

ARCHAEOLOGICAL RESOURCES AND LAND-USE PLANNING AN ARCHAEOLOGIST SPEAKS

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INTRODUCTION

When I was approached about writing an article on archaeological sites for this issue of *Field Notes* it was requested that, if possible, I follow the theme of the recent article by Dr. Wesley Peirce, "Geologic Hazards and Land-Use Planning" (*Field Notes*, September, 1972). In my case, the concern was to be with natural and man-made hazards that had or could affect archaeological remains. After reading Dr. Peirce's excellent review of geologically related land-use problems in the Tucson Basin, I devoted some time to a consideration of similar hazards (drainage problems, rock fall, earth cracking, subsidence, etc.) that had or might have an effect on prehistoric sites not only within the Tucson Basin but in the Southwestern United States in general. I ultimately came to the



Fig. 1. The Wild Goose site on the Virgin River in northwestern Arizona. This site consists of a rockshelter (arrow) and an occupied terrace bordering the river. Excavation of the terrace is shown in progress. Much of the occupied portion of the terrace had been washed away by periodic flooding of the Virgin River.

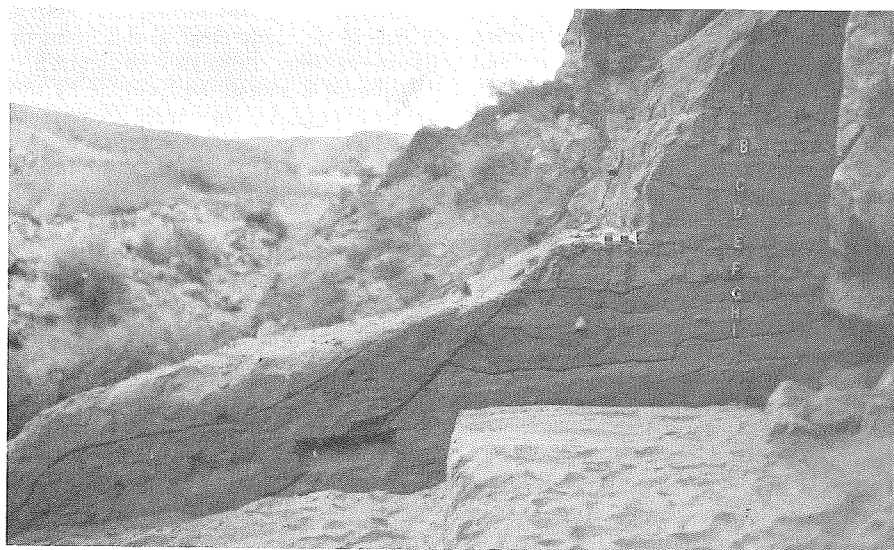


Fig. 2. Cultural stratigraphy at the Wild Goose site. At least eight separate occupation levels were recorded at this site. The earliest, I, was preceramic and could date as early as A.D. 1. The lower portion of level A probably was deposited in the 11th or 12th century A.D. Level F is non-cultural and consists of fine clay lenses deposited in standing water. A temporary damming of the Virgin River may have created this deposit. All of these levels extended much further to the north (left) at one time but have since been eroded away by floods in the Virgin River.

conclusion that the prehistoric peoples of Arizona and its neighboring states were actually much better land use planners than the modern inhabitants of these same regions!

GEOLOGIC HAZARDS AND ANCIENT PEOPLES

Certainly, examples of archaeological sites that have been cut by arroyos or removed through other erosional processes can be cited (Figs. 1 and 2). Several well-known sites in the Canyon de Chelly area including White House, Antelope House and Tse Ta'a have required special diking to prevent meandering washes from removing them. Furthermore, there are a number of ruins in the Southwest that now lie under rock falls. The latter situation is especially true of rockshelters in the canyon country of northern Arizona where spalling has occasionally caused large sandstone blocks to drop on portions of cliff dwellings. Earth cracking and subsidence

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ARCHAEOLOGIST *Continued*

also will destroy a few sites in areas where these phenomena occur. And it would be remiss not to mention that the eruption of Sunset Crater in approximately A.D. 1066 forced a sizeable aboriginal population in the Flagstaff area to temporarily abandon their homes.

By and large, however, the Hohokam, Mogollon, Anasazi, Sinagua and other prehistoric groups that once inhabited the Southwest selected village locations that presented a minimum of geologic hazards. This probably reflects the fact that these First Americans had gained an intimate knowledge of the country they inhabited — a knowledge that included an awareness of potential geologic hazards. For example, prehistoric occupation of the Tucson Basin was both extensive and intensive, but few villages were located on the floodplains of the various drainage systems that cut through the Basin. Terraces bordering the floodplains of the Pantano, Rillito and Tanque Verde, on the other hand, supported numerous villages. One such village, the University Indian Ruin, evolved from about A.D. 1200 to A.D. 1400 on the lower east terrace of the Pantano Wash. The great Hohokam site of Snaketown, recently established as the Pima-Hohokam National Monument, is located on the north bank of the Gila River near Gila Butte. This large center also reflects the land use knowledge of the Hohokam, for house areas and ceremonial structures were placed on a terrace well above the flood zone of the Gila. Even the eruption of Sunset Crater proved to be a boon rather than a handicap to the 11th century Sinagua horticulturists. The fine volcanic ash that was deposited over approximately 800 square miles served as a water-conserving mulch on farmlands, and harvests of the Sinagua increased in the early 1100's.

Other examples could be cited to support the contention that an awareness of natural geologic hazards probably prevented a number of natural catastrophes for prehistoric peoples in the Southwest. It is unfortunate that this lesson has either not been learned or has been learned poorly by modern land planners, who too often assume that our technology is sufficient for coping with or preventing destructive natural forces.

MODERN DAY LOSS OF ARCHAEOLOGICAL SITES

One can conclude that loss of archaeological sites through natural destructive processes, and more specifically geologic hazards, has occurred. However, the loss of historic and prehistoric sites *by other than natural means* has been and is far from minimal. The rate of loss is of such significant proportions, in fact, that an opportunity

to comment on hazards to archaeological sites is a welcome one, for the preservation of this resource should be the responsibility of everyone and is a fitting subject for consideration in land-use planning. It is also appropriate that this problem be discussed in this publication of the Arizona Bureau of Mines inasmuch as increased mining in the Southwest is one of the several activities detrimentally affecting archaeological resources.

In addition, there are, at present, a wide-ranging number of Federal, State, County and municipal projects, in addition to many private ventures, that are systematically removing evidence of historic and prehistoric inhabitants of Arizona and other states. A brief review of the major activities involved will help to clarify this problem and indicate what steps have been taken to reduce the loss.

ARCHAEOLOGICAL SITES AS RESOURCES

Before discussing the loss of archaeological remains, a comment on the designation of historic and prehistoric remains as resources is in order. Coincident with the realization in the past few decades that our national resources are not limitless has been an awareness that vestiges of our cultural heritage found in sites dating from at least 15,000 B.C. to the past century methodically are being destroyed. Ironically, destruction of these sites was often the result of development of some natural resource considered critical to the continued economic and social betterment of the nation. Until the past few years, it was difficult to persuade much of the citizenry that preservation of a Butterfield stage station, a Hohokam platform mound or a Paleo-Indian campsite was more crucial than continued national "progress." The increasing demands upon our natural resources and the accelerating use of land surface, especially in our Western states, however, has prompted increased concern for the archaeological sites that remain. It has become apparent that if we are to have even a minimal record of man's development, steps must be taken to preserve sites or preserve information through controlled excavation, analysis of recorded materials, and publication of recovered data. At this point the question is usually asked, "Why is a complete record of man's development necessary?" Beyond the simple answer that the archaeologist's reconstruction of past cultural systems help to satisfy man's curiosity about his predecessors, is the fact that many archaeologists, working as anthropologists, believe that a better understanding of man's past adaptations to his social and natural environments will make future adjustments easier. A better understanding of prehistoric land

and water use in southern Arizona, for instance, could in some cases save water and reduce property loss for the modern Arizonan. Certainly the bearers of these early cultural systems had the benefit of much longer exposure to these problems than the relatively recent European.

Preservation of these resources is even more important when it is acknowledged that archaeological remains are "a limited, fragile, non-renewable part of the environment, and disturbance of them results in irreversible and cumulative impacts" (Scovill, Gordon and Anderson 1972).

CURRENT LAND-USE HAZARDS TO ARCHAEOLOGICAL RESOURCES

At least seven types of human activities prevalent in the Southwest today pose threats to archaeological resources. A rough estimate of the extent of the threat to the resource is the amount of land utilized by any one activity. Such an estimate must be factored by the probability that an event of archaeological importance took place in any one section of land used by that activity and the degree of severity of the disturbance to the surficial character of the land caused by that activity. Table I shows the comparative land use in Arizona in 1966 by several categories of activities and may be considered to some degree an estimate of the magnitude of the insult to archaeological resources which has already taken place. The rate of increase of certain of these activities is the source of concern to archaeologists today.

Inasmuch as many activities planned for land usage require surficial modification or depth excavation, archaeological sites are of necessity destroyed while conducting that activity. It should be made clear at this point that preservation through excavation is considered a second-best choice by most archaeologists. In most cases the continued preservation of the site in an unaltered state is the optimum condition for these resources. Techniques for extracting increased amounts of information from the archaeological record are perfected yearly, with the result that a site excavated today will yield infinitely more data than if it had been excavated ten years ago, and even more information will be obtainable ten years hence. Each site preserved intact is, in a sense, data in the bank to be drawn on in the future. Additionally, contrary to popular opinion, archaeologists are not constant field men but devote an equal amount if not more time, to analysis and interpretation of their finds in the laboratory. An increased excavation schedule resulting from increased land use means less time for research and publication.

Table 1
COMPARATIVE LAND USE IN ARIZONA, 1966

Primary Use	Estimated Area (Acres)	Percent Of Total
Grazing (Minimum)	40,039,000	55.08
Recreation	23,092,000	31.76
High Density Recreation Areas	92,000	
General Recreation	3,000,000	
Natural Environment, Scenic Splendor, and Wilderness Areas	20,000,000	
Commercial Forestry	3,870,000	5.32
Military	3,134,000	4.32
Crop Agriculture	1,250,000	1.72
Water Surface Area	384,000	0.52
Inter-city Roads and Highways (Does not include 49,000 acres of roads in national forests and parks)	373,000	0.51
Urban (residential, commercial, and industrial)	320,000	0.44
Mineral Industries	93,000	0.13
Public Utilities	60,000*	0.09
Railroads	54,000	0.08
Burned-over Areas (1967 Only) (47,000 acres burned over in 1966)	19,000	0.03

Source of data: Division of Economic and Business Research, The University of Arizona, and various other sources.

In the following discussion of each type of expanding activity it will be noted where steps are being taken to mitigate the adverse effects of these activities on the resources. Activities have been listed roughly in the order of the magnitude of their effect on archaeological resources.

Land Development

Probably no other activity is removing archaeological sites at a faster rate today than land development for housing, industry and commercial recreation. Tract housing construction in areas such as the Tucson Basin and "planned" cities and retirement centers developed by large corporations are stripping archaeological remains from the land in unbelievable numbers. The proportionately great loss of sites as a result of these activities can partially be attributed to the fact that modern cities frequently are located in the same areas selected prehistorically for dense population clustering. As an example, Phoenix and its neighboring communities are situated in one of the most intensively occupied Hohokam areas in Arizona. Yet less than five percent of the sites that once dotted the Valley in the Sun (and now are under housing) have been studied or preserved.

Unfortunately, most land development enterprises are not characterized by a concern for preservation of sites or site information. This situation is largely because much of this type of development is not on State or Federal land and, therefore, antiquities are not

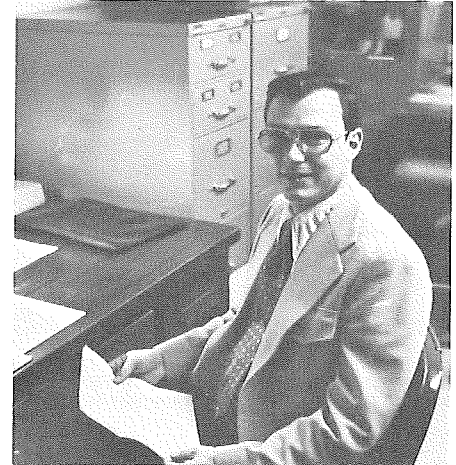
protected. The potential development of the Rancho Romero properties along the Canada del Oro north of Tucson, for instance, could reduce drastically our knowledge of the evolution of prehistoric agricultural societies in southern Arizona. Although a few far-sighted developers have set aside small tracts for the preservation of particularly important sites (as at G.A.C.'s Rio Rico development), the acreage devoted to preservation is proportionately insignificant to developed acreage.

Agriculture

Increased agriculture in Arizona also is affecting archaeological and historical resources. Expanded farming along the lower Gila River within the past decade has removed numerous prehistoric and historic sites, and our knowledge of the long occupancy of this area is severely reduced. Similar situations prevail in most the major river valleys of southern Arizona.

Farmers have been notable contributors to archaeological discoveries. Often, though, disturbance of these sites takes place before experts are alerted to their existence. This results in the loss of valuable information concerning the context in which a relic was found and contributes only the relic itself to science and public view. The large number of individual agricultural activities makes it all but impossible for the professional archaeologists in any region to anticipate and to be present at the time of discovery.

NEW METALLURGIST



Dr. Walter W. Fisher, New Assistant Metallurgist

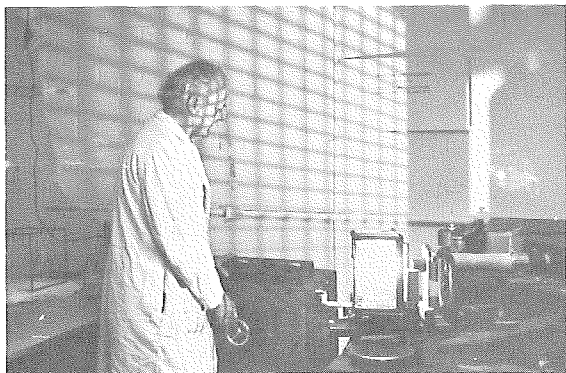
The Bureau is pleased to welcome Dr. Walter W. Fisher to its staff as Assistant Metallurgist. Dr. Fisher was formerly a metallurgist with the U.S. Bureau of Mines in Salt Lake City, where he did research work in copper cementation and refining of cement copper and leaching of sulfide minerals. His primary areas of interest are hydrometallurgy, reaction kinetics, and solution chemistry.

He received the Ph.D. and M.S. degrees from New Mexico Institute of Mining and Technology, and the B.S. Degree from the University of Utah. He is a member of AIME.

Mining

Increased mining in the Southwest, and especially in Arizona, can only lead to further loss of antiquities. In view of this problem, several of the various companies concerned have taken steps to aid in the conservation of site information where actual site preservation is not possible. Perhaps one of the best examples in Arizona is the work carried out in conjunction with strip mining in the Black Mesa district of northern Arizona. An agreement between the Peabody Coal Company and Prescott College during the early phases of geologic exploration of the mesa provided for the systematic survey of the region for archaeological remains and the excavation of these remains prior to land stripping. Since 1967, when work was started, approximately 300 sites have been located by the survey, and 25 of them have been excavated. Analysis of materials recovered and publication of the results of both excavation and survey have been funded by the company. Similar agreements have been established between the Arizona State Museum and Continental Oil Company for work near Florence and with Cities Service Company for survey and excavation in the Globe-Miami area (Fig. 3). Similarly, Arizona State University is under contract with the Hecla Mining Company

Continued on page 6



An arc of a SPECTROGRAPH produces eerie shadows while the different wave lengths of light are being recorded on film for subsequent analysis of chemical elements.



Many elements, such as the metals copper, lead, zinc, iron and magnesium, can be detected by VISUAL SPECTROSCOPIC ANALYSIS.



ROCK HOUND

The Arizona Bureau of Mines offers mineral identification services to residents of Arizona on specimens originating within Arizona. J. Mark Richardson, a graduate student in the College of Mines at The University of Arizona, has cleverly cartooned some of the people who utilize these services.

Minerals are identified by observing and testing for a combination of distinctive properties, including crystal form, hardness, and color. Many of the Bureau's testing services are free, but occasionally, samples submitted are intimate mixtures of fine-grained minerals which cannot be satisfactorily analyzed without utilizing such specialized equipment as the spectrograph (up). In such instances, a minimal charge is made to cover overhead costs. There is always a charge for any work performed on out-of-state samples.

WHASSIS ? ? ?



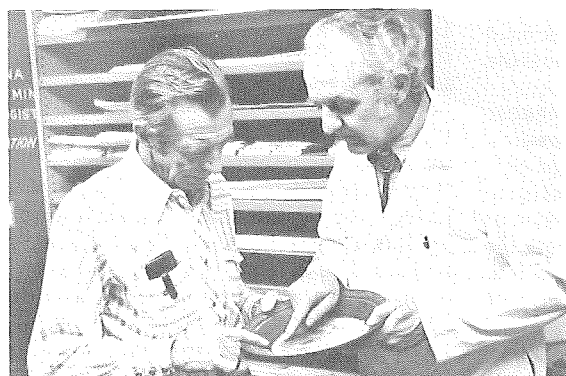
ANTHROPOLOGIST



Robert "Holmes" O'Haire, Mineralogist



PROSPECTOR



Far from being a thing of the past or a relic of the old West, a GOLD PAN is a very useful "now" tool for concentrating all heavy minerals, as prospector Ray Wallace knows.



Bureau laboratory assistant Tom McGarvin prepares a THIN SECTION—a slice of rock 3/1000" thick, mounted on a slide. Microscopic examination will reveal the optical properties of the minerals in the rock.



By X-RAY DIFFRACTION ANALYSIS, the mineralogist can establish a mineral's crystal lattice structure—the patterns that atoms assume in a mineral—thereby aiding mineral identification. In general, all minerals have unique crystalline structures by which they can be distinguished, even when composed of the same elements.



METALLURGIST



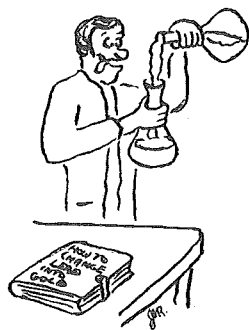
Small particles are sometimes quantitatively assayed by ATOMIC ABSORPTION SPECTROGRAPHIC ANALYSIS to gain knowledge of a mineral's chemical formula.



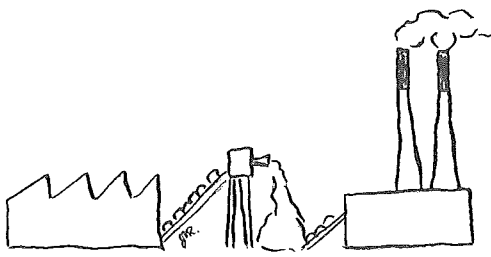
TREASURE HUNTER



HYDROLOGIST



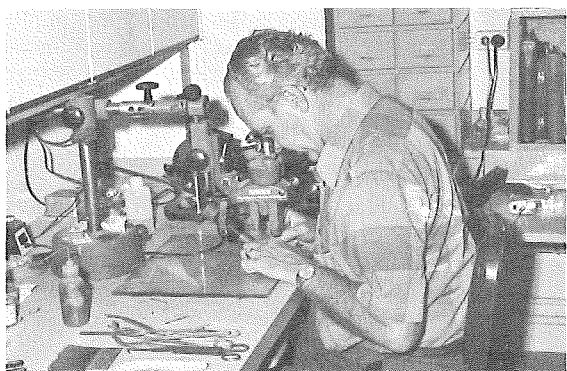
ALCHEMIST



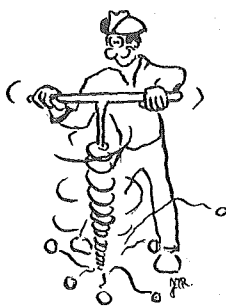
MINING COMPANY



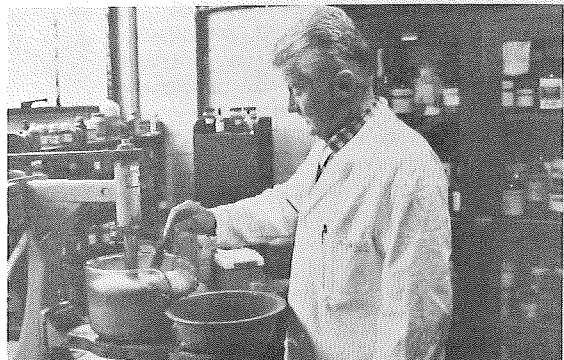
Many Arizona science teachers request the free mineral and rock kits prepared and distributed by the Bureau. These are available only to Arizona schools and, due to the heavy demand and limited supply, records are carefully kept of the number of sets sent to each school. Since 1970, 353 sets have been distributed to 188 schools.



Many samples have been identified under this BINOCULAR MICROSCOPE, which magnifies the specimen and therefore clarifies such physical details as striations, crystal forms, and grain relationships.



SOIL SCIENTIST



Dave Rabb is preparing a FLOTATION CONCENTRATE. Reagents are added to the ground-up ore. The desired mineral floats with the froth and the waste sinks. When the froth is skimmed, the concentrate can be analyzed by a method such as X-RAY DIFFRACTION to determine the ore minerals present.

ARCHAEOLOGIST *Continued*

Fig. 3. Excavation of Ta-e-wun, a Hohokam site in the Pinto Creek drainage. This site and several others have been excavated by the Arizona State Museum in cooperation with the Cities Service Company.

for archaeological work on the Papago Indian Reservation.

Not all mining activity in the Southwest is characterized by an interest in preserving archaeological resources, however. Despite the fractional cost of conserving information via excavation, the recovery of archaeological data is often considered a burden by the mining industry in terms of cost and potential time lost.

Land Reclamation and Flood Control

Several Federal agencies, including the Bureau of Reclamation and the U.S. Army Corps of Engineers, are involved in designing projects that ultimately alter the landscape in some respect. Such alteration can and often does affect archaeological resources. Implementation of the Central Arizona Project presently calls for the construction of a major tunnel through the Buckskin Mountains, three aqueduct systems and as many as four detention reservoirs. Several hundred miles of right-of-way for the aqueducts and as many as a hundred square miles of land in potential reservoirs must be examined for historic and prehistoric remains prior to construction. Surveys completed on two of the aqueduct transects located over 75 sites, and more than 200 sites are expected in just one of the proposed reservoirs.

Many Corps of Engineer flood control projects also submerge or remove archaeological resources. A recent archaeological survey of the planned Tat Momlikot dam and reservoir on the Papago Indian Reservation revealed 41 sites within the project boundaries. The sites are estimated to date from about A.D. 600 to the early 1900's. In this case, funds for the survey and the analysis of materials recovered from the survey were provided by the National Park Service.

Recreation

Development of State and Federal land for recreational purposes also affects archaeological sites. At present the Bureau of Land Management, National Forest Service and National Park Service, among others, are agencies involved in the creation of additional facilities to meet the demands of a public, that in ever increasing numbers, is discovering the recreational potential of our natural environment. Development of these facilities means not only the recovery and interpretation of information from sites that must be removed for parking lots, visitor centers, etc., but the protection of sites left intact as in-place exhibits. Occasional vandalism and the constant and increased use of these exhibits invariably result in site deterioration.

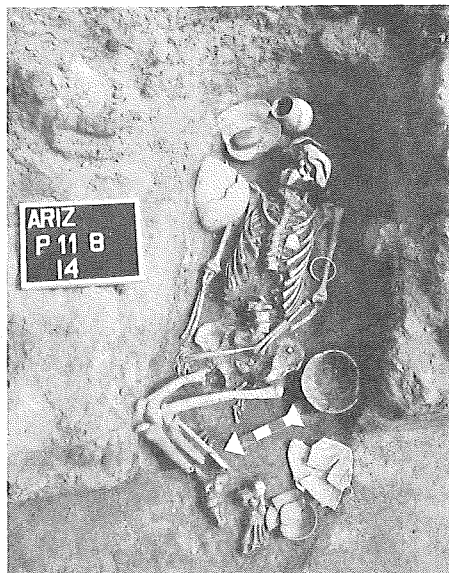


Fig. 4. A burial exposed as a result of trenching. The trench cut visible at the bottom of the photo disturbed a number of bones and two ceramic vessels. These were replaced for the photo. Note the Glycymeris shell bracelet on the left arm.

Highways, Public Utilities and Pipelines

Unlike most of the above activities, construction of highways, transmission lines, and pipelines result in linear swaths cut across the landscape rather than large blocks or tracts of land being leveled. The accumulated acreage, power line right-of-way, and trenches cut (Fig. 4) is as great, however, although the immediate impact may not seem as significant. Large-scale projects such as the installation of Tucson Gas and Electric power lines from the Four Corners area to southern Arizona, and the Interstate Program of the Arizona Highway Department have a notable impact on Arizona's archaeological remains. Historically, linear type projects were some of the first construction activities that were structured to include funds for recovering prehistoric data. The Arizona Highway Department was proceeded only by New Mexico's department in sponsoring a program designed to survey for archaeological sites within the right-of-way of proposed or enlarged highways and within borrow pits on all State and Interstate roads. This program also provides for the excavation of historic and prehistoric remains located within endangered areas (Fig. 5), the analysis of materials recovered and some assistance in the publication of results of data analysis.

Arizona Public Service, Tucson Gas and Electric and several other power companies have recently provided funding for study of areas proposed as power plant locations and corridors for transmission lines. Of special note are the pioneering efforts in pipeline archaeology supported by the El Paso Natural Gas Company in the early 1950's.

Vandalism

One additional activity affecting archaeological resources merits special attention. Vandalism, ranging from occasional weekend "potting" to the systematic looting by professionals of cremation areas, cliff dwellings, historic trash dumps and other sites specifically for recovering items to sell, is increasingly removing knowledge from the public domain. "Pot-hunters" not only remove artifacts from context, but disturb non-artifactual data in the process, making the task of the archaeologist who attempts to "salvage" a vandalized site all the more difficult (Fig. 6).

Unlike the other activities noted above, destruction of archaeological sites is the only purpose of vandals and not the by-product of another action. Although both State and Federal laws protect archaeological sites of these lands, vandalism has increased. This situation may be attributed in part to ignorance of the full implications of the statutes, and in other cases to a flagrant disregard for

the laws. Other inducements to looting are the relatively mild penalties if enforced and a large and lucrative market for Pre-Columbian artifacts. This problem also is partially aggravated by the exchange and sale of State and Federal lands, inasmuch as no antiquities legislation covers private holdings.



Fig. 5. Excavations of a kiva or ceremonial room on the Globe-Showlow highway (U.S. Highway 60). A portion of this structure was destroyed during the early construction of this highway. Road widening activities prompted subsequent salvage of this and other structures at the Skiddy Canyon Ruin.

WHAT HAS BEEN DONE TO PROTECT ARCHAEOLOGICAL RESOURCES

A concern for the protection and preservation of historic and prehistoric remains has characterized the Federal Government during this century and has been manifested in a series of statutes designed to safeguard our cultural heritage. Initially, despoilation of these resources prompted the enactment of the Federal Antiquities Act of 1906. This act gave the government the responsibility and ultimate accountability for the preservation of archaeological resources on lands under its ownership and control. This statute was followed by more specific acts including the Historic Sites Act of 1935, the Reservoir Salvage Act of 1960 and the National Historic Preservation Act of 1966.

The most recent legislation designed to safeguard archaeological materials includes the National Environmental Policy Act of 1969 and Presidential Executive Order 11593. The NEPA - 69, viewing historic and prehistoric sites as a part of the human environment, is concerned with the disruption or destruction of cultural resources and requires consideration of means that may be taken to mitigate their loss. A direct consequence of the NEPA - 69 has been the requirement that all Federal agencies prepare environmental impact statements on their projects. Archaeological resources must be considered in these statements, and all statements must include information relative to the cumulative impact that the project will have on future interpretation and study of the archaeological resources.

At present a number of institutions in Arizona including the Museum of Northern Arizona, Prescott College, Arizona State University and the Arizona State Museum are involved in developing archaeological data sections of environmental impact statements. Using guidelines established by the National Park Service, Arizona Archaeological Center, personnel at these institutions have evaluated both the direct and indirect cumulative effects of proposed construction on the historic and prehistoric cultural resources of the State. Similar studies are being carried out nationwide, especially in the Western states. This concept of preserving sites and designing research for preservation of site data goes much further than the earlier concept of "salvaging" archaeological sites prior to destruction.



Fig. 6. Dr. Emil Haury, Arizona State Museum and Department of Anthropology, viewing a vandalized site on the San Pedro River. Random digging has resulted in the loss of more than half of this Salado village.

WHAT CAN BE DONE TO PROTECT ARCHAEOLOGICAL RESOURCES

Public awareness and responsibility are the most important factors that will determine how much of our cultural heritage will be saved for future generations. The support of governmental legislation providing for the recovery and interpretation of these data will guide the extent to which funds can be expended for the necessary studies. A recent bill introduced in the United States Congress would have provided funds in the amount of one percent of all construction costs on Federal projects for recovering archaeological information directly affected by these projects. Though the bill did not pass last year, it will be reintroduced and passage is expected.

In addition to supporting proposed legislation, each citizen can aid in preserving these non-renewable resources by supporting enacted legislation.

The current conceptual orientation will provide a much firmer data base for interpreting this particular resource in the future.

Many Western states have passed legislation protecting antiquities located on state lands. Arizona pioneered in this field with the enactment of the first legislation in 1927, followed by the revised Arizona Antiquities Act of 1960. This legislation makes it illegal to despoil archaeological, historical and paleontological remains, to unnecessarily deface sites, and to fraudulently reproduce original archaeological specimens. Enforcement of the State act has not proved to be an easy task, but public awareness that this particular resource is constantly diminishing has helped in the curtailment of violations.

Observation of antiquities acts is more than the lawful duty of all Americans, it is basic to perpetuating their cultural heritage. Although a well-worn analogy, it is true, nonetheless, that each archaeological site lost is a page torn from prehistory. Americans are becoming increasingly conscious of the necessity to conserve our water, faunal, floral and mineral resources. A similar concern for past cultural systems is no longer a goal, it also is a necessity.

REFERENCE CITED

- 1973 Scovill, D.H., G.J. Gordon and K.M. Anderson - *Guidelines for the Preparation of statements of Environmental Impact on Archeological Resources*. Arizona Archeological Center, National Park Service, Tucson. Ms.

NEW BUREAU BULLETIN

Arizona Bureau of Mines Bulletin 186, **GEOLOGY OF THE VIRGIN AND BEAVERDAM MOUNTAINS**, which is the latest report to be published in the Bureau's series of geologic field studies, was released early in March.

The report, which was written by Dr. Richard T. Moore, Principal Geologist in the Bureau, describes the geology of a structurally complex range of mountains in the extreme northwestern part of Arizona, on the boundary of the Basin-and-Range and Plateau provinces.

Paleozoic and Mesozoic sedimentary rocks in the range have been deformed by major folding and disrupted by high-angle reverse faults, strike-slip faults with displacement of up to 8 miles, and normal faults with stratigraphic displacements of as much as 8,000 feet.

The bulletin, which is illustrated with numerous photographs and full-color geologic maps and structure sections, is priced at \$2.00 per copy to non-residents of Arizona and is free to residents of the State.

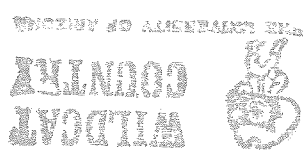
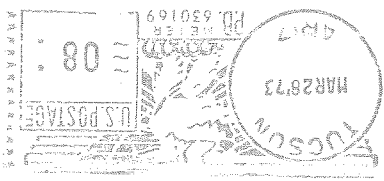
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