A UNIQUE PREHISTORIC IRRIGATION PROJECT

BY

HENRY C. SHETRONE

Director, Ohio State Archaeological and Historical Society, Columbus, Ohio

Joseph K. Long III

FROM THE SMITHSONIAN REPORT FOR 1945, PAGES 379–386
(WITH 5 PLATES)

(PUBLICATION 3834)

SMITHSONIAN INSTITUTION
WASHINGTON
D. C.

3834

A UNIQUE PREHISTORIC IRRIGATION PROJECT

BY

HENRY C. SHETRONE

Director, Ohio State Archaeological and Historical Society, Columbus, Ohio

FROM THE SMITHSONIAN REPORT FOR 1945, PAGES 379–386
(WITH 5 PLATES)

(PUBLICATION 3834)

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1946

A UNIQUE PREHISTORIC IRRIGATION PROJECT[1]

By Henry C. Shetrone

Director, Ohio State Archaeological and Historical Society
Columbus, Ohio

[With 5 plates]

Intentional diversion of water from its natural channels, for the purpose of irrigating regions of inadequate rainfall, is widespread in time and space. Usually, however, it is thought of as something of an innovation and as of more or less local significance.

Inhabitants of humid areas are likely to underestimate the very considerable portion of the earth's surface where the natural supply of moisture is insufficient to meet the needs of agriculture and other human economic requirements. In the United States alone virtually one-half the land area, westward from its longitudinal center, is arid or semiarid, as are vast areas in Mexico and South America.

Much of the Old World, particularly those countries adjacent to the Mediterranean and in the Near East, where ancient civilizations originated and flourished, are arid and desertlike. The valleys of the Tigris, the Euphrates, and the Nile are classical examples of the dependence of life on the natural or induced overflow of these great river systems.

The importance of water—and the tragedy of too much or too little—are reflected in the early literature, both sacred and profane, from the time of the Babylonian poet-philosophers downward through the centuries. An outstanding record of excessive rainfall is that of the Noachian flood; a minor example may be found today in the rain belt where someone, perhaps with a picnic in prospect, hopes that tomorrow may be fair! In between, the annals of virtually every people contain legends of floods and consequent devastation. Because of insufficient rainfall Moses, leading the Children of Israel back to the homeland, smites the rock, that they may drink; and the Arab

[1] Address of the retiring president of the Ohio Academy of Science, delivered at the annual meeting of the Academy held in Columbus, Ohio, May 5, 1944. Reprinted by permission from The Ohio Journal of Science, vol. 44, No. 5, September 1944.

sheik bespeaks the compassion of Allah in the matter of the failing desert spring.

The crude methods of conserving water for domestic and agricultural use employed by present-day Pueblo Indians of the arid southwestern United States are a matter of common knowledge. Natural springs and water holes are seasonal sources; rivers which carry water through the year serve those living adjacent thereto; but by far the greater number of inhabitants must conserve rainfall and storm water from the mountains and the high mesas in natural depressions, converted into reservoirs by means of dams and other artificial modifications. While in some instances ditches lead from these to nearby fields and gardens, the Indian women usually must carry water in jars for hand-irrigation of their meager crops. Archeological investigation has shown that, with few exceptions, surprisingly similar methods were employed in prehistoric times in the same general area.

This paper, however, is concerned with the historic aspects of irrigation only as a frame or background for an even more romantic phenomenon—prehistoric irrigation in the New World!

Although a matter of record, it is not generally known that in south-central Arizona, long before the discovery of America, the native aborigines had perfected an impressive system of irrigation, which made possible the successful practice of agriculture over a period of several centuries. This system has been referred to as a "million-dollar project, constructed with nothing more than rude stone hoes and wooden digging sticks."

Residents of Ohio and adjacent parts of the Middle West, where the civilization of the so-called Mound Builders has been made known through exploration of their ancient tumuli, may not find this so incredible; but to many persons, accustomed to thinking of all prehistoric peoples as mere savages, the phenomenon is certain to be something of a surprise.

A glance at the map of the southwestern United States will serve to set the stage for the human drama which now unfolds itself. It will be noted that the State of Arizona, youngest of the American commonwealths, is bounded on the north by Utah and Colorado; to the east is New Mexico, and to the south is old Mexico. The great Colorado River, beyond which is California, forms Arizona's western boundary.

Traversing the State from northwest to southeast are southern extensions of the Rockies, and the high plateau where today live the Pueblo Indians and where in ancient times lived their predecessors, the prehistoric Pueblos and the so-called Basket Makers. To the west and south of the mountains is the Arizona desert region of scant rainfall, where, because of its much lower altitude, relatively high temperatures prevail.

In south-central Arizona is the city of Phoenix, capital and metropolis of the State. From the mountains and high plateau toward the east come two rivers—the Salt from the northeast and the Gila from the southeast. They converge just west of Phoenix and find their way, as the Gila River, to the Colorado and the Gulf of California.

The State of Ohio sometimes is referred to as the land of the Mound Builders; the valleys of the Salt and the Gila, particularly the region of which Phoenix is the hub, may with equal justification be referred to as the land of the Canal Builders! Here we have the double phenomenon of an area of considerable extent, by nature arid and uninviting, which, for several centuries in prehistoric times, was made to "blossom as the rose"; which then reverted to its natural aridity; and now, once again, has become one of the more fertile and productive regions of the continent!

The visitor to Phoenix need walk but a short distance outside the city limits to come upon one or more ancient irrigation canals. Accompanied by a guide familiar with the terrain, he will be able to trace a number of others, and will learn that prior to their partial obliteration by present-day agriculture, some 125 miles of main irrigation canals were existent in the Salt River Valley and perhaps half that mileage in the valley of the Gila. Many of these measure as much as 30 feet between their crowns and reach depths of 10 feet or more. Even at this late date some of these may be traced for as far as 10 miles.

The canal system in the Salt River Valley consisted of several independent units, or main canals, each with many branch canals and ditches. Intakes of the main canals were far enough upstream to provide sufficient "fall" for successfully irrigating their respective areas. The lateral branches, most of which long ago were obliterated through erosion and silting, must have aggregated hundreds of miles.

An aerial survey of the valleys of the Salt and the Gila was effected in 1930 through the cooperation of the Smithsonian Institution, the United States Army, and certain authorities in Arizona. This aerial reconnaissance, during which the region was accurately photographed and mapped, was followed by a ground survey under the direction of Phoenix city archeologist, O. S. Halseth. As a result of this dual survey, what admittedly is the only true irrigation culture in prehistoric America has become a matter of record.

This brief outline of prehistoric irrigation and agriculture in Arizona should elicit a desire on the part of the reader to learn something of the people responsible for their development. Who were the ancient Canal Builders? Spanish padres and adventurers from old Mexico, who came into the region toward the close of the seventeenth century, perhaps were the first white men to ask this question. Naturally, they sought the answer from the native Indians,

676212—46——25

the Pimas, resident in the district, and received the reply, "Ho-hokam!" meaning nothing more nor less than "those who have vanished." The canals and the adjacent ruins already were abandoned and ancient as far back as Pima tradition carried.

Thanks to archeological researches sponsored by the University of Arizona, the city of Phoenix, Gila Pueblo of Globe, Arizona, the Bureau of American Ethnology, and other agencies, the erstwhile forgotten annals of the Canal Builders in great part have been recovered and recorded. This is particularly true of the material aspects of their culture.

As indicated by their numerous irrigation canals, the Hohokam peoples were agriculturists. In and adjacent to the Salt River Valley there are the ruins of some 20 ancient farming communities, each with its central communal adobe structure, with perhaps half that number in the valley of the Gila. The most impressive of these ruins in the Gila drainage is the noted Casa Grande, now preserved as a national monument.

Outstanding in the Salt River Valley is Pueblo Grande, a part of the park system of the city of Phoenix, located just east of the city limits. Here the enterprising capital city of Arizona has erected an anthropological laboratory in which is housed a museum of the Hohokam culture, workrooms and laboratories, accommodations for visiting anthropologists and students, and living quarters for the director of the laboratory, who also has the title of city archeologist. During the months of February and March 1944 the author had the pleasure of being a guest at the laboratory, with unusual opportunity for studying the Hohokam culture at first hand.

A brief description of Pueblo Grande ruin and its adjacent farming community will serve as an index to the culture as a whole, which is quite homogeneous throughout the area of its occurrence.

The ruin of the Pueblo Grande community structure, adjacent to the laboratory, is a more or less rectangular truncated mound of earth and stone, some 150 feet in width and 300 feet in length with an approximate height of 30 feet. It has been partially excavated by Director Halseth and his associates and students, and proved to consist of a large number of rooms or compartments of varying sizes. The walls and partitions are constructed of flat stones and boulders imbedded in adobe clay, with roofs of logs, poles, brush, and adobe. Enclosing the structure, and built from similar materials, was a high wall. Entrance to the resulting compound presumably was by means of ladders. The structure and its compound served the community as a granary and storehouse for their corn, beans, squash, and other products and possessions, and as a safe retreat from marauding tribesmen from outside their borders. The great size of the structure

and its many rooms are accounted for by the fact that adobe construction was at best only temporary or semipermanent, and required frequent repairs, abandonment of certain parts, and the building of new units.

Outside the compound and adjacent thereto were the cultivated fields, comprising many acres. Here, too, the people lived, their domiciles being merely crude shelters of poles and brush, their floors somewhat below the surface of the ground—a type of domicile known to archeologists as pit houses.

It would be unfair to judge the culture of the Hohokam peoples solely by their unassuming dwellings, for it should be remembered that in the mild climate of their country they could be, and were, people of the great outdoors. Their amazing system of irrigation canals and the resulting agricultural development, together with their pretentious communal centers and their ceremonial ball courts, are sufficient to place them on an advanced plane of culture; nor should one overlook their admirable development of the minor domestic arts. While little of a perishable nature has survived the destruction wrought by time and the elements, their utilization of clay, stone, shell, and other time-resisting materials, is in keeping with their major accomplishments. The potteryware of the Hohokam, particularly, is exceptional, and many fine examples of pots, jars, vases, and bowls, of pleasing form and decoration, have been recovered. Equally impressive, if not as artistic, are the numerous metates and manos, for grinding corn and other grains and seeds, while their stone axes are among the finest known. Beads, pendants, bracelets, and necklaces of shell and other materials are much in evidence, and turquoise occurs sparingly. Chipped flint projectile points and knives, while often of good workmanship, are much less abundant than in the Middle West, obviously for the reason that the Hohokam were mainly agricultural and only moderately dependent on wild game for food. Tobacco pipes are of very infrequent occurrence, as contrasted with Ohio, where large numbers are found in the ancient mounds and burial sites. Tobacco doubtless was ordinarily smoked as cigarettes.

While archeologists specializing in the culture are virtually agreed that the Hohokam came into the Salt and Gila Valleys at or slightly before the beginning of the Christian Era, there is no definite evidence as to their origin. There *is* some evidence of affinity with the lesser-known Mogollon and Cochise cultures to the south, and of contact with the Pueblo peoples to the north, but the full significance of these remains undetermined.

Fortunately, however, the approximate period of their occupancy and the probable time and cause of their disappearance from their

homeland in Arizona now are known. The techniques employed in discovering and recording a major part of the story of the Hohokam peoples, after the lapse of centuries, not only is a romance in itself, but is an example of the efficiency of the methods of archeology as well. Here, briefly, is the story.

Earlier in this paper it was stated that the Hohokam are believed to have come into south-central Arizona around the beginning of the Christian Era. At this point it may be stated that they disappeared from the region around A. D. 1400, some three centuries prior to the arrival upon the scene of Spanish explorers and adventurers from old Mexico. For the evidence on which this chronology is based, we must turn momentarily to another region and another people—the Pueblo nations of the high plateau and canyons.

Here in a region of evergreen forests, the ancient ruins of the Pueblo peoples actually have been dated by means of tree-ring counts, a technique developed by Dr. A. E. Douglass of the University of Arizona. Details of this immeasurably important development cannot be given in the limited space of this paper. It is one of the romances of American science. (See bibliography.) Suffice it to say that most of the major ruins and scores of minor ones in the Southwest now have been dated by this method, and that the chronology of the region has been carried back to the first century A. D.

As a result of the tree-ring method of dating, those ruins in forested areas adjacent to the Hohokam country show significant changes through the centuries in types and decorations of potteryware and in virtually every aspect of their material culture; and since there was more or less of trade and barter as between the two areas, the finding in a Hohokam site of a Pueblo pottery vessel of, let us say, the period of A. D. 1000, is suggestive to say the least. Multiply such individual instances by any reasonable number, and at least a near-contemporaneity is the result. Although the Hohokam country is virtually lacking in large trees, through such analogy and comparison its ruins are dated.

Finally, when all evidence of Hohokam activity ceases, and no further objects known to pertain to other cultures appear in their ruins, it is logical to assume that their career as a people was ended. Such conditions are found to obtain not much later than A. D. 1400.

The disappearance of so advanced a people from a region which they had converted into an admirable place of residence was due to two major causes. One of these is disclosed in a brief consideration of the present-day situation.

In the 1870's Mormon settlers appeared in the Salt River Valley and began clearing out ancient irrigation canals and constructing others. In the ensuing years this initial enterprise has grown by

leaps and bounds, with some 400 square miles of terrain, requiring annually 1,000,000 acre-feet of irrigation water, now under cultivation. Thus the land of the ancient Canal Builders once more has come into its own, and the Salt River Valley—the Valley of the Sun—with its great citrus groves, date orchards, farms which produce as many as three crops annually, and subtropical plants and flowers growing in great profusion, is indeed an oasis in the desert.

In view of the fact that this transformation is due entirely to irrigation, it may appear contradictory to suggest that irrigation was the principal cause of the downfall of the Hohokam peoples. The Salt River Valley is underlaid with a "volcanic pocket" of clay or marl which is virtually impervious to water. According to estimates of the Salt River Waters Users Association, one-fifth of the total irrigation water enters the ground as seepage, and builds up the water table at the rate of from 3 to 5 inches each year. During the period from 1870 to 1920, when irrigation was much less intensive, one-third of the area under irrigation was rendered unfit for cultivation as a result of accumulated seepage and attendant alkalinity. Under present-day intensive irrigation, the entire area, within a comparatively short time, would be little short of an alkaline bog. This threat now is averted by periodic flooding to eliminate alkali and by using a battery of electric pumps for the purpose of removing surplus water—some 300,000 acre-feet annually.

The ancients had no drainage facilities, pumps or otherwise. The result was inevitable; surplus water and alkalinity, water-logged soil, and dwindling productivity. This is evidenced by the fact that exploration of the Pueblo Grande ruin demonstrated that the floors of granaries and storerooms had repeatedly been elevated in an effort to keep them above the water-logged surface of the ground.

An additional situation, which may have been the coup de grace of Hohokam survival, was the constant threat from marauding nomadic tribesmen from the plateau areas. It is known that from early historic times the agricultural peoples of the valleys were frequently raided by the Navajo, the Apache, and other predators who made bold to reap where they had not sown, and there can be but little doubt that the peaceful Hohokam peoples, throughout their sojourn in their chosen country, were forced to contend with similar hostile incursions. Faced by such handicap, and seeing their once fertile acres gradually transformed into water-logged and alkaline wastes, it was inevitable that their numbers must decline to the point where a few hungry stragglers either found refuge with other tribes or passed entirely from the picture.

Today there remain only the old canals and the ruins of once impressive communal structures—mute evidences of a people who

had carried the human experiment, through trial and error, to a level which must command the admiration of all discerning men; a people who, but for a natural calamity with which they could not cope, and because of the rapacity of unscrupulous and hostile neighbors, might have borne the torch of civilization to undreamed-of heights. The construction of a million-dollar irrigation system, representing a high degree of engineering skill, attests to their energy, strength, courage, and initiative.

Our culture of today is complex, while theirs was simple; but who would venture to say that ours is "higher" or better? We, as were they, are still beset with the threat of natural calamity, and by "man's inhumanity to man." The first of these is nothing as compared to the latter, which precipitated all mankind into a holocaust such as the world never has known, the aftermath of which conceivably might be more disastrous than the titanic struggle itself.

The only criterion which justifies an assumption that one culture is higher or better than another, is proof that it provides a larger measure of cooperation, usefulness, spirituality, morality—and human happiness!

A BRIEF BIBLIOGRAPHY

Irrigation:

General

Newell, Frederick H. Irrigation in the United States. New York, 1902.

Arizona:

Halseth, Odd S. Prehistoric irrigation in central Arizona. The Masterkey, Los Angeles, 1932.

Halseth, Odd S. Prehistoric irrigation in the Salt River valley. Bulletin 296, Univ. New Mexico, 1936.

Schroeder, Albert H. Prehistoric canals in the Salt River valley, Arizona. American Antiquity, vol. 8, April 1943.

Tree-ring Dating:

Douglass, A. E. Tree rings and chronology. Bull., vol. 8, No. 4, Univ. Arizona, 1937.

Douglass, A. E. Southwestern dated ruins, V. Tree Ring Bull., vol. 5, No. 2, 1938.

Hohokam Culture:

McGregor, John C. Southwestern archeology. New York, 1941.

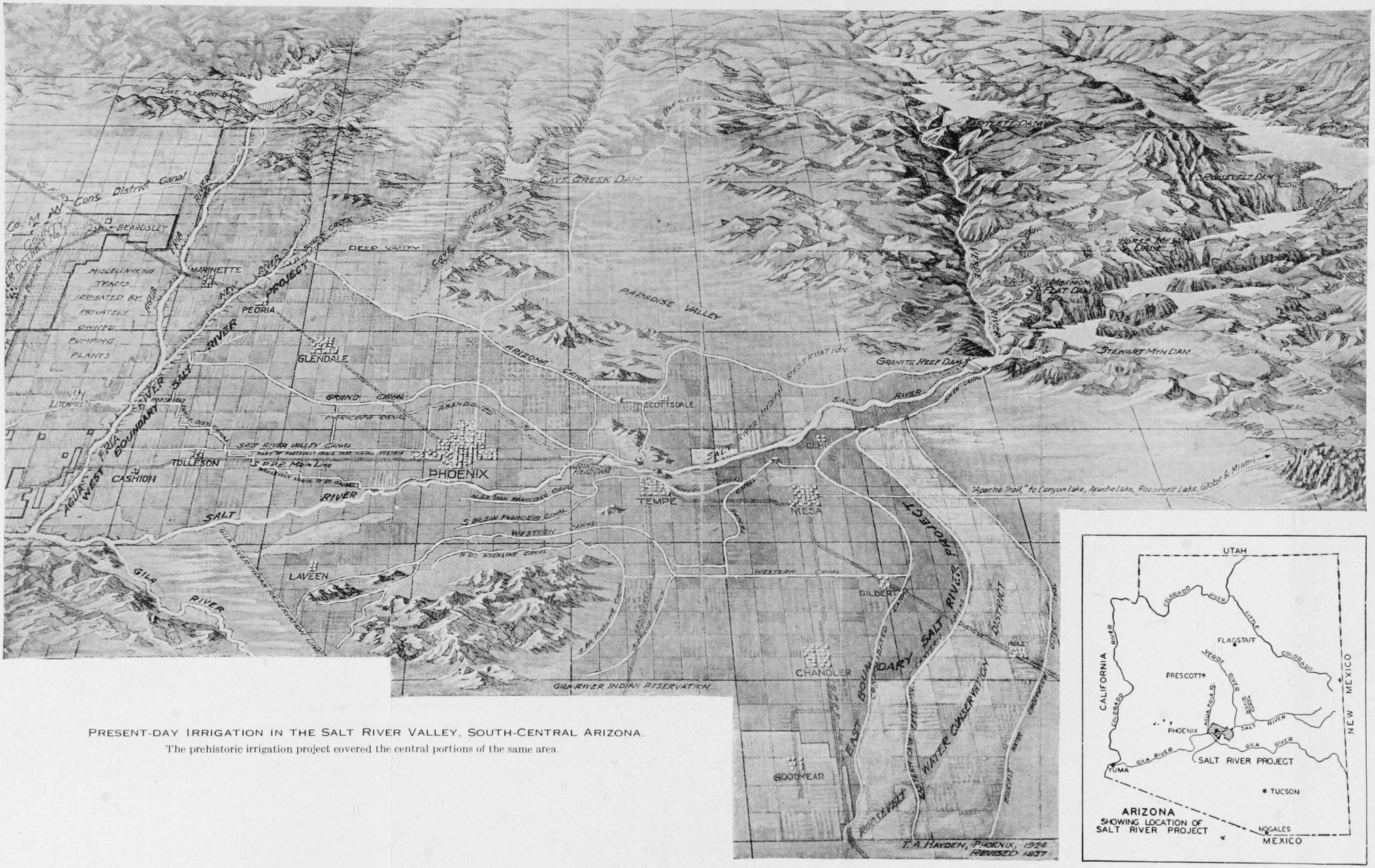
Various authors in Medallion Papers. Globe, Ariz.

Southwestern Archeology:

Kidder, Alfred V. An introduction to the study of Southwestern archeology. Andover, Mass., 1924.

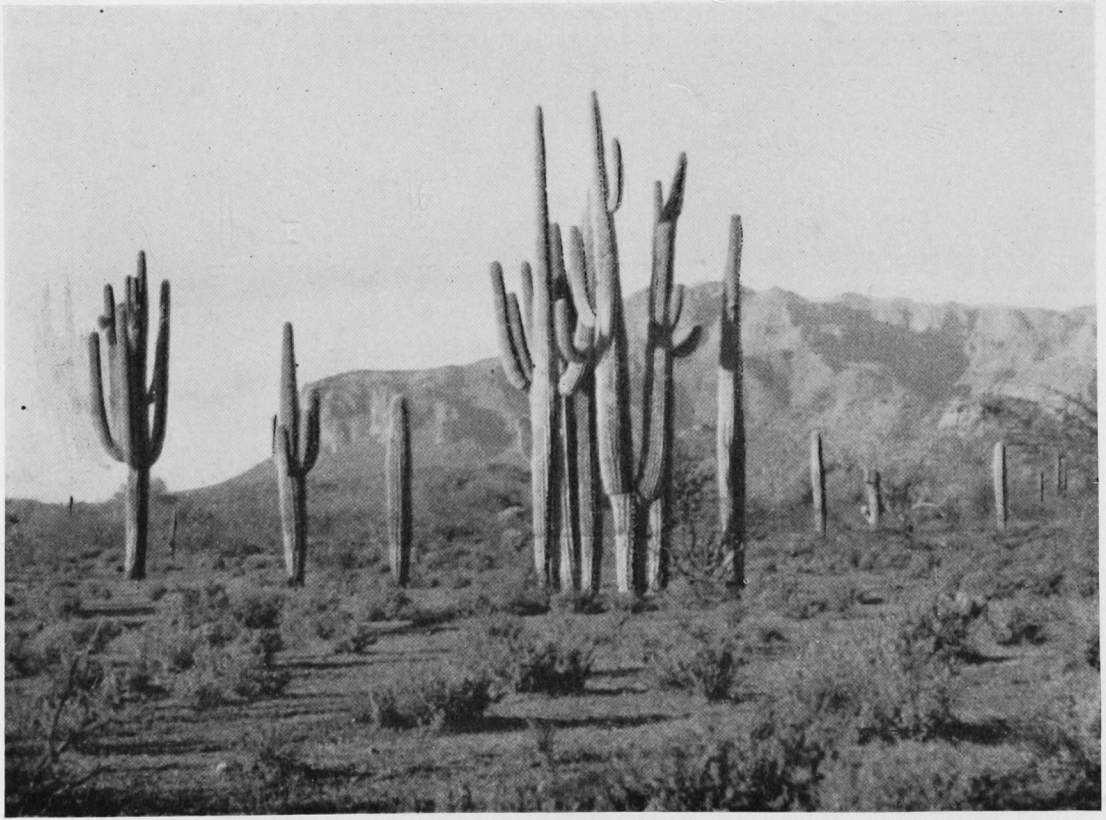
McGregor, John C. Southwestern archeology. New York, 1941.

For earlier references, see Handbook of American Indians. Bur. Amer. Ethnol. Bull., Washington, 1910.



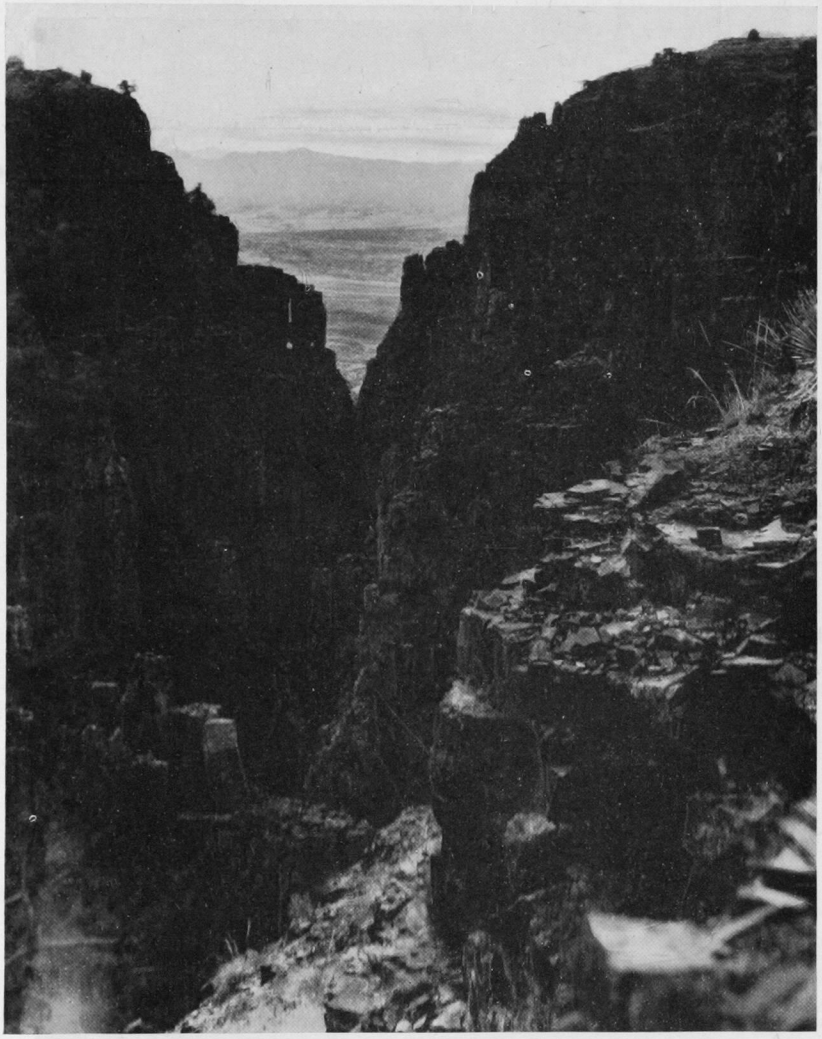
PRESENT-DAY IRRIGATION IN THE SALT RIVER VALLEY, SOUTH-CENTRAL ARIZONA.

The prehistoric irrigation project covered the central portions of the same area.



TYPICAL LANDSCAPE OF UNIRRIGATED SECTION OF SALT RIVER VALLEY.

(Photograph by Odd S. Halseth.)



VIEW OF MOUNTAINS FROM APACHE TRAIL, EAST OF PHOENIX.

Upper course of Salt River, source of irrigation water, seen through the gap. (Photograph by Odd S. Halseth.)

SECTION OF A PREHISTORIC IRRIGATION CANAL, JUST EAST OF PHOENIX.

(Photograph by Odd S. Halseth.

SMALL SECTION OF PUEBLO GRANDE RUINS, PARTLY EXPLORED.

(Photograph by Odd S. Halseth.)