with fired bricks. The west one led to a bake oven, and was 9" wide and 10" high. I do not know the exact height of this opening above floor level but it was approximately 2' 9". The other opening was 3½" high, 5½" wide, 1' 9" above floor level, and 1' 1" west of east wall of room. It extended at a downward angle through the 2' adobe wall, but was blocked by the later 1' 9" boulder wall. Perhaps at one time this opening had been part of a drainage system for waste water.

The east wall was sadly vandalized. Also it had been undermined from the large treasure hunting hole.

Along the south wall had been a bench (bench table) with only an adobe core remaining. A plaster line in floor, 6" in front of core, indicated the original width to have been 1' 9". Three broken brick at west end, but apparently in place, indicated there had been two courses of burned brick on top, giving a height of 2' 3". Along the north wall there was evidence of a bench constructed entirely of burned brick. The remains never exceeded two courses in height but the plaster line above indicated a height of 1' 4", or four courses of brick with the plaster between and on top. The bricks used were 3" x 12½" x 12½" (there were no two bricks of the same size at Tumacacori. Whenever a brick size is given in this report, it is the average of several measurements). There was a 3½" plaster fill back of the bricks, giving 1' 4" as the width of bench.

In the northwest corner of Room 1 was a large quantity of burned brick with lime plaster adhering to their surfaces. A few were smoke-blackened. Their occurrence suggested, at first, the possibility of an inside bake oven destroyed by the treasure hunters.

A large treasure hunting hole had been dug through the floor. In the east portion of room, the floor had been of fire brick, while the west portion of floor was of well laid stone flagging. Both materials had been set in lime plaster. The brick, 2-3/4" x 6" x 12½", were laid in a herring-bone pattern as in Rooms 2 and 3. An unusual feature of the room was the plaster lined conduit or drain leading in from the patio, through Room 2. It ended in the treasure hunting hole.

There was little wall plaster present, except on the north wall over bench. The west wall had been plastered in part with adobe mud, sometimes

two inches thick. I believe this wall had been exposed to erosion for a time and then smoothed over with adobe mud before a final application of lime plaster. This would indicate a period of time with roof gone. All lime plaster was approximately 3/4 inch thick. From the plaster line in floor along the whole length of room in front of south bench it was evident that the present floor had been laid after the bench was plastered.

At the northeast corner of treasure hunting hole, 8" from east wall and 1' 5" from north wall, was what first appeared to be the corner of an underground room. This plastered corner extended downward 1' 9", and terminated where the walls had been undermined from the treasure hunting hole. From the corner, the plaster faces extended about 2' west, and 1' 8" south, before ending in the treasure hunter hole. The north face corresponded rather closely to the front of bench while the east face appeared to be in line with the east edge of conduit. The significance of this structure is lost in the treasure hunting hole. Perhaps the conduit led to a cistern in this corner of the room, and was mistaken for a treasure vault by the treasure hunters. The loose brick in the northwest corner of room could have been from a cistern.

The central portion of this room lying over much of the treasure hunting hole was not excavated.

ROOM 2

The west wall was broken by the doorway to Room 1. A very little plaster on the sides at floor level gave the exact width of door. A large gap in the south wall prevented the exact location of the door which was certainly there. The doorway to Room 4 was closed crudely with courses of different sized burned brick and adobe mud. The thin wall between Rooms 2 and 3 had been vandalized considerably and the exact location of doorway was not ascertained. The floor bricks butted against this partition but the few bricks which would have located the doorway were missing.

The floor of burned brick, laid in a herringbone pattern, was fairly well preserved. However, the pattern was broken by two rows of brick side by side, with bricks laid end to end, which extended from the south doorway to the north doorway. Investigation under this break in pattern (where bricks were already missing) disclosed nothing, and I have no theory about this unusual feature.

A few small holes in floor may indicate storage places for small objects. I found a portion of a small jar in one such hole, while later in Room 7 a large olla was found under the floor. I suspect the storage of small articles in this manner is less typical of the Spaniards than of the natives who occupied these buildings after 1837. The plaster-lined conduit crossing a corner of the room was under one thickness of brick, 2 3/4".

ROOM 3

The only interesting features of this room were the two benches (wall tables) and the floor. Some bricks were missing from each but compared to other structures at Tumacacori; they were well preserved. The west bench, with two rows of brick laid end to end along the back wall and a third row in front with brick laid side by side, was slightly wider than the east one. On these brick in a few places was a $\frac{1}{2}$" layer of white plaster, unlike the red-topped benches of the south side of patio.

North of Room 3 was a solidly built floor of river boulders (stone paved terrace). From east to west this floor was level but the north edge was about 0.8 of a foot lower than the south side. The east and west edges had an abrupt straightedge appearance while the north edge was ragged. The south edge merged with the stone reenforcing wall which protected the north wall of Rooms 1, 3, 4, 5, and 7. Some lime plaster remained on the north face of the boulder reenforcing wall; the lower plaster line being 1' 10" above the boulder floor. Evidently, almost 2' of fill had accumulated over the boulder floor before the wall was plastered. The top of the reenforcing wall sloped downward from the inner wall so I do not believe it ever supported an adobe wall.

ROOM 4

There was no constructed floor present; the floor level given on Plan is that of a hard uneven earth floor on which occurred more or less loose soil. The wall carried quite a bit of plaster, 3/4" to 1" thick, but there was no definite lower edge to establish a floor level.

A test pit, about 6' square and 5' below adjacent floor levels, was excavated without finding anything of importance.

The only entrance to Room 4 was the filled-in doorway leading to Room 2. Evidently, Rooms 1, 2, 3, and 4 formed a separate unit in the original structure.

ROOM 5.

This room contained more plaster than any other on the north side of patio. The walls carried the usual white plaster, 3/4" to 1" thick, while the surface of the plaster floor was rather dark in color. I believe the dark color was due to use instead of stain.

A small cache of lead ore (?) was found under the floor, 1' from west wall and 6' from south wall.

A mortar was found just inside doorway, 10" above floor level.

ROOMS 6 AND 7

Room 6 had been floored with plaster laid over large boulders, but much of the plaster is now gone. Construction here suggests that boulder floors elsewhere were once topped with plaster. A trench around the walls of Room 7 uncovered only a boulder floor but, as suggested above, the room had probably been floored with plaster.

Two holes in the floor of Room 7 were noteworthy. One, with center 1' from south wall and 6' 5" from east wall, contained a large olla. The olla, containing only a few minute fragments of egg shell beside earth, was found upright with mouth about one inch below floor level, had the boulder floor been covered with plaster. Under the floor and almost touching olla, were two other artifacts; a small jar, and a crude candlestick (?) fashioned from a portion of a fired brick.

The other hole, figure-eight-shaped, had contained two wooden posts, side by side. The contents of this hole were so well rotted that the type of wood or the exact size, about 5" and 6", could not be determined. This hole was at base of south wall, 5' 6" east of west wall.

The three light walls of the storage bin were of unplastered adobe bricks laid on the plastered floor, and butted against the plastered south wall of room. I suspect it dates since 1927.

The most perplexing problem in regard to Rooms 6 and 7 concerned the types and amount of plaster in the room fill. Three types were abundant. The top two to four feet of fill were composed of fallen walls carrying the usual room plaster, 3/4" to 1" thick. Between these fallen walls and the floor was a layer of loose fill, from 6" to 2' 6" thick, which contained large fragments of two other type plasters. One type was from 3" to 4½" thick, contained a core of broken brick, and had one polished red surfece. This type exactly resembles the remnants of floor to be seen in the mission. Isolated chunks of this plaster had also been found in Rooms 1, 2, 3, 4, and 5. The third type was plain white in color, and varied from 1 3/4" to 3" in thickness. One side appeared to have been laid on smooth earth while the other surface was very smooth, or, it could be said, polished. Except for the excessive smoothness, this latter type suggested a plaster roof.

The last two types were mixed indiscriminately in the loose fill. Pieces of both were found inside and on top the storage bin. From the top, I removed a section of an island left by trenching around the walls, and nothing developed from which I could form an opinion. Sometimes one type was on top; sometimes the other. Sometimes the smooth surfaces were up; sometimes they were down; and, sometimes they were on edge. In regard to quantity and distribution, I estimated there was about half enough of each type to cover each room, and they were evenly distributed over both rooms.

The red flooring suggested a second story but were that the case, I believe supporting evidence of some sort would have been discovered. If the white type had not been found above the red so often, I could have been sure it was the missing plaster from the boulder floor. I believe now that the broken pieces of red flooring had been introduced after the rooms were abandoned and that the whole fill had been churned by treasure hunters.

Except for the east one, all walls of these rooms were of the double adobe type characteristic of this side of the patio. The bricks measured 2 3/4" to 3" x 11½" x 24". The east wall was of the single adobe type, but it may not have always been so. Possibly the adobe bricks of the eastern half have been removed in the last hundred years. The foundation which would have supported this tier of adobes was not noted, but the south wall of Room 8 lacked an even foot of reaching the east wall of Room 6.

No evidence of a door was found in the east wall of Room 6; the gap shown, on Plan, seemed to have resulted from vandalism. However, the extra width of the east end of this room would permit an opening through the east wall in front of Room 8 at the expense of having a curved south wall.

ROOM 15

A special feature of this room was a floor of burned brick, 1½" to 2" x 10½" x 10½". The bricks were laid checkerboard fashion instead of the herringbone manner so common about the patio. Much of the floor had been destroyed by vandals, but several courses were uncovered along the west wall near the north end. Between the two western courses was a row of spalls. Evidently the floor had been laid from the east and when the last row of bricks did not fill the final space, some small pieces of brick were used to bring the last row against the west wall.

The plaster of this room was unusual also. A white wash had been applied to the walls on the south, east and north. On the west wall a thin layer of ash colored plaster had been troweled before a final application of white wash; while in the doorway on both sides was found the white wash topped with red stain, which is believed to be associated with the oldest buildings on the Monument. The plaster on the west wall, unlike any other on Monument but akin to the plaster of Room 36, may be seen where this wall extends through the north wall of Room 16.

The north end of the east wall butts against the corner of Room 14, and the upper part of the west wall has been restored by Mr. Frank Pinkley.

The artifacts of this room consisted principally of tin cans.

ROOM 16

The walls of this room are still standing several feet above ground level. Probably, much of them are recent. Local people speak of Room 16 as Pedro Calistro's room. Calistro, an Opata Indian who died recently, was known as the "Keeper of the Mission" and lived nearby for many years. (See article "Indian Holy Week at Tumacacori", Southwestern Monuments Monthly Report for August, 1935).

The east wall contains pieces of fired bricks, a piece of modern glass, and a recently sawed timber. Both ends of the wall butt against a thick layer of plaster which suggest that part of the side walls are of Spanish origin. Several wooden boxes of modern date are built into the south wall. The north wall is divided into two parts by the west wall of Room 15. The age of the western portion is important, for, possibly, there was once an entrance to the graveyard here. Now, visitors reach the graveyard via the sacristy window, and one would not expect to find only the one entrance, on the west, to the graveyard. However, nothing was learned about the age of this segment of wall from excavation inside, and I did not dig outside.

The west two-thirds of this room have been deeply excavated by treasure hunters and I could not learn if the west wall of Room 15 once passed underneath. There were several square feet of plaster flooring along the north wall near the east end. Perhaps, this floor, about 2' 6" below present ground level, belonged to Room 38 before the south wall of Room 16 was constructed.

ROOM 38

Due to vandalism not much of these walls remained. A portion of the south wall carried some unusual plaster: a brown sandy application, 1" to 1½" thick, topped with white wash. Some adobes of west and east walls had been reutilized as they carried a white wash topped with red stain on surface inside wall.

ROOM 39

Another room sadly vandalized. Several adobe bricks of the east wall carried white wash topped with red stain on surfaces inside wall.

ROOM 40

A few floor brick, laid in a herringbone pattern, were found along east wall, but rest of floor had been destroyed by vandals. A large amorphous mass of bricks and plaster was found in a treasure hunting hole under floor level in north part of room.

Four or five square feet of plaster on the east wall near the north end proved interesting. A thick, 1", layer of white plaster had been troweled on a covering of white wash topped with red stain. If there were two building periods at Tumacacori, one in which lime was scarce and applied only with a bruck, and another when lime was more plentiful and applied thickly by trowel, here is positive proof of their relative ages.

A short bench was found on east wall. As this left a very thin wall between Rooms 40 and 43a, this bench may have been a wall niche topped with a wooden lintel or an arch of adobe bricks. The bricks forming the bench top were missing, but their impressions remained in a layer of plaster.

ROOM 42

The north, west and south walls are of an earlier period than the east wall which butts against the side walls and contains more pebbles than the others. Evidently the entrance has been blocked by the more recent wall. The gap in the north wall, dug by some fool seeking treasure in a drain, would not be wide enough for a doorway with sides at right angles to the wall.

Except for the treasure hunting hole, the floor was in good condition. A 3" layer of wood ash was found in the northwest corner where the square corner had been rounded out and a few brick inserted into the walls to form a small crude fireplace. Adjacent walls evince signs of heat and smoke. Undoubtedly, this room has been occupied since 1827.

The wall plaster, where it remained, varied from ½" to 1" in thickness.

An interesting feature was the drain passing under the floor. It began at the restored tanks in front of mission and emerged into the patio through a large hole in the north wall of Room 43a. It should be noted that the drain of Rooms 1 and 2 fell about .1 of a foot in 25 feet. The floor level of Room 43a, about 140' from south end of drain, of the latter drain was 0.5' higher than the floor level of Room 1. Possibly, there was once a continuous drain from the tanks in front of mission to Room 1. The drain of Room 42 was 2½" high and 7½" wide.

ROOM 43

43 was the number given to the south portion of cloister that once surrounded the patio on the south, west and north. Apparently the principal entrance to the patio was through the south side, and it is marked by a filled-in arch in the south wall of Room 43. 43a is the part of this enclosure west of the arch, and 43b is the part between this entrance and a deep treasure hunting hole at the east end. 43c is the treasure

hunting hole, and is bounded on the west by an underfloor wall. This wall is a continuance of the east wall of Rooms 47 and 48.

Directly in front of the arch mentioned above, the floor has been destroyed by vandals, but Mr. Boundoy, then custodian of Tumacacori National Monument, assured me the driveway had once been paved with bricks in which were worn deep ruts by cart wheels. Two and a half bricks were found in place in driveway and indicated the floor pattern differed from the herringbone pattern to either side.

There was a bench extending along the west side and most of the south side. It terminated with a ragged end in the treasure hunter hole of 43c. It was missing in the driveway, while the plaster line in floor indicated it had once ended flush with each side of arch. In several places this bench gave evidence of having been topped with a thin layer of plaster stained red. This red stained plaster was much thicker than the white wash topped with red stain to be seen on older walls. The wall plaster, 3/4" to 1" thick, was plain white in color.

One short bench and part of another were found in the western portion of the north wall, while not enough remained of the eastern portion of wall to indicate the occurrence of others. The eastern portion of the easternmost bench had been destroyed so its exact length could not be determined. The westernmost bench was in fair condition and perhaps its length indicates the distance between the pillars of the colonnade mentioned by Professor Wrightson, 1860. However, I discovered on proof of a colonnade or arcade anywhere. The two short benches had thin backwalls whose original height I do not know.

The drain which entered Room 42 from the south had been entirely destroyed in Room 43a. However, its passage through the north wall was marked by a large stone lined hole.

There was a large treasure hunter hole through the floor of Room 43b. From this one, like most others, the adjacent floors had been undermined. After settling, the floors always sloped toward the holes. I was never able to reach the sides of these holes without damaging structures above; so was never able to examine the strata pierced by the treasure hunters. There were many rumors of underground passages or tunnels at Tumacacori, and I suspect that most had their birth with vandals who had dug through the floors of Rooms 43 and 45 to find the floors and walls of older buildings on the same level as Rooms 46, 47 and 48.

All of 43c had been excavated to a depth of about 7' below floor level by treasure hunters. The fill was typical of all treasure hunter holes except it contained more large boulders. There was a large shapeless mass of boulders set in adobe mud, in the southwest corner of the room. Probably, boulders had been loosened from this mass to supply

the loose boulders of the fill. The floor of Room 43, on the wall between 43b and 43c, was interesting. Above the adobe wall bricks was a ½" layer of lime plaster; above this plaster was a 5" layer of adobe mud; and, above the solid adobe was a 3" layer of plaster in which were set the floor brick.

On the outside of the north wall, 43c, was the bottom end of a wall drain similar to the drains on the walls of the mission. Below, and to the east, of the drain was a lump of plaster and brick whose part in the original scheme could not be guessed. Just above this object was a layer of loose soil and pieces of brick in the wall. Evidently the wall had been rebuilt at one time. The drain appeared to belong to the older wall but quite possibly it could have been constructed at the time of rebuilding and just had its lower end seated in the older wall. The layer of loose soil and broken bricks could be seen in the wall from the drain east of the corner, along the east wall, and west to the corner of Room 45. The level of this layer corresponded to the floor level of Room 43. The eastern part of the south wall butted against the corner of Room 45.

An unusual feature of construction about 43c was the depth of walls below floor level. There was no floor present but the bench height at southwest corner indicates a floor level similar to 43b. Probably, the walls were begun at ground level and then filled with earth to support a brick floor at the proper height.

AREA 41

41 was the number given to the area which I supposed to be the west and north portions of the cloister. 41a designates the part in front of Rooms 14, 15 and 16; 41b lies south of 41a; while 41c applies to the section in front of Rooms 2, 4, 5 and 6.

The west wall of 41a was marked by a stone foundation on which, in a few places, was found one course of adobe bricks, 3½" x 11½" x 24". In front of the entrance to Room 15 was a 5' gap in the adobe bricks, which I think marks a doorway between the patio and cloister. I did not dig in the gap to see if a boulder foundation was present.

Six adobe bricks, 3½" x 12" x 24", seemed to be in place against the east wall of Room 14. The group was laid three courses high and two bricks long. Possibly they marked the site of a bench.

Just north of these adobes and south of the east entrance to Room 14 a test pit was begun. A boulder floor was encountered on a level about 2' below the east wall of Room 41a. About five square feet of this floor was uncovered without reaching an edge, when refilling became a necessity because it appeared the FERA project was about to end. Previously, I had suspected the light colored, pebbly adobes of Room 14 of having been laid on foundations or walls of earlier date.

In this test pit against the side of Room 14, all courses of adobes seemed to be the same.

The original west wall of 41a exactly in front of Room 16 had been destroyed and then rebuilt with a mixture of adobe and fired bricks.

The the present ground level, one course of small boulders extended foundation-like about 6' northeast from the corner of Room 16. This is shown as a stone wall on an earlier map of Tumacacori. It may have marked a recent wall but it had no part in the original construction.

Much of the east wall of 41b was traced by trenching along each side of the foundation, and it was never uncovered from the top. Perhaps, another door as in front of Room 15 would have been found had it been uncovered properly.

The south wall of 41c was marked by a stone foundation without any adobe bricks. A break near the west end gave passage way for the drain. A much longer gap near the east end may be attributed to vandalism. Near the latter break was a problematical structure which the laborers identified as a foundation of a primitive flour mill. On this foundation could have been placed a nether stone with spindle. On the nether stone and pierced by the spindle would have been the upper millstone attached to which would have been a pole projecting horizontally. A burro hitched to the pole and walking in a short circle would furnish power for the operation of the mill. The grain would be introduced around the spindle, and the flour would be collected at the edges of the stones. To support the theory of the laborers, there was a hard-packed adobe floor from 5' to 8' in all directions from the foundation. The floor, yellowish in color, could be distinguished both in color and in density. As this floor was above the south foundation of 41c, the milling operations were subsequent to the destruction of the wall.

Immediately in front of Room 4 and perhaps a part of the south wall foundation was a short length of stone foundation whose original purpose is doubtful.

About three feet in front of the foundation, and on the same level, were found together a small milling stone, a small mortar, and the major portion of a metate.

The east wall of 41c continued southward to form the east boundary of the patio. This was only a rock foundation with the south end terminating in a modern drain ditch. About 9' south of 41c this foundation was pierced by a plaster lined drain. Both ends of drain ended in treasure hunting holes. No fired bricks were used in the construction of this drain, in contrast to the brick drains of Rooms 1 and 42.

ROOM 50

Possibly these foundations mark the site of an early mission. Facts in support of this belief are: the large size; appropriate proportion of length to width; foundation stones correctly placed to support the pilasters of a choir loft; the absence of any knowledge of other foundations which might locate one of the early missions supposed to be at Tumacacori; and, stone foundations high enough to carry plaster, unlike any other building on monument except the present mission. The constricted sanctuary is not uncommon in early Southwestern missions.

The objection voiced to Room 50 being a mission is because of the weakness exhibited at the offsets in the side walls near the west end. To some (J. H. Tovrea, Monthly Report for Southwestern Monuments, Jan., 1936, page 44) these offsets have suggested the possibility of two buildings of two different periods. As the foundations on either side of offsets are similar in character and on the same level, I see no reason for speaking of different periods. Possibly, they are two rooms of the same building with the partition removed. However, if there was a partition there at one time, the foundation stones have not been molested by treasure hunters as the soil had not been disturbed in modern times. There is a possibility of the stones having been removed to be used elsewhere, a practice noted frequently with adobe bricks. However, it seems improbable that the foundation would be removed in its entirety without taking any stone from the adjoining walls. In line with the latter statement, it would be just as probable that the foundations once overlapped a short distance and that someone had removed the overlapping sections.

Again, the weakness at these offsets is none too important if they occurred inside a building and were not exposed to weathering and rodents. For, if Room 50 be considered as a mission, I believe the side rooms, 51, 52, and 53, would have been under the same roof.

The two offsets had been uncovered when I reached Tumacacori, but they were further cleaned after my arrival. I found the north one to have been disturbed by a trench at some previous time. Probably, the trench for the pipe line ending at hydrant just short of offset had been dug a greater distance than necessary. But the south offset did not evince signs of having been disturbed. After all the darker soil had been brushed from the foundation, the offset was still unexplained. A thin wall could have been curved around the corner and still remained on the foundation. But this would have been an unusual construction feature not to be expected.

On the side walls near the east end, a few adobe bricks, 3" x 12" x 25", remained in place on the foundations. The brick at the northeast corner, several courses high, were laid across the wall or side by side, instead of end to end as was the usual procedure at Tumacacori. Disregarding any lime plaster that may have covered the outside surface,

this gives a wall thickness of only 25". The foundation ranged from 30" to 36" in width, but wherever it remained the wall above was only 25".

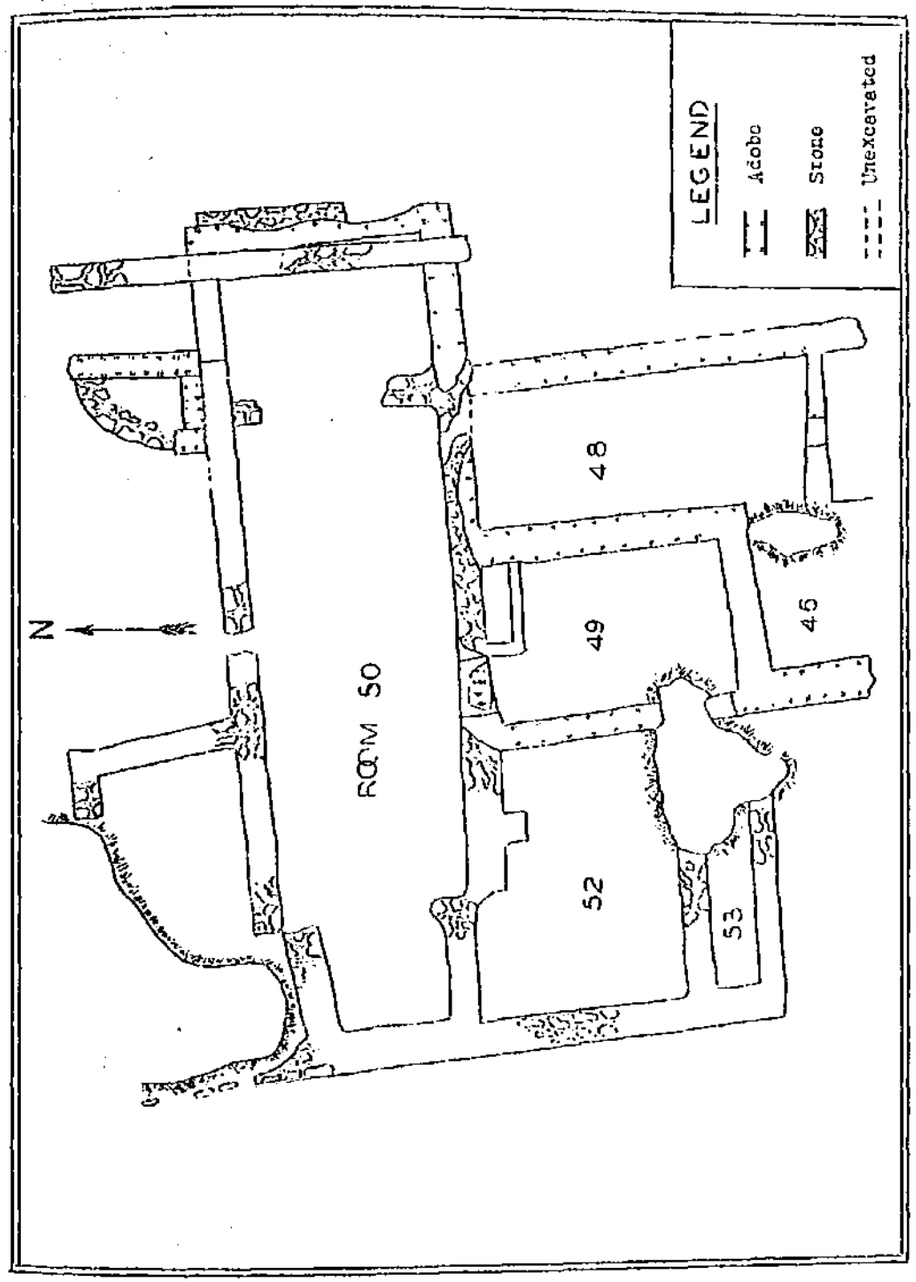
Here and there a bit of white wash topped with red stain remained on the inner surface of the walls, both on the stone foundations above floor level and on the adobes. On some spots of plaster here, as well as in Room 46, there was a thin film of lime over the red, which could be rubbed off very easily. Whether this was a coat of white wash or a deposit of lime from the soil, I do not know. It seemed to be on some of the wall surface where the white wash topped with red stain was missing.

Along the south wall near the east end, a little blotch of plaster lay on the hard packed, but sloping, adobe floor. This bit of plaster, a mixture of red and white, resembled stains left on a floor near a well newly calcimined by an awkward workman. I do not believe this bit of plaster marks the floor level but I do believe it marks the level on which a constructed floor could have been laid. However, no evidence of a constructed floor was discovered. The elevation of this bit of plaster is several inches under the top of the foundation of Room 50.

In the eastern portion, a short length of foundation projected inward from each side wall. These could have been foundations on which were built pilasters to support a choir loft. Also, they could have been ends of a vandalized partition foundation. However, their tops were flush with the floor instead of being equal in height to the side wall foundations. The north one was the smaller but it was as large as the foundations of the pilasters supporting the choir loft of the present mission. Just a few feet west of the south one, a trench for a modern pipe line had been dug through the wall of Room 50.

Midway along the top of the south wall, an interesting construction feature was encountered. The stone foundation had been covered with a layer of plaster for a distance of about 4'. In the plaster, a row of brick had been laid flat, side by side. At each end of the row, one brick had been set on edge with top slightly above the row of flat brick. The two end bricks of the flat series had been broken to a triangular shape, 6" wide at base, and laid with the pointed ends northward. This caused the edgewise bricks to have their south ends farther apart, approximately 12", than their north ends. Also, the edgewise bricks sloped gently to the south. Although this structure was a foot above floor level, I believe it to mark a doorway.

At the east end where a doorway was to be expected if Room 50 was a mission, I did not find one. Of the two walls encountered there, the inner one was the foundation of the east wall of patio, and was about 18" above the foundations of Room 50. The position of the patio wall prevented the uncovering of the inner surface of room wall.



The uncovering of the outer surface was begun by one of the most intelligent and careful workers on the project. Later he was suspected of tendencies toward practical joking so I do not know positively whether the design, depicted on plan, was carved into the top course of this wall by him or by the early builders. Shortly after the top course was uncovered, the east edge was caved off by careless visitors. Just below the top course, the wall was straight faced, and evidently 25" in width.

There was a step-like projection of the foundation about 10' 7" long at the north end of the wall. Whether it once extended the w length of wall can not be known. Its level was similar to the pr floor level inside, but it was approximately 2' below the top of th adobe wall. Because no doorway was found here, I am in doubt about Room 50 being a mission. There was no supporting evidence of a later wall having been built on an old foundation here, or that the mission was entered over a threshold 2' high. Perhaps, if it were permissible to remove the foundation of the patio wall and uncover the east wall of Room 50 properly, more evidence would be obtained.

Butting against the north wall of Room 50, on the outside, was part of a small room structure. The walls were constructed of adobe bricks, $2\frac{1}{2}$" x $7\frac{1}{2}$" x 16". The floor was of hard packed adobe mud laid over a layer of small boulders. Some of the laborers spoke of social gatherings, on the order of Fourth of July picnics, that had taken place at Tumacacori some thirty years ago. Meast was barbecued; pumpkins roasted; etc. One laborer said he remembered carrying some pumpkins from a small granary on the site of this room structure, to the bake ovens nearer the Santa Cruz. He said the granary had been constructed by families living at Tumacacori long after the abandonment by the Spaniards. I consider his explanation as good as any.

ROOM 51

Only stone foundations found here. A tree prevented a thorough exploration of the eastern part while a large treasure hunter hole, 7' 6" below foundation level, had been dug in the west and north portions of room. If the stub north wall once extended to the damaged west wall, it would have been directly in the treasure hunter's path. The west boundary of the loose fill lay along the inner line of west wall. "Cave-ins" along the edge of the hole would account for the missing portions of the west foundation. The foundations of the east, west, and north walls were not as wide or as deep as the south foundation.

A thick piece of lime plaster had been built into the western end of the north foundation. It may have marked the side of a doorway or the bottom of a wall drain, but there was not enough of the structure present to be accurately identified.

ROOMS 52 AND 53

Except for a few adobe bricks, laid side by side, on the east wall foundation, only stone foundations remained. The side walls of Room 53 ended at the edge of a treasure hunter hole which extended into Room 49. The north wall of Room 53 did not end in as ragged a fashion as did the south wall, so the rim of the treasure hunter hole may have coincided with the side of a doorway or the end of the wall.

Some fifteen square feet of hard level adobe floor remained in the northeast corner of the room. Here and there, but always within a foot of the wall, a bit of white wash plaster seemed to be in place on the floor. To me, it seems improbable that an earth floor would be white washed, but I do not know. The plaster, while thin, was much more substantial than the thin white film noted in Room 50 which I thought could have been deposited by ground water. The walls adjacent to this floor carried some white wash topped with red stain.

The stone foundation, 2' 2" x 1' 9", was found against the north foundation with top flush with floor. I always identified such structures as pilaster foundations, but the purpose of any one is unknown.

The western portion of Room 52 had been disturbed to a shallow depth by vandals. Just west of Rooms 50 and 52 was found what first appeared to be a floor of small boulders, two or three inches below foundation level. From one to seven feet away, the boulders thinned rapidly, presenting a very ragged margin. Perhaps the boulders had been placed there to protect the walls from running water after rains.

ROOM 49

There was nothing here to indicate a floor level, and there was no plaster present. The only evidence of a doorway was the one between this room and Room 50, but at one time there could have been a door to either Rooms 46 or 49 without being found now. A thin stone foundation inclosed, on the south and west sides, a pit in the northeast corner of room. The pit was excavated to a depth of about four feet before a firm and smooth earth floor was found.

ROOM 46

Little of this room was excavated because of a big tree. No plaster was seen, and there was no floor at the north side.

ROOM 48

This room was in a fair state of preservation, with a plaster floor and some wall plaster. The wall plaster was of white wash topped with red stain, plus a thin film of soft lime. The white film

could be brushed easily from the red under-plaster.

The floor was covered with a thin layer of lime plaster (my notes do not give the exact thickness), which was dark in color on the surface. I believe the color was due to use and not to any stain. The most important character of the floor plaster was that it contained small pieces of slag, evidently as reenforcement. The presence of slag indicates smelters were operated at Tumacacori at an early date. On the other hand, it indicates that this series of rooms, Nos. 46 to 53, were constructed after 1736 when the discovery of the Bolas de Plata silver mine brought mining men to Pimeria Alta.

The sides of the west entrance were excavated a bit but a tree prevented the clearance of the door. Another doorway was found midway in south wall. This door, 3' wide, had been neatly filled with adobe bricks. There was a little white wash on the filled-in door but no red stain. The south wall was unusual in another respect, being 1' wide at the east end and 1' 9" wide at the west.

This room had been excavated before, as a bucket coated with cement and a celluloid comb were found on the floor.

ROOM 47

No plaster remained in this room. The adobe floor was 6" below the plaster floor of Room 48. All walls were well made of close set adobe bricks except for a vertical crack at the east end of the west one-fourth of the south wall. This suggested another room just south of the eastern three-fourths of Room 47; one that I could not reach without destroying the floor of Room 43b. The floor of Room 43b was constructed about 2' 9" above the floor of Room 47 and, without digging on the south side of the north wall of Room 43b, little can be said of Room 47. I have no explanation for the thin section of the Room 43b wall near the west end of Room 47.

The east wall of Rooms 47 and 48 continued south, under the floor of Room 43. Non-bonded joints showing in the wall between Rooms 43 and 45 indicate that the underfloor wall was once much higher. The plaster on the exposed portion above present ground level is the only plaster nearby.

ROOM 8

Room 8 differed in appearance from the rooms to the west. The adobe bricks of the north wall were laid unevenly on loose soil. In fact, a layer of slag lay under the eastern part of this wall. The double wall between Rooms 8 and 9 was well constructed, but there was no stone foundation under the south wall.

At the base of the south wall was a problematical structure (see plan) of fired brick covered with lime plaster. A 5" layer of wood ash covered this platform and extended into the room some five feet while gradually decreasing in thickness. Just outside the room at this point was a reenforcing wall of stone. Perhaps the problematical structure inside was the floor of a fireplace while the reenforcing wall was necessary to uphold or protect a heavy chimney.

Near the center of the room was found a large millstone. The hole, bushed with lead, extended only half way through the stone; evidently, it was a nether stone. It was found in loose soil above floor level, with the working face at an angle of about 30 degrees from the horizontal.

Several large mesquite trees, growing within the room, prohibited a thorough exploration. One grew just inside doorway so only the tops of nearby walls were outlined. A test pit, 6' below floor level, disclosed nothing but a few river boulders scattered through the soil. Possibly, a boulder floor has been vandalized here.

The poorly laid north wall, over a layer of slag, suggests to me that at least some of this room was built or rebuilt after abandonment by the Spaniards.

ROOM 9

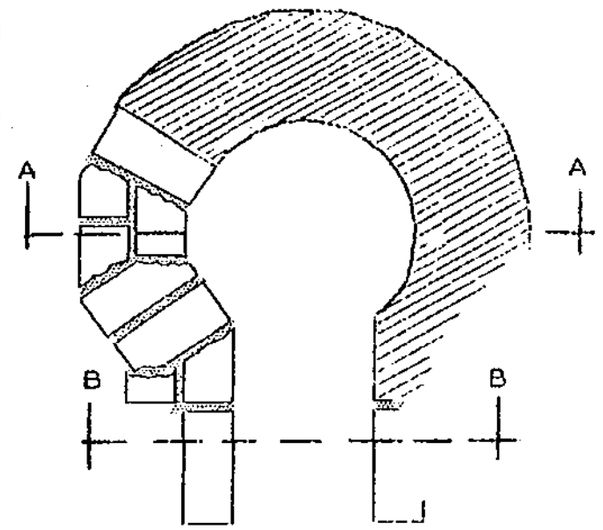
The north, east, and south walls were laid on loose dirt. I am unable to explain the filled-in corners of the east side. The north wall, near the west end, carried about one square foot of plaster which had been applied with a trowel. The plaster lay over several adjoining bricks, so was in place; that is, plastered bricks from other walls had not been assembled into the wall here.

ROOM 10

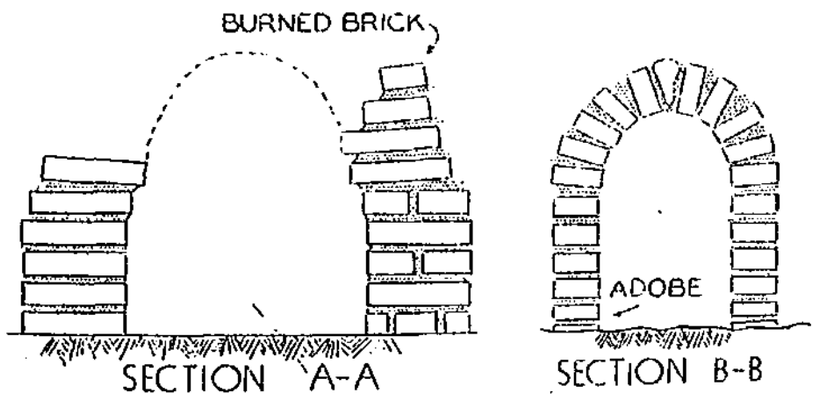
The south and west walls were laid without stone foundations. The outer north wall was of adobe bricks, 3" to 4" by 12" by 24", without a foundation. Most of the adobes of this latter wall carried some whitewash plaster stained red, either on one edge or an end. Evidently they had been removed from another building. The inner north wall was of boulders laid in mud. The east wall was well laid on a stone foundation.

ROOM 11

This room had a well-made boulder floor but contained no plaster. There were no adobe bricks on the east wall and only three at the west end of the north wall. The foundation stones of the west, north and east walls were slightly higher than the floor, but there was no trace of a south wall. Against the west wall, near the south edge of floor,



PLAN OF VASO III



SECTION A-A SECTION B-B

DETAILS OF VASO III

SEE PAGE 212

SCALE ½" = 1'-0"

were found about two pounds of copper sheeting from which small discs had been stamped. Possibly the discs had been used either for medals or coins.

The north portion of the west wall of orchard began at the northeast corner of Room 11.

AREA 12.

Not a room, but an area partially inclosed by boulder foundations. Excepting the present mission, the south and west walls were the heaviest and best made foundations found on the monument. The inner portion of the east wall, 1' 7" wide and one course of small boulders deep, probably served as a foundation for a light wall at one time. The eastern part of this wall, is composed of small boulders loosely scattered in the soil. They did not have the appearance of a wall foundation; but rather, suggested a batter of boulders and mud which had weathered away. No floor level was apparent.

In the northern portion of the inclosure were found about 200 pounds of animal bones; mostly sheep and cows, but with a few horse and pig bones. Two mandibles of domestic pig and one of peccary were noted.

Between A 12 and the east wall of the patio were five problematical structures (see plan). When they were being surveyed I suggested to the engineers that three could probably be vasos (primitive smelters), and that another could have been an ore roaster. The problematical structure by the patio wall was identified by two or three laborers as a place where several families could cook food. However, I am unable to identify any of these structures without comparative material.

Vaso I or V I had been partially uncovered by the time of my arrival. Part of a broken pot had been found in the arched entrance. Some lime plaster, one inch thick, was still clinging to the inner surface of the arch. This plaster was smoke blackened but gave no indication of intense heat. Except for a six inch lining of dried mud and charcoal, the bowl part of structure was filled with broken brick, slag, earth and pieces of lime plaster.

I was unable to determine whether the charcoal and adobe mixture was an integral part of the structure, or whether the bowl had once filled with charcoal and mud before a test hole had been excavated by some treasure hunter. This lining was not found in V I or V II.

V II differed from V I by having a conduit through the north wall, besides being of adobe brick. The floor of the conduit sloped into the bowl. Possibly this was a smoke flue but all evidence of the super-

structure had been demolished long ago.

V I, V II and V III all possessed a smaller diameter some two to three feet above the earth floors, but whether the missing tops were done or bottle shaped could not be determined from the remaining evidence. Possibly they had been hourglass shaped as the adjoining structure.

One of the laborers, none too reliable on other bits of information, spoke of recently seeing such structure in use in Mexico. According to this information, the complete structure should have an inverted bowl shape. Fuel and copper ore could be introduced through a small hole at the rear, near the top. A large bellows playing into the arched entrance would create a small blast furnace. The molten material would pour out the entrance where a large pot would be buried with the rim flush with floor. The slag would escape over the pot, depositing the heavier copper below. If the ore carried sulphur, it would have to be roasted before the smelting operation.

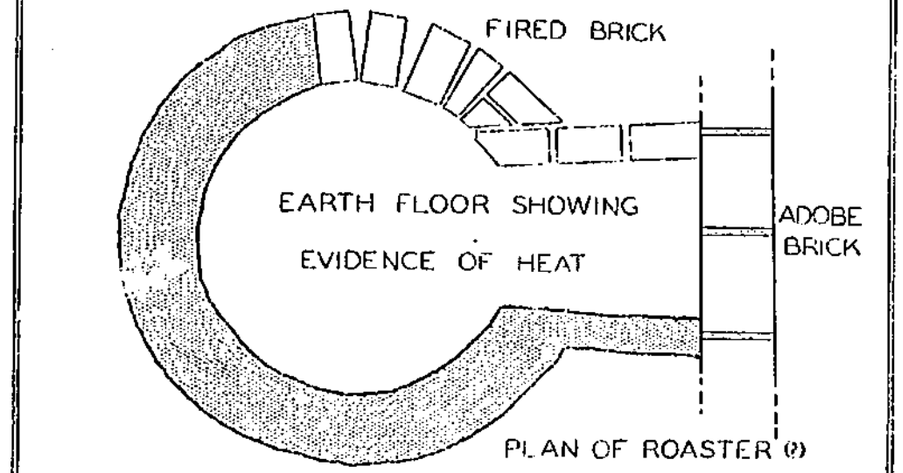
If these were vasos or primitive smelters, one would expect to find evidence of intense heat, a character not encountered. Perhaps an inner lining had been removed in recent years when some citizens of Tubac gathered quantities of slag here to be resmelted by modern methods.

The use of the problematical structure beside the vasos (Plate 3) is unknown. Its proximity to other structures tentatively identified as smelters suggested that its purpose was of a metallurgical nature. Some lime plaster inside the upper part was black from smoke, but was not fused. About six inches of wood ash lay on the earth floor. Resting on the ash layer were several tin cans whose paper labels had not entirely rotted. The top of the arched entrance had been vandalized. However, it appeared to have been a foot more in height than the entrances of the problematical structures nearby. The floor level of this structure was 3 3/10 feet lower than the floor level of V II, and 3 feet lower than the floor level of V III.

The problematical structure by the patio wall was simply a brick-lined hole with a side entrance. The vertical portion had been smoothly plastered inside with lime plaster. The side entrance was located by removing loose fill in the surrounding packed soil; there were no constructed sides of burned or adobe brick. Slag was conspicuous by its absence in comparison with the structures several yards to the east, but pottery was more abundant here than at any other area on Monument. A broken burned brick from this hole bore a deep impression of a chicken's foot. Evidently a chicken had stepped on a freshly made adobe before it was placed in a kiln.

AREAS 54, 62, 63, 64 and 65

Only stone foundations found here except for the adobe pilaster of A 65 and the south walls of Areas 54 and 65. The two pilasters of Areas



SEE PAGE 212

65 and 62 are almost in line with a third on the wall between Areas 54 and 65. The wall between Areas 54 and 62 is above their west wall. Nothing was found to indicate the age of these foundations, except their low level, but they may well be among the oldest on the Monument.

AREAS 55, 56, 57, 58 and 59

The east wall foundation of Areas 56 and 59, with the east foundation of Areas 11 and 12, form part of the western boundary of the old orchard. As this boundary is at the brow of a slope, it has suffered some damage from erosion.

The north foundation of Areas 55 and 56 carried one course of adobes for more than 2/3 its length. These brick were of an unusual size, 6" x 15" x 24". No other adobes approaching this size were seen on Monument.

The north wall of A 57 ended just short of the west wall, and the south wall ended in a treasure hunter's hole.

There was a hard, uneven adobe floor over much of this area. Immediately above the adobe floor were several layers of odd colored soil, quite porous and friable. These layers varied greatly in type and thickness, sometimes within a few feet.

Some examples are given below:

North side, A 55		East side, A 55		South side, A 55	
white	6½"	white	4"	white	2"
dark blue	1"	blue	1"	blue black	7"
light blue	7"	white	1"	light blue	5"
adobe floor	--	black	1"	black	2/3"
		adobe floor	--	white	½"
				adobe floor	--

North side, A 57		North side, A 57		South side, A 57	
white	2½"	(a few feet west)		white	3"
blue	2"	white	4"	black	1"
black	¼"	blue black	2"	sandy	
white	1"	very friable		sediment	2-3/4"
blue, pwd.	8"	soil from		brown	5½"
black	3/4"	white to		adobe floor	--
white	½"	yellow	5"		
adobe floor	--	adobe floor	--		

South side,	A 58	West side,	A 58	South side,	A 59
white	2"	white	2"	yellowish	5"
blue	2"	blue	1"	blue, ashy	4"
black	1"	sandy sediment	3"	yellowish	4"
brownish red	½"	blue	2"	adobe floor	--
blue	6"	brownish black	1"		
adobe floor	--	adobe floor	--		

North side,	A 60	South side,	A 60	Center,	A 61
white	3½"	white	3½"	white	5"
black	2"	black	½"	blue	5"
brown	1½"	sandy sediment	1"	black	1"
blue brown	5"	black	1"	blue, pwd.	5"
adobe floor	--	blue	¼"	adobe floor	--
		adobe floor	--		

Some of the laborers on the project believed these layers resulted from burning the manure of a corral on several occasions. Perhaps, their explanation is as good as any. Modern methods of farming would demand that the fertilizer be taken to the fields but, I was told, some of the more lazy native farmers have cleaned their corrals by burning within the last few years. Just what sort of soil would result from keeping a corral free of manure by burning, for a long period of time, is something I don't know, but I suspect it would appear much like the soil of these rooms. The black layers did contain small pieces of wood charcoal.

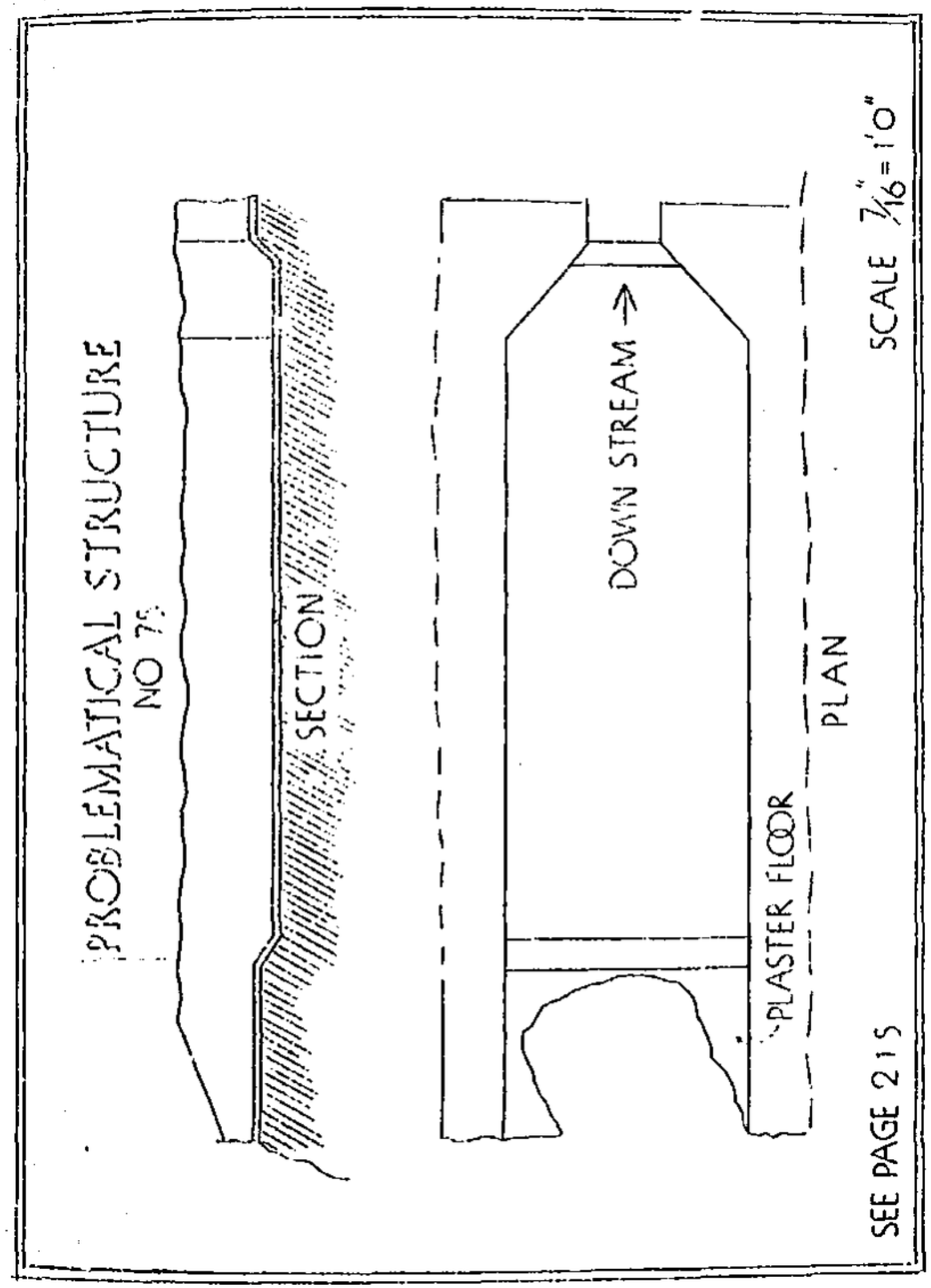
These layers extended over the walls of Areas 57 and 58, which indicates the corral (if it was a corral) was in use after the walls of Areas 57, 58 and 59 were demolished. Perhaps, Areas 55 and 56 were corrals at one time and Areas 57, 58 and 59 were stables or storerooms for husbandry supplies. Then with the abandonment of Areas 57, 58 and 59, Rooms 60 and 61 became the storerooms or stables. The short length of wall connecting the northeast corner of Room 61 with the southwestern corner of orchard would have maintained a stock-proof corral.

Perhaps, some of the fires were set by the Apaches who are on record as having burned Tumacacori several times. As they couldn't get much smoke from adobe bricks, they must have had something to burn.

ROOMS 60 AND 61

Some adobe bricks remained in place on the stone foundations, and a few carried white wash topped with red stain on surfaces inside the wall. Evidently they had been taken from another wall. One brick carried several layers of plaster thinly applied with a brush; first, white; then, red; then, white; then, black; and then, white.

Soil layers, not so thick but similar to the layers of Areas 55, 56, etc., were found in these rooms. The layers did not extend over the



dividing wall however. Nor did they extend south of these rooms.

The north wall of Rooms 60 and 61 was outlined by trenches on either side, and was never cleaned from the top. Possibly, doors would have been found. (Because visitors to the Monument had a habit of walking on walls newly uncovered, it was advisable to uncover the wall tops just before the rooms were to be backfilled. The laborers were taken from my charge before the refilling of these rooms was contemplated.) I do remember one gap, where a pit for an outdoor toilet had recently been excavated through the wall.

AREAS 66, 67, 68, 69, 70, 71, 72 and 74

Nothing found here other than the foundations. One of the younger laborers of project said that some of the younger boys of the neighborhood had scraped out a large swimming pool in this area, just a few years ago. Said lots of walls were found, and a few burials. The pool was filled from the nearby irrigating ditch which is probably the acequia mentioned by Prof. Wrightson, 1860.

AREA 75

75 was the number assigned to a problematical structure of burned brick, with plastered walls and floors. It was located in an irrigation ditch, about 14' inside south wall of orchard.

The constricted outlet would serve to raise the level of a stream flowing through this structure. The raise in water level might be desired to provide a "washing vat" or to introduce the water to another irrigation ditch. A 3" dip in the floor at the south end with a corresponding 3" rise at the north end suggests a secondary purpose for which I can not account.

ROOMS 19 to 36

Quoting from Prof. Wrightson's description: "To the south of the mission building, and fronting the church, was laid out a large plaza, which was surrounded by peon houses, thus forming a respectable village." Evidently this series of rooms represents the peon houses of the west side of plaza.

The east wall was eventually uncovered, and nowhere were there enough adobes in place to indicate a doorway. While this group of rooms had not been subject to much treasure hunting, water from the hills to the west had washed away much of the adobe and some of the light foundations. The thin wall between Rooms 23 and 24 contained some fired brick, indicating late construction.

Offsets in the side walls indicated that all rooms were not

constructed at the same time, but I was never able to tell which of two adjacent rooms was the older. Foundations of older walls were found under the east wall of Rooms 25, 26, and 27.

The only constructed floor was found in Room 23. It was made of broken and overfired brick, laid irregularly in adobe mud. One brick in the northwest corner of Room 21, elevation 60 2/10, may indicate the floor level. The floor level of Room 22 is more confusing, with 6 or 7 bricks in the southeast corner, elevation 59 6/10, and 2½ brick in the southwest corner, elevation 60 8/10. In Room 25, the small area of smoke-blackened, adobe floor probably represents a floor in that room.

The floor levels of the other rooms could only be approximated from foundation levels.

The only plaster of this group of rooms was found in Room 32, where the adobe wall bricks had been smoothed with adobe mud before an application of white wash. No red stain was discovered.

The benches of Rooms 25 and 26 were much alike, and appeared to be cheap imitations of the benches in the rooms around patio. They were constructed of adobe brick, plus a top course of fired brick laid unevenly in adobe mud. Many of the fired brick were broken; some were overfired and twisted; and, some carried a little lime plaster indicating their removal from other structures.

Foundations of other rooms in this group extended south to a distance some fifty-six feet beyond the monument boundary. The outside of the east and west walls had been uncovered when the project was taken from my charge. Later, the trenches were backfilled before they could be properly surveyed.

ROOM 79

Only a floor of broken, burnt brick, laid in mud, found here. This lay directly in an old roadway, a few feet from a cattle guard. Where there should have been stone foundations, I found nothing except on the west side where a wall, 3' long and three courses of burned brick high, remained. This structure was only a few inches below the surface of the road.

An old drawing of Tumacacori by J. Ross Brown shows a series of rooms in this vicinity. Several long deep trenches were excavated without finding anything. I believe he drew, with artist's license, the west side of plaza as if it extended west instead of south.

AREA 80

80 was the number assigned to the lime kiln some 100 feet north of the graveyard, beyond the monument boundary. This was a circular structure with a bench, 8/10' wide and 3' high, around the inside. The remaining wall above the bench was nearly 4' high. The floor was 7' feet in diameter. An arched doorway, 2 7/10' wide, through the southeast side would serve for introducing fuel.

The walls had been constructed with adobe bricks, but due to the intense heat needed to produce quicklime, the inner surfaces of the adobes presented the appearance of overfired bricks.

In operation, pillars of limestone would be built bench-high on the floor. Arches of limestone would be built from the pillars to the surrounding bench. Above these arches more limestone would be placed. Fuel would be placed under the arches and ignited. After burning, perhaps for 10 days and nights, the arches would crumble, and the bottom layers of lime would be ready for use. The stone which had not received enough baking, would be placed in the next charge. Of course, impure nodules in the limestone would be discarded as worthless. Thus, quite a bit of reject material would accumulate if the kiln was much used.

There were several mounds of rejects adjacent to this structure, besides some unfired limestone. We found a few inches of slaked lime (slaked by rain water) on the floor, close to the bench. As there was possibility of this structure having something to do with metallurgical operations, a sharp watch was kept for slag and pieces of ore. However, this is the one area on Monument where none was found.

Several mounds in this vicinity suggested the possibility of small dwellings. Two or three were trenched without finding anything. A stray sherd or two were found in this vicinity, as one might find near any long occupied Indian village.

AREA 37

37 was the number assigned to the area between the mission and the west side of patio. 37a was a large area east of nave, and 37b was the small area just east of bell tower. This was a pleasant area in which to work, being in the shade of the mission on warm afternoons and protected from the prevalent southwest winds at all times. Such a delightful spot must have appealed to the treasure hunters as most of the area had been dug and redug, usually deeper than I cared to discover.

The remains of the south wall of 37b was constructed of a mixture of fired brick and unweathered adobe brick. Perhaps there was a wall there before 1827, but the remains found appeared to be more recent.

An interesting feature of the area was the amount of copper it contained. Small pieces were everywhere in addition to a few large pieces. Altogether, some fifty pounds were collected. Samples taken to the University of Arizona were said to be copper with no silver.

There were three problematical structures of burned brick here which I have identified as units of a foundry. The north structure was identified as the retort. It was round in shape, and consisted of a deep foundation filled with sand. The top of the brick side walls was found at the present ground level, and the superstructure, perhaps dome shaped, had been demolished. The sandy floor inside was a few inches below the surrounding wall. The floor was almost covered with a thin layer of copper which had solidified in place. Small streams of copper had worked their way to a depth of six inches in the floor.

At the southwest side, an inch and a half below the floor level of the north side, was found a smooth, heat-darkened outlet for the molten metal.

About 1' 2" below the outlet was the top of another structure, 2' 8" high. This horseshoe-shaped structure of mud and fired brick is where the metal could have been cast. Obviously, it would be partially destroyed when the mould or metal was withdrawn.

Small lumps of sand, somewhat solidified from heat and coated thinly on one side with lime, were found about this latter structure. I believe they were pieces of moulds. Mr. Bounday told me of finding a mould of this type nearby. At first he thought it was the base of a statue, but later he decided it was the core mould of a bell. While he was conducting some visitors through the mission, another party arrived and dropped a heavy rock on the object. Of course, it crumbled into small pieces. No moulds found by me were complete enough to indicate what objects had been moulded.

The heat necessary for foundry operations could have been generated in a burned brick structure some four feet southeast of the retort. It was tunnel-like in appearance with the long axis north and south. Approximate inside dimensions were: 1' 0" wide, 3' 0" high, and 7' 9" long. Just north of this structure was a few square feet of earth floor reddish in color from heat. Its level was about two feet above the floor of the furnace. In removing the ordinary fill from the floor, a trench leading from the furnace to the north side of retort was discovered. I do not know whether this was a treasure hunting trench or whether it once contained a flue for conducting heat from the furnace to the retort. It was not lined with adobe or fired brick, nor did it show indisputable signs of heat. However, two brick appeared to be in place as a roof at one point. Perhaps a brick lining had been removed by vandals. I have no theory about the few square feet of reddish floor.

In operation, I believe a bellows playing on a charcoal fire in the furnace would drive enough heat through some sort of conduit to melt copper placed in the retort. The retort would be tapped at the outlet of southwest side, and the molten metal would flow into moulds placed in the structure below outlet.

Because of the churned condition of the soil due to treasure hunting activity, there was no means of accurately dating the foundry operations. As the retort lay in part above the wall of Room 17, it is evident they were subsequent to the abandonment of this room. This points to a late date. Further, it is doubtful that the Spanish Fathers would care to have a foundry so intimately associated with the church. I suspect the foundry postdates the abandonment of Tumacacori by the Spaniards.

CONCLUSION

The principal objective of the project was obtained in that the National Park Service now has maps of most of the walls and structures just below the surface. In the future it will be unnecessary to locate drainage ditches, pipe lines, adobe pits, etc., where they will do irreparable damage to the ruins. Further, rumors of buried treasure should die after 919 man-days were employed in excavation without finding material of five dollars value.

The almost total absence of worth while artifacts plus the greatly damaged structure remains, both resulting from unhampered treasure hunting over a long period of years, prevented the forming of many definite conclusions of archeological nature. However, differences in plaster types aided in many instances.

One series of rooms, 46 to 53, could be distinguished from the others by the use of whitewash topped with red stain. At a later date, during the last period of building activity by Spaniards, thick plaster applied with a trowel was characteristic of the rooms around the patio while plain whitewash was characteristic of the less important rooms about the plaza.

The present church carries a distinctive covering on the outside where groups of brown and black pieces of brick have been imbedded at regular intervals in the lime plaster. At an earlier period the building had been plastered both inside and out with a somewhat similar covering in which the spots were red in color and were irregularly arranged. This latter type was found inside Room 16, the sanctuary and the sacristy, and indicates that all were in use at the same time. It was found behind a pilaster which serves in part to uphold the dome over the sanctuary, so evidently the church has been remodeled with the roof changed and Rooms 17 and 18 abandoned.

Quite definitely, most plaster was applied evenly in a workmanlike

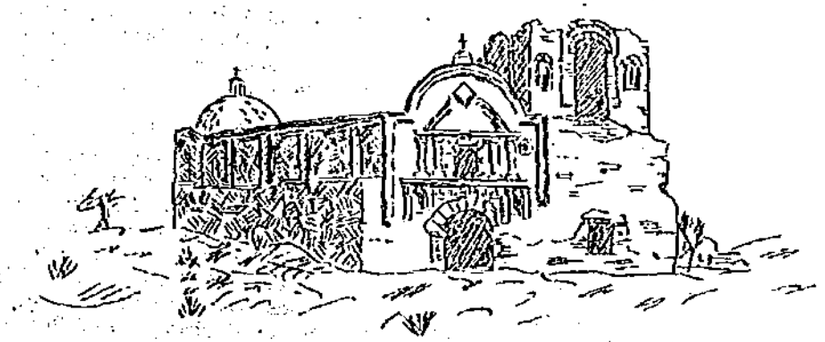
manner. The crudely applied plaster of Rooms 13 and 14 may be attributed to the native families who have lived there into the 20th Century.

The different types of plaster were not always associated with a special type of floor. On the north side of the patio, some rooms had floors of plaster on boulders, while others had brick floors laid in a herringbone pattern. Room 15 on the west side of the patio had a checkerboard floor of square bricks. The only room plastered with the red stained whitewash, 48, possessed a plaster floor.

Of particular interest were the problematical structures which were not positively identified as to purpose. Their identification must await further research at other sites less damaged by vandals. Nothing was ascertained regarding the date of the structures, and all could postdate the abandonment of Tumacacori by the Spaniards.

One thing quite obvious on the map of the ruins is that the area of Tumacacori National Monument is too small. The lime kiln is some fifty feet beyond the north boundary; several acres of the small orchard lay north and east of the Monument; while the south wall of the Monument was built across the series of rooms which formed the west side of the plaza. Just south of these latter rooms was the brick kiln (identified by Mr. Frank Pinkley at the time he restored the roof to the church in 1921), while southwest of this kiln is a ditch which applied water to the village.

Probably household water was procured from shallow wells, but none were discovered. Also, the rumored tunnel at Tumacacori was not located.



SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 16

THE VIKITA CEREMONY OF THE PAPAGO

BY

JULIAN HAYDEN
AND
CHARLIE R. STEEN
WITH
LIFE SKETCHES
BY
ISABELLE PENDLETON

·DEPARTMENT·OF·THE INTERIOR·
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THE VIKITA CEREMONY OF THE PAPAGO

BY

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·DEPARTMENT·OF·THE INTERIOR·
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Since this paper was written some doubt has been raised as to whether we are correct in saying that the ceremony took place in old Santa Rosa. One critic, Mr. S. J. Jones of Sells, Arizona, says that the village in question is named Ar-chi and is thought by the Papagos to be their ancestral home. We can find no reference to Ar-chi in the literature of the Papago country nor on maps of the district, however the site is also well known as Ak-chin (at the mouth of the wash).

THE VIKITA CEREMONY OF THE PAPAGO

By Julian Hayden

In November, 1936, a dance, marking the end of a four year period, and apparently combining a harvest ceremony with a rain dance and possibly a commemoration of the sacrifice of the children, was held at old Santa Rosa, Papagueria. The dance, scheduled for 1935, but for some reason deferred till 1936, began November 1 at old Santa Rosa and continued there for ten days. On November 11 a ceremony was held at the shrine of the children, west of old Santa Rosa. A second ten day dance began there on the twelfth, reaching its climax and its end on Saturday, November 21. The following is an eye-witness account of events taking place from twelve noon Friday, the 20th, to the end at four PM, Saturday, November 21.

Our party, composed of Charlie R. Steen, Junior Naturalist, Southwestern Monuments, Isabelle Pendleton and Julian D. Hayden, of Pueblo Grande, Phoenix, Arizona, reached Anegam, a large Papago village about two miles north of new Santa Rosa, at twelve noon on Friday. Stopping on the south border of the village, we heard singing and jangling of bells in the brush nearby, and saw wagonloads of Papagoes in holiday dress driving into the brush in the direction of the singing. A passing vaquero told us that it was permitted for white men to witness the dancing, so we followed a trail through the mesquite into a clearing, in which stood a dozen or more wagons, each with its family sitting in it or standing nearby.

In the clearing was a circular enclosure of tall arrowweeds, about ten feet in diameter, with an opening on the east side. A group of eight masked and costumed men was dancing in front of this enclosure, attended by a line of thirteen male singers, in work clothes, each man or boy with the half of a gourd tied over his face. Within the enclosure were several old men, also in work clothes, who apparently supervised the distribution of the articles carried by the members of the chorus. These, with an old man outside, seemed also to direct the dancing, correcting steps and gestures.

COSTUMES

Since the costumes of the masked dancers were the same, except for minor individual variations, as those worn on Saturday, they are described now. All wore great headdresses of turkey tail feathers, arranged in a clump tied to the top of the masks. Long feathers, one on either side of the clump, made by tying two or more feathers end to end, with white and in some cases red downy plumes tied to the upper ends, stood erect and waving above the headdress proper. The sack-like masks of deerskin or canvas had small eyeholes and a mouthhole, reached down over the shoulders, and had deeply fringed lower borders. The faces of these

masks were painted in a black chevron pattern, the chevrons arranged in columns side by side, about an inch wide.

Attached to the back of the mask, below the clump of feathers and at about the base of the head, was a strap or panel of variously colored cloth or canvas, hanging free, usually about 4 to 6" wide, and reaching to the small of the back. This panel was fringed, usually with short turkey feathers, and had ornaments fastened to it. These ornaments were, variously, of tin, cut into diamonds, squares, or circles, of mirrors large and small, of cutout paper figures representing both a person picking sahuaro fruit and a curious human figure with what seemed to be horns on its head. One back strap had the chrome plated hub shields of an Essex and Plymouth automobile fastened to it, brilliantly polished. Several had spread hawk wings tied to the panel edges in place of the turkey feather fringe. Others had the tail feathers of the Western Red Tail Hawk arranged side by side across the bottom, with turkey feather fringe on the sides; another had the spread tail of a similar hawk tied across the bottom. The fringe of one strap was of the green imitation grass used in Christmas decorations. Another had, in place of the usual panel, a medallion about two feet in diameter, of long hawk or eagle feathers arranged radially about a small central disc, and attached to the headdress by a slender strap.

Many or all masks had a braid or twist of horsehair or human hair attached to each side, hanging down over the dancer's breast, and ornamented with tufts of red down or other bright plumes.

The dancers wore white garments reaching to the knees, usually sleeveless. Some of these shifts or tunics were opened up the side from hem to armhole, with overlapping edges apparently held closed by the belts which the men wore. Others wore plain tunics without the side opening. The belts were varied. Many were of wide canvas, with cowbells and dinner gongs tied to them. These sometimes had a fringe of tinklers, made of cones of rolled tin five or six inches in length, hung by thread or copper wire from the lower edge of the belt. One man wore several immense brass bells, resembling sleighbells, three or more inches in diameter, on his belt. While most belts had a few bells, several were solidly hung with them.

Many dancers, in addition to a narrow belt with bells tied to it, wore fringed aprons, consisting of two roughly semi-circular pieces of canvas, one before and one behind, joined at the hips with string. One at least wore a black apron. Another dancer wore a cloth cartridge belt, with large wooden cartridges four inches long, painted red and blue, in the loops. At least one dancer wore a machete, in its scabbard, stuck through his belt. Some carried pouches attached to their tunics below the right breast, and several of these pouches looked suspiciously like ladies' handbags.

All the dancers carried quivers of arrows, the quivers being made of canvas, painted red or left natural color, or of skins. At least one quiver was made of the entire skin of a kit fox. These quivers were fastened across the small of the back at an angle, open end up and to the dancer's right. Many quivers were fringed.

Two or more men carried imitation powderhorns of cowhorn, in one case carried slung over the left shoulder and resting on the right hip, in the other, tied to the belt on the right side.

The dancers' arms and legs were bare, though a few men had shirt sleeves and Levi legs rolled up and showing beneath the tunic. Legs and arms were painted with what seemed to be white clay, decorated with groups of short vertical lines, done both in red paint and by scraping off the clay.

On the left wrist the dancers wore ornaments of skin, canvas, or of both. One wore the entire skin of a ringtailed cat wrapped around his wrist, the tail dangling. Other wrist decorations were made by wrapping the end of a long strip of material, two to four inches wide, once about the wrist, letting the end dangle a foot or more. These were often fringed, or had plumes tied to them, and were painted in colors. Many were red with white geometric patterns; one was yellow with diagonal green lines.

Each dancer carried a wooden arrow, fletched with turkey feathers, the point carved out the wooden shaft, or carried a wooden wand or lance, in the left hand. These were red, with white banding. In the right hand most carried a bow made of grotesquely twisted wood. These bows ranged from two to two and one half feet long, and were also painted red with white banding. A few men carried wooden guns, one being made of a twinned saguaro rib, the butt representing the stock, and the ribs the barrels of a double barrelled shotgun. One or two men carried cheap commercial popguns. Several men with guns carried arrows in their left hands, though others carried wands and used them as ramrods.

Legs were bare from knee down, and the dancers wore anklets of black leather or of black cloth on which were sewed one or more rows of cocoons, fastened by one end. One dancer's anklets were solidly covered with cocoons, as if he had strung them and wrapped the string spirally about his ankle. All dancers wore sandals, of leather soles tied on with thongs. In some cases cocoons were sewn to the ankle binding, on the outside.

The chorus was made up of both men and boys, and each member carried ceremonial objects in both hands. All but two were bare headed, and wore halves of gourds bound over their faces. These gourds were decorated with horizontal zones of color, consisting of a blue band one and one-half or two inches wide at eye level, a red zone, extending

from the blue to the top of the mask, probably painted with ochre, which bore white figures in dots or short lines, and the lower zone in white, probably clay, which extended to the bottom of the mask and bore designs in red, which varied with each mask. All these red patterns resembled the typical Papago black-on-red pottery designs, consisting of scrolls, hachuring, diagonal lines, diamonds, etc.

The two choristers who did not wear gourd masks were small boys, who wore instead sack-like coverings of canvas which fitted down over their shoulders. These were not fringed. On the crowns was a clump of mustard yellow material, possibly dyed cornhusks, about two inches in diameter and an inch high. The masks had eyeholes, round ears of some thick material, possibly rawhide, about two inches long semi-circular and concave, and plugs of round wooden sticks, each about three-quarters of an inch in diameter and three inches long, fastened to the mask in place of a mouthhole. One of these was straight with squared end, the other was hooked and pointed. They were not painted, nor did the masks bear any painting.

DANCE MOVEMENTS, SONG, RITUAL OBJECTS

The dancers and chorus at this noon ceremony on Friday performed evolutions which were simpler and less elaborate than those performed on Saturday. The chorus entered the enclosure and there received from the old men the objects which its members were to carry. The dancers meanwhile waited outside the enclosure, posturing and treading the ground and jingling their bells. When the choristers had received their equipment, they formed in line in front of the enclosure and marched single file around it, contra-clockwise, preceded by the dancers, who leaped and ran and cavorted in front of them. When they had completed the circuit, the chorus came to rest, facing south, the leader nearest the enclosure, and the dancers stopped before the entrance, in front of the chorus, in a group. During this march the chorus was singing, and continued to sing after halting, raising and lowering their right heels in time to the song. The dancers shuffled or stamped or leapt into the air as they pleased, always in time to the song. They did not follow any fixed pattern in their movements about the dance ground, but milled about in a group, some dancing in one spot throughout.

The song, always to the same tune, seeming to be repetitive generally in the pattern a-a-b-b-a, was wordless, the syllable o-o-o-oh being used throughout, although words may have been rendered indistinguishable by the muffling of the masks. The time was the same throughout the song, but the rhythm was varied. The range of notes was short, probably not exceeding an octave. At the end of the pattern, the chorus repeated twice a long drawnout o-o-o-oh, each beginning on the same note, increasing in volume and rising about a half tone, held for a moment and ending in a slight diminuendo and a very slight drop in tone. At the

end of each, just before the tone stopped, a high pitched, clear, two syllabled call was sounded by a chorister, possibly by means of a whistle, which resembled a phrase of turkey or quail conversation.

During the first o-o-o-oh, the choristers raised the objects which they carried to armslength above their heads; during the second, they lowered them again to waist level. The dancers poised themselves at the end of the tune, and violently shook their hips during each o-o-o-oh poising again at attention between the two. The chorus repeated the song several times while standing in line, then trotted around the enclosure in silence, preceded by the running dancers, and entered it, giving their objects back to the old men and receiving new ones.

The objects which they carried varied with each period of dancing. No order or sequence in the distribution was noticed, though the cotton covered triangles, described below, were carried at intervals. These objects were, variously, slender wands 18" long or so, painted red with white banding; similar wands with desert grasses, possibly Indian wheat, tied around them at the top; slender wands, red, with balls made of raw cotton, about 4" in diameter, formed on the upper end, and with zigzag brown lines radiating from the top center and running down the sides; isosceles triangles held upright, the downward extension of the two long sides serving as handles, and the triangles filled in solidly with raw cotton, with a zigzag brown line on the front; husked ears of corn.

The chorus also carried, during one period, a flat, stretcher-like framework covered with white cloth, about eight feet in length, with rounded upper end, made by lashing light cross pieces to an outside frame. This was carried upright by several choristers, and the other choristers took sahuaro fruit-gathering sticks from the sides of the enclosure where they had been placed, and supported the frame with these hooking them over the top. These poles were about twelve feet long, with a short stick crossed near the top at an angle, the whole painted red. When the period ended, these poles were stuck back vertically into the arrowweed walls of the enclosure.

This dance lasted possibly an hour and a half. Towards the close, the old men inside brought out bundles of the objects, wrapped in burlap or blankets, and placed them in the wagons. They also brought out several bundles of clothing belonging to the dancers and put them also in wagons. Men also brought out gourd vessels, painted white with red designs trailing from the mouths, and placed them in the wagons. Several of these were wrapped in sacking.

At the close of the dance, the choristers took the cloth-covered framework and arranged themselves about it as if carrying a stretcher. The dancers grouped themselves at the forward end of the chorus, carrying the sahuaro poles, and they all set out down the road to old Santa Rosa, to the southeast a couple of miles. While the chorus and dancers

were forming thus in procession, boys and men, not in costume, brought out bull roarers, and these formed the vanguard, keeping the bull roarers whirling continually.

These bull roarers consisted of two pieces of wood, each about 18" long and about $\frac{1}{4}$" thick, an inch wide at the upper end and two or more inches wide at the outer end, which was cut to a short point. The pieces were attached to each other by a heavy cord five or six feet long. The sticks were painted, usually with red ochre, with geometric designs in white on them, of hachuring, diagonal lines, diamonds, or bands. A few were painted with white clay, with red decoration.

The wagons fell into line behind the dancers and chorus, some twelve or fifteen of them, dogs and colts trailing along, young bucks on horseback riding up and down. A little over half way to old Santa Rosa the procession halted, and the dancers and chorus marched into a field to the left of the road. Here they rested a few moments, while the men got water to drink, and then sang and danced there in the field for about half an hour. Dancers and choristers alike broke ranks as they pleased and went into the brush, resuming the dance when they returned. The chorus did not march during this dance, although the song was the same as before, but formed in two lines facing each other, one on either side of the framework, which had been laid on the ground. The dancers were grouped just to the north of the ranks. We did not see whether or not the chorus carried any objects during this dance. At the end of this time the procession formed again and resumed its way, preceded by the men and boys with bull roarers.

Just before reaching the plaza at old Santa Rosa, the procession stopped, the wagons going on to the dance ground, the dancers and chorus remaining in formation while girls came running with blankets. They held the blankets up, apparently to shield the dancers from view of the crowds in the plaza. After a wait of half an hour or so, the dancers moved to the north edge of the plaza and halted again, still screened by the blankets, which were held before and about the group during this last short march.

Another group of dancers was gathered on the opposite side of the plaza 300 yards or so to the south, screened behind brush.

We were told by Papagoes that a similar dance was held that noon both in old Santa Rosa and in new Santa Rosa, and that both the Anegam and old Santa Rosa groups were now waiting for the new Santa Rosa group to arrive. During this wait the Anegam men lay down on the ground and rested.

The dance ground here was laid out between two NW-SE trending lines of houses, a hundred or more yards apart. A square enclosure of cane and tall arrowweed, neatly tied between horizontal poles into

walls about eight feet in height, had an entrance in the centre of the east side, and was oriented so that the sides lay NxS, ExW, respectively. This enclosure was about 30' along each side. Directly west of this and probably fifty feet away was a lean-to open to the east and west, measuring perhaps 12' across the entrance, and 10' deep. Between this and the enclosure was the dance ground proper, about which the chorus marched in a circle about 30' in diameter, as described below.

In front of the entrance to the enclosure, distant 30' or so, was a great pile of mesquite logs. About three P.M. small groups of gaily dressed women and girls, one group from the Anegam villagers and one from the old Santa Rosa, ran to the pile of wood. Each woman took up a piece and ran to the enclosure and left it, running out and making a complete circuit of the enclosure before running off the dance ground to her own people. This was done to the accompaniment of much laughter and gaiety among the crowds of women and spectators. Later, just before four P.M., and the beginning of the dance, after the new Santa Rosa dancers had arrived, this was repeated.

Meanwhile, many wagons had arrived, ranging in a great crescent about the west side of the dance ground, with the lean-to as center. School busses full of children from Sells Day Schools drove up, and several truck and trailer loads of Papago cotton pickers, brought in by white men from the direction of Casa Grande.

At four P.M. the new Santa Rosa dancers and chorus, who had arrived shortly before, drew up in front of the enclosure, where they were joined by the local dancers and chorus. The Anegam group moved up to within 30 yards or so and halted. A crowd of men, mostly young men and a few boys, assembled, all with bull roarers, and raised a tremendous noise. The combined groups of dancers then trotted and ran around the enclosure several times, accompanied by the wielders of the bull roarers as well as by men and boys who ran alongside, laughing and shouting. The dancers clowned all through this, shaking their bells and cutting up in comical fashion.

The choruses of the two groups dashed inside the enclosure, without running around it, carrying their equipment, and remained inside. The Anegam group joined in after the others had made several circuits, the chorus going directly inside the enclosure.

Then, the choruses inside, the dancers outside, singing began within. It seemed the choruses remained separate inside the enclosure, one in the SE quarter, one in the NE, and one in the NW quadrant. These choruses sang the same song as that sung at Anegam, but not in unison, each chorus singing independently of the others. The masked dancers outside stationed themselves in groups, one outside each corner within which a chorus was singing, and kept time, shuffling and stamping and jumping, to the chorus opposite which they were stationed. Dancers

from each group continually broke ranks and ran to the next, hesitating as if to catch the new rhythm, and joining in, only to break again in a moment or so. When darkness fell, most of the dancers were gathered on the north side of the enclosure near the NW corner, although a few were at each of the other two corners. This was all accompanied by much clowning and grotesque pantomiming, with hilarity in the crowd of onlookers, now numbering several hundred Papagoes.

After dark, about eight P.M., the number of dancers seemed to diminish, and many were running about over the plaza and among the crowds. We were told by a Pima that the masked dancers did individual dances before the camp fires of many or all of the Indian families gathered there, and asked for food. This received, the dancer put it in his pouch and ran with it back to the enclosure, where it was placed in the common supply for the dancers during the night. Within the enclosure six fires were blazing, about which throughout the night the dancers and chorus and onlookers warmed themselves. At four A.M. the dance stopped, the performers presumably getting some rest, and was not resumed till just before seven A.M., at sunrise. During the early hours of the morning, at least, only one chorus was singing, and few dancers were about.

The plaza was a colorful place Friday night, scores of camp fires blazing, masked dancers jingling about among the wagons and here and there in the darkness of the plaza new arrivals, in wagons and in cars, coming up and making camp, the singing continuous, with the repeated o-o-o-oh at the end of the tunes affecting us much as does the never-ending beat of the drums at other Indian ceremonies.

Before daylight the camp fires were burning brightly, lighting the great crescent of closely spaced wagons; a few babies cried here and there, and the soft pat-pat of women making tortillas was a monotone underlying all the varied sounds of the encampment. Horses whickered in the fields about the village, and now and then a mule brayed. The dancers were silent, save for an occasional jangle of bells as some dancer joked and postured for his friends about a fire.

The sun rose behind clouds, a brilliant dawn turning to a grey, cold morning. As the light grew stronger, but before the sun was surely above the desert ranges, the dancers began to gather in front of the enclosure. Just before seven A.M. they marched, jangling bells and cavorting in high spirits to the dance ground between the enclosure and the lean-to, and there broke ranks and gathered with the crowd of spectators on the south side of the dance floor. Visitors came running from all sides to the spot where they were, and we could not find out what was happening. A Papago, camped beside us, suggested that a fight was going on, but the crowd was quiet and orderly, though interested, and we were inclined to discount his opinion. Soon, however, the dancers broke away from the crowd and ran to the entrance of the enclosure, where they waited for the chorus to appear. There were now two choruses only,

one which was to march out with the dancers, and one which was to remain inside. Singing began, the same song as that sung during the night, and one chorus, of about fifteen singers, in elaborate costume, emerged from the enclosure and, preceded by the herd of dancers, marched to the dance floor. This chorus sang independently of the chorus inside.

Meanwhile, from somewhere came two score or more of men, all in army overcoats, who lined up against the west side of the enclosure outside, some standing, some sitting, as though they were privileged persons occupying reserved seats.

The chorus carried, the first time, the triangular forms of cotton, representing, we were told, clouds, the brown zigzag lines signifying lightning. The costumes of the chorus were, in the main, as follows. Each man or boy, most were in their teens, was stripped to the waist, with bare legs and feet. They wore skirts brilliantly colored, both of cotton and of rayon, reaching to the knees. Many of these skirts had had panels in contrasting colors sewn to them, and one in particular had a vertical red panel on the left side of a blue skirt, with the four playing card symbols appliqued on it in blue. Several had Christmas tree decorations, tinsel, glass balls, etc., sewn to their skirts. Each chorister had, stuck in his belt behind, a pair of bull roarer sticks, nearly all of which were red, with white decoration. They all wore anklets of black material with cocoons sewn to them.

From the waist up the choristers were painted red, spotted all over with inch wide circular daubs of white clay. About their necks all wore bright silk rodeo neckerchiefs. One boy wore a mirror strapped across his chest with bright ribbons. Several boys wore strands of Christmas tinsel, like crossed bandoliers, over their shoulders. All wore the gourd masks, with the exception of the two little boys who wore the sacklike masks described above. These boys also wore skirts.

At the head of the chorus, which marched in single file except when several had to help carry floats, the two little boys trotting alongside near the head of the column, was a leader. This leader, a middle-aged man, was clad in a plain white tunic, belted at the waist and reaching to the knees. His legs were painted white, and he wore sandals; his arms were bare and painted white, his hands were black. About his head he wore a white band in which on the left side was stuck a long tail feather of hawk or eagle. The upper half of his face was painted black, and the lower half smeared with white.

This leader carried in the crook of his left arm a deep tray basket of Pima manufacture, about 16" in diameter, painted white and black inside and out in alternate eighths. In the basket was white meal, which held in place four sectors of short, dark turkey feathers, lying against the inside of the basket.

The chorus marched to the dance floor in single file, the leader, head bowed, in front. While the dancers, numbering about 34, grouped themselves near the center of the dance floor, the chorus halted facing south, on the north edge of the floor. Here they sang for a few moments, repeating the song more than once, the dancers jangling their bells at each long drawn out tone. Then the chorus marched again, still singing, making a complete circuit of the floor, while the dancers remained in the center, still dancing. This circle was about 35' in diameter. The chorus halted in front of the lean-to, facing east, and sang the tune through several times, possibly four in all. The leader, when the chorus had halted, walked back along the line, tossing a pinch of meal upon each one in turn. Then the chorus, ending the song, followed their leader in single file off the dance floor, marching along the south side of the enclosure and into it, while the dancers ran on ahead and waited for them outside, near the northwest corner.

Inside the enclosure, the second chorus, in similar costume, had been singing, holding the objects which the marching chorus was to carry on its next circuit. A number of times this chorus ended its song before the marchers had arrived, and waited in silence until they had entered. The outside group took the objects, and formed again at the entrance and began the march, resuming their song while the inside chorus received new objects from attendants and began the song also.

In the entrance of the lean-to, facing east, stood six people in costume, who apparently paid no attention to the dancers and chorus. Two girls in their teens, one younger than the other, stood side by side in the center of the entrance. They were flanked by two boys, one on each side, who in turn were flanked by two middle-aged men. The two men wore costumes similar to that worn by the chorus leader, were similarly painted, and held the baskets of meal. The two boys were nude to the waist, wore brightly colored skirts, and were bare legged and barefooted. The left half of their heads and torsos was painted black. Each wore a white head band with a feather stuck in the back of it. In their left hands each held a miniature bow and arrow, also painted black. The two girls wore ankle length skirts of bright material, one of brilliant green rayon, and were barefoot. Their arms and shoulders were bare, their upper clothing consisting of two wide ribbons or sashes crossed over the breasts and reaching the waist. The younger girl, in the green skirt, wore purple ribbons. These girls hold in their right hands husked ears of white corn.

An old man who seemed to be attendant upon these four young people was dressed in blue denim trousers and coat, and wore a headband and feather. Inside the lean-to was a seated man in a white tunic and head band, with the lower half of his face painted white. His arms and hands were also white. He had in front of him several large bowl shaped baskets, inverted, and painted white. Throughout the morning he beat on one of these baskets with a stick, in slow even tempo, the beats about

DESCRIPTION OF PLATES 1 TO 6

1 - Member of the chorus

2 - Objects carried by chorus and dancers

3 - Dancer, front view

4 - Dancer, rear view

5 - Costume of chorus leader and of the attendants in the lean-to

6 - Lean-to with attendants and four young people

PLATE NO. 1

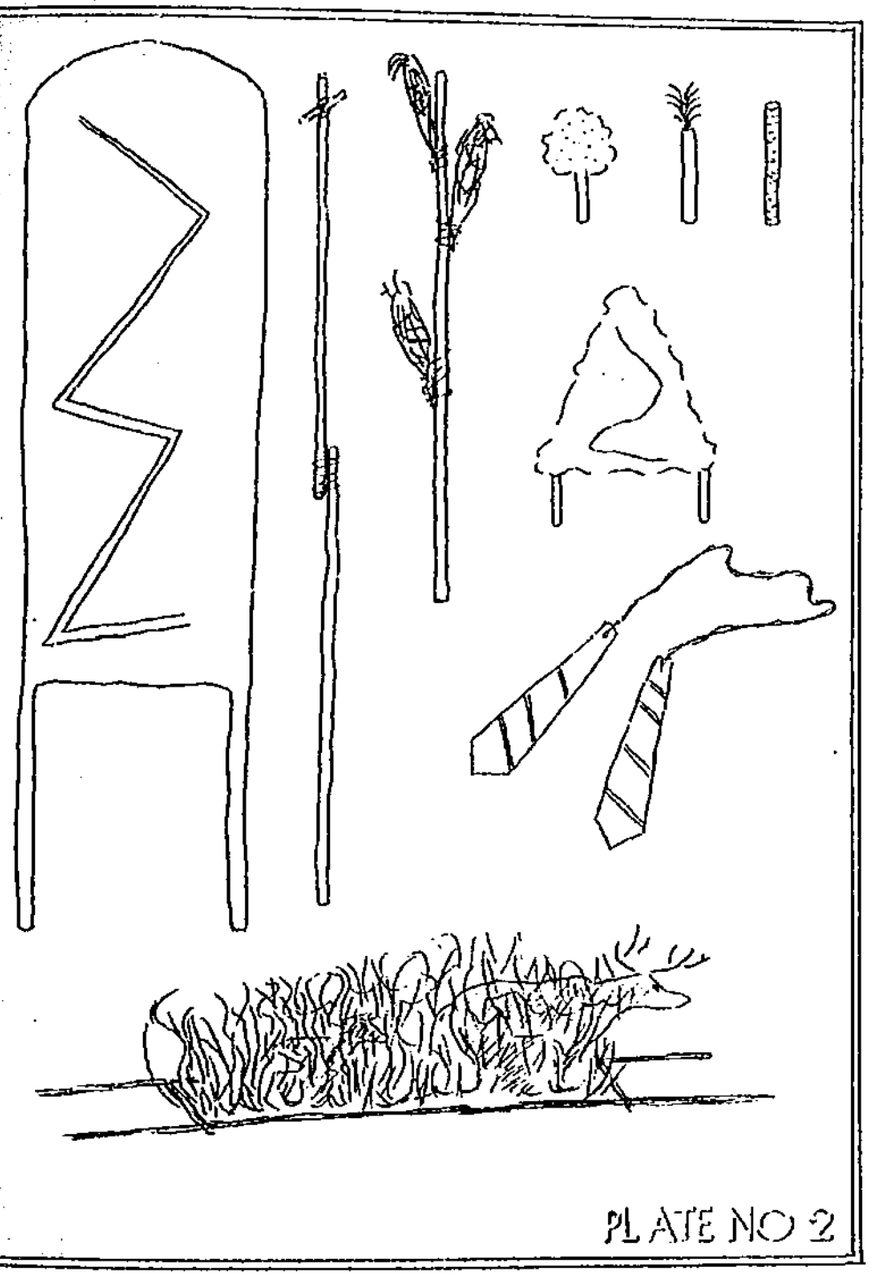
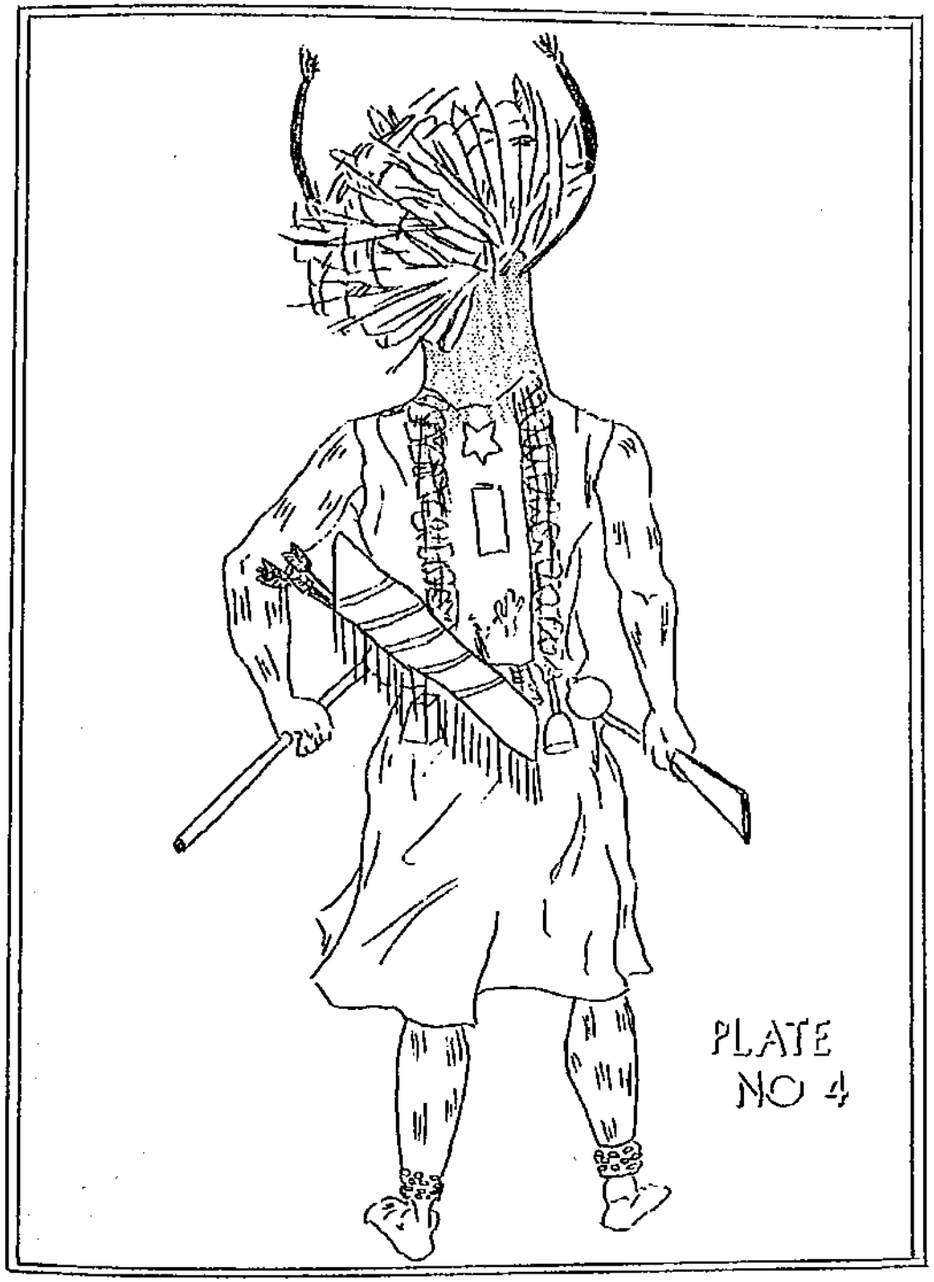


PLATE NO 2

PLATE NO.3



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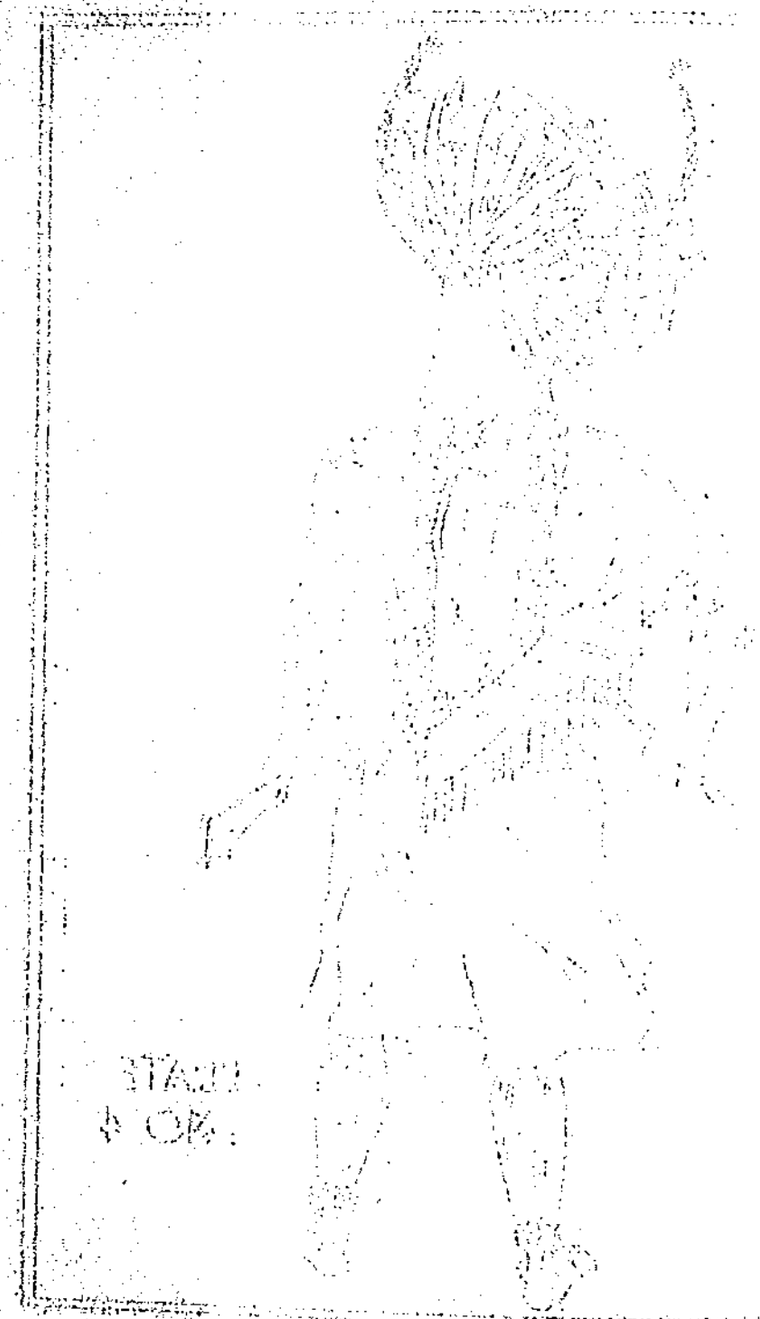

PLATE NO 5

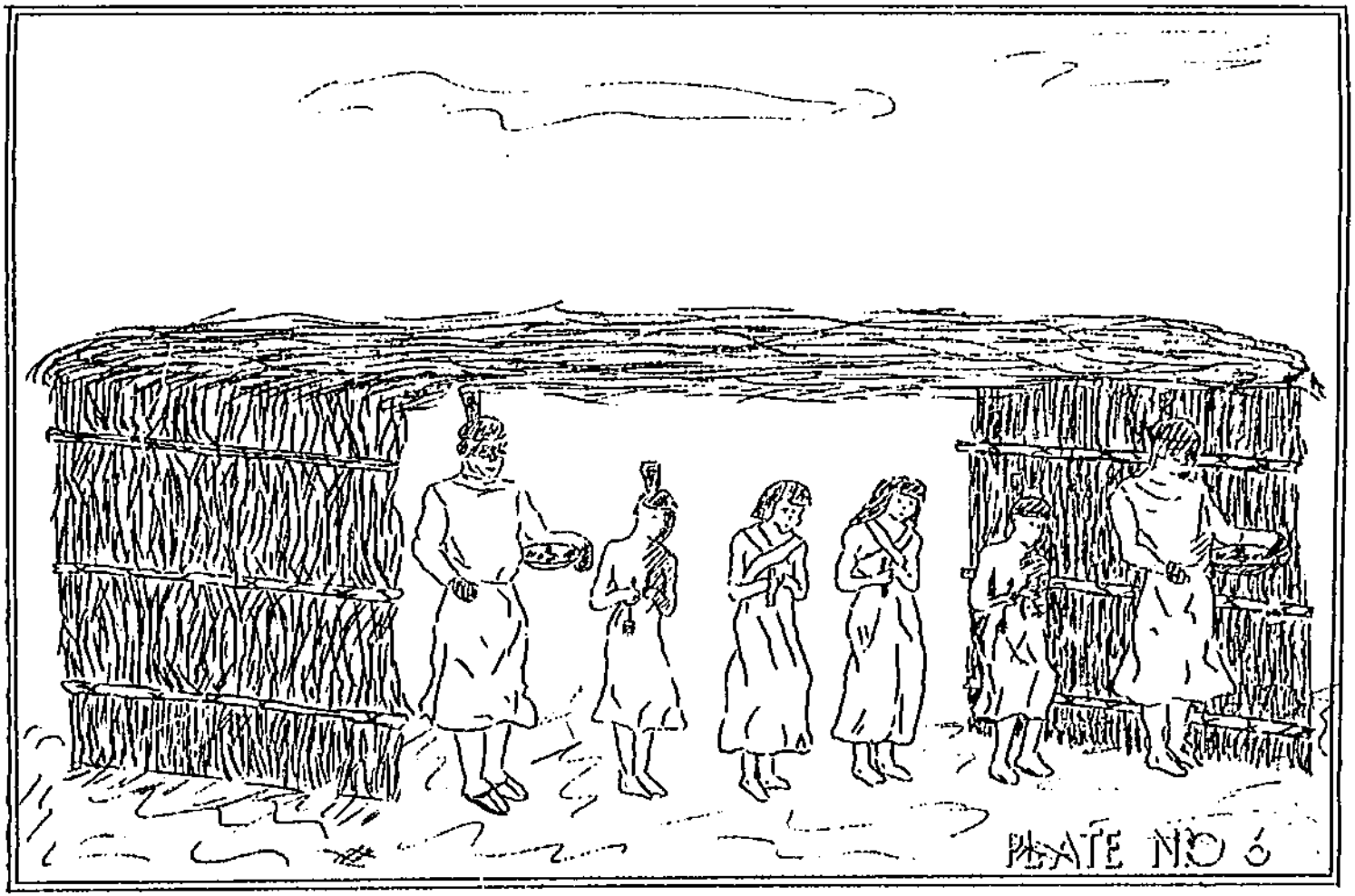

PLATE NO 6

four seconds apart. Throughout the afternoon he pulled a stick across a notched and concave piece of wood supported between two of the baskets, in the same tempo. He held the far end of the notched stick firmly against the basket with his left hand, and pulled the other stick toward him with his right. The movements were evenly spaced, but abrupt.

The two boys, arms stiff at sides, extended them slightly at one drum beat, and returned them to position at the next. The girls bent a little at the knees at one beat, and straightened at the next. The denim-clad attendant watched over these four like a hawk, correcting the angle at which the girls held the corn, or the boys their bows and arrows, tilting their heads up if they drooped, and wiping their faces carefully with a cloth every few minutes. These four, at intervals of possibly half an hour, were helped to a kneeling position by the attendant, where they remained, heads bowed and eyes closed, for perhaps ten minutes. At the end of this time the attendant carefully helped them to their feet again.

The men in white walked up and down at intervals in front of these four, and spectators were seen to walk with them on several occasions. What they or the spectators did we could not find out. Many of the people in the crowd watched these performers in the lean-to with great interest and respect, and the whole atmosphere of this part of the ritual was that of solemnity, in contrast to the clowning of the dancers.

During the morning, the chorus carried many different objects, including several elaborate floats. In addition to the objects carried by the chorus at Anegam, there were red staves about 6' long, with bundles of grass, resembling ears of corn, tied to them at intervals. Similar staves were carried at another time, with the addition of what seemed to be imitation corn tassels on the top of each one. Husked ears of corn were carried at least once. Each of these different objects was carried more than once during the day, notably the "cloud symbols" which were carried at more or less regular intervals.

The first float was a well stuffed deer standing on a stretcher-like framework of poles. The dancers prepared for his appearance with a great hullabaloo and much pantomiming, some crouching and aiming their guns, others pretending to set up blinds of grass, others stalking the deer and hunting for tracks. When the deer appeared, and during the marching, the dancers aimed at it with guns and bows or touched it with lances. The men with guns pretended to place the charges or to clean the barrels with their ram rods. The crowd applauded all this with much excited talk and many jests, answered several times by dancers who ran at the crowd and scattered the onlookers with fierce charging and warlike gestures. The chorus carried tiny bows and arrows painted red, held at the draw, each chorister aiming his arrow upwards to the left.

Later, after the chorus had marched several times with small objects, another float appeared, this one long, with four deer in single file upon it, with short arrowweed tied to it in bunches to simulate brush. These deer were made of dried deer skins and heads stretched over frameworks of sticks.

Another float, some time later, bore a deer and two fawns, in single file, partially concealed by clumps of arrowweed. Beneath the deer on the float was a small hemisphere of black cloth, about 12" high, and on top of this perched a bird cut out of thin wood and painted black. It had a humped back and large hooked beak.

The last float of this kind bore one deer, a shaggy old brute with tremendous grizzled head, the hide stretched crudely over sticks, as was done in the case of the two preceding deer floats.

The dancers went through the same performance with each one of these floats, and the chorus carried bows and arrows with each. Beside the deer floats, there were several others. One, requiring six choristers to carry it, was a long stretcher on which was a model of Baboquiviri, some four feet long and two feet high, with the peak standing a foot above the sharp ridge. This was of cloth stretched over a frame, painted an uneven green color. Behind the mountain, one on each side, were two pyramids of white cloth, about a foot high. In front of the mountain, and on the same float, was a large black hemisphere, some two feet in diameter, on which perched a bird, possibly a foot high, cut out of a flat piece of wood. This bird also was humpbacked and had a large hooked beak. The wing, beak and legs were black, the rest of the body and the head were white. The chorus carried triangles in this procession.

One float, coming later, was a representation of Santa Rosa mountain about three feet long and twenty inches high, sharp ridged. This was painted a dirty grey color and on it were sahuaros about ten inches high, painted blue. Just below the peak, on the side of the mountain was a human figure in black, cut out of flat wood, square-shouldered and square-headed, about six inches high. Its arms were straight and held out from the sides, and its legs were bent out at the knees, feet apart.

Another float consisted of a roughly hemispherical frame, covered with brown cloth, about 3' long and 2' wide, on top of which stood what seemed to be a clump of grass about 6" high. A similar float, but smaller, a foot and a half in diameter, was carried later by one man of the chorus, and this had what seemed to be two green corn leaves sprouting from the top of it. What the choristers carried with these floats we did not notice.

In the afternoon a white cloth covered framework similar to that carried at Anegam was brought out. This was about ten feet high and four feet wide, with a bilobate top, each lobe the same size, one of which had a smaller lobe at its edge just below the top. The high wind which came up before noon made this an extremely difficult thing to carry, and the dancers, propping it up with sahuaro sticks, were hard put to it to keep it from blowing away. In this period the dancers discarded their bows and arrows, took up the sahuaro fruit gathering poles and held the frame upright by hooking the short sticks at the end of the poles over the top of the frame. A similar framework was brought out a little later, probably the same one carried at Anegam.

After this a float bearing a blue mountain about 3' long and 18" high appeared. Triangles and semicircles of white paper pasted on light stick frames were fastened upright about and on the sides of the mountain. The choristers carried triangles behind this float.

The last float observed was a hemisphere on a stretcher, some four feet in diameter, solidly tied in with raw white cotton, and with brown zigzags leading from the top centre down the sides. This was almost demolished by the wind before the procession was completed. The choristers carried the wands with the cotton balls on the upper ends during this period.

About ten A.M. an east wind came up, blowing in gusts, and increasing in velocity as the day wore on. The dust blew in dense clouds, along the north and south sides of the enclosure, across the dance floor and directly into the lean-to. How the four young folks there breathed at all was beyond our understanding. The old man was continually wiping their faces, especially their eyes, with his cloth. In the afternoon the dust was so heavy and thick, swirling in stinging blasts, that we could not see the dancers eight feet away from us. A little girl sitting on the front bumper of a car nearby went to sleep and fell off on the ground without waking up. An hour later she was drifted deep in sand, and we were afraid she would suffocate.

About 11:30 A.M. the chorus entered the enclosure and remained inside, and we were conscious of a renewed interest and vitality in the crowd of patient and dusty spectators.

A dancer ran around to the dance floor and there, with a stick, described a circle on the ground, about 8' in diameter, leaving a narrow opening on the east side. He then returned to the group, waiting on the east side of the enclosure. Then several dancers ran to the dance floor, each carrying a gourd, painted white, with red lines trailing from the rims, each with a stopper of wadded cloth, and very carefully set them upright around the circle, just inside the line, scooping out a hollow in the ground to hold each gourd upright. These men entered the circle on hands and knees, head down, as though crawling

through a low doorway. Other dancers, by twos and threes, did the same, while the dancers already on the floor postured and clowned and apparently made fun of the newcomers. When most or all of the dancers had brought in their gourds and set them up, the whole group ran around to the front of the enclosure and halted for a moment. Then the group again ran to the dance floor, one man carrying an effigy of a deer, made by stretching a small deer hide over a stick framework, with antlers tied to its head.

This the bearer set on the gourd just south of the circle, and the dancers stalked and killed it with lances. This was accomplished with the most grotesque pantomiming, the dancers creeping up on the deer and spearing it. The crowd of spectators enjoyed this tremendously, cheering on the hunters and offering advice. Meanwhile the high gusty wind kept blowing the gourds over and rolling them on the ground, so that the dancers had to chase them and put them back in place. A little yellow puppy, very much excited by the uproar, dashed into the milling dancers, barking and chasing them. The dancers turned on the pup and pretended to hunt it, finally chasing it off, brandishing their weapons and leaping into the air. This also was much enjoyed by the onlookers.

After the deer had been dispatched, it was skinned and divided, still in pantomime. Then the dancers gathered in a great circle, tangent to the east side of the circle inscribed on the ground, and sat down. The ensuing few moments were apparently spent swapping lies about their hunting exploits, one holding his hands apart to describe the length of his catch. Another took a Bull Durham sack from his pocket and pretended to roll and light a cigarette. Others reached over and took up gourds, only to be stopped and apparently scolded by two men who sat in front of the entrance to the circle of gourds.

Soon, however, the men guarding the gourds turned and on hands and knees took them up and passed them out through the entrance. They were handed about the circle of seated dancers, who removed the stoppers and pretended to drink deep from the vessels.

Now occurred a drunken riot in pantomime, in which the dancers became drunker and drunker, and the action more and more ridiculous. One man imitated a drunk sick to his stomach, with appropriate motions, collapsing on the ground and rolling about, helped up by other drunks who then collapsed with him. Others performed various obscene gestures, mimicking the discharge of natural functions, and evincing a rather considerable knowledge of various perversions.

One by one the drunken dancers staggered off the dance floor, breaking into a run when outside the ring of spectators, and going to the enclosure. Last out were three, apparently boon companions, who had a most difficult time helping each other off the floor, complicated by the puppy, which dashed about them, yapping and snapping...

at their heels, quite terrifying them.

Now, the time being twelve noon, the crowd dispersed to its various camps, and ate lunch, and for about an hour no dancers or choristers appeared.

About one P.M. a few dancers straggled out of the enclosure, as if to warm up before the afternoon performance, and by two P.M. the dance was in full swing again. The wind and dust had increased, and a heavy black cloud was moving up from the southeast, from the direction of Baboquivíri.

The dance from two until four P.M. employed no new floats or objects other than those noted above, but about 3:30 the young people in the lean-to, with their attendants, disappeared. The crowd began to disperse, and an old Papago told us that rain, for which they had been dancing, was coming soon, that the dance would end before five, and that after the dance, in the evening and night, everyone would get drunk. We left at four, and as we left the crowd of spectators, the dancers were coming out carrying hoes and rakes, the choristers carrying sticks on which were imitation ears of corn. The rain was almost upon us then, dense clouds of dust preceding it and blotting out the entire scene.

The dust was so heavy in the moments before the rain began that we had to stop our car, unable to see the road, or even houses and corrals within three feet of us. Then the rain started, and in this rain we proceeded homeward.

MORE ABOUT THE VIKITA CEREMONY

By Charlie R. Steen

During the summer of either 1922 or 1923 Mr. Frank Pinkley and Mr. George Boundey were camping in the Papago country and were told by an Indian trader that a large amount of old Papago ceremonial material was cached northeast of the village of Santa Rosa. The two men decided to look for the cache and left Santa Rosa by the road which leads to Ajogan. 1 mile north of the village they left the road and followed a narrow trail which led east through the mesquite thickets, and at a distance of about a half mile came upon the remains of a brush enclosure similar to that which was used at Santa Rosa in 1933. In the immediate vicinity of the enclosure was found much paraphernalia which the Papagos claimed to have been used during the Vikita; some had been shoved under coral mesquite and some deposited in the forks of the branches of taller trees. Apparently, at the conclusion of the dance, the Indians had secreted their costumes and other objects which had been used where they might be hidden from prying eyes; no attempt had been made, however, to prevent deterioration for everything was exposed to the elements and badly weathered.

The dance at this enclosure, according to the best information available, had been held in 1911. Several facts suggest that the Indians had intended or desired that this equipment be used only once, and that when the time for another ceremony arrived that a new enclosure and new accouterments for the dancers be prepared; these are: The enclosure had not been kept in repair (and apparently had seen no more use), the costumes and devices carried by the dancers had been discarded and at least two dances had been held since this dance area had been used.

The Papagos of both Santa Rosa and Ajogan felt a sort of half reverence for the site but when Pinkley and Boundey asked permission to gather specimens of the material lying about no objections were made. Some time later, in fact, Indians from the Santa Rosa Valley expressed their satisfaction that the articles were being cared for. Their attitude seemed to be that although they were unable or unwilling to provide a place of safekeeping for these ceremonial objects they were glad to see someone else do it.

Accounts of the Vikita (Pima-Navitco) are rare in ethnologic literature. Lumholtz (4), Russel (5) and Mason (3) have recorded second-hand descriptions or have described collections of ceremonial material which had been used in the dance, but as far as we have been able to determine there are no written accounts by an eye-witness. Dr. Frank Russel, in his paper on the Pima Indians, described the following objects or customs which were also noted during the dance of 1933 or which have a direct bearing on the ritual.

"The Papagos have a tradition that the gourd was introduced by Navitco a deity who is honored by ceremonies at intervals of eight years - or if

crops are bountiful - at the end of every four years at Santa Rosa." p 91.

"Dr. McGee has called the writers attention to the fact that the angle at which the hook stands (on the saguaro gathering stick) is of great ceremonial importance among the Papagos", p 103.

"During his stay among the Pimas the writer heard of but two wooden masks being in their possession. One of these was collected and is here depicted in Fig. 26. Dr. Hough called his attention to the fact that it resembles those made by the Yaquis of Sonora, and it is probable that the conception, if not the mask itself, was imported from the south along with the masked Navitco ceremonies, despite the assertion of its former owner to the contrary, because it represents a higher degree of skill in woodworking than the writer has seen done by a Pima. It is of cottonwood, perforated for the insertion of horsehair eyebrows, chin whisker, and two tufts in the center of each cheek, and is ornamented by an interrupted scroll and other lines unmistakably intended to be decorative. The mouth contains a half dozen pegs, giving a very realistic representation of teeth" p 108.

"Any shallow basket of sufficient size, such as are in common use in every household for containing grain or prepared food, may be transformed into a drum by simply turning it bottom up and beating it with the hands. In accompanying certain songs it is struck with a stick with rapid glancing blows." p 167.

"The notched or scraping stick is in very general use to carry the rythm during the singing of ceremonial songs. When one end of the stick is laid on an overturned basket and another stick or deer's scapula is drawn quickly over the notches the resulting sound from this compound instrument of precussion may be compared with that of the snare drum--" p 167.

"A disk rattle that has been used in the Navitco ceremonies was secured at the village of Pe-eptcilt. It is not a Pima instrument but whether Papago or Yaqui the writer cannot say. It contains two sets of four disks loosely held by wires passing through a wooden handle." p 168.

"From the same individual who owned the disk rattle the writer obtained a rattle that had been used as a belt during the Navitco ceremonies. It is made of successive layers of canvas, red cotton cloth, oil cloth and an old braided hatband, to which are attached by leather strings 21 brass cartridge shells.

"There are two sets of cocoon rattles in the collection that were worn in ceremonies. The cocoons were obtained from the Papagos or Yaquis of Sonora. They are of a specie of bombycid moth; their outer coverings

have been removed, and a few gravel have been sewed into each cocoon. There are seventy pairs of cocoons in one string and sixty-seven in the other." p 168-9.

The Navitco of the Pima seems to have been identical with the Vikita but apparently has not been held for about two generations. A Pima at Santa Rosa claimed that in the old days his people had held a similar ceremony but that the words had been different. By 'words' he must have meant 'vowel sound'. George Webb, a Pima living at Gila Crossing, told Julian Hayden that he remembered hearing of such a dance from his father but that it had not been held for about fifty years.

Although Mason (3) did not see the Vikita of 1913 which he described he secured a very good description from the villagers of Santa Rosa. Mason is the only one of the several writers who mentions the parody of the tizwin festival which occurs at noon. Worthy of mention is the fact that a tizwin festival held every year in July, by Papagos living south of Sonoita, Sonora, is also known as Vikita (1).

In January, 1937, Miss Rosamond Norman of Ontario, California, furnished the Southwestern Monuments library with an account of the Vikita which took place during the first week of December, 1921. The dance which Miss Norman witnessed, and which she mistakenly called a Sun Dance, was held at Santa Rosa. She possessed a simple camera of the box type, and, with it carried under her arm, was able to take seven pictures of the dancers and the crowd. The description and pictures of the ceremony, as furnished by this correspondent, tally exactly with our own observations. While watching the dance she overheard a rancher from near Ajo say that a Papago cowboy had asked for the feathers of his Thanksgiving turkey so that a headdress could be made of them.

Description of Articles collected at Santa Rosa in 1922

11 Bull-roarers: These range in length from 40 to 60 centimeters and were made of flat sticks squared off at one end, which was perforated for a cord, and pointed at the other. In use two bull-roarers are tied to opposite ends of a six or seven foot cord and one is used as a handle while the other is being twirled. They have been painted on both faces, the designs consist of rows of bands or chevrons on a lighter background.

12 spears of wood. Average length 90 cm. The spears are simple round sticks, round at one end and painted red.

1 mesquite root bow. This is identical in character with the crooked bows carried by the dancers at Santa Rosa.

1 large gourd with the stem end sawed off. This has the same appearance as the gourds used during the parody of the tizwin ceremony. There is decoration on the specimen.

1 mammal skin, probably of a cat. The animal was shaved of all hair except for the whiskers, then skinned. The empty skin was then loosely filled with grass.

1 long string to which are tied primary feathers of a white chicken and secondary feathers of turkey. The feathers, 25 of each, are tied alternately at the quill end.

1 cow horn, in imitation of a powder horn. The skull end has been sawed off and blocked with a piece of wood. The pointed end has a .32 caliber cartridge shell tied to it.

1 effigy of a rifle. A short piece of wood, 32 centimeters in length and roughly shaped to resemble a gun, has a portion of an old percussion rifle hammer tied to it with baling wire. The hammer is from a percussion lock musket, army type, made at the Harpers Ferry Arsenal and dated 1857.

1 bird effigy - see plate

1 fringed canvas mask. The face consists of three holes for the eyes and nose and a large painted square in which is a design consisting of rows of small chevrons. This might easily have been a mask to which a headdress of turkey feathers could be attached.

2 primary feathers of turkey, tied together at the quills.

1 fringed kilt of blue denim and white canvas.

1 anklet or garter of harness leather to which are sewed three sleigh bells.

2 thick bundles of turkey feathers.

5 batons painted white with a red spiral running their entire length. Length: 44 to 60 cm. Thickness: 2 cm.

3 batons, painted blue. Length: 40 to 55 cm. Thickness: 2 cm.

1 crude dagger carved from wood. Length 26 cm. no painting or other decoration.

2 strips or belts of cotton cloth to one side of which feathers were sewed. Some of the cotton used in the cloth is apparently of native spinning and dying (brown) while other threads are undeniably of commercial manufacture. The feathers seem to have been white and were dyed a deep purple with a dye which has not yet been identified. These belts or straps are 6 cm. wide and 82 and 94 cm. in length. A few threads of the cloth were sent to the Ethnobotanical Laboratory

of the University of Michigan but not much was learned, chiefly, I think, because not enough material was furnished. These small pieces of cloth are quite interesting and as soon as more is known about them a descriptive paper will be prepared.

Duplicates of practically everyone of the items listed above were recognised in the costumes and paraphernalia used by the dancers at Santa Rosa in 1936.

Summary:

The conservative nature of the Papago is evident upon comparing the earlier written accounts of the Vikita with the ceremony which we witnessed. For the past thirty years observers have cried out that each succeeding Vikita would probably be the last held, yet the dance of 1936 seems to have been no different than any other unless one counts the larger percentage of articles of white manufacture which were used as adornments.

The astonishing thing which we noticed was that after nearly three hundred fifty years of association with Jesuit and Franciscan missionaries there is not a single phase of the ceremony which might suggest Christian influence. It so happened that the subject of borrowing of religious practices was discussed early in the day and all three of us were on the watch for an element of christianity to appear.

The Papagos seem to share with the nomads of northern Mexico the practice of destroying or abandoning ceremonial equipment after it has served its purpose. In this connection, the turkey feather headdresses furnish a puzzle. The canvas mask in the Casa Grande collection is almost certainly the mask worn by a dancer, minus its crown of feathers. Lumholtz collected two complete headdresses which suggests that these are sometimes preserved.

The best information concerning the four youths in the ramada west of the dance plaza was that this portion is a modified representation of a family, a warrior of which had either been killed by enemies or had killed; our various informants were very hazy on this point. During the old days this rite served as one of the purification ceremonies. The old man who tended the four was necessary because during the dance they may not touch their bodies with their own hands. These youngsters must fast during each day of the performance.

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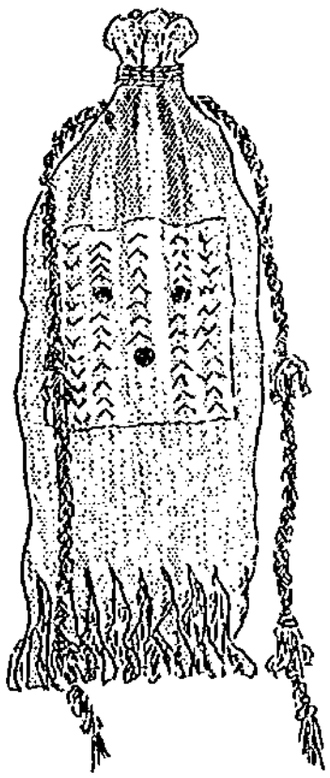
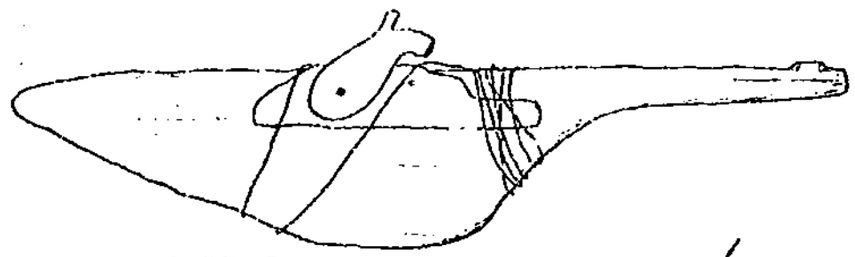
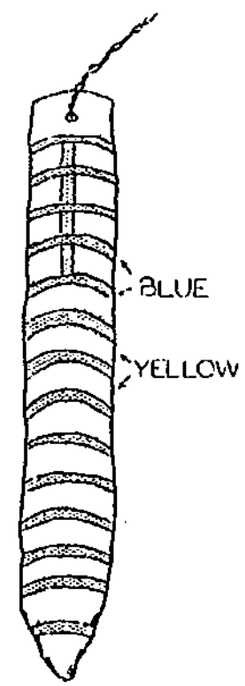


CANVAS MASK

SCALE 1/5

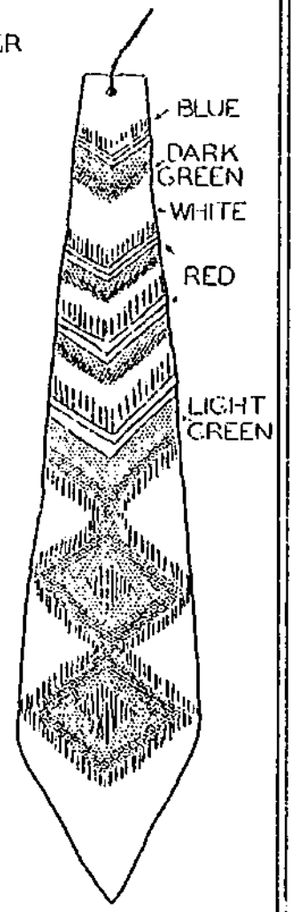


A REMOUNTED RIFLE HAMMER



BULL ROARER

SPEAR



BULL ROARER

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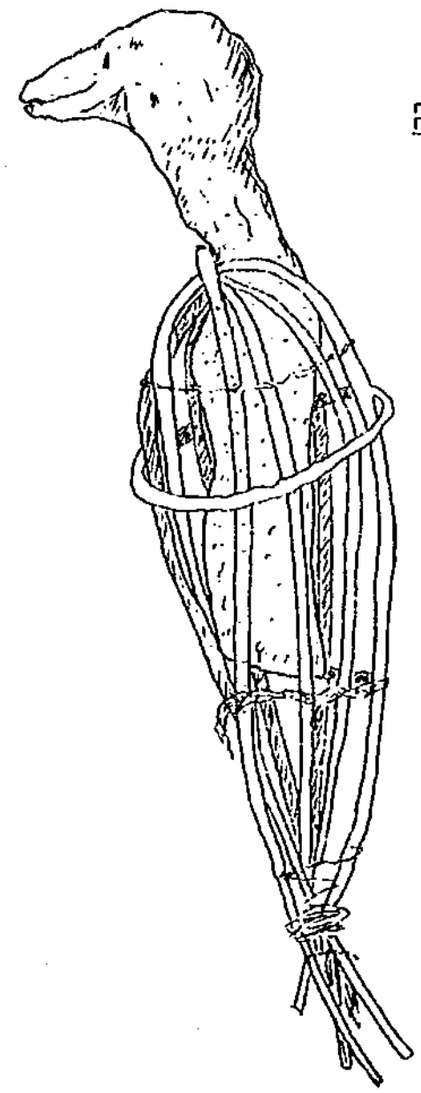

BIRD
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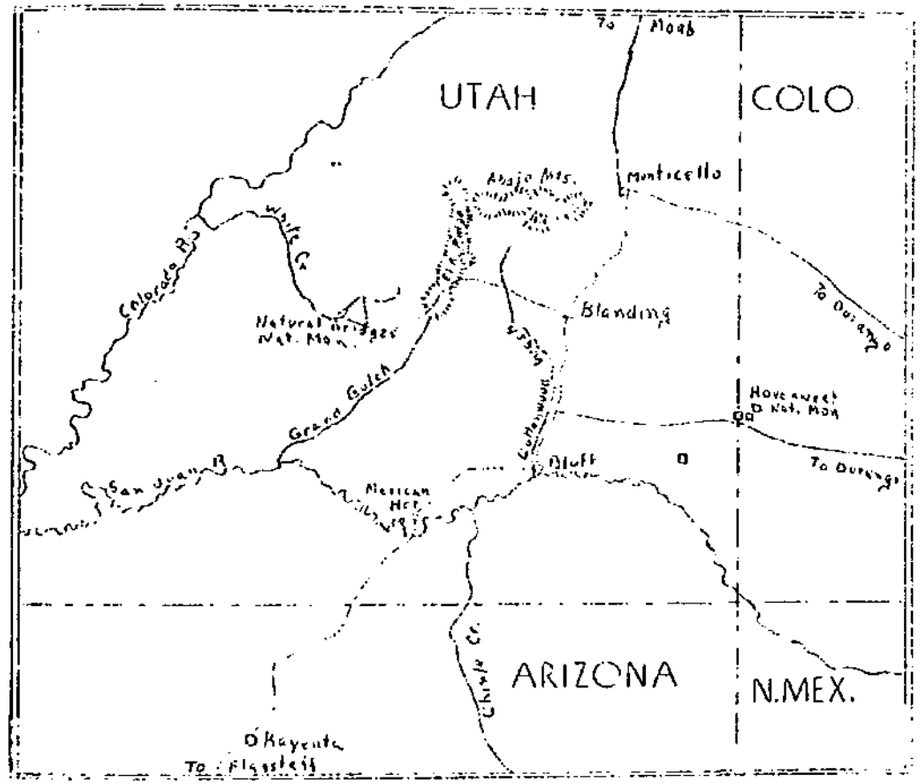
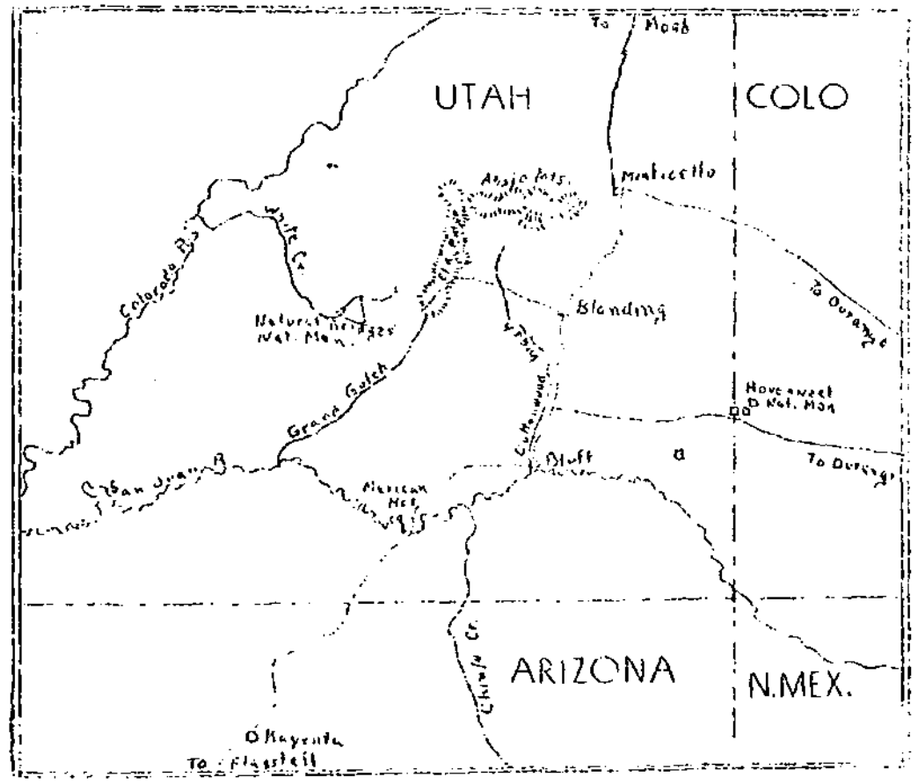
SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 17

ARCHEOLOGICAL INVESTIGATIONS
AT
NATURAL BRIDGES
BY
CHARLIE R STEEN

·DEPARTMENT· OF ·THE INTERIOR·
·NATIONAL· PARK·
·SERVICE·


To Moab
UTAH
COLO
Abajo Mts.
Monticello
Colorado R.
White Cr.
Natural Bridges Nat. Mon.
Blanding
To Durango
Grand Gulch
Hovenweep Nat. Mon
San Juan R.
Bluff
To Durango
Mexican Hat
Chinle Cr.
ARIZONA
N.MEX.
To Kayenta
To Flagstaff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ARCHEOLOGICAL INVESTIGATIONS AT NATURAL BRIDGES NATIONAL MONUMENT

By Charlie R. Steen, Jr. Park Archeologist

Introduction

During October, 1936, Mr. Zeke Johnson, Custodian of Natural Bridges National Monument in San Juan County, Utah, was repairing the trail in White Canyon between the Caroline and Augusta Bridges. One cool afternoon he looked about for a warm spot where he might eat his lunch in comfort and noticed that the sun was shining on a ledge about thirty feet above the floor of the canyon. After a little climb he gained the ledge, which was much larger than it appeared from below, and was quite surprised to find himself standing before a small but well preserved cliff dwelling. The feature of the dwelling which particularly caught Mr. Johnson's eye was a roofed kiva, through the roof of which passed the poles of an old ladder.

There are several small ruins on the Monument but until this site was found there were none which could be reached without a strenuous or even a dangerous climb. The one humorous exception to the foregoing statement is that on the same ledge and about one hundred yards north of the site in question is a group of about 12 rooms in a poor state of preservation which is visited by scores of people every year. Due to a constriction in the width of the ledge and the presence at that narrow place of a small group of junipers it seems that no one during the past 25 years had felt it necessary to explore the entire length of the shelf.

Since most visitors to the Monument express a desire to see ruins it was decided that I should accompany Mr. Johnson to the Bridges before the beginning of the 1937 travel season and do any needed work so that hikers to the Bridges might inspect the dwelling. I left Headquarters, Southwestern Monuments, at Coolidge, Arizona, on the morning of April 13 and arrived in Blanding, Utah, the following evening. The road over Elk Ridge was blocked by snow at that time so it was necessary to pack out to the Monument. One day was spent in Blanding getting our equipment together and in visiting a few ruins in the vicinity, and on the morning of the 16th we left for the Monument. Two days were spent in traveling each way and four days at the Bridges, which put us back in Blanding on the 23rd of the month; two days later I was back at Headquarters.

During the trip I visited and took notes of nine sites and cleaned two kivas and a small circular room in the dwelling at the Monument, which is designated as site 8 in this paper. Sherds were collected at six sites - these were left at the Museum of Northern Arizona for identification.

A Short Description of Sites Visited - Other than Site 8.

(1) A series of small cliff dwellings four miles southeast of Blanding and located on the east side of Brown's Draw. A small two-story house and about a dozen single rooms are all in a poor state of preservation. The houses and storage rooms are built under a long ledge and have much the same appearance as the ruins at Walnut Canyon National Monument.

(2) - A cliff dwelling, originally of about twenty rooms on the west side of West Water Canyon. The dwelling has been pretty well wrecked by vandals but is still a fine appearing ruin. Dorie Nusbaum named this five kiva house because of the five kivas in connection; he also collected some beam specimens from the site which were dated 1234-35 by Stallingsof the Laboratory of Anthropology. One kiva is still in a fairly good state of preservation nearly to viga height. It has red plastered walls with broad white decorative lines between its five pilasters. Just across the canyon is another and smaller dwelling.

(3) - A sherd area on a ridge one mile north of Blanding. A few scattered rocks might indicate a house but there is nothing definite.

(4) - A badly weathered stone house of about ten rooms on a low ridge on the west side of Comb Wash just below the mouth of Arch Canyon.

(5) - A large cliff dwelling about a quarter mile up Arch Canyon from its mouth. The site is located under a high shallow overhang on the north side of the canyon. The ruin covers an area of about two acres and must have been a large village but at present, except for a few walls which stand two stories high, there is nothing but a huge mound, some sherds and viga holes in the cliff to mark the building. Judging by the height of the viga holes, petroglyphs and sharpening grooves on the rock the structure must have stood four or five stores high while it was being occupied. Hundreds of pecked and painted pictographs have been placed on the cliff; these include one long panel (20' x 3') of white paint on which many zoomorphic figures had been painted in red. Six kivas are in evidence with possibility of more being under the fill in the large plaza. Because of the difficulty of access to this site the only evidences of vandalism are a few very small holes.

(6) - A two-story cliff dwelling of ten rooms located on the west side of Fish Canyon and about one mile south of the trail from Comb Wash to Natural Bridges. The structure is in almost perfect condition with most of the rooms filled with pack rat debris. No sherds were collected at this site although a few were in evidence.

(7) - A group of five circular structures whose walls stand from one to five feet high located in a large rock shelter in a short spur of Fish Canyon around which the trail from Comb Wash to Natural Bridges passes. These houses are of the same general type as rooms 1 and 2 in site 8

which will be discussed further on in this paper but there were some differences which should be noted here. All five rooms are partially destroyed but the walls of two stand five feet high in part, which seems to have been the original height. The bases of the walls were formed by a double row of sandstone slabs, set on edge and plastered with adobe. On the slabs several juniper poles were laid end to end then plastered over with mud. Additional courses of poles and mud were applied until the desired height was reached. I found no pottery at this site nor has Zeke Johnson, who has visited this group on a number of occasions, ever noticed any sherds in the shelter.

(9) - A cliff dwelling 1.5 miles up White Canyon from Augusta Bridge. There are two groups of houses at this site, one on the talus slope at the foot of the cliff, the other on a ledge sixty feet above the floor of the canyon. To reach the ledge one must climb a forty-foot ladder the uprights of which are of Douglas Fir poles apparently cut by the builders of the houses. Rungs have been nailed to these poles during recent years. On the ledge are several dwellings, some storage rooms and a large kiva; all the walls are in a poor state of preservation. At the foot of the cliff the houses are more numerous and in better condition. Two wattle and daub lean-tos and a couple of rectangular storage rooms cut into the hard clay at the foot of the cliff show very little evidence of the passage of the years since they were used. There are two kivas at the lower site, both with complete roofs. One of the kivas was cleaned out years ago (the site is more than a mile above the Monument boundary) and shows no particularly important feature aside from a very large niche in the wall behind the ladder and above the ventilator and a large number of pictographs scratched into the wall plaster. The pictographs are in the form of rectangles averaging two by eight inches with pottery designs scratched within the limiting lines of the figures. The second kiva is still about half full of packrat trash. Above the trash line are three niches set rather closely together. The center niche is much larger than the other two. An interesting feature of this structure is the construction of the pilasters or columns between the niches. Both are masonry columns ten inches wide, 18 inches deep and two feet high. A short juniper log, eight inches in diameter, was set upright at the front of each column and runs for its entire height. The arrangement is reminiscent of the short timbers which were placed at the bases of pilasters in the Chaco canyon area.

Site 8

This small cliff dwelling, situated in White Canyon and approximately half way between the Caroline and Augusta Bridges, consists of two groups of houses on the same ledge and about three hundred feet apart. The first or northernmost group will not be considered in this paper as no work was performed in the ten or twelve badly demolished rooms which comprise it. As I mentioned in the introduction just south of these dwellings the ledge is constricted in width and half a dozen good sized junipers occupy this

small area, effectively blocking any view from one end of the lodge to the other. South of the trees is the second group of buildings, five houses, two storage rooms and two kivas.

Although my principal purpose in visiting the site was to clean out the roofed kiva and to arrange for its protection, the presence of two round structures similar to those in Fish Canyon (site #7) so excited my curiosity that I decided to clean one of those as well. It was later decided to clean the debris from Kiva #2 since there seemed to be very little fill in it as proved to be the case. The three rooms in which we worked are described herewith.

Room #2

Room #2 is a small circular room abutted against Room #1 which is of the same type. The outstanding features of these rooms are the type of wall construction and the shape of the doors.

Mention has already been made of the walls at Site 7. The walls of Rooms 1 and 2 are similar except that instead of juniper poles, river boulders were used as a basic material. Here too, a double row of upright sandstone slabs were laid in a circle with a nine foot diameter as a foundation. The slabs were well cemented with adobe and a single row of small river boulders laid on the slabs; adobe was then patted around and over the boulder to form a single course. When the adobe was dry another course was added and the process repeated until the walls had reached a height of approximately five feet.

The door of room 2 (and of all similar rooms that I saw) is heart shaped, and had a pronounced moulding of mud around the door on the outer wall. This room had the smallest doorway of any of the round rooms seen. The door was only 1.4' high with a maximum width near the top of 1.4' and a minimum width at the base of 0.75'. While it is possible to enter the room it takes a little effort. Two other complete doors of the same nature were noted, each of them was approximately three feet high.

A ventilator, or a similar rectangular opening, had originally been constructed through the wall below the door but it had subsequently been chinked with small spalls of sandstone. Apparently at the same time the opening was filled the small granary which I have designated as Room 3 was added to the existing round houses and a buttress placed against the wall of room 1. This buttress came up to and squared off at the base of the door.

Inside the room the walls show only one feature worthy of mention, four plugs of wood which are imbedded in the walls 3.3' above the floor and which are spaced so that they quarter the circumference of the room. These plugs are securely cemented in the wall and are stuck in at an

angle of about 45 degrees from the perpendicular. All the plugs point toward the center of the room and although they have been broken off almost flush with the wall it is possible that at one time they helped to support the roof although there is no evidence on which to base such an assumption. A close examination of the walls of Room 1 failed to disclose similar sticks.

The debris on the floor was from three to six inches in depth and was composed only of roofing material and of a few artifacts. I am not able to reconstruct a plan of the roof from the evidence disclosed by the floor fill. Apparently the main support of the roof was a series of short sticks .75" in diameter and from 1.5' to 2.0' in length. Over these sticks, which were far from being long enough to reach across the room, was laid a thin layer of willow wands then a layer of adobe which was patted down by the bare feet of children as a large number of foot impressions show. The entire roof was no more than three inches thick; the roof had been destroyed by fire.

The floor of the room was slightly concave and plastered. There are no features on the floor except for five rough boulders which were found lying in a semi-circle facing the doorway. These stones served no apparent function. While cleaning the floor a pair of yucca fibre sandals, some small fragments of turkey feather cloth, a few pieces of yucca cord, some pointed sticks and a few sherds of two corrugated pots were found. No wall material was found on the floor nor did any charcoal or evidence of fire other than the charred roofing material turn up.

Kiva #1

This was the structure that caused the trip. A fine looking, rectangular roofed kiva with original ladder poles protruding through the hatch is not found every day. Unfortunately, when we had cleaned out the debris only one of the rungs of the ladder was found to be in place. The other three rungs, however, were lying on the floor at the foot of the ladder.

The fill in the room was approximately four feet deep around the ladder but shoaled off to not more than eight inches at the back of the kiva. The kiva was built against the rear of the rock shelter and a large block of sandstone weighing several tons is incorporated in the structure by forming the southeast corner. It may be well to call attention that a seeming difference in plan as shown in Plates I and III is due to this large rock. The measurements in Plate I were taken on the roof of the kiva whereas Plate III is a plan of the floor and shows the irregularity of the room itself as caused by the rock.

A very interesting feature of the exterior is what is left of an adobe ramp which led from the floor of the rock shelter to the hatch of

the kiva. Originally this ramp was approximately fifteen feet in length but only three feet of the center portion remain in good condition. The ramp was of solid mud, two feet wide with a plaster finish.

The roof of the kiva is of large cottonwood vigas, juniper poles, juniper shakes and mud. Large cottonwood poles were laid along and on top of the walls with the vigas resting on them. The smaller poles and shakes were laid above the vigas in alternating directionr in the usual southwestern fashion.

The walls of the kiva are thick, from one to two feet, and are of double faced masonry set up in adobe with the center of the wall filled with spalls.

Two short wooden pegs and a few pictographs are the only features of the smoke stained walls of the kiva. The pegs protrude 0.3' from the south wall at a height of 3.5' above the floor. One is 2.2' the other 3.75' from the southwest corner of the room. The pictographs consist of a spiral, some triangles and a figure of a man painted in black on the west wall, near the southwest corner.

Along the west wall are two small, narrow shelves which run along the wall from the southwest and northwest corners, respectively, of the room. The first shelf extends 4.4' from the south wall is 0.4' broad and 0.45' above the floor. This shelf is pecked out of the rock of the cliff. The second shelf, or small bench, is built of adobe. It extends 3.7' from the north wall, is 0.3' deep and 1.0' high. At right angles to the second shelf are two upright stone slabs 0.6' high, 1.1' apart and extending 0.95' into the room.

The only other features of the floor are the firepit, a roof support, the deflector, the ladder and the ventilator. These, with the exception of the pole which supported one of the vigas, are in line. The firepit is large, 2.2' in diameter and has a rim raised 0.2' above the floor. The deflector consists of three stone slabs set on edge and leaning against the ladder poles. Raised 0.4' above the floor, the ventilator passes directly through the wall into the open; the ventilator is square in cross section and measures 1.6' for each of its sides.

Kiva #2

As was the case with Room 2 this kiva had very little fill on its floor so I decided to clean it as a supplemental exhibit. Digging the twelve to fourteen inches of soft sand which covered the floor disclosed the fact that this structure was probably abandoned and partially destroyed while the cliff dwelling was occupied. No roofing material of any sort was found nor were the few blocks of sandstone lying within and around the kiva sufficient carry the walls to a suitable height for a roof. Two other factors which point to the same conclusion are that

only a very few pot-sherds were found in the fill (none on the floor) and while we noted no signs of activity by rodents the floor plaster was in a very bad condition with large portions of plaster entirely missing.

The walls of Kiva 2 are very thick, from two to three feet. Both sides of the wall are of faced sandstone masonry and the middle of the wall is a rough mixture of large sandstone blocks, spalls and a[illegible].

Around the wall of the kiva are three niches, one quite [illegible]ll and two large ones. The small niche is located in the north wall of the room at a height of 0.6' above the floor. Although the wall has been destroyed down to the recess enough was left to indicate that the face was probably one foot square and that the niche extended 0.85' into the wall.

The other two niches in this kiva are of the same size and height from the floor. Both are 3.5'wide, 1.6' high and 1.8' deep. The backs of both are of faced slabs of sandstone set upright and each has a half dozen juniper headers to support the wall above and serve as a ceiling. Nothing was found in either of these recesses.

A square opening measuring 1.5' on each side and passing through the wall served as ventilator. The ventilator, as was the case in Kiva 1, is raised 0.4' above the floor. A stone and adobe deflector two feet from the ventilator protected the firepit which is so badly torn up that measurements were impossible. The wall deflector is 2.1' long, 0.6' wide and 1.1' high.

The only other feature of the floor is a small hole, 0.4' in diameter which might have been a sipapu.

Recommendations

(1) That a light ladder be made so that the cliff dwelling might be visited without a long and somewhat arduous climb by way of the north group of ruins. Such a ladder can be taken down and laid at the base of the cliff where it will be completely hidden so that parties who walk along the trail unaccompanied by a ranger will be unaware of the presence of the dwelling and, consequently, the ruin will be saved from vandals. Custodian Johnson was to make this ladder at the beginning of the 1937 travel season.

(2) That another archeologist investigate the occurrence and construction of the round houses which seem to be peculiar to this district. So far as I have been able to determine this type structure has not been reported up to the present.

Summary

The most important result of the trip was the establishment of certain definite and peculiar methods of construction for small round houses whose function is unknown. These methods are:

1 - Wall footings of parallel rows of upright stone slabs (this method of wall construction is not common in the San Juan region)
2 - Walls of river boulders, or poles laid horizontally, carried up in courses.
3 - Heart shaped doors surrounded by a heavy moulding.
4 - Possible additions to the three features listed above are: concave floors and a lack of pottery.

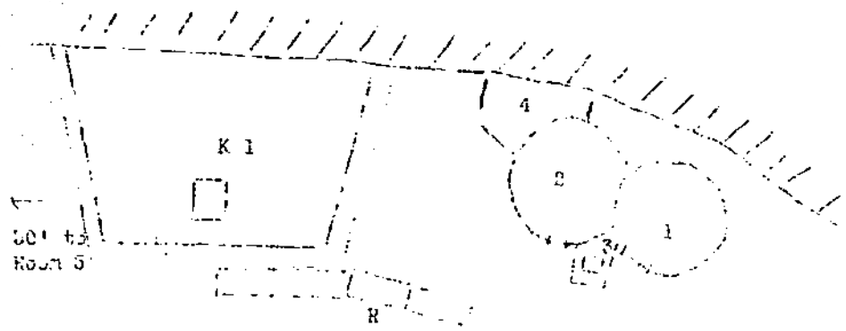
A possible explanation for these houses, since usually no smoke stain is found on the walls, is that they were storage rooms, but at site 8 there were storage rooms adjoining the two round structures and all other rooms of the site were built of horizontally coursed masonry of sandstone blocks. Aside from the two doors in the round houses, all doors at the site were plain and rectangular. It does not seem probable that a specialized type of construction should be developed for granaries - besides, Room 2 at one time had a ventilator - but no firepit. Further excavation of this type house is suggested. According to Zeke Johnson there are a number of round houses scattered through the region.

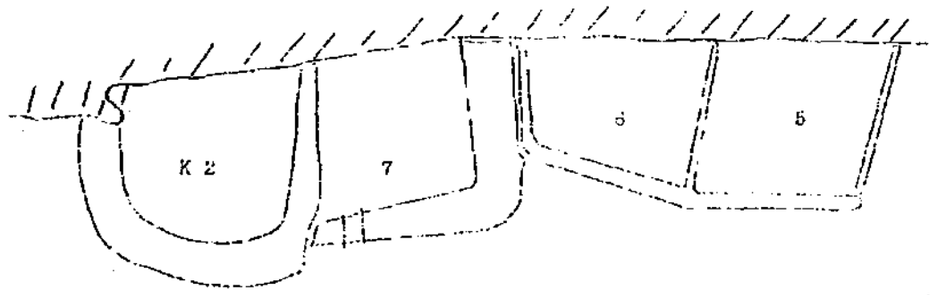
The well known fact that the kivas of southeastern Utah are far from being of standardized shape or construction was further borne out by the excavation of the two kivas at site 8 and observations of kivas at other sites.

Unfortunately lack of time prevented us from cleaning the floor of one of the living rooms.

Catalogue

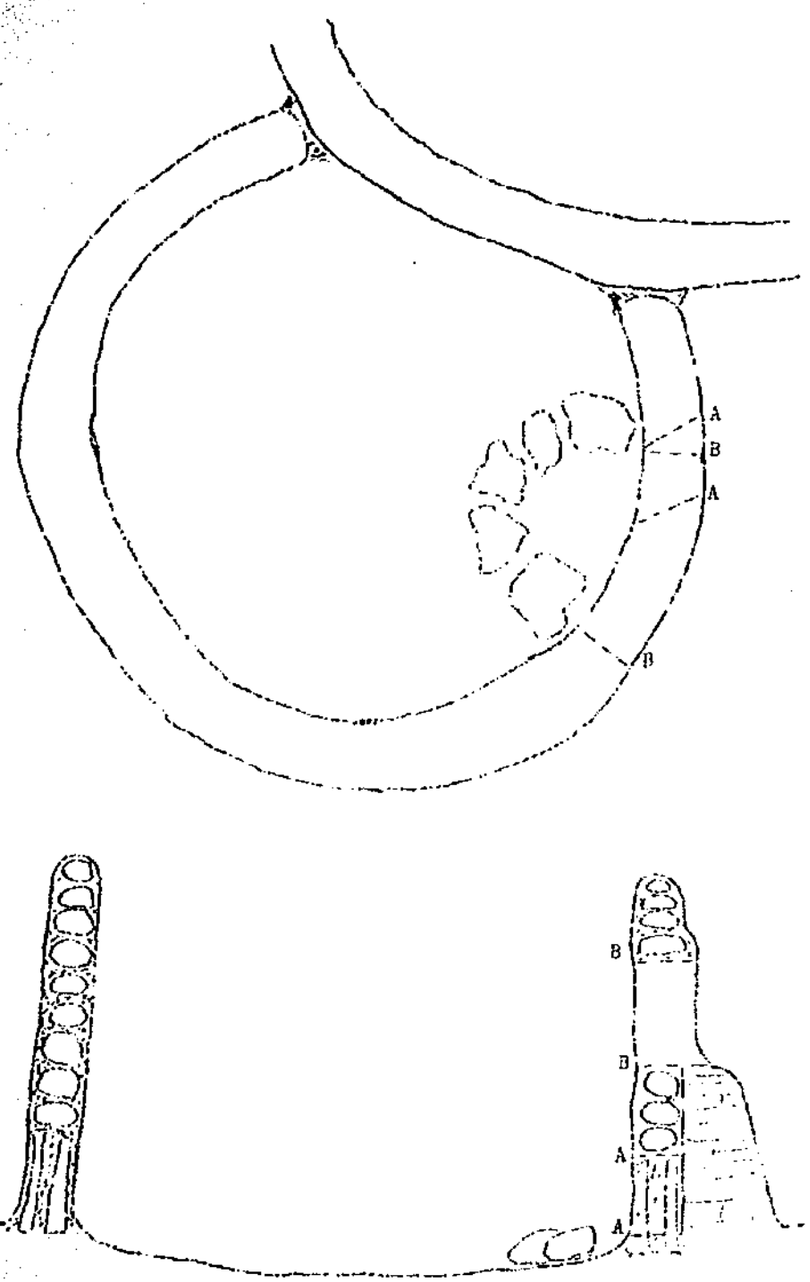
Catalogue Number	Description	Provenience
K1-1	Portion of reed screen	From fill of Kiva 1
K1-2	Oval ring of willow, lashed with yucca fibre-possibly rim of basket	"
K1-3	Fragment of fibre sandal	"
K1-4	Fragments of turkey feather cloth	"
K1-5	Bone awl	"
K1-6	Bone awl	"
K1-7	Bone awl	"
K1-8	Bone awl	"
K1-9	Corn cob with twig inserted in stem end	"
K1-10	Yucca fibre sandal-heel worn through	From floor of Kiva
K1-11	Bundle of grass, similar to Navajo comb	"
K1-12	Stone ax	"
K1-13	Billet of wood	"
K1-14	Trough shaped billet of wood	"
K1-15	Willow pot ring	"
K1-16	Short stick with grass brush tied to it	"
2-17	Bundle of yucca leaves	Floor of Room #2
2-18	Bundle of yucca leaves	"
2-19	Yucca sandal	"
2-20	Yucca sandal	"
2-21	Short length of turkey feather cord	"
2-22	Sharpened willow wand	"
2-23	Corn stalk (short length, smoothed at each end)	"
2-24	Three pieces yucca fibre cord	"
2-25	Several pieces of knotted grasses and canes	"





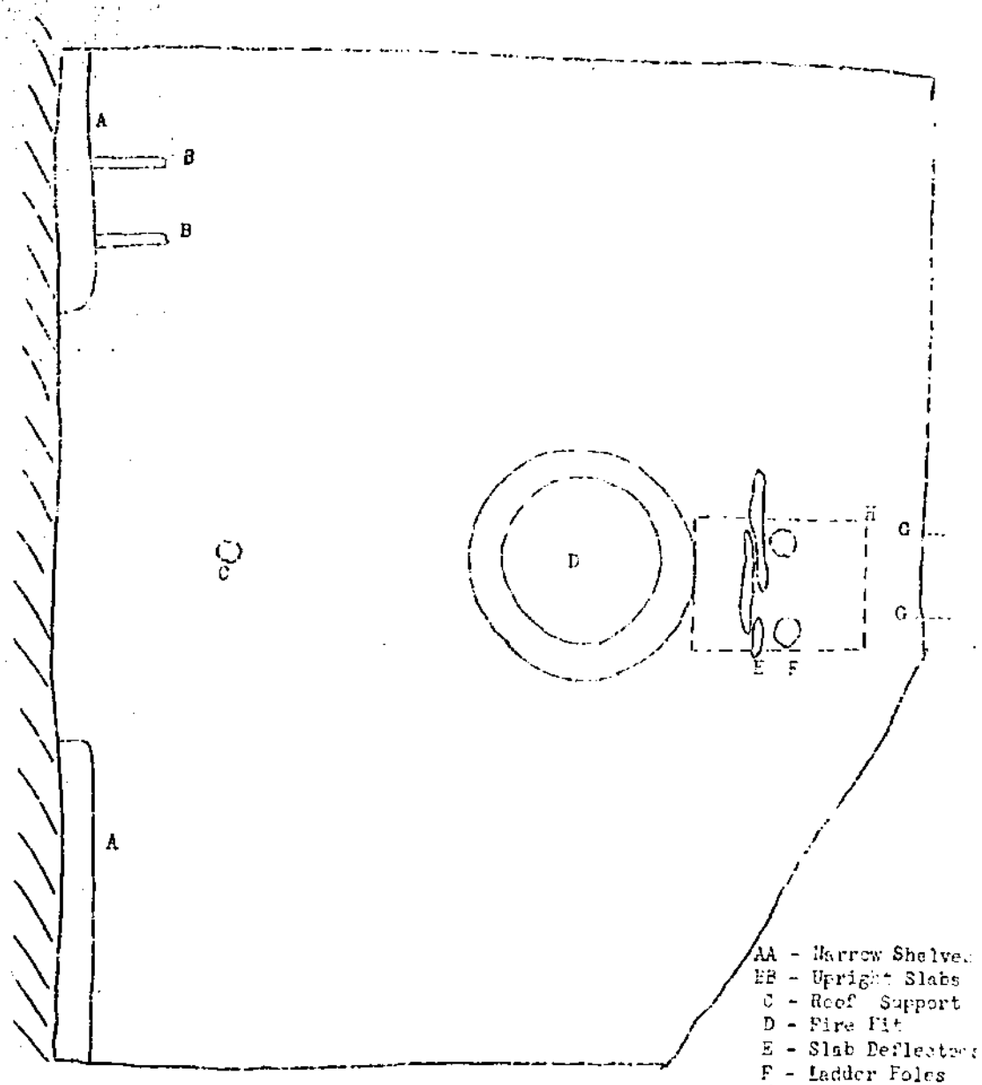
Scale = 20'

1 - PLAN OF SITE



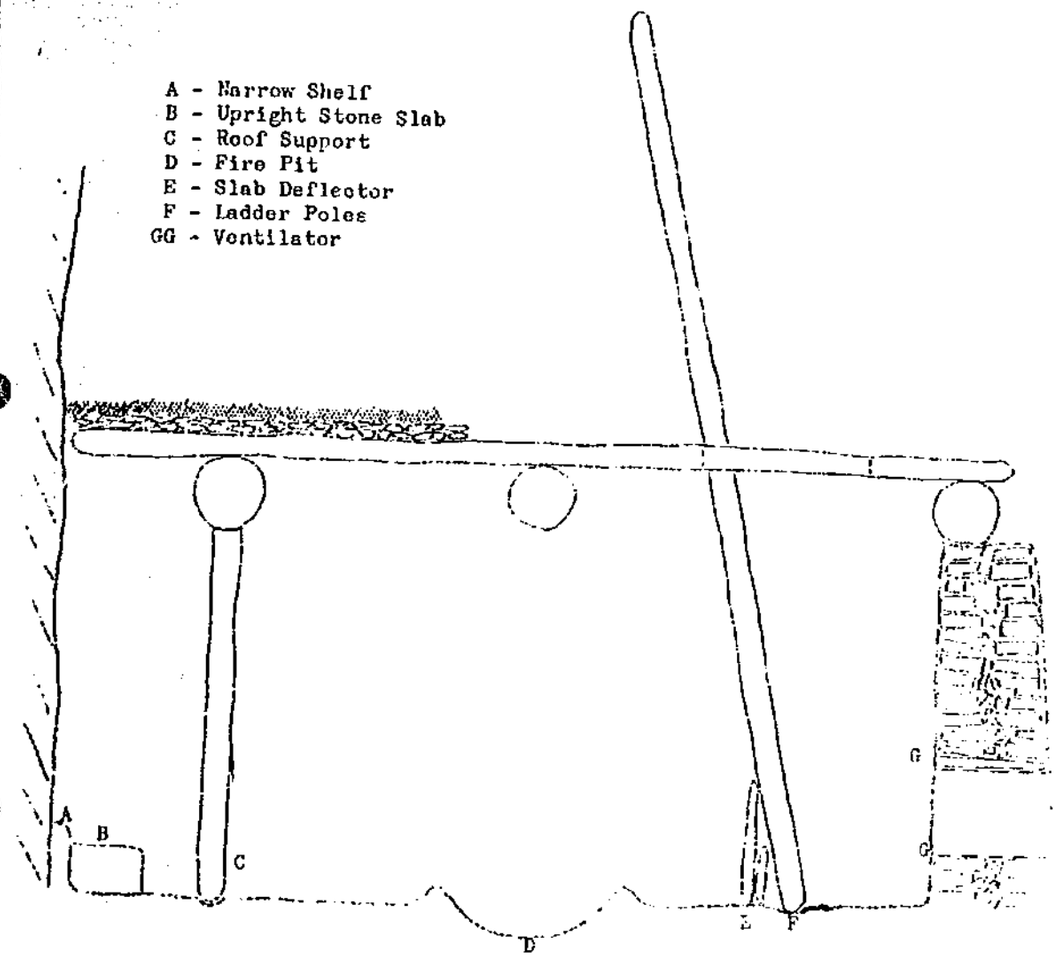
AA - Ventilator
BB - Door

II-PLAN AND PROFILE-ROOM.2



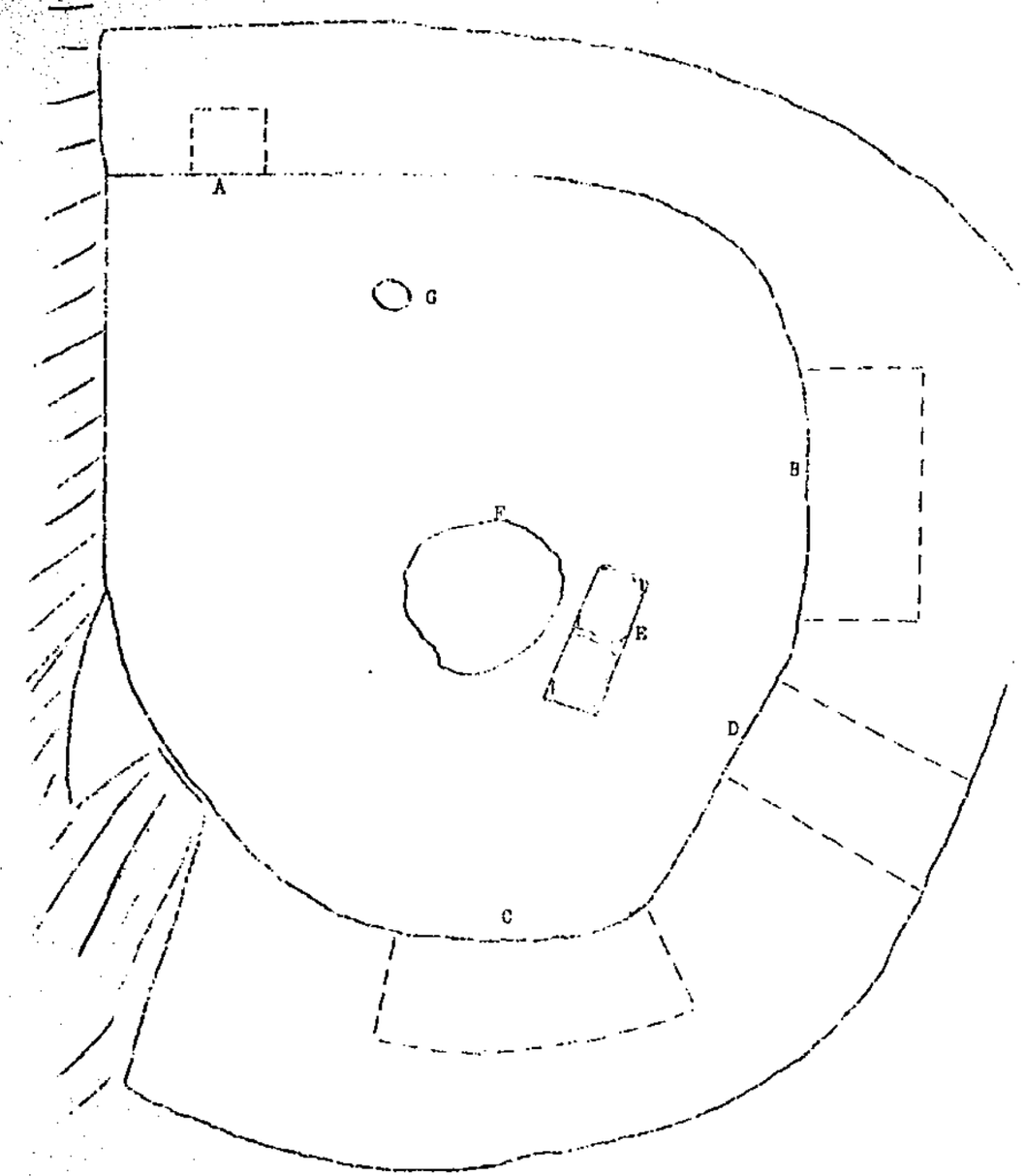
III - PLAN - KIVA 1 Scale $\frac{1}{2}$" = 1'

A - Narrow Shelf
B - Upright Stone Slab
C - Roof Support
D - Fire Pit
E - Slab Deflector
F - Ladder Poles
GG - Ventilator



Scale $\frac{1}{2}$" = 1'

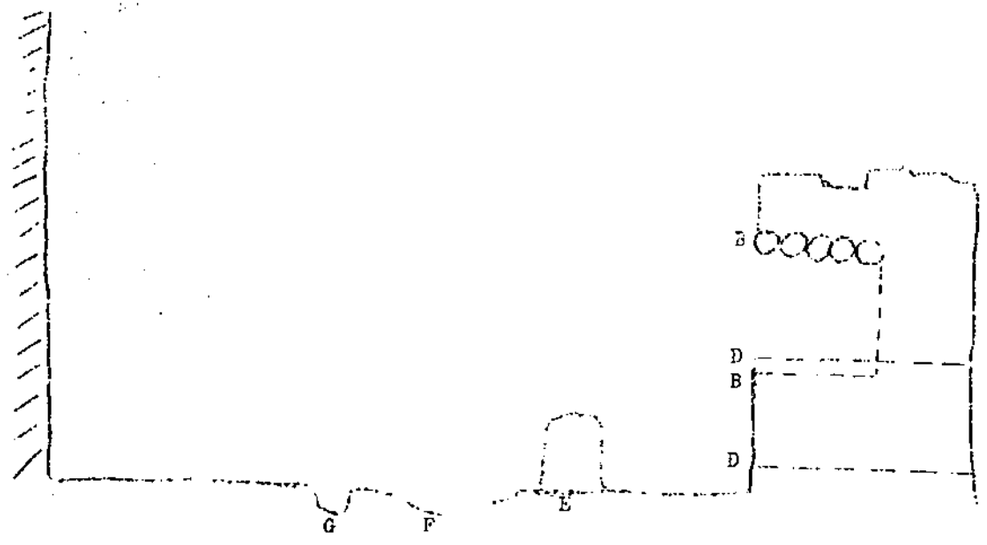
IV - PROFILE - KIVA 1



A - Niche #1
B - Niche #2
C - Niche #3
D - Ventilator
E - Masonry Deflector
F - Firepit
G - Sipapu

Scale $\frac{1}{8}$" = 1'

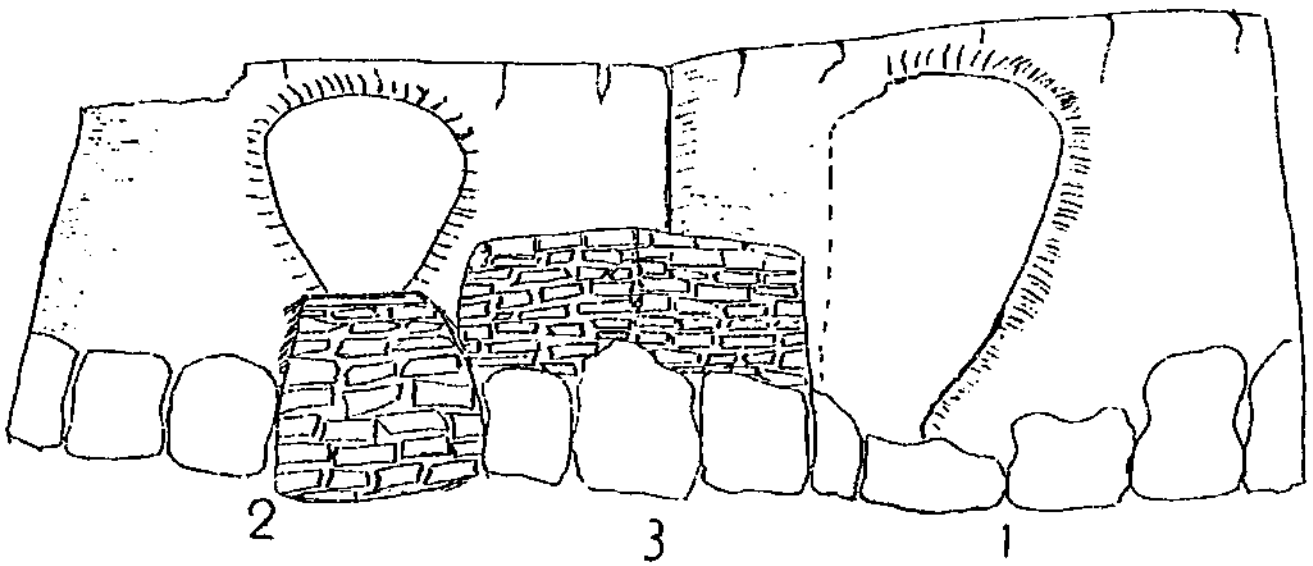
V - PLAN - KIVA 2



B-B - Niche #2
D-D - Ventilator
E - Masonry Ventilator
F - Fire Pit
G - Sipapu

Scale ½" = 1'

VI - PROFILE - KIVA 2



VII - ROOMS 1, 2 & 3

SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 18

PERSONAL DIARY OF

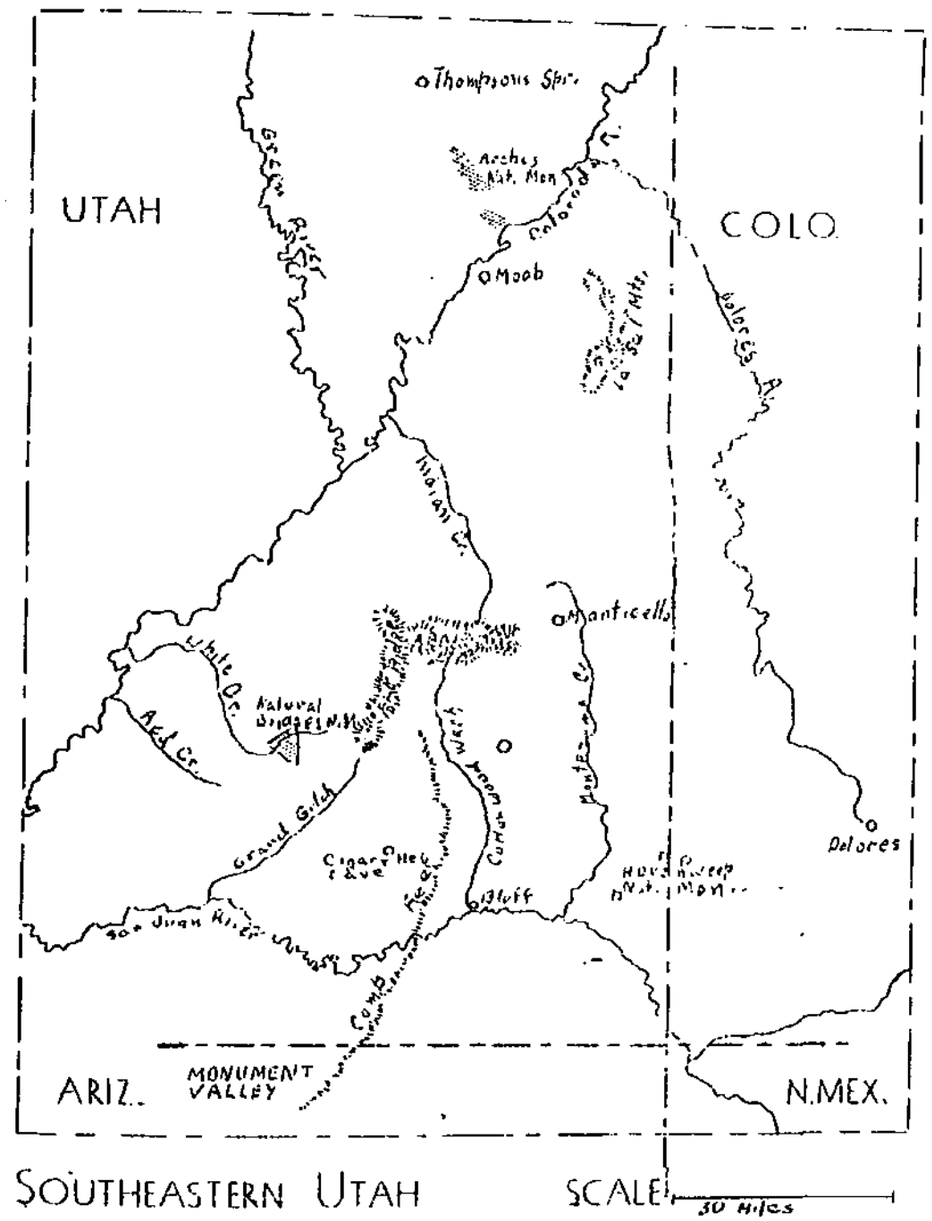
H. A. CULMER

1905

DEPARTMENT OF THE INTERIOR

NATIONAL PARK

SERVICE



SOUTHEASTERN UTAH

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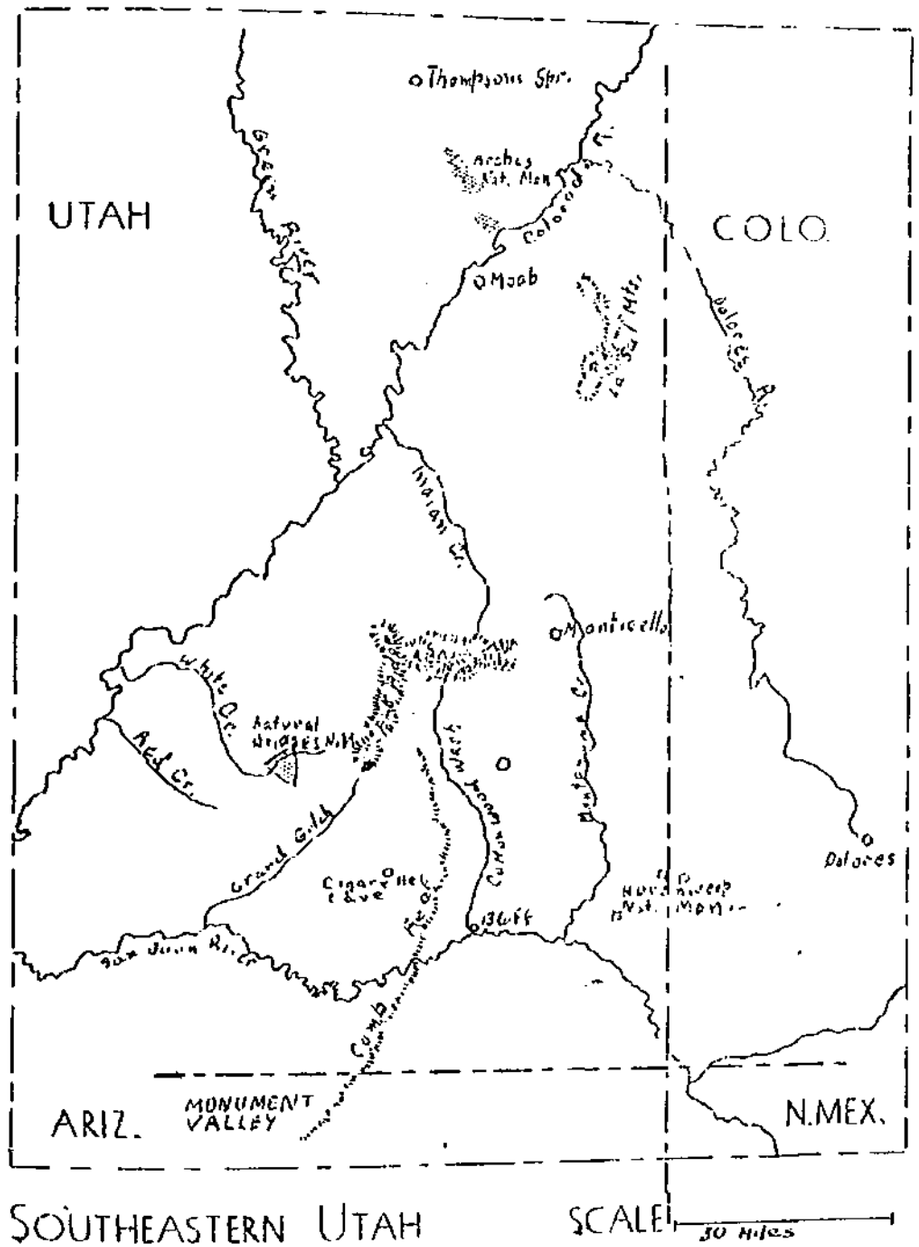

SOUTHEASTERN UTAH

EDITOR'S NOTE:

The diary which we are reproducing here was found last year in the effects of the late Mr. Culmer by his son. The small volume was given to Dr. J. E. Broaddus, a Salt Lake City dentist, who used the very interesting story of the trip to the Natural Bridges in a series of radio broadcasts. Custodian Zeke Johnson of Natural Bridges National Monument told me of the existence of the diary in April, 1937, and said that he believed that Dr. Broaddus would give the Park Service a copy of the document for this report. Our gratitude to Dr. Broaddus for his kindness in allowing the Culmer Diary to be run as a supplement to the Southwestern Monuments Report is hereby acknowledged.

During the thirty days consumed by the trip the expedition visited three areas which have subsequently been proclaimed national monuments. On the first day out of Thompson Springs the party was drawn from the road by the monoliths and arches of Arches National Monument. On their way to Dolores, Colorado, from Bluff, Utah, the men passed through and spent a night in the present Hovenweep National Monument.

As the measurements of the bridges as given by Culmer do not jibe with more recently determined dimensions, the latter are given here:

Bridge	Height	Span	Width	Thickness
Edwin	108	200	35	11
Caroline	205	206	49	107
Augusta	222	261	37	50

The Mustang Springs mentioned on April 7 are on Mustang Mesa eight miles east of Blanding and the Chuckaluck Mountains are probably those known as the Carrizos today. Mr. Johnson does not know which is Unknown Canyon as a number of large canyons in the vicinity have never been given names; neither is Zeke familiar with the Grand Opera House.

The spelling and punctuation of the original have been retained.

C.R.S.

PERSONAL DIARY OF H.A. CULMER

Artist for the Salt Lake Commercial Clubs' Expedition into the Natural Bridges of San Juan County in 1905. The other members of the party were S. T. Whitaker and Carlton Holmes.

Saturday, April 1st, 1905

Left Salt Lake 8:50 A. M. Arrived Thompson's Springs 4:20 P. M. Found no news of team promised by J. A. Scorup but H. A. Ballard of this place in response to previous wire arranges to have team and wagon start at 6:30 tomorrow A. M. for Moab, 35 miles south; Thompson's Springs are 6 miles north of here. Water is piped to railroad and one-half dozen houses supplied, two stores, little hotel.

Steve Ballard says he has seen one of the big bridges in White Canyon. Canyon runs on two levels (diagram inserted here) and water is under arch. Next big canyon south of White is Red Canyon, next north is Dark Canyon which runs into Colorado near Cataract Canyon off the Colorado River. Next is Indian Canyon. Cooper of Cooper Miller & Company has just sold out cattle herd that he has kept in Dark Canyon for ten years.

To the south east fifty miles away we see the La Sal Mountains in snow and clouds. Water here good after treatment but of sheepy flavor. Hotel kept by man named Fike. No snow in sight east of the Wasatch, though it snowed heavily in Salt Lake.

Sunday, April 2nd, 1905

Morning cloudy, threatening. All expect rain except barometer and me. Start 7 A. M. with light load having sent 360 pounds forward by stage. Air soon proves delicious and balmy, the traveling good and all are in fine spirits. To the east 5 miles away some handsome rock forms worth take if we had time. Are to noon at a seep in a creek bed at station called Court House from design of big isolated rocks. As we approach we get a glimpse up a distant side canyon of some obeliks or monuments that seem remarkable and we leave wagon, taking camera. At noon, saying will visit obeliks and reach Court House at 1. Walk briskly for an hour, monument still distant. We first estimated them 50 feet high and 1½ miles away. They prove to be over 400 feet high and 4 miles from where we saw them. Are of maroon and dark red sandstone, three of them--close together but quite detached by ½ mile from surrounding buttes, beautiful pedestal of nearly 80 feet. From one view two of them show heads of Egyptian profiles. Are most impressive, standing alone in the great surrounding

temples. Cut across country and down another gulch and over the hills to Court House Station reaching there shortly after 3. Poor meal, fair water. Started 3:30 P. M. for Moab. Off to the east and north other strange rock forms and arches and bridges, 15 miles or more to the N.E. a tremendous monolith, apparently down on Grand River. A lively clip down a sandy wash, roads just right for speed and the Grand River Valley and Mnat are a sight, a most beautiful panorama. A gorge where the river enters from the left, thence westward. It makes its passage across the green and fertile valley into another deep red gorge where it plunges to escape. Beyond the verdurous valley are broken red sandstone steppes, and above them magnificent snow-cloaked peaks 13,000 feet high. The barometer shows altitude at Moab to be 3,550 feet. There are few scenes, in America to equal this one and we hope to sketch here tomorrow. We cross the river on wire rope ferry and 5 miles more to town. Stop at a fairly good hotel, meet Cooper Martin & Co. who say they hear that Scorup is headed for us, but if he does not come we can be pulled out anyway on Tuesday. Vote this to have been a most enjoyable day and beautiful cloud panantry. Tonight clear and sweet. Stars never so bright, no moon but Venus is brilliant for Evening Star.

Cooper Martin fail to secure an outfit. We apply to other store, Hammonds, who say they will do it on time. -- Will they?

April 3rd, 1905, Monday

Bright and balmy. No news from Scorup. Engaged another outfit to take us out tomorrow morning to meet him, teamster named Foy from Hammond's outfit. Dr. J. W. Williams took us across the Grand today to sketch and photograph the La Sals that today gleam like white spirits above the red reefs. Dr. Williams is well informed, bright, genial. The "news" of April 1st arrived today and added to the previous newspaper accounts, the page and a half in the News with our portraits puts the town agog as much as if we were celebrities and I must say most people go out of their way to serve us on more than (or rather less than) reasonable terms. Many trees are green with leaf and yet they say this is a backward season. It is a fine fruit town, but Dr. Williams says the people get Moab fever after the first year. It is so easy to make a bare living and so hard to get rich here. The symptoms of Moab fever are chronic laziness.

Tuesday, April 4th, 1905

A start with a horse outfit and driver (Tom Foy) who is also cook. Time 5:30 having had to complete a number of matters. Weather clear and beautiful, air delicious, invigorating, temperature just right. Went up Pack Creek, again heading to the glorious La Sals, until we are within 12 miles of the base of Mt. Peale when we noon at Poverty Hill. Make

small sketch. Was a dry noon, we having brought our water in canteens. Started at 3:10 reached Kane's Spring 4 miles at 5:30 and continued onto Jacob's Wells 4 miles reaching at 7:30. The afternoon among huge sandstone cliffs, with rocky and sandy road, wonderful descent into Kane wash with the gleaming Peals dominating the head of the canyon. This was after crossing Blue Ridge altitude 5,230. On ascending from Kane Wash we wound around the edge of Mule Shoe Wash to Jacobs Wells. Here we can no longer see the La Sals, but on Blue Ridge we caught a glimpse of the Blue Mountains far away. It seemed as if our destination was nearly in sight, though we know that we have hundreds of miles of rough travel ahead. We camp on a rocky promotory with half a gale blowing, but all are hearty and good-natured and enjoyed our supper by the big cedar fire. That altitude is 5,050. No news of Scorup and though we have pressed on, it seems that we may not make Gordon's (6 miles this side of Monticello) by tomorrow night. Feed is scarce all along the line as the country is sheep-cursed.

Wednesday, April 5th, 1905

Started early from Jacob's Wells or as some name the camping place, "Shirtail Point." Thrilling picture of getting water. Was uncomfortably cold in the night, frost this morning. After going a few miles the La Sals again swing into sight as near and almost as beautiful as ever. The Blues are closer. Mt. Abajo here called the Shay Mountains to the South West quite handsome. Soon we come to Looking Glass Rock where we make some fine subjects. About here the lonely carrier of the U. S. Mail passed us, a quaint figure on a wierd cayuse. He said that Scorup's team was waiting for us at Hatch's Wash where we would noon. We found Irum Perkins here and exchanged loads and sent Foy back to Moab. We made a long traverse of Dry Valley in the afternoon. Thought we would camp at the Tanks but it was so sheep-cursed that we moved on to the open desert where we camp at 8:00 P.M. Weather warmer, clear and fine. Dry Camp. But for lack of water this would be one of the finest valleys in Utah but the thirsty soil drinks up the rain and the grass that is disposed to grow freely is stamped out by the sheep. Altitude 6,130.

Thursday, April 6th, 1905

Going at 6:45 A. M. and up on Peter Hill ridge by ten o'clock crossing at an elevation of 6,980, but kept on climbing to Gordon's ranch where we nooned at altitude of 7,160, the Blues close by with snow to their base.

Lone Cone, Telluride Colo. to left, Rico to right, ranged along in the Colo. line, Ute Mountain nearly to the south. Orson Dalton here nearly 7 years. This is noted old ranch, cabin being built in 1883. Some wild stories told of it. An Irishman, a bum and a nuisance hit up the ranch one night when the keg was full and they said they wanted him to have enough red eye for once, so they threw him and poured the whisky

down his throat as they sat on him and in an hour or two he was dead. They fixed up a box for him and it was too short, then debated whether they should cut off his legs or make another box. All drunk; made another box and squeezed him in and took him to Monticello where they told the populace that he was too long for the box but he was all there and if they opened up they would find his legs, one on each side of him. Gordon himself has been known to shoot up the town and has made the boys dance to a tune while he shot at their toes. Even we got Dalton to ride a couple of pitching horses while we tried to snap them. It was too quick work in all probability for any camera. The cabin is full of holes from guns. Gordon in one fray stood off three men in the East cabin, beat two of them till they ran and was on the other beating him over the head with a six shooter when help came. Meantime Gordon had nine wounds, one through the lungs. The ran he had discharged, and they came back, found his "six" on the window sill, took out the cartridges and put the gun back, then turned loose. Got a doctor from Denver who gave him one week to live. He replied "G-d-You. I'll be riding the range when you are dead." Two years later the doctor died.

Gordon and Dalton went to Moab last winter and stuck a fellow up with feathers. The town thought the Gordon outfit was loose and the Marshall was not to be found. They just had a good time. Gordon had $800 worth of fun in "Monticello" last Spring shooting through a man's hat. The man turned out to be Dalton's uncle, though Dalton was not there. They were fighting at close range and Gordon's gun was taken away from him in the scuffle, as he was not the only nervy man in "Monticello." Gordon's place is the old Carlisle station and probably the Carlisles have an interest in it yet. They came here from Scotland, three brothers--twenty years ago and became ranch kings of this part.

Some years ago in the good times, a bunch of cowboys came and shot up the school house at Monticello. Someone had tied up a bottle to the school-bell in the rude tower and this challenged the marksmen. They shot through the windows into the ceiling and the poor kids thought their end was at hand, until the boys rode away yelling like Apaches.

In the Gordon Cabins, Dalton said there must have been a million shots fired. Certainly the logs are well peppered, and we were shown a post where three bullets went through from a Winchester after they had wounded Gordon. Gordon has no fingers on his right hand. They were pulled out by getting them in a twist or loop of the rope when making an exhibition here of cow throwing. He calls a district or space of country: "I have never been over that scope of country." He is a goodlooking, intelligent man and except when charged with red eye very kind and peaceable. We met him on the road. He was on his way to a ran herd in Rattlesnake Valley and could not go back, but he said we could walk right in and take away the ranch and Dalton would be there and tell him to give us everything. I had a present for Gordon in the shape of a quart demijohn of whisky from Cooper of Moab and a letter of

introduction stating that the bearer carried a small bottle of red eye, and he hoped we would hit a few and he would give us some stories as to his experiences and some examples of his wit.

Hoped to reach Verdure and see Scorup tonight, but it was sunset and growing cold when we reached Monticello and Verdure 7 miles of bad roadway. We went to Benjamin Perkin's home, which is the most comfortable semi-hotel we have so far met and go to bed early, tired and well. New moon tonight. The La Sals still loom to the north many miles away. Monticello altitude 7,250 feet. Today we injured our odometer, putting it out of commission in a canyon, by riding on a jutting rock that just fitted the job. It was through no carelessness, but it was a hard country we were coming through.

Another Gordon ranch story. Had a new cook--a cowboy came in late after the others were through. Cook served up liver. Cowboy tired and cross, "Who the hell ever saw liver served up in a cow camp?" Take it away and bring me some meat." Cook draws gun, "Proceed to eat that liver and proceed quick. Eat it all up. Now tell these gentlemen that you like liver, and that you are stuck on liver."

Slept tonight at Benjamin Perkins in a bed. A Welsh family, clean and comfortable home. His brother has been our teamster for several days and is a quaint old customer. The other night Carl remarked last thing, "I wonder if I shall be troubled by tarantulas or rats or any small varmunts?" "Never mind," said he, "they won't bother strangers."

Friday, April 7th, 1905

Camp tonight at Mustang Springs, 25 miles from Monticello and 25 miles from Bluff. It is warmer tonight and we are among the cedars on the south slope of the Blues. This afternoon at an altitude of 7,250 we looked to the southeast and saw into Colorado, New Mexico and Arizona. To the south the sandy desert and strange forms in the Navajo reservation and a weird and desolate stretch--we were thankful were not bending in that direction. In the west to our right and not so very far away was the Elk Ridge; and the Orejas del oso (Bear's Ears) sticking above the level marks the head of White Canyon. They were only about 20 miles away, but the snow was too deep for us to go that way and we have to go around 100 miles yet. (A gap in Elk Ridge marks the head of Dark Canyon.)

At Verdure--Bob Nott's place, 8 miles south of Monticello, we met Bot and Scorup. The latter rode with us a few miles and we had our first opportunity to plan the essential part of our adventure and it certainly looks more formidable than ever. We can already see the necessity of hiring four man to go with us and 16 horses at a minimum. On the other hand it seems imperative to limit our trip from Bluff and return in twelve days.

Still the things we are promised to see are so splendid that it will probably be an exciting and glorious jaunt, full of ha d work but fine results. We have to give up the idea of going into Dark Canyon as that requires passing over Elk Ridge and the snow there is too deep, but in compensation we can get down into Grand Gulch, a canyon 20 miles long and full of wonders and of great depth. It is said to surpass Dark Canyon, and yet we have never before heard of it, and some well informed people who claim to know the country, deny its existence. In fact it is only in the last few days that we have heard of Dark Canyon, which runs to the north from Elk Ridge. Mustang Springs must be pretty when the leaves are out. The water lies in a dark grotto and only flows a few rods down the gorge. Shading the spring is a magnificent old cottonwood that we would like to see in leaf.

The country all around is still sheep-cursed and we long for the canyons to the west, where the cattlemen have kept out the sheep. We know more about the Bridges and they will be fine. Scorup had to go away to the White Mesa, but will reach Bluff tomorrow night ahead of us.

Saturday, April 8th, 1905

Reach Bluff this evening, Scorup kindly sent out a light rig to bring us in from a few miles up the road. Traveled today through Cedar Woods or over rolling sage brush land of fine quality. From Dry Valley nearly to Bluff, a distance of 75 miles, there has been abundance of good farming land that only requires a water supply to make it productive; or else the work of the experiment stations in the direction of dry farming will be the only way to utilize it except for grazing land. Even as it is, the grass would now grow freely over large areas but for the sheep. Today we saw far into the Navajo country and the forms that seemed faint yesterday show bolder today and through the glass seem to be extraordinary in character, especially those in Monument Valley with their forms something like these (Sketch here) and the monuments about 500 feet high, apparently.

It is doubtful whether we can get away Monda y morning. Tomorrow is Sunday and but little can be done in preparation. We have been so slow coming that we have about decided to go home by way of Dolores, Colo., a point on the Rio Grande that we can reach with light conveyance in two days.

About noon we crossed a muddy stream named Recapture Creek. We are now in the midst of the so-called Cliff Dweller's ruins. Frank Adams, who goes with us to White Canyon and Grand Gulch, says he has explored many of them and thinks there were three successive races, the cave dwellers, cliff dwellers, and mound builders. We shall see whether his theory appears to be tenable.

We sleep at Scorup's and eat at Mrs. Allen's. This old lady has been here some 23 years and has many a tale to tell.

Sunday, April 9th, 1905

Little doing today. It is now decided that we must use four men and twenty head of horses for which we must pay for twelve days $384.00 and furnish food for the men. This will give us seven days travel and five days stopping in White Canyon and Grand Gulch. We can not leave tomorrow morning but must wait until Tuesday as horses have to shod and the men have to be gathered up. The resources of the little town are taxed to provide for us. There are some handsome residences here built of buff stone in coursed Ashlar and with hard oil finished wood work interiors and neatly painted wood work outside. I had a bath today in a nearly modern bath tub and all has to be brought ninety miles from the nearest railway point, Dolores.

The peach trees are in full bloom. It has been showery today, the first rain fall since we started. Last Tuesday I said it would rain here on Sunday and not before. Altitude here 4700 feet.

Monday, April 10th, 1905

Making preparations to start tomorrow morning--rained a good deal today.

Tuesday, April 11th, 1905

A lost day. It rained all last night and nearly all day today. This evening barometer is rising. So much rain is remarkable here at this season, but the stockmen and farmers are rejoicing. We hear fairy stories of the wonders of Monument Park Valley on the Navajo Grant which could be reached by a five days trip from here.

Wednesday, April 12th, 1905

We "plunged" and had twenty-five miles of life in the mountains with a pack train. Starting not before 9:30 owing to the labor of saddling and packing twenty animals, we certainly made a startling effect as we passed through the town of Bluff and most of the populace turned out to see us depart. I never enjoyed myself better than today. It was cloudy and threatening but did not rain until about 4 P. M. A local photographer named Goodman, a very skillful man, took the cavalcade on our departure and again as we splashed through the swollen waters of Cottonwood Creek. The first adventure was six miles further in crossing Butler Wash. I took photos of the party coming down the trail-then stopped to renew my films. By the time I came to the wash, the others were all across, but my handsome horse (misnamed Dobbin) dashed down into the quicksand and rushing torrent and up the impossible rocks with a speed that took

my breath away. I had an audience that was scarcely over the excitement of crossing and I guess they concluded that I was no tenderfoot the way Dobbin carried me through. The next adventure was two miles later crossing Navajo Pass. This is over Comb Ridge into Comb Wash. This ridge is about 500 feet high and runs north and south thirty miles with only this place to cross it, and it is one of the dizziest things on earth. Narrow, steep and rocky, but at the foot is Navajo Spring, a cold, clear, sweet and never failing supply that is famous for its excellence. Here we took lunch. Then up Comb Wash, fording a fierce stream a number of times, then up rocky steeps to the cedar mesas above. We were at a high altitude and the view in every direction was superb; rocky canyons, breaks and cliffs, the Blues to the Northeast, the Elks to the northwest, where we were heading, and swooping twirling thunder clouds everywhere. Then the rain overtook us and every rock and cliff glistened in the rainshine. Among the sand and cedars in a land where the sheep have never groused, for none have been permitted to pass Navajo Trail, Grass and flowers and an abundance of sweet water at this season. Then as evening approached we entered Cascade Gorge with a hundred merry waterfalls swelling the stream and around among the pine and cedars by a dizzy trail to a huge cave discovered by the cowboys a year or two ago. They asked us to name it and we called it Cascade Cave.

The day was not without mishaps. Among other things, two or three mules gave out right after lunch and they lay in the sand by the river as forlorn a sight as one might wish to see. But they "dismulated." As their loads were released one of them turned loose with his business and and sent some of our food over into the Navajo Reservation. A fine shot at a can of Bents crackers filled the air with dust and sent the larger pieces over to Monument Park twenty miles away. So they say.

The altitude at Cascade Cave is 5,850 feet and the distance yet to go to the Little Bridge is about twenty-five miles. Our trail yesterday was so direct that it shortened the distance by many miles over the usual trail.

Cascade Cave is fully 350 feet from the front springs of arch, 100 feet, from floor rim to back and 100 feet from floor to top of roof. At the furtherest recesses are two springs of delicious cold pure water that never fail in the dryest season. Evidence of Cave dwellers have almost been obliterated but are still plain, the rocks squared up and "bonded" just as a modern mason would do. But the floor is solid rock and probably nothing is buried here. Tonight the bonfire lights up a portion of the cavern, but the rest is buried in the blue depths of a smoky haze. Outside, the moon is breaking through indigo clouds and the whole scene is weird. Tales of robber's retreats and pictures of old time gatherings of ancient tribes in this important cave come to the mind and fill the night with strange dreams.

Thursday, April 13th, 1905

At the Little Bridge! Arrived at 5:30 P. M. with no mishaps. Most of the way has been over woods of pinion pine and cedars with little grass, and with evidence that the snow had but recently melted away. To the east was Elk Ridge above which the flat topped Bears Ears towered a thousand feet and were covered with snow. We crossed Cedar Ridge and could see far down across the San Juan and for the first time saw Navajo Mountain, lonely and desolate near the junction of the San Juan and the Cold River to the Southwest. All between was cedar, cedar, cedar and they say that hardly anything will grow among them, perhaps owing to the pungent odor, which we know in cedar oil to be a vermi-fuge.

A few men have fenced or barred the few passes along the trail to keep here as many cattle as the range will feed. They use it as a breeding place selling their yearlings for about $16.00 and could only get $4.00 more for two-year olds. They are bought by Colorado feeders and usually the cattle men do well, but winter before last nearly ruined the range and the cattle men too. It rained a little on the first of September and not again until the twenty-first of March--nearly seven months.

We nooned today at Kane Gulch where we hoped to find two large jugs that had been dug out and hidden six years ago. But someone had found the hiding place for they were missing.

A good ten miles through pathless woods and rocky breaks and we saw the Little Bridge about a mile away. It spans a gulch from the north that feeds Armstrong Creek, a branch of White Canyon and where another stream comes in from the south. We took a few photographs, but I am too tired to sketch or measure and we will leave that for tomorrow. We are camped right under it, and the impression I have is that it is wonderfully lofty, graceful in style and very symetrical.

April 14th, 1905

"Brite and faro." Up at 5:15 to see the sunrise on Little Bridge. Got a good start for a sketch before breakfast, though I had to cross the gulch with a good climb and come back at the breakfast yell. By rising early I got a good sketch, made a number of photographs and pulled out for White Canyon after lunch, leaving at 11:45.

Seeing the "Little Bridge" this morning at sunrise only deepened the impression of graceful beauty. Reflected in a quiet pool the Arch appeared so frail that one might hesitate to venture out on it and yet it measured ten feet thick, thirty feet wide, one hundred and eleven feet high and a span of two hundred and five feet. We christened it "The Edwin Bridge" in honor of Colonel Edwin F. Holmes, ex-president of the commercial expedition.

I took a photograph while these measurements were being made and C. W. Holmes, Freeman Nielsen and Al Scorup were on top. I was making my sketch at the time. The camp had been against the base of the bridge. The stream that runs under the bridge joins the Armstrong just as it emerges. The canyon from which it comes has not been named so we called it Edwin Gulch. Opposite are the remnants of some so-called cave dwellers which we explored, but though difficult of access it had already been looted and only a few broken pieces of pottery were found. The structures and conditions further confirmed my belief that they were tombs, not homes of a forgotten race.

A mile on our way we saw picture painting on the rocks which were in such an awkward position that it is not likely our photographs are successful. They seemed to me to be an epitaph and nearby were ruins of structures that seemed to belong to the signs. These, too, were much despoiled. A couple of miles further and a well preserved structure was seen and our guide thought this had never been molested as it was so inaccessible. We, therefore, proceeded to scale the lofty cliffs and in about an hour we were there. It was closed up and in perfect preservation, but contained very little. I found a bone awl and an arrow head. While the others dug into an adjoining structure and found corn cobs, wheat stalks (said to be very rare, in fact, altogether new) squash rind, rushes woven and some strong string made they say from the fibre of the ooze. We crawled along the narrow opening and believe we were the first whites to enter the room. Why it was deserted is a mystery.

We are now camped in a pleasant spot near Caroline Bridge, having descended a frightful trail, which we can see from the camp. We shall remain here part of tomorrow before going to Augusta Bridge. On the way today we had a great mishap. The old mule named William Livingston had left the trail at the rear of the outfit, got into a deep water hole in Armstrong Creek and was discovered laying on his side, with the pack under water. That is, he was struggling and floundering and finally got rid of his load and struck for shore. He was not caught until he had made two good miles up the canyon. His was the choicest load of the lot having the big camera box and nearly all our plates, our two telescopes with all my films, clothing, et cetera, and finally our two grips, having all our little gimcracks. That is why our camp tonight looks like a laundry and this book is stained and generally disreputable. It was an anxious moment as we unpacked and even now we do not know whether our films are ruined or not.

April 15th, 1905

Dried all our stuff this morning in the bright sunlight, then I spent some hours in the difficult task of making a sketch of The Caroline Bridge, but was somewhat distracted by the cries of the rest of the party in their discoveries of the relics and hieroglyphics in the

surrounding caves.

The Caroline Bridge, named by Long in honor of the mother of his guide, James Scorup, is a most imposing work of nature. The span is 350 feet, it is 182 feet high, 63 feet thick and 60 feet wide.

Our cook, Franklin Adams who has had a lot of experience in digging out caves and cliff dwellings, went to the place we explored yesterday and returned with a big bowl or water jar and a digging or planting stick, some examples of the woven willow sticks used for coffin making and the shucks that we thought was wheat, but which he says is only the head of wheat grass.

The hieroglyphics or picture (painting) scratching or peckings was written the name of W. C. McLoyd and C. C. Graham, Winter 1892-3. McLoyd is considered to be the first white man to explore White Canyon and he gathered a number of relics, making a collection that was exhibited in Durango and afterwards sold to Eastern parties for over $5000. Last evening Carl Holmes climbed to the top of Caroline Bridge alone and stuck on a tree two red flags made from a handkerchief. He tried it again this morning for the purpose of measuring but there was a slight frost and the rocks were too slippery. It is said that no one has climbed this bridge before.

The ancient dwellers at the bridge have left the imprint of their hands in good red pigment on the wall, as though they intended the imprints to form a frieze. It is usually a fine quality of Tuscan red, but others are of a rich golden ochre. We later saw these handprints in such numbers and arrangements as to suggest a census of the inhabitants. What a chance for Pudenhead Wilson. This afternoon Carl Holmes and Freeman Neilsen again reached the top of the bridge and let down a rope for measurements. Frank Adams and George Perkins attempted the ascent, but failed. I did not fail.

I think that Ruskin lamented that in all his examination of cliffs in the Alps he was unable to find one that was really perpendicular. They all fell short of the vertical having a slight slope backwards at the top. He should come here and lament no more for there are scores and scores of them, hundreds of feet in height overhaning from 10 to 60 and 70 degrees. Caves unnumbered. They are pleasant places, many of them sheltered, ferny and ample; cool, echoing lofty and often affording fine views up or down huge canyons. From them the approach of friend or enemy could be easily marked. Frequently, a cool spring drips from the ceiling, especially at the time of the year we are here, and probably throughout the winter. From the brink, hug clambering pines wind their way from the cool and damp to the outer sunshine and these pines are tenacious of life and engage in a life and death struggle with the cedars. We have seen many instances where the pinion pine has survived, throttling its victim like a Laocoon, and there it was

living vigorously with its serpent strangle hold around the dead but never decaying cedar. One of the best examples of this, we saw on the very top of Edwin Bridge and I have always been sorry we did not have the camera with us to preserve the memory.

April 16th, 1905.

This has been a notable day! I have seen and sketched the Great Augusta Bridge! It is a magnificent and shapely structure and one of the biggest things in nature.

Measurements show it to be 265 feet high, 35 feet wide, 83 feet thick with a span of 320 feet. Geologically, the great Augusta Bridge is very young and yet millions of years were required by nature in its construction. Wind, rain and frost have been the sculptors. With these facts in mind as one views this marvelous work of nature it is easy to understand how the Indian mind would so revere this mighty bridge.

It has been deemed inaccessible, but again Carl reached the top in company of George Perkins and F. A. Nielsen and they were probably the first men to set foot there. Later in the day I went across with Frank Adams. The afternoon was spent in climbing high places in search of Mogui or Aztec ruins and relics. By the aid of ropes and ladders, we got to ledges that no white man had scaled, but found little to reward our labors. Whitaker and I each drew out a stone ax or hammer, unusually well preserved with handles complete. When we returned to camp at the Caroline we were all thoroughly tired. I think I have hit on the reason for the many caves that abound in this region, the same causes producing the bridges. The canyons are all eroded through a series of sandstone strata. Between the ledges, the mass is often to 200 feet in thickness, and made up of beds from a few inches to 30 and 40 feet in thickness. These beds are frequently nonconforming and of unequal compactness. In some the cementing element is almost wholly lacking and they crumble away like brown sugar. In others the cement is lacking in the laminations and where they are underneath they fall in great flakes, although sometimes the chunks come down with a conchoidal fracture. These pieces, if soft, are disposed of by sand, blast of the winds, or by water erosion, while the ceiling is being air slacked ready for another fall.

The wind usually keeps the back chamber well cleaned and gives a chance for the soft stratum to dessicate. Nearly all of the cave houses are in such places and the clay from the soft stratum has been manipulated with burnt lime or some other medium so as to make it very enduring. Nearly all of the houses are braced at the front by poles sunk into ceiling and floor. The causes of the caves are partly the causes of the bridges. The three big ones are at the junction of streams.

The bridge ledge is hard and covered with water pockets, full of water when we saw them. This ledge is level strata or beds. Below the beds are cross-bedded in every way and of varying hardness. In each case, at the original base of the spring of the arch is this soluble clay bed and it is evident that the streams attacking on each side of the wall that separated them one or the other finally found a way through this clay seam, and the rest was merely erosion and successive fallings of the ceilings. The bridges will become higher all the time from these causes.

April 17th, 1905

We climbed again the dangerous steeps at Augusta Bridge, which we have named in derison, the Scorup Trail and from the high mesa above tramped eastward four miles over rocky ledges and cedar ridges and across small canyons to the canyon we have named, "Unknown." No white man has ever before been into it. Scorup has tried to get down it from the head in vain. A day or two ago, Whitaker and Scorup tried to get up it from the mouth, and now we tried to get in it from the top, but would certainly have failed but for our equipment of rope ladders and scaling lines. The descent was made more eagerly because of the extensive ruins that were plainly seen close by on the other wall. Unknown Canyon does not appear on the maps but it is one of the deepest, wildest and most tortuous gorges in this part of the country.

Although, these dwellings had not been previously molested they afforded little reward for our labor. Sandals were in curious abundance, and some fragments of especially well decorated pottery. These and some cordage were all we got.

Scorup and I returned ahead of the party and managed to get down cliffs that had only previously been scaled by use of ropes and ladders. We are getting to know our feet better and fearlessly go in places that a few days ago would have taken the color from our cheeks.

It was sunset when we returned, footsore and weary. Whitaker and Adams had spent the morning in a village further up the White and had more trophies to show than we. From their descriptions there is so much to be learned there that we will visit it tomorrow.

Unknown Canyon runs its course winding along the foot on the south side of the West Elk Ridge, the latter not appearing on any of the maps. Its length is about 15 miles to follow its windings but not more than half that in a straight direction. Our walk across country took us nearly to its head.

April 18th, 1905, Tuesday

Beautiful morning, cool and sparkling. The canyon narrows quickly above to Augusta Bridge and in about 2 miles after passing huge caves, or oves, one of which was 600 feet in length by 150 front to back, we came to a cave settlement of great interest. It was in two parts, the lower being but little above the trail and consisting of a dozen or so houses, so fashioned that it is difficult to decide their uses, whether for sleeping rooms or receptacles for the dead. Few of them are lofty enough to sit upright in, while some are so shallow that one's toes would touch the ceiling in the only way he could lie down if he were five feet long. It was suggested that perhaps these smaller ones were for children. There were much larger circular apartments, cemented inside, but so arranged with flues, alcoves, etc., that they must have been kilns for either baking or finishing pottery. Many fragments of well decorated pottery lie everywhere, but McLoyd had looted the place years ago.

The interior of one of these round apartments was well covered with scratched sketches of the designs most frequently found on the pottery, as though the artist had sketched out the designs for less inventive artisians to follow. There was room in these chambers for a dozen workers, and except that rats had partially filled the place it was pretty much as it must have been abandoned many centuries ago. Above this - and only to be reached by an ancient ladder 60 feet in length, and then by some hazardous climbing, partly on steps cut in the rock, partly by wooden stairs of cedar, cemented into the wall - was a fortress, well arranged, and supplied with portholes. Many chambers ranged along the wall of the cave and other Kilns were there - a cistern and a font to catch the water of a spring that once flowed in this upper gallery.

If these small rooms were occupied by living people, which continues to be doubtful in my mind, there were accommodations in the lower village and in the stronghold above for at least 200 people. A clue that indicates their living occupancy is the polished or worn condition of the sills of the apertures; but if they were caches as the one described previously, certainly seemed to be (It had thongs hanging from the rafters to hang meat upon and they were as many as the room would hold) or if they were individual storehouses, or warehouses, for food or valuable pottery made by the people below, it can be understood why the place would be fortified against banded invaders. With the water supply indicated the place could be made to held out for a long time.

The cliffs and caves hereabouts are of hugest proportions and with but a narrow winding passage for the stream beneath. In a month or two this stream and all the others in the vicinity will have dried up, and one not knowing of the secret water pockets might wander to his death by thirst; but now many of the cliffs are ashine with running water and every side canyon furnishes a little rill. A couple of weeks ago, the

center canyon bottom and all those of the tributaries were filled with torrents from 10 to 20 feet deep that have washed out trails and left rugs of weeds and cedar bark clinging to high boughs of trees under which we now ride. Many of the places which we have formerly ridden are filled with deep water holes where the horses lose their feet (and we our heads) while quicksands abound that sometimes set us floundering, and the horses either struggle with us to firm land or we roll off to lighten his weight and get there the best way we can. With such torrents as appear to have recently rushed through these gorges, we can understand how erosion is going on, and how the landscape is being swept down into the Colorado River. The nights are flooded with brilliant moonlight, the moon being now almost at the full.

Wednesday, April 29th, 1905

Moved camp today 20 miles to Collins Canyon, occupying a cave at an altitude of 5,450 feet. This canyon is sometimes called Trail Canyon, as it is the one way of getting down into Grand Gulch, the bottom of which is only about a mile distant.

This has been a day of trouble with our animals, the several days' rest having made them full of the old nick. A sorrell that had been named after a certain Senator, on account of his mild and retiring disposition, ran amuck among the rest and shed his pack. He caught sight of a dozing mule on the bank of the river bank and deliverately bunted him over with his pack into our swimming pool. He then proceeded to kick up the camp and seven men for awhile failed to catch him.

The next mishap was that we heard a wild rumor that the camera mule, bringing up the rear and being led had fallen over the precipice. An hour later he joined us, little the worse for wear but he had had a frightful slide to the brink of a cliff and would have gone over but for the two men's help.

While we were waiting for them to come up, the sorrell again became festive. He had borne most of the food supplies and the long climbing rope 250 feet in length was coiled on his pack. With a few well arranged pitches he soon got these in a fine mix up. The air was full of flying missiles. While the coffee can was in the sky, he smashed two potatoes against it with a well directed blow; but before he was completely undressed, the line became entangled in the branches of a cedar and he proceeded to do business with it. He made a ring around the tree and nearly included several horses and men in his round-up. They had to step lively to prevent being bound to the tree. He himself miraculously escaped from the tangle and bounded for the same mule who was now with Whitakor (who had not dismounted) gazing into the depths of the abysses below. But muley was not going to be shoved again. One double slug in the breast and then a couple of rapid fire shots in the ribs turned the sorrel and probably saved Whitaker's life. The circus continued but

finally ended happily with peace restored and we were on our way again.

Upon on the mesa a furious wind was howling, driving the sand in our faces. As soon as we got clear from the cedars and reached the Scorup winter range, the wind was so fierce that we looked like a party of Bedouins transversing the desert. I tried to kodak the pack but my horse was so restive that I could not even get a snap. The cook rode up to hold my bridle. He is an expert horseman but we got badly mixed up and he was thrown with a broken bridle and stirrup in hand. His horse careened over the plain and it took us a long time to catch him. I am not quite certain what happened to me. I managed to keep my saddle, Kodak in hand open for use, but whether I made a snap shot or not only the developer can tell. Be some miracle if I had taken a good picture.

Tonight James Scorup paid us a visit from his camp near by and I learned a lot more about the surrounding canyons, their names and courses, The government map is evidently a work of imagination.

It has been a day of swirling clouds and snow flurries and threatens rain tonight, but we are under cover and don't care.

Thursday, April 20th, 1905

Early morning we all went down break neck trails into Grand Gorge. Bad as the way is, it is the only means of getting into this strange canyon, and in order for us to get out on the East Side we must go ten miles up the stream. It is called a stream, but most of the time the water is invisible, and only quick sands fill the river bed. At the foot of Trail Canyon, we sent the pack 5 miles up Grand Gulch to camp, while we went as far down the gorge to examine the scenery. It was certainly very wild and strange. The cliffs rose higher than any we had yet seen on the trip--500, 800, 1000 feet sheer, and the canyon so tortuous that we sometimes traveled half a mile to make 100 feet of direct distance. Strange shapes and grotesque faces varied the forms and huge cottonwood trees, hoary with age, twisted and bent in dragon writhings to add to the effect. But we had descended many hundreds of feet and for the first time this year we saw the cottonwood and maples in their bright spring green. The season had developed here while we were up on the higher lands. The day was sweet and cool, the tempest had subsided, linnets sang sweetly in the old trees, and the glow from the salmon-hued cliffs warmed the landscape and made every turn in our course either interesting or beautiful. Our voices echoed and the foot falls of the horses resounded in the narrow passes. We have been in many canyons, but Grand Gulch seems to have character of its own. It is rarely more than 200 feet wide at the bottom, sometimes only 15 feet and it winds like a wounded worm; but the feature that was repeated again and again in the few miles we explored was a line of overhanging cliffs from 300 to 600 feet in length, washed at the base by the stream and lined at a few feet distant by splendid old cottonwoods through which the

sunlight gleamed in fine contrast with the shadowy cliff. The latter was always on the south side of the creek and the trees bordered the stream on the north. Each of these made a fine subject for a painting and it was an artist's morning never to be forgotten.

Returning to Trail Canyon, we continued up Grand Gulch to Castle Pasture where camp had already been made and dinner awaited us. Altitude at camp nearly same as Collins Cave -- 5,320 feet.

Scorup assures us that in all probability no man has been in the Grand Gulch below Trail Canyon for five years, or since some parties were there hunting Mogui relics and very few ever enter the part where we are now camped. The canyon continues in the same character nearly 40 miles to the San Juan River where it grows even wilder and the stream leaps some 300 feet into that river. No one goes down its lower stretches.

Ruins of ancient people are around us now on every side, but they are unimportant repetitions of others we have seen. Where the canyon narrows to less than 30 feet, the evidences of torrent work are tremendous. At one place, where it is only 5 feet wide the water has been backed up to 50 feet in depth and the bury must have been terrific at flood times as the huge trunks of trees piled up show.

If these wild gallaries are weird in the day time, how do they seem at night? Tonight the moon rose late, and in the early part of the night, I made my way in the silence through deep and dismal passages where the starlight scarcely penetrated, and above me were many shelves--the desolated abiding places of a long forgotten people. The echoing corridors responded to a finger-snap, and the cracking of a twig brought forth a rustling whisper from the depths that were deeper than the eye could penetrate.

Soon a faint, warm and ghostly glow seemed lighting hidden places, for high overhead the moon beams had reached the rocky crests and seemed to render the spires and domes transparent. As the moonlight reached them in succession, the outlines, that had been hard against the sky, disappeared, and melted away in a faint rosy gray mist. The nearby crages were firm and plain enough, part in the light and the rest in shadow; and now fingers of silver light stole through the trees, or gave a trembling touch on some uprearing cliff, playing with the mystery of these dusky gallaries.

Friday, April 21st, 1905

We camped tonight in a cave in Horse Creek Gorge, and were glad to get under cover as it is windy and rain is threatening. Today we rode many miles up Grand Gulch amid bewildering arrangements of crags and gorges, the lines growing heavier as we descend until they are cyclopean, titanic rather than fantastic. Cliffs with holes through them, cap rocks like tam-o-shanters, rim rocks far overhanging, cave seams with

Hogui houses not all in ruins and with seeing so many I begin to see darkly through the mystery--rich bits of bottom land that must be extremely fertile, sage brush, rich and luxurious 10 feet high and splendid in bluish green contrast to the pink and orange rocks and gleaming sands. Maples and tremendous cottonwoods make imposing features of the landscape. We were again assured by Mr. Scorup that no one had been up this canyon.

Returning to Horse Canyon we made pictures of the interior of the splendid "Grand Opera House" and going afoot up the frightful passes of this canyon, found the pack animals and the rest of the party awaiting us near the head where we went into camp, tired but thoroughly satisfied with the day.

Saturday, April 22nd, 1905

Rode 27 miles today, again crossing the Cedar Ridge and camp in St. George's cave just below the rim that looks down on Dead Bull Flat. We made an 8:00 start, but it rained while we were eating breakfast. So there was no flying sand among the cedars, though the wind was blowing fiercely. Soon after ten it commenced again to rain and continued all day and far into the night. Yet we enjoyed the ride, being high up among the flying clouds. The land is blessed with unusual rains this Spring and responds with grassy slopes and flowering meads to the great satisfaction of the cattlemen whose herds are flourishing. Frank Adams gave some exhibitions of cattle roping.

We nooned under the cedars in the rain but are all provided with waterproof clothing, and tonight in this greatest cave of all, sleep snugly while the rain falls in torrents outside. At the extreme back of this cave is a never failing spring of purest water. Today, Scorup trusted the lead to George Perkins, whose cattle roam through "Cigaret" and he lost his way in fifteen minutes. We were only one-fourth mile from the trail, yet found ourselves at the brink of an awful canyon cut up in gorges of the wildest description. Sunshine was bursting through the rain and mists were driving among the temples and broken crags for miles and miles. Scorup promptly rescued us by leading us to the trail with unerring instinct; but the sight we had seen well repaid for the adventure. This is our last night out on this jaunt, but in the wierd charm of this cave our interest is as vivid as ever.

Sunday, April 23rd, 1905.

Left St. George's cave at 8:00 A. M. and rode out on a point that overlooks Road Canyon and Comb Wash. We were on a high outjutting point and saw a world at our feet and in the distance. Not far away to the south in "Barton's Land" were pinnacles and monuments but far across the San Juan, some 30 miles away were the spires of Monument Park that we are so anxious to visit. To the East of them the Chuckaluck Mountains

--snow covered--and the Comb reefs stretching across our path from as far as we could see--reaching from the Elk Mountains clear into Arizona. We rode gaily homeward, having only 20 miles to make. The stream in Comb Wash was higher which gave ominious suggestion as to the San Juan. I have not yet fallen from my horse, but it is not the fault of the rest of the crew, who love to see Dobbin prance in his high spirited way. While we were crossing the river, one of them fired a Winchester three times and I thought Dobbin would jump over the Comb reefs but we stayed together and it was George Perkins who nearly bit the sand. I had the advantage, however, of suspecting what was intended and was watching the gun out of the corner of my eye.

We lunched again at Navajo Springs, where we met an old Navajo named Jim-Joe, who is one of the brightest Indians in the country and has settled at the foot of the Comb and off the reservation. He was intending to herd his sheep near the spring, but the party told him he could not. He said he had a paper from Washington saying he might, and promised to bring it to town and show us tomorrow. I avoided Butler Wash, remembering my flying exploit on the way out; but was relieved to find the stream had changed its course and it was not necessary to make the leap off a high rock into the water. The crossing was bad enough, however. I learn today for the first time that on the way out the party all dismounted at this rock and were petrified to see me come along and take the whole thing on horseback. They did not know that I couldn't help it and that Dobbin was the real hero.

We came into town in lively marching order, everybody feeling well and a large proportion of the townspeople watching the parade. It was Sunday and the well dressed folks made us appear like a lot of tramps.

Monday, April 24th, 1905

This we had set apart as a day to rest and look into the question of crossing the river for a four days' trip to Monument Park. We spent most of the morning by the river bank watching the Indians in their daring performances on the water. The San Juan was furious, and rushing its muddy volume laden with big drift wood at the rate of 8 or 10 miles per hour, yet we saw a couple of Navajos put off from our side and make the passage across in a wretched flat bottomed dingy that leaked. They had paddles, roughly made and clumsy rowlocks, yet they landed safely about a half a mile below. They ten towed the boat up the opposite bank for a long distance and took in some passengers with bundles of wool. They then crossed to a sandy island in midstream. Back again for another load until they had eleven persons in all of squaws and bucks. The bucks waded and pushed and towed to the edge of the deep water, when all got in and let the rushing current carry them in an eddy to our side, they paddling for life and making the crossing successfully. They can all swim like fish and have no fear of water, as they understand the currents and how to manage them perfectly.

If we cross, it must be this way and I think we will not trust ourselves to the ordeal, but it is not necessary for either of us to back out, for everybody agrees that it would be a physical impossibility to get our horses and packs across. No one will undertake it, and the chances of drowning several valuable animals are so great that we decide to cut out the trip.

The afternoon is spent in trading off saddles, guns and other things for Navajo blankets and we prepare to start bright and early for Dolores, Colorado, where we take the train for Utah.

Tuesday, April 25th, 1905

As we pulled out this morning, Mrs. Jones ("Aunt Mary") who runs the Coop Store asked "When shall we see you again?" "Probably this evening," I replied and sure enough here we are. We were out 8 miles this morning, when the river proved to have overflowed to such an extent that we had to turn back. It was past noon when we reached here and to take another road at that time of day was out of the question, as we had no facilities for camping out and must make 45 miles to the first house. So we resolve to start earlier tomorrow and take the mountain road via Recapture Creek. Whether we shall run into fresh difficulties is still unknown.

Tonight we were invited to address the community at the meeting house, and I spoke for an hour on Art as my duty as a member of the Board of the Utah Art Institute. It seemed like carrying the subject far afield, but the principles are universal and apply here as well as anywhere.

Wednesday, April 26th, 1905

Left Bluff at 5:30 in a light outfit, the most of our baggage having gone forward yesterday afternoon in a heavy wagon. Nooned on the prairies a mile or two from Montezuma Creek and at night reached Major's place, a sort of Mexican adobe home where beds were supplied and although things were of the crudest, the hearty welcome made all pleasant. Mrs. Perkins and Mrs. Wood had already arrived and prepared our meals. The ranch is in McElmo Canyon and ruins of the ancient dwellers are everywhere.

In Bluff, the last day we were there, we met two worn and half sick men whose story told to what remote and untrodden fields we had wandered. They were James McEwen and a Mr. Tolmy who had been to the settlements in Rabbit Valley to buy cattle for Colorado. They live at Cortez. They thought they would return by a direct course crossing the Colorado River at Hole in the Rock, a few miles south of Hite. Both were experienced men in this western rock country and McEwen had crossed the San Juan region before, but they got lost in the maze of rim rock and box canyons and for fourteen days wandered among the mountains unable to find their way

westward. The wet weather gave them plenty of water but for four days and a half they were without food until they ran across James Scorup in Grand Gulch and found the trail we had left. And the reason James came to be there was that we had made a big smoke and cedar fire to attract his attention as had been previously arranged with Al, our object being to get some fresh meat, and this was to be the signal for him to bring an animal over from the winter range.

Scorup came and stayed with us all night and being so far from his usual camp and the spring round-up at hand, he decided to go down to Grand Gulch for any stray cattle that might be there. It was the first time he had been down the canyon for a year and no one else had been down in the meantime, so the meeting of these men was well nigh a miracle. McEwen looks upon James Scorup as being his deliverer and says he can have anything of his he wants as long as he lives. This dramatic incident impresses us the more that we were camped within a few miles of security and plenty, hardly able to realize that we were in an unknown land, yet our presence there led indirectly to the rescue of these homeless wanderers who confess that they were nearly to the end when help came. And but for the very exceptional rains they would have perished sooner for want of water.

Never in the memory of the oldest inhabitant have there been such rains--never have the hills been so green. Passed Ruin Canyon today.

Thursday, April 27th, 1905

One of our horses died in the night, perhaps overworked yesterday on the heavy roads. We drive 18 miles to N. Hall's place at foot on Ute Mountain 9,660 feet, where we take luncheon at a thrifty farm. Large fields, green and glowing. Peach orchards abloom. Father and mother, two sons and three daughters all work in the fields, stop to prepare a meal and entertain us. Cliff dwellings among the run rocks with steps cut in rocks to ascend. Are still in McElmo Canyon.

In the afternoon we drive to Cortez, altitude 6,600, a trading town of two or three hundred people. Strong contrast to Bluff there being saloons and gambling--no shade trees.

Friday, April 28th, 1905

Drove in morning by stage 16 miles from Cortez to Dolores, where we reach the narrow gauge Rio Grand Southern Railroad. Snow bound passes awaiting us for Thompson's. The heavy storms in the mountains had made all trains late and we were a couple of hours behind time in starting. Then the trip up the Dolores River to Rico, a former prosperous mining town but now most of the houses are empty. The splendid San Miguel peaks, the highest being Mt. Wilson, 14,309 feet, were observed at the Lizard where the pass was 10,500 feet and we dropped rapidly to Vance Junction,

8,400 feet, only to start up again on the Telluride branch, reaching the latter town at Sunset. Altitude 9,150 feet.

Here we have to stop all night, at a good hotel, the New Sheridan, population 2,500. The mines are of permanent character being low values in gold. Milling mostly, but a grant hydraulic plant is in operation on placer mining. The fortunes of Rico seem to be on the rise owing to its being a zinc camp and the great demand arising for zinc is great.

Saturday, April 29th, 1905.

Left Telluride at 9:15 A. M. Swung around among the great Uncompagre Peaks into Happy Valley where the long range of high peaks that surround Ouray and Telluride make a splendid panorama. The unusual quantity of recently fallen snow and the very clear day comine to make them impressive. Stopping for a few moments at Ridgeway and went onto Montrose for noon. Waited there a couple of hours and went down the Gunnison River Valley to Grand Junction at 6:15. Here we had to stay until 2:00 A. M. though if the train had been on time would have left at 12:15. Went to theatre to see White Whittlesey in "Soldiers of Fortune."

Sunday, April 30th, 1905

Arrived home, 12:20, train two hours late.

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SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 19

TONTO RUINS STABILIZATION
MAY 27 TO JUNE 30, 1937

BY
WILLIAM A. DUFFEN

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

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TONTO RUINS STABILIZATION MAY 27 TO JUNE 30, 1937

By William A. Duffen

Work began May 27 and continued until June 30.

The working crew consisted of the writer, who was in charge, two laborers and two burros, the latter being used for transportation of water and adobe from the ranger cabin up to the ruin.

This period of work was wholly upon the lower group, which was really in a bad state of repair, and consisted of the rebuilding of retaining walls, and cleaning of rooms which had been dug out at earlier times. In many cases the debris had just been mulled over in the quest for "antiques". The slowest part of the job was the rebuilding of the rear wall of Room 2 (Stoner's map. See Southwestern Monuments Monthly Report for April, 1936, page 305).

The first unit of work accomplished was that of rebuilding the retaining wall in front of the cave, and the continuation of the same across in as near level manner as possible until it reached the remnant of the south wall of Room 1. This latter chore also added much strength to the front wall of Room 2. The dry masonry retaining walls now in place, we had a place to put the debris from the rooms.

The second work unit was removal of the aforementioned accumulation of trash in excavated rooms. All rooms of the ruin had been gutted before the ruin was put under protection of the National Park Service with the exception of Room 16 which we left undisturbed. Removal of this debris brought to light features that had not been reported to date as well as some very interesting artifacts. Room features will be included in the section of the report on room descriptions; artifacts were entered in the catalog of Tonto National Monument museum and will be described in a future Southwestern Monuments report.

In some cases only a couple of inches of dust would be found on the floor and in several cases as much as two feet of trash was removed. Even though the rooms had previously been "gutted" great care was taken by the writer in the removal of this material and as a consequence the artifacts were removed in good shape. In most cases the floors which have been left as such are in reality false floors which are the result of careless housekeeping by the ancient dwellers. The firepits will however in all cases be filled in save one which is in Room 15. This room will not be entered by visitors. However, its features may be observed from Room 16. This is a safety measure as well as one of exhibition, in that the room may be seen in its original floored condition with fire-pit, metate, etc.

The third work unit was the removal of the old ramp that used to lead from the cave floor to Room 7. Its removal allowed much more space and was in reality unnecessary in the exhibition of the site. The slats of a cradle were uncovered at the base of this ramp.

The fourth chore was to get good adobe for the reconstruction of a wall of Room 7. It was necessary to go as far as Windy Point, several miles from the ruin, to obtain this material. The adobe then had to be handled a second time. The transportation of same from the parking lot to the ruin was a slow tedious one. The beasts of burden would balk when one pound too much was hoisted upon their lazy little backs. The trip up was then very slow, as only a burro can make it. Five-gallon oil cans were used as containers for getting water to the site. All materials now being in place, the last task was ready to begin.

This consisted of cutting down to bed rock and obtaining a good foundation on which was laid dry masonry on which to build the wall. The steps built by the Southern Pacific Railroad Company leading to the little court, or Room 11, were moved to the spot where the door once penetrated this room.

It was found necessary to build up the wall in courses not much over a foot in height and let this set before the next layer was put on. The wall was constructed a trifle higher than beam height and then stepped off gradually down to about a foot high, the stepping commencing just beyond the beam axis. The large beam that had for years lain in Room 10 was replaced for exhibition purposes as well as to strengthen the newly built wall and to support the roof timbers which had for so long projected into Room 10. They form the roof for Room 9, or hallway, and part of the roof of Room 10. This part of the work really added much to the appearance of the ruin. It was the writer's wish to clean up and strengthen so far as such work would stabilize the ruin and yet not polish it up to the extent of looking too new or artificial. He hopes that it will be satisfactory.

The construction of several steps of stone and adobe in several of the rooms was deemed necessary to preserve walls that must be stepped over by visitors.

The final bit of work was the policing up of the area traversed by the burros and the return of tools borrowed to complete the work.

The cooperation of local people and the Forest Service, who lent equipment, is to be highly commended.

LOWER RUIN: ROOM DESCRIPTION

(Note: Room numbers taken from Victor R. Stoner, "A Reconnaissance of Tonto," Southwestern Monuments Monthly Report, April, 1936, opp. p. 306)

Room 1

Only a bare remnant of this room remains today, and none of the floor level. The room had without doubt been built on the edge of the cave floor and partially on fill. When depredations were begun at this site it is possible that this was one of the first rooms to go.

Room 2

In its original state this room was in all probability two rooms. A map of the lower ruin taken in 1920 shows the complete back wall standing, being pierced with a doorway at the point where the steps now lead visitors into a small open court. (Room 11). There were no floor features remaining. Room 2 was two stories in height, a fact substantiated by remnants of walls still erect at the south end.

Room 3

Practically nothing remains of this feature. A rock which anciently had fallen from the roof of the cave had formed part of the back wall to this room. The crevice between the floor and stone was walled up with adobe masonry. There had been a door connecting this room and Room 4, but it has been destroyed. On top of the stone remains a bit of cross-wall. The dimensions are indeterminable as practically all of this room has sloughed over the cliff edge.

At the edge of the large rock is a small firepit made of small stone slabs set upright.

Room 4

This room in its complete state was 19 feet long by an unknown width. Only a small amount of floor remains and that is in the southwest corner.

A small firepit, circular in form and clay lined, having a diameter of 10 inches and a depth of 6 inches is located 19 inches from the back wall and 12 inches from the south wall.

Due to the height of the door leading to Room 7 it was necessary for the dwellers to place a stone in front of it as a step. This feature remains.

Room 5

Stoner's map errs in regards this room. The south wall should be shown to continue completely across shutting Room 6 off from Room 5. The east wall does not continue across in front of Room 5 but terminates at the corner of Room 6. There is nothing to show that this room ever had a front wall. It is sure that Room 5 was used as there is much smoke on the roof and walls. The roof was formed by the cave top itself and the north wall continued up to it. The floor consists of a natural ledge. This room was roughly 6 by 11 feet.

Room 6

This room belongs to the early period of occupation and was never more than one story in height. The south wall is 8 feet, 3 inches long. The north: 10 feet; the west, 12 feet; and the east, 10 feet, 7 inches.

A circular clay-lined firepit 20 inches in diameter by 8 inches in depth is situated 3 feet, 10 inches from the east wall and 3 feet 5 inches from the north wall.

There is a possibility that a door led into Room 16 but as no lintel marks remain we cannot be certain.

Room 7

Room 7 shows all evidence of having been two stories in height. Dimensions are: north wall, 10 feet 11 inches; south wall, 10 feet 2 inches; east wall, 12 feet 11 inches; west wall, 12 feet

This room had three exits: in the east, west, and south walls. In order to enter Room 15 it was necessary to make a step up of two feet.

A circular clay-lined firepit was situated two feet from the east wall and five feet 4 inches from the south wall. This feature was 10 inches in diameter by five inches deep.

The ceiling in this room had been about seven feet high. It is an interesting point to note that the ceilings were all of a good height in this ruin.

A fine example of a wooden lintel remains in the west wall. It is 15 inches wide by two and one-half inches thick by four feet three inches long. This door is two feet wide by two feet five inches high and 17 inches above the floor of Room 15.

Room 8

A large part of the east wall of this room is made up of a large stone from the roof.

Room 8 measures along the east wall 12 feet 11 inches and along the west wall 11 feet one inch. The south wall is 10 feet four inches and the north wall 10 feet five inches.

This was a two story room. A door pierces the south wall entering into the hall which is of an undetermined width, while the height is two feet four inches. A blocked doorway exists between this room and Room 14. This was brought about probably by the addition of Room 8.

Room 9

This hallway is probably the dividing line between the old and the newer construction units. As it exists now it measures 23 feet 10 inches along the north wall, 18 feet 10 inches on the south wall, with an average width of three feet four inches.

The roof also forms part of the roof of Room 10. Apparently Room 9 was never more than a single story.

Room 10.

This room was very badly damaged and was the focus of a goodly part of the stabilization work carried on. Walls that were standing gave a width of 11 feet five inches along the back wall while the north wall measures 18 feet five inches. A beam which had for a long time lain on the floor of this room was replaced in the ceiling, and some of the walls were repaired.

A circular clay-lined firepit is located a couple of feet in from the north doorway.

Several fine artifacts came from this room.

Room 11

The feature designated as such is a small alcove or patio and probably was not used as a room. There is an outdoor firepit without much form against the west wall. The floor is formed by the bare rock of the cave floor.

Room 12

Room 12 on Stoner's map appears not to have been a room. The remnants of walls which exist probably were of a defensive nature.

Room 15

This was a small room formed by building a wall across a natural recess in the cave wall. The great amount of smoke on the ceiling labels it a living room. Had it been a storage room and had it been destroyed by fire there would have been burnt deposits on the floor. They were missing. The debris was dust and decayed organic material.

No clay-lined firepit was present but there is a small depression in the rock floor that gave up some wood ashes.

This room contains a very interesting type of door.

Room 14

This room is the most complete in the entire ruin, having the roof intact.

The north wall measures 12 feet seven inches; the south, 11 feet seven inches; and the east wall is 15 feet three inches. The west wall is 15 feet three inches long.

This room was one story high and was one of the first to be built in the cave.

The hatchway leading to the roof is 17 inches wide by two feet nine inches long. The roof is six feet seven inches above the floor, which is a generous height for cliff dwelling rooms.

A doorway on the south side of the room measures 22 inches wide by three feet high, and exhibits a four-pole lintel.

On close examination it will be noted that the crotch in the center post has been padded with grass. Could it have been done to prevent the creaking of the timber as it lay in it?

Room 13

Room 13 produced some of the good artifacts which were obtained. This room had been turned out and there was a goodly amount of trash in the back mixed with pack rat nests, composed largely of cholla cactus. This room, along with Room 14, is the oldest in the ruin. The floor is largely the natural floor of the cave.

A firepit 12 inches in diameter by six inches deep is located three feet seven inches from the north wall and six feet two inches from the east one.

This room was one story, and the roof was six feet eight inches above

the floor. Dimensions of walls: east, 11 feet 10 inches; west, 12 feet seven inches; north, 12 feet three inches; south, 12 feet six inches.

Room 16

Was this a room or an open court? The writer does not see how it could have been roofed over. There is a hole which might have well been one to hold a support post, but, the diameter of the post which this hole could have taken could not have supported the great weight that would have been produced by two beams at right angles. This hole is found on the rock ledge in the floor.

Room 16 is unexcavated, and should at some later date give some good information. Then, perhaps, the former existence of a roof can be proved or disproved.

The rough measurements on this room are: 15 feet nine inches north and south by 21 feet eight inches east and west.

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HYPOTHETICAL RECONSTRUCTION OF BUILDING PERIODS

This reconstruction is based largely upon evidence presented by wall joints, blocked doorways, etc.

It appears that the first unit was composed of Rooms 14, 15, and 16. Later Room 6 was added and automatically brought Alcove 5 into being. At a later time Rooms 7 and 8 were added and two doorways that had been in the original part were blocked. Rooms 7 and 8 were two story affairs. A parapet was added to Room 15 where it overlooks Room 16. Rooms 14 and 15 appear never to have been more than one story in height. Room 16 appears never to have been roofed, but this fact will not be known until it is excavated.

Following the building of Rooms 7 and 8, the hallway or Room 9 was brought into being as were Rooms 10 to 13, inclusive. From all appearances Room 10 was a single story. The north wall of the hallway shows that it is a later addition in that the cross beams for the ceiling were set into holes which had been pecked into the wall. The roof of the hall extended on over and formed the north half of the Room 10 roof.

Room 11 was no room but an alcove having an outdoor fireplace.

It does not seem logical that such a room as Number 12 could have ever existed. The wall remnants might have been no more than defensive measure, and it would help keep the aboriginal kiddies who might have played in the alcove out of the canyon below.

Room 13 has much smoke blackening on the roof which would seem to set it off as having been living quarters in place of a storage room. Just when this was built is unknown. It could have been constructed at any time without altering the setup in any way.

Evidence of Room 1 is nil. No statement is safe.

Room 2 had been two stories high as is shown by a picture taken in 1920. The major part of this room has gone over the edge.

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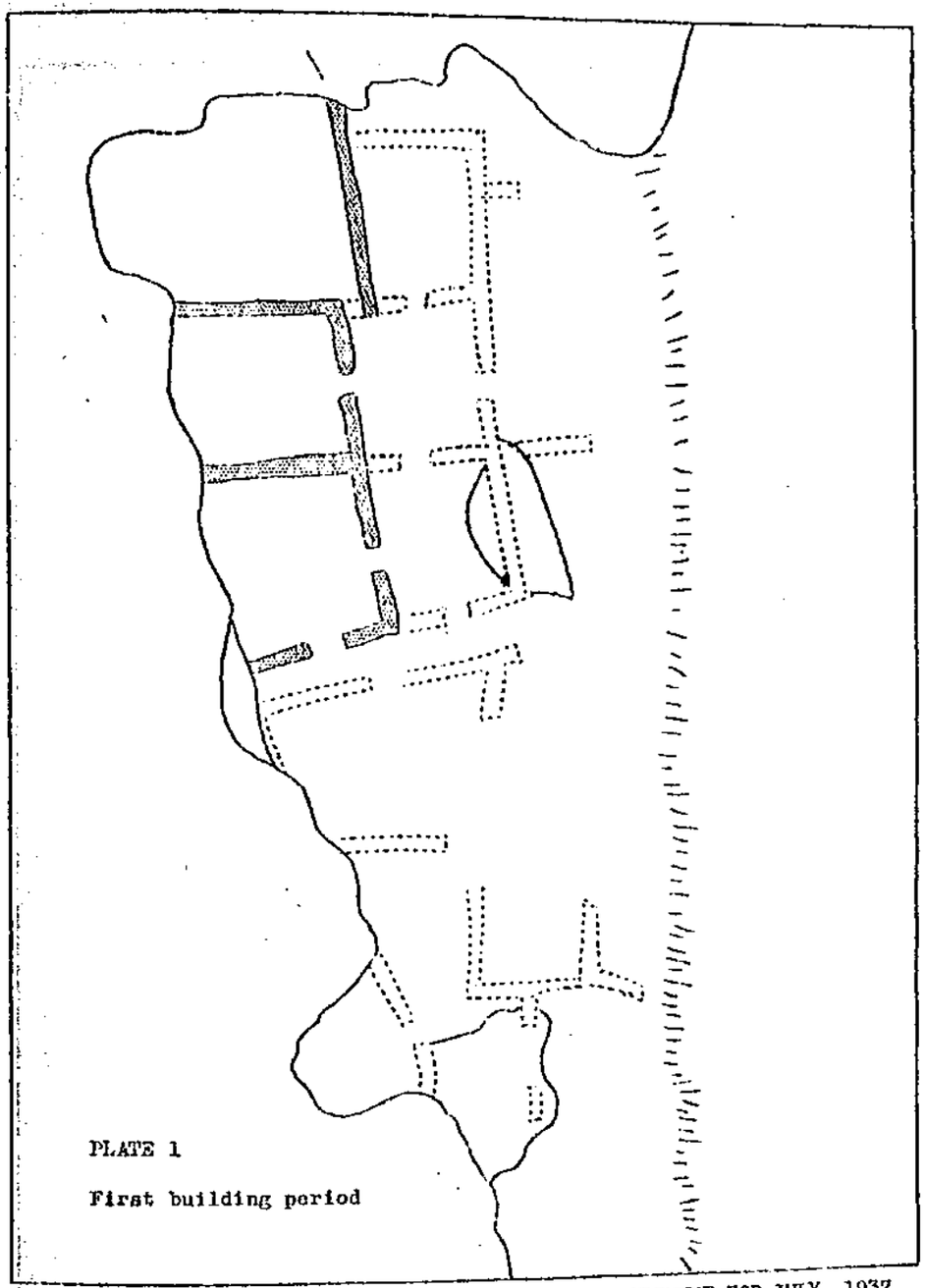

PLATE 1

First building period

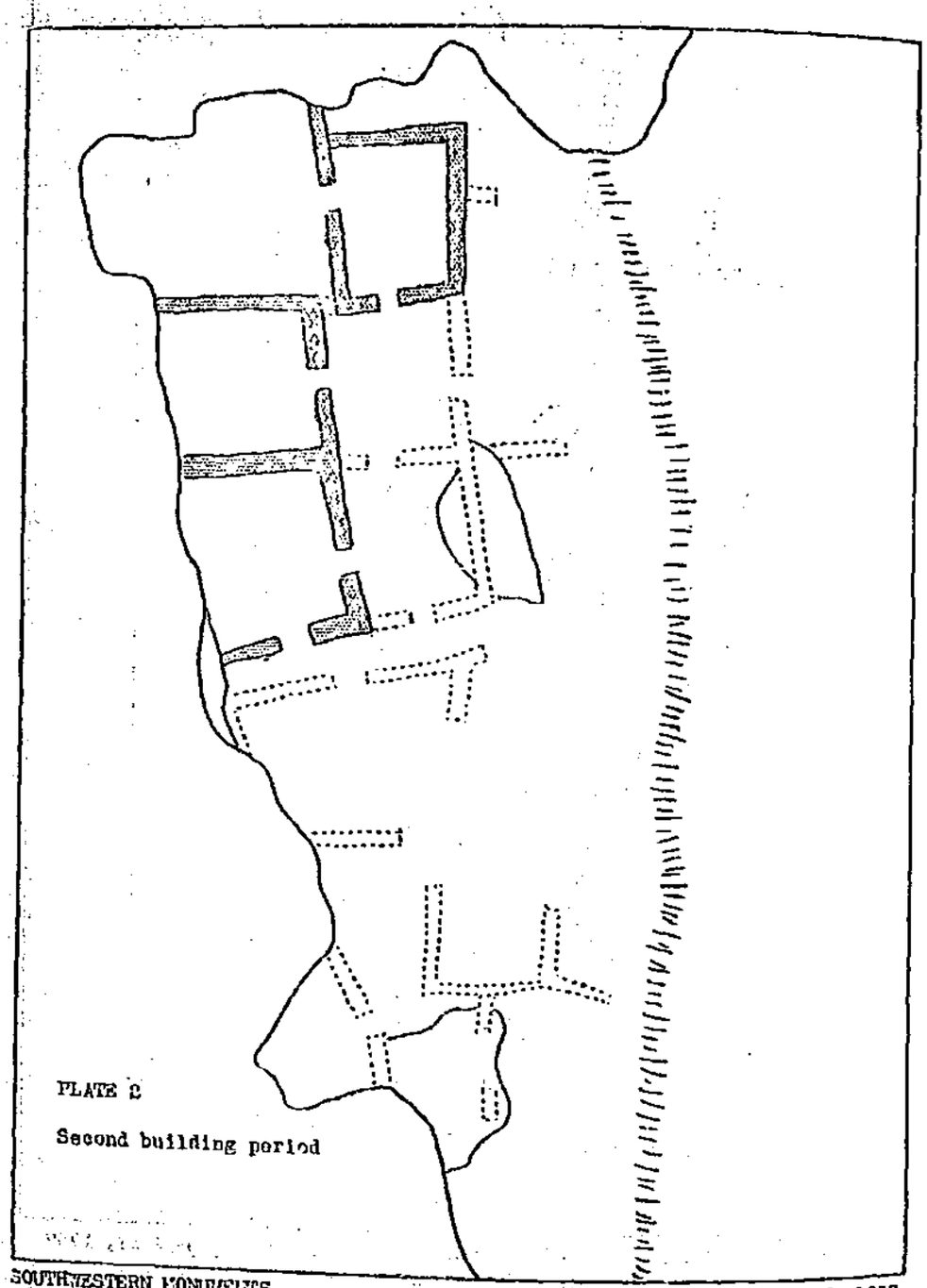

PLATE 2

Second building period

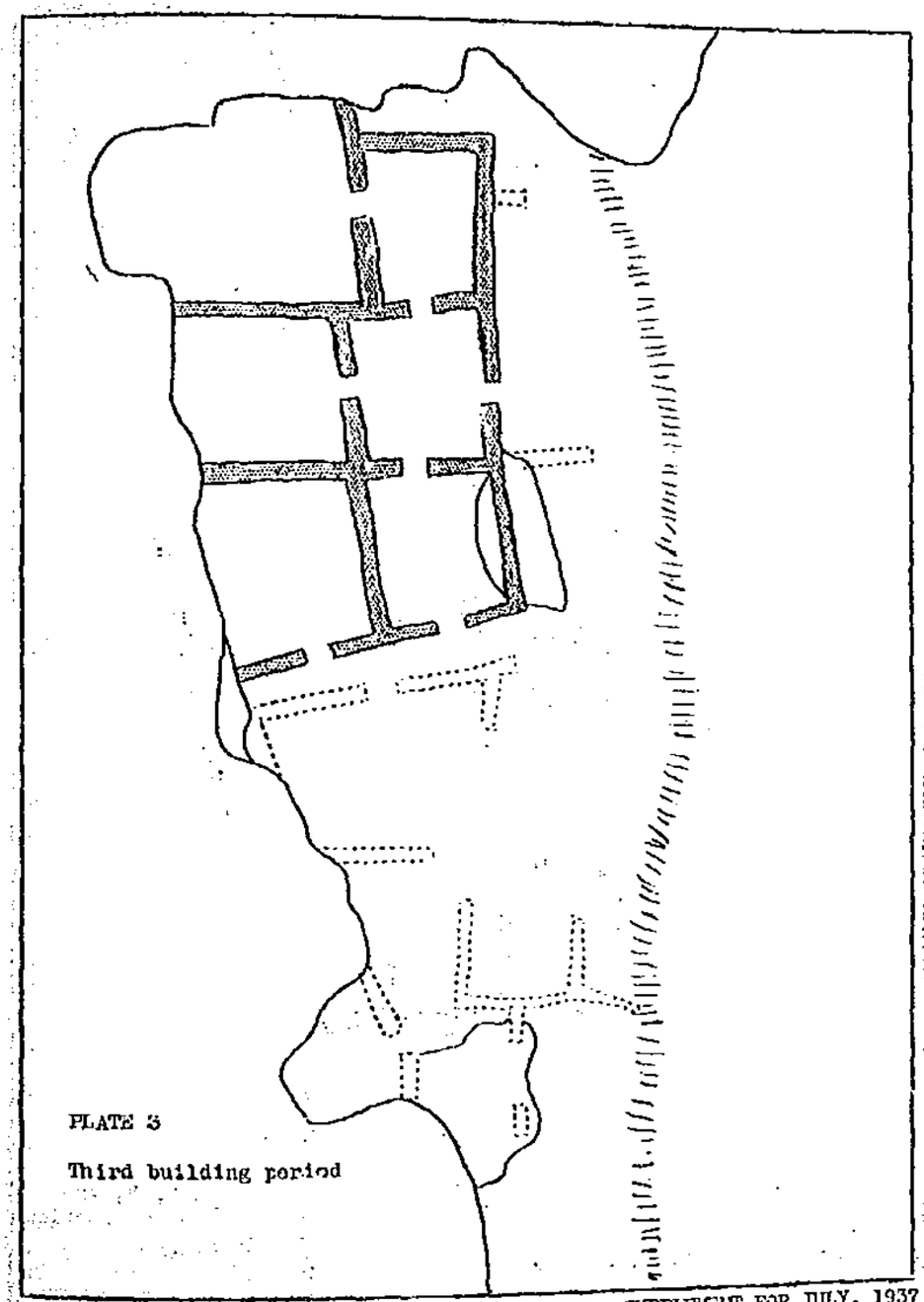

PLATE 3

Third building period

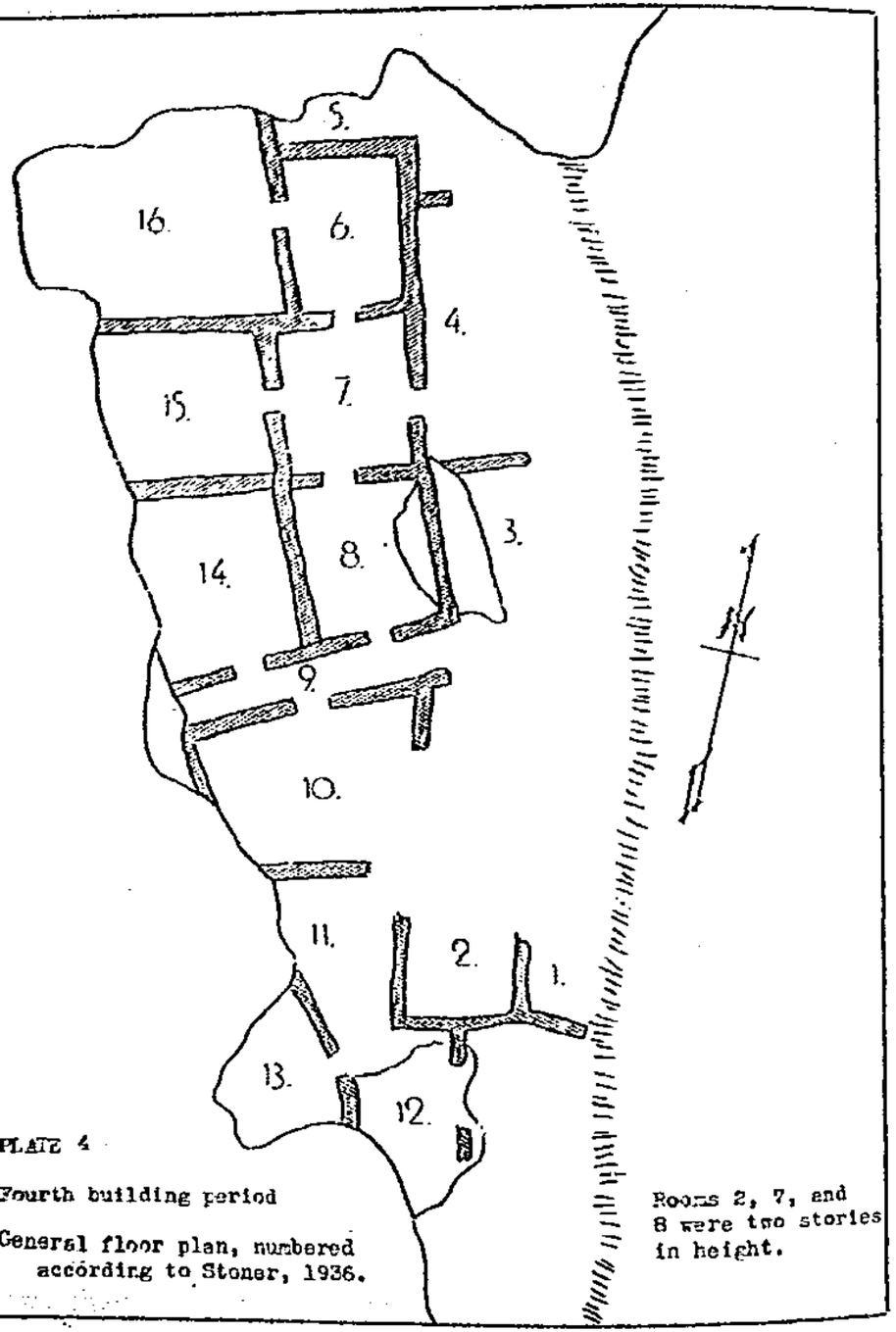

PLATE 4

Fourth building period

General floor plan, numbered according to Stoner, 1936.

Rooms 2, 7, and 8 were two stories in height.

SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 20

GEOLOGIC REPORT
CANYON DE CHELLY
NATIONAL MONUMENT

BY
VINCENT W. VANDIVER
DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

GEOLOGIC REPORT, CANYON DE CHELLY

By Vincent W. Vandiver, Associate Regional Geologist

INTRODUCTION AND LOCATION

This report is intended to supply the main geologic facts regarding one of the most important Monuments of the Southwestern group, Canyon de Chelly, pronounced "shay". The Monument is situated in northeastern Arizona, near the center of the large Navajo Reservation, and consists of approximately 83,840 acres. It was established by Presidential Proclamation on February 14, 1931, and the description of the lands was amended by a Second Proclamation on March 3, 1933. The latter Proclamation defines the boundaries as follows:

> "All land in Del Muerto, de Chelly, and Monument Canyons, and the canyons tributary thereto, and the lands within one-half mile of the rims of the said canyons, situated in unsurveyed Townships 4 and 5 North, Range 7 West; Townships 4, 5 and 6 North, Range 8 West; Townships 4 and 5 North, Range 9 West; and in surveyed Townships 4 and 5 North, Range 6 West; Townships 3, 6, and 7 North, Range 7 West; Township 6 North, Range 9 West; and Township 5 North, Range 10 West; all of the Navajo meridian in Arizona."

Existing approach roads to Canyon de Chelly are as follows: (1) Gallup to Chinle via St. Michaels and Canado: 101 miles. (2) - Gallup to Canyon de Chelly via Ft. Defiance: 76 miles. (3) - Winslow via Hopi Indian Villages to Canyon de Chelly: approximately 128 miles. (4) - Shiprock to Chinle, via Redrock, Lukachukai, and Greasewood: 70 miles. (5) - Kayenta to Chinle via Rough Rock: 80 miles.

The settlement of Chinle, near the mouth of Canyon de Chelly, was so named by the Navajos meaning "a place where water flows out of a canyon." Here the Custodian has a splendid Pueblo style residence with a more or less separate office to contact visitors. There is a large Indian Day School in the village and two trading posts. One of the trading posts has been operated for years by Cozy McSparron and is known as the Thunderbird Dude Ranch. In certain seasons arrangements may be made at this ranch to secure cars for trips into the canyons and horses may likewise be procured during most of the year. Visitors at the Monument during the year ending September, 1936, numbered 1,091.

Much of the enchantment of the area lies in the primitive and picturesque background. In order to properly assimilate this setting it is preferable to spend several days at the Monument, to view the canyons from the rim, and then to take trips along the floor of the canyons and observe the towering cliff buttes, obelisks, pinnacles, not to mention the numerous arches and alcoves where the ruins of many Pueblo settlements

arm Contract. Many Navajos are living in the canyons at the present time. The Monument Ranger is at the station this morning before breakfast of observing the ruins of the Pueblos and at the same time seeing the modern Navajo in his daily routine. In the midst the elegant or drab glaring natural background, as well as the ruins of the present inhabitants of the canyons, that the Park Service has always endeavored to keep this area as nearly as possible in the original primitive scene. Only the very limited and absolutely necessary development is encouraged.

HISTORY

Records remain of the cliff-dwelling habitation of the canyon by the Basket Makers and later by the Pueblos. The most important ruins are the White House, which has been dated by the tree ring method as 1050-1300 A.D., Antelope House and Mummy Cave as 1000-1300 A.D. Archaeological expeditions were made by the Hyndeleff's in 1894 (3) and by Earl Morris of the American Museum of Natural History in 1923 (4).

According to Colton (5), Canyon de Chelly was first explored by Americans in 1849, when it was found not to be the impregnable Navajo stronghold that had been reported. He further states that "By 1858 the Navajos had occupied Arizona east of the Hopi country, but had progressed very little farther. By 1863, because the U. S. troops had been withdrawn on account of the Civil War, the depredations of the Navajos had become serious. In that year a special expedition under Col. Kit Carson was sent against them. He rounded them up in Canyon de Chelly, captured about 8000 from all over the whole reservation and deported them to a reservation called Bosque Redondo near Fort Sumner in New Mexico. They were not all captured and the bands scattered. Some took refuge in the maze of canyons in the Rainbow Plateau and others invaded the Kaibito Basin near the Grand Canyon. In 1868 the 8000 were returned from Bosque Redondo to their old desert home. Here they increased rapidly until their great reservation is now overpopulated. Spreading north of the Utah line and west to the Little Colorado River, the Navajos, estimated at 50,000 souls, occupy the largest Indian Reservation in the United States - a great area of 25,000 square miles. On the rock, plains and juniper-covered mesas they tend their flocks of sheep and goats. They may be truly called "The Arabs of the American Desert."

At present there are from 350 to 400 Navajos living along the 30 miles of canyon floors within the Monument. Water may be secured from pit holes in the sandy flood plain at depths of 3 to 4 feet. The higher portions of this plain are utilized for their hogans ("hugans") built of earth and logs, and adjacent plots of land are being farmed in much the same way as they were centuries ago.

GEOGRAPHY

Land Forms

Canyon de Chelly lies in the south-central portion of the Colorado Plateau Province. The rocks of this section of the province are in the main horizontal or gently folded, in some instances they are sharply folded and faulted. Vegetation is scant and streams have cut deeply into the surface with the controlling factors generally conforming to the attitude or structure of the beds and to the relative resistance of the various strata. The soft shale members form broad valleys and slopes, with the hard sandstone layers forming steep walled canyons and cap rocks of the many escarpments or mesas. These briefly mentioned land forms are in evidence at Chinle, where to the west may be observed the enormous Black Mesa, containing some 2,400 square miles, capped largely by competent Upper Cretaceous sandstones; also in this same direction the broad Chinle valley composed of soft shales or "marls"; and to the east the west flank of the Defiance uplift where streams have been given added gradient to carve deep canyons in resistant strata.

Drainage

Canyon del Muerto drainage has its headwaters in Spruce Brook, to the northeast in the Lukachukai Mountains, and Canyon de Chelly in the Cushka Mountains proper to the eastward. Both canyons drain into Chinle creek and the waters ultimately reach the master stream of the province, the Colorado River, through the tributary San Juan. South of the Monument, drainage from the west flank of the Defiance uplift, reaches the Colorado River via the Little Colorado. Streams in the general area are mainly intermittent though some in their lower drainage and near their sources, at higher elevations, are perennial. The stream occupying Canyon de Chelly flows for a distance of some 15 miles as a permanent stream. The large valley of Chinle creek, of which de Chelly and del Muerto are tributaries, drains an area of approximately 4,600 square miles.

Climate

Topography is the prime factor as regards to climate in the Navajo country. The cliff-dwellers were aware of this fact and gave consideration of this feature in the establishment of their settlements along the canyon walls. Rainfall averages approximately 10 inches per year at Canyon de Chelly with around two-fifths of the precipitation generally falling in July, August, and September. Temperatures of -24° have been recorded at Ft. Defiance and highs of over 100° are not uncommon during the summer months. The prevailing winds are from the southwest.

Dr. Gregory (1) expresses these points regarding Navajo climate, - "The keynote of the climate of the Navajo country is variability, marked by sudden changes in temperature and wide fluctuation in rainfall. An intensely hot summer day may be followed by a chilly night; sunlight is

GENERALIZED STRATIGRAPHIC TABLE

ERA	PERIOD	FORMATION	THICKNESS (FEET)	LITHOLOGY
CENEZOIC	QUATERNARY			Alluvium, gravel and eolian deposits.
	CRETACEOUS	Mesa Verde Mancos Shale Dakota ss.	2500 +	Grey, yellow, brown sandstone and blue grey to iron grey shales. Contain coal, Conglomerate.
	Unconformity			
	JURASSIC	Morrison	200 +	Buff to grey and pink sandstone. Variable in thickness. Contains reptilian remains, non-marine invertebrates, silicified wood. Formerly McElmo Formation.
	Unconformity			
		Navajo ss.	100 +	Usually buff to grey, white and red, massive, intrically cross-bedded sandstone. Contains quartz with some feldspar poorly cemented by lime and silica.
MESOZOIC	JURASSIC(?) (Glen Canyon Group)*	Kayenta	40	Reddish irregularly bedded sandstone with grits and fine conglomerates. Minor shales and impure limestone. Contains dinosaur tracks, pelecypods, and plant remains. Formerly Todilto.
		Wingate ss.	275	Massive cross-bedded cliff forming, pale red to light buff sandstone; mainly quartz grains poorly cemented with lime and silica.
	Unconformity			
	TRIASSIC	Chinle	1132	Non-marine varicolored marls, thin sandstone and limestone conglomerate. Contains vertebrate, fresh water invertebrate fossils and silicified wood.
		Shinarump	20-60	Coarse sandstone, irregularly conglomeratic, grey in color. Fragments of petrified wood.
		Unconformity		
		Moenkopi	50	Chocolate, red and grey sandstone and alternating red shale. Partially marine to westward.
	Unconformity			
		De Chelly ss.	825	Reddish cross-bedded sandstone. Composed variable sized grains white and red grains quartz with kaolin. Calcareous and iron cement. Cliff forming.
PALEOZOIC	PERMIAN	Supai	600 +	Red sandstone and shales, uniformly bedded. Fossil plants.
	Unconformity			
PROTERZOIC	PRE-CAMBRIAN			Massive and bedded grey quartzite. Granite

*No diagnostic fossils discovered.

Compiled from various USGS reports by Vincent W. Vandiver, NPS, Santa Fe, N.M.

is absent on the north end of the uplift. It can be observed anywhere in the vicinity of the Monument that the Shinarump conglomerate (Triassic) rests unconformably on the de Chelly sandstone.

Pre-Cambrian

The oldest rocks on the Defiance uplift are quartzites, probably pre-Cambrian in age. They occur in Quartzite canyon, northeast of Ft. Defiance. Moenkopi sandy shales overlie the quartzite unconformably but the underlying strata are not exposed. Darton (2) states that the quartzite which occurs along the axis of the Defiance uplift is an old ridge which extends northwest from the Zuni mountain uplift in New Mexico and apparently persisted through a large part of Paleozoic time, since Permian rocks are abut against it. From well records we know that granite forms the core of the Defiance uplift.

Permian

Supai Formation

The type locality for the Supai formation, which consists of red sandstones and shales, is in Havasu canyon and adjacent portions of Grand Canyon. Here it consists of 1100 to 1200 feet of red beds. A well drilled 18 miles southeast of Chinle, on the west flank of the Defiance uplift, encountered granite at 906 feet. In this well which started in the de Chelly sandstone, the Supai red beds were reached at 250 feet. Supai strata may be observed in Canyon de Chelly east of the junction with Monument canyon where the beds are composed of red sandy shales and fine grained sandstones. Supai red beds overlie granite on the Defiance uplift. Darton (2) observed a short distance west of Ft. Defiance that there is a fairly strong break between the Supai formation and the overlying cross-bedded sandstones. He states that to the northward the distinction is lost somewhat by the development of redder and lighter beds in the upper part of the Supai, suggesting transition. Fossil plants have been found in this formation three miles west of Ft. Defiance and they have been determined by paleobotanists (2) to be Permian in age.

De Chelly Sandstone

Conformably overlying the Supai formation in Canyon de Chelly are the vermilion, highly cross-bedded sandstones, which have been termed the De Chelly sandstones by Gregory (2). Edwin D. McKee, park naturalist at Grand Canyon National Park, has written a very interesting paper (4) on the De Chelly sandstone and its relation to the Coconino and other cross-bedded Permian sandstones of the southern portion of the Colorado plateau. The writer of this paper has taken the liberty to use portions of this reference by McKee.

Sandstones comprising the vertical walls of Canyon de Chelly were originally considered to be the equivalent of the Vermilion Cliff or Wingate sandstone of the Mesozoic by early geologists. As above stated they were termed the De Chelly sandstone in 1917 by Gregory and assigned to the Permian due to their stratigraphic position unconformably beneath the Shinarump conglomerate of the Triassic, and conformably above the Supai red beds containing a Permian flora. They have since been considered by Darton (2) and by Baker and Reeside (10) to be a continuation of the Coconino sandstone found to the west and southwest. McKee, in the more recent paper mentioned above, states that the De Chelly sandstones of Canyon de Chelly are a well defined formation composed principally of red cross-bedded sandstones which are different from the Coconino in the type of cross-bedding, variety of grain size, mineral composition and kind of cement. He concludes that the upper De Chelly sandstone and the Coconino sandstone were formed contemporaneously, but under different conditions of deposition and from materials derived from different sources. The source of the Coconino is regarded by McKee (3), in another paper, to be from the south and to have been deposited in the main as dune sands by the winds. The De Chelly was at the same time being formed from sands of a different source, probably from the north, as suggested by the remarkable uniformity of dip in the opposite direction. Most of the De Chelly section contains cross-bedding indicative of wind deposition, however, some portions especially in the upper part are redeposited or at least reworked by water, as shown by the non-cross-bedded layers of shaly sand.

McKee finds that where the entire thickness of the De Chelly sandstone is obtained that there appears to be two well defined units separated by some horizontally bedded layers of very fine-grained, red, argillaceous sandstone. Also that by the color, type of cross-bedding and erosional behavior, the upper and lower sandstone members may be readily distinguished, but that in mineral composition they are similar in most places. The upper member generally forms bright red vertical cliffs while the lower member is reddish brown in color and usually weathers into rounded slopes containing many alcoves and cavities. Cross-bedding in the lower member shows dips in nearly every direction, whereas in the upper portion the beds are much longer and the slope is remarkably constant, ranging from southwest to southeast and suggesting that the source of the latter beds must have been from the north.

The following section was measured by McKee near the south of Monument Canyon:

	Feet
Shinarump Conglomerate	
Unconformity	
De Chelly Sandstone	
1. Sandstone, fine grained: Vermilion red, cliff-forming. Cross-bedded. Composed in vertical section of a series of similar units, each with long, sloping, nearly parallel laminae which curve at their bases tangential to flat-lying, brown, shaly sandstone layers 6" to 3' thick, that separate the units. Twelve to twenty units ranging in thickness from four to eighty feet constitute this member. Sand grains of two sizes	359.5
2. Sandstone, argillaceous. Deep red, very fine-grained, non-cross-bedded. Rests on truncated surface of underlying sandstone. Some traces of sand of type found in upper and lower members	36.0
3. Sandstone, fine-grained; Red-brown, weathers to rounded surfaces. Cross-bedded with short curving surfaces forming irregular wedges, truncated at bases. Sand grains of two sizes .	219.0
Total	624.5 ft.

Red Permian shales and flat-lying beds of sandstone.

Many geologists have observed the formation of arches, alcoves, and caves in the cross-bedded sandstones of the southern part of the Colorado Plateau, and numerous explanations have been offered as to their origin. These features are so constant in some sections that it would almost seem that one could chart a formation by spotting the cliff dwellings on a map, for almost invariably the Pueblo people have utilized these alcoves at one time or another for their settlements. These erosional features have been observed by the writer throughout southern Utah, northern Arizona and southwestern Colorado and it is concluded that they are the result of several factors, the most important of which are the structure and porous nature of the rocks in which they occur. The tangential cross-bedding permits ready access of the surface waters along the angular bedding planes in the porous sandstone. Such waters percolate into the face of the cliff and thus at first small units are weakened as the loose cement is dissolved and the shell-like forms are carried down by gravity.

These processes are repeated over long periods of time, the curved laminae being removed on an increasing larger scale, until the shells have cut back into the cliff to form alcoves large enough to house whole settlements of Pueblo people. The jointing is generally of lesser importance than the tangential cross-bedding in this process although in some instances it is a major factor. For many of the larger alcoves especially in Navajo Canyon, at Mesa Verde, and at Zion Park it is a common occurrence to observe a concentration of surface water at the top of a cliff directly over the alcove, giving a funnel effect, with the result that there is a concentration of water above the cave site. Alcoves and recesses may be observed in all stages of formation. In some cases the shells are so loose that they might seemingly be expected to crash to the floor at any minute, as in the alcoves in Navajo Canyon.

Near the head of the trail leading from the rim of Canyon de Chelly to the White House ruins are some minute erosion forms in the De Chelly sandstone which have been termed as worm borings by some and to the work of the wind by others. It appears that the wind has played only a very minor part in the formation of such features and that they may be attributed to normal processes of surface water carrying away the softer, less resistant, and more poorly cemented material to form the fine holes along the face of the cliff.

Triassic

Moenkopi Formation

This formation consists of chocolate, red and grey sandstone with alternating red shales. The Moenkopi does not occur in the vicinity of the Monument but is mentioned for completeness since it is present on the southern portion of the Defiance uplift. In this section, with the Kaibab limestone absent, the Moenkopi rests directly on De Chelly sandstone, and thins out just north of Ft. Defiance.

Shinarump Conglomerate

The Shinarump consists of coarse grey sandstone and conglomerate. It occupies much of the surface over the northern sector of the Defiance uplift and forms a resistant cap as may be noted from contacts along the rim of the canyons within the Monument boundaries. The conglomerate is unconformable with the underlying De Chelly sandstone and that there was a considerable period of erosion in post-De Chelly time and prior to the deposition of the Shinarump is attested from the very irregular contact, with numerous ancient valleys carved in the sandstone, and now filled with Shinarump conglomerate. Fragments of petrified wood are common in the Shinarump.

Chinle Formation

The name Chinle was proposed by Gregory (1) in 1917 to include a group of shales, "marls", thin soft sandstones and conglomerates lying above the Shinarump and below the Wingate formations. This formation although widely distributed in the Colorado Plateau province was named from the type locality in the Chinle valley, immediately west of Canyon de Chelly, where the entire section of 1,182 feet has been measured. The Chinle is usually considered to be the most beautifully colored formation in the Navajo country, certainly it is the most highly colored. These marvelous color effects may be seen in Beautiful Valley along the route north from U. S. Highway 66 to Canyon de Chelly, at Petrified Forest National Monument, east of Holbrook, Arizona, and in the vicinity of Cameron, on U. S. Highway 89, north of Flagstaff, Arizona. The rather pastel tones change with the angle of the sun but they are probably more effective at sunrise and sunset. The sediments are considered to be non-marine and to have been deposited by great shifting streams and in shallow bodies of water. During deposition there were occasional outbursts of volcanic activity in nearby areas with the result that there is considerable volcanic ash in the Chinle and some of the color variations are due to the presence of ash. Fossil vertebrates, fresh-water invertebrates, and quantities of silicified wood have been found in the Chinle which further attest to its non-marine character.

Jurassic (?)

Glen Canyon Group

This group consisting of the Wingate sandstone, Kayenta formation, and the Navajo sandstone contain no diagnostic fossils and are therefore assigned with some question to the Jurassic. They do not occur in the Defiance uplift proper and the details of the formations will therefore be omitted. A ridge of these sandstones form a prominent structural feature on the west side of the Chinle valley. These massive sandstones are merely a remnant of a much more extensive deposit but surely fail to attract attention of visitors. It should probably be stated that the uniformly bedded reddish sandstone which separates the Wingate and the Navajo is now called the Kayenta formation. It was formerly known in this area as the Todilto. Glen Canyon National Park is carved largely in the Navajo sandstone.

Jurassic

Morrison Formation

Unconformably overlying the Navajo sandstone is the Morrison formation. It is composed of buff, grey and pink sandstone and varies considerably in thickness. It has until recently been largely included in the Mancos formation. Important reptilian remains have been found in

those strata, also non-marine invertebrates and considerable petrified wood. Many complete dinosaur remains have been taken from the Morrison in the vicinity of Dinosaur National Monument in northeastern Utah.

Cretaceous

Black Mesa to the west of Canyon de Chelly is made up principally of Cretaceous formations, namely, the Dakota sandstone, Mancos shale, and the Mesa Verde group. This is a thick series of grey, yellow, and brown sandstone, and blue-grey or iron grey shale. The strata is drab in appearance and is somewhat monotonous as compared with the highly colored Jurassic and Triassic formations. Coal is mined from Cretaceous rocks on Black Mesa by the Hopis and Navajos. In the Gallup basin, in northwestern New Mexico, there is considerable coal mined for commercial purposes. These strata comprise the section at Mesa Verde National Park, in southwest Colorado, northeast of Canyon de Chelly.

Quaternary

Recent alluvium, gravels and wind blown sands are in evidence throughout the area.

Structure

Sedimentary strata are in most instances deposited in a horizontal position. Exceptions to this rule may be found in the walls of Canyon de Chelly where the rocks are cross-bedded and largely eolian in character deposited by the wind. Sediments after deposition are often times uplifted resulting in tilted, folded and broken or faulted strata. Their present attitude, or position, is called the geologic structure and this feature must not be confused with the land surface or the topography of the area since the sub-surface attitude of rocks does not necessarily bear any relationship to the configuration of the earth's surface.

The principal structural feature of the Monument area is, of course, the Defiance uplift. It is an anticline, with axis almost due north and south, extending from near the Santa Fe railroad almost to the Utah line, or a distance of over 100 miles. The structure is 30 miles or more in width. The attitude of the strata on the Defiance uplift are well illustrated by Darton (2) Plate 52, page 148). It will be observed that the east flank is the steeper, is faulted on the southeast, and that the beds then flatten to form the Gallup basin to rise again sharply along the Zuni mountain uplift. To the west, beds forming this flank of the uplift, dip gently at angles of 2° to 4° to form the great Black Mesa Coal Basin.

Structural considerations are important in a study of the Monument area since it is due to the uplift that streams have been given increased

gradient or added power to carve the beautiful canyons of de Chelly, Del Muerto, and Monument as we see them today.

The most detailed study of the structural history of the Navajo country has been made by Gregory (1) and the following is taken from his paper:

"The dates assigned to the several epochs of faulting, folding, and peneplanation during the history of the Plateau province rest on the assumptions that the upwarps trenched by the middle Colorado date from Pliocene, Miocene or late Eocene time. There is reason to believe, however, that the first profound faulting and flexing, which built the horizontal strata into a series of domes and monoclines, occurred at the end of the Cretaceous period....."

-"Among the probable events in the Tertiary and Quaternary history of the Navajo country, the following are recorded:

1. A period of widespread folding associated with regional uplift from the Cretaceous sea. The Defiance uplift was one of the major structural features developed during this period, which is believed to date from the Cretaceous-Tertiary interval.

2. A period of erosion, during which the domes and ridges of Cretaceous rock were much reduced in height and a system of subsequent streams was developed. Earliest Tertiary.

3. A second period of differential warping, perhaps associated with regional depression. On the long slopes and on the floors of the basins thus formed the Eocene beds of continental origin were laid down.

4. Post-Eocene uplift.

5. A period of extensive and long-continued erosion, interrupted by intervals of quiescence and uplifts. During this period most of the Tertiary beds were removed, the present plateau blocks were outlined, and erosion surfaces of low relief were developed.

6. A regional uplift that revived the streams of the region and provided favorable conditions for the cutting of Glen Canyon and its many companions.

7. A period of aggradation - the filling of the rock canyons with alluvium in consequence of regional downwarp or climatic change.

8. A period of degradation - the trenching of gravel floors, of canyons, and of alluvial slopes on mountains.

The filling and trenching of the rock-walled canyons are not events of great antiquity and may have been accomplished within the period of

human occupation. The cutting of Canyon de Chelly, and other profound gorges - gigantic pieces of river sculpture - does not demand a long period of geologic time. The conditions for river erosion in this region are so favorable that even a part of Quaternary time is sufficient."

Water Facilities

Water for the headquarters area is obtained from a well 100 feet deep. A gravel strata at from 46 to 50 supplies 25 gallons per minute with water level in the well at 20 feet from the top. The well is cased with 6" pipe. A three h.p. engine with deep well pump was installed by PWA in 1936 and supplies from ten to fifteen gallons per minute. From the well the water is pumped through a 1½" pipe line to a 5,000 gallon concrete reservoir which is buried on a hill near the Custodian's residence.

The well seems adequate to meet the requirements of present facilities.

ROADS AND TRAILS

There is at present a low standard road, about eight miles in length, from headquarters along the rim of Canyon de Chelly to the overlook opposite White House ruins. This road should be improved to enable the hurried traveler some knowledge of the Monument, especially for those who do not go into the canyons. Modern cars could not get over this road at the time of my last visit. Parking area near the overlook has been proposed. The roads leading into the canyons all have to be taken with care and preferably under the guidance of the Custodian.

A horse trail has been constructed in recent years to enable visitors to reach White House ruins from the rim of the Canyon. This trail is about 4,000 feet in length, contains several short tunnels to pass vertical ledges, and was treated with bituminous surface in 1936. No other trails are being considered for the present and I do not see that any are needed.

SIGNS AND MARKERS

This is one of the few Parks and Monuments that I have visited where I hesitate to recommend construction of signs to call attention of the visitors to geologic features. I feel quite sure that with the small number of visitors at Canyon de Chelly the Custodian will be able to handle the situation, at least for the present, and get across to those who seem interested the main geologic facts which I have endeavored to portray in this paper. This is especially true since I understand that a Park Service representative accompanies all parties on trail and canyon trips. A geologic map of at least the northeast portion of Arizona should be exhibited in the office.

It is also suggested that the references included in the attached bibliography be obtained for the Monument library. Those by Gregory (1). McKee(3 and 4) and Baker (6) will supply the geologic facts.

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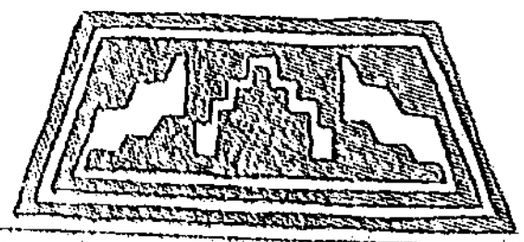


SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 21
METEOR CRATER
ARIZONA

BY
VINCENT W. VANDIVER

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

METEOR CRATER, ARIZONA

By Vincent W. Vandivor,
Associate Regional Geologist.

INTRODUCTION

It is the purpose of this report to summarize some of the various theories which have been advanced, during the past 35 years, to account for the origin of Meteor Crater. To outline some of my observations regarding this phenomena of nature which has attracted scientists from all parts of the earth for many years. Efforts to exploit the meteoric mass by commercial interests in which large sums of money have been expended will be noted. Briefly it is proposed to bring up to date our present knowledge of Meteor Crater for the Park Service records and the possible interest for various members of the staff concerned.

The noted Astronomer, Arrhenius, is said to have declared that Meteor Crater is the . st fascinating spot on earth. The interesting fields for investigation in this area are innumerable. Facts may be disclosed which to an astronomer might give concrete evidence as to our theories of origin and the building up of our solar system. Should the crater be definitely proven the result of a meteoric impact, the geologist will be interested to have the evidence to be found in the behavior of rocks under sudden stress, not to mention the later effects of chemical reactions underground. From the point of view of the physicist and chemist the various features prove none the less interesting. The average visitor stands in amazement when the great pit is viewed from the rim for the first time.

LOCATION

Meteor Crater is situated in Coconino County, northeastern Arizona, in the southern portion of the Colorado plateau, amid many National Parks and National Monuments which have been reserved for preservation by the Government. The crater may be reached on U. S. Highway No. 66 by traveling 23 miles west of Winslow and thence seven miles southeast. The loop road south to the crater is taken at the Sunshine station on the main highway. The feature is most accessible to transcontinental tourist travel, being located near one of the main highway routes through the Southwest. Stops may be made and visits arranged for at Winslow or Flagstaff situated on the Santa Fe Railroad.

METEORS AND METEORITES

Very few meteors reach the Earth's surface as meteorites and still fewer meteorites give rise to meteoric craters. Meteorites, as is known from studies of those that have been seen to fall, are bodies which before their striking the Earth were pursuing independent orbits around the Sun, usually in an elongated form similar to comets. Their velocity averages

around 26 miles per second and with the Earth moving 18 miles per second in its own orbit, the meteorite can strike at any speed from eight miles per second if it overtakes us, to 44 miles per second if it meets us squarely. At even the lesser speed the meteorite is subject to great friction as soon as it enters the Earth's atmosphere, some 80 to 100 miles distant, which heats the surface of the body and the air about its track. Small meteors appear as shooting stars and large ones as fireballs.

A few of the most important meteoric craters thus far discovered are listed as of possible interest.

The Texas crater is situated about nine miles southwest of Odessa in Ector county. It is a shallow depression, roughly circular in outline, with an average diameter of 530 feet. The steep inner slopes show the limestone dipping 20° to 30° away from the center. Fragments of meteoric iron have been found and some have been located mixed with the limestone and sandstone debris forming the rim. Although this crater is now generally recognized to be of meteoric origin, various suggestions have been made to account for it; namely, - volcanic explosion, salt dome, expansion by hydration of anhydrite, explosion of gas, etc.

The Henbury craters in central Australia are located about seven miles southwest of Henbury, on the Finke river. Much meteoric iron has been collected from this area and within an area of a half square mile 13 craters have been mapped. The largest crater is 220 yards by 120 yards across, and 50 to 60 feet deep. In this area there must have been not a single mass, but a shower of large masses of iron that formed this group.

The Wabar craters, discovered in 1932, are located in Arabia. Two distinct craters have been mapped with the indications of others buried in the sand. The larger of the craters is approximately circular in outline, has a diameter of 100 meters, and a depth of around 10 meters. The rims of the craters appear to be built up mainly by silica-glass. A few pieces of meteoric iron have been collected from the outer slopes of the craters. It has been suggested that the reason for the unique occurrence of silica-glass is no doubt that large masses of iron fall on clean desert sand.

The group of craters in Estonia, 20 kilometers northeast of Arensburg, were first described in 1827. They have been considered as being earthworks made by man, to be the result of gas explosions, oozing out of a bed of clay, weathering of limestone, expansion of anhydrite, but recently detailed borings and trenches undertaken by the Inspector of Mines, has resulted in their being identified with the fall of a shower of iron meteorites. The main crater is occupied by a lake, with a diameter of 92 by 110 meters, and depth of 15.5 meters. The steep inside walls show beds of Silurian dolosite dipping from the center of angles of 30° to 40°.

No meteoric iron has been found in the locality and this is explained by the fact that the ground has been tilled since time immemorial.

The Siberian craters are said to be rather disappointing, showing only a series of small pools in a swamp. It is certain that some catastrophic event occurred there on June 30, 1908, but the exact nature remains doubtful. It is stated that a fireball had been seen and that loud explosions were heard over a wide area, blasts of hot air were felt, and earthquakes recorded at several points. Pine trees were felled outwards for a distance of 37 miles from the center. Numerous round depressions have been found in a swamp area but no meteoric iron has been collected, although it is rumored that natives have collected pieces of iron in the central area of the fallen forest.

The Campo del Cielo craters of the Gran Chaco, Argentina, are now considered meteorite craters. Native iron has been known in this district since 1576. Transparent glass has been found. There are no volcanic rocks in the surrounding pampa, and the Andean volcanoes are 500 miles away. One of the craters has a width of 183 feet and a depth of 16 feet.

Direct observation as to how the larger craters are formed seems to be out of the question. Meteorites which have been seen to fall have been comparatively small in size. They make small holes usually only a few feet in depth. The largest meteorite which has been observed to fall is of the stony type, which weighed 820 pounds, and fell near Paragould, Arkansas, in February 1930. This stone penetrated the soil to a depth of only eight feet. The largest known iron meteorite is the Hoba meteorite, discovered protruding from the surface in Southwest Africa in 1920, and weighing 60 tons. It was not seen to fall and there is no sign of a crater in the vicinity.

GEOLOGY

The surface geology of Meteor Crater and vicinity is comparatively simple. The sediments of the surrounding region lie practically horizontal and as the crater is approached, the beds may be seen to dip away from the center in all directions, at angles of from 10° to 80°. One is astounded by standing on the rim and peering into the high crater for the first time. The irregular rim of up-thrown rocks rises over 150 feet above the surrounding plain. The main portion of the rim is more than 1,000 feet in width with scattered remnants of debris as much as six miles from the crater. The floor of the crater is flat and is approximately 1,500 feet across. The elevation at the cabin on the north rim is 5,860 feet above sea level.

The upturned sediments of the rim consist of from 0 to 60 feet of Moenkopi (Triassic) sandstone; around 250 feet of Kaibab (Permian) limestone; and 150 feet of Coconino (Permian) sandstone. From the drill records a total thickness of the Coconino sandstone is given as 660 feet.

Below the Coconino sandstone is the Supai formation, also Permian in age, and from records of [illegible] holes and sections in surrounding region it is believed to be around 2,500 feet in thickness. It is also assumed from drill hole records that the Supai was apparently not disturbed by the forces responsible for the crater.. The Redwall limestone, of the Mississippian, underlies the Supai formation. For a generalized stratigraphic section see following:

STRATIGRAPHY OF THE METEOR CRATER AREA

ARIZONA

SYSTEM	SERIES	FORMATION	THICKNESS (FEET)	CHARACTER
QUATERNARY	RECENT AND PLEISTOCENE	LAKE BEDS, ETC.	90 to 500	Lake beds containing some lignite, fresh water fossils and thin bed of rhyolitic ash. Talus consisting of sand, gravel and boulders. Limestone and sandstone blocks representing material thrown out of the time of the impact. Some meteoric fragments found in debris.
TRIASSIC	TRIASSIC	MOENKOPI	0 to 60	Chocolate brown sandstone
CARBONIFEROUS	PERMIAN	KAIBAB	250	Grey limestone with some thin sandstone members.
		COCONINO	650	Light colored cross-bedded sandstones.
		SUPAI	1000	Uniformly red to buff sandstone and red sandy shales.
	MISSISSIPPIAN	REDWALL		MASSIVE, Grey, fossiliferous limestone.

The masses of rock which are upturned consist in the main, therefore, of Permian sediments with the exception of a variable thickness of thin

Moenkopi outliers. There is observed on the rim much debris and fragmentary rock materials which have been classified as Quaternary in age. Comprized in this group is the meteoric shale, meteoric rock fragments of the original formation, and metamorphosed masses of Coconino sandstone (rock flour,. On the floor of the crater is some recent stratified rocks, consisting mainly of crushed limestone and sandstone fragments, which have been identified as lake beds, indicating that the interior was once occupied by a lake, at a time when the climatic conditions of the region were much humid than at present. These lake beds are around 90 feet in thickness and are considered to be of Pliestocene age. They contain fresh water fossils.

The crater rim is capped by material thrown out of the crater. Land slides along the rim have removed portions of the Kaibab limestone and Coconino sandstone. Limestone and sandstone blocks are present on and surrounding the rim. They range from small fragments and fine dust up to 25 feet or more in thickness. Most of the coarser material is limestone since the sandstone is more easily crushed.

Regionally the rocks lie nearly horizontal with dips of only a few feet to the mile. Angles of dip along the rim of the crater vary from 10^{0} to 80^{0} with an average perhaps of around 30^{0}. The dips are all in rough radical fashion from the center of the crater and has been stated previously, they become increasingly greater from a point on the north rim, until the arched portion of the rim at the south is reached. A dozen or more faults may be seen on the inner walls of the irregular rim but due to the debris they cannot be traced to any extent. The regional structure is broken by Sunshine mountain, 12 miles southeast of the crater.

AGE OF THE CRATER

D. M. Barringer, Jr., has considered briefly the age of the cone. He states that it cannot be less than 700 years old, since a cedar tree with that number of annual rings was found growing on the rim. He also concludes that it cannot be more than 5,000 years old, from the lack of erosion, particularly of the chemical erosion on the limestone blocks, and finally infers that the true age will no doubt be found between these two limits. Mr. Barringer mentions the legends of the Navajo Indians, who are said to have a story about the crater which coincides very closely with what actually occurred. A hole in the ground would not likely stir the imagination of the Indians, since they are familiar with the many volcanic craters of the San Francisco mountains, 50 miles or so away, and attach little importance to them. But about Meteor Crater they are said to have marked superstitious beliefs, and they are supposed to have a legend which describes the descent of one of their gods from the sky, in clouds of fire, to bury himself in that particular spot. I do not attach much weight to such traditions among the Indians since it is generally considered as improbable that legends

could be carried down for more than a few centuries by such primitive people. Professor Elihu Thompson (29) mentions these Indian legends which state that a number of their tribe were killed when the body fell and that they now send to the crater and secure the white silica dust to sprinkle around when they have their ghost dances, indicating that they still retain some superstition in regard to this natural phenomena. Mr. Barringer states that the Indians will not carry away any of the iron, however, I have been informed from other sources that there was quite a traffic in this material for many years and that tons of it was collected by the Indians and sold to traders.

On the basis of the effects of erosion Tilghman favored an age of not more than 10,000 years and probably less than 5,000 years for the crater.

According to the geologist attached to the geophysical survey the age of the crater is estimated at 50,000 years. This figure was arrived at upon consideration of the sedimentary deposits, conditions for deposition of same in arid climatic regions, is recognized as an extremely slow process. The proof of a very considerable period of erosion.

The most exhaustive study of the age of the crater which has come to my attention was made by Professor Eliot Blackwelder (7) in 1930. He lists five factors which have a bearing on the determination of the age of the crater as follows:

(1) - The lake deposits at the bottom of the crater, shown by drilling to be from 70 to 90 feet thick, comprise stratified sand and quartz flour with many lacustrine gastropod shells and diatom frustules. This is interbedded with platy fresh-water limestone, lignitic beds, diatomite and a single layer of rhyolitic ash $\frac{1}{4}$ to 3 inches thick (12). The characteristics of the deposit are such as to indicate a body of water of many years duration, rather than a seasonal pond of playa. This in turn suggests a climate distinctly cooler or more humid than the present one, for there has been no pond in the crater since it first became known to white men. At present the water table is about 200 feet below the floor of the pit, whereas during the presence of the lake it must have been somewhat above it.

(2) - The bed of volcanic ash is plainly the record of an explosive eruption in the southwestern arid region. No such eruption (rhyolitic ash) is known to have occurred since late glacial or Pleistocene times.

(3) - Both upon and beneath the lake beds are wedge shaped alluvial deposits built out by streamlets descending the crater slopes. The lower fans are said by Tilghman (3) to extend under the lake deposits, although not to the center of the crater, as indicated by exploration in shafts and drill holes.

(4) - Most of the limestone blocks upon the parapet are deeply cavernous and corroded by the effects of solution. As this process works rather slowly in an arid climate, the advanced stage of solution pitting indicates a long period of time. A study of the ravines and graded valleys on the parapet indicates that the latter has suffered more erosion than the latest (Tioga) glacial moraines, but hardly so much as those of an older epoch.

(5) - As a fifth source of evidence, the present condition of the talus slopes within the crater affords instructive suggestions regarding the physiogrphic history. A close scrutiny of the talus shows that it is no longer growing but has extensively eroded into a series of ravines between which a few wedge-shaped remnants of the talus still remain. The talus is therefore the product of an earlier age, long since past. It is a well known fact that talus formations is particularly favored by the wedge work of ice (frost action) and that aridity tends to prevent it.

Dr. Blackwelder summarizes his points by stating that it seems very significant that the evidence along these five independent lines points to a long period of atmospheric action and also rather definitely to climatic changes from warmer and drier to colder and moister and back to dry again. From these considerations he is led to suspect that the crater was made during the last interglacial (or Post-Tahoe) epoch, perhaps 40,000 to 75,000 years ago. He concludes that no finality can be claimed for this estimate, but as a counterbalance for the current view, that the crater is only a few thousand years old, it has considerable value.

CANYON DIABLO METEORITES

It has been stated by Mr. Barringer that a far greater number of iron meteorites have been collected from the debris around the crater rim and a short distance from it than have been found in all the rest of the Earth's surface. By looking over a map showing the distribution of some of the material collected up to 1908 one cannot fail to be impressed with the concentration of meteorites as the rim is approached. This fact alone, it seems to me, presents some evidence that there is a connection between the meteoric material and the crater.

But how do we know that this is meteoric iron? All of the meteorites collected give what is known as the Wiedmanstatten figures, that is if they are etched, they will show after smoothing a peculiar internal crystalline structure which is characteristic of those iron meteorites which have actually been seen to fall upon the earth's surface. Iron meteorites are so unlike the normal rocks of the Earth's crust that they are easily recognized.

Mr. Barringer gives this description of the meteoric material

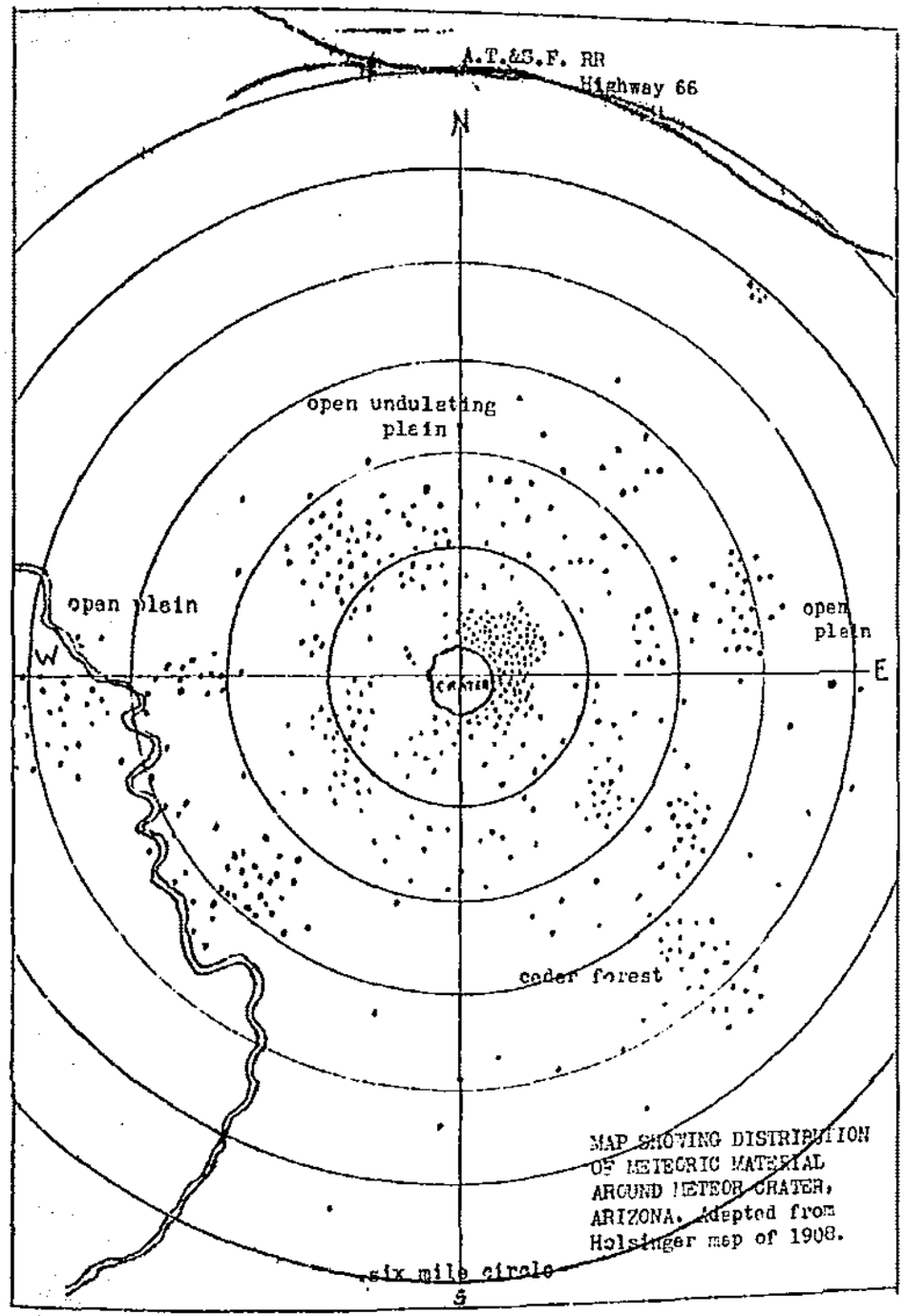
found at or near the surface in the vicinity of Meteor Crater. The chunks of solid nickel-iron, known as Canyon Diablo meteorites and which may be observed in most of the large museums, are irregular shaped fragments of metallic nickel-iron, with the surface, which is characteristic of many iron meteorites, looking as though thum-prints had been made all over it when it was soft. When cut they reveal a bright, silvery surface, which will rust only very slowly if at all. If the surface is etched, the so-called Wiedmanstatem figures of crystallization may be plainly seen. The composition of the unoxidized fragments is roughly as follows: iron, 92%; nickel, 6%; carbon, (both crystalline and amorphous) phosphorus etc., 2%; cobalt, copper, etc., traces; platinum, iridium, palladium, etc., about four-tenths of an ounce per ton. The pieces so far discovered range in weight from less than an ounce to about 1,400 pounds.

Dr. L. J. Spencer (26) considers a point of interest about the Canyon Diablo irons in the presence in some of the masses of small diamonds, both black and white; and it is stated that doubtless this observation suggested to H. Moiscan his experiments on the artificial production of diamonds. Moissan also detected in the iron the presence of native carborundum (silicon carbide), which as a meteoric mineral has been named moissanite. Other rare constituents of this meteoric iron are platinum metals. One assay yielded platinum 3.65 and iridium 14.95 grams per metric ton, but some other later trials gave negative results.

There has been much speculation as to the magnitude of the meteor which would be required to form a crater of this size. One of the first methods of calculation used by the Barringer interests and suggested in an old handbook of artillery, was to a formula for computing the probable effect of bombarding masonry with round-shot. This formula stated that where the diameter of the shot was 1, the depth of the hole would be about 2, and the diameter of the hole about 7. Applying this to the observed features of the crater it was estimated that the diameter for the projectile would be around 550 feet.

Tilghman (3) has calculated that the debris now represented in the parapet would, if replaced in the crater, fall short by millions of cubic yards, of filling the cavity. The difference may well have been removed by erosion. Gilbert (16) has estimated the capacity of the crater at 82 million cubic yards. Dr. Elihu Thompson and Dean Kagie of Princeton have made a number of calculations, considering the speed of the projectile, the amount of work involved in throwing out of the hole some 350,000,000 tons of rock, and arrived at a somewhat smaller figure for the diameter of the projectile than that calculated by Barringer. The latter concluded that a sphere about four hundred feet in diameter, which is probably a conservative estimate, would weigh in the vicinity of 10,000,000 tons.

Professor Thompson (29) makes the following calculations, - assuming that one ton of material in the meteor was capable of displacing thirty tons of rock when it struck, then the mass of the meteor should have been



MAP SHOWING DISTRIBUTION OF METEORIC MATERIAL AROUND METEOR CRATER, ARIZONA. Adapted from Holsinger map of 1908.

approximately at a low estimate, say, five million tons. By using a figure of six-tenths of an ounce of platinum and iridium per ton, with an estimate of three million ounces, at a value of $30 to $35 per ounce, the total value would be in the vicinity of $100,000,000. Various estimates of this type have been made and there is little wonder that extensive exploration work has been undertaken to locate the ore body, for this would represent only one of the valuable constituents of the mass, as indicated by assays.

HISTORY OF EXPLORATION "METEOR CRATER"

Army scouts first visited the site of Meteor Crater in 1871 and called it "Franklin's Hole". It was 15 years later that Mexican sheep herders gathered some of the metal and gave it to railroad contractors, who in turn sent it east, where it was identified as meteoric iron. Thus the first known example of a supposedly meteoric crater was discovered. Thousands of specimens of the meteoric iron were collected and shipped to museums in all parts of the world as well as to other interested parties. "Canyon Diablo" meteorites, as these fragments have been called, range in weight from a few grains up to 1,400 pounds. It has been stated that more iron meteorites have been found in this locality than have been discovered thus far in all of the remainder of the Earth's surface. The circular ridge forming the crater rim, which may be observed as a range of low-lying hills for miles around, had been referred to as "Coon Butte", "Crater Mound", "Meteor Butts", "Crater Mountain", but it is now generally called "Meteor Crater". The meteoric iron which is supposed to exist beneath the crater, and which has been found in large quantities in the vicinity, has been called the "Canyon Diablo meteorite", from the Canyon Diablo nearby, and also the "Barringer meteorite" from the Barringer family, who have been interested in exploration for many years.

In 1903 Mr. D. M. Barringer, of Philadelphia, became interested in the commercial prospects of the locality, and was among the first to advocate the theory of meteoric origin. Briefly Mr. Barringer and his associates reasoned as follows, - as one approached the crater the amount of meteoric iron became greater and it was also noted that the size of the fragments increased in this direction; that the fragments of metallic iron and pieces of iron oxide (which by their structure and composition was considered to have been derived from terrestrial oxidation) were found to be intimately admixed with the material excavated from the hole - the conclusion being that the excavated material and the meteorites got there at the same time. They likewise assumed that the hole was made by a meteorite or a cluster of meteorites, or else the juxtaposition of the hole and the meteorites was accidental. If accidental, there remained the coincidence of an unprecedented fall of meteorites hitting the same spot on which suddenly appeared an unprecedented crater in the sedimentary rocks, and hitting it at the same instant of time in which the crater was made. Prominent scientists who critically examined the locality and agreed to the meteoric origin as advanced by Mr. Barringer were Professor Elihu Thompson, of Boston, and Dean William F. Magie, of Princeton.

Mr. Barringer interests at first reasoned that since the hole was round, the meteorite must have fallen vertically, and therefore the main mass must be in the center of the hole. On this assumption they started a shaft at the center and expected to run radial drifts, like the spokes of a wheel, after reaching the required depth and until such time as they encountered the main mass. They assumed that the meteorite had not penetrated more than 1,300 feet below the surface of the plain since none of the fragments of Red Beds, which lie around this depth, had been thrown out of the crater. At 200 feet they encountered soft Coconino sandstone, which had been so shattered by the impact as to be in the form of fine white dust, so fine that 55% of it would pass through a 200 mesh screen. This silica dust had become mixed with water from the rather large catchment area of the crater and formed a quicksand through which they were unable to drive their shaft.

They next proceeded to sink drill holes in the bowl of the crater in an effort to locate the meteoric mass. The central portion was explored by this method to a depth of 1,000 feet. Although they failed in the main purpose of the work some interesting facts regarding the crater were ascertained. To a depth of some 90 feet there occurred stratified lacustrine sediments. Below this depth and for a distance of six or eight hundred feet there was encountered a jumble of large and small fragments of limestone and sandstone (unstratified), which was considered to be material thrown into the air at the time of the impact, immediately falling back into the hole. Two types of metamorphosed Coconino sandstone were found in the drill holes. The first type, which is also found on the rim of the crater, appeared like unaltered sandstone. Upon close examination, however, it was found that nearly every individual sand grain had been cracked and shattered so that it could be rubbed to dust between the fingers. The conclusion was that a shock wave, of sufficient intensity to crack the sand grains, ran through the solid rock ahead of the impacting meteorite. The second type of metamorphosed sandstone was considered to be due to heat caused by the friction of the advancing meteorite. The heat was so intense as to fuse the silica and it was stated that the only other case known in nature of pure silica being melted without a flux, occurs when lightening strikes a bed of sand, producing fulgurite glass.

According to the Barringer interests the two types of meta morphosed sandstone presented additional proofs of the meteoric theory. The shattered sand grains show the effect of a sudden terrific blow, rather than the effect of any volcanic explosion. The millions of tons of finely pulverized sandstone (rock flour) which is found abundantly on the rim in the crater and in the drill holes could not have been produced by a steam explosion. Likewise it is stated that no volcanic action has ever been known to fuse pure silica.

At depths of around 800 feet the drill holes were said to have encountered unaltered "Red Beds" sandstone. This gave them a clew as to

the maximum depth at which the meteorite must lie buried and also presented additional proof that whatever caused the crater came from above and not below. The work was suspended in 1908, since the drill holes failed to locate the whereabouts of the meteorite, and most of the funds available for the search at this time had been exhausted.

An intensive study of the physical features of the crater was then undertaken by the Barringer interests with the hope of finding some clue as to the direction of approach of the meteorite, since from the results obtained by explorations to this date, the evidence seemed to point that the meteor had not fallen vertically at all. They observed that by firing a rifle into mud an excellent replica of the crater could be made, that the rifle need not be fired in a vertical direction downward, but that it might be held at an angle even less than 45 degrees from the horizontal. A detailed study of the walls of the crater finally revealed what was considered an important fact. The rocks exposed in the walls were seen to dip radially away from the hole and it was observed upon plotting these dips that their magnitude increased rapidly until a point on the south rim was reached. They then reasoned that as the southern portion of the rim was approached the projectile was plowing deeper and had therefore bent back the rocks more steeply on either side, with its lifting force eventually spent, the mass was lodged in the southern sector. Factors tending to strengthen this theory were given as follows, - the north rim is lower than the south, which is due in part to the lower dip of the strata, but chiefly due to the fact that far less volume of excavated material has been deposited on the north; the amount of ejected material increases progressively towards the south, on both sides, until the greatest volume is found on the southern rim, where the greatest arching and uplifted strata appears.

Due to lack of funds, the theory of oblique approach of the meteorite, was not acted upon until 1920. A churn-drill hole was then sunk on the southern rim, as near as possible to the center of the great southern arch, and after many difficulties the drill eventually reached a depth of 1,376 feet where it became permanently stuck. At a depth of around 1,200 feet it was stated that small fragments of oxidized meteoric material were found mixed with the shattered sandstone. As the hole was drilled deeper this material increased rapidly in quantity until it composed about 75% of the mass and in all respects it answered the description of the oxidized meteoric iron found at or near the surface. It was assumed that it would have been impossible for a small amount of this material to drive itself to this depth in the rocks had not a much larger mass have plowed the way for it. It was considered almost certain that the drill had at last encountered the main mass of the meteorite. Since the mining company had greatly exceeded the estimated cost of drilling the hole and were unwilling to go to further expense, they abandoned their lease at the termination of the drilling in 1924.

Besides the interest of the Barringer family in exploration up to

this time the Standard Iron Company, the United States Smelting and Refining Company, the Mining Exploration Company had been and printed with various projects to discover the meteorite. In 1929 another company, the Meteor Crater Exploration and Mining Company was organized, obtaining a long-term lease on the 2,560 acres formerly owned in fee by the Standard Iron Company.

GEOPHYSICAL SURVEY

The Meteor Crater Exploration and Mining Company who at no time own the lease, instigated a geophysical survey of the area by the International Geophysicists, Incorporated, of Los Angeles, in October, 1931. It was stipulated that independent surveys were to be made by three different groups of their staff and that separate reports were to be submitted by each group. A geologist examined some 1,000 acres at Meteor Crater and vicinity; the magnetometer party, consisting of three members, surveyed some 5,000 acres; and the electrical survey party, of two members, reported on 700 acres. The details of the various surveys was presented in a paper by Mr. J. J. Jakosky (17) at a meeting of the American Institute of Mining and Metallurgical Engineers in New York City. While I have not had an opportunity as yet to review this paper, Mr. George H. Fetherstonaugh, general manager of the Meteor Crater Mining and Exploration Company, of Phoenix, Arizona, kindly permitted me to read a copy of their formal report. The objective of the geophysical survey was to obtain information about the origin of the crater, the advisability of continuing with exploration work, and if the latter was to be undertaken the location where such exploration work should be directed.

The factors governing the choice of geophysical methods were as follows: (1) The electrical conductivity of the mineralized meteoric material was over a million times greater than the surrounding country rock. If sufficient quantities of this material existed underground the electrical studies would indicate its presence (assuming no other electrically complicating factors) by a decrease in the effective resistivity. (2) The magnetic permeability of the mineralized meteoric material was also over a million times greater than the surrounding sedimentary series and should cause a magnetic anomaly if the material existed in sufficient amount at its depth, and again assuming no complicating magnetic factors.

In the magnetometer survey two factors were watched closely, - (1) anomalies which would indicate presence of meteoric materials; (2) anomalies which would be caused by an igneous intrusion or any change in the basement complex. This data was later correlated in connection with the possibility of a steam explosion being the cause. Should such a steam explosion have occurred, its origin and source would probably be indicated by magnetic anomalies associated with deeper structural effects.

From a study of the results obtained by the magnetometer survey it was concluded that the crater is of meteoric origin in view of the following:

(1) Magnetometer work does not show a change of regional gradient which would account for a buried igneous mass from which the steam might have emanated. (2) If the steam explosion were the cause one would expect some evidence of hydrothermal action which is not in evidence. (3) It is doubtful that, in a steam explosion, temperatures, sufficient to account for the formation of Le Chatelierite (1625° Centigrade) would obtain. (4) The intimate association of meteoric fragments with the ejected debris is undisputable evidence. (5) The fact that previous magnetometer surveys did not show anomalies due to the buried meteoric material has long been cited by those favoring the steam explosion theory. This was because their instruments were not sufficiently sensative and also because such work was not carried out in sufficient detail to allow differentiation between regional gradient, increases anomalies due to a buried mass, decreased anomalies due to pulverizing and shattering of the fill material, and topographic attitude effect.

The results of the electrical work were as follows: (1) The water level inside the crater (about 180 feet beneath the present dry lakebed) and level outside the crater about 550 feet below the level of the plateau are of the same elevation. (2) A well defined electrically conductive area occurs in the southwest quadrant of the crater. This calculated to be caused by two factors, (a) a deeper fragmatized or shattered zone underneath the area, and (b) such meteoric fragments as may be mixed with the field material in this zone. This zone is the area wherein all future exploration efforts should be directed. (3) No such area exists in any other part of the crater. (4) Sub-surface structural conditions are quite uniform through the crater area. (5) The crater is undoubtedly of meteoric origin. (6) The electrical effect would be classed as moderate to fair.

Briefly the geological report considered the crater to be formed by the impact of a meteor or a swarm of meteoric material. The possibility of a steam explosion is not probable. The age is estimated at 50,000 years. The latter figure is arrived at since there is a series of sedimentary deposits originating in arid climatic conditions, under which conditions of sedimentation is recognized as an extremely slow process. The record in these beds of a volcanic disturbance in the vicinity, probably at Sunshine mountains. The proof of a very considerable period of erosion. From a geological study of the crater there appears to be foreign material in the southern portion of the crater.

By way of summary the magnetic survey pointed to the presence of an area of continuous magnetic material in the southern portion of the crater, at depths of 200 feet and more, with concentration probably increasing with depth. By this method it was regarded that the mineralized area appeared to be as much as 600 feet in length and possessing appreciable depth and breadth. The electrical survey indicated the presence of an area of high conductivity in the southwest quadrant, between the center and the rim of the cone, at a depth of approximately 700 feet. That the original and

altered material found in the area indicated that the zone of higher conductivity cannot be due to rocks in place, or to their products, or to fill material. The conclusion advanced by this group infer that the material is almost certainly of metallic character. The geologist observed that the regional conditions are more or less simple, with flat sedimentary beds lacking in igenous intrusions or structural deformation, except local faulting caused by the impact. It was concluded that the absence of such complicated factors were indicative of the presence of meteoric material. Evidence warrants drill-hole exploration and five tests are recommended. The general location of the areas within which magnetic highs was located, agrees with the locations obtained in the electrical surveys, wherein a higher conductive zone was found. The magnetic high is also in the same general area as the location obtained from geologic data.

The results of the geophysical work are not considered sufficiently definite, in view of the complicated factors involved, to warrant calculations or predictions regarding the tonnage or mass of material which may be present. The chief result of the work has been to definitely delineate the area wherein future development work should be concentrated.

DRILLING OPERATIONS

Many trial shafts, six or more in number, and some 25 test holes have been put down in an effort to locate the meteorite. The results obtained in the deepest test hole, which reached a depth of 1,376 feet, have been described. Mainly upon the recommendations of the geophysical survey, the present management, the Meteor Crater Exploration and Mining Company, in the last few years made another attempt to locate the supposedly buried mass. Since considerable difficulty had been encountered in previous tests due to pulverized material and debris it was decided to sink a 1,500 foot compartment shaft, on the south rim of the crater, outside of the crater and then cross-cut to the location of the main mass as determined by geophysical methods. This shaft reached a depth of 715 feet. Large amounts of water, 1,000,000 gallons per day, were encountered at around 650 feet from cracks and fissures in the Coconino sandstone, and the operation had to be abandoned at the above depth. Some have suggested that it might be possible to cut an underground tunnel for the transportation of this water to the Salt River valley some hundred miles to the south, however, we are interested to know that work on this venture has not started as yet. It is stated that approximately $500,000 have been expended in efforts to exploit Meteor Crater up to the present time. No work is being carried on at present. The Mining Company has a custodian of the crater to show visitors around for which a fee of 25 cents is charged. An observation tower has been erected on Highway 66 recently and is called the Meteor Crater Observatory. True little can be observed from this point.

THEORIES AS TO ORIGIN

As may be seen from the partial bibliography at the end of this report, the literature has contained many articles on Meteor Crater during the past 35 years. While I do not mean to imply that I have read all of these references I have perused many of the more recent ones and there seems to be only two real theories as to origin, namely, meteoric or volcanic. The limestone sink idea has been well disproven as will be noted from the following page.

Meteoric Theory of Origin

The Meteoric theory for the origin of the crater which was first propounded by Ballinger has since been agreed to by G. P. Merrill (19); J. J. Jakoski (17); Elihu Thompson (29); L. J. Spencer (27); C. L. Longwell (18); Eliot Blackwelder (7); H. N. Russell (25); C. O. Lampland (30); H. S. Colton (31); and others. Some have argued that the meteorite was in the form of a single projectile and others that it was a swarm of meteoric material but all consider the crater the result of a meteoric impact of some sort. There has also been some disagreement among the above writers as to whether there was an explosion accompanying the impact. Most of the authors seem to favor the idea of an explosion.

Some of the main ideas advanced which tend to prove this supposition are as follows:

1. The actual presence in the debris around the rim and for miles around of much meteoric iron. The fact that concentration of this material increases as the center of the cone is approached. That the meteorites, admixed with the debris, must have had something to do with the formation of the crater or else they must be assumed to have fallen at exactly the same time and precisely the same spot on which a crater was being moulded, however formed. Such a double coincidence they contend would be next to a physical impossibility.

2. No evidence whatsoever of volcanic activity has been noted in the immediate vicinity of the crater.

3. Borings show that the crater is filled to a depth of about 700 feet with debris shattered by the original disturbance. The sandstone has been crushed to powder or "rock-flour" and some has undergone fusion, indicating a temperature of around 1,600° Centigrade. The temperature of a steam explosion which may have accompanied a volcanic intrusion, as inferred by the opponents of meteoric origin, would not be high enough to produce the silica-glass.

4. The structural features of the crater, the dip of the strata, with notable increase in dip towards the arch on the south rim, seems to be of considerable significance, with such an arrangement not probable.

under volcanic origin.

5. The results of the geophysical survey as conducted by three independent parties have been detailed on the preceding pages and they all point to a meteoric impact.

6. The argument that to date no meteoric mass of any size sufficient to have produced the crater has been located and that therefore it could not be meteoric in origin, means no more than the assumption that there are no oil pools in certain areas because of the fact that many dry holes have been drilled, or that there are no commercial ore deposits in certain localities since much prospecting has been undertaken.

7. If the crater were formed by a steam explosion from hot solutions or gases coming from underneath the present sedimentary strata then there should be evidence of hydrothermal action. Also from the results of borings and geophysical work it was observed that the underlying Supai red beds are in undisturbed position.

Volcanic Theory of Origin

The theory that the crater was produced by a volcanic steam explosion in the Coconino sandstone was first advanced by Gilbert (15). He arrived at this conclusion since the feature is in the midst of an area of volcanic activity, with many recent volcanic cinder cones at no great distance, and its similarity to these latter features. But there is no evidence of volcanic activity at Meteor Crater such as is present at these other localities. I have been informed that Mr. Gilbert leaned toward the theory of meteoric origin prior to his death although he refrained from publishing anything in this regard. Barton (16) has been one of the few prominent scientists in recent years to hold to the theory of volcanic origin and the writer is frank to admit that he does not present much evidence in support of same. It is most certainly difficult to conceive of huge chunks of limestone being blown for miles around the crater, and to visualize the force involved in such a blast, with no semblance of volcanic rocks left behind. I might add also that the surrounding countryside has been pretty well looked over in search for meteorites.

LIMESTONE SINK THEORY

In Science, Jan. 9, 1931, Mr. F. S. Dellenbaugh (11) suggests that the great pit of Meteor Butte is a sink formed by ground water solution in the Kaibab limestone. The geologic facts as enumerated by Mr. Chester S. Longwell (18) disprove Mr. Dellenbach's theory conclusively. The former agrees that the Kaibab limestone of this region contains many sinks, which receive much of the drainage of the Kaibab plateau, but states that it would be a wonder indeed to find in a semi-arid country a sink, almost circular in plan and nearly a mile in diameter, occupying the entire top of a hill, where the only water available for solution consists of the

scanty rain that falls directly on the area of the pit. Meteor Butte is a hill with the ground sloping away from the very edge of the rim on all sides and hence no outside drainage can enter the depression. Mr. Longwell mentions further the following points which are considered sufficient to remove the sink hypothesis from consideration, -

1. A limestone sink does not reach deeper than the base of the soluable formation in which it is formed. The Kaibab limestone here forms less than half the height of the walls. Beneath the Kaibab is the Coconino sandstone which is one of the most insoluable rock formations known. Any suggestion that the Coconino sandstone may have been caved owing to solution directly beneath it is ruled out, because the sandstones rest on red shales and sandstones many hundreds of feet in thickness.

2. At the top of the pit the slopes on all sides are littered with fragments of the Coconino sandstone. These fragments range in size from minute bits of broken sand grains to blocks of large size; and they are mixed with similar debris derived from the Kaibab limestone. How were these pieces brought up from their normal position hundreds of feet below? Obviously by a great force that acted upward and was explosive in character.

3. Although the rock strata are practically horizontal beneath a wide surrounding area, in the walls of the crater these strata are tilted and otherwise disturbed. On the south side, where the wall is steepest, the beds dip directly into the wall, at a high angle. There is no haphazard arrangement, such as would be expected if the disturbance were due to slumping into a solution pit. The tilt is consistent in direction and indicates that a powerful lifting force acted inside the pit, with concentrated action on the south side.

4. In places the quartz sand in the Coconino sandstone forming the lower part of the walls has been fused to glass (lechatelierite). This is astonishing in view of the high melting point of quartz (nearly 1500° Centigrade). Evidently the crater has been subjected to intense heat, such as could be generated only in an exceptional way.

Mr. Dellenbaugh sees support for his hypothesis in the fact that both inside and outside slopes of the crater show effects of erosion. Whatever its origin, the crater has been outdoors since its formation, and modification of its slopes by erosion has been inevitable, the fate it shares with every other landscape feature.

CONCLUSIONS

The writer has conversed with numerous geologists, astronomers, mining engineers, and has communicated with geophysicists who are familiar with and have examined Meteor Crater. After reviewing many of the various theories advanced to account for the origin of the crater and after studying

the situation on the ground I can see no other solution than that it was formed by a meteoric impact. I was skeptical at first due to the fact that to date, despite many years of work in exploration, no large mass of meteoric material has been found buried in the crater. But this does not alter the fact that more meteorites have been found outside of the crater than have been discovered to date in all the rest of the earth's surface. As the crater is approached the meteorites are more concentrated and some of them have been found mixed with the debris on the rim; therefore, if the crater is due to some cause other than meteoric impact it must have been formed at the identical moment that a mass of meteorites struck the spot. With the world for a target and in consideration of the time element it does seem that such a double coincidence would be improbable. Then there is the matter of intense heat which fused the sandstone, the large blocks of limestone scattered for miles around the crater, the arrangement of dips along the rim becoming increasingly greater at a point on the south, not to mention the general form of the crater with no evidence of volcanic activity it now appears that practically all of the real evidence points to meteoric origin. The concensus of opinion of most of the leading scientists is that the crater is the result of a fall of a meteorite. -

Regardless of the origin, however, the crater contains much in the way of inspirational appeal, and would doubtless make a most important addition to the National Park Service chain of monuments throughout this region. Due to the fact that considerable sums of money have been spent in exploration it is not known if satisfactory arra ngements could be made in this regard. If the cone is the result of an impact of a meteor, as is now generally conceived, it is the largest known crater in the world formed by such a phenomena.

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SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 22

BIRD BANDING IN THE SOUTHWESTERN MONUMENTS

— 1937 —

BY

DALE S. KING

DEPARTMENT OF THE INTERIOR

NATIONAL PARK

SERVICE

BIRD BANDING IN THE SOUTHWESTERN MONUMENTS

The Director,
Bureau of Biological Survey,
U. S. Department of Agriculture,
Washington, D. C.

Dear Mr. Director:

During the fiscal year 1937 bird banding projects in cooperation with your Bureau were carried on in five of the 26 national monuments which are administered by this office. This represents a decrease from nine stations to five, a situation caused by changing personnel and other factors.

No banding was done at Bandelier National Monument because Mrs. Earl Jackson, who was the operator at Bandelier, changed her residence to Montezuma Castle National Monument. This eliminated the Bandelier station.

The Chaco Canyon National Monument station was abandoned during the year, as the operator found he did not care to carry on banding in conjunction with his other work.

Milton Wetherill, our operator at Navajo National Monument, was away from Navajo National Monument all winter, the best banding season, being stationed at Walnut Canyon National Monument. He thus was able to carry on work at Walnut Canyon but the Navajo station failed to make any progress in 1937.

Lack of funds forced us to transfer our man away from Wupatki National Monument, so no birds were banded at that station, either.

With somewhat more adequate and stationary personnel in 1938, we hope that all stations, plus some new ones, will be banding regularly.

A total of 1,273 birds of 63 species were banded at the five stations. This total contrasts with 1,547 birds of 64 species banded in 1936. All stations increased their totals except Casa Grande which dropped from 738 to 39, due to the absence of Operator Dale S. King.

Brief resumes of the work at each station follow:

Casa Grande National Monument.

Two miles north of Coolidge, Arizona. Lower Sonora zone. Altitude 1,420 feet.

BIRD BANDING TOTALS, FISCAL YEAR 1937

Species	Casa Grande	Montezuma Castle	Pipe Spring	Tumacacori	Walnut Canyon	TOTAL	1935 Total	Banded in U.S. in 1935
1.Blackbird,Red-winged			18			18	0	2545
2.Bluebird,Chestnut-bkd					279	279	215	*333
3.Bluebird, Mountain					1	1	0	47
4.Bunting, Lazuli				1		1	0	33
5.Cardinal, Arizona		1		22		23	9	*1524
6.Chat, Long-tailed						0	2	64
7.Cowbird				1		1	0	*2021
8.Cowbird, Red-eyed				3		3	0	
9.Crossbill, Bendire					20	20	17	*41
10.Chickadee, Mountain					1	1	4	*62
11.Creeper,Rocky Mount.						0	2	*207
12.Dove, Inca	2			8		10	4	4
13.Dove, Western Mourning	1			4		5	17	*1654
14.Dove, White-winged				3		3	0	0
15.Finch, House	37		3	21		61	139	3352
16.Flicker, Red-shafted					1	1	1	28
17.Flycatcher,Ariz.Crst			5			5	3	3
18.Flycatcher,Ash-throat				1		1	0	*6
19.Flycatcher,Vermillion				4		4	2	2
20.Goldfinch,Grn-bkd						0	2	*45
21.Grosbeak, Ariz. Blue				2		2	0	0
22.Grosbeak,Black-headed				2		2	1	235
23.Grosbeak,RM Evening					3	3	0	349
24.Hawk,Desert Sparrow				5		5	0	*80
25.Jay, Arizona				1		1	0	0
26.Jay, Long-crested						0	2	*2716
27.Jay, Woodhouse						0	9	23
28.Junco, Gray-headed			10		11	21	77	*594
29.Junco, Montana						0	5	
30.Junco, oreganus		16				16	13	
31.Junco, Pink-sided		9			3	12	8	
32.Junco, Red-backed			3		10	13	54	
33.Junco, Shufeldt			91		22	113	25	
34.Junco, Slate-colored		1				1	0	
35.Kingbird, Arkansas						0	8	74
36.Mockingbird, Western				54		54	19	664
37.Nuthatch, Pygmy					38	38	46	113
38.Nuthatch,Rocky Mount.					5	5	8	
39.Oriole, Ariz. Hooded				4		4	0	39
40.Oriole, Bullock				2		2	0	99
41.Owl, Mexican Screech						0	1	0
42.Owl, Western Horned						0	3	*44
43.Phainopepla				2		2	4	12
44.Phoebe, Say	3			9		12	34	49
45.Pyrrhuloxia, Ariz.				28		28	0	0

Species	Casa Grande	Montezuma Castle	Pipe Spring	Tumacacori	Walnut Canyon	TOTAL	1936 Total	Banded in U.S. in 1936
46.Quail, Gambel	8	5		80		93	68	612
47.Roadrunner		1				1	5	7
48.Robin, Western					13	13	7	*2012
49.Sapsucker,Red-naped					6	6	4	*70
50.Sapsucker,Rocky Mt.						0	2	
51.Shrike, White-rumped			2	1		3	9	*82
52.Siskin, Pine					41	41	1	118
53.Solitaire, Townsend					2	2	60	61
54.Sparrow, Gambel	41	6	88	127	1	263	814	*4912
55.Sparrow, Lincoln	1			12		13	1	1413
56.Sparrow, W. Chipping		3			6	9	0	*3030
57.Sparrow, W. Lark				1		1	5	54
58.Sparrow,Nev.Savannah						0	1	*1118
59.Sparrow, Song			19			19	0	6670
60.Sparrow, W. Vesper			1			1	1	160
61.Sparrow,White-crnd						0	10	
62.Swallow,Rough-winged	1					1	6	44
63.Tanager, Western						0	1	64
64.Thrasher, Bendire				5		5	11	12
65.Thrasher, Crissal				1		1	9	11
66.Thrasher, Palmer				5		5	2	*10
67.Thrasher, Sage						0	2	3
68.Thrush, Russet-backed						0	2	*1183
69.Titmouse, Gray						0	1	83
70.Towhee, Canyon				23		23	10	*59
71.Towhee, Green-tailed			6	7		13	11	42
72.Towhee, Spurred						0	3	*284
73.Verdin				1		1	1	3
74.Warbler, Lucy				1		1	0	*11
75.Waxwing, Cedar						0	1	2030
76.Woodpecker, Cactus						0	2	*3
77.Woodpecker, Gila				5		5	8	8
78.Woodpecker,White-brst					1	1	0	*78
79.Woodpecker, Mearns					1	1	9	*109
80.Woodpecker,RM Hairy						0	1	*78
81.Wren, Baird Bewick				1		1	3	*59
82.Wren, Cactus	5			22		22	6	43
83.Wren, Canyon						0	0	3
84.Wren, House			1	1		1	0	9752
85.Wren, Rock						0	2	2
TOTAL	99	42	219	448	465	1,273	1,547	
GRAND TOTAL,'36 & '37							2,820	

*---Group total which may include several races.

With Operator Dale King absent on a furlough, Junior Archeologist Charlie Steen was able to devote little time to banding, but managed to add 99 birds to the 1936 total. A very good percentage of returns were received on Gambel Sparrows. Data concerning these have not as yet been thoroughly studied, and will be described at the end of the 1938 season in which we hope to do very intensive trapping.

With some 450 bands out on Gambel Sparrows, and this species apparently returning to very restricted localities every winter, research on the Gambels promises to be productive..

Montezuma Castle National Monument.

On Beaver Creek, approximately five miles north of Camp Verde, Arizona. Altitude approximately 3,200 feet.

The report of Mrs. Earl Jackson, operator, follows:

All banding was done between February 12 and April 19, 1937. Total captures were 178, including 42 new birds, 5 returns, and 131 repeats.

The traps used were Government Sparrow Traps, and the bait was chick feed and occasional bread-crumbs. The only interesting thing about the method was that the Quail, being somewhat tame, were kept from hurting themselves in the trap by my constant conversation, which seemed to soothe them.

The new birds banded were as follows:

Arizona Cardinal	1
Oregon Junco	16
Pink-sided Junco	9
Slate-colored Junco	1
Gambel Quail	5
Road-runner	1
Gambel Sparrow	6
Western Chipping Sparrow	3
	42

The returns consisted of four Gambel Quail which had been banded here by Norman Jackson, one of which repeated twice thereafter, and one Arizona Cardinal, which died from exposure in the trap.

At present there is no banding going on at the monument. I am, however, attempting a check on relative frequency of birds at Montezuma Castle, after the method described by Jean M. Linsdale, "A Method of Showing Relative Frequency of Occurrence of Birds", The Condor, Vol. XXX, pp. 180-184, May, 1928.

Pipe Spring National Monument.

Four miles from Moccasin, Arizona. Upper Sonoran zone. Altitude 4,960 feet.

Operator Leonard Heaton boosted his 1936 total of 105 to 219 during 1937. Juncos and Gambel Sparrows make up the major portion of the total, although Heaton has trapped a nicely varied list. A very careful observer, Heaton is accumulating valuable information, and should begin to show worthwhile results during the 1938 season when those totals are compared to his 1937 work, his first year.

Tumacacori National Monument.

Nineteen miles north of Nogales, Arizona, in Santa Cruz Valley. Lower Sonoran zone. Altitude: 3250 feet.

Louis R. Caywood, operator, was able to catch a more widely varied list of birds than any of the operators at the other stations. 1937 was the first year in which trapping was carried on at Tumacacori, and the 1938 comparisons should bring valuable data.

Mr. Caywood's report follows:

"A total of 449 birds of 33 species were banded during the past year. Of these, four new species were banded which did not appear on the Biological Survey Species Total of 1936. These included the Red-eyed Condore, White-wing Dove, Arizona Jay, and Arizona Pyrrhuloxia. A total of 80 Gambel Quail were banded while the total for all stations in the United States for last year shows only 61 banded.

"This report is the first full year's report from Tumacacori National Monument. The banded birds represent only about one third of the species observed during the year. Although many birds cannot be taken for banding, a careful record is kept each month of birds observed, nesting and feeding habits, migrations, etc. In time these observations will be of value to anyone wanting specific information concerning birds in this section of the Santa Cruz Valley.

"Only one return has been reported so far from the birds banded under my permit. This bird was a Gambel Sparrow taken in Highlands, California."

Walnut Canyon National Monument.

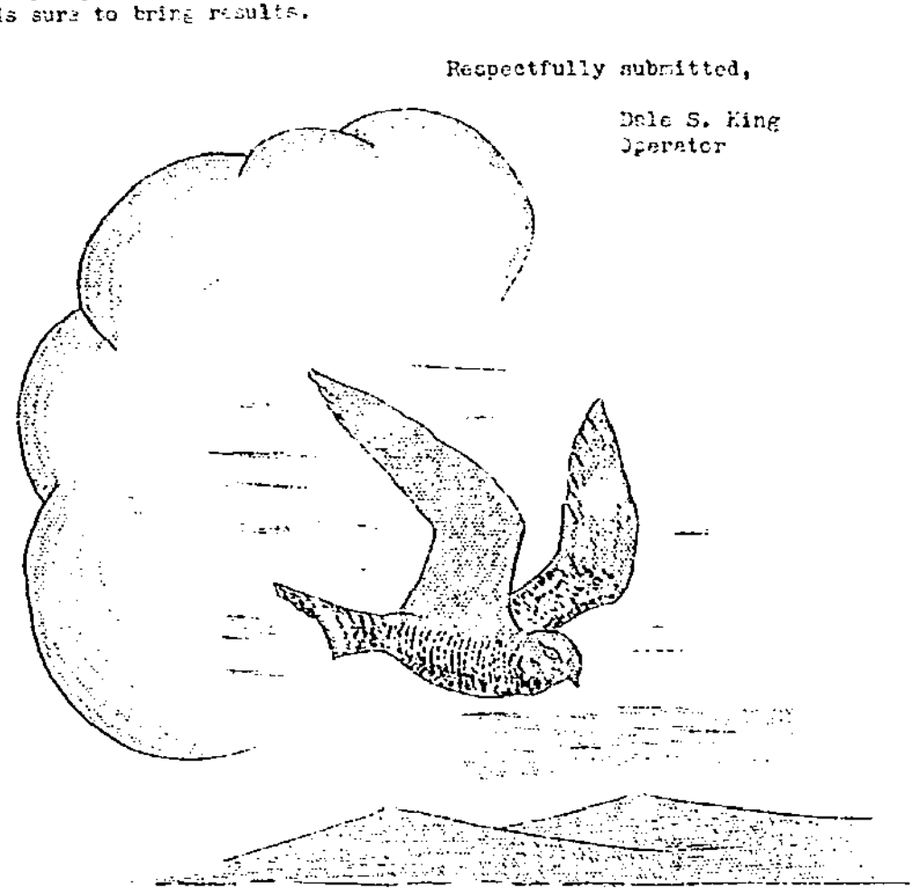
Ten miles east-southeast of Flagstaff, Arizona. Transition zone. Altitude 6,700 feet.

Operator Saubion was absent from Walnut Canyon during part of the winter, and, consequently the station was somewhat upset, but Operator Milton Hotherill was able to carry activities there so the 1937 total of 465 exceeds the 1936 total of 357.

Two years of quite intensive trapping activity at Walnut Canyon show that this station is potentially one of our best. Junior Archeologist Saubion is in all probability will be stationed at Walnut Canyon permanently in future years and his interest in bird banding is sure to bring results.

Respectfully submitted,

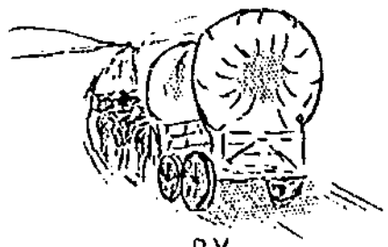
Dale S. King
Operator



SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NUMBER 23

ROMANCE OF EMIGRANT NAMES AT EL MORRO



BY
ROBERT R. BUDLONG
DEPARTMENT-OF-THE INTERIOR
NATIONAL-PARK
SERVICE

ROMANCE OF EMIGRANT NAMES — AT EL MORRO —

By Robert R. Budlong.

Among the hundreds of inscriptions to be found carved on El Morro Rock, are those of a number of emigrants to California who passed that way in 1858. One member of the particular party about which this is written left the following inscription: *

John Udell Age 63
July 6, 1858. First Emigrant.

(*See article on the founding of Fort Mohave by Mrs. Woodward in the "Pony Express and Courier", May, 1937, Volume 3, Number 12.--Ed.)

Another inscription reads:

Isaac T. Holland
July 8, 1858. From Mo.
First Emgt. Train.

Other names of members of this party are to be found, among them the following:

L. J. Rose. Iowa
July 7, 1858

Extracts from the Journal of John Udell, published in 1859 at Jefferson, Ohio, were sent Mr. E. Z. Vogt, Jr., by Mr. Charles Kelly of Salt Lake City in September, 1936, and these brief extracts are now in the official files at this monument.

During the past winter I was most fortunate in entering into correspondence with Mr. Leon John Rose of San Diego, California, whose father carved his name on the Rock July 7, 1858, as indicated above. To Mr. Rose I am deeply indebted for the following article, written by his father October 28, 1858, and describing what occurred to this party of emigrants on the banks of the Colorado River in that year. Mr. Rose expects shortly to publish a book entitled "Gringo Grandees" descriptive of his father's life, and we are looking forward with much interest to reading it.

This article makes a very valuable addition to the material being compiled on the names to be found upon El Morro Rock, and I know it will be found of absorbing interest to all who read it. Mr. Rose has very kindly given me permission to publish this document in the Southwestern Monuments Monthly Report. The article follows, exactly as sent to me:

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AN ACCOUNT WRITTEN BY L. J. ROSE WHICH WAS SENT BACK TO THE NEWSPAPER IN KEOSAQUA, IOWA, UPON HIS RETURN TO ALBUQUERQUE IN OCTOBER, 1858, AFTER HIS HARROWING EXPERIENCE WITH THE MOJAVES ON THE BANK OF THE COLORADO RIVER IN AUGUST OF THE SAME YEAR.

You may have heard of several parties of immigrants who started on Beale's route for California last spring, and possibly of their return from the Colorado on account of Indian troubles. I was in all of those troubles, and a plain statement of facts connected therewith may possibly be not uninteresting to yourself and readers.

The first company consisted of two parties: Jool Hedgpath, Thos. Hedgpath, G. Baily, Wright Baily, J. Holland Baily, John Udell, their families, and probably 18 hands, forming one party, who had with them 125 head of oxen and cows; 12 wagons, and 15 horses -- Messrs. Bentner, Alpha Brown, S. M. Jones, myself, and families, and 17 hands, the other party, with 247 head of cattle, and 21 horses and mules. We kept our stock separate until our troubles with the Indians began, although we traveled together and camped near each other.

We left Westport, Missouri, the first of May, and Albuquerque, New Mexico, the 30th of June, with E. M. Savedra, as a guide, who had been guide for Whipple and Beale. We got along reasonably well until we arrived at what, I think, Beale names Hemp-hill Spring (our guide calls it Peach Tree Spring) where we saw the first Indians on the route and they, by way of introduction, stole one mare and one mule. Three of the men went in pursuit, tracking them nearly for a day, and while going through a deep canyon were shot at with arrows by the Indians, but without being hurt. Night coming on, and their animals being tired out, they gave up the pursuit and got back to camp in the night, very hungry, thirsty, and tired. This according to Lieutenant Beale's report, is 112 miles this side of the Colorado. The next evening, near dusk, while under way, Savedra espied some Indians on the side of a mountain. After much coaxing by sign and speech he succeeded in prevailing on them to come down to us. They, finding that no harm was meant them, followed us to camp. While coming down, they kept up a continual rapid jabbering, and when near us would pat their breasts, saying "hanna," "hanna," "hanna," repeatedly. They also used the word "Mojaves." Savedra, who understands their language to some extent, said that they said they (the Cosninos) had our horses, and had taken them from the Mojaves, who had stolen them from us, and that they would bring them to us the next day. That they were good, or "hanna, hanna", and that the Mojaves were bad. We treated them kindly, gave them as much to eat as they wanted, wishing to have no trouble with them, and thinking that possibly they might return the horses, although we rather inclined to the belief that they themselves had stolen the horses, Savedra saying that the Mojaves never came out so far from their own country.

Next morning, about ten o'clock, word came up, sure enough, the Indians

were bringing the horses. Of course, everybody was surprised and in good humor. About eleven o'clock a.m., we got into Indian Springs, 91 miles this side of the Colorado, when about 25 Indians came up with the horses and gave them up to us. It was soon evident that they anticipated very extravagant rewards, all expecting shoes, clothing, and trinkets, besides some cattle. I gave each of the two a blanket, shirt, pants, knife, tobacco and some Indian trinkets, and the balance tobacco and some trinkets, also preparing an ample dinner for them, and again a supper. I also gave the two who had returned the horses a certificate that they had voluntarily returned them, and that I believed they had also stolen them. Many remained in camp with us that night, doubtless for the purpose of stealing, but the guard kept so sharp a lookout that they found no opportunity.

Next morning a new supply came in, numbering probably near 50, also claiming some reward, commencing with their jabbering as soon as in sight and keeping it up as long as breath would hold out, pointing out at the same time which way the horses had been taken when stolen, how they re-took them, how they fought -- wore out their moccasins running after them -- wanting shoes, etc., and, to our great relief, about eleven o'clock a. m. they all left. They were becoming very annoying, assigning as a reason that the Mojaves were pursuing them. I felt some little apprehension for the safety of the cattle, but as we expected to move camp about a mile as soon as we could eat dinner, no extra precaution was taken, and it would have been useless then. When we were hitching up we found some of our oxen missing and, on counting, found six of our cattle gone. Some of the men went in pursuit, and found four of them killed. From two the meat had all been cut, nothing but the carcass remaining; the other two the Indians had had only time to kill, and being apprised by their watchers of our men coming, had left them. It being near sun-down and the canyon becoming very narrow and rocky, the men thought it prudent to return, seeing nothing could be gained by pursuing, and not even seeing one Indian, but probably passing in thirty yards of many secreted among the rocks. From there to the Colorado we were continually harassed and shot at by them. Many of our horses and cattle were wounded, also one man whom I sent back from Savedras Spring, to let Mr. Brown know that there was but little water. He was shot with three arrows, and only after an illness of two months was able to walk or ride. But it would be tedious to narrate all the annoyances and, compared with what followed, petty troubles.

The 27th of August, about sunset, we reached the top of the last mountain between us and the Colorado. We had toiled two nights and days incessantly. Our animals without water, footsore and worn out; the weather had been hot. The men, too, were all worn out with incessant toil and nothing but the verdant valley with the Colorado meandering through it, looking in the distance like a brook, and the evening mountain breeze kept them in spirits and willing to encounter another night's toil. We halted and had supper, the first meal for the day, discussed the merits of green beans and corn, which we expected to eat when we got there; how long it would take to cross the river, and then, Oh then, only

ten days to St. Bernardino, California, and civilization. We gave one general hurrah and again rolled on expecting to reach the Colorado before daybreak. Some of the Mojave Indians here met us bringing a melon and a little corn which were greedily purchased. They asked us how many of us there were, and whether we expected to settle on the Colorado. (Rather an unusual question, I thought at the time.) We told our number, saying more were coming, and that we were going to California. They appeared very friendly all the way, showing the road and performing other service unasked during the night. Instead of getting there before morning, it was after 11 o'clock when we got to the edge of the woods, yet a mile from the river, and our oxen being completely exhausted, we had to unyoke and drive them to the water.

On nearing the river many Indians came out, and as the number increased, their manner changed to insolence and impudence. My wife and I were walking along the teams being unable to carry us. An Indian stepped between us asking many impertinent questions in bad English and Mexican, and laid his hand on her bosom and shoulder. I pushed him away and shook my head, assuming as pleasant a look as possible, which must have been a ghost of a smile, for my blood fairly boiled and nothing but the life of my wife and little ones prevented me giving him what he deserved. He merely laughed a big "ha, ha!"

By this time we had reached the wagons. Mr. Brown's wagon was probably a hundred yards from the others. Mr. Brown himself had gone to see to the watering of the animals and to bring water to the camp. The day was very hot -- the hottest I have experienced, and Mrs. Brown and children were very much in want of some to drink. I found them all in tears and begging the Indians to bring them some, at which they only laughed and told her if she would pull off her dress and give them that, they would give her some. She offered them various articles of more worth than it, but nothing else would answer. They also would take hold of her little boy saying that they were going to take him, and stood around laughing and talking in a very impudent manner, judging from their manners and actions and the little English they spoke.

I had the wagon hauled near the others, and Mr. Brown returning with water, they troubled her no more. Had they attacked us then, we would have been their easy victims, for there were not five persons awake in camp. The men were so exhausted that as soon as they reached camp they lay down under the trees, and fell into a heavy sleep, and amidst gnashing teeth and distorted faces around them, were still, in their dreams, driving oxen.

The Indians killed and drove off our cattle without much opposition, and when caught in the act would laugh and treat the matter as a very good, rich joke. They troubled themselves but little about us, and would cut up animals and cook them in sight of camp. But evening came at length, and the Indians started for their homes, leaving us in the enjoyment of

quiet and needful sleep.

Next morning, after a hearty breakfast, we moved camp to the river bank and all hands feeling refreshed got things in regular working order again. Some started in search of a place to cross the river, whilst others for better grass, in the finding of which they succeeded as well as could be wished and better than we had expected. A strict watch was kept over the animals and we lost nothing that day.

About noon one of the chiefs came to camp to pay us a visit. He had a number of his men with him. When told about his men stealing some of our cattle, he spoke to some of them, but evidently not very earnestly, and gave us but little satisfaction, only saying they would do so no more. He said but little, but was very attentive to all that was said or done and there was a cunning twinkle in his eye which I did not half like. He asked whether we were going to settle there and when told that we were going to California, he gave us a very searching look, as if not half believing it. I gave him presents which I had brought along for that purpose consisting of blankets, shirts, pants, knives, tobacco, beads, rings, bells, and looking-glasses, which he distributed among his warriors, and said we could now stay and cross the river when we pleased and none of his men would trouble or molest us. He was a stout, tall Indian, with a great deal of bluster and fuss about him. He was gaily rigged out in paint, feathers, bells, and gewgaws. I made him like presents, and he made like promises, harangued his warriors, all of whom, except a few, left.

About four o'clock p. m., we moved our camp down the river about a mile, where we expected to cross it, and found excellent grass, also plenty of cottonwood for constructing a camp.

Our new camp was a very pleasant one. Although the sun was very hot during the day, so much so that the horses were as wet with perspiration as if they had been in the river, yet we had a pleasant breeze from the river; the water was good and cool, and the animals were fairly "rolling in clover." The evening and night was cool and refreshing, and the next morning we felt as fresh and buoyant with hope as if we had never lost sleep nor had any trouble. But in the calm the storm was brewing. Only two Indians made their appearance; they looked around awhile and then left. About 10 o'clock a.m., we saw many Indians crossing the River, and we counted over 250 of them. Savedra said that the Indians acted suspiciously and I sent word to Mr. Brown to have the cattle herded near camp. Yet we had but little fear of an attack. I felt some little uneasiness on account of Mr. Bentner who was to come that morning from the mountains.

I will here explain how he came there. The first party, with Mr. Bentner of my party, had left their wagons in the mountains together with their families and most of their men, fearing that the animals

could not stand it to the Colorado and draw a load, and had driven their animals loose, while I had all my wagons, animals, and things at the river. They expected to recruit for a few days and then return with them for their wagons. Mr. Bentner having mules did not need so long a time for recruiting, and as we would cross the river before they could and would get some little start, and being of our company anyway, he felt anxious to be with us. I expected him early in the morning and his not coming, as I said before, made me uneasy, and I thought I would send back to the camp we had left and possibly we might find him and family there. Dinner being nearly ready, I postponed it until after the meal. While eating dinner, one Indian made his appearance. He looked around a little while and then left. One of our boys came in and said he had seen a good many Indians in the vicinity, and they had told him that a steamboat was coming up and pointed where the sun would be when the boat would land. There was quite an excitement in camp for a while, but we concluded that it was too good to be true. After dinner, two of my men left for the camp we had left the day previous, to see if they could find Bentner.

About half an hour after the men had left, the Indians came running from every quarter, out of the brush, completely surrounding the camp, and attacked us. They came within 15 feet of our wagons and they evidently expected to find it easier work than they did, for I have no doubt they expected to massacre us. But we were well armed and the men that were in camp ready to receive them. A short time afterward, all of the men came in except two, whom I had sent to see if they could find Mr. Bentner and family; and some of the enemy being killed, they retired to a safe distance. They kept up a continued shooting of arrows for nearly two hours, and part of them having driven off all the stock except a few near the wagons, they all left. During this time, the two men had returned and reported of having found Miss Bentner killed, her clothes torn off and her face disfigured. They knew that it was unsafe for them to make any further search, and made for the camp. From this and the fact of an Indian from the other side of the river shaking some scalps at us, which he had fastened on a pole, we supposed that they had all been killed. Mr. Brown was also killed, dying in camp without a struggle. We buried him in the Colorado, and its waters will never close over a nobler or better man, for to know him was but to like him. Eleven more were wounded, who have all since recovered, or nearly so. There were about 25 men in the fight.

We held a consultation, and concluded, after discussing various plans, to return the way we had come. There were cattle enough left to pull one wagon, and two mules for the carriage. We loaded these with as much provision and clothing as the oxen and mules were able to pull, leaving the loads of five wagons, undisturbed, behind. We scarcely expected to take our retreat, yet every man felt disposed to sell his life as dearly as possible. We also feared that the families with the few men left in the mountains were all killed; but we made our way back undisturbed, and found them all safe. Out of nearly 400 head of cattle,

we saved 17 head, and out of 37 horses, probably ten. The cattle that were mine have all died on the road from the fact of their feet giving out in again having to go over the rocky road which had previously made their feet tender; but they were in good condition otherwise, and with a few day's rest at the Colorado, and no rock on the other side (Savedra says there is none) would have been able to have gone on without difficulty.

We found, too, at the Colorado mountains, another party of immigrants from Iowa, and from the same county from whence I had come; in fact, old acquaintances to me consisting of Messrs. Caves, Jordan, Perkins and Davis with their families and about thirty men. They had been much troubled by the Cosninos Indians and in consequence had lost much stock. The joy in finding them was indescribable, for without their assistance I could not have gone ten miles further. They fortunately, too, had a large share of provisions which they very generously divided with us, but even with the assistence that they could render, it was a never-to-be-forgotten march back. Many wagons had to be left and in order to haul all the provisions, all the women and children, as well as the men, had to walk. On account of the heat of the day and the slowness of the cattle, and having to make certain distances to reach water, we had to travel mostly at night and at times night and day. A distance that we made in coming in a day now took us two and at times more. This was on account of the cattle's feet being sore and worn through by walking so long on rough rock. The Cosninos Indians troubled us all the way back, and a party of 45 men who had been sent ahead with the loose stock to Indian Spring, were there attacked, and had to fight half a day until we all came up to their relief. When some five miles yet from the spring a man came back who had gone ahead, but not with the first party, and reported that the first party had all been killed, that the Indians had their guns and were wearing their clothing, that they were herding the cattle around the spring and were evidently expecting to keep us away from the spring.

I shall never forget the consternation this created, but as we had to have water, there was no other alternative, and get it we must or die. When we got near enough we found the report a mistake, and a very joyous one it was, many shedding tears of joy in finding a son who they had supposed dead. They, too, were as glad as we. for their situation was anything but pleasant. One of them was badly wounded with a ball, (the Indians having one rifle among them) and one with an arrow. Both have since recovered. To give some idea how fast we traveled, making every exertion, for the provisions of many were all gone and had to live on beef alone, and that, too, feverish and worn out so that it made everyone sick who ate it, it took me and others 18 days to make 91 miles. I could yet write by the day of new troubles and hardships we experienced, but this account is already getting too long.

At Indian Spring we found E. O. and T. O. Smith and train, both

gentlemen with warm hearts and, too, willing and determined ones to help. We are all indebted to them for many favors and acts of kindness. They divided their provisions to the last mouthful, and when that gave out, killed their cattle, hauled all the women and children, and lent their stock as long as there was any to lend. Part of us, with mule teams, have now reached Albuquerque where are as warm and kind hearts as beat in the world. The Americans and the officers of the army station here have done everything in their power to help us. They have even sent a load of supplies to meet us, and have sent two more loads to those back with Smith's train who are now expected in daily. May they never need assistance.

The lot of many is a very hard one. Some are old, who, with large families, unable to work, were going to California to a fortunate son; some honest, industrious farmers, who had what was to them an independency; some delicate in health expecting to improve it by the climate of California, but with a sufficiency, and all have lost their all, and are now living beggars, or on the bounty of kind people, in a strange land and among strangers.

You can publish this as it is, if you think it would be of any interest to your readers -- or parts, or none of it, as you may think best -- but if you do not publish it as it is, then be kind enough to send it to Hon. H. K. S. O'Melveny, Central City, Illinois. I have no time to revise it, and many corrections will have to be made, which I would do, were it not for my anxiety to get it off by this mail, which closes soon.

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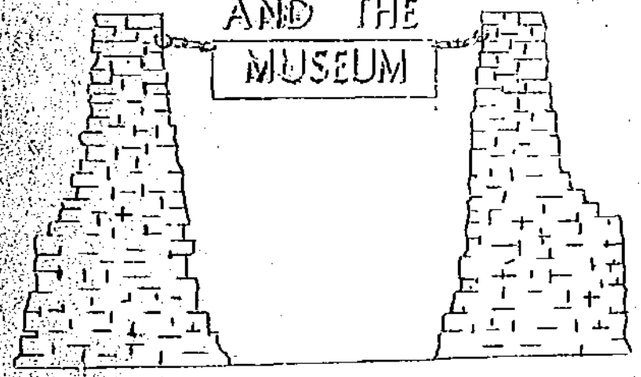
SOUTHWESTERN MONUMENTS
SPECIAL REPORT
NUMBER 24

ANTHROPOLOGY AND THE MUSEUM



BY
KATHARINE BARTLETT

DEPARTMENT-OF-THE INTERIOR
NATIONAL-PARK
SERVICE

ANTHROPOLOGY AND THE MUSEUM

By Katharine Bartlett

(This paper was presented at the Social Science Section, American Association for the Advancement of Science, Albuquerque, New Mexico, April 26, 1938. Ed.)

Perhaps a discussion of museums is out of place on a scientific program, but I do not believe that it is for there is hardly a Southwestern anthropologist who is not connected with a museum of some kind -- university, state, national park, or private.

A museum is a place where the finds of anthropology should be interpreted to the public. A museum should be like the conclusion of a scientific book where the results of research are summed up and not, as in the body of the book, where all of the evidence is presented. The evidence must be known, of course, and placed where it may be seen by any person who wishes. There are very few museums like this.

Anthropological museums are divided into two groups: those that present anthropology as and art, and those that present anthropology as a science. The first group exhibits archeology and ethnology as art, and in that they seem to be much more successful, as museums, than the second group. Only the best and finest objects are exhibited, usually in tastefully chosen settings that enhance their beauty and interest. The scientific museums, on the other hand, tend to show all of their material, good and bad alike, poorly arranged and with uninteresting backgrounds.

It is with scientific anthropological exhibits for the public that we are particularly concerned here. Museums of anthropology, one of the oldest classes of museums, have been excessively slow to profit by new museum methods, especially in the United States. In

recent years, art museums, natural history museums, and science and industry museums have outdistanced anthropology and history museums in pleasing and instructive presentation of material. They are employing the most up-to-date methods.

A good museum exhibit of any kind, whether one case or a gallery, should tell a story, or, in other words, present a few definite and clearly expressed ideas, and only a few. It is impossible for a museum visitor to absorb in the short time at his disposal very much information, but if he goes away enriched with a few clearly defined ideas, then he has not wasted his time.

As I was going around in a large eastern museum where there were endless cases full of objects, I noticed an ordinary man and woman. The woman was obviously bored, but her husband was intently studying every case. Finally said she, "Henry, if you stop to look at everything, we'll never get out of here!" This sentiment expresses perfectly the spirit of most archaeology and ethnology exhibits--a multiplicity of objects.

Let us take the Southwest as an example. Of course, it is needless to remark that Southwestern archaeology has made great strides and we now have a sequence of well defined cultural periods, practically all dated. Even a few museums realize this, and they exhibit in sequence the objects of material culture from Basket Maker through Pueblo IV, or Pioneer through Classic Hohokam. Unfortunately, to the general public, these objects all look about the same, except perhaps the pottery which looks different from period to period. Take Pueblo III for example. To a Southwestern archaeologist it immediately brings up ideas like this: "1100 to 1300 A.D.; large Pueblos--Wupatki, Betatakin, Aztec, Pueblo Bonito, Cliff Palace; finely made pottery with great local variation; distribution less extensive than in Pueblo II; kivas and development of religion; beginning of complex social organization; abrupt ending caused by great drought of 1275 to 1299." We forget that the public does not know all that this period designation means to us and consequently any intended time sequence is lost and the exhibit appears flat and lacking in perspective. Dwellings, religious life, social evolution and other intangible evidence, etc. are not there. It is this lack of time perspective that makes archaeological exhibits so dull from the visitor's point of view, yet is the very thing archaeologists are striving to bring out.

I represent the general public in search of knowledge when I look at exhibits of the archaeology of Middle and South America, Europe, Greece, Egypt, and the East, and China. One knows from the literature that a great deal of research has been undertaken, and chronologies and sequences of cultural periods have been established in many parts of the world, but it is practically impossible to find

a museum where such finds are interpreted intelligently, if at all. One of the best examples, is the new National Museum in Copenhagen. Here the prehistory and history of Denmark is set forth from the end of the Old Stone Age through Maglemosian, Kitchen Midden, Neolithic, Bronze, Celtic Iron, Roman Iron, Migration, Viking, German, and Historic Periods to the 19th Century. After looking at this splendid exhibit, one can understand the present day culture of Denmark, even though all labels are in Danish.

Another fine museum which, though devoted only to history, is worth of emulation, is the Hause den Rheinischen Heimat in Cologne. Here the history of the Rhine Valley is excellently treated according to various subjects--the historical and political development of the Rhineland, the Church and Church estates, the Rhenish city and its people, the Rhenish peasantry, and Commerce and Industry.

The third example is the new Hall of the Natural History of Man, at the American Museum of Natural History, which depicts in a very simple but comprehensive manner the physical evolution of man. This exhibit is somewhat like the Deutsches Hygiene Museum in Dresden which is devoted to Human Physiology.

In the museums which are the most interesting and instructive one finds simple, well thought-out exhibits, carefully labeled, extensively amplified with charts, maps, diagrams, and models, used in connection with carefully selected material. In showing a sequence of objects or cultures, it is the differences, and not the likenesses, which are the most significant.

One eastern university museum maintains that it is not faced with the same problems as ordinary public museums, and that it is proper for them to exhibit all their material so that the students can study it. If carefully prepared exhibits, no matter on what minute detail of anthropology, were available, I believe students as well as public would profit by it. Such exhibits should, of course, be augmented with easily available study collections.

In fact, a university museum is an opportunity for any anthropology department. By encouraging advanced students to prepare synoptic exhibits on any phase of the subject, the museum might build up a fine series of exhibits on its research problems. Many good students, who from lack of opportunity will never be able to be field archaeologists, can find positions in the vast number of museums springing up in the country--every city, town, county, and state must have them. Many of these local museums are being run by people who have not the slightest conception of what a good exhibit should be. Certainly a good exhibit would be worth as much as a term paper from a student, and requires as much research. Also a museologist with good anthropological knowledge is better than a jobless anthropologist.

ANTHROPOLOGY AND THE MUSEUM (CONT.)

In concluding, I wish to say that as anthropologists we should take the trouble to interpret to the layman what we learn through the dark and devious ways of research. By means of very simple, clear exhibits carefully labeled and augmented with charts and diagrams, the most intricate problems can be successfully "put over", remembering all the while that the differences are more important than the obvious likenesses. We should make an effort to present the anthropology of the Southwest as a predigested subject in three dimensions rather than as a mass of undigested material that satiates the public mind, and in so doing train our students to prepare such exhibits. We cannot expect a museum visitor -- even the most interested -- to expend much grey matter upon what he sees, and therefore we must do this thinking for him, in advance.

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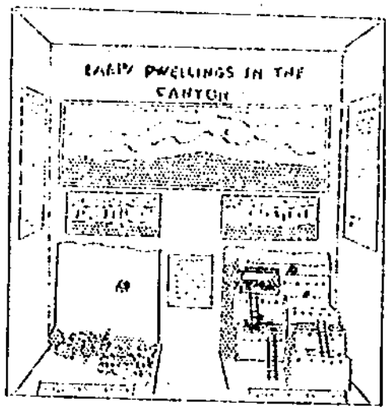


SOUTHWESTERN MONUMENTS

SPECIAL REPORT

NO. 25

BIRD BANDING IN THE SOUTHWESTERN MONUMENTS 1939

BY
DALE S. KING

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

1939 BIRD BANDING IN THE SOUTHWESTERN NATIONAL MONUMENTS

July 1, 1939

The Chief,
Bureau of the Biological Survey,
U. S. Department of the Interior,
Washington, D. C.

Dear Sir:

During the fiscal year 1939, bird banding projects in cooperation with your Bureau were carried on in nine of the 26 national monuments which are administered by this office. A tenth station established in 1938 was not operated due to the transfer of the operator. A total of 1,614 new birds of 62 species were banded during the year, making a total of 6,183 birds of 101 species banded by stations under the jurisdiction of the Southwestern National Monuments since bird banding was started in 1936.

With permission granted by your Bureau to operate the various stations under the centralized supervision of this office, our efforts during the year have been concentrated on standardizing procedure and record keeping throughout the various stations. This is of the utmost importance as shifts in personnel are frequent and nothing is more conducive to discouragement than for a man who has been operating one of the stations to be transferred to another monument and find a different and puzzling system of record keeping in use. With independent operators each devising system of records based upon his own particular interests, considerable confusion resulted with the shifting of personnel.

Another major effort exercised by this office during the year has been to impress upon operators the desirability of concentrating upon one or two definite species of birds or upon some definite problem. Many operators of long experience, and practically all new enthusiasts, band birds for the pleasure derived from the work and set as a goal only a record number of birds banded, or an imposing list of species handled. It is the desire of this office that the various operators, wherever possible, make use of the opportunities afforded by their banding work to obtain data which will add to the knowledge regarding the activities and habits of species and contribute to the solution of definite problems, some of which may prove to be of economic value. It is the object of this office to encourage such concentration of effort with the publication of worthwhile contributions to ornithological knowledge as a goal.

Following is a brief resume of the work carried on at the various stations during the fiscal year:

CASA GRANDE NATIONAL MONUMENT

Lower Sonoran Zone. Two miles north west of Coolidge, Arizona. Altitude 1,420 feet. Bird banding at this monument has been carried on under the supervision of the Headquarters Branch of Research and Information with a double purpose in view. First, to maintain close touch with the detailed operation of a banding station and the record keeping involved as a basis for aiding, advising, and supervising the activities of operators in the various monuments; second, a study of bird life in the creosote bush-salt bush - mesquite lover type of the Lower Sonoran Desert with studies, for the present, concentrated on the habits and activities of House Finches, Gambel Sparrows, and Pallid Horned Owls. In addition to banding, an observation record file has been maintained. The station is operated under the permit of Dale S. King.

TUMACACORI NATIONAL MONUMENT

This station is located in the Santa Cruz Valley, 19 miles north of Nogales, in the Lower Sonoran Life Zone at an elevation of 3,250 feet. Following is the report of Louis R. Caywood, operator of the station:

A total of 223 birds of 22 species was banded. This record is just five below that of 228 birds of 15 species banded last year.

Again this year the number of Gambel Sparrows banded leads the list. Since banding has been carried on at this station, 379 Gambel Sparrows have been banded. Compared with Casa Grande National Monument where returns on these birds are numerous, it would seem that returns should be recorded here. However, of this number there has been only one return.

White-crowned Sparrows closely followed the Gambel Sparrows this year. The last Gambel was banded on March 20 and the first White-crown was banded on April 3. There were White-crowns here until about June 1.

Only one casualty occurred during the year and this was caused by a Roadrunner. The Roadrunner killed a Gambel Sparrow in a government sparrow trap. It, in turn, was caught and banded by using the dead Gambel for bait and raising the front of the trap so it could enter the second compartment where the dead bird was.

A great number of Black-headed Grosbeaks were observed this year as long as the mulberry trees had fruit on them. Only one of this species was taken and that one by hand after it had bathed until it could no longer fly.

WALNUT CANYON NATIONAL MONUMENT

Ten miles east-southeast of Flagstaff, Arizona, in the Transition Life Zone, at an elevation of 6,700 feet.

This station offers a valuable opportunity for the study of migrating birds in addition to nesting species. Because of the lack of water sources in the immediate vicinity of the station, great success has been obtained through the use of a water trap except during the rainy season when operations have been suspended. Operator Paul Beaubien has obtained considerable interesting data much of which pertains to seasonal differences in migratory habits and is now concentrating on a study of this phenomenon to determine the cause.

PIPE SPRING NATIONAL MONUMENT

Fifteen miles west of Fredonia, Arizona, in the Upper Sonoran Life Zone, at an altitude of 4,960 feet.

Although hampered by a severe winter and the closing of the station for several weeks due to predatory activities of hawks, operator Leonard Heaton banded 361 birds, 272 of which were Gambel Sparrows. Local movement of these birds, as noted in individual trap records, showed a definite trend which Mr. Heaton has taken as a basis for study. In December, 63 Gambel Quail were banded prior to release in the vicinity of the mall monument in an effort to restock the area.

SAGUARO NATIONAL MONUMENT

Located 19 miles east of Tucson, Arizona, in the Lower Sonoran Life Zone, 3,400 feet above sea level at the foot of the Tanque Verde Mountains.

Although a bird-banding station was established at this monument in 1936, removal of all personnel from the area terminated banding activities until the fall of 1938 when Ranger Carleton Wilder re-established the station which continued in operation until the termination of his tour of duty in April, 1939. Although very few birds were banded, a great many repeats were recorded and some data accumulated. The majority of the birds of the locality are apparently year-around residents indicating that the potentialities of this station deal with intimate studies of a few permanent residents rather than with seasonal or migratory numbers. With the establishment of permanent personnel at this monument during the coming fiscal year, it is hoped that this station will be operated continuously in the future.

TONTO NATIONAL MONUMENT

Four miles southeast of Roosevelt, Arizona, at an elevation of 2,800 feet, with both Lower and Upper Sonoran Life Zone conditions in the immediate vicinity.

Following efforts by Ranger Thomas Onstott to establish a banding station in the spring of 1938, Ranger G. C. Philp placed traps in the fall of 1938 and maintained the station until his tour of duty terminated in April, 1939. Although only 51 birds were banded, the establishment of this new station greatly stimulated the interest in birds at this monument and resulted in the compilation of a check list of 52 species, seven of which were recorded nesting. With the establishment of a permanent custodian for this monument during the 1940 fiscal year, it is anticipated that banding activities will be placed on a continuous basis.

BANDELIER NATIONAL MONUMENT

Location 46 miles northwest of Santa Fe, New Mexico, the banding station is in Frijoles Canyon at an elevation of 5,600 feet with both Transition and Upper Sonoran Life Zone conditions present.

Due to the transfer of Operator C.G. Harkins, all activities of the monument were placed on the shoulders of Grader Operator George Sholly who was forced to curtail bird-banding activities in consequence. Nevertheless 85 new birds were banded and a number of repeats and returns were recorded. The

to pressure of guiding duties, it has been impossible to operate this station during the summer months, hence the majority of birds captured have been winter residents, especially juncos. With the appointment of Junior Archeologist Thomas effective June 1, 1939, the seriously undermanned situation at this monument has been remedied and bird banding should be placed on a more secure basis for the future.

CHACO CANYON NATIONAL MONUMENT

Located 64 miles south of Aztec, New Mexico, at an elevation of 6,500 feet in the Upper Sonoran Life Zone.

Continuing the work started just before the beginning of the 1939 fiscal year, Operator Carolie McKinney banded 127 new birds. Although the station is too new to have accumulated much data, Mrs. McKinney has the distinction of having banded two unusual species, a Loon and a White-throated Swift. Through the banding operations, bird study has progressed in this area where the avifauna is little known and where a wealth of prehistoric ruins yields numerous bird and mammal bones. It is possible that an accurate knowledge of the present bird resources of the area may furnish a check as to changes in climatic conditions, or the absence of those changes, since prehistoric times through a comparison with excavated animal remains.

WHITE SANDS NATIONAL MONUMENT

This station is located eighteen miles southwest of Alamogordo, New Mexico, at an elevation of 4,500 feet in the Upper Sonoran Life Zone.

Shortly after establishing this station, its operator, Ranger James Felton, was transferred to the Southeast and prior to the end of the fiscal year, no one was available to operate the station, hence no work was done. However, prospects are very bright for the coming fiscal year for Ranger George Sholly, who operated the Bandelier Station following the transfer of Custodian Harkins, has been moved to White Sands. Mr. Sholly has had considerable experience in bird banding at Bandelier and is much interested in this activity. He has applied to your Bureau for a banding permit, following receipt of which he will immediately re-open banding activities at White Sands. This station offers interesting possibilities especially with ducks and wading birds as there is a large pond on the monument resulting from the flow of an artesian well. This water, in an otherwise arid region, attracts great numbers of birds.

WUPATKI NATIONAL MONUMENT

Located 49 miles northeast of Flagstaff, Arizona, in the Upper Sonoran Life Zone at an elevation of 5,000 feet.

Although a few birds were banded prior to the beginning of the 1939 fiscal year, operation of this station started by Ranger David Jones, who was stationed at Wupatki only a portion of the year, is now on a year-round basis and will be in a much better position to obtain useful data. Bird banding activities have stimulated observation and study at Wupatki with the result that a paper covering observations on the nesting activites of Rock Wrens has been completed. (See page 69, Supplement to July,1939, SWNM Report)

BIRD BANDING TOTALS FISCAL YEAR 1939 *New Species This Listing — Species Banded	A Casa Grande	B Tumacacori	C Walnut Canyon	D Pipe Spring	E Saguaro	F Tonto	G Bandelier	H Chaco Canyon	I White Sands	J Wupatki	Total 1939	Total S.W.N.M. 1936-1939 incl.	Total Banded in U.S., 1938
1.Blackbird, Red-wg.	0	0	0	0	0	0	0	0	0	0	0	34	[illegible]
2.Blackbird, Yel.Hd.	0	0	0	0	0	0	0	0	0	0	0	1	7
3.Bluebird, Ches-Bk.	0	0	38	0	0	0	0	0	0	0	38	569	[illegible]
4.Bluebird, Mountain	0	0	0	0	0	0	0	0	0	0	0	1	[illegible]
5.Bunting, Lazuli	0	0	0	0	0	0	0	0	0	0	0	1	[illegible]
6.Cardinal, Arizona	0	6	0	0	1	1	0	0	0	0	8	45	[illegible]170
7.Chat, Long-tailed	0	1	0	0	0	0	0	0	0	0	1	4	[illegible]
8.Chickadee, Mountn.	0	0	0	0	0	0	0	0	0	0	1	6	[illegible]
9.Cowbird	0	0	0	0	0	0	0	0	0	0	1	1	[illegible]032
10.Cowbird, Red-eyed	0	0	0	0	0	0	0	0	0	0	3	[illegible]	
11.Crossbill,Bendire	0	0	73	0	0	0	0	0	0	0	73	114	[illegible]
12.Creeper, Rky. Mt.	0	0	0	0	0	0	0	0	0	0	0	2	[illegible]
13.Dove, Inca	0	0	0	0	0	0	0	0	0	0	0	17	[illegible]
14.*Dove, Mex.Ground	0	1	0	0	0	0	0	0	0	0	1	0	[illegible]
15.Dove, West, Mourn	4	0	0	2	0	0	0	0	0	0	6	37	[illegible]
16.Dove, White-wingd.	0	0	0	0	0	0	0	0	0	0	0	3	[illegible]
17.*Finch,Cassin' pol.	0	0	2	0	0	0	0	0	0	0	2	0	[illegible]
18.Finch,House	235	1	0	0	0	0	0	0	0	0	236	350	[illegible]
19.Flicker, Gilded	0	0	0	0	1	0	0	0	0	0	1	0	[illegible]
20.Flicker, Red-shaft.	0	0	0	1	0	0	0	0	0	0	1	4	[illegible]
21.Flycatcher, Ariz.ac.	0	0	0	0	0	0	0	0	0	0	0	11	[illegible]
22.Flycatcher,Ash-thr.	0	0	0	0	0	0	0	0	0	0	0	1	[illegible]
23.Flycatcher, Vermil.	0	3	0	0	0	0	0	0	0	0	3	6	[illegible]
24.Goldfinch,Gr.-back.	0	0	0	0	0	0	0	0	0	0	0	4	[illegible]
25.Grosbeak,Ariz.blue	0	0	0	0	0	0	0	0	0	0	0	2	[illegible]
26.Grosbeak,Blk-head.	0	1	0	0	0	0	0	0	0	0	1	3	[illegible]
27.Grosbeak,Rky.Mt.Ev.	0	0	3	0	0	0	0	0	0	0	3	5	[illegible]
28.Hawk,Dos.Sparrow	0	3	0	0	0	0	0	0	0	0	3	5	[illegible]
29.Hawk,W.Red-tailed	0	0	0	0	0	0	0	0	0	0	0	1	[illegible]
30.Jay, Arizona	0	0	0	0	0	0	0	0	0	0	0	1	none
31.Jay, Long-crested	0	0	0	0	0	0	3	0	0	0	3	4	[illegible]
32.Jay,Woodhouse	0	0	0	0	0	0	1	0	0	0	1	9	[illegible]
33.Junco, Grey-headed	0	0	4	0	0	0	19	0	0	0	23	225	[illegible]
34.Junco, Montana	0	0	0	0	0	0	0	0	0	0	0	19	(Ore)
35.Junco, Oregon	0	0	3	10	0	0	0	0	0	0	13	31	14701
36.Junco,Pink-sided	0	0	1	0	0	0	0	0	0	0	1	33	none
37.Junco,Red-backed	0	0	1	0	0	0	0	0	0	0	1	83	[illegible]
38.Junco,Shufeldt	0	0	0	0	0	0	0	0	0	0	0	159	(Ore)
39.Junco,Slate-Colored	0	0	0	0	0	0	0	1	0	0	1	1	(R.E)
40.Kingbird,Arkansas	0	0	0	0	0	0	0	0	0	0	0	8	[illegible]
41.*Loon	0	0	0	0	0	0	0	1	0	0	1	73	1
42.Mockingbird,Wstn.	0	0	0	0	0	0	0	1	0	0	1	[illegible]	

BIRD BANDING TOTALS FISCAL YEAR 1939 * New Species This Listing	Casa Grande	Tumacacori	Walnut Canyon	Pipe Spring	Saguaro	Tonto	Bandelier	Chaco Canyon	White Sands	Wupatki	Total 1939	Total S.W.N.M. 1935-1938 incl.	Total Banded in U.S., 1939
Species Banded	A	B	C	D	E	F	G	H	I	J			
43.Nuthatch, Pigmy	0	0	65	0	0	0	0	0	0	0	65	156	36
44.Nuthatch, Rky.Mt.	0	0	5	0	0	0	0	0	0	0	5	16	# 496
45.Oriole,Bullock's	0	0	0	0	0	0	0	0	0	0	0	3	41
46.Oriole,Ariz.Hooded	0	0	0	0	0	0	0	0	0	0	0	4	6
47.Owl,Great Horned	3	0	0	1	0	0	0	3	0	0	7	7	4
48.Owl,Mex.Screech	0	0	0	0	0	0	0	0	0	0	0	1	# 12
49.Phainopepla	0	0	0	0	0	0	0	0	0	0	0	6	7
50.Phoebe, Say	11	1	0	1	0	0	0	0	0	2	15	64	35
51.Pyrrhuloxia	0	1	0	0	0	0	0	0	0	0	1	38	38
52.Quail, Gambel	13	11	29	63	0	1	0	0	0	0	117	249	31
53.Quail, Scaled	0	0	0	0	0	0	56	9	0	0	65	9	[illegible]
54.Roadrunner	0	1	0	0	0	1	0	0	0	0	2	9	12
55.Robin,Western	0	0	5	0	0	0	6	0	0	0	11	29	#802
56.Sapsucker,Red-napo	0	0	1	0	0	0	0	0	0	0	1	11	58
57.Sapsucker,Rky Mt.	0	0	0	0	0	0	0	0	0	0	0	2	none
58.Shrike, Northern	0	0	0	0	0	0	0	0	0	0	0	1	7
59.Shrike,White-rump	1	0	0	0	0	0	0	8	0	0	9	22	# 14
60.Siskin,Pine	0	0	1	0	0	0	0	0	1	0	1	44	449
61.Solitaire, Townsend	0	0	3	0	0	0	0	0	0	0	3	67	22
62.Sparrow,Ariz.Chip	0	0	0	0	0	0	0	0	0	0	0	1	none
63.*Sparrow,Baird	0	0	0	2	0	0	0	0	0	0	2	0	none
64.Sparrow,Brewer	0	0	0	0	0	0	0	0	0	0	0	1	3
65.Sparrow,Desert	0	0	0	0	1	2	0	6	0	6	15	2	none
66.Sparrow,Gambel	190	116	0	272	0	24	0	77	0	0	679	1588	Wh.Cr
67.Sparrow, Lincoln	0	0	0	0	0	1	0	0	0	0	1	15	2097
68.*Sparrow,Nor.Sage	1	0	0	0	0	0	0	0	0	4	5	0	none
69.Sparrow,West,Chip	0	0	0	0	0	0	0	0	0	0	0	9	2761
70.Sparrow,West.Lark	0	0	0	0	0	0	0	0	0	0	0	6	none
71.*Sparrow,Westn.Tree	0	0	0	0	1	0	0	0	0	0	1	0	#3418
72.Sparrow,Nov.Savan	0	0	0	0	0	0	0	0	0	0	0	1	# 907
73.Sparrow,Song	0	0	0	2	0	0	0	2	0	0	4	58	#7028
74.Sparrow,West Vespor	0	0	0	0	0	0	0	0	0	0	0	2	# 389
75.Sparrow,Wh-Crowned	1	41	0	0	0	0	0	0	0	0	42	10	#5869
76.Swallow,Rough-wingd	3	0	0	0	0	0	0	0	0	0	3	7	76
77.*Swift,Wh-Throated	0	0	0	0	0	0	0	1	0	0	1	0	none
78.Tanager,Western	0	0	1	0	0	0	0	0	0	0	1	1	95
79.Thrasher,Bendire	3	2	0	0	0	0	0	1	0	0	6	19	14
80.Thrasher,Crissal	8	2	0	0	0	0	0	0	0	0	10	20	5
81.Thrasher, Palmer	0	2	0	0	7	2	0	0	0	0	11	15	none
82.Thrasher, Sage	0	0	0	0	0	0	0	0	0	0	0	2	none
83.Titmouse,Gray	0	0	0	0	0	0	0	0	0	0	0	2	[illegible]
84.Towhee,Canyon	0	17	0	0	1	7	0	11	0	0	36	58	21

BIRD BANDING TOTALS FISCAL YEAR 1939 *New Species This Listing	A Casa Grande	B Tumacacori	C Walnut Canyon	D Pipe Spring	E Saguaro	F Tonto	G Bandelier	H Chaco Canyon	I White Sands	J Wupatki	Total 1939	Total S.W.N.M. 1936-1939 incl.	Total Banded in U.S., 1939
Species Banded													
85.Towhee,Green-tailed	2	8	0	4	0	2	0	5	0	0	21	35	27
86.Towhee,Spurred	0	0	0	1	0	0	0	0	0	0	1	6	#1800
87.Verdin,Arizona	3	0	0	0	0	0	0	0	0	0	3	9	14
88.Warbler,Lucy	0	0	0	0	0	0	0	0	0	0	0	1	1
89.Warbler,Pileolated	0	0	0	0	0	0	0	0	0	0	1	1	none
90.Waxwing,Cedar	0	0	0	0	0	0	0	0	0	0	0	1	1566
91.Woodpecker,Cactus	0	0	0	0	0	0	0	0	0	0	0	2	none
92.Woodpecker,Gila	2	1	0	0	6	2	0	0	0	0	11	16	13
93.Woodpecker,Lewis	0	0	0	0	0	0	0	0	0	0	0	7	none
94.Woodpecker,Nearns	0	0	4	0	0	0	0	0	0	0	4	13	none
95.Woodpecker,Wh-brst.	0	0	1	0	0	0	0	0	0	0	1	1	# 93
96.Woodpecker,R.Mt.Hy	0	0	0	0	0	0	0	0	0	0	0	1	# 98
97.Wren,Baird	0	1	0	0	0	0	0	0	0	0	1	3	157
98.Wren,Cactus	5	2	0	0	0	7	0	0	0	0	14	65	45
99.Wren,Canyon	0	0	0	2	0	0	0	0	0	0	2	22	9
100.Wren,House	0	0	0	0	0	0	0	0	0	0	0	1	#2792
101.Wren,Rock	2	1	0	0	0	1	0	0	0	5	9	4	5
TOTALS	487	223	245	361	18	51	85	127	0	17	1614	4569	
GRAND TOTAL NEW BIRDS BANDED 1936-1939 inclusive 6183													

*New Species This Listing #Groups, several species or races.

SUMMARY OF BIRD BANDING IN SOUTHWESTERN NATIONAL MONUMENTS

Year	New Birds Banded	Species Banded
1936	1,273	63
1937	1,547	63
1938	1,749	57
1939	1,614	62
Total to date	6,183	101

Respectfully submitted,

Frank Pinkley,
Superintendent

By Dale S. King
Dale S. King, Park Naturalist

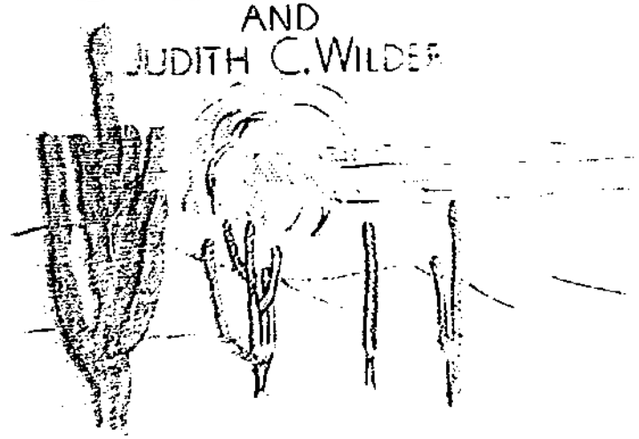
10-23a

SOUTHWESTERN MONUMENTS

SPECIAL REPORT
NUMBER "2"

RE-ESTABLISHMENT OF SAGUARO

By
CHARLETON S. WILDER
AND
JUDITH C. WILDER



DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

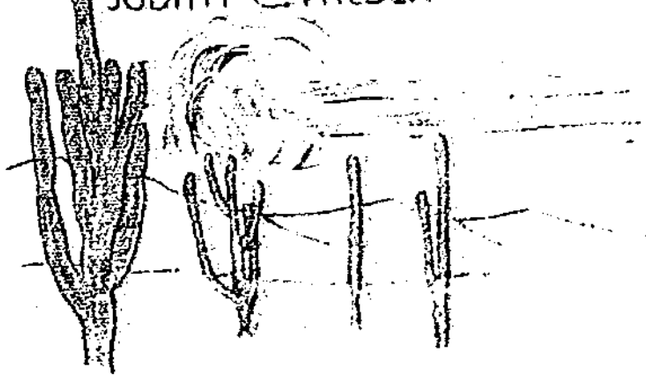
10-23a

SOUTHWESTERN MONUMENTS

SPECIAL REPORT
NUMBER 26

RE-ESTABLISHMENT OF SAGUAROS

By
CARLETON S. WILDER
AND
JUDITH C. WILDER



DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

RANDOM PAPERS

RE-ESTABLISHMENT OF SAGUAROS

By Carleton S. Wilder and Judith C. Wilder

Counts on sample plots were made in the Saguaro National Monument as a study of the relative abundance of young and mature saguaros (Carnegiea gigantea) from which conclusions might be drawn as to whether this cactus is re-establishing itself satisfactorily.

From casual observation it appeared that where the great, branched individuals grew the thickest the fewest number of small ones, under six feet, would be seen.

If this were true did it mean that the saguaros were not replacing themselves in the places which once evidently had offered optimum growing conditions? Or were they not anywhere replacing themselves at a rate which would produce a forest of similar proportion to the present one? Would the center of population of saguaros on the Monument two hundred years from now be in the same place as at present? Do the saguaros in the most densely populated section of the Monument represent a peak not to be reached again?

Some two hundred years ago[1] all weather and soil conditions were perfect at a spot twenty miles east of Tucson for the germination and growth of Carnegiea, resulting in a forest of phenomenal density and vigor. High soil temperature and adequate moisture are necessary for the germination of saguaro seeds.[2] There were, apparently, a few years of these optimum conditions and the forest was started. The plants are now mature; because of their limited life span, the forest cannot exist in its present size many more years.

. . . . . .

1 Life span of the saguaro is about 200 years. Forrest Shreve, The Longevity of Cacti, Cactus and Succulent Jour. VII: 5.

2 Shreve, The Cactus and Its Home, Williams & Wilkins Co., Baltimore, 1931. Spalding, Volney M., Distribution and Movements of Desert Plants, Carnegie Inst. Publication, 1909, p. 127.

Are other plants growing up to replace the doomed ones or will a different vegetation claim this area and saguaros grow elsewhere, if at all?

Method

Three areas representative of the types of places where saguaros grow on the monument were chosen. On each area, thirty 60-foot quadrats were paced off (in one case there were two sub-areas, each with 30 quadrats). The method of selecting these quadrats was as follows:

An arbitrary starting point decided upon, at least ten quadrats in an approximately straight line were paced off and the saguaros counted and classified. Choice of where to count saguaros was thus far kept unprejudiced. The quadrats were selective, however, in the choice of the general area for counting and in consciously tending, once the line was started, to make counts where small saguaros were seen. An area where no saguaros grow was passed over. No definite distance was kept between plots. Ten or 15 plots usually fell within a distance of a half mile or a mile. Since the ground would often be rough and broken, with thickets in the way, plot boundaries were not survey-accurate; plants, however, not legitimately within the quadrat would not be counted. The selecting and pacing off was done rapidly, one saguaro usually being taken as a corner post.

Three major height classes were established, two factors being considered: convenience of measuring and grouping of the plants according to height so that some conclusions concerning the relationship of young to mature saguaros could be reached.[3] The height classes are as follows: under two feet, from two to six feet, six feet and over (branched and unbranched). The first height class was established in order to have a record of very young saguaros -- those less than approximately 20 years of age. The second includes all those approximately 20 to 35 years of age. The third obviously includes all those over 35 years of age and was divided into two groups, unbranched and branched. By dividing the last class thus it was hoped that some degree of age differentiation in this large height class might be arrived at, the majority of branched saguaros being taller and representing longer growth than ones without branches.

The four areas will be designated as follows: Lower Desert Floor, Sub-areas I and II, Upper Desert Pocket, and Foothill. A brief description of the character of these areas with regard to topography, vegetation, and saguaro stand will be given. Elevation of all areas falls between 2,600 and 3,000 feet, so there is little significance in difference of elevation.

Lower Desert Floor, Sub-areas I and II

By the Lower Desert Floor is meant that part of the Monument where the land has smoothed out from the Tanque Verde foothills into almost level table-lands a little higher than the valley floor surrounding Tucson, where, also, saguaros grow. The surface soil is sand and gravel with a light covering of winter annuals and six-week grasses. The predominant plants are saguaros and palo-verdes.

. . . . . .

3 The only method known so far for determining the age of a saguaro is by its height. Forrest Shreve, The Rate of Establishment of the Giant Cactus. The Plant World, XIII: 10, p.257, 1910.

Creosote and mesquite fringe the area, but are almost lacking in the plots counted.

This is the section of the Monument where the saguaros, on casual observation seem to be the tallest and densest. Their relationship here to the palo-verde is interesting. Frequently saguaros were found growing in a circle around a palo verde. If the saguaros were small or medium-sized, the palo-verde tree would still be alive; sometimes a palo-verde dying because of the encircling saguaros would be seen; at other times, in the case of very large or close-growing saguaros, the circle would be plain but the palo-verde would have disappeared entirely or only a dead bush would remain. In other places on the Monument where very young saguaro plants are abundant they are characteristically found under the protection of the low, spreading limbs of a palo-verde.

Counts were made east, west, north and south from the Public Campground, about two miles from the north entrance gate. Straightline counts extended west to the Monument boundary and east to the section line fence. Two lines went north and south, approximately parallel to the road, which follows a slight rise of ground. Sub-area I includes east-west plots and Sub-area II, north-south plots.

Upper Desert Pocket

This area is a flat, desert floor surface immediately beneath the Tanque Verde foothills, slightly higher than the so-called "lower desert floor" but not in itself sloping. The "pocket" is formed by the abrupt Observatory Hill rising about a mile north and west of the curving base of the Tanque Verde mountains. Three lines of counts of ten plots each were made in this pocket -- south, southeast, and east, starting in each case at the foot of Observatory Hill and ending at the base of the foothills. Ribbons of small washes extend down from the foothills through the pocket. These are usually shallow and sandy with a thick growth of cat's-claw and mesquite. In the south line of counts there was a deeper gully with rocky sides where a few weather-scarred saguaros keep root and larger mesquite and cat's-claw trees grow. Between the washes are alluvial flats, sometimes well covered with small herbaceous growth, sometimes showing the effects of sheet erosion by a bare gravelly surface. As on the lower desert plots, palo-verde is the chief plant associating with the saguaros. Creosote bushes grow in the places where saguaros are least frequent. The circles of saguaros around a palo-verde were not noticeable here, tall, mature saguaros standing alone or in a clump of two or three. Small saguaros are abundant, invariably growing close under a palo-verde.

Foothill

The foothill counts were made on a representative area at the north end of the Skyline Loop Road where a series of steep hills leads up to the Tanque Verde mountains themselves. The counts were not made in a straight line but at random over the north, west, and south slopes of a rough, irregular hill which merged to the east with the higher slopes. Following a straight line here would have been impossible and meaningless. The foothills are of granitic origin covered by rocks of boulder

size with steep drops and abrupt outcroppings. Stunted palo-verdes, ocotillos and creosote bushes, Encelia and Franseria compose the vegetative cover. At the base of the foothill in question, a steep wash was cut down from the mountain. Counting was started at the base of the foothill, at the top of the bank of the gully. At this particular place, a spectacular bed of six small saguaros, one of them four inches tall, was found.

The largest number of saguaros under two feet in height was found on the foothill area and the largest number in proportion to saguaros over six feet high. Overhanging rocks afforded advantageous spots for germination and early growth. The same rocks evidently limited the number which grew into fine tall specimens of saguaros.

Results

Table 1 shows the numbers of saguaro plants in three representative areas and in three height classes (which imply age), and the percentage the number for each class is of the total for the area.

The sample plots showed that on the Lower Desert Floor saguaros are two and a half to four times as thick as in the Upper Desert Pocket. In the Foothill they are about the same as on Sub-area I of the Lower Desert and about one and a half times fewer than on Sub-area II. These numbers, derived from totals, are illustrative mainly of tall, half-grown or mature plants. If only young plants are considered the picture is just the opposite. In one case there were twice as many saguaros under two feet in height in the Upper Desert Pocket as on the Lower Desert, and in the other, 21 times as many. In the Foothill plots there were, moreover, twice as many under two feet high as in the Upper Desert. Actual numbers range from one on Sub-area II to 43 on the Foothill area. Numbers of saguaros from two to six feet are more uniform throughout the Monument, the sample plots indicated, numbers ranging from 10 to 12 on the Lower Desert areas to 24 and 28 on the Upper Desert and Foothill areas. In every case the percent of the total is largest for plants six feet and over. On the Lower Desert Floor they constitute 91.24 percent and 97.22 percent of the total number of saguaros on Sub-area I and II, respectively; 55 percent of total Upper Desert saguaros counted; and 69.53 percent of the Foothill saguaros (where it will be remembered the largest number of very small saguaros were found). In every case except in the Foothill there were more plants in the two to six feet group than in the less than two feet group. The percentage of branched saguaros in the six feet and over class was about twice that of the unbranched ones in every case except in the Foothill where it was just one percent more. In other words, there were approximately an equal number of half grown and mature saguaros on the Foothill area, while on the other areas mature trees predominated over half grown ones as well as over infant ones.

The results of the saguaro counts on the Lower Desert Floor areas substantiated observations made at large over that part of the Monument that small, obviously very young saguaros are almost entirely lacking. The figures show that the saguaro is not continuing to establish itself in this vicinity.

Table 1. Numbers of saguaros in three height classes in three representative areas, Saguaro National Monument.

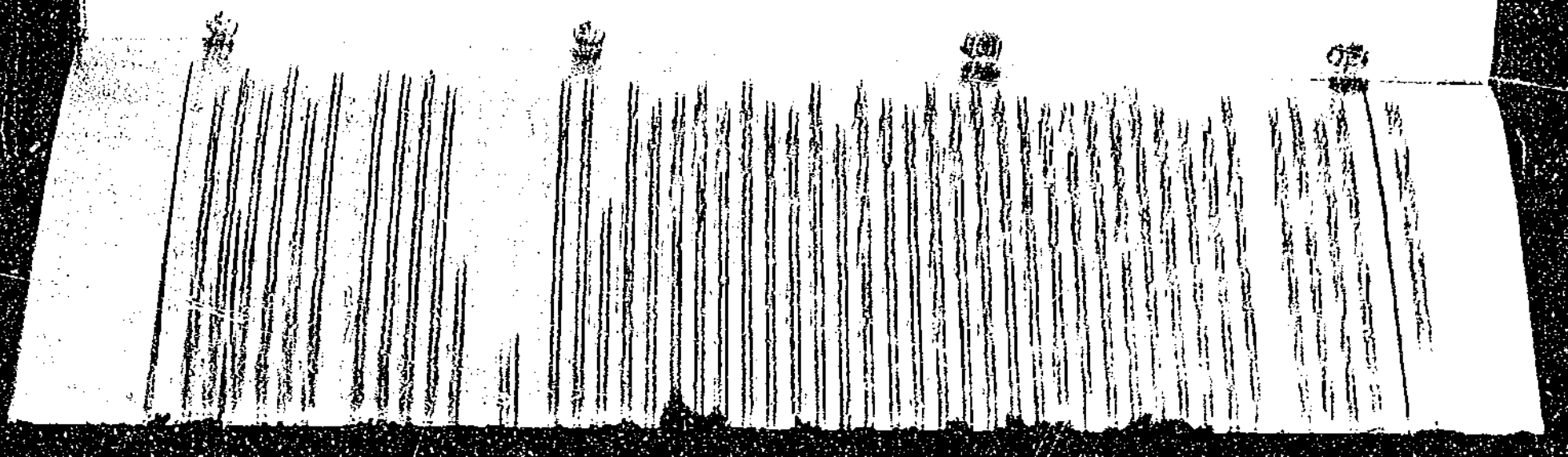
Heights	Areas: Lower Desert Floor, Sub-area I (east-west)		Lower Desert Floor, Sub-area II (north-south)		Upper Desert Pocket		Foothill	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Under 2 feet	10	3.98	1	0.25	21	21.00	43	16.45
2 to 6 feet	12	4.78	10	2.54	24	24.00	28	12.02
6 feet and over:								
Unbranched	82	(32.67)	130	(33.00)*	17	(17.00)	80	(34.33)
Branched	147	(58.57)	253	(64.21)	38	(38.00)	82	(35.20)
Total	229	91.24	383	97.21	55	55.00	162	69.53
TOTAL	251	100.00	394	100.00	100	100.00	233	100.00

*Adjusted .01.

Table 1. Numbers of saguaros in three height classes on three representative areas, Saguaro National Monument.

Heights	Areas							
	Lower Desert Floor				Upper Desert Pocket		Foothill	
	Sub-area I (east-west)		Sub-area II (north-south)					
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Under 2 feet	10	3.98	1	0.26	21	21.00	43	16.45
2 to 6 feet	12	4.78	10	2.64	24	24.00	30	12.02
6 feet and over								
Unbranched	82	(32.67)	130	(33.90)+	17	(17.00)	60	(54.93)
Branched	147	(58.67)	253	(64.21)	38	(38.00)	82	(36.20)
Total	229	91.24	383	97.21	66	66.00	162	69.63
TOTAL	251	100.00	394	100.00	100	100.00	233	100.00

+Adjusted .01.



Of the total of 645 saguaros counted on the Lower Desert, 11 were less than two feet in height, 22 were less than six feet but more than two feet, while 612 were over six feet high -- 212 unbranched and 400 branched, this latter figure indicating an overwhelming number of tall, mature, many-armed individuals.

Density figures are interesting as illustrative of the present distribution of saguaros on the Monument. The average density on the Lower Desert Floor -- the region which is responsible for the Monument's existence -- is 10.75 saguaros per quadrat. Actual numbers ranged from four saguaros in a quadrat in one instance to 28 individuals in two other quadrats. In both of the latter cases there were no saguaros less than six feet in height, and of the two totals of 28 tall ones, 22 were branched in one instance and 19 in the other.

Average density in the Upper Desert Pocket quadrats is only 3.33 saguaros per quadrat, and in the Foothill, 7.77.

A search for small saguaros was made exclusively of the quadrat counts. The results of this point to the same fact as that drawn from the quadrats: there are almost no knee-high saguaros (and no observed tiny ones three or four inches high) where Carnegiea grows the tallest and densest, while in some other places they are surprisingly numerous. All over the Upper Desert and Foothill region, four-, five-, and six-inch plants ceased to be a rarity after it was found that their invariable habitat was under palo-verde bushes. The smallest saguaro discovered was three-fourths of an inch high. It was growing next to one seven inches high. Fifteen years ago at the Desert Laboratory, Dr. Shreve planted saguaro seeds, the seedlings now ranging in height from about that of the three-fourth inch saguaro to the seven inch one, which demonstrates the erratic growth rate of young saguaros and precludes any very close estimates of age of those found in the field.[4]

Conclusions

Quadrat counts and general observation lead to the conclusion that saguaros are not replacing themselves in that part of the Saguaro National Monument, called in this paper the Lower Desert Floor, where at the present time the thickest stand and the largest trees are found. They are, apparently, reproducing satisfactorily in level-floored pockets just below the foothills and on the foothills (or mesas leading up to the Tanque Verde mountains). In fact, the number of young plants indicates the possibility of a denser stand of mature trees in the future than exists on these areas at the present time.

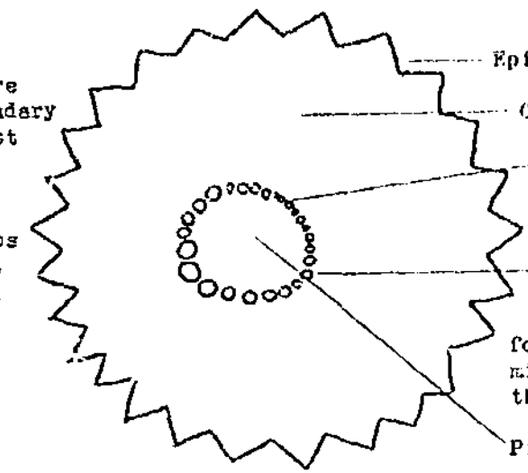
The center of population two hundred years from now cannot be in the same place as it is today because new plants are not coming up to take

. . . . . .

4 "A four inch plant may be anywhere from 8 to 25 years old. Likewise a tree 16 foot high may be only 60 years old or may be nearly 100. The rate of growth of the main trunk in middle-aged individuals is about 4 inches per year. The age of the tallest trees is probably between 150 and 200 years, depending on the rate of their start and the sort of situation in which they grow."

Shreve, The Longevity of Cacti.

Cross-section of Saguaro

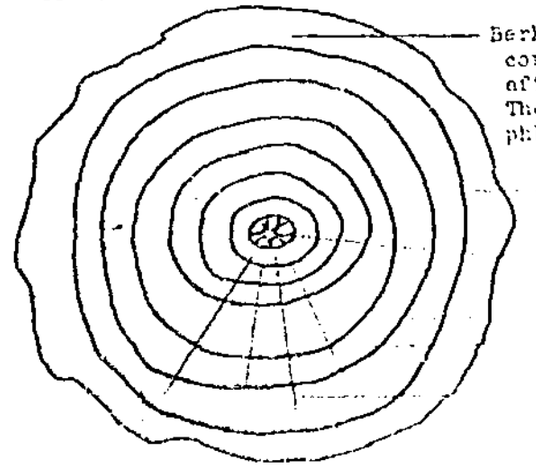


The woody ribs are composed of secondary xylem for the most part.

There were 26 flutes and 26 ribs on this specimen, arranged in the pattern shown.

1/5 natural size

Cross-section of Pine



Brief comparison: The stem of the saguaro from the pith to the [illegible] side of ribs roughly parallels structure of a woody tree [illegible] pine. The proportion of pith is much greater; the vascular rays are much larger that they form spaces between the wood; the vascular cambium, and xylem (fibrovascular bundles) follow around the pith [illegible] the "ribs"] as in an ordinary tree, though the line is broken by the vascular rays. There are no annual rings laid down by seasonal growth. The cortex serves the purpose mainly of water storage. The woody ribs [illegible] water an food materials as well as support the plant. Photosynthesis is carried on by chloroplasts found in the green epidermis. A waxy cuticle covers the epidermis, reducing transpiration of water.

—From interview with Dr. Brooks, head of Botany Department, University of Arizona.

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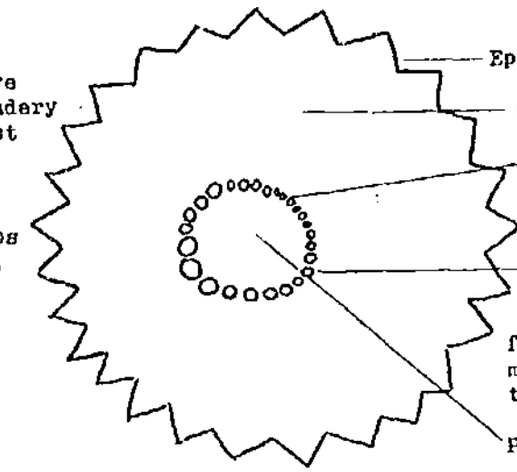

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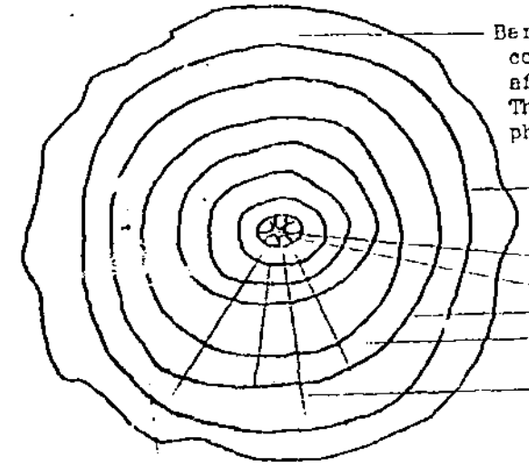

Brief comparison: The stem of the saguaro from the pith to the outside of ribs roughly parallels structure of a woody tree trunk such as pine. The proportion of pith is much greater; the vascular rays are so much larger that they form spaces between the wood. The circles of phloem, cambium, and xylem (fibrovascular bundles) follow around the pith (within the "ribs") as in an ordinary tree, though the line is broken by the wide vascular rays. There are no annual rings laid down by cambium growth. The cortex serves the purpose mainly of water storage. The woody ribs conduct water an food materials as well as support the plant. Photosynthesis is carried on by chloroplasts found in the green epidermis. A waxy cuticle covers the epidermis, reducing transpiration of water.

---From interview with Dr. Crooks, head of Botany department, University of Arizona.

the place of the old; it will probably be nearer the foothills, but whether it will be of as great proportions as the present famous stand will not be ventured in these conclusions.

Why are Carnegiea seeds germinating and small plants growing in the vicinity of the Upper Desert Pocket and on the foothills while such growth is absent in the old forest? The answer, which might be revealed by further study, may lie in subtle differences in moisture and temperature; in the effects of erosion and cattle grazing; in competition with the mature plants.

If competition is the factor limiting the reproduction of saguaros, the answer to the question at the beginning of this paper (do the saguaros in the most densely populated section of the Monument represent a peak not to be reached again?) may be that such a phenomenon might be repeated four or five hundred years from now, provided climatic conditions, soil, and other factas were the same as those existing when the present forest originated.

In 1910, Shreve said, "It is bootless at this time to attempt to explain the apparent decadence of the Giant Cactus." [5] Through his work on Tumamoc Hill and on a southern slope at the base of the Santa Catalina mountains, he had come to the conclusion that "it is not maintaining itself in either of two (favorable) situations."

We suggest in this paper that Carnegiea is maintaining itself, tending to do so not by continuous re-establishment in one place, but by irregular periods of establishment -- correlated with favorable growing conditions -- and in shifting spots of greatest density.

. . . . . .

[5] Shreve, The Rate of Establishment of the Giant Cactus.

SWNM

Archeologist Paul Beaubien at Walnut Canyon wonders whether he has not seen a fairly unusual occurrence. In July Paul had placed some cantelcupe rinds outside the cabin for birds and rodents. A gray ground squirrel was eating the rind when a chipmunk on the roof of the cabin began to scold. The ground squirrel took note of the chatter and was seemingly irritated by it. He finally ran up on the roof and chased the chipmunk, catching it and killing it. He then went off, carrying the body.

SWNM

At Casa Grande the difference in actions of various species of birds when imprisoned in bird traps are of considerable interest. Cactus wrens, for example, show considerable spunk resisting capture to the utmost and, when taken in the hand, clenching their toes about the wires of the prison so tenaciously that it requires some time and effort to break them loose. Upon being realeased, they usually fly to the ground a short distance away and, as they fluff their ruffled feathers into place, upbraid the bander with a series of harsh wren invectives.

16-23a

SOUTHWESTERN MONUMENTS
SPECIAL REPORT

NO. 27

1941 ANNUAL REPORT

NAVAJO INDIAN MOBILE UNIT

CHACO CANYON NATIONAL MONUMENT

BY

GORDON VIVIAN

JUNE 30, 1941

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

1941 ANNUAL REPORT
NAVAJO INDIAN MOBILE UNIT
CHACO CANYON NATIONAL MONUMENT

By Archeologist Foreman Gordon Vivian

This report covers ruins stabilization done by the Navajo Mobile Unit, a cooperative project between the National Park Service and the Navajo Service. Equipment, material, funds, and supervision are furnished by the National Park Service while the Indian Division of the Civilian Conservation Corps provides the labor, enrolled from among skilled Navajo living in the vicinity of Chaco Canyon National Monument.

Work this year was confined to Chaco Canyon National Monument with stabilization being carried on at three of its major ruins; Pueblo Bonito, Wijiji, and Pueblo Pintado. Bonito, the largest of these sites, and occupied between 919 and 1150 A.D., has been extensively excavated so that its nearly 400 ground floor rooms and kivas form the focal point of the Service's interpretive program in the monument. Stabilization of this ruin is based on a comprehensive plan to preserve permanently here what can be safely said to represent the acme of prehistoric masonry in the Southwest as well as a building of unique size and architecture.

The other two and smaller ruins, Pintado and Wijiji, are unexcavated, also excellent examples of the Chaco style of architecture but in an untouched state. Here are mounds out of which rise fragments of two and three story walls and numerous rooms partially filled with debris of walls already fallen. Preservation of these sites is done with a view to holding those ruined portions now above ground in an unchanged condition to preserve them both for future archeological study and as a valuable item in the present interpretive program. This year saw all work completed at Wijiji; in its present unexcavated state it is completely stabilized. Work at Pintado, a site of difficult access, is only partially complete.

Stabilization of the east half of Pueblo Bonito and drainage of the two plazas were completed last year. This year work was concentrated on stabilizing the west half of the site, an area of earlier walls, cruder masonry, smaller and less complex rooms - an area architecturally poorer though of equal importance in interpreting the building's life span of more than 200 years. The fall of Threatening Rock in January, destroying 23 ground floor rooms with 123 feet of exterior wall added to the work of the Unit. With money supplied by the Emergency Reconstruction fund, an additional 15 Navajos were added to the crew and the purchase of additional material was made possible. The rock fall, partially or completely filling the 23 rooms, was left as it fell but repairs were made to 87 nearby walls, some struck by flying fragments, some split or buckled by the concussion and others severely cracked by the weight and settling of the adjacent rock mass.

During the year regular enrollees laid a total of 156 square yards of stabilized capping on exposed and eroding wall tops, a capping in which the top courses of the original masonry are relaid in a soil-bitumen mortar. The masonry remains the same, only the soil-bitumen mortar replacing the weak mud used between the joints by the prehistoric builders.

The emergency crew relaid 105 square yards of soil-bitumen brick plating and laid a new 139 square yards of stabilized capping on the tops of cracked and settling walls. The total capping laid this year protects the tops of 1329 lineal feet of wall ranging in height from three to 25 feet.

In the following figures on the preservation of wall surfaces, both the work done to stay the deterioration caused by natural agencies and the more violent damage caused by the rock fall are included. Wall surfaces are affected by a number of natural agents, although most damage is caused by moisture softening the mud in which the stone is set. Various degrees of this damage are apparent: deeply washed mortar between still-standing masonry to large areas of fallen wall caused by failure of aboriginal mortar. In Pueblo Bonito a total of 5490 square feet of wall surface was saved by various techniques ranging from replacement of fallen masonry where necessary to the more important preventative measures of grouting between loosened masonry, the filling of small holes, and the replacement of large areas of exposed mud with soil-bitumen mortar. At the unexcavated sites, wall treatment was of less necessity, 275 square feet having been treated there.

Of equal importance with the capping of walls and repair of their surfaces is drainage of the site, since surface water damages by washing to lower areas causes settling of the loose soil, and in standing in low areas disintegrates the soft sandstone of the masonry itself. As noted above, the two large plaza areas, some 3900 square yards, and 1400 square yards of room area, had been reported drained by the Unit last year. This year an additional 644 square yards of room area was graded and drained, in part by the laying of soil-bitumen brick plating and 119 square yards of impervious seal coating. Eighty eight feet of tile line was laid to carry the accumulated water to the exterior of the site.

Regular support work at Benito consisted of repairs to foundations principally below the level of present fill, small buttressing extensions of weakened walls and concealed reinforced cores in bulged and sagging walls. Two hundred seventy-seven yards of such supporting masonry were laid to save approximately 517 yards of prehistoric work. The low percentage of masonry saved to that laid is due to the poor condition and low height of the earlier walls in the west side of the ruin. In repairs to walls damaged by the fall of Threatening Rock, such support work was a large item; 53 yards of concealed integral structural members were laid mainly in cores and buttressing extensions.

Support work was the major item at the two unexcavated sites where it was particularly necessary due to weakened foundations, rotted lintels, areas struck by falling material, and the general decay of 800 uncared-for

years. There were laid in the two sites 71 cubic yards of repair masonry, all in concealed members. This repair masonry saved in walls supported above it approximately 345 cubic yards of irreplaceable prehistoric work. Also laid in support were 23 replaced lintels and 11 concealed steel lintels reinforcing weakened original timbers.

In addition to the stabilization done by the Unit, the architect foreman attached has been employed in the preparation of Historic American Building Survey drawings of Pueblo Bonito and has prepared a ground plan of Wijiji ruin.

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Schrift for Nat Bridges

SOUTHWESTERN MONUMENTS SPECIAL REPORT

NO. 28

BIRDS OF MONTEZUMA CASTLE

BY

BETTY JACKSON

NOV., 1941

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

BIRDS OF MONTEZUMA CASTLE

By Betty Jackson
Montezuma Castle National Monument, Arizona

The last monthly report on Birds at Montezuma Castle (see pages 247-49, Supplement to April, 1940, Southwestern Monuments Monthly Report and previous reports) covered the period from March 25 to April 25, 1940, through April 30, 1941; virtually one year. As the Bird Calendar which follows covers the four years ending in December, 1940, you may want to check some of these birds with that, and I shall refer to it at times. (See Editor's note on page 11.)

The birds are arranged alphabetically, rather than in check-list order, as that is the way the layman can find them most easily. Only such activities as are noteworthy are mentioned, which means that the Baird's Wren, for example, is only spoken of three times, though it is with us the year around. Many other birds, such as the Chestnut-backed Bluebird, are not mentioned because the Calendar shows all there is of special interest about them in my records.

CARDINAL, ARIZONA: So far I have not succeeded in seeing a Cardinal's nest. During April, May, and June they made themselves inconspicuous, and though I saw one male with an immature on July 6, they kept out of sight afterwards until September. Only then did they bring out their youngsters for display. From then on through February and into March the whole family of two adults and three young became very friendly, coming every day to our window and enjoying whatever I put out for them, even some cooked beef in November. On February 10 the spring song started, and has been repeated daily ever since. By the end of March the immatures had either become mature, or been run off, because the male and female came daily without them. My griddle-cake recipe makes one more than we can eat, so I cook it a little longer and throw it out for these appreciative birds. Hot-cakes, biscuits, and brown bread seem to please the Cardinals most, though the sunflower seeds in chick feed are well received. On April 6, 1941, the female, eating griddle-cakes, chipped loudly, a different noise from her anger chip. Pretty soon the male came over and sat on the bush beside her. She reached her bill to his, put a piece of hot-cake in his mouth. Then they both cleaned their bills and went off.

CHAT, LONG-TAILED: Seen only in September this year.

DOVE, WESTERN MOURNING: By May 16 they were starting nests all over the monument. In July the young were seen, two at a times, with their silly abbreviated tails, playing together and attempting longer and longer clumsy

flights. Nesting and young continued through September, when they all began to look alike, and flock together around the Bee Plants (Cleome lutea) and "Dove-weed" (Croton texensis). They were absent from the monument for nearly two months in the winter, coming back on February 16. They were paired by the end of April.

COWBIRD: On June 23 I saw two pairs. On April 26 two, probably of the same species, flew over.

DOVE, WHITE-WINGED: Not seen this year. Perhaps if I could learn their call I should have some records.

FINCH, COMMON HOUSE: On the corner of our porch, where we had put up a board for them to nest on, a couple spent most of the month of April trying to build. They'd work in the early morning and around noon, both bringing material to the nest site. But she, though not so particular about her morals (See the April 1940 report) was very fussy about the construction of the nest, and would rearrange any bits of mustard he put in. And for some reason every day or two we would see the nest strewn on the porch below, and they would start all over again. The seventh attempt got well enough started by April 28 so that I thought it would succeed. I was right. But they had taken so long about building the nest that she lost one egg, and I found it broken on the floor below. My next records show no egg in the nest May 2, but four there by May 16. After these eggs were laid the female became a model mother, and had hatched three of her eggs by May 28. On June 3 I had an opportunity to notice feeding times, my attention being called by the youngsters' squalling. I looked at my wrist watch each time and noticed that she fed them at 8:27, 9:27, 10:27, and 12:27. How much more often she fed them I don't know. On June 4 the three babies that had hatched out first flew in the morning, but returned for the night for several nights. The other baby was underdeveloped, and took several days longer to get up his strength.

By the end of July these birds are less noticeable, as they sing much less. On September 17 there was a good rain, which started up the singing again until January 25, when they started their spring song. By the first week of February they were beginning to pair off.

Nesting started again early in March, and by the 26th a pair had built a new nest in "the Hussy's" spot, and had laid two eggs. On March 30 and 31 respectively one egg was laid in a nest in the weather station, and one egg was laid each of the following three days, making five eggs in five days.

On April 16 or 17 a man from the Weather Bureau came in and said this nest must be moved. If the birds perched on the thermometers it would throw off our temperature records. So the nest was removed and the eggs disposed in different nests. The two that were put in the Hussy's site caused some trouble. When the young one appeared, (there was only one),

the mother got uneasy, and by April 30 had built another nest right beside the first on that board. She then moved her youngster to the new nest, and left the eggs.

Before this happened, when she was sitting on her egg, she stayed on the nest almost all the time. Sometimes the male would feed her, and she would cheep like a young one between bites, and flutter her wings till he gave her more. Once in a while she would fly away with him for a few minutes afterwards.

On April 25 something tore out the entire nest over the museum door. All the eggs were smashed, including one from the weather station nest. Earl thinks it may have been the birds, as they have been fighting there frequently, sometimes a whole bunch of them. Perhaps the other nest, on a board a few feet away, was too close for comfort.

An interesting House Finch count in May revealed at least 26 individuals close about the houses, but only 13 were seen on the whole monument in the Christmas Census.

FLICKER, RED-SHAFTED: On June 8 my attention was attracted by much noise behind the house, and I saw a young Flicker, not so clearly marked as the adult, and without the sharp markings on the head, demanding food from Papa! And he was almost as big.

On June 9 I saw a nest with young in it. In July they all played hilarious and noisy games of tag about the sycamores, four or five at a time. I figured in October that there were 15-20 individuals on the monument. The Spring song started on March 20.

FLYCATCHER, VERMILION: On May 2 I saw what must have been an immature male. My description reads, "Looked moth-eaten", as the red coloration appeared in such a splotchy way. Two adult pairs were seen on May 17, and I have no other records for the year. As they probably nested up the creek, and not near the houses at all, it is likely that they were here after that for some time. As the calendar shows, May is their nesting time.

GOLDFINCH, GREEN-BACKED: I had quite a time identifying my first one this year. I heard his "pee-oo" with the half note drop long before I saw him, and when I did see him, all I could see were the white thumb-marks under his tail. Finally on October 15 I got a good look at him. There were several around then, and I saw them again on my Christmas Census, counting eight. I saw a few again on February 10.

GOLDFINCH, PALE: Sixty two or more were seen on the Christmas Census. Again in February I have a record, heard almost daily all month, but they sit in the tops of the sycamores or fly over so I haven't been able to determine whether they are really the Pale, or not."

GREBE, HORNED(?): On the Christmas Census, December 22, I saw one on the creek just north of the monument boundary. Looking at it through a 25 power telescope I could make out what seemed like winter plumage of a Horned Grebe. Grebe it was, of some species, anyhow. It dove and swam, and when swimming I could clearly see the feet behind. I saw it again on December 27 on the creek by the house, but it dove almost immediately.

HAWK, COOPER'S: On September 17 one perched on top of a sycamore where I could see and give visiting family a good look. It was probably a female. They had been heard several times previously that month. On October 4 one was soaring over the Castle on the updraft along with a Red-tail and two Turkey Vultures. One was seen several times that month and in November. On the Christmas Census one came swooping low over a covey of Quail and a flock of Gambel's Sparrows. The quail gave the warning and instantly every sparrow disappeared into the base of the bush they had been perched on. No harm was done. The quail didn't even finish trying to get out of the way. They would have been too slow anyway.

HAWK, DESERT SPARROW: On July 21 one was seen being chased by a Kingbird. On January 4, 1941, Norman got a male adult in a sparrow trap. Apparently he had eaten a small bird. He was banded and released. A beautiful creature!

HAWK, MARSH: September 16 brought the first record for the monument! One was flying low over "the island" across from our house. It was probably a female, as the wings were quite brown, almost rusty.

HAWK, WESTERN RED-TAILED: On May 17 Earl reported one across the creek below the Castle. It circled, screaming above him for several minutes as he walked across the flat on patrol. On October 11, I saw one sitting on a mesquite at the top of the cliff near the north boundary. Two flops of his wings, and then he straightened them out, not moving anything more but his tail for steering as he glided smoothly away on the updraft.

HERON, ANTHONY'S GREEN: Arrival date was April 28 for 1940, April 26 for 1941.

HERON, BLACK-CROWNED NIGHT: On April 28 one was sitting in the sycamore below our house. We could see him perfectly, red eye and all. He has previously been seen here only in June and July.

HERON, TREGANZA BLUE: On October 15 Earl reported hearing one make a "spanking" sound as he was starting up from the puddle in the slough. I saw one soaring on March 16, 1941. Didn't know they indulged in that sport.

HUMMINGBIRD, BLACK-CHINNED: On June 19 a female was seen sitting in a nest over the trail to the Castle. On June 21 one was collecting lint for a nest. The arrival date in 1941 was April 6, when a male came and tried to get water from the hose as I was sprinkling.

JAY, WOODHOUSE'S: On November 21 one came to take meat put outside our window. They became a familiar sight then, and have been ever since. One was banded by Norman in November. This one came nearly every day to the feeding station, and on January mornings he'd watch for me to take out the garbage, and then I had gone in again to the house, he'd come down to see if I had kept out any scraps for him. Four or five were on the monument then. In February and March he kept close watch too, and it was never more than ten minutes after I had put out food that he arrived. Sometimes he would get away with as much as a half slice of stale bread at one time, and he seemed especially fond of meat scraps from the table, and suet. Two were still around at the end of April.

JUNCO, OREGON: In 1939 I remarked that the Juncos were arriving very early, on October 23. That showed my ignorance, for they arrived on October 11 this year. Strangely enough one that was banded was the first I saw, probably one of the ones previously banded here when Norman later got in his traps. On the Christmas Census I counted at least 59. In January and February a flock of ten or so came to feed at the house, but they thinned out toward the end of February to one or two; and quit coming altogether in March. Two were still on the monument, however, on April 9.

JUNCO, PINK-SIDED: Arrival date was October 28. Eight or more were seen in the Christmas Census, December 22.

KILLDEER: Here's one of those funny things the calendar won't show. Killdeer were not seen from March 24 to July 3, 1940, nor between October 12, 1940 and January 12, 1941. On October 12 I heard them persistently, and couldn't see them until I finally spotted six of them soaring in circles high up in the sky. They were fully three times as high as the Castle cliff, which would make them at least 450 feet up. I never saw such a thing before, though I've heard they fly high on migration. In January they circled and called over the slough, occasionally dropping to the sand to sit and call some more. Toward the end of the month they spent more time in their usual way on the ground, and there seemed to be fewer of them. I never got a good count, but I imagine there were at least ten at one time early in the month.

KINGBIRD, ARKANSAS: If You've ever heard a Kingbird, you can't help laughing at this. On May 17 I was walking up the creek when I heard one shriek from the top of his tree, "I'm the best man here! I'm the best man here!" Suddenly from three other trees came the answer, "The Hell you are! The Hell you are!" They all flew up and met in the air a little way from the challenger's tree, and fought it out, violently and vociferously. By the time they had settled it to their satisfaction I was dizzy, and couldn't tell one from another, so I still don't know which is the best man there.

In May one chased a Sparrow Hawk, apparently for the exercise, as both birds spend most of their time in the same tree. Not until this

April did I discover that the Arkansas Kingbird is locally called a Bee-martin.

KINGFISHER, EASTERN BELTED: In October one female spent part of every day sitting on a low dead limb of a sycamore close to the parking area, where he could be shown off to the public with ease. But the public was awfully indifferent to a mere Kingfisher. On November 22 three or four were seen in the Census. Two had a fight near the Museum. As they came together one rattled and the other squealed his rattling call. Then the "Rattler" knocked the "Squealer" into the water, and they picked themselves up and parted.

KINGLET, WESTERN RUBY-CROWNED: They were not seen until October 6, on which date there were 11 or more about.

MERGANSER, AMERICAN: On May 6 Ed Alberts, relieving Earl during vacation, reported the following: As he took a party down to the Castle about 2:00 P.M., Mother Merganser appeared at the top of the first ladder with her brood. Being frightened, she flew off, leaving the ducklings yipping on the ledge. They began dropping off the ledge, a distance of about 15 feet. He and his party were worried for fear the young were injured, but they all got up and went on down the trail in a little army, heading toward the park bench and on to the creek. There were at least ten of the babies, maybe more. Whether this is the natural way Mergansers take their brood off the cliff is still undetermined, and from the books I have read, no one knows. If the party hadn't frightened the mother, she might have used some other method. In any case, they were uninjured from the fall.

On December 22, 10 were seen in the Christmas Census. These were the only ones of the duck family seen, and I got a wonderful view. I happened to come upon them in such a way that my head alone showed, and I crept nearer without alarming them until I could see clearly with the field glasses the red eye and bill and green head, as well as the black and white body. I had never realized before how beautiful they are.

On February 5 a female swimming around below the house attracted my attention because her crest was in such sleek condition. Getting ready for spring, evidently. March 22 found Earl observing one as it flew out of the cliff to join two others flying by, so I suppose the nest site has been settled on. I haven't discovered it yet.

There are two interesting things about the Mergansers that I have just become aware of. One is that; though they nest in the same cliff every year, they do not nest in the same hole. The other is that my books agree that ordinarily Mergansers nest only in the mountains this far south, nests having been reported from the mountains of north-eastern Arizona. We could hardly call this the mountains, yet at least one pair nest here every year, and I believe there are one or more other pairs

that nest within a five mile radius on the creek. Also they are said to prefer hollow trees, and to use cliffs only when they are not available. We have plenty of dead trees, many of them hollow.

MOCKINGBIRD, WESTERN: On June 6 I found a nest with three young almost spilling out, in the center of a very thorny False Palo Verde (Canotia holocantha). In early July one shuttled back and forth between the creek and the vicinity of this nest nearly every hour of every day. One was back for a day on March 9, 1941, which is the earliest arrival recorded. He didn't stay then, but several of them came back for good on April 26.

ORIOLE, ARIZONA HOODED: On April 25 one had started a nest in the vines not three feet from the office window. Earl could look out from his desk chair and see her bringing nesting material and weaving it in. One time she brought a rather long fibre, draped it over two corners of the nest support, and then wove the loose end in by tucking and pulling inside and out. The finishing touches on the nest were obscured by the growing leaves of the vine. The male was around most of the time, but didn't seem to do any of the nest building.

A sudden gust of wind on May 21 blew the vine down, and two eggs fell out and were smashed. Earl put the vine and nest back up, but said he couldn't get it to look the same. They abandoned it after that. Other pairs apparently had better luck, for on June 7 young ones were flying around the house, uttering hoarse cries.

Back April 5 this year. On April 30 I saw a second-year male, but it took me two days to figure him out, because up to that time I had assumed that they matured in a year, or at most two, and looked like the females till they did.

PHAINOPEPLA: A nest was found in a hackberry about 15 feet up on May 16. On the 17th there were at least 14 individuals on the monument. This number did not increase much, and there were less than the summer before.

PHOEBE, SAY'S: Quite rare. Seen once only in October, December, and February.

QUAIL, GAMBEL'S: On May 15 a nest was discovered containing nine eggs close to the park bench below the Castle. The morning of May 20 this nest had been destroyed, all the eggs were gone and not even a shell left. Earl says it was probably a King Snake. If that is the case, we don't resent it too much, as they do more good than harm, and our Quail population remains almost static here over the years, despite the predators, which include snakes, owls, and Cooper Hawk.

May 17, two nests were found, each with seven eggs. This makes 38

eggs seen (not counting losses), which would be a terrific addition to our 65-plus population if they lived, and those were surely not half of the nests on the monument.

On June 15 the first brood of young were seen. By July 9 some immatures already had top-knots, and were fair sized. The adults were together again in coveys. On July 22 two families were seen, one with nine tiny youngsters, one with eight or nine half-grown young. On July 27 I saw Ma and Pa and eight young ones, probably a different family yet.

On September 17 they had gathered in coveys, and three were seen on the monument. Late in October a covey coming to the house for grain could be identified by one female with a white spot on her chest. She is especially interesting, as I have seen her every year since 1937 when she flew against the store window in a squabble, broke the window, and cut her chest. The scar was longer at first, a sort of stripe, but now it is quite small. The lack of color in those feathers is a peculiar development from scar tissue. On December 22 I counted 69 or more. This is very probably the total monument winter population.

ROAD-RUNNER: July 4 Earl saw one running with a lizard or snake tail hanging out of its mouth. On July 9 he watched one fly across the creek, land on this side carrying a lizard half out of his mouth (this time he was sure), and then stalk off.

On March 26 I heard a sound like a Mourning Dove only louder and harsher. I cautiously peered out as it was repeated, with the rythm "hoo, hoo, huckuckuchuchuch". Then a Road-runner came from the direction of the sound. He went out of sight to the west of the house, and I heard the sound repeated from there. That is not proof he made it, but there was no other bird near afterwards when I stepped out to investigate, and Bailey mentions that they have such a note. It is the first noise I ever heard one make.

ROBIN, WESTERN: On November 26 I estimated at least 200, and more likely 400 on the monument at one time! They were here in such numbers only that one day. Ordinarily our winter population is between 25 and 50.

SAPSUCKER, RED-NAPED: One was seen in Camp Veide with my Girl Scouts on November 2. He was very close in a mulberry tree, and we were able to examine him and watch him use his square holes. He lapped or sucked sap in them for a bit, then lifted the bark between them to get his bill underneath. Dates on the monument were as shown in the colendar, except January, when he was not seen this year.

SHRIKE, WHITE-RUMPED: July 12 was the first seen on the monument since November 1936. Was seen again November, 22, and December 22.

SNIPE, WILSON'S: On patrol by the Slough Earl saw some ripples on

the puddle, and looked around till he saw this bird. It stood motionless for a while, then flew off saying "huweek". Earl got the glasses on him again when he lit on the other side of the pool, and watched him probing the mud "at least an inch and a half," sometimes outside, sometimes just inside the water. Between probes he made a springing or curtseying motion with his body. First record for the monument - date November 25, 1940.

SPARROW, BREWER'S: April 20 brought arrival of a flock of 20 or more. I took a specimen, and Milton Tetherell came in the next day, took it to the Museum of Northern Arizona, and identified it. Their nesting status is in doubt, and since I had seen one carrying sticks in 1939, I wanted to make sure my identification was correct, in case they nested this year. They did not, I think, as May 2 was the last I saw of them, although at that time I saw one carrying something that might have been a stick.

SPARROW, ENGLISH: On the afternoon of October 8 a small flock went through the monument. It was the first time I've seen them here. Fortunately they did not stay.

SPARROW, GAMBEL'S: May 17 was the departure date, the latest so far. Arrival was October 1. In November Norman banded six new ones and four returns, and in December, 11 new and one return. They came to my feeding station all winter and spring. In April one kept watch, and on April 12, after the snow, he apparently called the rest. Otherwise he comes alone, or with only one or two.

SPARROW, SP.: On the Christmas Census I saw 25 or more, but 'though they allowed me to come within 12 feet of them, I couldn't identify them. They were somewhere between a Tree Sparrow and a Chipping in looks, but moved along on the ground in short grass and rocks, and almost never flew up, except to a weed stalk to perch for a minute sidewise and look about. They were much smaller than a Gambel's Sparrow, had a squared-off tail, and twittered.

SPARROW, WESTERN TREE: Allen Phillips was very dubious of my July nesting record for this species last year, so I was rather pleased on November 22 to have Louise bring me one she got in a sparrow trap to identify. He had lost his tail feathers in handling, so I didn't make a specimen of him, but we went over him carefully, and both of us were quite sure he was a Tree Sparrow. Again in April three to five were seen in the mesquites, and I was able to get a good view of their chestnut crowns with no black.

SWALLOW, NORTHERN CLIFF: On May 21 Bill Bowen reported one got in a room on the Castle balcony. It couldn't seem to rise. It fluttered to the sill, over the sill and across the balcony to the edge of the cliff. Once at the edge, it took off easily, and flew away. I find nothing in my books about their lack of ability to take off from a plane surface. This may have been a youngster, or all of them may have this difficulty. They have not been seen around the Castle yet this year, though under the bridge on

they way to Camp Verde a great number are building nests.

SWALLOW, ROUGH-WINGED: On May 2 Earl observed them carrying twigs to a crevice over the Castle.

TANGER, COOPER'S: On September 16 Allen Phillips recorgnized the call, so I looked out and saw one male. The next week I heard them nearly every day, and saw a female, probably this species, since their call is heard more frequently than the western Tanger's.

TANGER, HEPATIC: Seen on July 4 and 5 by Earl and Norman. Two authorities who have been here disagree on those records, one stating we do not have Hepatic Tangers here, the other that we do not have Cooper's. We do have Cooper's, but I won't vouch for the Hepatic until I see it myself at close range.

TANGER, WESTERN: On September 17 a male was seen, and heard several times thereafter. A female of this species may have been seen, but it was more likely the Cooper's.

THRASHER, CRISSAL: On October 12 one played ventriloquist with me. I was searching the cliff high up for the bird which was warbling and trilling almost like a Mockingbird, but without the harsh interludes. Finally I found him under the bushes not thirty feet away, throat throbbing with song. His voice sounded far away even then. On October 28 I estimated at least seven on the monument.

Only two were seen in the Christmas Census, though more were around before and after. In January I saw one daily digging in the duff under the Mesquites with his bill.

THRUSH, HERMIT: One was observed on November 29, eating Hackberries.

TOWHEE, ABERT'S: Must have nested this year. Was seen on April 19 and June 17. In September I learned his loud "Chip" so that I can recognize his without seeing him. He may have been under my nose all along in previous years, but I didn't know his note. Certainly he has been a familiar visitor ever since then. On December 22 five were counted. During the winter they came frequently to the house to take grain I put out. I never saw them actually take it, but they chose that vicinity to scratch under the brush.

VERDIN, ARIZONA: October 23 was my first sight of one, though Norman says they have been here in previous years, and old nests bear him out. Seen in November and February, and on March 12, 20 were seen. On March 16 in Camp Verde with the High School Bird Club I saw one taking material from an old nest to build a new one, so they may be nesting here too, as they were seen then and through April.

WARBLER, AUDUBON'S: April 30 was the late arrival date this year. In October 15 it was seen again. February 4 was the early arrival in 1941, and it stayed through April.

WARBLER, LUCY'S: May 17 brought observation of a nest with four eggs, about three feet from the ground in a swinging mesquite branch. This is the "Bird, Genus (?), Species (?)" that nested in 1937 in a stump near the ranger's tent. I didn't succeed in identifying him for nearly a year. He arrived again April 2, and was courting, I think, toward the end of the month.

WARBLER, SONORA YELLOW: On May 17 I saw three pairs. One pair I watched making a nest, high on a sycamore limb where two small branches come out. The male flew everywhere with the female, and came to her in a cooing way, but she did the collecting and placing of whatever it was. It looked like cottonwood down, dampened and sticky. She would carry a bill-full to the nest, which was about a third built at that time, place it where she wanted it, and then scrape off her bill on one of the little branches there. The result was the nest grew faster by the branches then between.

WREN, BAIRD'S: All winter they came around the house to run up and down the trunks of the mesquites and watch the Cardinals and Gambel's Sparrows eat grain. The Spring song started February 2 or 3. On April 15 I saw one carrying nesting material to a hole in a sycamore about 15 feet up.

WREN, CANYON: This friendly little bird is always around, but on July 18 two of them got into the store. They were awfully busy, hopping in and out of pottery and baskets looking for bugs, coming out to sit on the edge and sing, darting into another corner and flying up to a rafter to sing again. When one succeeded in finding an insect in one of the pots he would come out and wipe his bill on the edge before going on to the next possibility. Norman says they stayed about an hour, and showed only slight inclination to go, but he helped them out at last.

On October 12 one obligingly showed off for little Martin. He dove into crevices of rocks on the revetment wall, then came out not 15 feet away, chirped, bobbed his tail and head, and went in again to repeat the process. On December 22 five were seen in the Christmas Census.

YELLOW-THROAT, WESTERN: April 25, 20 was the second record here. The other was May 3, 1937.

*EDITOR'S NOTE: This completes a series of reports on Birds at Montezuma Castle National Monument, by Betty Jackson, which appeared in the Superintendents to the Southwestern National Monuments Monthly Report during the years 1936, 1937, 1938, 1939, and through April, 1940. Indices of the annual volumes of the Monthly Reports for these years list the pages on which the Bird Reports appear. In the following Bird Calendar, Mrs. Jackson has condensed into chart form the records of her observations over the more than five years covered by her reports, thus providing an accurate and quite complete account of bird life in the immediate vicinity of Montezuma Castle.

Arizona [illegible] Library

MONTEZUMA CASTLE

BIRD CALENDAR

By Betty Jackson

This calendar has been made up from sight records at Montezuma Castle National Monument over a period of four years. It does not, of course, include all activities of the birds over this time. It does show trends.

Horizontal-lined blocks have been used for sight records of birds which are casual, or which have been seen at irregular times.

Vertical-lined blocks indicate when a bird may be reasonably expected in any year on the monument, as that is put through all records of residents, and from latest arrival to earliest departure on cases of regular visitants.

Solid shaded blocks indicate nesting, and where I have a v-shaped extension on one, it means that the records show that nesting activities must have occurred before or after the actual observation. For instance, the Anthony's Green Heron has never been observed to nest, but in one year young were seen. At that place I have the symbol ◀ meaning that nesting must have occurred previous to that time. Nesting I have considered as from the collecting of material for the nest until the young fly, even though, as in the case of the Say Phoebe and the House Finch, the young are dependent upon the adults for food for sometime afterwards.

Each month is divided into three sections, for greater accuracy. This has caused some grief, especially with 1937 records, as I had no card catalog, and simply wrote down at report time which birds had been seen during the month, unless they were acting in some especially interesting way. Cooper's Hawk was "seen during month" most of the time, so he appears in the second period - 11th to 20th in many places.

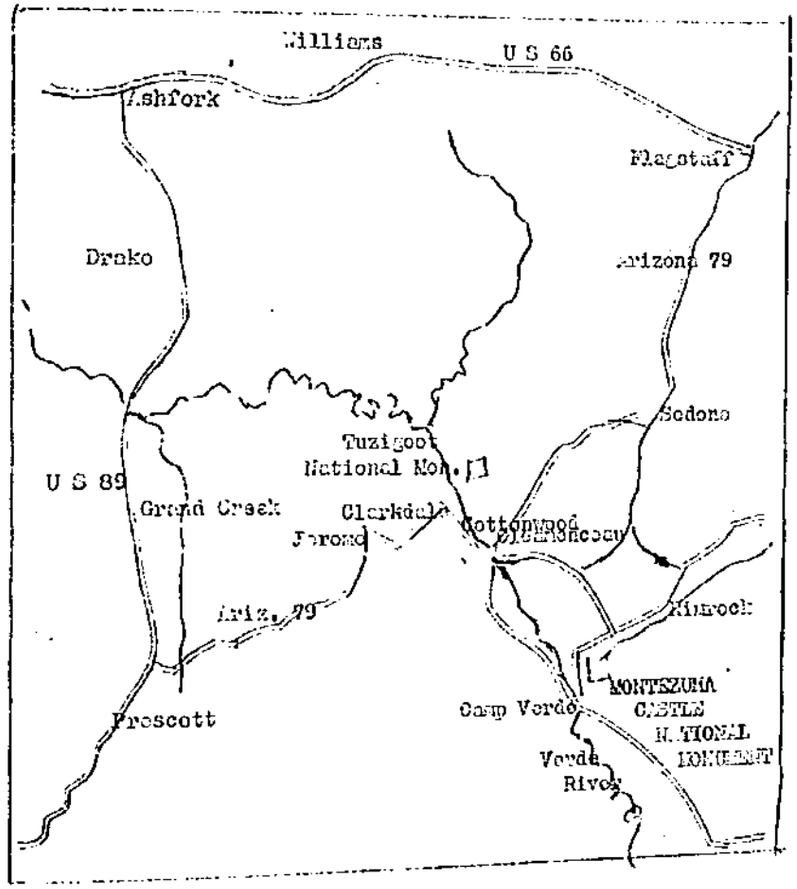
Several birds appear to be residents when they probably are not, but their departure is not at regular intervals. (The Killdeer was not observed in the spring of 1937 nor the fall of 1938, 1939, or 1940. They may have departed, or they may simply have been inconspicuous at the times I observed).

I have one bird to comment on, the Arizona Jay. He was first seen by the Jennings in December of 1937, and identified to Jane's satisfaction. I later saw a Jay which I called Arizona on the basis of Bailey's field mark "wings longer than tail", but I never got close enough to check the colors. I doubt the validity of the records. I had by that time seen the Woodhouse's Jay at close range, and one or two had been banded, and I thought it possible

that most or all of the Arizona Jay records were Woodhouse's Jays. It is still a possibility.

Mountain Song Sparrow is recorded only where it was identified in the hand. All other Song Sparrow records are sight records, and are included under Sparrow, Song.

Thanks and credit go to Earl Jackson and Ed Alberts for their assistance in compiling, and checking this material, and to John Baczuk for his draftsmanship on the calendar form.



VICINITY MAP
Showing Location of Montezuma Castle National Monument

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
20. Flycatcher, Vermilion												
21. Gnatcatcher, Western												
22. Goldfinch, Arkansas												
23. Goldfinch, Green-backed												
24. Goldfinch, Pale												
25. Goose, Common Canada (prob)												
26. Grebe, Horned (?)												
27. Grosbeak, Black-headed												
28. Grosbeak, Western Even												
29. Hawk, Cooper's												
30. Hawk, Desert Sparrow												
31. Hawk, Harris's												
32. Hawk, Marsh												
33. Hawk, Western Red-tailed												
34. Heron, Anthony's Green												
35. Heron, Black-crowned Night												
36. Heron, Treganza's												
37. Hummingbird, Arizona Blue-throated												

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
38. Hummingbird, Broad-billed												
39. Hummingbird, Costa's												
40. Hummingbird, Lucifer												
41. Hummingbird, Rufous												
42. Hummingbird, Violet-crowned												
43. Hummingbird, White-eared												
44. Hummingbird, White-throated												
45. Ibis, White-faced												
46. Jay, Arizona Long-crested												
47. Jay, Mexican												
48. Jay, Steller's												
49. Junco, Arizona												
50. Junco, Oregon												
51. Kingbird, Arkansas												
52. Kingbird, Cassin's												
53. Kingbird, Western												
54. Kingfisher, Belted												
55. Kinglet, Ruby-crowned												
56. Lark, Horned												
57. Longspur, Chestnut-collared												
58. Longspur, McCown's												
59. Longspur, Painted												
60. Magpie, Black-billed												
61. Mallard												
62. Martin, Purple												
63. Meadowlark, Western												
64. Merganser, Hooded												
65. Mockingbird												
66. Nighthawk, Lesser												
67. Nuthatch, Pygmy												
68. Nuthatch, Red-breasted												
69. Nuthatch, White-breasted												
70. Oriole, Arizona Hooded												
71. Oriole, Bullock's												
72. Oriole, Scott's												
73. Owl, Barn												
74. Owl, Burrowing												
75. Owl, Elf												
76. Owl, Flammulated												
77. Owl, Great Horned												
78. Owl, Pygmy												
79. Owl, Screech												
80. Owl, Spotted												
81. Owl, Western Horned												
82. Pelican, White												
83. Pewee, Western Wood												
84. Phainopepla												
85. Phoebe, Black												
86. Phoebe, Say's												
87. Pigeon, Band-tailed												
88. Pigeon, White-winged												
89. Pipit, Water												
90. Poorwill												
91. Quail, Gambel's												
92. Quail, Mearns												
93. Quail, Scaled												
94. Rail, Virginia												
95. Raven, White-necked												
96. Redpoll, Hoary												
97. Redstart, American												
98. Robin, Western												
99. Sandpiper, Spotted												
100. Sapsucker, Red-naped												
101. Sapsucker, Williamson's												
102. Sapsucker, Yellow-bellied												
103. Shoveller												
104. Shrike, Loggerhead												
105. Shrike, White-rumped												
106. Siskin, Pine												
107. Snipe, Wilson's												
108. Solitaire, Townsend's												
109. Sparrow, Arizona Rufous-crowned												
110. Sparrow, Black-chinned												
111. Sparrow, Black-throated												
112. Sparrow, Brewer's												
113. Sparrow, Chipping												
114. Sparrow, Desert Black-throated												
115. Sparrow, Desert Rufous-crowned												
116. Sparrow, Desert Song												
117. Sparrow, Fox												
118. Sparrow, Gambel's												
119. Sparrow, Golden-crowned												
120. Sparrow, Grasshopper												
121. Sparrow, Harris's												
122. Sparrow, Lark												
123. Sparrow, Lincoln's												
124. Sparrow, Rufous-crowned												
125. Sparrow, Sage												
126. Sparrow, Song												
127. Sparrow, Tree												
128. Sparrow, Vesper												
129. Sparrow, White-crowned												
130. Sparrow, White-throated												
131. Starling, European												
132. Swallow, Barn												
133. Swallow, Cliff												
134. Swallow, Rough-winged												
135. Swallow, Tree												
136. Swallow, Violet-green												
137. Swift, White-throated												
138. Tanager, Hepatic												
139. Tanager, Summer												
140. Tanager, Western												
141. Teal, Blue-winged												
142. Teal, Cinnamon												
143. Thrasher, Bendire's												
144. Thrasher, Brown												
145. Thrasher, Curve-billed												
146. Thrasher, Sage												
147. Thrush, Hermit												
148. Thrush, Russet-backed												
149. Thrush, Varied												
150. Titmouse, Plain												
151. Towhee, Abert's												
152. Towhee, Arizona Brown												
153. Towhee, Green-tailed												
154. Towhee, Spurred												
155. Towhee, White-throated												
156. Turkey, Wild												
157. Veery												
158. Vireo, Arizona Solitary												
159. Vireo, Bell's												
160. Vireo, Hutton's												
161. Vireo, Plumbeous Solitary												
162. Vireo, Warbling												
163. Vulture, Turkey												
164. Warbler, Audubon's												
165. Warbler, Black-and-white												
166. Warbler, Black-throated Gray												
167. Warbler, Grace's												
168. Warbler, Hermit												
169. Warbler, Lucy's												
170. Warbler, Macgillivray's												
171. Warbler, Nashville												
172. Warbler, Orange-crowned												
173. Warbler, Pileolated												
174. Warbler, Virginia's												
175. Warbler, Wilson's												
176. Waterthrush, Northern												
177. Waxwing, Cedar												
178. Wigeon, American												
179. Woodpecker, Arizona												
180. Woodpecker, Gila												
181. Woodpecker, Lewis'												
182. Woodpecker, Ladder-backed												
183. Woodpecker, Nuttall's												
184. Woodpecker, Red-headed												
185. Wood Pewee, Western												
186. Wren, Bewick's												
187. Wren, Cactus												
188. Wren, Canyon												
189. Wren, Rock												
190. Wren, Western House												
191. Wren, Western Winter												
192. Yellowlegs, Greater												
193. Yellowlegs, Lesser												
194. Yellowthroat, Western												

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1. Baldpate												
2. Bluebird, Chestnut-backed												
3. Buffle-head												
4. Bush-tit, Lead-colored												
5. Canvas-back												
6. Cardinal, Arizona												
7. Chat, Long-tailed												
8. Coot, American												
9. Cowbird, Bronzed (?)												
10. Creeper, Rocky Mountain (?)												
11. Cuckoo, Yellow-billed												
12. Dove, Western Mourning												
13. Dove, Western White-winged												
14. Duck, Ring-necked,												
15. Duck, Scaup (Var.)												
16. Eagle, Southern Bald												
17. Finch, Common House												
18. Flicker, Red-shafted												
19. Flycatcher, Ash-throated												

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
56. Oriole, Arizona Hooded												
57. Osprey												
58. Owl, Western Horned												
59. Owl, Screech (var)												
60. Pewee, Western Wood												
61. Phainopepla												
62. Pheasant, Ring-necked												
63. Phoebe, Black												
64. Phoebe, Say's												
65. Plover, Mountain (?)												
66. Quail, Gambel's												
67. Raven, American												
68. Road-runner												
69. Robin, Western												
70. Sapsucker, Red-naped												
71. Sapsucker, Williamson's												
72. Shrike, White-rumped												
73. Siskin, Northern Pine												

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
38. Hummingbird, Black-chinned												
39. Hummingbird, Rufous												
40. Ibis, Wood												
41. Jay, Arizona												
42. Jay, Woodhouse's												
43. Junco, Oregon												
44. Junco, Pink-sided												
45. Junco, Red-backed												
46. Junco, Slate-colored												
47. Killdeer												
48. Kingbird, Arkansas												
49. Kingbird, Cassin's												
50. Kingfisher, Belted												
51. Kinglet, Western Ruby-crowned												
52. Mallard, Common												
53. Merganser, American												
54. Mockingbird, Western												
55. Nighthawk, Texas												

*Includes more than one subspecies of Junco Oreganus which I have not attempted to separate.

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
92. Thrush, Hermit												
93. Titmouse, Bridled												
94. Towhee, Abert's												
95. Towhee, Canyon												
96. Towhee, Green-tailed												
97. Towhee, Spurred												
98. Verdin, Arizona												
99. Vireo, Western Warbling												
100. Vulture, Turkey												
101. Warbler, Audubon's												
102. Warbler, Black-throated Gray												
103. Warbler, Grace's												
104. Warbler, Lucy's												
105. Warbler, Pileolated												
106. Warbler, Sonora Yellow												
107. Waxwing, Cedar												
108. Woodpecker, Cactus												
109. Woodpecker, Gila												

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
74. Snipe, Wilson's												
75. Solitaire, Townsend's												
76. Sparrow, Brewer's												
77. Sparrow, Desert												
78. Sparrow, English												
79. Sparrow, Gambel's												
80. Sparrow, Mountain Song												
81. Sparrow, Song												
82. Sparrow, Western Lark												
83. Sparrow, Western Tree												
84. Swallow, Northern Cliff												
85. Swallow, Rough-winged												
86. Swallow, Violet-green												
87. Tanager, Cooper's												
88. Tanager, Hepatic												
89. Tanager, Western												
90. Teal, Green-winged												
91. Thrasher, Crissal												

Name of Bird	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
110. Wren, Baird's												
111. Wren, Canyon												
112. Wren, Common Rock												
113. Wren, Western House												
114. Yellow-throat, Western												

SOUTHWESTERN MONUMENTS

SPECIAL REPORT NO. 29

PRELIMINARY REPORT

ON

RUIN STABILIZATION

BY

A. E. BUCHENBERG

DEC., 1941

DEPARTMENT OF THE INTERIOR
NATIONAL PARK
SERVICE

PRELIMINARY REPORT ON RUIN STABILIZATION

SOUTHWESTERN NATIONAL MONUMENTS

By A. E. Buchenberg.

FOREWORD

The predominant interest and enjoyment of the average visitor to many Southwestern National Monuments is centered in and stimulated by the visual and mental impact of the remains of prehistoric architecture and workmanship: In other words the ruins.

Specialists in anthropology, archeology, ethno-botany; and associated sciences also find varied specific personal interests here, but in the summation of all visitors they constitute but a small minority. As the monuments have been set aside for the use and enjoyment of the public it would appear logical that the great preponderonce of attention to presentation should be focused on the average visitor made up of workmen, and business and professional men and their families, whose major interest in general lies in the beauty, age, and story of the ruins.

Custodians residences, administration and service buildings are being built; landscaping, road building, and various improvements for public use and convenience are being carried out; archeological data is being collected and recorded for interpretation of the ruins. To my mind none of the above is open to direct criticism, but I submit that the probable absence of public interest or enjoyment in formless mounds of debris does open the question of logical sequence of activity until such time as the ruins are protected against further disintegration, or adequate preservation work is carried on concurrently with the above.

It may be suggested that since these prehistoric structures have in some measure survived for six or seven centuries, the rate of depreciation must be low and that there is little cause for immediate concern. A careful study and analysis shows that disintegration is going on at a rapidly progressive and alarming rate due to time, and elements, irresponsible archeological excavators, vandalism, and other causes antedating present day protection. Certainly any further controllable depreciation is indefensible when the enjoyment of the public, now and in years to come, is considered. I am aware that there is a growing interest in ruin stabilization on the part of the Park Service, but the extent and rate of destruction make the present activity inadequate to meet the situation.

A deep interest in the preservation of prehistoric Southwestern ruins "as is" for the appreciation and enjoyment of the present generation and those to follow, and the realization of the need for immediate action in effective stabilization work to attain this end are the motivating reasons for the personal research and investigations outlined in the preliminary report which follows.

REPORT

In the general discussion below several basic principles as below are assumed:

1st. That a prehistoric structure shall when possible be preserved "as is", and that no changes in original structural details shall be made unless they are without question of doubt absolutely necessary for the preservation of what remains. Stabilization measures shall in every case involve only the minimum in changes or replacement of prehistoric material or workmanship as dictated by necessary structural requirements.

2nd. Where for unquestionable reasons of stability or preservation any changes are made in or of ancient materials or workmanship, they shall be easily be recognized as modern, but shall not clash in color, texture or contour with the original. Where this is not possible necessary structural supports shall be frankly and obviously modern.

3rd. No reconstruction work shall be done except under conditions of absolute necessity to meet structural requirements assuring stability or preservation of ancient workmanship.

4th. All work must be of such a nature as to allow future stabilization measures to become an extension of same. In other words it must be of a permanent nature with the exception of temporary emergency expedients.

Prehistoric ruins of the Southwest may be roughly classified on a basis of architectural details and stabilization needs as follows:

1st. Structures originally laid up of loose boulders or rock slabs without mortar or other form of reinforcing or support except "chinking". Stabilization "as is" must necessarily be limited to concealed concrete or cement based or cores, or the use of structural steel members such as stay rods, beams, or channels.

2nd. Solid mud and caliche structures present real problems in preservation, and it would now appear that the solution will be some form of impregnation as protection against the inroads of the elements, without materially changing color, contour, or texture.

3rd. Structures embodying a combination of loose rock, mud mortar or plaster, and original wood reinforcement present specific individual problems, some of which have as yet not been worked out.

4th. Rock structures laid up in mud mortar offer a comparatively simple stabilization problem. Mechanical supports such as reinforced concrete, stay rods, or other structural steel members are sometimes indicated. However in general the stabilization problem resolves into the replacement of the ancient mud mortar which has disintegrated or washed away.

As the predominating types of prehistoric structures at Wupatki National Monument are of stone laid in more or less regular courses in mud mortar, it was decided advisable to concentrate attention for the present to stabilization problems of this locality. Mechanical measures such as drainage, stay rods, beams, struts, and cores are occasionally dictated by well understood engineering principles. But unfortunately the major requirements call for the replacement of ancient mud mortar with a material whose specifications are in general as follows:

1st. A long time resistance to serious disintegration by the elements.
2nd. Satisfactory mechanical strength and stability under pressure stresses.
3rd. Close matching in color with the original mud mortar.
4th. Close matching in texture with the original mud mortar.
5th. Low cost of materials and transportation.
6th. Application technique allowing the use of unskilled labor under competent supervision.

Since the natural forces of rain, frost, wind, and variation of temperature are the major items now controlling deterioration, it was considered good procedure to subject all contemplated materials and techniques to the conditions which would obtain if they were actually used in ruin stabilization. It was therefore decided to set up an "outdoor laboratory" and record the effect of the elements on both materials and technique. Accurate and detailed data is to be accumulated for a sufficient length of time to afford conclusive comparative results. The limited rainfall in this locality has made the use of "acceleration tests" by means of carefully controlled water sprays advantageous to reduce the time required for definate comparative determination.

Standard samples, 6" x 10" x 3/4", have been prepared from various local soils and combinations of same, from plain soils mixed with water, through various percentages of cement, raw linseed oil, anti-hydro, bitumuls, and other admixtures. These samples have been exposed to the weather on a flat bench, one half of each protected by a cover to afford a comparative indication of possible changes inside walls away from the weather. The following tabulation up to date was made using loss of weight by erosion from water spray and light rains, under the same test conditions, as a determinant of stability.

TABULATION OF TEST DATA

Soil #	Sample #	Exposed Date		Color	Texture	Cracking	Erosion
9	15	10-26-41	Water only	Natural	O.K.	None	36%
9	16	" " "	9 water; 1 AH	"	"	Slight	45%
9	17	10-22-41	19 soil, 1 ETC	O.K.	"	None	None
9	18	" " "	9 soil, 1 ETC, 1 AH	"	"	Slight	"
9	20	10-26-41	1 RLO; 1 water	Dark	"	"	"
9	26	3-13-41	3 BIT, 1 water	O.K.	"	None	"
10	21	10-26-41	Water only	Natural	"	"	38%
10	22	" " "	9 water; 1 AH	"	"	Slight	19%
10	23	" " "	19 soil, 1 ETC	O.K.	"	"	None
12	1	10-14-41	Water only	Natural	"	Bad	54%
12	3	" " "	9 soil, 1 MC	Light	"	None	None
12	6	10-31-41	19 soil, 1 MC	"	"	Slight	"
12	8	10-21-41	8 soil, 2 RLO	Dark	"	None	"
12	12	10-22-41	9 water; 1 AH	Natural	"	Slight	33%
12	13	10-23-41	19 soil, 1 ETC	Light	"	None	None
12	14	10-22-41	19 soil, 1 ETC, 1 AH	"	"	"	"
12	19	10-26-41	1 water, 1 RLO	Dark	"	Slight	"
12	24	10-28-41	7 soil, 3 BIT	Black	Bad	None	"
12	25	10-23-41	3 eater, L BIT	O.K.	O.K.	"	"
13	2	10-21-41	Water only	Natural	"	Badly	60%
13	4	" " "	9 soil, 1 MC	Light	"	None	None
13	7	" " "	19 soil, 1 MC	"	"	"	"
13	9	" " "	8 soil, 2 RLO	Dark	"	Slight	"
14	5	" " "	Water only	Natural	"	None	37%
15	27	10-29-41	Water only	"	"	Bad	56%
18	41	11-3-41	4 soil; 1 ETC	Light	"	None	None
18	42	" " "	9 soil, 1 ETC	"	"	"	"
18	45	" " "	3 gasoline, 1 RLO	Dark	"	"	"
18	43	" " "	19 soil, 1 ETC	Light	"	"	"
18	46	" " "	3 BIT, 1 water	Dark	"	Slight	"
21	29	10-29-41	2 water, 1 RLO	O.K.	"	"	"
21	28	" " "	Water only	Natural	"	Bad	30%
31	30	" " "	3 BIT, 1 water	O.K.	"	Slight	None
22	31	10-31-41	Water only	Natural	"	Bad	45%
22	32	" " "	1 BIT; 1 water	Dark	"	None	None
22	33	" " "	1 RLO, 1 water	"	"	"	"
22	34	" " "	19 soil; 1 ETC	Light	"	"	"
22	35	" " "	9 water, 1 AH	Natural	"	"	50%
23	36	" " "	Water only	"	"	"	10%
23	37	" " "	1 water, 3 AH	"	"	"	23%
24	38	11- 3-41	Water only	"	"	Slight	30%
24	39	" " "	2 water; 1 AH	"	"	"	10%
26	40	" " "	3 water, 1 water glass	"	"	None	28%

NOTE: All mixtures are by volume
Mixtures of oil and water are in emulsion.

SEE KEY ON NEXT PAGE

KEY TO TABULATION

SOIL #9
Taken from partially disintegrated shale beds in Deadmans Wash, on the North side of the canyon.

SOIL #10
Taken from the East bank of Deadmans Wash.

SOIL #11
From same locality as soil #10, but about 50 feet S.W.

SOIL #12
Taken from about 200 yards N. of Clydes stone hogan.

SOIL #13
From a location about ½ miles S.W. of Wukoki.

SOIL #14
Prehistoric mortar taken from Wupatki ruin.

SOIL #15
Prehistoric mortar taken from Wukoki ruin.

SOIL #16
Taken from pit adjacent to Clydes stone hogan.

SOIL #17
From wash on lower slope of east side of Wukoki.

SOIL #18
Disintegrated sandstone from the foot of various ledges.

SOIL #20
Screened sand used in building operations at Wupatki during 1941.

SOIL #21
A mixture of 2 parts of soil #17 and 3 parts of soil #16.

SOIL #22
A mixture of 1 part of soil #16 and 1 part of soil #17.

SOIL #23
A mixture of 5 parts of soil #16 and 1 part of soil #20.

SOIL #24
A mixture of 5 parts of soil #16 and 2 parts of juniper ashes.

SOIL #25
A mixture of 5 parts of soil #16 and 2 parts of soil #20.

AH is symbol for Anti - Hydro.
ETC " " " El - Toro Cement.
RLO " " " Raw Linseed Oil.
BIT " " " Bitumuls.
MC " " " Monolith Cement

NOTE: As nearly as possible all mixtures were made to the consistency of stiff putty.

TEST #106

A replica of a ruin wall of the "core" type, 5' long, 22" wide, and 3' high, was built for the investigation of technique and materials in the "capping" of walls. In accordance to a suggestion made by Mr. F. Preece core material and debris was removed from the top of the wall to a depth of approximately 12", and what remained of the original mortar raked out from the inside from between the top two or three courses of stone. Cement morter was then forced between these courses from the inside by hand and trowel. What remained of the cavity was filled with soil cement made from 9 parts of soil #16 and 1 part Monolith cement. The top stones were then "bottom bedded" in the same material to duplicate the original position and appearance.

TEST #107

It was found that grouting in the cement morter from the inside, and then plastering was a somewhat difficult and slow job, and a second wall as above was built to try out a variation in materials and technique. The core material and debris was removed and the courses raked from the inside as above. The cavity was then poured full of soil cement as above but mixed to the consistency of thick molasses, so that all interstices were filled by the thin grout, and the surface of same formed a watershed. The top rocks were then bedded as in test #106.

TEST #108

A third test wall was built in which the capping technique was the same as test #107 except that a soil mortar made up of soil #16 mixed with an emulsion of 3 parts of water and 1 part of raw linseed oil was used.

Various other researches and tests are being conducted and will be covered by full reports as conclusive data becomes available.

It is my conviction, based on tests being made, that soil mortars with the proper selection of local soils for color and texture, and with approximately a 10% addition of cement, will meet over structural, archeological and esthetic requirement until the possible future development of a much superior material. The cost of materials, handling, transportation, and application is probably as low as can ever be reached with any substitute for the original mortar.

I am offering the above as a contribution from a citizen deeply interested in ruin preservation, for the comment, approval, or disapproval through the regular channels of the National Park Service, and in hopes that my efforts will in some measure facilitate transition from "reports" to "repairs".