Pictured rocks in every locality are usually attributed to whatever group of ancient peoples had formerly inhabited the place, and so in this vicinity it has been customary to connect them with the Canal Builders, regardless of the fact that in their every appearance they look more recent and from the farther fact that they are not found within the subsurface remains of the homes of the earlier peoples. In only two instances have we found a picture rock inside a ruin, and these were surface boulders which had been exposed from the time the walls had fallen. Within the homes of the Canal Builders are found rocks which would seem to have invited the pictographer’s art had there been a willing artist present. Concerning the sex of the artists, we assume that the rocks were inscribed by men, and would anticipate that the inscriptions would indicate men as inscribers, and we find the assumption justified.

We believe that pottery was decorated by women and we look for designs which would support the expectation, and again we make the anticipated discovery. How much our judgment has been warped by preconceived conclusions, we are unable to say, but naturally feel that it has not been influenced in any degree whatsoever. Whether the pictures were made by the Canal Builders or by a later Columbian people may perhaps be determined by an examination of the pictures themselves, and since we believe that the decorated pottery is some thousand years the older, it may be first considered. Reference will be made only to the decorated shards of the Lower Salt.

The noticeable figures have been preserved and counted with the following results. In eight cases, pictures of birds have been found on the pottery, but in delineation they are dissimilar from the pictures of the birds on the rocks. On the pottery, eight instances of animal figures have been seen, but in only one of these was it possible to determine what kind of an animal was intended, in that case it being a turtle. It may have been due to his sacred character that the frog, so commonly carved in shell by the Canal Builders, was never used as a decoration on pottery. In the rock pictures the kind of animal is usually evident, such as the horned sheep, the deer, and other animals.
which had a food value to the hunter. Neither the frog nor the turtle have been seen in rock pictures. We dismiss as unworthy of consideration all pictures of so-called dinosaurs.

On the potteries, six cases of representation of the human figure occurred, usually in profile, as a man walking with a cross-hatched bag over his back and holding a long stick with a hook at the top; or again wearing a horned mask and blowing through a long reed: all of these figures imbued with life, and representing a definite personage in the social system. On the rocks, men are also seen, usually in front view, with arms and legs strangely jointed and held in preposterous positions; the nearest to a representation of an historical event being a pair of men with a row of animals standing on a line held between them, a suggestion of a hunt.

This gives twenty-two instances of designs found on pottery which also occur on the rocks, but when so occurring all are in quite different form. In order to secure these twenty-two, we have been compelled to examine the figures on 12,000 shards, a fact which shows the extreme rarity of parallel designs.

No count has yet been made of the elements of art design in the Lower Salt pottery. When made it will be found that there are very few; indeed increasing experience with them seems to reduce the number. One impressionistic element frequently used as a space filler is called a group of flying birds, perhaps correctly so, although we must say that as delineations, they might as well be called a flock of steamboats.

That overworked symbol, the swastika cross, has been observed by the writer just three times during forty years in the instances where it had been made before the white man insisted on seeing it in a blanket or basket before he would purchase it. These three examples are in the Turney collection; forms hammered into boulders and all left hand crosses: the modern made are usually right hand. In no instance have we seen the true swastika placed on pottery.

Some people call any set of crossing lines a swastika, but the name should be applied only to a figure of two straight lines, crossing at the middle, and forming four arms bent to a right angle at the ends. In every swastika which we have seen that was made before the advent of the white man, if the beholder imagines himself placed at the center of the cross, the arms are bent to the left. Dr. Martin Gusinde, Professor of Anthropology in the Chilean Government, tells me that the swastika is found
in the rocks all the way up and down the Andes, and that in every case it is the left hand cross. In present day commercial Indian art the cross is bent either way.

In four instances on rocks, we have seen a simple cross with straight, unbent arms of equal length with an unbroken enclosing line surrounding it and indented at the four angles; a very simple figure which a child might develop: this is not a swastika. This figure occasionally occurs on the pottery shards strewn about the ruins, where the rock cutters must have observed it many times.

The simple coil has been seen nine times on stone, of which eight run from the center outward in a direction opposite to the hands of a watch; usually this coil figure terminates at the outer end in a wavy line with a snake head, sometimes diamond shaped like the rattlesnake. Emphatically we say that we have never seen the simple coil on pottery, although the commonest pottery design is the double opposed coil, either curvilinear or rectilinear, so common that it seems to have been on two-thirds of the decorated ollas. But in the pottery, neither of its two interlocking elements terminate in sinuosities nor with snake heads. This rectilinear involute has been found twice on stone, once at Arlington and once on the Agua Fria.

In the four cases above, a design on pottery has been found on stone, out of 815 rock pictures examined around Phoenix. Combining these results we have a total of 22 instances of similarity in 12,815 cases examined. The very rareness we believe proves that they were not made at the same time, nor by the same people. No counts have been made of the elements of design in the rock pictures, although some student artist will find them instructive.

Concerning interpretation of the rock pictures, or pictographs, or petroglyphs or hieroglyphics, whichever term the idea behind them justifies, the interpretations are as numerous as the interpreters; any Pima buck Indian can read them, but no two will give the same translation. In every locality they have been studied, that which one archaeologist calls a water sign, another calls a voyage record, while another calls it a life fertility emblem. We have seen the accepted trail sign hammered into cliffs too sheer and abrupt for an ivy to climb, and we have seen it on the open desert where the beholder could go any direction except straight down. We have seen the sign of the hidden spring of water on top of a mountain of volcanic rock, and we have seen it on the banks of a river.
From time to time we have believed all the varying interpretations which scientists have published, but now we call all the rock pictures in Central Arizona pure art; aimless art, with rarely a record of events. We have abandoned symbolism, fetishes and clan emblems; we have discarded human names, effigies and danger signs; we have repudiated food indicators, trail guides and the other explanations of the Sunday newspapers. We recognize pictures, sometimes of a bird with a serpent in its mouth, or of two snakes fighting, or of the sahuaro cactus, and we say that any primitive artist would be inclined to make a picture of the common things, of a bird, an animal, or of a man, whether hammering on rock or painting on pottery, even though separated by a thousand years of time.

Given a sufficient period of years, the rock pictures would gradually have passed from the stage of ideographs into that of permanent records, and in the transition would have become one of the three forms which evolved under similar circumstances in the Old World. They might have passed into the combined ideographic and arbitrary forms of the Chinese script, or into the syllabary system of the cuneiform writing, or into the gradual simplification of original pictures which resulted in an alphabet. The end of independent evolutionary development came to the Indian with the discovery of America: that it would have been an entirely different culture from that in Europe was shown by the civilization of the Mayas.

Several factors indicate the Canal Builders were a people different from their neighbors on all sides. They were builders of the clan-castle and in no case did they build homes resembling the pueblo of the east and north, none of their buildings are D-shaped nor did they have upper stories set back in terraces. While the pueblo buildings, both ancient and modern, are devoid of an encircling defense wall, the clan-castles generally were protected by a partial or complete encircling wall. Around the clan-castle were many small, one-room houses, in appearance resembling the homes of retainers governed by over-lords. The castle and the one-room homes in every instance in the Lower Salt were oriented, and every inside wall was also so set.

At every cluster of homes there was an elliptical structure built of loose earth which has been called a sun temple, but in no instance has a kiva, or any inside room suggesting a kiva, been found. Every detail of civic life suggests a centralized authority, and such an authority seems needed where canals of great size were required. The removal of 15,000,000 cubic yards
DR. O. A. TURNLEY
of earth and the clearing of a forest of hard wood trees necessitated an organized community with centralized authority. The defense of such a community from the raids of mountain nomads required a military system, and the decay of such a system may well have been one of the causes of their downfall: no fact is better proven in all pueblo history than the havoc wrought by the hostile raider.

In the details of life their individuality is also shown. They made the choicest stone axes in America, fashioned in a distinctive form, with a three-quarter groove and straight back, and with the same peculiarities they made the stone adz. They fashioned great numbers of minute carvings in stone and shell and bone figures of birds and animals, particularly those living about water. Their carvings representative of both the male and female sex worship are so truly representative and unmistakable as to prevent photographs from being introduced into this report; objects which range in size from the sub-normal to those four feet long and weighing several hundred pounds. The so-called phallic stones found in the ancient pueblos to the east and north, in Arizona, New Mexico and Colorado, can be classed as such only by a wrench of the imagination, since they are destitute of realism. The care used in the carving of hard stone cups bearing phallic figures suggests their use in the preparation of medicines, or in ceremonies and rites; the form of the stone ring indicates their use in petitions for the fertility of the fields.

Here are found the so-called stone slates, here and nowhere else. It may be accidental similarity, but the fact remains that the marking along its frame is the same as that on the dress of the Aztec god of rainfall. Here are found stone cups along with circular stone covers having a small hole in the center; probably lamps. Similar cups and covers of buff painted pottery occur. Such cups and covers, found in ruins at the pyramids in Egypt, have been proven by chemical test to have been used as lamps. In the Lower Salt ruins are found baked clay beads, and clay images of the human face, and occasionally a carving of the human head nearly life size; these heads are fashioned with the abnormal occipital flattening of the artists themselves.

Around the ruins are thousands of diorite knives, not found among other pueblo peoples. Here occurs a totally different pottery technique. In no case has the broken line encircling the rim, the life line, been found in Lower Salt pottery, but only in the intrusive Central Gila. The presence of this late intrusive
ware did not influence the local artists in their style, design or finish, neither did it suggest to them to bake their wares to the hardness of the foreign made.

In pointing out their distinctness, Dr. Kidder calls attention to the presence here of bowls with flat bottoms and flaring sides and states that this type is not found elsewhere in the Southwest; but to him the most conclusive evidence is the utter difference in decorative designs and the entire absence of the designs used in other localities; especially the absence of the kiva or anything which resembled a kiva, that most prominent feature of pueblo life. If we suggest a Mexican origin, we remember the minute carvings of the owl made in shell and stone, a thing not found among the pueblos, but which occurs in archaeological remains in Central Mexico.

In nearly a score of points their individuality is shown, and in only two features do they resemble their neighbors; they had Brachycephalic heads and they used a hard cradle board for their infants: some have even said these two resemblances are but one; the one producing the other. Work in the ruins left by the ancient people imbues within us a respect for their accomplishments; Gladwyn has well stated the emotion: (1)

"The mistake is often made of looking upon all American Indians as a race of savages, when, as a matter of fact, there is as much difference between the various Indian nations as there is between the nations of Europe. We are apt to forget how recent is the growth of Western civilization. At the time of Christ, Europe, north of Rome, was in a more primitive stage of development than the Southwest, and could not be compared favorably to the Pueblo civilization where people were living in three and four story communal houses. At the time our ancestors were making the shell mounds which litter the Danish and Scandinavian coasts, in much the same stage of culture as the Indians of California, whom we now regard as low in the scale of native Americans."

"The continents of North and South America were populated by a steady infiltration of people through Alaska, with occasional waves of migration due to unfavorable conditions in Northeastern Asia. This does not imply that any one nation was the source of supply; on the contrary, it is certain that differentiation had already occurred in the Old World. Evidence of this is found in the head form of the early settlers, all of whom

(1)—The Red-on-buff Culture of the Gila Basin; The Medallion; 1929.
were Dolichocephalic, or Long-headed. These people were killed off or thrust aside into peripheral or refuge areas by subsequent invasions of Brachycephalic or Broad-headed people. It is equally certain that these Broad-heads had little, if anything, in common when they entered America, a fact which is indicated by the fundamental differences in language stocks."

A larger population tilled the fields of this valley before the commencement of the Christian Era than farm its lands today. Through climatic change and channel erosion the Canal Builders were compelled to relinquish their dominion, but the greatest irrigation achievement of ancient man in America had been wrought in this, the land of Forgotten America. These were the Original Engineers, the true Pioneers; the feats performed with the Stone Axe and the Stone Hoe demanded as lofty purpose and high courage as those created with later day devices.

Canals and clan-castles were built, used, abandoned, forgotten, when London and Paris were yet clusters of wild huts. Theirs was a prowess which rose to zenith and sank to nadir: with a piece of stone held in the fingers they had created an empire. As they left they forsook homes which had been theirs for more years than white man has been in the New World; all abandoned to uncomprehending and unsympathetic archaeologists, vandals of tombs and pilferers of shrines. Their middens have been leveled, their shards have been read, their era told. Treasure their artifacts, you who live in Phoenix, the city from them so well named. Are they yours alone: are they not rather the heritage of one race to another?

And now let us attempt in a rational way to reconstruct the story of house building here in the Salado, but in so doing we must unload the romantic conclusions of the earlier observers, even though they had opportunities which we never had and which no one can again possess.

Earlier houses probably were built than any which have been excavated, but the earliest type known was a semi-pit form in which an excavation three feet deep was made, the walls and floor thickly plastered with mud, and posts set along the sides, leaning slightly toward the center, while in the middle of the room one or more posts were set up to support the roof. The earth excavated in making the pit was not used in carrying up outside walls but was partly used in plastering the pit walls and roof: the inference is supported by the finding of thick chunks of adobe in which are the impressions of twigs and grass.
No trace has been found of any defensive or protective wall surrounding this house. From pottery within these rooms, we know these were the homes of the earliest pottery makers whose output we have found.

Gradually disappeared the custom of placing the house floor three feet below the surface, and the level ground became the floor: posts were no longer set at an incline toward a common center and lightly plastered, but were placed in regular lines, with adobe piled up on both sides, forming a substantial wall. As these houses decayed from the action of rain against the walls, and from flood waters, and from the filling-up of rooms, a mound gradually arose. When this mound became about eight feet high, there came in a new custom of building the main outside walls, by making them three to five feet thick, built with a double row of posts, in which were no outside openings, which converted them into places of defense from enemies.

This procedure continued until the mound had taken on six feet or more of added height, then came a period of deterioration, when walls again took on the lighter form. This was the history at La Ciudad, and perhaps it was the history generally in the Salado. The use of stone at Pueblo Grande may have altered the progress of its evolution from that followed in the adobe structure. We cannot say what were the causes for the later deterioration; if we call it cultural decay, that is a result, not a cause. It may have been due to a combination of causes which presaged the abandonment of the valley.

All walls were invariably oriented: we believe that the apparent rotation of the stars had nothing to do with placing the walls in this position, but that they were set normal to the rising and setting sun for the reason that when in that position the room would receive the greater amount of sun light through its openings during the course of the day, and remembering that the custom established when they were building pit houses would remain when building great communal apartment houses. The length of rooms varied with the needs of the occupants, and in some cases was as much as forty feet, but the width was limited by the length of the tree branches used for roofing; the cottonwood affording the longest spans. On account of flood waters reaching the house walls, a protective wall was built part way or entirely around the whole compact group of houses, with a wide patio between it and the building on all sides, which became a factor in the next step in house building.
When a room has neither doors nor windows, there is a tendency toward accumulation of material on the floor; as the floor is of earth, it becomes easier to bring in more earth and cover up the debris than to clean out, thus the floor is constantly rising. Then with the added practice of floor burials, in time the head room was cramped. There was no material loss in abandoning such a room, the only article of value was the roofing logs; so these were removed and the remaining space below was filled up to the top of the walls standing, and then a new room was built on the filled-in remains of the old one. Part of the new walls might rest on top of the old walls, and part might stand across an old floor, the only rule was orientation. The first homes were those at the center of the group, and so they were the first to become filled up, thus the second story rooms first appeared at the center. In some cases two stories may have been occupied at the same time where the walls were thick enough, as in the case a part of the walls at La Ciudad and Pueblo Grande. If this greater thickness were to support a second or third story, where all were occupied at the same time, then the same thickened walls would be required in the center of the building, which is not the case. Hence we infer that the seven-foot outside walls were due to military necessity, to prevent the enemy from penetrating the wall.

Around this group of rooms, wind-borne sand and dust accumulated next to the walls and the later rooms tended to have floors following the line of slope, unless they were trued up to a level grade. This was seldom the case, and the outer rooms on all sides of the group had floors half a yard lower on the outer side, and in this manner the occupants lived, when with a few hours’ work the floor might have been leveled. The presence of the surrounding patio and protective wall necessitated the building of rooms on top of filled-in rooms, and the process continued for several stories. In Pueblo Grande the use of stone in the military wall held the later construction within its limits. Of the large buildings in the valley, nine were set with their long walls north and south and three lay east and west: in the same relative ratio the large buildings at Casa Grande also run north and south. Probably there was a reason.

These communal homes we have called clan-castles; if we estimate 25 square feet of floor space for each occupant, which seems a minimum even for a savage, then clan-castles of the valley could have housed but a small fraction of the population, perhaps not over ten per cent of the number which the lands would have supported at the rate of two acres of productive
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ground for each person. We cannot believe that canals would have been constructed to irrigate more land than was required for the population. We are then compelled to find the homes occupied by the other ninety per cent. Strange to say no trace whatever has been found of them. Perhaps they were of the pit-house type, perhaps an intermediate form, and perhaps only of brush, similar to those built by modern Indians in this warm climate. If so, then they were not permanent and no high trash piles accumulated, or perhaps but a few feet of thickness and these were ploughed down by the first settlers. At the clan-castles all trash mounds were restricted to as limited a spot of ground as possible, and thus they were piled up so that after a lapse of centuries they stand in some cases twelve feet deep.

Having formed the habit in the pit-houses of setting up central posts to support the roof, the plan was continued in the clan-castle rooms whose beams were supported by one or more posts. From limited observation it seems that the central rooms of the clan-castle were used more largely for grain storage, with the outer rooms on all sides taken for living rooms. The thick deposits of ashes are in outer rooms; the floors were more uneven, and were placed sometimes a few inches apart and sometimes several feet; these successive floors might extend over the entire room or over only a portion.

In the central rooms the floors were practically level and not encumbered with litter; the walls were more carefully made and new floors were put in only when there was a floor burial. The few doors in the castle are all of them between these inside rooms, and most of them had been walled up, while rough partitions had been built across some of the long rooms. Stores of grain are not looked for in these inner rooms, for if it had been possible to have kept them filled, then why would they not have remained in their homes beside the canals? This valley could readily have supported a population of 50,000 people, yet not enough food for a single meal has been found in all their combined homes.

The absence of food cannot be accounted for as due to decay entirely, for we have the dried remnants of very many perishable articles, such as cactus fruit, (a little lint cotton, some squash seed) and a few fragments of cloth. The testimony of the homes is that of starvation, and that could have been produced by only one cause, dry canals, due to climatic change or channel erosion or both. Not a vestige of evidence has been found by any workers to indicate that a military campaign or
even a single battle occurred in the Salt River Valley, yet the newer archaeologists constantly declare it without a hatfull of military proof.

Inability to interpret the evidence can not be attributed to the searchers. As proof we cite the work of Mrs. Helen R. Healy, owner of a large ruin at Globe, who found in one stone-walled room the skeleton of a woman lying full length across a metate in the middle of the room. In a nearby room she found a few beads on the floor and digging carefully across the room she found a trail of beads leading to an olla in which were found 12,000 perfect, unburned, white shell beads. Her conclusion, after having excavated thirty rooms in this building of more than a hundred, was that a battle had occurred and the building had thereafter never been occupied.

This ruin is now the property of Harold S. Gladwyn who calls it Gila Pueblo; he is excavating it with scientific care; the first ruin to be carefully studied in the eastern part of the state. Without fear of controversy we definitely state that the Valley of the Salt was the most densely populated area in America north of Mexico and its census the largest; its environs extended on the south to the Gila where were settlements every shard of which is red-on-buff; there we find the largest modern Indian villages standing on sites of the larger of the prehistoric such as Casa Blanca (Vaaki) and Snaketown.

Outside of irrigated lands, there was an absence of earth suitable for walls, but plenty of stone; of necessity architecture changed. The clan-castles remained as one story buildings, trash mounds again became prominent, defense walls followed a prolongation of the two outside walls of the group and developed into a court: the whole a parallelogram in the farther end of which a few rooms were added, and there the general gateway was flanked by walls and rooms. This was the simplest form of adapting the defended home to a different environment.

Some archaeologists have attempted to group the southwestern peoples wholly according to house construction, but the majority have emphasized the closer life details, such as pottery types, which more quickly reflect changes in human conditions. By pottery changes we know that Pueblo Grande is older than La Ciudad but we would have drawn the reverse inference if we were depending upon comparative excellence of architecture.

To the north and east of the homes of the Canal Builders, the Cambrian and pre-Cambrian rocks at many points rise up, vertical extrusives unweathered and abrupt except for a sloping
approach of talus; ideal escarpments for the defense of homes, nothing needed but a stone wall across the approach. On these headlands they built villages of stone with a patio between the houses and the wall so that defenders could move to any point attacked. When the summit was large, the enclosed patio surrounded the entire group of houses; where stone was plentiful a wall was built along the precipice. The rooms seem to have been built outward from the central original rooms and so resemble concentric circles of additions.

Close to the valley of the Canal Builders, the pottery is red-on-buff with varying amounts of outside wares depending upon the distance from the focal center of red-on-buff ware, until in the farther distance this disappears entirely to be replaced by others. This statement will seem to shatter any theory that the red-on-buff people were a distinct cultural group, but pottery is not the only index of a people; there was the clan-castle and numerous other points. Even if they had originated in the south and had become migrants at an early date, their distinctive traits would blend along the line of contact with neighbors, so that we may not be able to draw any precise boundary line which governed during all the hundreds of years of their residence. These mountain homes may be excavated in the future and search made for technical details: for the present we shall refer to these mountain group homes as walled villages.

For an anthropologist to express an opinion as to the place of origin of the pueblo culture is to invite some fellow craftsman to hurl a stone axe in his face; the camp of the archaeologist is a place of din; even such a minor detail as the time when pottery making was invented receives dogmatic assertion and positive denial in terms of a thousand years. The Lower Salt culture belongs to the general prehistoric history of the Southwest, but it is distinct from the northeastern pueblos in life and customs; it stands by itself alone; its contact with them was only an external contact. With them it had a common need for pottery and for the cultivation of corn and beans; both universal needs. Like all other peoples in the past, they too were influenced by their neighbors, especially in customs of burial. But they differed from them in a score of points. During the life of the Canal Builders they passed from crude ditch diggers to irrigation engineers; in architecture their progress was equally marked. Similar changes in pottery technique are to be expected, yet strange to say, such changes have been reported by only one observer, Harold S. Gladwyn. (1) Probably not all

(1)—Red-on-Buff Culture of the Gila River: cit. opp.
the facts have been discovered as yet, but he finds that the early pottery shows flaring rims, like inverted bells, and decorations with small, sketchy figures, many times repeated in red paint on a surface given an artificial buff finish. Small ollas were finished with a dull black interior and left unburnished.

During the middle period there was an increase in the redwares which were decorated on the outside with firing clouds and the interior with black, carbonized surfaces highly polished. Ollas are found with vertical necks and decoration tends more to the geometric. In the late period large ollas were decorated on the outside in combined geometric and curvilinear patterns in which standard designs, such as the "lazy S," is used in many harmonious forms. Negative figures appear and the bowl with firing clouds outside and black polished interiors became increasingly popular.

Gladwyn gives us a valuable basis; the foregoing is our own modified statement of his definitions. We disagree in his conclusion that the heavy, coarse, undecorated pottery found in the mountains north of the Salt River Valley belongs to a decadent period of the Canal Builders. Rather would we agree with Frederick W. Hodge, as reported by him in the American Anthropologist, in 1893, that irrigation was first learned on the small creeks and later practiced on the large rivers. Logically we should expect that these fortified villages on mountain ridges and peaks, with the coarse, undecorated potteries, belong to the youth, rather than to the old age of the race.

Surface finds afford treacherous inferences; no subsurface work has yet been done in these fortified villages. Emphatically do we object to any classification of undecorated shards as belonging to any particular type, either the red-on-buff or the polychrome. Undecorated pottery was made by all peoples. Counts of surface-found shards may be very misleading. If two ollas of similar size be broken into fragments, the one a decorated red-on-buff and the other a polychrome, every little fragment of the polychrome is readily distinguished, classified and counted, but of the red-on-buff fragments fewer than half will reveal their origin, and usually not over one quarter can be known to have come from a red-on-buff. But on just such counts an elaborate story has been built by several workers who assume a conquest of the Canal Builders in the Salt River Valley by the polychrome intruders from the Central Gila district.

Here is an instance of such reasoning. In Pueblo Viejo, across the river from Phoenix, the writer found an astonishing
high percentage of polychrome shards among red-on-buff shards on the surface of a field which had never been ploughed. Three trips were made to consider the matter, in the end it was found that all the polychrome shards were the finely broken-up fragments of a single olla, or at best of not more than two. A single captive woman might upset the culture ratio of a small settlement, as has occurred, but in this case a single pot had done it!

Not all the pioneers ignored the ethnologic opportunities in their pathway; with respect we remember Dr. Joshua Miller, the first man to gather a state-wide collection, and a valuable one; it is now in the state university. When this physician came to the valley, lands were being cleared and men were frequently killed by rattlesnakes. At that time everyone believed that the Hopi snake dancers had a certain antidote; neither the honesty of the ceremony nor the risk involved had been questioned, while in later years only the sincerity of the rite passes unchallenged. And so the doctor set about finding the antidote.

Failing by direct methods, he joined the tribe, and asked to be made a member of the snake clan. With them he received instruction as to what desert herbs to gather, each man directed to take but one kind, and to do it rapidly and alone. All set out on the run, the doctor collecting the kind which had been shown him; at evening all returned to the hilltop, where in the gathering darkness a big pot of water was boiling. All emptied their bags and danced in a circle about the fire; the doctor with the rest, but with every nerve intent, watching those two who had not gone out and who alone knew the secret of the herbs. At an unexpected instant, these two grabbed here and there and picked out a handful and threw them into the boiling pot and thrust all the rest in the fire. What with the steam and the smoke, the dancing and singing, the constant going in line about the fire, the doctor saw he had failed.

But the next day, with body stripped and bedecked with paint, he took his place in the snake dance; while tourists perched high up in safety jeered a white man dancing with a rattlesnake in his mouth. A few days later, he left the tribe, but when his friends remonstrated with him for the risk he had taken and said that it might have cost him his life, he said: “It would have been worth it.” This is the story as Dr. Miller told us and we believe it; but we expect some who have read about the dance in magazines to point out errors.

A Hopi boy, Matthew Coayawyma, employed for several years in Phoenix, tells us the following:
"I am glad I am civilized and am a Christian; I have been in schools in several states, I am 21 years old, but my sister has gone to college and is now teaching near Flagstaff; she is writing out all the old-time stories of our tribe.

"My father has told me many times about dancing in the snake dance with a snake in his mouth, for he and all the rest thought it would bring rain. Then he was taken east and taught tree planting and grafting and pruning; then he returned home and planted 40 acres to trees. After being converted to the white man's religion, he and my mother lost their belief in the value of the dance, and he was no longer afraid of the other men in the tribe and glad to tell the truth about it.

"My father told me they took the snakes into the cellar and took the teeth and all the poison out of the snakes before the dance. Once a Hopi when gathering snakes for the dance was bitten before he could get the snake in the bag; he died before he could get home."

In the mountains south of Prescott, Dr. Miller found a hard granite metate which cost a week's work to bring to Phoenix; it weighed 600 pounds and had been worked into regular shape on all sides. It had been used until the channel was 10 inches deep, 14 inches wide and 30 long. During the years it has been in the Turney Museum no one has reported a larger one. An assayer in Phoenix married a Mexican girl who then insisted on having a metate made for her; it was done and made lightly channelled; this she used once a day for forty years. At her death her husband found she had deepened the channel three-sixteenths of an inch.

At that rate, provided that this huge metate were a community stone and all the women constantly using it, as may have been the custom, it would have taken a hundred years to have cut it down to this depth. As the metates found here run from the very large down to miniatures two inches long, yet carefully detailed, it becomes impossible to say where utility passes over into ceremony, or perchance on down into children's toys.

Among modern Indians the metate is not a community stone neither does the woman have a set of coarse and fine manos to use in reducing the corn: that theory is suggested though by the comparative ratio of these two stones as found. The Turney collection contains twelve hundred manos and sixty metates, a ratio of twenty to one, which resulted from picking up all as they were seen.
Other acequias existed above and below these which have been described and on all the streams and creeks of these mountains and valleys; once semi-arid, destined later to become arid. To the southeast had been extensive terrace irrigation, demanding a regular and uniform rainfall; the Santa Cruz River had supplied a civilization which must have existed several centuries, so thoroughly and deeply is the soil filled with artifacts, yet today it debouches a lost river, lost in the desert. To the northeast, near cave and cliff dwellings, were numerous irrigation terraces where no possibility existed for connection with any stream or gully; all their water caught by v-shaped embankments along sloping hillsides and led out to their fields, now submerged beneath the Roosevelt Reservoir.

Modern engineers should preserve and honor the conquests of the Original Engineers; the deeds of an Archaic Culture should constitute an imperishable heritage.

We are prone to boast of our Nordic ancestors; but when our Nordic ancestors, clothed in skins, wandered through the forests of central Europe, unable to record ideas by any form of written characters, the Canal Builders were erecting clan-castles of six hundred rooms and canals that turned dry a river. While now today, in the Southwest, an empire has arisen on the ruins of a vanished civilization; Phoenix is rightly named; irrigation canals have been built in the channel of water-ways constructed and abandoned a thousand years before the day of Columbus; the Roosevelt Project copies a project perfected by a forgotten race.

The cities of the Salt River Valley stand on sites of prehistoric clan-castles, where a newer civilization has replaced the old. Here great dams storing and controlling the destroying floods, along with cost-free electric power pumping the underground water which water-logged the fields of the Ancient Colonists, have reclaimed 408,000 acres, and developments under way will increase this to 652,000 acres. (1) Well may the later race take pride in their conquest over the forces of nature which defeated the First Race.

In the ultimate correction of the culture map herein outlined, let it be understood that we entertain no naive ideas of the simplicity of the task. Several waves of peoples have occupied strategic and tillable localities in Arizona and then moved elsewhere. The Indian has been a nomad. The nomadic

(1)—Phoenix Chamber of Commerce, 1929.
life was imposed upon every race where grass became an all-devouring weed after trees had been removed and the sun given access to the soil, unless that race were possessed of iron implements with which to fight the destroying grass. In Europe the sedentary life of civilization was possible only through the discovery of metals.

In the New World the discovery of metals in usable quantities was never made and the nomadic life was enforced. In the pueblo area there was no grass and here the sedentary life developed to a greater extent than in other places. But where the nomadic life has been enforced upon an entire race for some thousand years, the lack of such necessity does not immediately result in a change of racial habit.

It may be that Dr. Douglass, by the tree-ring method, may be able to give us definite anno domini dates for the pueblo periods; but until that time we may follow the chronology outlined by Dr. Kidder, which follows. (1) From an unknown beginning down to 2000 B. C. is the time of the Pre-basketmaker culture. From 2000 B. C. to 500 B. C. the Basketmaker; from 500 B. C. to 1 A. D. the Post-basketmaker. From 1 A. D. to 250 A. D. the Pre-pueblo; from 250 A. D. to 500 A. D. the Early pueblo; from 500 A. D. to 1100 A. D. the Great pueblo. From 1100 A. D. to 1540 the period of decline; from 1540, the time of European discovery to the present, the historical period.

A general gathering of field workers was held at Pecos, N. M., in August, 1927. The work in this field being so new, the disagreements on mooted questions outnumbered the agreements. Terms heretofore used by all writers to designate chronologically sequent periods were attacked and a new set advanced which still farther complicates the layman’s task, since both are in use and the new set is not self-explanatory. It runs as follows:—(2)

Basketmaker I: A postulated stage, pre-agricultural, yet adumbrating later developments.

Basketmaker II: The agricultural, atlatl-using, non-pottery-making stage.

Basketmaker III: The pit, or slab-house-building, pottery-making stage; these three stages characterized by a long headed population, which did not practice skull deformation.

(1)—American Farmers of 400 B. C., A. V. Kidder, Scientific American, July, 1927.

Pueblo I: The first stage during which cranial deformation was practiced, vessel neck corrugation was introduced, and villages composed of rectangular living rooms of true masonry were developed.

Pueblo II: The stage marked by widespread geographical extension of life in small villages; pottery corrugation often of elaborate technique, extending over the whole surface of cooking vessels.

Pueblo III: The Great Period of large communities, broad development of the arts, and growth of intensive local specialization.

Pueblo IV: The stage of contraction of areas occupied, by the gradual disappearance of corrugated wares, and a general decline from the preceding cultural peak.

Pueblo V: The period from 1600 A.D. to the present.

Constant are the discoveries of ditches along mountain streams whose discoverers declare they antedate all human records; their appearance certainly supports the claim. In these cases the first test to apply is the question of the presence or absence of stone digging tools, stone hoes, and of broken pottery and chips of diorite or an occasional stone hammer or axe. If the ditch is ancient then some trace of early human habitation is to be expected. Even these are not entirely conclusive, for all might be present under an abandoned and eroded mining acequia.

The writer has laid out many miles of placer mining conduits, starting out in a narrow mountain canon, and leading along hillsides, down to open, grassy glades, which would seem might have been perfect farming lands for any prehistoric homesteader. But alas for the modern mining company, the flour gold refused to be washed out, the sluices rotted away, and fell down, and were burned by cowboys; the mountain rains cut across the hillside conduits in myriad places, and the winds half filled the ditches. Many a hillside rincon has been irrigated by a Mexican and abandoned.

What archaeologist, finding these water-ways, can tell their age; the writer has been deceived in the past and expects to be deceived in the future. So we hesitate to record all the reported ditches, a mile or more in length, and without distributaries, which at some time served an acre or more of ground, and wherein no record accompanies of pottery shards and stone hoes and refuse middens.
On the north side of the Gila, midway between Liberty and Buckeye, 25 miles southwest of Phoenix, a rather large clan-
castle well oriented, stood near the river, but during a recent 
flood it was gradually washed away. A nearby rancher gathered 
a couple hundred ollas as they fell down into the rushing waters: 
more were lost, but examining those remaining we have found 
all of them to be Lower Salt wares, although in some there is an 
absence of the wash-white, leaving them a red on gray. Searchers 
report this difference a definite feature at points farther down 
the Gila. In this building was found a pottery bird-bottle with 
handle: since fragments of the detailed wings and tail are occa-
sionally found, it seems that this bottle was made here but not in 
the profusion of the Mesa Verde country.

As soon as we pass out of the part of the valley where clan-
castles were built, then different types of homes are found, and 
so different that we see no cultural connection except that the 
pottery is similar in varying amounts of red-on-buff and red 
with firing clouds. Typical ruins occur on the Agua Fria, 8 
miles north of Grand Avenue, a structure now showing only lines 
of smooth river boulders in regular lines. The largest village we 
have called Casa de Piedras, Stone House, consisting of two 
parallel walls 249 feet long, with end walls of 183 and 168 feet. 
It runs northeast and southwest, as do others in the neighbor-
hood, although orientation would have been perfectly feasible. 
The boulders had been built into a wall along with adobe con-
taining little clay, with the result that the mortar has disap-
peared and the stones lay in rows. The northern half of the 
space within the four walls is subdivided into small courts and 
large rooms, which in fact are so large as to have required many 
pots to support the roofs. The only opening in the outside 
wall is a gateway in the middle of the opposite end, this farther 
half showing no inside walls.

A trash mound 30 feet in diameter and ten feet high stood 
outside the walls awaiting stratigraphic study, but the impatient 
enGINEER of an irrigation company ploughed it through “to see 
what was in it.” An examination of the sidewalls in this cut 
revealed no stratified differences in pottery types; it was heavy, 
thick stuff, with rarely a thin decorated fragment; those few 
may have been trade pieces since some corrugated made from 
kaolin may be seen.

To the southwest 200 feet, lays a similar ruin, although 
smaller, having but one side and one end wall visible and fewer 
inside rooms. The trash mound is fully as large, but has been
destroyed; it was similar in content to the other and with the same lack of stratified modifications. Wind borne dust has placed a deposit two feet in thickness within the walls of these compounds; digging beneath it a few shards were obtained, all similar to those in the trash mounds. Between these ruins a burial was found; one foot deep, a flexed adult, with undecorated pottery gifts: skull measurements not possible. No attempt has been made to find burials and nothing is known concerning cremation.

These buildings depart wholly from the clan-castle form, and they are not pueblos. An eminent authority in describing similar structures on the Verde has called them "trincheras;" the poorest possible name since they are not "entrenchments," a better name would be "fortin," a small fort, but we shall call them walled villages, remembering that the development in human civilization has been generally similar in all parts of the world, and the walled village was the normal type in Europe for some hundreds of years.

Southeast of the main village, on the bank of the river, are several well built boulder walls which form the face of the river bank, walls apparently as old as the villages, but held in place by the earth bank. These form two rooms, 10 feet square, inside of which is a half ton of friable red sandstone, which suggests a storehouse of pigment material. Nearby in the river bottom is a deposit of disintegrated red earth which seems to have been produced by long water action; no other red sandstone is known in the neighborhood. Dim traces of cultivation are present on the river benches and we can speculate that the flat river bottom was used then as now for fields. Smaller buildings are visible to the south, and a large one a mile to the north, and others across the river, with traces of cultivation at various places in the river bottom and on the benches. Casa de Piedras lies in Sec. 31, T. 5 N., R. 1 E., and traces extend two miles south and west, while another stone ruin is in Sec. 30 and another in Sec. 21 across the river.

A complication now enters the scene, for picture rocks are found in a scattered way over twelve square miles of the surrounding country. The desert is strewn with boulders, with tops blackened with manganese; weathered surfaces inviting the photographer's art. On the south side of Calderwood Butte across the river are more hieroglyphics. Careful search has revealed only one rock within any of these walled villages which bore a picture. Picture rocks are found in Sec. 1 in the township south and west; in Sec. 24, 25, and 36, T. 5 N., R. 1 W., and in Sec.
5, T. 5 N., R. 1 E. and in Sec. 32 in the township to the north. Perhaps the greatest number of these pictures are to be found in a narrow pass near the eastern summit of the White Tanks mountains, far from any possible irrigation country; here a seventy-foot facade is closely strewn with them.

Pictures which seem but aimless art representations, pictographs, and others which seem to be records of events, as hunting trophies, pictographs, are scattered through the Salt River Mountains. This range, embracing 14,960 acres, is the property of the City of Phoenix, and the boast is made that this city alone owns an entire range for a park. The writer named this the Salt River Mountains when making government topographic maps, not knowing its Pima Indian name of Mohatuk and the legend. The mountains to the west were named by Chas. M. Clark, the Sierra Estrellas, Mountains of the Stars, while the Pimas called them Komatke, the High Wall. This is the story as told by a Pima:

"Once the tribe lived far to the south and there they had a custom that when a man died a great fire was built, the body put on the fire and the men danced around the fire until it was burned up. One time the Fox became angry with the Pimas and was watching a chance to prevent the next fire dance. A man had died and the body had been placed on the pile of wood, the dancers were going around in a circle and the fire was just starting. The Fox saw that the dancers on one side were young boys and not so tall as the men, so he jumped over them and seized the body in his mouth and jumped back.

"Then he ran north all that night and all the next day; he ran for four nights and four days, and then he came to the top of a range of mountains. Here he could see a river from the east and one from the west and they came together. The Fox was thirsty and so he laid the body down on the high rock and went toward the setting sun. But the body made a stain on the rock which we call mohatuk in Pima and that is the name of the mountains, Mohatuk."

Pima Canon, at the east end of this range, is a spot revered by the Pimas, for this was their first home. The long, narrow canon leads into the range in a line directly west of the church at the Yaqui village of Guadalupe. A Pima told us the following:

"The Pimas lived far, far to the south and there they were very happy; but one night there came a star in the north, very bright. The medicine man said that was a sign that everybody must leave their homes and follow the star until it stopped shin-
ing, and there build new homes. So they went forth and followed the star until it ceased to shine, and there they built houses and everyone was happy. After some years the star came again in the north, and once more they followed the medicine man and made new homes and were happy. This happened four times, four is the sacred number, it means completeness and the end, and so the medicine man said that never again would the Pimas have to find a new home.

"But some of the young men wanted to see how far north the earth went, and so they stole away at night. They hid by day and travelled at night for four nights; then they came to a range of mountains, and beyond was a river, and far away four peaks (Four Peaks) rose up in the sky, and there the earth came to an end.

"There was a narrow canon in the mountains, and at its end a spring of water; no one could ever find them there. But the tribe had been following them to take the young men back; so there was a battle at night; but in the morning they all agreed to stay with the young men and live in the canon. Here they were happy, for game was everywhere and arrows flew true, the rains were sure and the fields bore corn and squash and beans, and all the world was good.

"They made pictures on the rocks to show how many mountain sheep were killed, and to point out where water could be found by digging. But one night the Apaches came from the edges of the world, out from those four peaks, and there was a great battle, and many Pimas were killed. The Apaches hammered strange signs over the pictures on the rocks, signs that nobody can read, and hammered in their victory signs, and then went away.

"But after the white men came the true name for the canon and the spring was lost. The white man calls it Yaqui Village Canon, and for that reason the spring refuses to flow its water, but when they call it by its right name, Pima Canon, then the spring will send forth its waters, and everyone will be happy."

On Cave Creek and Camp Creek, and scattered about the country 30 miles north of Phoenix are many stone built ruins of the walled village type, usually on commanding points, where the walls are built flush with the edge of a bluff. Some of these contain from 50 to 100 rooms and are in a good state of preservation. That on the west side of Camp Creek south of the state highway is a good example of a fortified village with a central open patio. We believe these walled villages belong to the Lower
Salt culture, yet the surface shards and those obtained in scanty digging are all coarse, dull gray.

Added knowledge frequently complicates a problem. In one fortified village near the Sears Ranch, on Camp Creek, 30 miles north of Phoenix, the decorated surface shards run 100% brown on yellow, of the type made at Sikyatki, the prehistoric pottery found at the Hopi Villages. Whether these shards belong to this early Sikyatki or to the later Jeddito can not as yet be determined, but they certainly are antecedent to the Hopi.

A stockman, Jas. Bark, found a canal six miles long, on the north side of Queen Creek where it emerges from the mountains onto the desert. Near the head it is 15 feet wide and 10 feet deep, while out on the sloping desert it has the same width but is three feet deep. There are several dozen ruins, some of them of considerable size, all yet unmapped. The shards so far found belong to the Lower Salt. Overlooking this ground is the Superstition Mountains, and on their crest, on a high pinnacle, Bark found a lightning shattered olla, and from the surrounding rock crevices he gathered up several thousand beads of shell and turquoise, all with holes too fine to string with a needle, and along with them were a thousand minute arrow heads, all carefully finished. From Ft. McDowell has come a smoke blower of catlinite, highly polished. Other pieces of catlinite, generally carved, have been found in the valley, while beads, apparently of catlinite, are common in graves.

The delta of Queen Creek, where it subdivides into more than a dozen channels and spreads out on the desert, is known as Sonoqui Ranch, a locality rich in ruins, and traces of irrigation ditches. Some of the delta forks have been thought to be ditches, since true ditches are found on both sides and extend up to the point where the creek first emerges from the mountains. On the open desert, Paul Fuller, City Engineer of Mesa, found an entire irrigation unit, undisturbed from the time when it first served the land. The canal branched and branched and rebranched again until it resembled the veins of a leaf; with each last branch a tiny rivulet. The whole ground was thus fed, the service lines being but a few yards apart. An unavailing attempt was made to have this ground reserved from entry and made a National Monument. This distribution system, crude as it may seem, with no rectangular plots of ground and no parallel ditches, is the method still used by the natives of Upper Egypt in irrigating cotton.

Interesting finds have been made in the vicinity of Sonoqui, and the word vicinity in this report is used advisedly in every
the man who digs on unimproved desert ground knows that some person, failing even to clear the brush from his entry, is ready to demand any article which has value to a scientist. We have been driven away from the cactus and catclaw of Queen Creek by an unworking homesteader with a shotgun. However, Dr. Phillips found five large metates, every one finished in squared form, inside and outside, all of them nested and stacked, at a depth of several feet under the surface. Then he found a shell carving of a human face with bobbed hair; a regular present day feminine fashion plate.

Within the defense wall of one of the adobe ruins, a wall located on the south and west sides only, and the drainage coming from that direction, there stood a buried row of extremely large ollas of heavy, undecorated ware, in the making of which so much mica and silt had impregnated the clay that it was impossible for the untrained explorers to get them out intact. Yet one has come to our collection which measures 102 inches in circumference, the largest prehistoric olla so far now existing in the southwest; that at Casa Grande, not far distant, measures 89 inches. With this large olla was found a red stone hoe which had been regularly shaped, ground to an edge and polished over its entire surface.

Across one of the many deltas of Queen Creek an embankment 250 feet long had been built which must have backed up water to a depth of fifteen feet; only the ends of the dam remain, earth embankments of good proportion. That the dam is prehistoric is proven by the finding of large pieces of pottery within it, pieces which would have been broken in modern movement of earth. In the channel is a circular pit five feet deep and eight feet across, which had been lined with two layers of dense, black material, the inner layer eight inches thick and the outer five inches. Search was made for traces of its former use, but the ground had been swept by numberless rushes of water. A similar pit lay in the center of the channel a half mile east. A pit of this form was found north of Phoenix on Clarenden Street, larger in size; its top had suffered in the first ploughing of the ground. The ties to its exact location are filed with the Arizona Museum.

On the Reese Homestead, near the highway east of Higley, are two elliptical pits, 450 feet apart. The north one lays east and west 225 feet long and 160 wide, with side embankments 8 feet above the center which is 3 feet above the general surface: there are openings at the two ends. The south pit is 135 feet east and west and 175 feet wide and has an opening on the east
leading out on a low platform 62 feet long. Its sides are 4 feet above the inside center which is 2 feet above the general surface. Not a trace of house walls is visible for miles in any direction.

These pits were not reservoirs, for the centers are above grade even after allowing for the slumped down wash from the embankments. In this whole Sonoqui and Higley locality there is an absence of adobe and of boulders, any former habitations would not now be noticeable as in other places, but we do not see any trash mounds, which are usually present where the occupation has been lengthy. Apparently the earth had been stripped away, revealing clay beneath: these pits then were wholesale pottery manufactories. This being a waterless spot, homes were over on Queen Creek.

A study of the surrounding lands makes the theory seem correct but when we ask the origin of two clay banks on a sandy loam plain, miles from the mountains, then doubt arises. There are nearby sand dunes, which from the absence of pebbles, seem to be aeolian deposits; we leave to the geologists to answer if a clay bank might have a similar origin.

The slopes of all the embankments are so completely paved with small fragments of pottery that the eye does not see the dirt. Test holes in several places revealed the earth well filled with large shards even up on the embankments. Every fragment is of exactly the same color, Lower Salt red-on-buff containing a high ratio of mica. Not a fragment of intrusive ware is to be found, although it is but a few miles across to the Gila where Central Gila is so common.

The shards are thin, many of them decorated and show particular care in making: very few are of the heavy water-olla type with thick, rolling lip. While all shards are of the same faded red-on-buff yet the decoration frequently takes the form of a rectangular block from which square hooks dangle in a regular four-direction plan. This motif has not been found in the Salt River Valley. Six-foot holes were sunk in the center of each of these pits, revealing shards plentiful all the way down.

While these excavations were pottery manufactories, yet they may have been made to resemble sun temples: possibly there was a mixed use. They exactly resemble those structures which every archaeologist who has worked in this valley has called a sun temple. But in those other structures called sun temples there is a particular scarcity of shards. Again we remember that this Sonoqui pottery is more fragile than any other made in
the Salado, and the breakage in manufacture must have been large.

It may be possible that the ellipse was the accustomed manner of excavating down to pottery clay, and that the slight platforms with an enclosing ring were the firing places, built above damp ground and sheltered from wind by a small ring of earth. Furthermore the absence of shards around these places might be due to their universal employment as tempering material. The presence of a pottery making pit at each of the large groups of buildings is to be expected all over the valley, and we know that an understratum of clay was generally available. But enough clay could be obtained without making a pit 200 feet long and digging them every mile apart, as around Mesa and Pueblo Moroni; unless each clan used their own.

Apparently all types existed; reservoirs, temples and clay pits. The problem is left to future archaeologists to classify the few remaining. The sun temple at Casa Grande does not resemble those in the Salado nor these at Higley. It has a hard floor sloping to the center where a large stone was placed; it lacks the doors at the ends, and the low platforms beyond; it is only about half as long, being 120 feet long and 80 feet wide; and it is placed north and south: in fact its only resemblance lies in the fact that it has elliptical embankments.

This Sonoqui district was occupied by Lower Salt red-on-buff people and by the Central Gila polychrome people and by groups which used both styles of pottery. Three miles south of the Pottery Pits is a sand dune well covered with shards, and village sites surround; here red-on-buff runs 47% and polychrome 53% with an occasional New Mexico black on white and a Sikyatki yellow and a few Central Gila red-on-buff. These sites indicate both successive and commingling occupations.

In the Museum of Santa Fe, shards are shown which are pieces of jars made on a potter's wheel in Spain, and there used for storing olive oil. These jars had come up from Mexico during the Conquest, had been broken and fragments had fallen among shards of pueblo origin. In building the Museum at Santa Fe shards from both were found: not ordinarily is a museum enriched from its own basement. On top of a trash mound at Snaketown, similar pieces of Spanish made oil jars were discovered by us. There also was picked up a well made shell carving of a rattlesnake, the tail rattles cut on its neck: this misplacement of the parts of a figure is not uncommon. The rattle-
snake might well be called the patron saint of this village, for in startling numbers they still guard its ruins.

On the southern slope of the nearby San Tan Mountains are clear traces of terrace irrigation which was supplied by small ditches from the mountain gullies. Heavy brush prevents determining its extent, but shards and diorite slips are strewn over a thousand acres. Six miles west of Sacaton a canal starts out on the south side of the Gila and runs twelve miles west; at its middle point it is five feet wide and three feet deep; in all it covers 3000 acres. Several observers believe this is an ancient canal, but it may have been constructed at a comparatively recent date and still be placed in the prehistoric class. This same question concerning age might apply to two canals near Maricopa Station on the Southern Pacific Railroad; these are twenty feet wide, and although well filled with blown sand, are three feet deep.

Attempts made to map the prehistoric canals in the Casa Grande valley were abandoned due to difficulty in distinguishing between the ancient and those dug by the early settlers and now forsaken and well-nigh filled up. In 1926, A. Larson, (1) a student in the University of Arizona, performed a creditable work in making a survey and map of those ancient canals. He found two on the south side of the river and three on the north. On the south side, one heads nine miles above Florence at the granite reef where the government diversion dam is being built; this passed just south of the town of Florence and runs directly to the ruin of Casa Grande, winding about it on its north and west and terminating a mile to the south. This canal was 20 miles long; one lateral only was found, four miles long, on the north side of the ruin and near the river. The other canal on the south side diverted water directly north of the ruin and continued its way nine miles to the west, averaging only a mile distant from the river.

On the north side, a canal was diverted two miles east of Florence, and extended eight miles; while opposite its end was another six miles long, and farther down was another four miles long. This last canal throughout its length was scarcely more than a quarter of a mile away from the river, and the others on the north side, on account of the rapidly rising ground, were close to the river.

To an irrigation engineer, familiar with the topography of the Gila Valley, it seems particularly clear that all of the ground covered by ancient canals is shown on his map. Even though the distribution laterals have disappeared yet it seems evident that there were no outside laterals and no other canals. The ancient engineers had gone as high up the river as feasible and had selected the point where modern engineers have found the largest amount of underflow raised to the surface, and where the government engineers found the best dam site.

Under the canals on the north side are 3,540 acres, but part of this is rough, and hard with caliche; perhaps twenty per cent was undesirable, leaving 4,200 acres. On the south side 11,940 acres were under canals with about ten per cent unfitted for use, leaving approximately 10,740; with a grand total of 14,950 acres. The copyright on this map prevents its use in this report. The average water supply on the Gila is less than that of the Salt, and far less uniform; at times its bed is entirely dry and remains so for many weeks; then follow floods greater in volume than any in the Salt. When we remember the scanty results which were obtained before the construction of the San Carlos dam, the supply of water must have been greater and more uniform than at present if all of the above acreage was supplied.

At that time the forests had not been destroyed and the ranges eaten bare, the rush of rainwater down the mountain sides was retarded, and the mountain valleys had not been dissected by gullies. Even a cursory examination of the headwaters of the streams reveals the recency of this topographic change. The ancient engineers may not have found it necessary to span the wide Gila with their dams, perhaps only wing-dams of rock-and-brush were necessary; if so, the burden of floods passed on down the deeper channel and left less rebuilding to do. This seems a reasonable assumption, yet we have no proof whatever; the only fact that can be posited with certainty is that water can be raised five feet with a well made rock-and-brush dam and no higher; above that head the hydrostatic pressure sweeps it out. The same materials and methods could give no better results in one age than in another; they had no better materials and methods than we, and we had many years experience with such dams before the building of rock-filled timber dams in the Valley of the Salt.

The people of the Gila suffered more acutely and the end came more suddenly than to those on the Salt. There seems to have been a reduction in run-off, and channel erosion completed the catastrophe; the time came when they could no longer divert
water with a five-foot dam. There is no evidence that in the Casa Grande valley they attempted to push their canal heads farther upstream as in the Salt, yet they should have been familiar with that recourse as practiced some hundreds of years earlier in the nearby Salt. If it were done, the maps and published reports do not indicate it. The last people in that valley were the black on slip white pottery makers of the Central Gila, who occupied it after the real hydraulic engineers, the red-on-buff people of the Lower Salt had developed it and abandoned it. We do not know why the red-on-buff people left it; perhaps for the reason that the Gila was so very difficult to control, and the streams on the upper waters of the Salt offered good lands with a minimum amount of labor in reclamation and maintenance.

In passing, we may consider the similarity in construction of the ruin of Casa Grande with the larger clan-castles of the Lower Salt, also the similarity in artifacts of every type, to the similarity in burial customs, and to the total absence of dissimilar customs. The only evidence we have that there was a separate Central Gila culture present during the latter days of the Casa Grande is due to the fact that in the upper layers of middens the Central Gila pottery is there present and no other, while in the lower layers the pottery is Lower Salt; the difference in their cultures was in pottery technique. Due to the apparent recency of construction of the ruin of Casa Grande, it seems likely that this building was constructed by the later Central Gila people.

Frank Pinkley, Superintendent of Southwestern Monuments, has pointed out that at Casa Grande the surface shards belong to the two types of Central Gila, but that in excavating there comes a brief zone in which these are mixed with the red on buff of the Lower Salt and then below these the pottery is exclusively red-on-buff. Dr. Kidder has stated that throughout the southwest the black on white and the corrugated occur together, and that statement is correct for New Mexico, Colorado and all of Arizona, except that from Roosevelt directly south to the Mexican line corrugated is found, while the limits of the black on white passes north of Roosevelt and over to the San Francisco River and the New Mexico state line. The corrugated is not particularly plentiful at sites west of Globe, and is extremely rare as an intrusive in the Lower Salt. Some corrugated was found by Dr. Schmidt at Togetzoge, "where yellow water meets clear water," around Roosevelt and also at points in the crest of the mountain range west of Globe.
All the evidence goes to indicate that the standing ruin of Casa Grande is much later than the worn-down ruins in the Lower Salt. Mr. Pinkley has stated his belief that it was abandoned 600 years ago, or possibly 1,000 years at the time of the great pueblo concentration. He adds that the earlier surrounding ruins date back 1,500 to 2,000 years and oldest of which traces have been found may run back to 2,500 years ago. The trash mounds cover considerable areas, but are not as thick as those around Phoenix, the deepest being but six feet deep. He states that cremation ashes are not found in the polychrome black and white ollas but that the black on white wares were placed as gifts only in the interment burials: while this clue is important to the ethnologist, yet considerable additional evidence is desired.

Pinkley also reports that along the Mexican line he has found a few scattered shards of red on buff, but Mitvalski, during a search of several weeks along both sides of the line, devoted to hunting shards, found dull gray ware with no Lower Salt red on buff, but including a few examples of red on maroon. In a hundred miles the pottery making materials should change so that different shades of color may be expected even if made by the same people. Migrations were slow and the design of decorations was constantly changing. The evidence goes to show that the Canal Builders came from the south, but they only brought with them the germ of the industrial development which grew up here.

The general belief is that the ruin of Casa Grande was destroyed by fire caused by lightning, but we are skeptical. In 1879, Harry Hancock accompanied his father to the ruin where they removed a wagon load of timber and brought to Phoenix as curiosities of an ancient building. No one will doubt the correctness of a statement made by him. The father, Capt. Hancock, will be remembered as the engineer who surveyed out the Townsite of Phoenix. At that time the ruin of Casa Grande had not been made a National Monument and such a trip was looked upon as scientific work. The writer felt pride in removing a log lintel from the now famous Cliff Dwellings at Walnut Canon near Flagstaff in 1889. These had been cut with stone axes with a tapering cut of 45°, much the same as a beaver makes in felling a tree.

Volumes of discoveries in the pueblo region have appeared, but no attempt has been made to unite them into an ordered chronology until Dr. A. V. Kidder published his Southwestern Archaeology, a work which had been needed for a generation
past while men had been digging in the ruins. To improve on such a work is not easy, but we can change his culture boundaries in this part of Arizona where he has not had the opportunity for field work. Referring to his culture map (1) we change his western boundary of the Little Colorado district by swinging from the junction of the Little Colorado River directly to the south and pass Prescott on its east, thence across the Verde south of Camp Verde, and to the southward to Roosevelt Reservoir, thence northeast to meet his boundary line near Zuni. This will slightly reduce his Upper Gila boundary.

We abandon his designation of the Lower Gila and instead use the term of Central Gila, for the reason that the term Lower Gila must be reserved for a district extending from the neighborhood of Gila Bend to Yuma; an area recently worked by Malcolm Rogers. The district of the Central Gila takes in Globe, passes south of Roosevelt, thence to the west and includes the ruin of Casa Grande, and around to the south about midway to Tucson and back to Globe. The Central Gila wares have a black design, placed on a slipped white, over a red exterior on a gray base. If we call them black on white we are in immediate conflict with the potteries of New Mexico with which there is not any degree of similarity. The body of the bowl is grayish with a solid red exterior, and over this was painted a strong wash white and then a black design. The work was crudely done, in broad bands of color with ragged edges. The dual reversed stepped design of the Tularosa wares never appears.

The other Central Gila ware is called polychrome, as three colors are used in the design; red, white and black, all applied over a gray base; the lines are broad, applied with a rough brush, and with little attempt at retouching. Some writers call both of these “Polychrome,” although two colors only appear. Compared to wares generally, this ware must be called fragile, yet it is harder to drill than that of the Lower Salt. No strong, ringing wares have been discovered south of Sikyatki and west of the wares with bordered designs on the Little Colorado.

With particular emphasis we defend the designation of these wares and the nomenclature of their districts; the red-on-buff of the Lower Salt; and the polychrome of the Central Gila. When a sack of coins is poured out before a bank teller, no faster does he separate gold, silver and copper than we can separate these shards as turned out of the earth by the shovel.

(1)—Kidder, Dr. A. V. Introduction to the Study of Southwestern Archaeology, Yale University Press; pg. 47.
We care not where the Canal Builders learned to make pottery, nor who were their teachers, certainly the art did not originate in any district to the east, the west or north, and if in the south, or southeast, then it was made in too sparing quantities to justify giving it a name from that area.

The red on buff was made in the Lower Salt in vaster quantities than any other pottery in any other district in the whole Southwest, and due to two reasons, its fragile character and the denser population in its district.

Searches have been made in Sonora and nothing found to indicate that the Canal Builders learned their arts there. (1) This statement does not militate against our former argument that they came up from Mexico and developed their independent culture in the valleys of the Salt and Gila. Sonora is not the country to invite the permanent abode of any strong group of peoples passing through. Concerning its former occupation, Monroe Amsden states: (2)

"In view of the paucity of internal development manifested by the remains of these Sonoran cultures, it is safe to say that their period of existence was brief. The absence of rubbish mounds at any of the sites support this statement. Apparently this part of Sonora was an unpeopled wilderness until the upper Southwestern cultures reached their zenith and began to decay. Then a thin wave of population crossed the Sierra Madre from the east and settled in the valleys among its foothills, to remain a short while and disappear. Later, the Opatas, according to tradition, moved into the valley of the Rio de Sonora and built the villages we have seen, and lived in them until the Spanish colonization. Short though the entire period of occupation was, it provides another opportunity for linking the prehistoric southwest with the historic times and may eventually shed light upon the important cultures of Chihuahua."

Amsden places the first development at a recent time, that of the Great period of Pueblo expansion, and concludes that it may not have occurred even then but during the later time of general concentration of a thousand years ago. He makes these deductions from a comparison of decorated potteries.

Lumholtz, Carl. Unknown Mexico, Scribner's, 1902.
(2)—Archaeological Reconnaissance in Sonora, Southwestern Museum Papers, No. 1, 1928.
A few ollas have come to Phoenix, found at various points in the area of the Central Colorado river, which are all precisely alike; a black-on-gray. They have come from burial caves and field burials in the mountains in Imperial Valley; from Blythe, from Needles, and the Lost City of Nevada, and from around the Colorado near its junction with the Little Colorado, and in very considerable quantities from Prescott and Skull Valley, where they are intermixed with Lower Salt pottery; and some beautiful ollas have come from State Highway work around Ash Fork. Many exquisite examples have been found in burials and in caves near Perkinsville by an enthusiastic amateur, Mrs. Evelyn Perkins; there they are associated with Little Colorado ware. The exact similarity of all these would seem to justify the creation of a district of the Central Colorado and the naming of its potteries as black-on-gray.

On Oak Creek, reports state that there was a series of puny ditches in ancient times, but careful search by the writer, when an irrigation engineer, failed to reveal any traces; although the ancient conduits may have been obliterated by the thirty or more modern ditches. (1) Presumably there were small ditches on Clear Creek, Beaver Creek, Dragoon Creek and the Upper Verde, but eighty modern ditches now reclaim all the ground. From one of these tributaries comes a white quartz ball, highly polished, and bearing a complete equatorial groove, deeply cut; many days of work were required in its making.

When the waters in the Roosevelt reservoir were low, an intrusive black on white pitcher of Tularosa motif was taken from the Grape Vine Spring Ruin, and a sealed olla containing small carvings and a 15-inch square of cotton cloth. From the Superstition Mountains comes a hard stone carving in the form of a chopping knife with handles at the two corners; this was found near a stone lined pit, where the mescal plant is growing; its heart bud when roasted is also considered by modern Indians to be delicious. From a cave in Cochise County comes a plaque made of reeds split open, and sewed with sinew on cross reeds and then the surface decorated with black pigment in the interlocking spiral design found on ancient pottery. From a spring in the same locality came several hundred arrow heads ranging from those made in eolithic crudeness to late neolithic spear heads of perfect workmanship. Perhaps this spring may have furnished waters during a long period of human

(1)—Use and Duty of Water on the Verde River, O. A. Turney, 1901; Cleveland Daily Record, Publishers.
progress, and its bounty was propitiated by gifts during many generations.

West of Prescott, in Skull Valley, Dr. Phillips has found pottery which had been moulded on finely woven bags filled with earth or sand; after the clay had dried, the bag was removed and the olla fired; an ingenuous form of mold. In the same locality he found shards of pots made over woven cloth similarly used. These lack but one step of being the earliest type of pottery made anywhere.

On the Verde River are ancient irrigation systems which have been described in print many times and the statement made that they are on grades impossible to use today. We believe that these misunderstood features are due to channel erosion. In the Verde Valley are old buildings of such solid construction and numerous rooms as to constitute villages, while scattered about the irrigated areas are numerous single room houses. The location of the larger buildings suggests that the need of water caused strife with the resulting construction of numerous out-post houses in the cultivated fields, while the towns formed the general defensive homes of the gens or clan. Domiciles were of varying types of perfection in workmanship, largely of loose stone, irregularly laid. Along the canon walls are many caves which had been enlarged and doorways built in front, indicating a rather dense population or much change in habitat. Cosmos Mindeleff in his bulky report on these villages concluded that the occupation of the Verde was not for a long period of time but of comparative recency. (1) At Camp Verde he found a series of ancient canals of small size. The heads having been destroyed by floods, it was impossible to determine how much erosion had taken place since they were used, but in the case of one canal at a distance of two miles from its head it was elevated upon the mesa forty feet above the surface of the river, and about ten feet above the grade of modern ditches which headed at practically the same point. Other ancient ditches on the Verde and its tributary, Clear Creek, are three or four feet above the level of the stream. A few kivas have been found on the upper Verde: the kiva was essentially a ceremonial-club chamber. It has been thought that some of the interior rooms in the Lower Salt clan-castles were kivas, but we doubt it on account of the presence of sun temples, which are not found where kivas abound.

In many localities in Arizona are traces of ancient irrigation ditches though usually very small. Major Frank Alkire found one on New River, forty-three miles northwest of Phoenix, which he estimated was located forty feet above the present river surface, but its head was obliterated. Here may be seen 200 acres of terraced lands where crops had been grown by collecting hillside water.

A study of the climatic changes in the southwestern portion of the United States and the adjacent areas of Mexico was conducted under the direction of the Carnegie Institution. An especially uninviting section was selected as one unit, a locality north of Tucson where today the water supply is practically nil. The Santa Cruz River debouches on an open desert, its waters lost in the sands, but the course of this river can be traced far beyond any point to which water ever reaches, even during the heaviest storms. Evidences of many villages and of scattered dwellings are found throughout the area wherever the ground slope and soil would permit cultivation, provided there had been water in the river channel. Pottery fragments were scattered over the ground in these village sites and found to a depth of two feet, indicating an occupation of many generations. This being a locality in which little game existed, the occupants, having no domestic animals, must have subsisted on agriculture.

Village sites are numerous where pottery, flint knives, arrow heads, stone hammers and axes, manos and metate stones are strewn about.

These ruins occur in localities where water runs in the few arroyos only during the actual continuance of the downpour. Men do not build irrigation works and leave them strewn with potsherds without a reward; food could be their only reward. Many stories come of single canals on mountain streams, stories difficult of confirmation; generally they seem to be based on fact, but over rated. The following is a typical example: on the Little Colorado, somewhere north of Springerville, is a prehistoric canal twenty miles long which was discovered by the Mormons, cleaned out by them and used to irrigate several hundred acres, which had been cultivated in the same manner by an ancient race.

On the Gila, near Solomonville, were reservoirs on the mesa from which terraced gardens below were irrigated. Reports have been made of a limited amount of irrigation in the valley of the Rio Grande and its tributaries in New Mexico, all ditches
being short and small, and the ground limited. (1) Irrigation was practiced in a comparatively limited way on several streams; but that which the nearest approached hydraulic engineering was in the Chaco Canon where the people of Penasceo Blanco diverted water by means of a ditch which supplied a reservoir built in sand, and partially prevented seepage by lining its bed with slabs of stones and clay. There were works at Una Vida, Pueblo Bonito, Kinklazhin, Kinbineola and Kinyaah. F. W. Hodge states; cit. op.

Kinyaah exhibits the best example of irrigation works of any of the Chaco group of villages, water having been diverted from the sandy wash to a large natural depression and thence conducted to the fields, two miles away, by a ditch dug around a mesa and along a series of sand hills on a fairly uniform grade. This ditch was mainly earthwork but where necessary the lower border was reinforced with retaining walls of stone. Kinyaah is said to have been provided with two large reservoirs and a canal 25 to 30 feet wide and 3 to 4 feet deep.

Rolt-Wheeler (1) in describing the prehistoric canals of the Southwest states that the Chaco irrigation works comprise fifty miles of ditches which exhibit a high degree of skill, and that many smaller ones are being traced from time to time. He says that in Arizona and New Mexico can still be traced a thousand miles of irrigation ditches which were made before the coming of Columbus and of these one-third or more antedate the establishment of the Maya Empire.

Neil M. Judd reports in general that; (2) Early man could exist comfortably on a quart or so of water for household purposes each day, but Pueblo Bonito had a thousand inhabitants, and the other neighboring villages were dependent upon the same supply. Behind the ruin the broad stairway may have led to water seepages in the rocks above where crevices still hold water for a short time following the few summer and fall rains. More likely it is that once copious springs at the foot of the canon wall have been covered over by blown sand, so that their location is no longer apparent to the white man.

Certainly the people of Pueblo Bonito were compelled to raise their food by irrigation yet positive proof is lacking. No certain trace do we find of ditches or acequias and Chaco Canon has no living streams, hence canals seem scarcely feasible. The

(1)—Handbook of American Indian north of Mexico, article by F. W. Hodge on Irrigation.
(1)—In the Days Before Columbus, Rolt-Wheeler, Doran, 1921.
(2)—National Geographic Magazine, July, 1923 and Sept., 1925.
waters that flowed down from the mesas after torrential mid-
summer rains may have been caught by low ridges of earth and
provided water for little plots sometimes only a few yards
square, wherever corn and beans would grow. By this system
of inundation moisture was gathered into the cultivated ground.

Frank Pinkley, Superintendent of Southwestern Monu-
ments, states that the entire bed of the Chaco is a level, damp,
sandy bottom, where corn would have grown with very little
or perhaps without any irrigation, and that he has seen no traces
of ditches on the canon floor which has been swept by floods
innumerable since its abandonment. The sufficiency of the
canon bed to afford fields for the people is a complicated ques-
tion and hinges largely on the number of rooms within the ruin
occupied at one time; Pueblo Bonito contains 1000 rooms, Pen-
asco Blanco ranks next to it in size, then comes Chetro Kettle,
to be followed by many others.

But Judd in discussing the causes for abandonment of
Pueblo Bonito mentions the possibility of disease, warfare,
drought, water-log and alkali. In general he states that: cit. op.

The water supply may have dwindled and there may have
been years of continuous drought, when new crops were not rip-
ened. Or again the long continued irrigation may have rendered
their cultivated fields impotent. This latter seems an important
contributory factor. Experiments in semi-desert areas show
that irrigation water sometimes tends to wash out chemicals
helpful to the soil and leave behind a too high ratio of sodium
bicarbonate. This has a hardening effect on the soil.

The fields were likely located along the sandy edge of the
Chaco Canon in order to benefit from such rains as came down
from the mesas; but if this water gradually brought in harmful
elements to the soil, even a small population would soon have
found themselves in a desperate condition and threatened with
failure of their means of livelihood. Pueblo Bonito was almost
wholly dependent upon agriculture. These people had no beasts
of burden; with prowling enemies present they could not have
cultivated distant farms or supported themselves through barter
with other tribes.

Dr. E. L. Hewett, the trained observer who has studied the
archaeology of New Mexico for many years, gave close study to
this subject a score of years ago, when possibly the clues were
less obliterated than today. He states: (1)

(1)—Records of the Past, Nov., 1905.
"The practice of impounding the drainage of small catchment basins in natural depressions and artificial ponds by the construction of dams of earth and stone were common wherever the pueblo mode of life prevailed, but only in a few localities have remains been found that point to anything like a system of irrigation; that a well developed system existed in the Gila drainage has been fully established. No higher development of the science of irrigation was reached in prehistoric America, and, indeed it is doubtful if any people of the Old World practiced irrigation on a larger scale or by a more perfect system as early as the fifteenth century.

It seems certain that no such system existed anywhere within the present limits of the United States outside of the Gila drainage. In the Rio Grande valley only the most rudimentary form of irrigation was practiced. Small reservoirs are found in conjunction with almost every pueblo ruin. These evidently served to impound the waters of flood seasons for domestic use, and also for the purpose of watering small fields, but at best they could have served only slightly to supplement the natural rainfall. In places small ditches are found extending from the mountain sides into the valleys evidently designed to divert the waters of mountain torrents to irrigable fields. None of these are of any considerable extent save one at Puye on the Pajarito plateau. Here a large, well constructed ditch, originating in a catchment basin of considerable area, west of Puye Mesa, is carried along the hillside a few feet above the level of the dry Puye arroyo for a distance of over two miles to the level plain east of the ancient village site. It cannot be proven, however, that this is the work of the prehistoric period. It is well known that the Puye pueblo and cliff village was reoccupied by the Santa Clara Indians late in the Seventeenth Century after having been long abandoned, and after the Spanish system of irrigation had been introduced among the Rio Grande Pueblos."

Irrigation was perhaps developed in the Little Colorado drainage in pre-Spanish times and may have reached a somewhat higher plane in the San Juan Valley. The remains of rather extensive works have been reported from time to time in the latter region, but these have been for the most part destroyed in recent years.

A totally unlooked for development of irrigation works was observed by the writer in the midst of the Navajo Desert in Northwestern New Mexico. Entering by way of Jemez, the last stream of any consequence that is crossed is the Puerco, and this is by no means permanent. A few miles farther west water is re-
tained in holes during the greater part of the year. Beyond this, vegetation quickly disappears and absolute desert is encountered. For the next hundred miles or so, a more barren waste cannot be pictured by the imagination. There are vast stretches where no living objects, not even the ordinary desert plants, are to be found. A loaded wagon sinks half hub deep in the sand, the wheels leaving great furrows which are filled by the winds in a few minutes, leaving the trail completely obliterated. There are places where the entire horizon is unbroken, where there is not a tree, not a bush, hummock, undulation or mark of any sort, where the wind immediately obliterates all tracks and the traveler must steer by the compass.

In the midst of the appalling waste is the famous Chaco Canon group of ruins. They extend for about 30 miles along the dry wash of the Chaco and form the most imposing group of ruins in the Pueblo region. Not all the large ruins of the group are in the narrow valley of the Chaco, nor on the mesas immediately overlooking it. Several of the most important lie in the desert some miles to the south of the Chaco and it is about these that the ancient irrigation works are the most conspicuous.

The best preserved works in the canon are at Una Vida, two miles above Pueblo Bonito, and those belonging to the pueblo of Penasco Blanco, three miles below Bonito. Near Una Vida, which is situated against the north wall of the canon, a reservoir and a system of ditches is discernible. Penasco Blanco is situated on top of the mesa south of the canon. Its fields lay in the bottom north of the pueblo. No great area was cultivated and it is difficult to understand how any such land could ever have produced sustenance for such a large community. The reservoir was built in a bed of sand where seepage would have been so great as to render it useless. This was overcome, at least partially, by lining the bottom with clay and slabs of stone. The waters from the main channel of the Chaco were diverted by means of a weir and conducted to the reservoir. Seepage in the weir was overcome by the same means as in the reservoir.

Kinklizhin is a large ruin on the mesa about eight miles southwest of Bonito where there are fairly well preserved irrigation works. The pueblo stands on a hill while nearby is a broad wash in which are the well preserved remains of a stone dam. On the east side is a waste-way cut through the solid rock. The reservoir was large enough to impound a meagre supply of water for the irrigation of the fields of about 200 acres; the ditch is filled with sand but discernible.
The best example of irrigation works is in the Chaco at Kinbineola, about 15 miles southwest of Bonito; a ruin in the basin of a wash tributary to Chaco. South of the ruins is a large natural depression which was made to serve as a reservoir for the flood waters diverted from this wash. A ditch fully two miles long conducted the water from this lake to the fields, which were quite extensive. The ditch is carried around the mesa and along a series of sand hills on a fairly uniform grade. The ditch was mainly earthwork, but whenever necessary the lower border was reinforced with retaining walls of stone, portions of which still remain in place.

It is stated that the small ruin of Kinyaah, 40 miles south of the Chaco, shows vestiges of an irrigation system; the ruin, situated on an open plain, is surrounded by a large area of irrigable land. The works consist of two large reservoirs and a ditch, 25 to 30 feet wide, and in places 3 or 4 feet deep.

This irrigation on the Navajo desert is on a plane of development intermediate between the advanced system on the Gila and its tributaries and the very rudimentary form common to the entire pueblo region; for it represents but modest achievement as compared with that of the Gila people, but a marked advance over the common achievements of the prehistoric pueblos.

In the Mesa Verde country, in the southwestern corner of Colorado, irrigation was practiced in prehistoric times, but the systems were on a small scale. At Aztec, New Mexico, on the La Plata, some of the ditches can still be traced for several miles. (1) Attempts were made to store water in some sections of the Animas Valley, New Mexico, where a gigantic earthwork or a dam 51/2 miles long was built, which stands 22 to 24 feet high. (2)

Now in conclusion I will say that I believe there were no true dams built in prehistoric times in North America, except an occasional embankment placed across the mouth of a gully to form a reservoir, or a row of stones laid across a broad, flat channel to swing the water into a ditch. The great canals were so aligned as to become drainage ways from creeks and rivers. No trace of a true dam to force water into a conduit has been found, and, having seen practically all of the large canals, I can say that every one of them, before this last thous-


and years of erosion had occurred, would have been drainage ways, needing no dams.

Endless are the myths concerning early North America, and one of them, long yet to live, is the story of irrigation canals in Yucatan and the earlier home of the Mayas on the mainland, and throughout Mexico and Central America generally. A few small ditches remain, but all the ancient irrigation canals in North America have been described in these pages.

Asst. Prof. Schenck, of the University of California, Berkeley, has made several trips to compare the irrigation systems in the ancient Salt River Valley with those of similar antiquity which he had studied in South America. After a year spent in going up and down the Andes, he failed to find a single ancient dam, but unnumbered small ditches cut and built in the stone mountain sides. In each case, at the river, a sunken gallery, lined and roofed with stone, drained away a part of the mountain stream. The modern natives call this a “pukio,” and use them today, unaltered from the time of the ancient builders, to serve the same puny strips of ground.

A German scientist, Prof. Dr. Martin Gusinde, entered the employment of the Chilean government and was detailed to study these ancient systems throughout the central Andes. Later he became a Franciscan teacher and when in Phoenix he gave the writer the results of years of work. With emphasis he stated that he had never seen an ancient canal which had served more than a thousand acres, and that he doubted if there ever would be found in all South America an ancient irrigation system which had supplied five thousand acres.

A chapter has been written on the type of canal building in these districts of South America, but my physical strength prevents editing it. Data has also been gathered concerning the irrigation areas served in Egypt and Mesopotamia 3000 years ago, and with the unexpected discovery of the smallness of each separate district served. Also was noted that Old World scholars are as human as the rest of us: as one example, what one distinguished authority declares to have been a great storage reservoir is declared by another equally eminent authority to be but an accident in the terrain. We believe that the only single irrigation unit in the ancient world larger than this in the Salt River Valley existed in China, but health having prevented the opportunity to submit to the editor four more chapters to prove all these things, I close.

These four chapters on Prehistoric Irrigation have been bound as a separate monograph, price $1.00; address State Historian, Capitol Bldg., Phoenix.