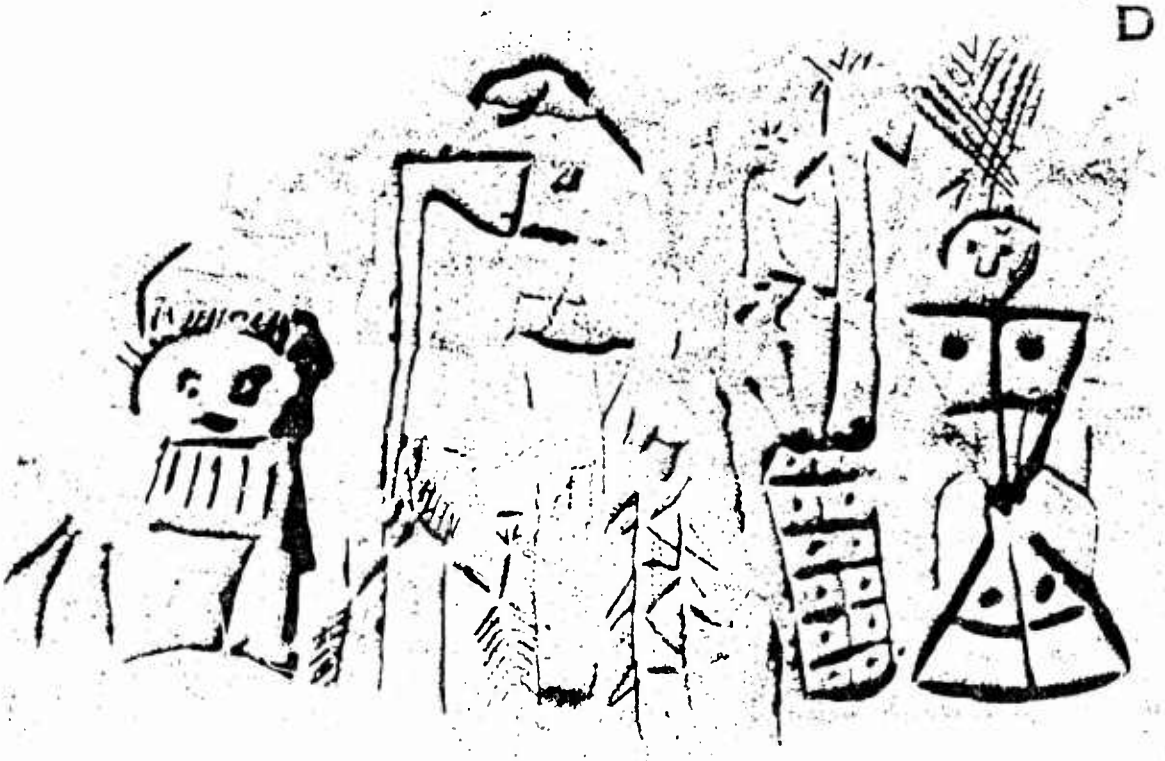
The Indian Hill Petroglyph Site, 14EW1, Kanopolis Lake: Development of Alternative Mitigation Plans

for the
U.S. Army Engineering District,
Kansas City, Missouri
Purchase Order No. DACW 41-79-M-1799



Grand River Institute
Grand Junction Colorado
1980

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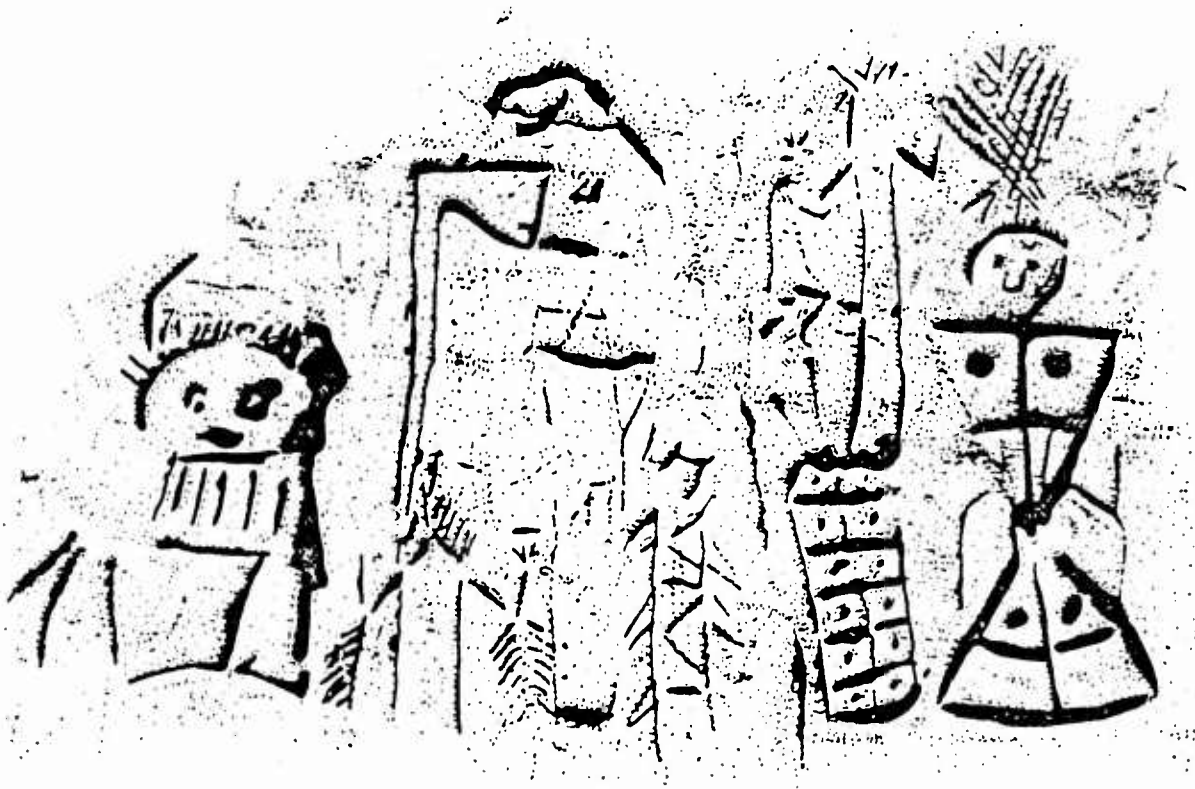

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Abstract

A study to determine alternative mitigation measures for the Indian Hill petroglyph site (14EW1), Ellsworth County, Kansas was undertaken by Grand River Institute, Grand Junction, Colorado at the request of the U.S. Army Corps of Engineers, Kansas City District. Currently listed on the National Register of Historic Places, the Indian Hill petroglyph site is being threatened both by natural and man-induced adverse effects. On-site inspection by Carl E. Conner (archaeologist) and John A. Burger (geologist) occurred 7 and 8 September 1979; evaluations concerning local rock structure and stability, present condition and rate of degradation of the petroglyphs, and possible mitigation measures were made. A literature search was conducted to provide information on the cultural background of the study area and to examine previous work done at the site.

The study determined that the Indian Hill petroglyphs are incised into a very weakly cemented, porous sandstone, the naturally high erosion rate of which is being compounded by undercutting through reservoir wave action and by increasing vandalism. Alternatives for mitigating the adverse effects being suffered by the site include documentation of the site through photography and molding/casting, stabilization of the sandstone, protection of the slope, control of public access, and education of the visitor.

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Preface

On 13 August 1979 Grand River Institute was authorized by the U.S. Army Corps of Engineers, Kansas City District, to commence work on a study to determine alternative mitigation measures for the Indian Hill petroglyph site (14EW1), Kanopolis Lake, Kansas. Principal Investigator for the project was Carl E. Conner, Project Geologist was John A. Burger. Clifton M. Wignall, Ph.D., served as Project Director.

The project was administered by Grand River Institute, 1030 Colorado Avenue, Grand Junction, Colorado 81501. The report was written and prepared by Carl E. Conner, Diana L. Langdon, Richard W. Ott, and Amy L. Reeder.

Acknowledgments

We sincerely thank John Burger, Senior Geologist with Bendix Field Engineering Corporation, for his contributions as Project Geologist. The help of Darrell Dodge and Lynn Gibson of the Soil Conservation Service, Salina, Kansas, who contributed information concerning the soils and biota of the study area, is greatly appreciated as well. Finally, we thank the U.S. Army Corps of Engineers personnel who provided assistance throughout the project.

INTRODUCTION

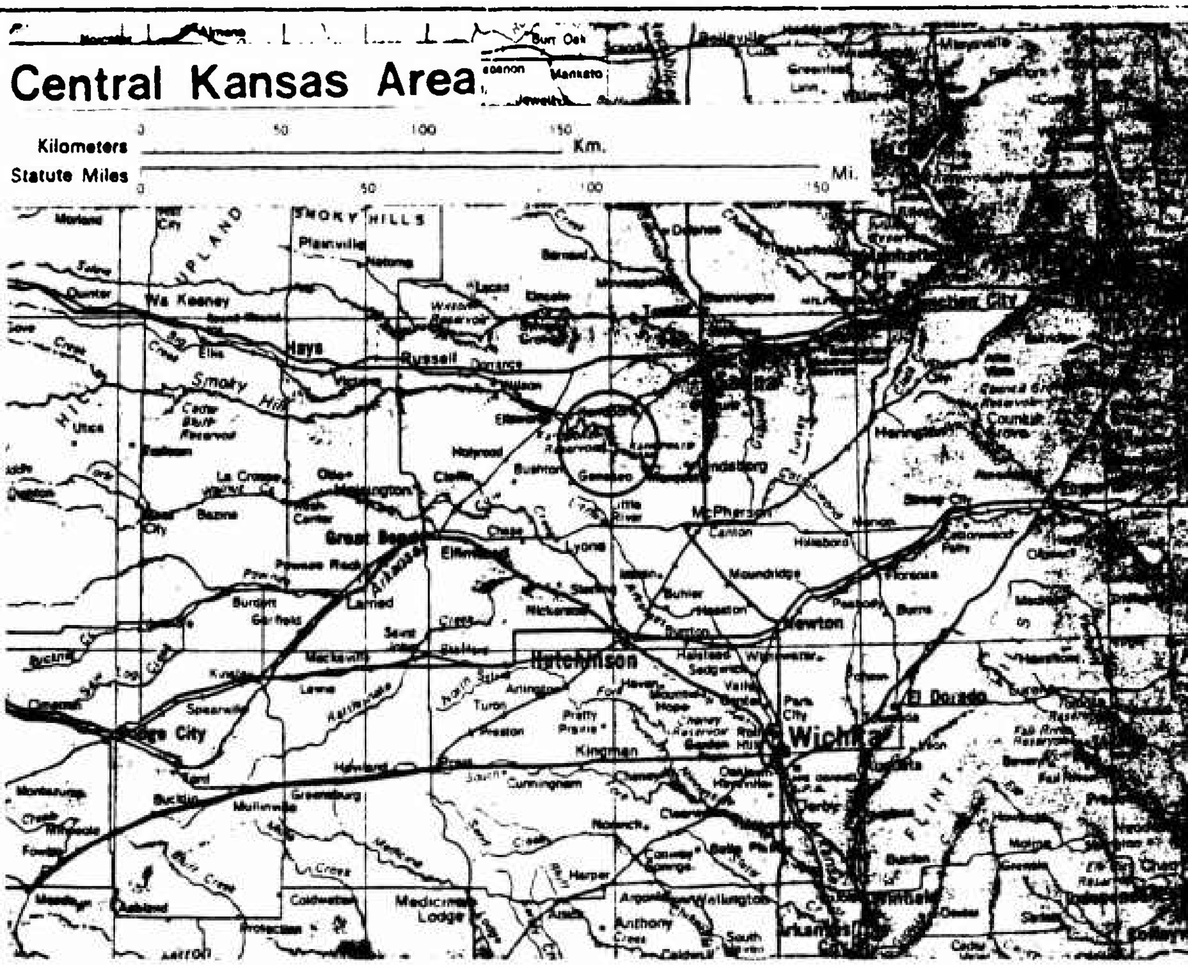
In August 1979, Grand River Institute was contracted by the U.S. Army Corps of Engineers, Kansas City District to conduct a study to determine alternative mitigation measures for the Indian Hill petroglyph site (14EW1) at Kanopolis Lake, Ellsworth County, Kansas. The site had already been nominated to the National Register of Historic Places; the current study was requested by the controlling agency to comply with the Advisory Council on Historic Preservation's regulations for the protection of Historic and Cultural properties (36 CFR 800.6 Council Comments, (b) Consultation Process); the National Historic Preservation Act of 1966 (Public Law 89-665); and Executive Order 11593, "Protection and Enhancement of the Cultural Environment", Section 2(a) (5/13/71). Funding for the study is authorized under Public Law 86-523 as amended by Public Law 93-291.

The purposes of the study were to: 1) conduct a review of the literature, government reports, and other sources of information on the Indian Hill site; 2) perform an on-site inspection of the site, examining the present condition of the petroglyphs and evaluating the structure and stability of the rock into which they are incised; and 3) develop alternative mitigation measures for the site and make appropriate recommendations.

The literature search involved reviewing previous archaeological reports for the Kanopolis Lake area and consulting library sources to determine the cultural background of this central Plains region. The on-site inspection was performed by Carl E. Conner and John A. Burger on 7 and 8 September 1979 under permission of the U.S. Army Corps of Engineers and under Purchase Order No. DACW 41-79-M-1799. This report presents the findings of both the literature search and the on-site inspection and discusses various mitigation alternatives for the protection and preservation of the Indian Hill petroglyph site.

LOCATION

The Indian Hill petroglyph site (14EW1) is located on the northern shore of Kanopolis Lake, Ellsworth County, Kansas (see Figure 1). Kanopolis Lake is formed by an earthen dam originally constructed for flood control in the Smoky Hill River basin in 1948. The dam is approximately 33 miles southwest of Salina, Kansas. The lake stores 61,400 acre feet of water at 1463 feet m.s.l., is 12 miles long, and has 41 miles of shoreline. Site 14EW1 occurs between the mouths of two tributary canyons, Red Rock and Horsethief; the numerous petroglyphs are on a south-facing exposure of Dakota Sandstone at an elevation of 1523-1535 feet m.s.l.



Map of central Kansas, showing general location of Kanopolis Lake and the Indian Hill site.

Figure 1.

ENVIRONMENTAL OVERVIEW

This section presents a summary of the modern physical environment of the Kanopolis Reservoir area and includes descriptions of the local topography, climate, geology, soils, flora, and fauna.

Topography

The Kanopolis Reservoir is located within the Smoky Hill River drainage at an elevation of approximately 1463 feet. The surrounding area is characterized by low rolling hills which expose occasional sandstone bluffs. A series of north/south-flowing tributaries feed the reservoir, many of which have springs at their sources.

Climate

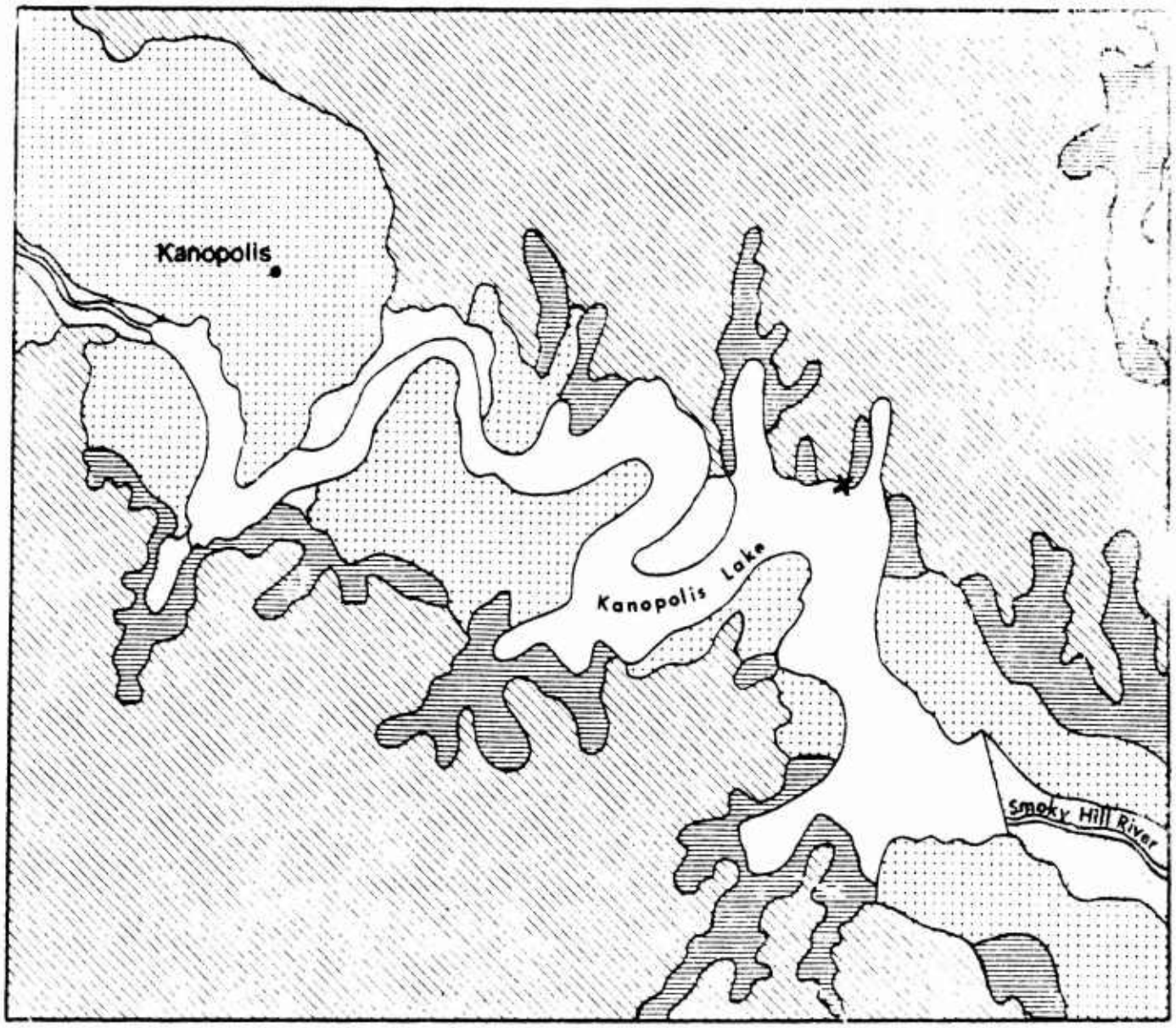
The climate of the study area can be described as moist subhumid (Robb 1959: 676-677). Mean annual precipitation is 24-28 inches, about 75% of this falls between April and September (the crop growing season). Annual snowfall averages about 10 inches. Mean annual temperature for the area is 58° F. Summers can be quite hot -- temperatures of 100° F. or higher occur on an average of 15 days. Mean maximum temperature for July is 96° F., mean minimum is 68° F. Subzero temperatures are common in the winter. Prevailing winds are from the south except during the period from December to March when they are often from the north/northwest. Wind speeds are generally around 10 m.p.h., but extreme winds of 90-95 m.p.h. have been recorded in the region (ibid.).

Geology/Soils

The Lower Cretaceous-age Dakota Sandstone is the dominant geologic formation in the Kanopolis Reservoir area. This formation is exposed along much of the northern shore of the reservoir and occasionally along the southern. Interbedded and lenticular deposits of shale, clay, siltstone, and sandstone characterize the Dakota, which regionally attains thicknesses of 100 feet to 300 feet but is exposed locally in sections less than 50 feet high (Kansas State Geological Survey 1964).

The Kiowa Shale, also lower Cretaceous in age, underlies the Dakota and is exposed in several locations bordering the reservoir. This deposit constitutes the uppermost formation of the Comanchean Series and is predominantly a medium- to dark-grey, micaceous, silty, carbonaceous, soft-to-hard marine shale with minor beds of limestone, sandstone, and bentonite (Merriam 1963).

Pleistocene alluvium occurs around much of the reservoir (particularly in the areas bordering the reservoir on the west and south) (Kansas State Geological Survey 1964). Figure 2 illustrates the surface geology of the Kanopolis Reservoir vicinity.



Geology of Kanopolis Lake Area

(Indian Hill site is indicated by an "X".)

Figure 2

Soils in the study area are brown and sandy and are derived from the underlying sandstones and shales. The significant soil is the Hedville loam, a shallow, excessively drained soil formed in residuum from non-calcareous sandstone. This is interbedded with the moderately deep, well-drained, clayey Edalgo loam which is formed from non-calcareous shale. The Eldago comprises about 35%-40% of the soils. The Lancaster loam comprises 10%-15% of the area's soils; it is a moderately deep, well-drained sandy soil, similar to the Hedville (Darrell Dodge, personal communication).

Flora

Although there are occasional cottonwoods (Populus deltoides) and willows (Salix spp.) growing along streambanks and in other moist spots, grasses and shrubs comprise most of the vegetative cover of the Kanopolis Lake area. Grasses are mixed: the short grasses are dominated by buffalo grass (Buchloe dactyloides), blue grama (Bouteloua gracilis), and hairy grama (B. hirsuta); the more important tall grasses are big bluestem (Andropogon gerardi), little bluestem (A. scoparius), silver bluestem (A. saccharoides), switch grass (Panicum virgatum), side-oats grama (Bouteloua curtipendula), and Indian grass (Sorghastrum nutans) (Hitchcock 1950: 2-3). Also present in the area are sand dropseed (Sporobolus cryptandrus), tall dropseed (S. asper), purple lovegrass (Eragrostis spectabilis), prairie three-awn (Aristida oligantha), red three-awn (A. longiseta), western wheatgrass (Agropyron smithii), windmill grass (Chloris verticillata), tumblegrass (Schedonnardus paniculatus), Canada wildrye (Elymus candensis), and annual brome (Bromus sp.) (U.S.D.A. SCS 1967: Loamy Upland, Clay Upland, Shallow Sandstone Range Site Descriptions). Other plants in the area include chokecherry (Prunus virginiana), tamarisk (Tamarix pentandra), skunkbush (Rhus trilobata), gooseberry (Ribes missouriense), yucca (Yucca glauca), smooth sumac (Rhus glabra), catclaw sensitive brier (Schrankia nuttallii), prickly pear (Opuntia sp.), western ragweed (Ambrosia psilostachya), leadplant (Amorpha canescens), prairie clover (Petalostemon purpurea), dotted gayfeather (Liatris punctata), prairie coneflower (Ratibida columnaris), and slimflower scurfpea (Psoralea tenuiflora) (ibid).

Fauna

Settlement of central Kansas relieved the region of many of its large native mammals, but numerous smaller mammals remain. Among the mammals of the Kanopolis Lake area are the opossum (Didelphis marsupialis), shrew (Blarina sp.), mole (Scalopus aquaticus), raccoon (Procyon lotor), badger (Taxidea taxus), skunk (Mephitis mephitis), coyote (Canis latrans), ground squirrel (Spermophilus tridecemlineatus), plains pocket gopher (Geomys bursarius), prairie dog (Cynomys ludovicianus), eastern cottontail (Sylvilagus floridanus), whitetail deer (Odocoileus virginianus), mule deer (Odocoileus hemionus), and pronghorn (Antilocapra americana) (Burt and Grossenheider 1976).

Several species of waterfowl were noted on the reservoir, among them the white pelican (Pelecanus erythrorhynchos), mallard (Anas platyrhynchos), and blue-winged teal (Anas discors). Game birds likely in the area include the ring-necked pheasant (Phasianus colchicus), quail (Colinus virginianus),

prairie chicken (Tympanuchos cupido pinnatus), and mourning dove (Zenaidura macroura). Numerous other birds are common to the area as well (U.S. Dept. of the Army 1977).

A variety of fish are found in Kanopolis Reservoir and the Smoky Hill River, some of them (e.g., largemouth bass (Micropterus salmoides), walleye (Stizostedion vitreum)) the result of stocking the lake since construction of the dam. Among the native fish present in the lake are carp (Cyprinus carpio), gizzard shad (Dorosoma cepedianum), river carp sucker (Carpiodes carpio), channel catfish (Ictalurus punctatus), freshwater drum (Aplodinotus grunniens), flathead catfish (Pylodictis olivaris), bigmouth buffalo (Ictiobus cyprinellus), black bullhead (Ictalurus melas), bluegill (Lepomis macrochirus), green sunfish (Lepomis cyanellus), black crappie (Pomoxis nigromaculatus), white crappie (Pomoxis annularis), and longnose gar (Lepisostelus osseus) (ibid.).

CULTURAL BACKGROUND

A review of all available sources of information pertaining to the Indian Hill petroglyph site (14EW1) was made to establish a framework within which to determine the possible origin of, assess the present condition of, and evaluate possible preservation measures warranted by the petroglyphs. The Corps of Engineers provided the following reports specific to the site:

1947 - Kivett and Shippee - "Preliminary appraisal of the archaeological and paleontological resources of Kanopolis Reservoir, Ellsworth County, Kansas."
1949 - Smith - "Archaeological Investigations in Ellsworth and Rice Counties, Kansas."
1957 - Horr and Johnson - "Petroglyphs of Central Kansas."
1977 - Leaf - "A preliminary shoreline reconnaissance and a management program for the cultural resources of Kanopolis Lake, Ellsworth County, Kansas."
1979 - Hayden - "Preserving the Indian Petroglyphs at Kanopolis Lake."

The Indian Hill site was first photographed in 1868 by Union Pacific Railroad photographer Alexander Gardner (Hayden 1979: 27). In 1869, Edward Miller wrote a brief description of the site and made drawings of several of the panel's elements (1869: 382-384); a summarization of Miller's paper appears in Garrick Mallery's book Picture Writing of the North American Indians (1893: 80-81). No further recordation of the site seems to have been made until nearly 80 years later, when Kivett and Shippee (1947) performed a reconnaissance survey of the area to be inundated by the reservoir, recording 13 occupation, 3 petroglyph, and 2 burial sites. In a very brief summarization of the Indian Hill site, the authors provide locational data, comment on the block removal of parts of the panel by erosion, and note the popularity of the site as a focus of recreational activity.

In another short description of the site, Carlyle Smith (1949) mentions a diamond-shaped knife and several end scrapers which were found at the top of the talus slope below the Indian Hill site petroglyphs and suggests that such implements were probably used in carving the rock art. He states that similar artifacts occur in Great Bend and Upper Republican Plains sites but recognizes that such evidence is insufficient for determining the figures' authorship (Smith 1949: 293). Smith also notes the presence of two places on the panel which depict equestrian forms, suggesting a late date for some of the drawings. He goes on to discuss the Kanopolis Reservoir area as having been a border land for several protohistoric peoples -- the northern border of the Wichita, the southern border of the Pawnee, the western territory of the Kansa, and the eastern territory of the Apache. The Cheyenne and Arapaho roamed the areas in the late 1800s (ibid.: 292).

In 1957, Horr and Johnson wrote a detailed description of the Indian Hill petroglyph panel, attempting to record those elements which appeared to be most "important in terms of size and prevalence" (Horr and Johnson 1957: 2). They note that construction of the reservoir encouraged use of the area as a recreational spot and accelerated the rate of erosion of the cliff by

breaking down the talus slope beneath the petroglyph panel and allowing the bluff to be undermined by wave action.

Supplied with photographs of the Indian Hill site, Waldo Wedel (1959) made observations similar to those of investigators before him. He talks about the variety of figures and states that the petroglyphs are suffering rapid erosion (both natural and man-caused). He claims the site to be "probably the outstanding petroglyph site in Kansas", containing "a wide range of figures, in all stages of preservation and unquestionably of varied authorship" (1959: 483-485).

None of the aforementioned authors attempts to assign cultural affiliations to the Indian Hill site petroglyphs. A study by Gary Leaf (1977) tenatively associates the prehistoric elements of the panel with the Smoky Hill, an aspect of the Plains Village tradition, but a 1979 study by Hayden points up the lack of datable artifacts associated with the glyphs and the apparent absence of similar motifs in pottery and/or other mediums, and reaffirms the uncertainty, therefore, of assigning cultural affiliations to the petroglyphs.

Leaf (1977) describes 20 archaeological sites along the shoreline of Kanopolis Reservoir, 9 of which were stratified multicomponent sites culturally affiliated with various combinations of the Woodland, Smoky Hill, Great Bend, and unknown. Four of the sites (including 14EW1) exhibited rock art, the prehistoric elements of which Leaf feels are probably associated with Smoky Hill village or occupation sites.

The Indian Hill site lies north of an inundated village site (14EW2) in the river bottom and is flanked by two others (14EW13 and 14EW35), all of which contain Smoky Hill components; therefore, the hypothesis that the Smoky Hill originated the rock art is based upon spatial proximity (Leaf 1977: 49-50).

Hayden (1979) believes it is impossible to attribute the Indian Hill petroglyphs to any one people or time period. Rather, he feels that the large number of glyphs and the variety present indicate use of the site by numerous peoples for many years. In his introductory statement to Hayden's report, State Archaeologist Tom Witty concurs with Hayden's opinion that the glyphs' origins are diverse but feels that, based on the rate of erosion of the Indian Hill site sandstone, they were probably carved not earlier than a few centuries prior to European contact.

Although it is uncertain who is responsible for the creation of the Indian Hill petroglyphs, certain cultural groups are generally believed to have occupied and/or hunted the physiographic provinces which border the study area, namely the Dissected High Plains (Smoky Hills subdivision) north of the Smoky Hill River and the Arkansas River Lowlands to the south of the river. Table 1 (from Witty, n.d.) outlines the archaeological and early historic cultures of these provinces; those cultures believed to have had the most influence in the Kanopolis Lake area are described below.

Table 1

Outline of Archaeological and Historic Cultures in the Arkansas River Lowlands and the Dissected High Plains of Kansas (after Witty n.d.)

Archaeological Period	Time Estimate	CENTRAL LOWLANDS Arkansas River Lowlands	GREAT PLAINS Dissected High Plains	Aboriginal Primary Subsistence Patterns
Historic American, European and Emigrant Tribes	1865 AD	Historic Forts, Trails, Domestic, Industrial	Frontier Trading Posts	Hoe Gardening and/or Bison Hunting Horse--- Nomads
	1800 AD	Kiowa Kiowa-Apache		
Early Historic and Proto-Historic Late Ceramic	1800 AD	Comanche-Ute Wichita	Pawnee (Lower Loup)	Hoe Gardening and/or Bison Hunting Horse Nomads
	1500 AD	Great Bend Aspect	White Rock Aspect	
Middle Ceramic, Plains Farmer Central Plains Phase (North), Late Woodland	1500 AD	Pratt Complex Bluff Creek Sites (Sites with Southern Plains Affiliation)	Upper Republican	Hunting Gardening Gathering
	1000 AD		Smoky Hill Aspect	
Early Ceramic Plains Woodland, Middle Woodland	1000 AD	Plains Woodland Cultures		Hunting and Gathering with Probably Introduction of Gardening
	1 AD	Keith Focus	Keith Focus	
Archaic	1 AD	Middle and Late Archaic Groups	Eagle Creek Complex	Hunting and Gathering
	8000 BC	Munkers Creek Phase, Coffey Site	(Matter Mound)	(Foraging)
Paleo-Indian	6000 BC	14BT402		Big Game Hunting
	20000 BC	Occasional surface finds of Clovis, Folsom, Plainview, Scottsbluff, Hell Gap, Browns Valley projectile points, etc.		

Paleo-Indian Horizon
12,000 B.C. - 5,000 B.C.

The Paleo-Indian Horizon encompasses the Big Game Hunting traditions -- the Llano, Folsom, and Plano -- which are characterized by bifacially flaked lanceolate- and leaf-shaped projectile points and a dependence upon now-extinct megafauna. The earliest dates for this horizon fall between 10,000 to 9,000 B.C. and demonstrate, beyond a doubt, man's presence in the New World by this time (Willey 1966).

A preoccupation with mammoth (Columbian) hunting and the Clovis fluted point mark the Llano tradition as it developed on the grasslands of the Great Plains and parts of the Southwest. Within these regions are sites which have produced radiocarbon dates of ca. 9,200 B.C. including: the U. P. Mammoth Kill Site near Rawlins, Wyoming at 9,280±350 B.C. (Lischka et al. 1979: 18); the Dent Site in eastern Colorado at ca. 9,200 B.C. (Willey 1966: 40); and the Blackwater Draw No. 1 Site in eastern New Mexico at 9,220 B.C. (ibid.).

As the mammoth began to decline and disappear on the plains, the bison became the quarry of the Folsom tradition hunters. This tradition is best represented at the Lindenmeir Site in northeastern Colorado, radiocarbon dated ca. 8,800 B.C. (ibid.: 43). At another Folsom site, the Lubbock site in Texas, the smaller fluted Folsom projectile points were found in association with Bison antiquus bones. This site dates between 7,800 to 7,300 B.C. (ibid.). From the dates yielded by these two sites, a time span of 2,000 years is suggested for the Folsom tradition; however, its climax probably occurred around 8,000 B.C., coincident with the appearance of the Plano tradition.

The Plano tradition is characterized by a variety of unfluted lanceolate projectile points of two basic types: those with an outline resembling the Clovis-Folsom types, and those with parallel flaking. The Plainview, Midland, Milnesand, and Meserve are of the former type; the Scottsbluff, Eden, Cody, Angostura (or Frederick), and Agate Basin are of the latter (ibid.: 44). The point which appears to be transitional is the Midland; it most resembles the Clovis-Folsom types and was in existence at the same time as Folsom but may have been too thin to channel flake. The time period for the Plano is suggested by the Plainview Site in northwestern Texas, a site which produced radiocarbon dates of 7,800-5,100 B.C. The Plainview point has been found throughout the Plains -- from Texas north to Canada and south into Mexico -- and it is safe to assume that the Plano tradition influenced much of the western Great Plains. A variant of the Plano, one which may reflect influence from the east, is found in northwestern Iowa: the Simonsen site produced notched spear points in association with Bison occidentalis dating at 6,471 B.C. (Wedel 1964).

Research into settlement patterns of Early Prehistoric peoples may produce the data necessary to locate Big Game Hunter sites throughout the Great Plains; the literature clearly indicates that these traditions or variants thereof are likely to be found in the central Plains region and occasional surface finds of Clovis, Folsom, and Plainview are reported by Witty (n.d.: 17).

Archaic Stage -- Plains
5,000 B.C. - A.D. 500

The Archaic Stage is marked by a change in the subsistence pattern from a dependence upon big game hunting (a hunting-gathering economy) to an exploitation of a wider range of food resources (a gathering-hunting economy). Archaic-type cultures came into existence at various times throughout North America and persisted in some places until historic times. The origins of the Archaic may derive from the subsistence patterns of the Big Game Hunting tradition or from an unspecialized lithic technology which accompanied the earliest immigrants to North America some 20,000-40,000 B.P.

In the west central Plains along the front range are two sites which have become reference points for Front Range archaeology. The Magic Mountain and LoDaiska Sites (eastern Colorado) exhibit predominantly Plains Archaic materials, although the LoDaiska Site evinces a few materials indicative of a Desert Culture influence. Both sites were excavated by Cynthia Irwin-Williams and Henry Irwin and have produced the best stratigraphic control on materials from the early Middle Prehistoric period for the region (Irwin-Williams and Irwin 1966; Irwin and Irwin 1959). These materials reflect a mixed gathering-hunting economy with incipient maize horticulture occurring in the late stages, probably the result of the influence of the Woodland tradition.

The Logan Creek Site in Nebraska produced two occupation levels with side-notched points (similar to the Simonsen Site) in association with "an abundance" of bison bones dating 4,674 B.C. and 5,300 B.C. (Wedel 1964: 200). Other similar point forms are found throughout the eastern Plains, demonstrating a strong influence by Eastern Archaic peoples, who were probably coming onto the Plains to hunt. Similarly, evidence from the northwestern Plains area suggests that these people also were availing themselves of the Plains hunting opportunity. Sites such as McKean (ca. 3,000-500 B.C.) and Signal Butte I (1,500-1,000 B.C.), which manifest the McKean technocomplex (through Duncan, Hanna, and Mallery projectile points), have yielded artifact and faunal collections that show that while foraging and small mammal hunting were significant in the subsistence of these cultures, the importance of bison hunting continued.

The Archaic in Kansas is represented by a small number of sites in the eastern part of the state. These include the Nebo Hill and Logan Creek cultures (Witty n.d.).

The Snyder Site, located in Butler County, Kansas manifests the El Dorado Phase of the Nebo Hill complex. This site was excavated by the University of Kansas in 1968-1969 and revealed non-continuous occupations spanning a period of 3,000 years (Grosser 1973). The earliest occupations are poorly represented, but the Chelsea Phase produced a projectile point reminiscent of those belonging to the Simonsen-Logan Creek Complex of eastern Nebraska. The excavation produced radiocarbon dates of ca. 3910-3650 B.P. which are associated with the El Dorado Phase. A permanent or semipermanent occupation based on hunting, gathering, and 'riverine exploitation' is indicated. Two other occupations followed, the last terminating around

A.D. 800 (Grosser 1975: 130).

The Logan Creek Culture has been identified in the Coffey Site, located in northeastern Riley County on the floodplain of the Big Blue River, and in the William Young Site in east central Kansas. The Coffey Site demonstrated that, while the Altithermal period was a time of aridity in eastern Kansas, the floodplain vegetation communities remained essentially intact and continued to provide aboriginal groups a basic subsistence. Although use of the site was probably seasonal (probably summer and fall months), base-camp activities are indicated by the artifact assemblages and floral/fauna remains present. There is evidence of small group bison hunting (and of the procurement and processing of other large game); fishing, bird (principally waterfowl), small mammal, and amphibian procurement; and seed processing. Tools and ornamental/ceremonial objects were also found (Schmits 1978). The Coffey Site demonstrates occupation of the eastern prairies during the Altithermal and a distinct relationship between cultures of that area and the eastern Archaic (ibid.: 167).

The William Young Site produced a radiocarbon date of 3390±160 B.C. for the Munkers Creek Phase (present at the Coffey Site as well). Besides the diagnostic Munkers Creek projectile points and knives and Clear Fork gouges and chipped stone axes, the site also yielded evidence of the domestic dog and of human burials.

Woodland Tradition
500 B.C. - A.D. 1,000

The late Plains Archaic period (ca. 500 B.C. - A.D. 1,000) shows a progression from the previous subsistence patterns of strictly hunting and gathering to an economy which included (on a minor scale) incipient maize horticulture, a change associated with the appearance of the Woodland tradition. The Woodland tradition is credited not only with the introduction of corn and bean cultivation to the Plains but with the introduction of pottery making as well. The Woodland is characterized by a village orientation represented by storage pits, community cemeteries, a variety of well-executed stone and bone tools, fetishes and jewelry, and occasional dry-laid masonry structures.

Two roughly contemporaneous Woodland cultural complexes occupied the Central Plains -- the Hopewell and the Plains Woodland. These peoples had "a creek-valley hunting and gathering subsistence economy, with deer and small game seemingly favored over bison" (Wedel 1964: 203). None of the Plains Woodland complexes had a material wealth equivalent to that of the Hopewell, and it is likely that the influence of the latter was felt throughout the central Plains.

The Hopewell were a people who followed the Adena culture in the southern Ohio region, assimilated it, and evolved a new culture patterned on Adena life (Willey 1966: 273). The Hopewell flourished in Ohio and Illinois for three centuries (100 B.C. - A.D. 200), spreading west in the early centuries of the Christian era (ibid.). Reynolds reports Kansas City Hopewell sites in Kansas having an occupation period of ca. 100 B.C. - A.D. 1,100,

with most of the dates falling between A.D. 1-500 (Reynolds 1979: 99-100). Similarities between the Kansas City Hopewell and Middle Woodland sites in Missouri and Illinois have been noted (ibid.: 84).

The Keith Focus is the predominant Plains Woodland culture found in both the Dissected High Plains and Arkansas River Lowlands (Witty n.d.). It has been defined by Kivett (1953) from excavations in Kansas and Nebraska, and also described by Wedel (1959). Representative sites are generally small villages containing up to six occupational structures thought to be made of pole and thatch (or skins) and identified by the remaining circular to irregular elliptical shallow basins, post molds, central firepits, and refuse pits (Wedel 1959: 552). Diagnostic artifacts recovered from mortuary sites include Harlan Cord-Roughened pottery, small- to large-stemmed and barbed projectile points (often serrated), small chipped celts, fresh water and marine shell ornaments and beads, triangular and crescent stone pendants, right-angle perforated stone beads, tubular bone beads, perforated canine teeth, and rodent teeth (Kivett 1953: 135). Keith Focus sites in Kansas are reported to radiocarbon date from ca. A.D. 350-800 (Reynolds 1979: 100).

More is being learned about the Plains Woodland, yet its relationship to other regions, particularly the southwest, is still unclear. It must be kept in mind that bison hunting cultures existed simultaneously with the Woodland on the Plains but were probably most prevalent in the northern Plains. Archaeologically, the Woodland complexes are differentiated by minor variations of material culture; there appears to have been a basic commonality with respect to funerary rites, as evidenced by the universality of burial mounds and community cemeteries. Mounds on the Great Plains may date as early as 200 B.C.; they began to disappear by A.D. 1,000. It is unknown how far north the Woodland spread, but mounds of the Manitoba focus were present on the Plains of Assiniboine ca. A.D. 1,400 (Wedel 1964: 204); however, there is speculation that these mounds and others east and north of the Middle Missouri Valley are of the Mississipian tradition rather than from Woodland origins.

Plains Village Tradition
A.D. 1,000-1,850

The Plains Village tradition appears to be a synthesis of the Archaic and Woodland cultures of the Great Plains, possibly influenced by the Mississippian tradition (to the southeast) as well. Willey suggests three subdivisions of the Plains Village period: Early (A.D. 1,000-1,550), Middle (A.D. 1,550-1,800), and Late (after A.D. 1,800) (Willey 1966: 219).

The Plains Village centered around the Missouri River and its tributaries in the eastern Plains. A village-oriented, sedentary lifestyle prevailed: the economy was based on river-valley cultivation of maize-bean-squash as well as hunting, fishing, and gathering. A pronounced diversification in pottery types occurred, the result of the blending of Woodland and Mississippian features. Housing became more permanent than that of the Woodland people -- rectangular earth-lodge houses with timber frameworks replaced pole and mat shelters. During the early phase of the Plains Village tradition,

villages of these houses contained perhaps 50 to 100 people. Later, houses of the central Plains became larger (30-65 feet long, rectangular in shape), and a village of 20 such buildings could house up to 300 people (Willey 1966: 321, 324). Villages in the earlier phase of the Plains Village period were widespread throughout the central Plains, located along tributaries of major rivers; gradually, however, these peoples gravitated to and concentrated along the major drainages in the eastern Plains, possibly to escape drought conditions and/or marauding nomadic bands.

Of the Plains Village cultures extant during the Early period in the central Plains, the Upper Republican, Nebraska, and Smoky Hill are the best documented. The Upper Republican were located primarily in western Nebraska and Kansas, but their early domain extended throughout the Plains as far west as the Front range (ibid.: 326). Between A.D. 1,450-1,500, they abandoned their small villages and migrated eastward into the Missouri Valley, an area already occupied by the Nebraska. This migration, perhaps prompted by drought or by raiding by the Plains Apache, may have "reconstituted the Lower Loup phase" of central Nebraska, a contemporary of the Great Bend phase of central Kansas (ibid.).

The Smoky Hill Aspect is the least known of the early Plains Village cultures but the only one represented in the Kanopolis Lake area. A temporal span of 700 years (A.D. 750-1,490) has been recorded from Smoky Hill sites between longitudes 95.95 and 101.62 and latitudes 37.43 and 39.5 (Roper 1976: 184 Table 1). Wedel assigns the Minneapolis, Griffing, and Whiteford sites to this aspect and draws his description from them (1959: 563). The Smoky Hill earth lodge villages were small with no defence works and consisted of from one to twelve or more surface house units scattered along creek terraces (tributory to main river or stream channels). The houses were square to rectangular with rounded corners and had four main roof supports. They had central fire pits and extended entryways. Smoky Hill pottery, orange-brown in color and having a friable surface and simple or slightly thickened cord-roughened rims, has been designated Riley Cord-roughened by Wedel (ibid.: 565).

Traits of the Smoky Hill shared by the Upper Republican and Nebraska include: bell-shaped and cylindrical storage pits; single (primary flexed) and communal burials; small, unnotched, side-notched, and side-notched/basal notched projectile points; diamond-shaped and elliptical stone knives, and end scrapers; pottery and stone pipes; bison scapula hoes; longitudinally grooved arrow shaft smoothers and arrow shaft wrenches of bone or antler; bone awls and fishhooks; stone grinding implements; and shell ornaments. Figurines are included as diagnostic artifacts of the Plains Village by Lehner and Hurt (ibid.: 566-567).

The Middle Plains Village period is represented in central and southern Kansas by the Great Bend phase. Traits established in the Early period persist, but cultural materials yielded by Great Bend sites indicate an increase in trade among the villages of the central Plains (i.e., Lower Loup and Dismal River) as well as increased contact wtih Puebloan groups of the Upper Rio Grande (ibid.: 580-584). Contact with white explorers was possibly made as early as 1541; Wedel suggests that the Quivira sites mentioned in 16th-

and 17th-century Spanish documents and visited by Coronado's expedition were probably Little River Focus sites of the Great Bend aspect (in all likelihood, the Wichita) (Wedel 1959: 587).

The greater mobility which resulted from the advent of the horse further modified the Plains Village tradition. Villages became larger, trading flourished, and buffalo hunting increased in the Late period. There was a mingling of the Plains Village tradition with Mississippian influences, and by the 1800s the Mandan, Arikara, and Hidatsa tribes were all that remained of the Middle Missouri Plains Village tradition (Willey 1966: 328).

Protohistoric/Early Historic Period
A.D. 1600-1875

The introduction of the horse had, by the late 1700s/early 1800s, mobilized both the bison-hunting, tepee-using nomads of the western prairies and the semihorticulturist Plains Village peoples of the central and eastern Great Plains. During the early Historic period, tribal groups reported to have been on the Dissected High Plains and in the Arkansas River Lowlands include the Pawnee, Wichita, Comanche-Ute, Kiowa-Apache, and Kiowa (Witty n.d.). Just to the east, the Kansa and Osage occupied the Flint Hills Uplands (ibid.).

The only tribes of Caddoan stock known to have resided in Kansas are the Pawnee and the Wichita (Wedel 1959: 58). Derived from a Plains Village (Lower Loup) people, the Pawnee are historically reported in Kansas in the late 1700s/early 1800s and, specifically, as late as 1830 along the Smoky Hill River (ibid.). The Wichita have been historically documented in Kansas as early as 1541 as the Quivira or Great Bend Culture of the Plains Village; but, by the 1850s, all Wichita tribes were reported to be in north central Texas (ibid.: 67).

The Comanche and Ute, Shoshonean speaking tribes originating in the Great Basin area, acquired the horse possibly as early as the mid-1600s (Schroeder 1965; Smith 1974). The acquisition of the horse (and firearms) affected every aspect of their lives -- social organization, food gathering, shelter, and warfare (Smith 1974: 19, 40). With their increased mobility, the Comanche-Ute swept southeastern Colorado and southern Kansas, pushing both the Plains Apache and Wichita from the area by ca. 1725 (Wedel 1959: 66, 76). By the 1820s the northern boundary of the Comanche appears to have been the Arkansas River, as the Cheyenne, Arapaho, Kiowa, and other northern tribes encroached upon Comanche territory (ibid.: 77).

The early histories of the Kiowa and Kiowa-Apache are somewhat obscure. The Kiowa were possibly one of the early Plains Apache groups who are described in 17th and 18th century Spanish documents (ibid.: 80). Some of the early Plains Apache people grew crops of maize, beans, and pumpkins, while others were nomadic bison-hunters (ibid.: 69, 72). It is certain that the Kiowa occupied the area between the upper Arkansas and Red Rivers by the early 1800s (ibid.: 79). The Kiowa-Apache apparently originated as mountain plains Apache of eastern New Mexico, becoming bison-hunting nomads after ac-

quiring the horse and joining the Kiowa on the southwestern plains of Kansas.

The Kansa and the Osage, both bison-hunting Siouan tribes of the Dhegiha branch, are believed to have originated east of the Mississippi River. Migration westward brought them to the mouth of the Missouri, which they ascended to the Osage River. Here, the Osage settled, while the Kansa continued up the Missouri to the Kansas River, along which they may have settled as early as the 1600s (Wedel 1959: 49). Historic records place one of the main Kansa villages at the mouth of the Blue River in the late 1700s (ibid.: 52). In the early 1800s, the Kansa were reported to be living near Topeka from whence they were moved to a reservation on the Neosho River in 1846. They continued their seasonal bison hunting on the Plains to the west until the late 1800s; in 1873, the few remaining Kansa moved to the Osaga Reservation in Oklahoma.

As the great buffalo herds diminished in other areas, the Plains region of the Republican/Smoky Hill/Arkansas Rivers became the focus of intensive hunting. The 1800s were a time of much conflict in central Kansas as Plains tribes (such as the Cheyenne and Arapaho from the west, the Kansa and Osage from the east, the Kiowa, Kiowa-Apache and Comanche from the southwest, and the Pawnee from the north) and eastern tribes which had been relocated in Kansas by the U.S. Government in the early part of the century competed for the remaining buffalo.

METHODS AND FINDINGS

An on-site inspection was conducted to obtain first-hand information on the present condition of the petroglyphs and the environment of the site, to evaluate the rock structure and stability, and to meet with project personnel. On 7 September 1979, John Burger and Carl Conner met with Corps of Engineers personnel and representatives from the Office of the Kansas State Archaeologist, Tom Witty and Brian O'Neill, and visited the Indian Hill Site. The emphasis this day was on the history of the site -- its past and present condition and work previously done. Burger and Conner returned to the site on 8 September to take rock samples, make observations concerning the cementation and jointing patterns of the sandstone, and assess the mass wasting and other erosional properties (both natural and man-induced) at work on the cliff face. Laboratory analysis of the rock samples collected was performed at a later date.

Description of the Site

Horr and Johnson (1957) characterize the Indian Hill Site as being quantitatively "the most spectacular of the sites examined [in the area]" but the victim of extensive vandalism and erosion. These authors completed a thorough recordation of the site; a summarization of their findings concerning the prehistoric and protohistoric elements is presented in Table 2 (pp. 18-19).

As is evident, much of the rock art attributed to prehistoric peoples (Smoky Hill ?) consists of anthropomorphic figures (circular heads and/or circular heads with rectangular or triangular bodies) and series of straight (mostly vertical) or slightly curved lines. Protohistoric glyphs include figures associated with horses and/or canoes; one figure has a wide-brimmed hat. Zoomorphic and abstract figures are also present and are assumed to belong to the prehistoric/protohistoric periods. Historic elements include names and dates from as early as 1876. There are numerous other dates, letters, names, sayings, bullet holes, and symbols from the recent period which mark over or otherwise lessen the integrity of the site.

All of the petroglyphs are either abraded or drilled into the moderately resistant, medium-to-fine-grained sandstone of the upper part of the cliff face to depths ranging to over one centimeter; it was noted that abraded marks could be made on this rock surface with one's finger. Attempts to reproduce elements or parts of the panel by using printer's ink and a latex derivative have left hard, visible residues. There is evidence of spalling, as portions of glyphs of some panels are gone. Open horizontal and vertical joints cut through one of the panels, delimiting new blocks which could spall off in the near future. Kivett and Shippee (1947) note that petroglyphs at the Indian Hill Site have been lost through just such block removal.

Geologic Character of the Site

Much of the on-going erosion of the Indian Hill petroglyph panels is due to the nature of the sandstone and the stratigraphy of the bluff where

Table 2

Major Prehistoric Petroglyph Elements
from 14EW1 (after Horr and Johnson 1957)

(* indicates definite protohistoric figure)

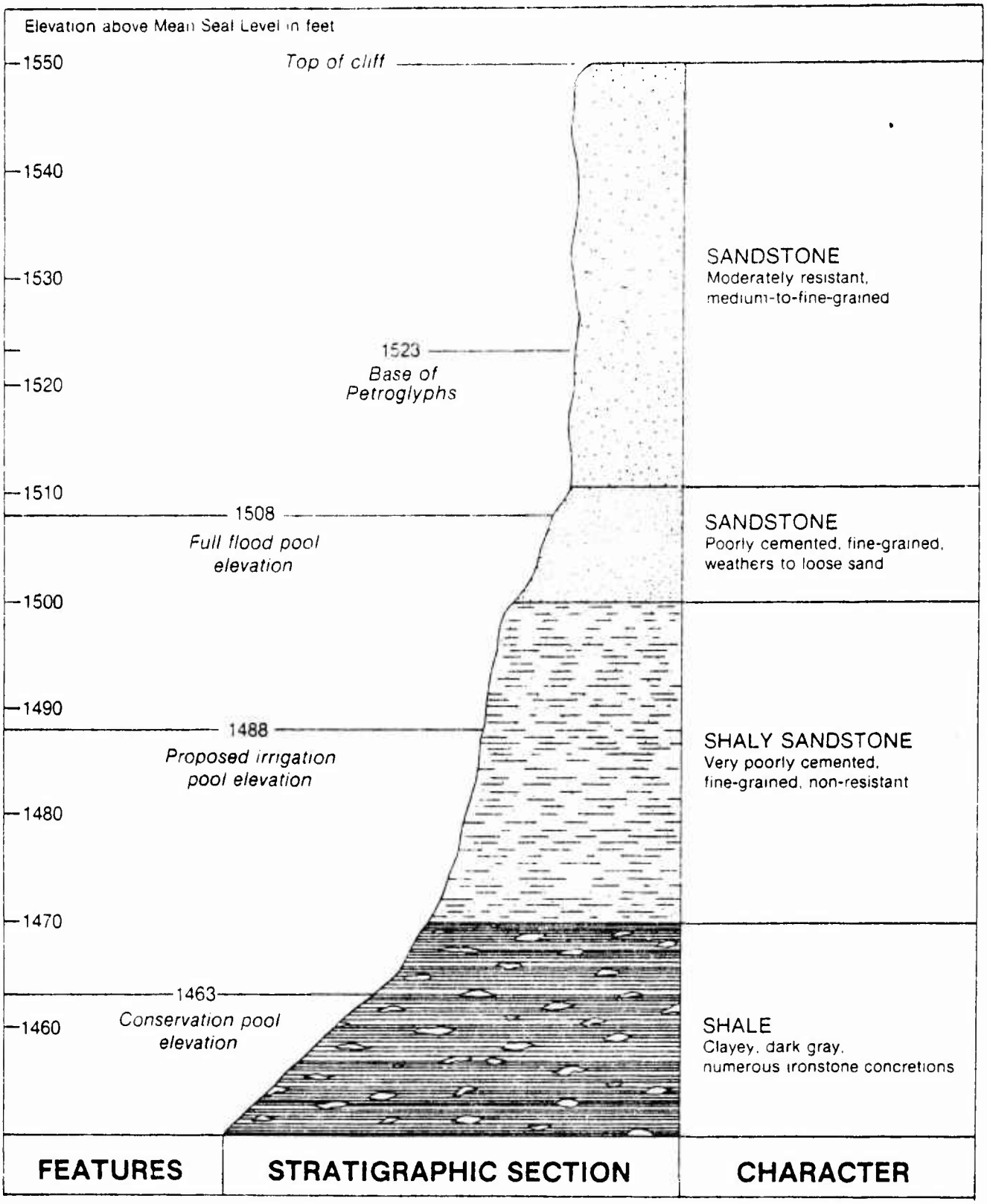
Major Element Categories	Attributes/Types	No. Glyphs
Anthropomorphic Figures (human-like)		
A. Circular headed w/circular eyes; circular or oval mouths; incised lines for noses; some with lines indicating necks.	1. No headdresses.	1[illegible]
	2. Bison-horn headdresses.	5
	3. Trianguloid projections from top of head.	1
	4. Four irregular incised lines.	.
B. Triangular headed w/triangular ears; "X" for mouth, horizontal line for eyes.		1
C. Circular head w/rectangular body.	1. Two roughly parallel lines; V-shaped, or straight line arms; other features, when present, are incised vertical lines.	5
	*2. Square well-defined shoulders w/rectangular bodies. Some with headdresses. A horse and rifle are associated with one of these elements.	9
	3. Ears and bison-horn headdresses.	1
D. Circular head w/triangular body (inverted triangle).	1. Extended sides of triangle form legs, also form hourglass shape when line added to connect bottom.	4
	2. Open at base of trunk with elaborations of body parts, i.e., extra lines for legs, one with headdress, interior designs.	3
	3. Wide-brimmed hat.	1
E. Profile view of head.	Facing right, no facial features.	2
F. Bending man (in profile).	Four bend at waist, one at knees.	5

G. Stick head, triangular body.	Head is straight, simple incised line.	1
H. Rectangular body, no head.	Parallel lines, curving or converging together at top to form head. Some have lines indicating feathered headdresses; one with phallus.	5
Zoomorphic Figures (animal-like)		
A. Horses.	One forms a scene w/three anthropomorphs.	4
B. Bison.		3
C. Deer.		4
D. Beaver.		1
E. Thunderbirds.		8
F. Unidentified types.		2
Abstract		
A. Arrows (projectiles).		3
*B. Crescent-shaped figures, possibly canoes.	Three of these have rectangular-shaped anthropomorphs in them. One is decorated w/zigzag line.	5
C. Ladders.	Single and double; one with curved lines w/connecting rungs.	3
*D. Pipe - elbow.		1
E. Stars.	Holes w/radiating lines (4 w/8 lines; 1 w/10).	5
F. Turkey tracks.		3
G. Possible female genitalia.		5
H. Numerous straight and curved lines.		

they are located. The petroglyphs are carved into the thickly bedded, Lower Cretaceous Dakota sandstone which is exposed in a 40-foot high bluff. Elevation at the foot of the bluff varies depending on how much of the bluff is obscured by erosional debris. The petroglyphs are located on the bluff in an area approximately 50 feet long by 8 feet high between elevations 1523 feet and 1535 feet -- about 60 feet above the water level of the reservoir. Figure 3 and Plates 1 and 2 show profiles of the bluff and beach

Two samples of sandstone were taken from the face where the petroglyphs are exposed. One was of soft sandstone, the other was of the best-cemented sandstone on the face. Examination using an American Optical Cyclopbic Series 56 binocular microscope revealed the following:

1. Approximately 97% of the sandstone is made of quartz grains.
2. Most of the quartz grains are clear, colorless, and have a very faint yellow surface stain.
3. A trace of pink quartz and a few grains of smoky quartz comprise less than 1% of the quartz grains.
4. Approximately 85% of the quartz grains are angular to subangular and clear; the remainder are well-rounded, slightly pitted, and frosted. The two kinds testify to derivation from two different geologic environments. The sandstone has no differentiation by shape sorting.
5. The quartz grains are well-sorted and have an average grain size of .5mm to .75mm.
6. About 3% of the sandstone consists of grains of feldspar, hematite, magnetite, dark chert, gypsum, and tourmaline, in decreasing order of abundance.
7. There is no reaction of the sandstone or its grains with dilute HCl.
8. There is a locally noticeable silt size fraction comprising 5% of the quartz grains in the better cemented sandstone.
9. Porosity of the sandstone is about 20% in the loosely cemented rock, slightly less in the better cemented sandstone.
10. Where cemented with manganese hydroxide, the quartz grains have a slight grayish stain. (This is not to be confused with smoky quartz which is generally of pegmatitic, vein, or high radiation damage origin and whose smoky aspect permeates the grain. Manganese hydroxide is a surficial stain.)
11. There is no definite evidence that the rock was once well-cemented and had undergone decementation. That the sandstone has had only one cement during its history is adduced by the fact that nowhere is carbonate



Stratigraphic Section of Cliff

Figure 3.

cement evident by the dilute HCl test, and microscopic examination does not reveal any carbonate cement either underneath the weak silica cement or on any sand grains.

These observations were determined through visual estimates, mineral identification and grain counts and estimates, color estimates, size measurements, shape estimates, and HCl cement tests.

A primary silica cement binds the Indian Hill Site sandstone, but the friability of the sandstone attests to the very weak nature of this cement. Also present is a thin secondary cement of iron and manganese hydroxides which is exhibited on weathering surfaces.* This secondary cement derives from water percolating through the sandstone, dissolving minute amounts of iron and manganese, which, when the water comes to the surface and evaporates, are left behind as a cement of variable thickness and hardness (see Plates 3 and 4). This process of secondary cementation is theoretically self-limiting in that a completely cemented sandstone allows very little water to come to the surface. However, the sandstone is subject to weathering and erosion, and at most places at this site these processes are occurring faster than is the formation of secondary cement. The sandstone in the lower, more accessible part of the bluff where the petroglyphs were carved is more poorly cemented than the upper, generally inaccessible portions. Erosion is further accelerated here by the act of carving a figure on these sandstone faces, which generally breaches the slightly harder secondary cement and exposes the weaker underlying sandstone cemented only by primary silica cement (see Plates 5 and 6).

Several sets of joints cut the sandstone bluff, delimiting large blocks of rock which break off when the softer, underlying siltstones and shales are eroded. One master set of joints strikes N10°W, is nearly vertical, and has spacings of approximately 1 to 2 meters; a second set of joints strikes approximately N70°W, is vertical, and has variable spacing (see Plate 7). The second set of joints is roughly parallel to the face of the bluff and in part controls the position of the bluff and its recession. A third set of joints is vertical and strikes N90°E (see Plate 8). There is a fourth set of joints visible at the top of the bluff where they form a polygonal pattern (see Plate 9). Origin of these vertical joints is not certain; suggested origins range from dewatering during diagenesis to shrinkage during

* Primary cement is the first cement deposited in the pores between grains. Secondary cementation occurs later, represents generally a change of physical-chemical conditions, and may or may not replace the primary cement. The two cements are often of different composition and are easily distinguishable. Where the two cements are of the same or nearly the same composition, they are most easily distinguished by euhedral growth surfaces of the primary cement which have acted as "seed bed" for the second episode of cementation. Frequently, there will be a corrosion surface between the cements; offtimes a pitted, dusty contact surface shows distinctly under microscopic examination.

weathering. The polygonal joints do not appear to extend more than a meter below the top of the outcrop. It is along the intersecting vertical joints that large blocks of sandstone are quarried by the natural erosive forces (see Plate 10). These joints also provide ground waters more rapid access to dissolve and remove cementing materials.

The joints as described occur throughout the whole of the bluff and can be predicted with great confidence to have the same features where they are not exposed in the immediate area.

Erosional Forces Operative on the Site

It is obvious to even the most casual observer that the Indian Hill Petroglyph Site is deteriorating rapidly. Both natural erosional forces and those occurring as a result of public use of the area are at work on the site. Comparison of photographs of the petroglyphs taken by Carlyle Smith in 1948 (Smith 1949) with photographs taken in September 1979 indicate that these erosional forces have been considerably accelerated by the construction of Kanopolis Reservoir, which not only altered the immediate physical environment of the site but, more importantly, provided easy access to the petroglyph panel.

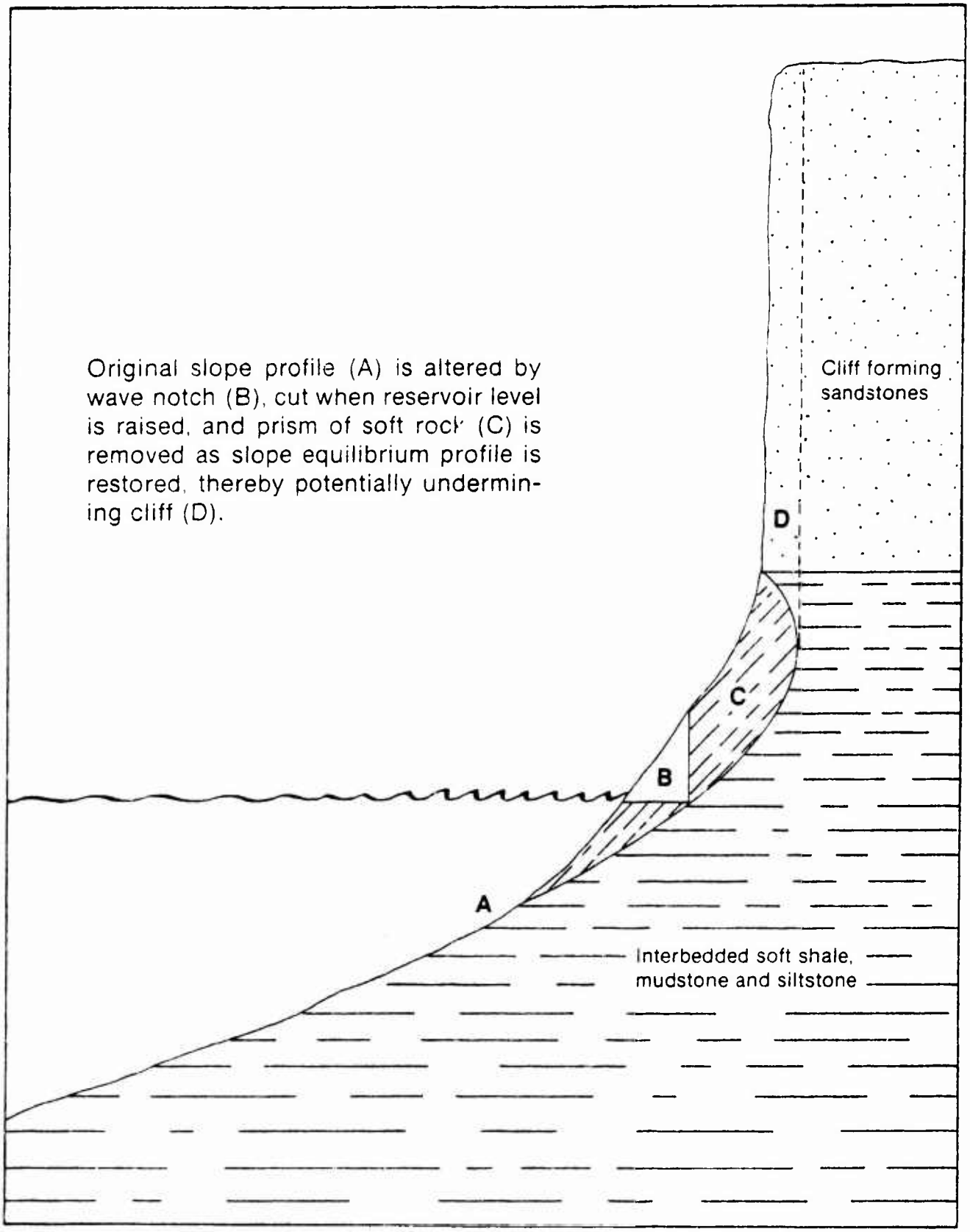
Because the sandstone is relatively soft and poorly cemented, such factors as sun (both direct and reflected), precipitation, and wind have undoubtedly caused some surficial damage to the petroglyph panel, particularly in those areas where the hard, secondary cement has been breached and the underlying sandstone is exposed. Hayden (1979) believes that solar reflection is a particularly effective erosional process at the Indian Hill Petroglyph Site. Blackwelder (1933) also states that "insolation aids in loosening the cohesion of the minerals, facilitates the entrace of moisture, and thus promotes the breakage of the rock by expansion due to chemical change". However, in experiments conducted by Griggs (1936) in which he repeatedly heated and cooled a rock to simulate the diurnal changes of 244 years, no change in the rock was detected, even though a temperature range of 110° C. (greater than from freezing to boiling) was effected. He calculated that, in his specimen, the heat penetrated to a depth of only 3.7cm. It is our conclusion, then, that solar reflection is a very minor agent in the disintegration of the Indian Hill sandstone chiefly because the excellent non-conductive properties of the sandstone make any temperature increase extremely surficial and because the temperature increase is not at that part of the curve on solution effectiveness.

In subsequent experiments, Griggs (1936) introduced the factor of moisture by cooling the sample with a spray of water rather than a spray of dry air. After being subjected to the equivalent of 2½ years of such treatment, the rock showed definite changes, suggesting that moisture is considerably more effective (about 500 times) in the disintegration of rock than is insolation. Thus the agents of rain and snow are thought to be more detrimental to the petroglyphs at Indian Hill than is the sun, although their surficial effect is probably minor because of the verticality of the bluff and its inability to retain water.

During most of the year, the prevailing winds are from the south and blow directly against the petroglyph panel. Hayden (1979) feels that these winds are constantly sand-blasting the petroglyphs and thus could contribute greatly to the disintegration of the panel's surface. Whether or not the reservoir's presence has affected (accelerated?) this erosional process is not certain, but it is likely that wind abrasion is an agent, albeit of relatively minor importance, in the obliteration of the petroglyphs.

Although sun, wind, and precipitation are probably somewhat deleterious to the surface of the petroglyph panel, their effects are considered to be minor relative to what is potentially the most destructive natural erosional force operative on the site -- mass wasting. The pervasive joint system of the Indian Hill Site sandstone provides many avenues for the migration of water and thus renders the bluff subject to the process of freeze-thaw action (water enters the joints, freezes, and expands, forcing the sandstone blocks apart). This natural process is accelerated by the wave action of the reservoir, which attacks the weak and easily eroded shales, mudstones, and siltstones (and, if raised to the irrigation level of 1488 feet, the poorly consolidated, non-resistant sandstones) underlying the sandstone bluff on which the petroglyphs occur (see Plate 11). The level of the reservoir is not held constant; each time it changes a new notch is cut. U.S. Corps of Engineers personnel stated that a wave notch can be cut in in as little as 4 to 6 weeks (see Plate 12). This succession of notches alters the slope equilibrium, and accelerated erosion results from the attempt to re-establish slope equilibrium. In the process, the slope retreats and the sandstone bluffs are slowly undermined (see Figure 4).

In addition to the erosion occurring at the site due to wave action and natural causes, extensive damage also results from visitor use of the area. Because there are no established trails providing access to the petroglyphs, people are free to clamber over the slope below, further breaking down the poorly consolidated shales and mudstones and weakly cemented sandstones beneath the petroglyphs. Too, the petroglyphs themselves are suffering differential erosion due to residues of printer's ink and latex left as a result of attempts to reproduce particular elements. More deliberate forms of vandalism (i.e., superimposed incisions and abrasions, bullet holes, removal of sections, etc.) have also served to accelerate the rate of degradation.



Mechanics of wave erosion on lake shore

Figure 4.

Typical profile of the bluff on which the Indian Hill Site petroglyphs are located.

Plate 1.

Beach profile beneath the Indian Hill Site. Soft nature of easily eroded shale beneath the sandstone cliff shows up well; notches in profile are marked by upper limit of driftwood. Non-sandstone nature of beach cobbles attests to the ease with which the sandstone breaks down and is removed. Profile shows how an apron of riprap or concrete would have to be constructed to prevent the ongoing undercutting of the sandstone cliffs.

Plate 2.

Red stain of iron oxide (left 1/3 of photo), purple stain of manganese oxide-hydroxide (right 2/3 of photo), differential staining of latter. Vertical joints are apparent on both left and right.

Plate 3.

Extensive but variable surface deposition of secondary cement (manganese hydroxides) on upper 2/3 of photo. Non-planar bedding and vertical joints are apparent.

Plate 4.

Differential resistance of primary and secondary cements to erosion. Thickness of layer of harder, secondary surface cement is apparent. Upper left shows possibly two cycles of secondary cementation.

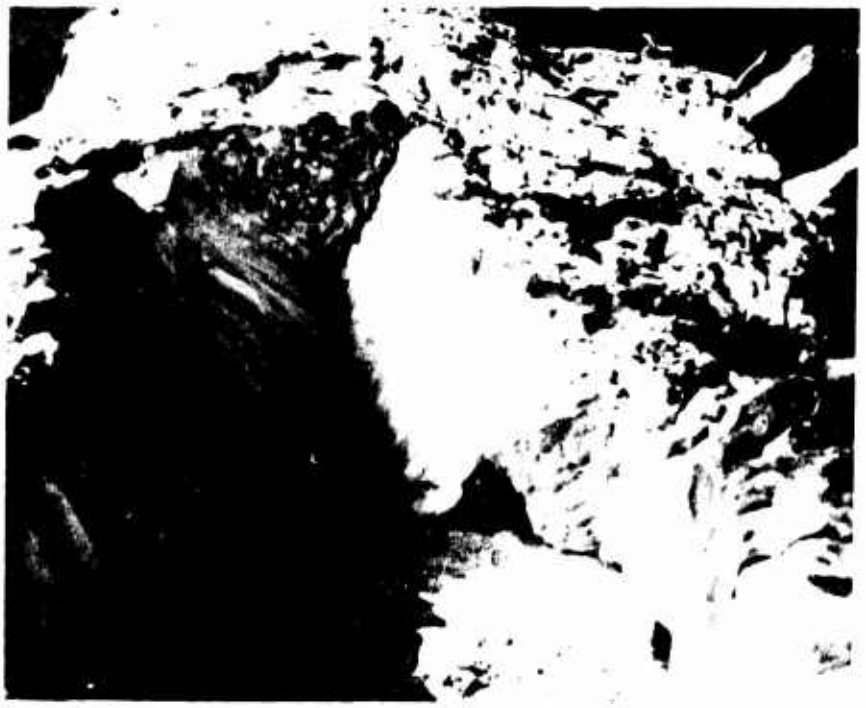
Plate 5.

Differential destruction of glyphs on same rock face. Joint surfaces are both parallel to rock face and perpendicular to it, marking potential sites for block removal or quarrying.

Plate 6.

Site of joint block at top of bluff which has fallen out. Intersecting joints apparent: plane facing observer is ~N10°W, face striking into photo is ~N70°W. Bedding thickness is variable.

Plate 7.



Intersecting vertical joints. Void has been created by recently fallen block.

Plate 8.

Polygonal joints on top surface of bluff, roughly vertical and perpendicular to bedding. Dark patch in upper right is loose sandstone rubble.

Plate 9.

Vertical parallel joints (surfaces facing toward left of photo) and intersecting joint system (into which "CP" is incised). Large block fell out prior to 1976, but after glyphs to right were cut. Notice undercutting at lower left of photo, also recent surface staining from above.

Plate 10.

Easily eroded grey shale, siltstone, and concretion layer of lower slope. Lag concentration at base of slope composed of more resistant concretions weathered out from layer above. Driftwood occurs at former water level.

Plate 11.

High water notches cut in soft siltstone. Rubble of fallen sandstone.

Plate 12.

MITIGATION ALTERNATIVES

The rapid and irreversible destruction of the Indian Hill petroglyph site is the result of many and varied adverse effects, both natural and man-induced. These adverse effects have led not only to the actual obliteration of the petroglyph panel but to the concomitant loss of inherent archaeological and historic data as well. The following list of mitigation alternatives is organized to address first, the preservation of scientific data, and second, the physical preservation and protection of the site itself.

Preservation of Scientific Data Through Documentation

Notwithstanding the considerable loss of integrity which it has sustained, the Indian Hill petroglyph site continues to have the potential to yield information important in the prehistory and history of central Kansas. The primary concern of the following mitigation alternatives is the preservation of information.

1. No action.

   The petroglyphs have been photographed by Gardner (1968), Whiteford (ca. 1940), Kivett and Shippee (1947), Smith (1948), Leaf (1977), and Hayden (1979), and numerous casts of select elements have been made by George Jelinek and Robert Hayden. Drawings of the panel's more distinct elements were executed by Mallery in 1869. All of these earlier documentary efforts are commendable but rudimentary.

   Photographs of the panel vary in quality, but none of them conform to minimum standards for accurate and complete scientific recordation. In addition, from the information available, it appears that none of the earlier photographic studies of Indian Hill have been made in accordance with archival standards for photography.

   Casts of the petroglyphs made by Jelinek are described by Hayden (1979) as "usually of one figure, reproduced on a flat, plaque-like base of plaster with the gold-colored sand from the talus as an outer coating"; several of these casts are of figures no longer intact and therefore would be valuable in a reconstruction of the petroglyph panel. Hayden himself molded a large panel and several small ones; while the smaller ones are still complete, the large mold disintegrated during subsequent casting.

2. Graphic recording.

   a. Measured drawings.

      The classic technique for recording rock art -- measured drawings -- is accomplished by superimposing a temporary grid reference system on the rock art which is then utilized by an on-site observer to produce a

scaled rendering. Contemporary use of this technique is usually reserved for those subjects which, because of their inaccessibility, indistinct nature, etc., preclude more accurate means of recording (photography). Measured drawings are subject to distortion inherent in any technique which depends upon human preception and translation.

b. Tracings and rubbings.

Tracings and rubbings produce accurate graphic representations of the form and proportions of petroglyph figures. These full-size reproductions, however, fail to describe the surface topography of the rock or the character of the carvings or peckings.

3. Photographic recording.

Of the technology currently available for recording rock art, photography is the most efficient, accurate, and useful means. Also, it is among those methods which are least damaging to the resource. Successful photographic recording of rock art depends on many factors, however; documentary efforts of this kind must follow a total systems approach and should include:

a. Selection of appropriate equipment and materials,

b. Implementation of appropriate techniques and processes, and

c. Utilization of qualified and competent personnel.

Serious efforts to produce permanent, comprehensive photographic records of rock art should be designed to meet the following minimum standards:

a. Use of a large format (4"X5" or larger) camera system with adequate perspective control capabilities (swings and tilts).

b. Use of professional quality lenses with low distortion and high resolution characteristics. Prime lenses should be of sufficient focal length to avoid any wide angle distortion effects.

c. Use of panchromatic black and white film as the primary recording material. The characteristics of this film should include: fine grain, high resolution, dimensional stability, and an appropriate characteristic curve (contrast and tonal range). Color film should be used only as a supplementary material or for interpretive purposes, because no currently available color film is archivally permanent.

d. Use of references for scale on horizontal and vertical axes, thereby allowing precise correction for perspective distortion and recordation of panel and design element sizes.

e. Use of a gray scale as a standard reference so that a known tone and contrast value is present in all photographs. (This allows efficient evaluation of film processing and print production, and is useful during subsequent interpretation of the photographs.)

f. Use of lighting controls necessary to produce optimum subject contrast. Such controls include timing of exposures to coincide with appropriate natural lighting conditions, and use of supplemental artificial lighting.

g. Use of exposure calculations to determine the optimum recording of the subject tonal range. Shadow detail must be adequate to record pertinent information, but key highlights should also be preserved. Exposure and film development should be used to selectively manipulate the contrast of the negative, thereby insuring the clearest possible delineation of rock art designs. If necessary, exposures should be bracketed.

h. Implementation of accepted professional standards with respect to all photographic phases of field operations (e.g., a tripod should be used at all times, a cable shutter release should be used, a lens shade and filters should be used when necessary, etc.).

i. Adherence to archival standards during all phases of film processing, print processing, and storage of finished materials.

j. Complete photographic documentation of rock art sites, including: general site views to record environmental setting, topographic features, and relationship of the rock art to those features; full panel views to record the extent of design element array; and sufficient detail views to clearly record all design elements and spatial relationships among design elements.

k. In addition to the data customarily recorded for an archaeological site, recordation of all pertinent photographic data. This record should include: date, time of day, weather conditions, light conditions, camera and film size, photographer, film type, emulsion number, exposure index, and film development recommendations. Specific data for each exposure should also include: frame number (holder number), view number, speed, aperture, lens, subject distance, filters used, and auxiliary lighting used. A sketch map of the site should be made and camera location for each view should be noted.

l. Use of a fully equipped, professional quality darkroom for film processing and print production. Accepted professional standards and techniques should be followed during all darkroom operations.

m. Production of prints of at least 8" X 10" size of each view taken of the rock art site. These prints should be clearly labeled with site number, view, number, and print scale.

n. Appropriate curation of the finished materials so that the record will be properly stored (to insure archival permanence), adequately protected from loss or misplacement, and retrievable and accessible for scholarly research.

Currently, two proven photographic approaches to the recordation of petroglyphs are in use -- conventional and stereophotogrammetric.

a. Conventional photography.

Conventional photography can preserve the following rock art information (Conner and Ott 1978):

1) form and proportions of design elements;

2) scale of design elements and their spatial relationships;

3) scale of entire panel;

4) physical characteristics of the panel, including type and condition of rock surface, color, tone, patination, degree of weathering, and the extent of vandalism; and

5) site configuration and environmental setting.

b. Stereophotogrammetry.

In addition to recording the kinds of information listed above, close-range terrestrial stereophotogrammetry allows the production of (Turpin et al. 1979):

1) planimetric plots,

2) contour plots, and

3) cross-section plots.

Also, it is possible to mechanically produce scaled, three-dimensional models, although as far as it is known, such model-making has not been used in petroglyph documentation. It is, however, considered a theoretical possibility.

4. Molding and casting.

Molding and casting, a commonly used technique in documenting petroglyphs, can be used to three-dimensionally record the following data:

a. Actual size, form, and proportions of design elements;

b. Relationships among design elements;

c. Physical characteristics of the rock surface, including texture and profile (or contour);

d. Depth and mode of carving (or pecking); and

e. Weathering and vandalism.

Currently, the most feasible approach to molding petroglyphs involves the use of thick, laboratory prepared latex, a material easily transported to the field and applied to the rock surface by brush. Allowed sufficient time to dry, latex produces a lightweight, flexible, durable, and well-defined negative impression of the rock art panel. Latex molds can then be used for reproduction casting of the petroglyphs.

Because latex molds are extremely flexible (a characteristic which makes this material so advantageous for rock art molding), they are not capable of recording the profile of a particularly uneven rock surface unless backed by rigid mother molds. Mother molds serve the function of holding the latex molds in the original curvature or relief (if any) of the panel surface during subsequent casting. It is necessary, of course, to use an appropriate separating medium between mother mold and latex so that these two components may be individually removed from the petroglyph panel (and from subsequent casts).

Several materials have proven themselves suitable for both mother mold and cast production, including resin-, cellulose-, and gypsum-based products. Because of its light weight, strength, and durability, fiberglass is probably the best suited of these materials for producing master casts and mother molds.

The following procedure for molding and casting is recommended. Its success -- i.e., the production of high-quality, accurate, and permanent molds and casts -- requires the employ of someone competent and experienced in the molding and casting of petroglyphs.

a. A separator (green soap) should be applied to the rock surface to be molded and allowed to dry.

b. Four coats of laboratory-prepared thick latex should be applied to the surface, a layer of burlap being sandwiched between the second and third layers of latex to minimize shrinkage and increase the strength of the mold. A minimum of 24 hours should be allowed for the mold to dry.

c. Because of the lack of relief and generally flat aspect of the Indian Hill panel, it is believed that these latex molds would, when cast, yield accurate reproductions of the images without being backed by mother molds. If, in some locations, panel relief requires the construction of a mother mold, mylar should be attached to the back of the latex as a separator prior to the emplacement of fiberglass sheets and the application of a

hardener. The mother mold is allowed to dry, then removed; the latex mold is also removed. Both types of mold should be stored flat in a cool, dry place.

d. A fiberglass master cast of each mold should be produced within a year, due to the inevitable shrinkage of latex molds. A non-silicon separator is applied to the mold, and the casting material is mixed and poured and allowed to harden. The latex mold (and mother mold) are removed, the mold(s) cleaned, and the cast allowed to dry completely. If for display purposes, the cast is then painted to simulate the appearance of the original petroglyph.

5. Other recording.

a. Collection of all available historical photographs.

Because of the extensive erosion and vandalism which is known to have occurred at the Indian Hill site over the past century, historical photographs would be of considerable value in the compilation of a comprehensive record of the site. Also, it is probable that photographs other than those by Gardner, Whiteford, Kivett and Shippee, Smith, Leaf, and Hayden exist, and a search for such unknown photographs could yield valuable information.

b. Collection of sample of sandstone with petroglyph.

A preserved sample block of the Indian Hill petroglyph panel would permit future methods of rock art analysis and study which might require a physical specimen. Ideally, such a specimen would be collected from a previously spalled-off block from the talus below the panel or, if necessary, from an inconspicuous location on the panel.

Physical Preservation and Protection of the Indian Hill Petroglyph Site

Even the most complete and accurate documentation, using methods such as those described above, cannot replace an original petroglyph resource. In general, while the scientific value of rock art can be adequately preserved through such documentation, the aesthetic value is best preserved through stabilization and protection of original carvings and paintings. The following mitigation alternatives are concerned with the physical preservation of the Indian Hill petroglyphs; #1-5 deal primarily with the stabilization of the panel against natural erosional forces, #6 concerns primarily man-induced adverse effects (there is, understandably, some overlap).

1. Stabilization of petroglyphs with epoxy.

The porosity of the Indian Hill site sandstone is high and affords relatively easy access to and transmission of

low viscosity fluids. Although there are differences in quartz grain shape, there is no shape sorting (i.e., the grains of various sizes are mixed) and thus there are no appreciable local variations in porosity due to grain size. The silt size fraction in the sandstone is also interspersed throughout and does not cause local variations in permeability. (When segregated into separate beds an inch or more thick, silt size grains will provide a less permeable barrier to the passage of fluids.) Without having performed any permeability tests with epoxies on this sandstone, but based on experience of artificially cementing beach sandstone of similar petrographic description (Burger et al. 1969), we estimate that penetration of CIBA 830 epoxy or equivalent at 90° F. would fill the voids to at least 3/16 inch. It has been demonstrated (ibid.) that penetration of epoxy in hand specimens can be enhanced by creation of a vacuum; theoretically, vacuum-assisted application of epoxy at the Indian Hill site would be possible, say by drilling a series of deep vertical holes behind the panel and attaching vacuum pumps. Such an approach requires experimentation in a non-petroglyph outcrop to determine size of holes, spacing, distance behind outcrop, viscosity and type of cement, and amount of vacuum required to see what (if anything) will work.

Another untested possibility for using epoxy to stabilize the petroglyphs is to again drill a series of closely spaced vertical holes approximately 2 inches in diameter some 2-3 meters behind the outcrop into which very low viscosity cement or epoxy is pumped under pressure until the binder is forced to the surface where the petroglyphs occur. Structural stability may be positively affected by this method of artifical cementation in that fractures as well as pore spaces would be filled. This approach also requires experimentation in a non-petroglyph outcrop to determine what will work.

2. Mechanical stabilization of petroglyph panel.

Several mechanical means of securing the petroglyphs are possible: rock bolting, grouting, and "dental" treatment. Rock bolting would involve the horizontal emplacement of a series of long bolts according to a design which addresses itself to the joint patterns of the cliff face; preliminary and necessary to this procedure, then, would be the mapping of the joint patterns present at the site. Securing the panel through "dental" treatment would entail the emplacement of several horizontal series of bolts spaced across the cliff face, between which steel cables would be tightly strung, with the intended effect of preventing block removal. Grouting would involve filling existing joints, supposedly inhibiting water movement through these fractures; the most effective compound would have to be determined by field testing.

There are serious questions concerning the efficacy of all of these mechanical methods of stabilization because of the extremely weak nature of the sandstone at Indian Hill. Testing of

any and/or all of these methods will be required before final determinations of effectiveness can be made.

3. Slope protection.

The primary natural erosional force operative on the Indian Hill petroglyph site is mass wasting, a process greatly accelerated by the wave action of the reservoir which causes retreat of the shale/mudstone slope beneath the petroglyph panel and results in the undermining of the sandstone bluff itself. Emplacement of erosion-resistant riprap or a concrete apron from low water level to the base of the sandstone would effectively stop the cutting of wave notches and would retard mass wasting effects for at least 100 years. Such a structure would become more important if the level of the reservoir is raised to the proposed irrigation pool elevation of 1488 feet (see Figure 3); such a rise would bring the water to the level of the shaly sandstone layer beneath the petroglyphs, a layer very weakly cemented, fine-grained, and non-resistant. Wave notch-cutting here would quickly undermine the upper portions of the bluff and could cause the petroglyphs to spall off in less than 50 years.

Construction of an erosion-resistant structure at the site would involve problems of access for construction equipment and materials. Access by boat seems impractical but, if combined with helicopter transport, may be feasible. Easiest access to the site would be by land (to the top of the bluff). Previous investigations (Leaf 1977: 58) have presented arguments against construction of slope protection structures, citing potential site damage from the heavy equipment that would be required. These arguments, however, fail to convince, since the imminent destruction of the petroglyphs by mass wasting renders inconsequential those surface disturbances which might result from protective measures. Any disturbance to erosion-inhibiting vegetation such as described by Leaf (ibid.) could probably be remedied by replanting. It may also be possible to reach the site by temporarily lowering the conservation pool so that land access could be gained along the shoreline from the East Shore State Park area. This action would require further study.

Other potential methods of retarding mass wasting include the construction of a cofferdam at the foot of the slope beneath the petroglyphs, or permanently lowering the level of the reservoir. Both would effectively stop wave notch-cutting, however neither would protect the slope from visitor degradation or natural weathering.

4. Climate control.

When compared with the major natural causes of mass-wasting, climatic factors do not appear to contribute significantly to the deterioration of the Indian Hill petroglyphs. In general, rock surfaces are altered by the effects of temperature, moisture, and wind. Mitigation of these effects at the Indian Hill site would

necessitate the construction of a large (and conspicuously costly) enclosed structure which is climate-controlled. Such a structure could be designed simply for the purpose of protecting the site, or, more elaborately, the structure could also serve as an interpretive visitors' center.

5. Removal of resource.

The most extreme course of action for mitigating the adverse effects upon the Indian Hill petroglyphs would be the complete removal of the resource. Such an action would destroy the integrity of the site, but would afford complete protection and preservation of the petroglyphs (if housed in a climate-controlled environment).

Because of its very weak nature, it might be necessary to stabilize the sandstone (perhaps with epoxy) prior to block removal.

6. Mitigation of man-induced effects.

Although natural erosional forces are constantly active upon the Indian Hill petroglyphs, the rate and extent of the site's deterioration is greatly accelerated by visitor use of the area. Visitors scrambling directly up the steep, easily eroded lower slopes of the bluff break down the poorly consolidated shales and mudstones and weakly cemented sandstones beneath the petroglyphs, thus contributing (albeit unintentionally) to the undermining of the panel. The petroglyphs are sufferring differential erosion due to residues of printers' ink, chalk, and latex left from attempts to reproduce particular elements. Deliberate acts of vandalism have also served to accelerate the rate of degradation. The following alternatives address the mitigation of these adverse effects caused by visitor use of the area.

a. Eliminate access.

Probably the most effective means of mitigating adverse effects incurred by the site due to visitor use would be the prohibition of site visitation. Methods for accomplishing this include:

1) Non-disclosure of site location by deleting references to the site in all brochures, posted maps, or other materials available to the public.

2) Closure of the Indian Hill site to the public. Enforce such closure through the use of buoys, fencing, posting signs, patrolling, and the taking of punitive action against all violators (U.S. Dept. of the Army 1973, Rules and Regulations Title 36 Chapter III Sections 327.12 and 327.27).

b. Control of visitor use.

Though probably less effective than elimination of visitors from the site, the following courses of action could minimize the adverse effects incurred by the site due to visitor use:

1) Construction of walkways or trails so that both hikers and boaters would be discouraged from clambering about the slope.

2) Construction of a boat ramp to direct visitor movement to the trail.

3) Posting a series of signs conveying interpretive and authoritative messages. The intent of interpretive messages would be to explain the petroglyphs' origin and significance (who created them, when, how, etc.) and to impart to the visitor a sense of the need for the site's protection. Authoritative messages would inform visitors of the possible legal consequences of vandalic acts.

4) Erection of protective barriers which would prevent contact with the panel. An 8-foot chain link fence topped with barbed wire and encircling the site would deter all but the most determined vandal.

5) Surveillance of the site to monitor visitor behaviour and establish a presence of authority.

6) Development of educational programs for the local community designed to promote understanding of and encourage an appreciation for the resource, in the hopes of reducing the frequency and severity of vandalism at the site. Vehicles for the implementation of such educational programs would include schools, the local media, archaeological and historical societies, rock clubs, environmental groups, and other organizations which might have an interest in the recreational value of the site.

7) Construction of an off-site interpretive center, perhaps located in the East Shore State Park boat ramp area. Such a center could serve not only as a display facility for photographs, casts, samples, etc. pertaining to the Indian Hill petroglyphs but also as a repository and display facility for cultural resources of the entire Kanopolis Lake area.

RECOMMENDATIONS

That the petroglyphs at the Indian Hill site are fast deteriorating due to the direct and indirect adverse effects caused by the presence of Kanopolis Lake is undisputable; the rapidity with which these impacts are obliterating the resource has been recognized for years. The Indian Hill site was entered on the National Register of Historic Places on 31 December 1974, thereby officially verifying the significance of this cultural resource and mandating its protection by the responsible government agency(s). However, a review of recent efforts clearly reveals that those adverse effects related to the presence of the Kanopolis Reservoir have not been satisfactorily mitigated. The recommendations for mitigatory action outlined below are grouped according to those which can and should be immediately undertaken, and those which will require further data to determine their feasibility or practicality.

Immediate Mitigatory Actions

The following mitigatory actions are considered necessary and urgent and we recommend that they be implemented immediately, and in the order listed:

1. The Corps should adopt a policy of immediate action, due to the rapid rate of deterioration being suffered by the site.

2. Public access to the site should be temporarily eliminated. This action will insure that man-induced adverse effects will be minimized or avoided prior to subsequent site documentation and permanent protective measures.

    a. The District Engineer should officially close the site.

    b. Such closure should be enforced through the use of buoys, fencing, signs, patrolling, and the taking of punitive action against all violators (U.S. Dept. of the Army 1973, Rules and Regulations Title 36 Chapter III Sections 327.12 and 327.27).

    c. The Corps should begin a policy of non-disclosure of site location by deleting all references to the site in brochures, posted maps, and other materials available to the public. Copies of the brochure entitled Kanopolis Lake, Kansas which is distributed by the Corps should be withdrawn (U.S. Dept. of the Army 1974).

These measures are recommended on the basis of the statistical findings in Williams' study of cultural resource vandalism (Williams 1978). According to this study, the actions described above should be the most likely to protect the resource from man-induced adverse effects. (See Appendix 1.)

3. The site should be thoroughly and competently documented so that the scientific value of the site may be preserved.

a. Because of its efficiency and accuracy, photography is recommended as the primary means of documenting the Indian Hill site. Measured drawings, tracings, and rubbings are not recommended because they are less efficient, less accurate, and less complete techniques.

1) The site should be conventionally photographed according to the minimal standards set forth in the preceding section. Because of the site's topography, construction of scaffolding will be necessary to achieve proper camera placement and satisfactory recording of the petroglyphs.

2) Concurrent with conventional photography, a limited series of stereophotographs should be executed. The purpose of these photographs would be to record the contour and relief of the panel surface.

b. The site should be molded and cast according to the procedures set forth in the preceding section. Generally, the petroglyph panel is characterized by clusters of figures (units) and a few isolated design elements incised into a fairly flat, even rock surface. The site should be molded by unit, so as to give coverage of the entire panel, and master casts should be made. The talus slope should be searched for spalled-off portions of the panel and casts should be made of any figures so located.

Because of the weak nature of the sandstone at the Indian Hill site, molding may superficially affect the petroglyph panel. Application of any molding material might result in surface grain removal, staining, and/or the occurrence of a residue. However, such possible affects are judged to be negligible when compared with the damage being inflicted upon the site by erosion and vandals, and we believe the scientific value of the reproductions and their potential use as display pieces warrant this preservation method.

c. Information supplemental to that preserved through photography and molding and casting should be recorded.

1) The site should be completely mapped on a 1' contour interval, using standard survey equipment and techniques. This would provide precise unit location within the panel and locations of any associated artifacts and spalled-off portions of the panel.

2) After being mapped, the site should be 100% collected of all surface artifacts and any spalled-off petroglyph fragments.

3) If not previously collected from a spalled-off portion of the panel, a sample of the rock art should be taken from an inconspicuous spot on the panel. This would provide a specimen for future researchers whose methods of analysis and experimentation may require an actual sample of the rock art. This action is justifiable in view of the imminent destruction of the panel and the loss of important data to future scientists which will occur otherwise.

d. A collection of all available historical photographs and other data pertinent to the Indian Hill site should be made. This information would be valuable in compiling a comprehensive record of the site. All historical photographs should be archivally copied.

e. The following curation of documentary materials should be arranged:

1) Original negatives and a complete set of prints, historical photographs and copy negatives, original molds and master casts, and all recorded data should be curated by the Kansas State Historical Society.

2) One complete set of prints from the photographic documentation, one complete set of photographic copies of the collected historical photographs, one master cast from each mold, and a copy of all recorded data should be curated by the Smithsonian Institution.

Other Mitigatory Actions

Pursuant to the completion of those mitigatory actions listed above, it is recommended that the following actions, listed in order of priority, be undertaken:

1. Mass wasting is potentially the most destructive adverse effect on the Indian Hill site and must be mitigated before any other actions concerned with the long-term protection or utilization of the site are considered. Emplacement of erosion-resistant riprap (or a concrete apron) is probably the only prudent method of protecting the shoreline and the slope at the Indian Hill site. Such a structure would protect the slope from the erosional forces of wave notch-cutting and pedestrian degradation.

It is recommended, then, that a number of field basic studies

be conducted to provide a body of information from which a management decision concerning the feasibility of this method of shoreline stabilization can be made. Arguments against such an action on the basis of difficulty and cost of construction or damage to site integrity must be weighed against the certain imminent destruction of the resource without such action.

2. Assuming satisfactory mitigation of the effects of mass wasting, it is recommended that stabilization of the petroglyphs panel surface be undertaken. (The latter action necessarily presupposes the former, as the rate of panel destruction through mass wasting exceeds the rate of surface degradation.) Because of the minimal damage to site integrity that is likely to result from stabilization with epoxy, this method should be considered a primary alternative for surface stabilization. Epoxy treatment should be begun only after materials and methods of application have been thoroughly tested on one of the bluffs adjacent to Indian Hill. CIBA 830 epoxy and other similar compounds should be tested for depth of penetration, brittleness, staining, and general effectiveness.

While the softness of the sandstone at Indian Hill may render rock bolting, "dental" treatment, and grouting ineffective, these methods of stabilization should be tested to definitively determine their feasibility. As with the epoxy approach, these tests should be executed on rock surfaces adjacent to the Indian Hill to avoid inadvertent damage to the petroglyphs.

3. Visitor access controls should be constructed and the Indian Hill site should be re-opened to the public. The construction of these controls must precede re-opening to insure mitigation of slope deterioration and to provide maximum visitor safety. Currently, the slope beneath the petroglyphs is rapidly eroding due to both natural forces and uncontrolled pedestrian movement; the resultant recession and steepening of the slope clearly present a safety hazard to site visitors. Construction of trails, a boat ramp, barriers around the petroglyphs, etc., as described previously under "Mitigation Alternatives", would effectively discourage random pedestrian traffic and would provide safe, stable pathways for site visitors. Because of the instability of the slope it is probable that trail construction would necessitate prior slope stabilization as described in No. 1 above. Engineering studies will be requisite to a final determination of the feasibility of and development of a design for visitor control structures.

Also, recreational use of the Indian Hill site predicates the necessity for vandalism control techniques. It is recommended, therefore, that in addition to the construction of trails and other visitor traffic controls, a series of signs be posted and an 8-foot chain link fence topped wtih barbed wire be erected in front of the petroglyphs. Signage should

provide interpretive information to enhance visitor experience and engender respect for the resource, as well as authoritative messages to inform visitors of the possible legal consequences of vandalism. Vandalism mitigation should also include enforcement of laws and regulations pertaining to the protection of cultural resources and, because it has been shown that local residents are responsible for most of the acts of vandalism inflicted upon cultural resources (Williams 1978: 65-66), educational programs for the local community (as described under "Mitigation Alternatives").

If shoreline stabilization and visitor controls are not implemented at Indian Hill, it is recommended that the area remain permanently closed to the public and that closure be enforced according to the plan outlined above for temporary closure.

4. An off-site visitors' center, perhaps located at the East Shore State Park, should be constructed. Minimally, this structure would house a photographic mural of the panel, several casts of select units from the panel, and a discussion of the archaeological and historical content of the Indian Hill site. It would seem appropriate that a facility of this kind could serve not only to interpret the Indian Hill petroglyphs but the cultural resources of the entire Kanopolis Lake area as well.

5. It is recommended that the following alternatives be given no further consideration:

a. Construction of an enclosed, climate-controlled building on the site.

When compared with the effects of mass wasting, the climatic effects at the Indian Hill site are insignificant. Construction of an enclosed, climate-controlled housing would be an involved and costly undertaking and does not seem to be warranted by the degree of degradation suffered by the site due to climatic factors.

b. Removal of the resource.

Although removal is probably the most effective deterrent to cultural resource vandalism (Williams 1978: 84), and to natural erosional forces as well, the size and nature of the Indian Hill petroglyph panel would render such an action extremely difficult, costly, and potentially threatening to the resource. The sandstone into which the figures are incised is very weak and, unless somehow stabilized prior to attempts at block removal, would be prone to abrasion and breakage during such a removal process. In addition, such an action would completely destroy the integrity of the site, as it

at a proper facility could preserve the actual figures indefinitely.

In conclusion, the mitigation of the Indian Hill petroglyph site poses a difficult challenge, but we believe that our recommendations provide a viable plan for satisfactory mitigation. However, it is clearly evident that time is of the essence -- the site is deteriorating rapidly. Delayed action will result in the irrevocable loss of both scientific and aesthetic values of the site. We urge the Corps to proceed with the mitigation of the Indian Hill site at once.

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APPENDIX A

Synopsis of Williams' Study on Cultural Resource Vandalism

Appendix A

(Synopsis of Lance R. Williams' Masters Thesis entitled
Vandalism to Cultural Resources of the Rocky Mountain West,
published by the National Forest Service,
Southwest Region, Albuquerque, New Mexico, 1978.)

The objectives of Williams' study were:

1. "To identify the characteristics of cultural resource vandalism in dispersed recreation areas, and to compare these characteristics with those for non-cultural resource vandalism" (p. 4).

2. "To identify the various techniques and approaches used by resource managers to control cultural resource vandalism; to describe their successes and failures; and to evaluate the effectiveness and limitations of these techniques" (p. 4).

3. "To offer recommendations for managerial solutions to problems of cultural resource vandalism" (p. 4).

Williams' study was geographically limited to nine states in the Rocky Mountains (Arizona, Colorado, Idaho, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming) and to limited portions of California, Kansas, Nebraska, Nevada, Oklahoma, and Texas. A questionnaire was devised as a survey tool and was sent to cultural resource managers in the survey area. Generally, these resource managers represented three federal agencies: the National Park Service, the United States Forest Service, and the Bureau of Land Management. A total of 160 responses were tabluated using the SPSS system for statistical analysis.

The following survey findings described in Williams' study appear to have relevance to the evaluation of mitigation of man-induced adverse effects at the Indian Hill petroglyph site:

1. Rock art resources have the highest proportion of reported vandalism of all resource types.

2. Rock art sites are considered to be the resource type most subject to vandalism.

3. The most common forms of vandalism which occur on rock art are: carving, general defacement, removal, shooting, and painting and chalking.

4. The vulnerability factors most affecting vandalism to rock art, in order of priority, are:

   a. The resource is well-known and people seek it out.

   b. The resource has obviously been vandalized previously.

c. The resource is located in an area of concentrated visitor use.

d. The resource is obviously deteriorating due to natural causes.

5. Most vandalism to cultural resources is perpetrated by persons who reside in the general area of the resource and who repeatedly return to the site and perform harmful acts.

6. Vandalism control techniques most commonly used by cultural resource managers are those listed in Table A.

7. The relative effectiveness of various vandalism control techniques is presented in Table B.

Table A

Vandalism Control Techniques Used by Resource Managers (adapted from Williams 1978: 81).

Control Technique	Percent Frequency
Posting of signs	48.8%
Ranger patrol as preventive measure	51.3%
Interpretative or education conducted for visitors	36.9%
Erection of physical barriers	32.0%
Punitive action for apprehended vandals	28.8%
Closing off of trails or roads	25.6%
Removal of resource itself by staff or other authorized personnel	18.1%
Working with local organizations	15.0%
No real control attempt has yet been made	35.6%
No disclosure of site locational information	9.4%

Table B

Most Effective Vandalism Control Techniques for All Resource Types Noted as Most Subject to Vandalism (adapted from Williams 1978: 84).

Control Technique	Mean Effectiveness Rating[1]
Removal of resource itself by staff or other authorized personnel	1.70
Closing off of trails or roads	1.90
Erection of physical barriers	1.92
Non-disclosure of site locational information	1.92
Interpretation or education conducted for visitors	2.01
Ranger patrol as preventive measure	2.12
Working with local organizations	2.12
Punitive action for apprehended vandals	2.36
Posting of signs	2.40

[1]Mean Effectiveness Rating obtained by weighting and averaging responses of: 1=very effective; 2=moderately effective; 3=not effective.

APPENDIX B

Glossary of Terms

Glossary

alluvium - detrital deposits resulting from the operations of rivers.

Altithermal - period of high temperature, particularly the postglacial thermal optimum.

anthropomorphic - having or suggesting human form or appearance.

archival - pertaining to an accurate, organized body of records of an institution or organization.

biface - an artifact having been flaked on both the upper and lower surfaces.

carbonate cement - a cement composed primarily of a compound containing the radical CO_3^{+2}

cast - an impression formed in a mold

cement - chemically precipitated material occurring in the interstices between allogenic particles of clastic rocks. Most common cements are silica, carbonate, iron oxides and hydroxides, gypsum, and barite.

channel flaking - fluting

contour plot - a map by contour lines, g.r., topographic or structural or thickness differences.

cross-section plot - a profile map of a vertical section.

curation - accessioning and proper storage of artifacts in a museum or other suitable repository.

diagenesis - process involving physical and chemical changes in sediment after deposition that converts it to solid rock (e.g., compaction, cementation, recrystallization, etc.).

end scraper - a tool (usually unifacial) showing wear on one end, used for flensing hides.

epoxy - a thermo-setting resin capable of forming tight cross-linked polymer structures characterized by toughness, strong adhesion, and high corrosion and chemical resistance.

euhedral - idiomorphic; (a crystal) completely bounded by its own regularly developed crystal faces.

fluted - longitudinally grooved (on one or both faces of a projectile point).

friable - easily crumbled, as in the case of rock that is poorly cemented.

glyph - a symbolic figure either engraved or incised.

horticulturalist - someone who cultivates plants (usually with a hoe).

joint - fracture in a rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred; often occur in regular patterns.

latex - an emulsion of rubber or plastic globules in water used in synthetic rubber products.

manganese hydroxide - a secondary cement derived from water percolating through a rock, dissolving minute amounts of iron and manganese which are left as residues when the solution surfaces and evaporates.

megafauna - animals, living or fossil, which are large enough to be seen and studied with the naked eye.

mold - a form for shaping a fluid or plastic substance.

panel - a surface comprising one or more rock art figures appearing on a cliff face or around a boulder.

parallel flaking - evenly spaced flaking, transverse or oblique to long axis (of an artifact).

permeability - capacity of a rock for transmitting a fluid.

petroglyph - a carved, abraded, or pecked drawing on rock.

planimetric plot - a map which presents the horizontal positions only for the features represented.

porosity - the ratio of the aggregate volume of interstices in a rock to its total volume.

primary cement - original cement, which forms at time of rock formation; the first cement deposited in the pores between grains.

protohistoric - the period in the history of a culture just prior to its earliest recorded history.

radiocarbon dating - the determination of the age of a material by measuring the proportion of the isotope C-14 (radiocarbon) in the carbon it contains.

secondary cement - cement formed as a consequence of the alteration of pre-existing minerals; often deposited from solution in the interstices of a rock through which the solution is percolating.

silica cement - a cement composed primarily of silicon dioxide, SiO_2 (quartz).

spall - to break off in layers parallel to a surface.

stereophotogrammetry - a form of photography from which can be constructed planimetric, contour, and cross-section plots, and 3-D models.

talus slope - a slope formed by the accumulation of fallen rock debris.

technocomplex - a group of cultures characterized by assemblages sharing a polythetic range but having differing specific types of the same general families of artifact types, shared as a widely diffused and interlinked response to common factors in environment, economy, and technology.

unit - a distinguishable figure or cluster of figures within a petroglyph panel.

zoomorphic - having or suggesting animal form or apperance.

APPENDIX C

Scope of Work, Comments on DRAFT, Responses to Comments

KANOPOLIS LAKE
SMOKY HILL RIVER, KANSAS
DETERMINATION OF ALTERNATIVE MITIGATIVE MEASURES
AT THE INDIAN HILL PETROGLYPH SITE, 14EW 1

Scope of Work

1. Introduction.

a. Kanopolis Lake is a multipurpose water resources development project located on the Smoky Hill River in Ellsworth County, Kansas. The project consists of 21,217 acres of Government-owned land of which 3,500 acres are permanently inundated by waters of the lake. The multi-purpose pool elevation is 1463 m.s.l. If irrigation storage is added to the current pool elevation, the conservation pool will be raised to 1488 m.s.l.

The Indian Hill Site, 14 EW 1, a petroglyph bluff, is the only site at the lake currently listed on the National Register of Historic Places.

b. The following reports are results of work funded by the Smithsonian Institution, the National Park Service, the Bureau of Reclamation and the Corps of Engineers.

1947 Kivett, M.F. and J.M. Shippee. "Preliminary Appraisal of the Archeological and Paleontological Resources of Kanopolis Reservoir, Ellsworth County, Kansas."

1947 Mattes, Merrill J. "Project Report on Historical Aspects of Kanopolis Reservoir on Smoky Hill River, Kansas."

1957 Horr, David and Alfred Johnson. "Petroglyphs of Central Kansas". (unpublished manuscript)

1977 Leaf, Gary. "A Preliminary Shoreline Reconnaissance and a Management Program for the Cultural Resources of Kanopolis Lake, Ellsworth County, Kansas."

1979 Hayden, Robert. "The Feasibility of Casting the Indian Hill Petroglyphs of Kanopolis Lake.

c. The work defined herein, to be performed by the Contractor, is called for in the National Historic Preservation Act of 1966 (PL 89-665) and is authorized for funding under Public Law 86-523 as amended by Public Law 93-291 Accomplishment of this work will provide documentation evidencing compliance with Executive Order 11593 "Protection and Enhancement of the Cultural Environment" dated 13 May 1971, Section 2(a).

2. Scope.

Past work concentrated on photographing the site and developing a feasible casting method. This work encompasses literature review, onsite inspection,

...mitigation plan for the Indian Hill site. This plan will include ... of alternative measures and recommendations for the most ... mitigating the site and will provide a base for future use by the ... logical profession as data for research. The contractor and his staff shall conduct this study in a professional manner, using accepted ... methodology in accordance with 33CFR305 and proposed 36CFR66.

3. Tasks to be Performed.

a. Conduct a review of literature, Governmental reports, and other ... on the Indian Hill site to the depth required for consideration of the study area and to accumulate, develop, and interpret scientific and technological data. This includes the review of all previous reports concerning cultural resources associated with the site and records, survey forms, and pertinent library sources concerned with cultural resources within the project boundaries for archeological or historical information that may relate to the site.

b. Make at least one visit to the site to consult with project personnel about conditions of the site and determine the physical condition of the glyphs and their setting in order to make suitable recommendations for their mitigation. A professional geologist who is a specialist in sandstone properties and its durability and preservation should be included in this phase of the study (and in preparation of the report).

c. Photograph phases of field investigation, using black and white film.

d. Outline and prioritize a plan of mitigation alternatives.

4. Schedule of Work.

a. Coordination and Meetings. All work to be performed by the Contractor shall be closely coordinated with the appropriate Corps of Engineers cultural resources coordinator. Also, the lake project manager shall be kept informed of all required field activities.

(1) The Contractor shall review progress of the work performed with representatives of the Corps of Engineers and the State Historic Preservation Officer (SHPO).

(2) The Contractor is to attend one meeting at the Kansas City District Office to discuss the review of the draft of the report.

(3) By written request, the Contracting Officer may require the Contractor to furnish the services of technically qualified representatives to attend additional meetings in addition to those cited in (1) and (2) above. Payment for ... will be made at a rate per hour for the principal(s) involved ... computed in accordance with Government Joint Travel Regulations for the time travel is performed.

b. Progress Report and Schedule.

(1) ... reports of findings shall be prepared by the Contractor and his

staff. The report shall be written in a professional manner but suitable for reading by persons not professionally trained as archeologists. The report is intended to be of use to the archeological profession as well as of interest to the general public. Use of illustrations is encouraged.

(2) The report of findings shall be authored by either the principal investigator or porject director. The principal investigator is the person directly responsible for field investigation, development of mitigation alternatives, and write-up of the initial draft of the report. The project director is that person who oversees and administers the purchase order and who does the final editing of the report. The archeologist (regardless of title) whose credentials are used to justify the assumption that professional work is being performed should either be the author or co-author of the report.

(3) Thirteen (13) copies of a complete draft of the report shall be submitted to the Contracting Officer for purposes of Governmental review within six (6) months after receipt of notice to proceed. In addition to standard review procedures, the Government may (at its discretion) send the draft report and Scope of Work to three qualified professionals not associated with a State or Federal Governmental agency for peer review of the merits and acceptability of the report. After a review period of approximately two (2) months after receipt of the draft report the Government will return the draft to the Contractor. The Contractor shall then complete necessary revisions and submit the final report, which shall be professionally edited, within sixty (60) calendar days after receipt of the reviewed draft. The Contractor shall submit one set of originals and two copies of the final report of findings to the Government. The copies shall include all plates, maps and graphics in place so that they may be used as patterns for assembling the final report. The Government will edit the final report and after approval, will reproduce this report and provide the Contractor ten (10) copies for personal use, plus two (2) copies for each major contributing author. The total contract time shall not exceed ten (10) months from the date of receipt of the notice to proceed.

(4) The report shall include the following:

(a) An abstract of work performed;

(b) A description of the site, including environment, geologic setting, etc.;

(c) A description of the cultural resources and culture history associated with the site;

(d) A detailed description of the site to support the discussion in the text which is to be used as valuable data for professional use of the report;

(e) A detailed description of the methods used during site inspection;

(f) A detailed description of the methods which could be used in mitigation including protection of the site;

(g) Recommendations which could be added to the preliminary cultural resources management plan for the operating project, and any suggestions for the archeological portion of the interpretive program;

(h) Illustrations, photos, maps, tables, and graphic representations of data appropriate to the text;

(i) A glossary of terms;

(j) Reference section with all sources referred to in the text and for the report: personal communications, interviews, bibliography, etc.

(k) Copies of all correspondence pertaining to review of the draft report. These are to include the comments of the State Historic Preservation Officer, Heritage Conservation and Recreation Service, and the peer reviews (if applicable) by professional archeologists requested by the Government, together with responses to each of the comments given. The Scope of Work is to be included in this section; and

(l) Listing of principal investigators and their personnel with their qualifications as an appendix.

(5) The final originals and two copies of the report shall be typed single-spaced on one side of paper with the margins set for reproduction on both sides of 8 x 10½ inch paper. One of the copies shall be assembled in accordance with the attached style sheet.

c. Other Information. Six copies of materials not suitable for publication in the report shall be submitted with the draft. These materials may include repetitious photographs, and other documentation not of interest to most readers of the report. Averages, graphs, or summaries of data are to be included in the publishable report.

d. Materials Not for Release. Materials dealing with exact archeological site locations are considered confidential and are not to be published or released.

5. Further Responsibilities of the Contractor and Government.

a. Contract Modifications.

The work identified in this document shall be complete in itself. There will be no assurance from the Government that additional work will follow, nor should such work be anticipated.

b. Data Availability. The Government will provide the Contractor with available background information, maps, remotely sensed data reports (if any), and correspondence as needed. In addition, the Government will provide support to the Contractor regarding suggestions on data sources, format of study outline and report, and [illegible]

c. Right of Inter[illegible] [illegible] of-[illegible] on all [illegible]

provide the Contractor with an extension ladder for the length of time required to complete the field investigation and transport the ladder to and from the site.

d. Publication. It is expected that the Contractor and those in his employ, may during the term of the contract, present reports of the work to various professional societies and publications. Outlines or abstracts of those reports dealing with work sponsored by the Corps of Engineers shall be sent to the Kansas City District Office for review and approval prior to presentation or publication. Proper credit shall be given for Corps of Engineers' sponsored work, and the Corps of Engineers shall be furnished six (6) copies of each paper presented and/or published report.

e. Court Testimony. In the event of controversy or court challenge, the Contractor shall make available, as appropriate, expert witnesses who performed work under this contract to testify on behalf of the Government in support of the report findings. If a controversy or court challenge occurs and testimony of expert witnesses is required, an equitable adjustment shall be negotiated.

f. Safety Requirements. The Contractor shall provide a safe-working environment for all persons in his employ as prescribed by EM 385-1-1, "General Safety Requirements," a copy of which will be provided by the Government.

6. Staff and Facility Requirements.

a. Project Director and Archeologist. Minimum qualifications are set forth in proposed 36CFR66, Appendix C, which is provided on page 5381 in the Federal Register, Vol 42, No. 19 - January 28, 1977.

b. Consultants. Personnel hired or subcontracted for their special knowledge and expertise must carry academic and experiential qualifications in their own fields of competence.

c. Equipment and Facilities. The Contractor must also provide or demonstrate access to:

(1) Adequate equipment necessary to conduct operations defined in the Scope of Work; and

(2) Adequate office space and facilities for proper treatment, analysis, and storage of records likely to be generated by the project.

United States Department of the Interior
HERITAGE CONSERVATION AND RECREATION SERVICE
INTERAGENCY ARCHEOLOGICAL SERVICES -DENVER
P.O. BOX 25387, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

APR 15 1980

Chief, Engineering Division
Department of the Army
Kansas City District
Corps of Engineers
Federal Building
Kansas City, Missouri 64106

Dear Mr. Fritts:

We acknowledge receipt in two (2) copies of the draft report entitled "The Indian Hill Petroglyph Site, 14EW1, Kanopolis Lake: Development of Alternative Mitigation Plans" prepared under your Purchase Order No. DACW41-79-M-1799. These documents were originally sent to Mr. Jerry Rogers of our Washington Office.

Due to our current workload, we are unable to provide a useful review of this report within the time limits requested by your letter of March 25, 1980. However, lack of review does not constitute agreement with any or all parts of the report. We suggest that future requests of this sort be sent directly to us, rather than Washington, in order to allow sufficient time for useful review.

Sincerely,

Jack R Rudy

Jack R Rudy
Chief, Interagency
Archeological Services - Denver

Kansas State Historical Society
120 West Tenth • Topeka, Kansas 66612 • 913/296-3251

May 14, 1980

Donald L. Fritts
Assistant Chief, Engineering Division
Attn: MRKED-BR
U. S. Army Corps of Engineers
Kansas City District
700 Federal Building
Kansas City, Missouri 64106

Dear Mr. Fritts:

Comments in my letter, dated April 27, 1979, on the proposed scope-of-work for determining mitigation measures for the Indian Hill petroglyph site expressed our concern over the delay which such a study would cause and whether it would produce any additional ideas or plans for mitigation which had not already been considered. One year after these comments were made we received a draft report resulting from that scope-of-work entitled "The Indian Hill Petroglyph Site, 14EW1, Kanopolis Lake: Development of Alternative Mitigation Plans" prepared by the Grand River Institute, Grand Junction, Colorado. Staff review of this document has shown that our previously expressed concerns were well-founded. With the exception of parts of the geologic study no new information about the site was presented and the mitigation plans mentioned in the report have all been previously proposed. The authors provided no information about the costs involved in each plan nor was there any discussion of the practical or engineering problems involved in executing the plans. A detailed description of the methods which could be used in mitigation is called for in section 4b (4)(f) of the scope-of-work and the report in its present form does not seem to satisfy that requirement. For example, casting of the glyphs is mentioned as a method for mitigation, but no discussion of casting techniques is included in the report. Additional comments are given below following the outline of the report.

The statement is made on page 1 of the "Introduction" that the Indian Hill site was "elected" to the National Register of Historic Places. Sites are approved for listing by the Keeper of the National Register after an appropriate review, but sites are never elected.

Information presented in the "Environmental Overview" is sketchy and some of it superflous to the study. Climate is a factor in the preservation

or destruction of the site; however, the relationship between the data collected on rainfall, temperature, etc., and erosion of the site is not discussed here or elsewhere in the report. The lists of plants and animals said to be in the region are not related to the site, either as possible contributors to site destruction or identified as the subject matter of glyphs. The information in this section should be oriented toward the site and not treated as a series of isolated and unrelated "facts."

The cultural/historical review is very weak, "dated," and for the most part does not deal with Kansas archeology. The primary reference used was Prehistoric Man on the Great Plains by Waldo Wedel. This 20 year-old publication is useful as a general reference, but is not a good primary source. Much archeological investigation has been done in Kansas since 1960 but virtually none of it is included in the report. The Archaic in Kansas is described in terms of the Desert Culture of the far west and from sites found in Utah, Colorado and Nebraska, while the Woodland description is based on sites in Nebraska. The Plains Village unit does include the Smoky Hill Aspect, which is regional to the Kanopolis reservoir area, but it is incorrectly summarized. For no apparent reason the horse nomads, a group which very likely had an important part in the creation of the Indian Hill site, are only listed by tribal name and included within the Plains Village period. The various horse nomadic groups are a totally different historic and cultural unit, and they deserve a more complete discussion.

The hypothesis of a Smoky Hill Aspect origin for some of the glyphs present at the site seems tenuous at best. Given the documented erosion of the cliff since it was first photographed in the latter part of the 19th century and the uncertain cultural affiliation of some of the sites located in the surface survey, Leaf's supposition of great antiquity for the glyphs seems improbable. In any event references to Smoky Hill peoples as the creators of the glyphs should be stated as hypothesized or supposed, rather than as fact as was done in the "Description of the Site" on page 20.

As stated above the geologic study was well presented and some important data demonstrated. Specifically, this was the discussion of the weak cementation, the formation of joint patterns and the inevitable mass wasting of the outcrop. This is documentation of what is obvious to even the casual visitor to the site, that is the cliff is being eroded away.

The mitigation schemes presented in the report are essentially those suggested in the original 1976 meeting between representatives of my office, the Corps of Engineers and the Bureau of Reclamation. Alternative number two is the same as our original request for a thorough, competent and appropriate photographic recording of the site in conjunction with competent casting, as the primary means of mitigation. However, we do not approve of the rest of the proposal, which includes construction of trails, boat ramps and signs for visitors. So much erosion has taken place that the construction of these facilities would endanger the site, and visitation has been the single most destructive element at the site in the last two decades. Any means to increase visitation there should not be considered.

Alternative 3 to include riprap or a paved apron in addition to the features of Alternative 2 would seem to be an appropriate means to physically protect the site from the effects of the lake's erosive force. The expense of this proposal as well as the logistical considerations involved in getting the construction materials to the site were not adequately discussed. We believe the cost of this alternative would be prohibitive when compared to the expected results and its implementation would result in an adverse impact to the site.

Alternative 4 to add fencing of the site in addition to those features mentioned above has some of the same disadvantages as Alternative 2 in terms of the adverse impact on the site. Construction of the fence would be one aspect of the impact and the suggested four foot height of the fence seems insufficient to discourage unwanted trespassing.

We believe that competent contemporary documentation, as proposed in 1976, is the best form of mitigation. This would serve the public while at the same time provide a relatively permanent record of the site. We believe a project exhibit facility for the casts and photographs would be far more meaningful, practical and economical than any of the suggested plans to physically protect the site and display it to the public.

As we have stated before, the Indian Hill Petroglyph site is a unique problem in cultural resource management. The impacts to the site are not proposed actions that can be changed by administrative means or postponed to a later date, but rather damage to the site can be measured on an almost daily basis from the results of natural erosion and man-made vandalism. The need for mitigation of the site and the urgency of the situation has been recognized for four years. We urge that a proper record of the site be made and made quickly.

Very truly yours,

Joseph W. Snell
State Historic Preservation Officer

JWS/maw

Responses to Comments on Draft Report

State Historic Preservation Officer

Comment 1. With the exception of parts of the geologic study no new information about the site was presented and the mitigation plans mentioned in the report have all been previously proposed.

Response 1. The Scope of Work did not charge us with providing "new" information about the site or with developing "new" mitigation plans. In its current form, we believe our report satisfies the stipulations outlined in ? of the Scope.

Comment 2. The authors provided no information about the costs involved in each plan nor was there any discussion of the practical or engineering problems involved in executing the plans.

Response 2. The Scope of Work did not charge us with providing cost estimates for the mitigation alternatives, nor with providing discussions of attendant engineering problems. Where possible, practical problems have been addressed within the discussions of the various alternatives.

Comment 3. A detailed description of the methods which could be used in mitigation is called for in section 4b (4)(f) of the scope-of-work and the report in its present form does not seem to satisfy that requirement. For example, casting of the glyphs is mentioned as a method for mitigation, but no discussion of casting techniques is included in the report.

Response 3. The section entitled Mitigation Alternatives has been rewritten to provide detailed descriptions of methods of photographing, casting, and otherwise documenting and protecting, the site (see pp. 38-47).

Comment 4. The statement is made on page 1 of the "Introduction" that the Indian Hill site was "elected" to the National Register of Historic Places. Sites are approved for listing by the Keeper of the National Register after an appropriate review, but sites are never elected.

Response 4. "Elected" has been changed to "nominated" (see p. 1).

Comment 5. Information presented in the "Environmental Overview" is sketchy and some of it superfluous to the study.

Response 5. The Scope of Work, Section 4b (4)(b) calls for a description of the site, including environment, geologic setting, ect. Sketchy parts of the description have been filled in by incorporating information subsequently provided us by the Corps entitled "Final Environmental Statement, Operation and Maintenance, Kanopolis Lake, Kansas".

Comment 6. Climate is a factor in the preservation or destruction of the site; however, the relationship between the data collected on rainfall, temperature, etc., and erosion of the site is not discussed here or elsewhere in the report. The lists of plants and animals said to be in the region are not related to the site, either as possible contributors to site and not treated as a series of isolated and unrelated "facts".

Response 6. Such are now discussed in Erosional Forces Operative on the Site (see p. 23).

Comment 7. The cultural/historical review is very weak, "dated," and for the most part does not deal with Kansas archeology. The primary reference used was Prehistoric Man on the Great Plains, by Waldo Wedel. This 20 year-old publication is useful as a general reference, but is not a good primary source. Much archeological investigation has been done in Kansas since 1960 but virtually none of it is included in the report. The Archaic in Kansas is described in terms of the Desert Culture of the far west and from sites found in Utah, Colorado and Nebraska, while the Woodland description is based on sites in Nebraska. The Plains Village unit does include the Smoky Hill Aspect which is regional to the Kanopolis reservoir area, but it is incorrectly summarized. For no apparent reason the horse nomads, a group which very likely had an important part in the creation of the Smoky Hill site, are only listed by tribal name and included within the Plains Village period. The various horse nomadic groups are a totally different historic and cultural unit, and they deserve a more complete discussion.

Response 7. This section was originally compiled from sources provided by the Corps, and from a few publications in our local libraries. The section has since been rewritten, after obtaining additional sources from the Corps and especially from Tom Witty of the Office of the Kansas State Archaeologist.

Comment 8. The hypothesis of a Smoky Hill Aspect origin for some of the glyphs present at the site seems tenuous at best. Given the documented erosion of the cliff since it was first photographed in the latter part of the 19th century and the uncertain cultural affiliation of some of the sites located in the surface survey, Leaf's supposition of great antiquity for the glyphs seems improbable. In any event references to Smoky Hill people as the creators of the glyphs should be stated as hypothesized or supposed, rather than as fact as was done in the "Description of the Site" on page 20.

Response 8. Agreed. Appropriate changes have been made in the report (see p. 8).

Comment 9. The mitigation schemes presented in the report are essentially those suggested in the original 1976 meeting between representatives of my office, the Corps of Engineers and the Bureau of Reclamation. Alternative number two is the same as our original request for a thorough, competent and appropriate photographic recording of the site in conjunction with competent casting, as the primary means of mitigation. However, we do not approve of the rest of the proposal, which includes construction of trails, boat ramps and signs for visitors. So much erosion has taken place that the construction of these facilities would endanger the site, and visitation has been the single most destructive element at the site in the last two decades. Any means to increase visitation there should not be considered.

Response 9. We agree that the mitigation plans discussed herein are similar to those proposed earlier -- there are a limited number of actions one can take in the preservation of an archaeological site! In response to Mr. Snell's disapproval of erecting signs, contructing trails, etc. -- we feel that <u>if</u> public access is not restricted, then such measures are necessary for visitor safety and site stabilization.

Comment 10. Alternative 3 to include riprap or a paved apron in addition to the features of Alternative 2 would seem to be an appropriate means to physically protect the site from the effects of the lake's erosive force. The expense of this proposal as well as the logistical considerations involved in getting the construction materials to the site were not adequately discussed. We believe the cost of this alternative would be prohibitive when compared to the expected results and its implementation would result in an adverse impact to the site.

Response 11. Height of fence has been changed to eight feet (see p. 47).

Comment 12. We believe that competent contemporary documentation, as proposed in 1976, is the best form of mitigation. This would serve the public while at the same time provide a relatively permanent record of the site. We believe a project exhibit facility for the casts and photographs would be far more meaningful, practical and economical than any of the suggested plans to physically protect the site and display it to the public.

Response 12. These ideas are discussed in detail under Recommendations (see pp. 48-53).

Comment 13. As we have stated before, the Indian Hill Petroglyph site is a unique problem in cultural resource management. The impacts to the site are not proposed actions that can be changed by administrative means or postponed to a later date, but rather damage to the site can be measured on an almost daily basis from the results of natural erosion and man-made vandalism. The need for mitigation of the site and the urgency of the situation has been recognized for four years. We urge that a proper record of the site be made and made quickly.

Response 13. Agreed.

APPENDIX D

Personnel Vitae

VITA

NAME: Clifton McKinley Wignall

PII Redacted

[redacted]

EDUCATION:

B.A. University of California, Berkeley, 1949 (Sociology and Social Institutions) (with honors).

B.A. University of California, Berkeley, 1949 (Philosophy) (with honors).

M.A. University of California, Berkeley, 1952 (Sociology and Social Institutions; Thesis: A Critique of Functionalist Theory of Social Order).

Diploma in Anthropology - Oxford University (General Anthropology and Archaeology), Oxford, England, 1951 (equivalent to an American Ph.D.).

Ph.D. International Studies in Sociology, Albert Schweitzer Colleges, Chur, Switzerland, 1972 (Dissertation: Theory of the State Mental Hospital).

PROFESSIONAL EXPERIENCE:

Research

1. IBM Program Designer, University of California, Berkeley, 1952.
2. Research Sociologist, Psychiatric and Tuberculosis Treatment Center, U.S. Air Force Hospital, Parks AFB, California, 1955-1958.
3. Consultant in Sociology, Stockton State Hospital, Stockton, California, summer 1958.
4. Consultant in Sociology, Mental Health Research Institute, State of Washington, Division of Mental Health, Fort Steilacoom, Washington, 1959-1961.
5. Consultant, Research Publications, Division of Research and Education, Dept. of Mental Hygiene, State of California, Sacramento, California, 1967.
6. Consultant, Epidemiological Field Station, The Greater Kansas City Mental Health Foundation, Kansas City, Missouri, 1968.
7. Consultant, Arizona State Hospital, Phoenix, Arizona, 1968-1969.
8. Consultant in Program Evaluation, Dept. of Psychiatry, School of Medicine, University of Texas, San Antonio, Texas, 1969.
9. Consultant, Pikes Peak Community Action Program, Colorado Springs, Colorado, 1969.

10. Research Associate in Psychiatric Epidemiology, College of Psysicians and Surgeons, Columbia Univeristy, 1970, 1971.
11. Consultant to Local Alcohol Reception Center Research Project, Maricopa County Agencies of Government, Phoenix, 1973-1975.
12. Consultant for Environmental Impact Studies, Paradise Valley, Arizona, 1974-1976.
13. Consultant in Anthropology/Archaeology, Antiquities Research Division, Museum of Western Colorado, Grand Junction, 1976-1978.
14. Research Director, Mesa College Fremont Studies Project, 1977-present.
15. Various archaeological surveys and test excavations Western Colorado, Grand River Institute. On-going.
16. Director of Research, Grand River Institute, Grand Junction, Colorado, 1979-present.

ADMINISTRATION

1. Director of Research and Programs Analysis, Sociology and Anthropology, Colorado State Hospital, 1962-1970.
2. Director of Research, St. Luke's Hospital Medical Center, Phoenix, Arizona, 1971-1974.
3. Director of Data Systems and Research, Phoenix Alcoholism Consortium, St. Luke's Hospital, Phoenix, Arizona, 1973-1974 (concurrent with 2. above).
4. Director of Research and Planning, Phoenix South Community Mental Health Center, Phoenix, 1971-1976 (concurrent with 2. and 3. above).
5. Executive Secretary, Grand River Institute, Grand Junction, Colorado, 1978-present.

Academic

1. Reader in History of Philosophy, University of California, 1948.
2. Teaching Assistant, Sociology and Social Institutions, University of California, Berkeley, 1949-1950.
3. Instructor in Philosophy, Santa Rosa Junior College, Santa Rosa, California, 1954-1955.
4. Instructor in Sociology and Anthropology, University of Puget Sound, Tacoma, Washington, 1958-1961.
5. Lecturer in Sociology, Colorado Springs Center, University of Colorado, 1962-1970.
6. Lecturer in Sociology, Arizona State University Extension Division, Tempe, Arizona, Fall 1973-1974.

7. Associate Professor of Anthropology and Archaeology, Mesa College, Grand Junction, Colorado, 1976 - present.

HONORARIES AND PROFESSIONAL SOCIETIES

Elected Fellow of the Royal Anthropological Institute of Great Britain and Ireland, 1951.

TEACHING INTERESTS

Prehistory, history of social thought, ethnology, primitive religion, science and mythology.

RESEARCH GRANTS

1966 NIMH grant for "Western Conference on the Uses of Mental Health Data" (8-year program in Boulder, Colorado, a several million dollar grant, member of grant writing committee of six).

1972 NIMH grant for childrens treatment and research in a poverty area of Phoenix, Arizona, Phoenix South Community Mental Health Center, (2.5 million dollars) grant preparator.

PUBLICATIONS (Archaeological)

Cultural Resources Inventory of Proposed Road Right-of-Way, Electric Mountain Recreation Subdivision, Delta County, Colorado. Prepared for U.S. Forest Service, November 21, 1976.

Antiquities Inventory for Cambridge Mining Co.: Coal Mine Portal Area for Coal Mine Debris Disposal in Coal Canyon and Coal Gulch, Cameo, Colorado. Historical Museum and Institute, Grand Junction, Colorado. March 1977.

Archaeological Reconnaissance of a Proposed Radio Repeater Station in the Ruby Canyon Area, Mesa County, Colorado. Prepared for Denver and Rio Grande Railroad Company. Historical Museum and Institute of Western Colorado, Grand Junction, Colorado. January 5, 1978.

Archaeological Reconnaissance of Three Proposed Well Sites in the Bar X Gas Field, Prairie Canyon Area, Mesa County, Colorado. Prepared for Palmer Gas and Oil Company, Billings, Montana. Antiquities Research Division, Inc., Museum of Western Colorado, Grand Junction, Colorado. April 20, 1978.

Archaeological Reconnaissance of the Loma Coal Prospect, Garfield County, Colorado. Prepared for Sheridan Enterprises, Englewood, Colorado. Antiquities Research Division, Museum of Western Colorado, Grand Junction, Colorado. July 1978.

Archaeological Reconnaissance of the Hopkins-Montrose County Airport, Nucla, Colorado. Prepared for Isbill Associates, Inc., Denver, Colorado. July 5, 1978.

Cultural Resources Inventory of Six Proposed Gas Well Sites on the Mancos Shale Lowlands, Mesa and Garfield Counties, Colorado. Antiquities Research Division, Museum of Western Colorado, Grand Junction, Colorado. July 16, 1978.

Cultural Resources Inventory of the Rangely Airport, Rio Blanco County, Colorado. Prepared for Isbill Associates, Inc., Denver, Colorado. July 24, 1978.

Cultural Resources Inventory of the Meeker Airport, Rio Blanco County, Colorado. Prepared for Isbill Associates, Inc., Denver, Colorado. July 26, 1978.

Cultural Resources Inventory of Eight Proposed Oil Well Sites in the Lake Canyon Area, Duchesne County, Utah. Prepared for the Ouray Ute-Uintah Tribe, Ft. Duchesne, Utah. August 1978.

Cultural Resources Inventory of Five Proposed Oil Well Sites in the Lake Canyon Area, Duchesne County, Utah. Prepared for the Ouray Ute-Uintah Tribe, Ft. Duchesne, Utah. August 1978.

Cultural Resources Inventory of Twenty-One Miles of Proposed Access Road, Loma Coal Prospect, Garfield County, Colorado. Antiquities Research Division, Museum of Western Colorado. August 1978.

Cultural Resources Inventory for Pipeline Right-of-Way for Gas Wells Federal 2-3-8-104, Federal 43-3-8-104, and Federal 3-9-8-104, Garfield County, Colorado. Grand River Institute, Grand Junction, Colorado. October 15, 1978.

Test-Excavation of the Gore Site Number 1: A possible Fremont Structure and Associated Petroglyphs. m.s., 1979.

Cultural Resources Inventory of Eight Proposed Oil Well Sites in the Lake Canyon Area, Duchesne County, Utah. Prepared for Environmental Engineering Company, Casper, Wyoming. August 1978.

Cultural Resources Inventory of Ute Tribal Oil Well [illegible] NW¼ NE¼ Sec. 12, T.4S., R.6W., U.S.B.&M., Rabbit Gul[illegible] Quadrangle, Duchesne County, Utah. Addendum to Report [illegible] August 1978. Prepared for Ute Indian Tribe, March 1979.

Cultural Resources Inventory of Four Proposed Oil Well Sites in the Buck Knoll Area, Duchesne County, Utah. Prepared for Gulf Energy Minerals Company. May 1979.

Cultural Resources Inventory, Ute Tribe Oil Well 1-23-A1, Duchesne County, Utah. Addendum to report of August 1978. Prepared for Ute Indian Tribe. December 1978.

Cultural Resources Inventory of Four Proposed Oil Well Sites in the Ouray Southeast Area, Uintah County, Utah. Prepared for Continental Oil Company, May 5, 1979.

Thirteen Point Surface Use Plan for Well Location Ute #1-17B6 Located in Section 17, T.2S., R.6W., U.S.B.&M., Duchesne County, Utah. Prepared for Shell Oil Company. 1979.

Thirteen Point Surface Ute Plan for Well Location Ute #1-16B6 Located in Section 16, T.2S., R.6W., U.S.B.&M., Duchesne County, Utah. Prepared for Shell Oil Company. 1979.

Cultural Resources Inventory Report of Ute Tribal 1-6C6 Proposed Oil Well Site Duchesne County, Utah. Prepared for Diamond-Shamrock Corporation. June 1979

Cultural Resources Inventory Report of Ute Tribal Proposed Oil Well Sites No. 1-16B6 and No. 1-17B6, Duchesne County, Utah. Prepared for Shell Oil Company. August 1979.

Cultural Resources Inventory Report of Four Proposed Well Locations (Steve Federal #14, #24, #30, #32) and respective access. Prepared for Burton-Hawks-Madex. Grand River Institute, Grand Junction, Colorado. November 1979.

Cultural Resources Inventory of 13 Proposed Seismographic Stations and 1 Proposed Stratigraphic Test Hole Site in San Juan County, Utah. Prepared for Woodward-Clyde Consultants Grand River Institute, Grand Junction, Colorado. August 1979.

PUBLICATIONS (Sociological)

"Influence of Policy and Drugs on Colorado State Hospital Population," Archives of General Psychiatry, April 1965, Vol. 12, pp. 352-352 (with Ted C. Smith and Willis H. Bower).

"Mexican American Usage of State Mental Hospital Facilities," Community Mental Health Journal, Summer 1967, Vol. 3, No. 2, pp. 137-148 (with Lawrence L. Koppin).

"Illegitimate Pregnancies in State Institutions," Archives of General Psychiatry, May 1968, Vol. 18, pp. 580-583 (with Charles E. Meredith).

"Patient Escapes, 1956-1962," Research and Statistics Series, Colorado State Hospital, Pueblo, 1963.

"Trends in Patient Population," Program Evaluation Series, No. 3, Colorado State Hospital, Pueblo, 1965.

"Adolescents in the Colorado State Hospital," Research and Program Evaluation Series, No. 8, Colorado State Hospital, Pueblo, November 1966.

"Trends in Patient Population, 1961-1968: Costs and Effects," Research and Evaluation Series, No. 8, Colorado State Hospital, December 1968.

"Evaluation: Program for Pupil Adjustment," Institute for Pupil Study, Kansas City, Missouri, 1969.

"Program Goals for Health Care and Education (Southeastern Colorado)," Governor's Commission on Health Care and Education, State Planning Office, State of Colorado, September 1969.

"Mental Illness and Its Treatment: from the perspective of historical sociology," Mental Health Research Institute Bulletin, State of Washington Division of Mental Health, Olympia, December 1960, Vol. II, No. 6, pp. 118-124.

"Program Evaluation Series," Phoenix Alcoholism Consortium, 1973 - et. seq.

VITA

NAME: Carl E. Conner

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EDUCATION:

A.A. Mesa Junior College, 1970 (Liberal Arts)
B.A. Adams State College, 1972 (Anthropology)
Senior Research - linguistics and Mesoamerican archaeology, University of the Americas, 1972, Puebla, Mexico.
Field School, Adams State College, 1973, Llaves, New Mexico.
Various seminars and special classes on museum administration, 1973-1975.

PROFESSIONAL EXPERIENCE:

Field Work, Research, and Projects Management

1. Administrator and field inspector for numerous small acreage cultural resources surveys in western Colorado, 1976-1980.
2. Project director and crew chief for the Spinney Mountain Project -- a cultural resources survey and evaluation of resources to suffer impacts from a proposed reservoir for the City of Aurora, Colorado, 1979.
3. Principal investigator for the Indian Hill Petroglyph Site, 14EW1, Kanopolis Lake: Development of Alternative Mitigation Plans for the U.S. Army Engineering District, Kansas City, Kansas, 1979.
4. Project administrator for the cultural resources inventory of a 62-mile long right-of-way for the Poncha-San Luis 230 kv Transmission Line for Colorado-Ute Electric Association of Montrose, Colorado, 1979.
5. Project administrator for the cultural resources inventory of 5200 acres within the Oak Creek Expansion (a proposed coal mine in northern Colorado) for Pittsburg & Midway Coal Mining Company of Denver, Colorado, 1979.
6. Project director for the archaeological excavations at Jerry Creek Reservoir No. 2, an excavation of four archaeological sites; supervisor of the excavations at 5ME428, 1978-1979.
7. Principal investigator for the cultural resources survey (a two year project) of approximately 11,000 acres of the Dominguez Project, a proposed reservoir near Whitewater, Colorado, for the Bureau of Reclamation, Grand Junction Projects Office, 1977-1978.

8. Project director of the archival documentation of selected petroglyphs and pictographs of the Grand Junction District for the Bureau of Land Management, Colorado. This was a two year project involving complete photographic and archival documentation of 34 prehistoric rock art panels and the molding and casting of portions of 14 panels, 1977-1978.
9. Principal investigator for the cultural resources survey of approximately 3,600 acres in tributary canyons of the Colorado River Corridor for the Grand Junction District Office of the Bureau of Land Management, Colorado, 1977.
10. Principal investigator for the antiquities inventory for the Wild and Scenic River Designation of the Colorado River, a survey of approximately 6,400 acres along the river corridor for the Bureau of Land Management, Colorado and Utah, 1976.
11. Project director of the Centennial-Bicentennial "Rock Art of Mesa County" recordation project, 1976.
12. Field inspector for small acreage cultural resources surveys in western Colorado for the Bureau of Land Management and private industry, 1975.
13. Project director of Rock Art of Mesa County survey project funded by the Historical Museum and Institute of Western Colorado and the Goodwin Foundation, 1974.
14. Supervisor for the Mesa College-Historical Museum and Institute of Western Colorado-Metro State excavation of a BLM III-Fremont site in Paradox Valley, Colorado, 1973.
15. Student attending Adams State College Field School in Archaeology with Dr. Herbert Dick; excavating and studying the Gallina Culture of North Central New Mexico, 1973.
16. Senior research in linguistics and Mesoamerican Archaeology, (at the University of the Americas) Puebla, Mexico, 1972.

Administration

1. Administrative Director, Grand River Institute, October 1978-present.
2. President, Antiquities Research, Inc., 1978.
3. Research Director, Antiquities Research, Inc., 1977-1978.
4. Assistant Director, Historical Museum and Institute of Western Colorado, 1974-1976.
5. Curator of Collections, Historical Museum and Institute of Western Colorado, 1973.

TEACHING EXPERIENCE:

Part-time instructor in archaeology, Mesa College, 1975-1976.

RESEARCH INTERESTS:

1. Prehistory of the Southwest, Ute Prehistory, Fremont, Petrolgyphs and Pictographs.
2. Anthropological Linguistics, Prehistoric Social Organization.

RESEARCH GRANTS:

1. Administrator for Western Interstate Commission on Higher Education (WICHE) intern grants for research in archaeological laboratory facilities and rock art studies, 1979.
2. Administrator for Centennial-Bicentennial Commission and Goodwin Foundation matching grants for the Petroglyph Study, 1976.

BIBLIOGRAPHY:

1980a The Indian Hill Petroglyph Site, 14EW1, Kanopolis Lake: development of alternative mitigation plans for the U.S. Army Engineering District, Kansas City, Kansas. Coauthors: D. L. Langdon and John A. Burger. Grand River Institute, Grand Junction.

1980b Poncha-San Luis Valley 230 kv transmission line cultural resources inventory for Colorado-Ute Electric Association. Coauthors: Paul K. Roebuck, Richard W. Ott, D. L. Langdon, and Thomas F. Rome. Grand River Institute, Grand Junction.

1980c The Oak Creek Expansion: a cultural resources inventory for Pittsburg & Midway Coal Mining Company. Coauthors: Paul K. Roebuck, Thomas F. Rome, D. L. Langdon, Richard W. Ott, and Lester A. Wheeler. Grand River Institute, Grand Junction.

1980d Archaeological excavations at Jerry Creek Reservoir No. 2 for Ute Water Conservancy District, Grand Junction. Coauthors: Curtis W. Martin, Lester A. Wheeler, Linda J. Scott, and Harley J. Armstrong. Grand River Institute, Grand Junction.

1979a Spinney Mountain Project, cultural resources inventory for R. W. Beck and Associates of Seattle, Washington. Coauthors: Richard W. Ott and D. L. Langdon. Grand River Institute, Grand Junction.

1979b The Dominguez Project, intensive cultural resources survey for the Bureau of Reclamation, Grand Junction Projects Office. Coauthor: R. K. Alexander. Grand River Institute, Grand Junction.

1979c Petroglyphs and Pictographs of the Grand Junction District Volume II for the Bureau of Land Management. Grand River Institute, Grand Junction.

1978a Petroglyphs and Pictographs of the Grand Junction District Volume I for the Bureau of Land Management, Grand River Institute, Grand Junction.

1978b Cultural resources inventory of the Colorado River tributaries for the Grand Junction District Office of the Bureau of Land Management. Grand River Institute, Grand Junction.

1976 Antiquities inventory for the Wild and Scenic River Designation of the Colorado River for the Bureau of Land Management. Historical Museum and Institute of Western Colorado, Grand Junction.

1975-1980 Numerous cultural resources inventory reports for the Bureau of Land Management, U.S. Forest Service, and private industry.

VITA

NAME: John A. Burger

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EDUCATION and SERVICE:

Graduated from Tooele High School, Tooele, Utah, 1946
Attended Utah State University, Summer, 1945
Attended University of Utah intermittently from 1945-1952, B.S. Geology, 1952
Served in the Swiss-Austrian Mission, L.D.S. Church, 1949-1951
Served in U.S. Army, Military Intelligence, Germany, 1952-1954
Attended University of Utah, 1954-1955
M.S. Geology, minor in Geophysics; Thesis: "Geology of Central Uinta County, Wyoming" (Structural geology)
Attended Yale University, 1955-1958
Ph.D. in Geology; Thesis: "Stratigraphy of the Mesaverde Group in adjoining areas of Utah, Colorado, and Wyoming" (1959)
Awards: Union Pacific Scholarship, University of Utah: H.G. Ferguson Fellowship, W. H. Twenhofel Fellowship, University Teaching Fellowship - all at Yale University.

EMPLOYMENT AND PROFESSIONAL ACTIVITIES

1. 1946-56 Mucker and miner, part-time and summers, underground at Bingham and Stockton mining districts, Utah.
2. 1947 Surveyor's assistant, Anaconda Copper Co., Death Valley, California, summer.
3. 1955 Stratigraphic research, Gulf Oil Corp., S. W. Wyoming, N.W. Colorado, summer.
4. 1957S 1958-61 Geologist, Texaco, Inc., Salt Lake City, Utah.
5. 1961-77 Asst. Prof., Assoc. Prof., Professor, Beloit College, Beloit, Wisconsin, Sedimentology, Stratigraphy, Historical Geology, Field Methods, Mineralogy, Petrology, Physical Geology.
6. 1962S Instructor, NSF summer Institute, Univ. of Colorado.
7. 1963S Participant, NSF summer course on volcanic rocks, Montana, Idaho, and Wyoming.
8. 1964S Instructor, NSF summer Institute for Science Teachers, Beloit College.
9. 1965S Research Associate, Hudson Laboratories of Columbia University.

10. 1966S Studies of stratigraphy and sedimentology of Outer Banks of North Carolina.
11. 1968S Participant, NSF summer course on Carbonate Sediments, Florida and Bahamas.
12. 1969S Asst. Director, Assoc. Colleges of the Midwest Summer Geology Program, Bozeman, Montana.
13. 1973F Research Adjunct Professor, University of Wisconsin; work on taking long cores from Arctic Ocean floor, Ice Island T-3.
14. 1975S NSF summer research appointment at Argonne National Labs, working on Transuranic elements in Lake Michigan sediments.
15. 1975S Associate Research Scientist, Argonne National Laboratory, working on Biogeochemical cycling of trace elements in Lake Mighican sediments.
16. 1976F Visiting Research Scientist, Argonne National Laboratory: Inventory of fly ash in Lake Michigan water column.
17. 1977- Senior Geologist, Pittsburgh Area office of Bendix Field Engineering Corporation: In charge of the NURE (National Uranium Resource Evaluation) Program for the northeastern United States on a contract with the Dept. of Energy.

ADMINISTRATIVE EXPERIENCE:

1. At Beloit College: Admissions Committee, Scholarship Committee, Academic Policy Committee, Chairman of Science Division, Deputy Geology Department Chairman.
2. With Bendix as Senior Geologist in charge of office of 10 geologists and 3 support staff.
3. Bishop, Beloit Ward, The Church of Jesus Christ of Latter-day Saints, 1965-1873.

MEMBER: Society of Economic Paleontologists and Mineralogists.

PUBLICATIONS:

1. Mesaverde Group in Adjoining Areas of Utah, Colorado, and Wyoming: University of Michigan Microfilms, 1959.
2. Age of the Adaville Formation, S.W. Wyoming: Intermountain Assoc. Petrol. Geol. Guidebook No. 10, 1959.
3. The Cretaceous System of Utah: Oiland Gas Possibilities of Utah Re-evaluated: Utah Geol. and Mineral. Survey Bull, No. 54, 1963.
4. Cyclic Sedimentation in the Rock Springs Formation, Mesaverde Group, Rock Springs Uplift, Wyoming: Wyo. Geol. Assoc. Guidebook No. 19, 1965.
5. Field technique for making epoxy relief peels in sandy sediments saturated with seawater: Jour. Sed. Petrology, 1969.
6. An inexpensive magnetic separator of fine-grained magnetic and paramagnetic particles in sediments: Jour. Sed. Petrology, June 1978.

7. The relative availability of selected trace elements from coal fly ash and Lake Michigan sediments; Proc. III International Conf. on Nuclear methods in Environ. and Energy research, in press.

VITA

PII Redacted

NAME: Diana Lee Langdon

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EDUCATION:

B.A. Bucknell University (Geology major, mathematics minor)

M.S. The Johns Hopkins University (Communication disabilities)

EXPERIENCE:

1. Technical report writer/editor for Grand River Institute, Grand Junction, Colorado.
   February 1979 to present
2. Free-lance writer/editor. Researched and wrote on specific questions concerning the natural and cultural history of western Canada.
   October 1977 to December 1978
3. Title I Reading/Language Arts Specialist for Mesa County Valley School District #51 in Grand Junction, Colorado. Provided instruction for elementary school children deficient in reading/language skills.
   September 1975 to June 1977
4. Mathematics instructor for the Baltimore City Public School system in Baltimore, Maryland. Taught general mathematics to inner-city, 7th grade students.
   September 1972 to February 1974
5. Field worker and research assistant on a geological study of igneous intrusions in the West Elk Mountains of Colorado. Work involved rock sampling, mapping, aerial photo interpretation, and petrographic analysis. (National Science Foundation student grant.)
   Summer 1968 and Summer 1969

BIBLIOGRAPHY:

1980a The Oak Creek Expansion: A Cultural Resources Inventory for Pittsburg and Midway Coal Company. Coauthors: Paul K. Roebuck, Richard W. Ott, Lester A. Wheeler, Thomas F. Rome. Grand River Institute, Grand Junction.

1980b Poncha — San Luis Valley 230 kV Transmission Line Cultural Resources Inventory. Coauthors: Paul K. Roebuck, Richard W. Ott, Thomas F. Rome, Carl E. Conner. Grand River Institute, Grand Junction.

1979a Cultural Resources Inventory of the Little Bear Creek Project for W. R. Grace and Company. Coauthors: Paul K. Roebuck, Thomas F. Rome, Lester A. Wheeler. Grand River Institute, Grand Junction.

1979b Spinney Mountain Project Cultural Resources Inventory for R. W. Beck and Associates. Coauthors: Carl E. Conner, Richard W. Ott. Grand River Institute, Grand Junction.

1980a Five Proposed Gas Wells/Access Roads for Colorado-Pacific Petroleum Corporation (BLM). January.

1980b Eleven Proposed Well Pads/Access Roads for Tenneco Oil (BLM). January.

1979a Five Proposed Drill Hole Locations and Related Access Roads in Gunnison National Forest for Mid-Continent Resources, Inc. December.

1979b Eleven Proposed Well Pads/Access Roads in Delta County for Colorado-Pacific Petroleum Corporation (BLM). December.

1979c Five Proposed Fuelco Well Pads/Access Roads for Fuel Resources Development Company (BLM). December.

1979d Proposed Amoco Bowie #1 Well Pad/Access for Envirotek of Evergreen, Inc. (BLM). December.

1979e Two Proposed Amoco Well Pads and Access Routes (Grand Mesa National Forest and Gunnison National Forest). November.

1979f Proposed Gas Wells H-25-7-96S and D-31-7-95S for Fuel Resources Development Company (BLM). November.

1979g Thirteen Proposed Well Sites/Access Roads for Fuel Resources Development Company (BLM). November.

1979h A Proposed Mining Access Road in White River National Forest for Mid-Continent Resources, Inc. October.

1979i Windy Point Antenna Site and Access/Cable Routes on lands administered by the White River National Forest and the Bureau of Land Management for Western Slope Communications. October.

1979j Colorado Pacific's Proposed Federal #9 Gas Well and Related Access in Grand Mesa National Forest for Colorado-Pacific Petroleum Corporation. October.

1979k Two Proposed Well Sites/Access Road for Texas Gas Exploration Corporation (BLM). October.

1979l A Proposed Pipeline and Water Gathering Facility in Gunnison National Forest for Mr. George Volk. September.

1979m Five Proposed Well Sites/Access Roads for Texas Gas Exploration Corp. (BLM). September.

VITA

PII Redacted

NAME: Richard W. Ott

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EDUCATION:

Bachelor of Fine Arts, 1971 - University of Colorado, Boulder, Colorado; 20 hours geology/paleontology.
Post-college: 1973, Exhibit design workshop, Smithsonian Institute, Washington, D. C.

PROFESSIONAL EXPERIENCE:

1. Private research. Field survey of fossils in the Green River Formation in Colorado and Utah, 6/71-9/71.
2. Historical Museum and Institute of Western Colorado, Grand Junction, Colorado. Classification of paleontology collection; site custodian at Newcastle, Colorado dinosaur excavation, 9/71-11/71.
3. Curator of Exhibits, Historical Museum and Institute. Research, planning, design, and installation of various exhibits, 1/72-6/72.
4. Curator of Exhibits and Collections, Historical Museum and Institute. Exhibit planning and design; supervision of collections conservation and cataloging, design of cataloging system, 6/72-12/72.
5. Assistant Director, Historical Museum and Institute. Administrative assistant to Museum Director; exhibit planning and design, 1/73-10/73.
6. Exhibit design consultant for Historical Museum and Institute. Research, planning, design, and installation of exhibits. Assisted in long-range planning of exhibit program and policy, 1/74-6/76.
7. Founder, President of Objects: Images, Illusions, Inc., Palisade, Colorado. Conceptual analysis, design, and practical application of various multi-media communications systems, including publications, two- and three-dimensional displays and exhibits, photography and audio/visual productions, 3/75-3/79.
8. The Grand Valley Gazette, Palisade, Colorado. Founder, publisher, co-editor. Primary and secondary research, writing, editing, design and layout, printing coordination, distribution, 4/75-8/76.
9. Historical Museum and Institute. Editor, Historical Museum Notes, 4/75-5/77.

10. Gazette Press, Palisade, Colorado (Publishing Division of Objects: Images, Illusions, Inc.), Chief editor, 1/76-3/79.
11. Photographic consultant, Antiquities Research Division, Historical Museum and Institute. Advising on solutions to various photographic problems, including recommendations for photographic systems, materials, and processes; performance of various photographic services with primary activity photographing petroglyphs and pictographs, 3/77-8/78.
12. Photographer, color lab manager for Smith Photography, Grand Junction, Colorado. Responsible for management and operation of color lab, including all production phases: film processing (C-41, E-6, and various black and white processes), color and black-and-white printing (EP-2 process with Kreonite 20" processor), and print finishing (spotting, retouching) and framing. Secondary assignments included commercial and portrait photography using small, medium, and large format systems in-studio and on location, 11/78-8/79.
13. Freelance photographer and graphic designer, 1/78-present.
14. Historical Researcher and Graphics Specialist, Grand River Institute, 6/79-present.

EXPERIENCE OUTSIDE MAJOR FIELD OF INTEREST:

1. Owner/manager of commerical peach and pear orchard, Palisade, Colorado, 3/72-5/78.
2. Good Karma Kite Company, San Francisco, California. Assisted in design of various products and organization of manufacturing procedures, 10/73-12/73.
3. Democratic candidate for Colorado State Representative, District 55 - unsuccessful, 1972.

PUBLICATIONS

Technical Papers:

1. Museography: Collections Cataloging; Western Interstate Commission for Higher Education, 1972.
2. Petroglyphs and Pictographs of the Grand Junction District; Coauthored with Carl E. Conner. Project report submitted by Grand River Institute to Bureau of Land Management, Grand Junction District, 1978.
3. Spinney Mountain Project Cultural Resources Inventory for R. W. Beck and Associates. Coauthors: Diana L. Langdon, Carl E. Conner. Grand River Institute, Grand Junction, 1979.

4. Poncha — San Luis Valley 230 kV Transmission Line Cultural Resources Inventory for Colorado-Ute Electric Association, Inc. Coauthors: Paul K. Roebuck, Diana L. Langdon, Carl E. Conner, Thomas F. Rome. Grand River Institute, Grand Junction, 1980.

Periodicals:

1. The Grand Valley Gazette; publisher, co-editor, 1975-1976.
2. Historical Museum Notes; Historical Museum and Institute; editor/designer, 1975-77; designer, 1977.

Books:

1. When the River Was Grand - Historical View of the Grand Valley; Gazette Press, 1976.
2. Grandma's Cooking! (again*); Gazette Press, 1976. Editor, designer.

Audio/Visual Productions:

1. Valley Grey, Valley Green; produced by Objects: Images, Illusions, Inc. for Historical Museum and Institute, 1974; 30-minute, two projectors, soundtrack. Scripting (with Mark Bonan and Bob Hurlbett), research, design, photography.
2. Valley Grey, Valley Green; 4th- and 8th-grade level education version; 18-minute and 20-minute, one projector, cassette soundtrack.
3. A Good Mother of Men; Mesa County Centennial-Bicentennial Committee, 1976; 45-minute, six projectors, soundtrack. Photography (with others), editing.
4. Images on Stone; produced by Objects: Images, Illusions, Inc. for Historical Museum and Institute, 1977; 30-minute, two projectors, soundtrack. Scripting and design (with Mark Bonan), editing, photography.

ART:

Group Shows:

1. 8 West Biennial - Western Colorado Center for the Arts, 1974.
2. 3rd Colorado Annual - Denver Art Museum, 1975.
3. All Members Show - Western Colorado Center for the Arts, 1975.
4. 20 and 20: Colorado-New Mexico -- Colorado Springs Fine Arts Center, 1975.
5. Spree '76 - Denver, 1976.

Other:

1. Guest lecturer, Mesa College Department of Fine Arts, 1976.
2. Advisory Committee, 5th Colorado Annual, Denver Art Museum, 1978.

VOLUNTEER ACTIVITIES:

1. Board of Directors - Women's Resource Center, Grand Junction, Colorado, 1976.
2. Board of Directors - Colorado National Monument Nature Association, 1976-77.
3. Board of Directors - Mesa County Chapter, American Cancer Society, 1976-77.
4. Mesa County Democratic Center Committe, 1973.
5. Society of Esthetic Engineers, 1976.
6. Organizing Committee, Colorado Plateau Rendezvous, funded by Colorado Humanities Program, 1975.

PROFESSIONAL ORGANIZATIONS:

1. American Association of Museums.
2. Colorado-Wyoming Association of Museums.