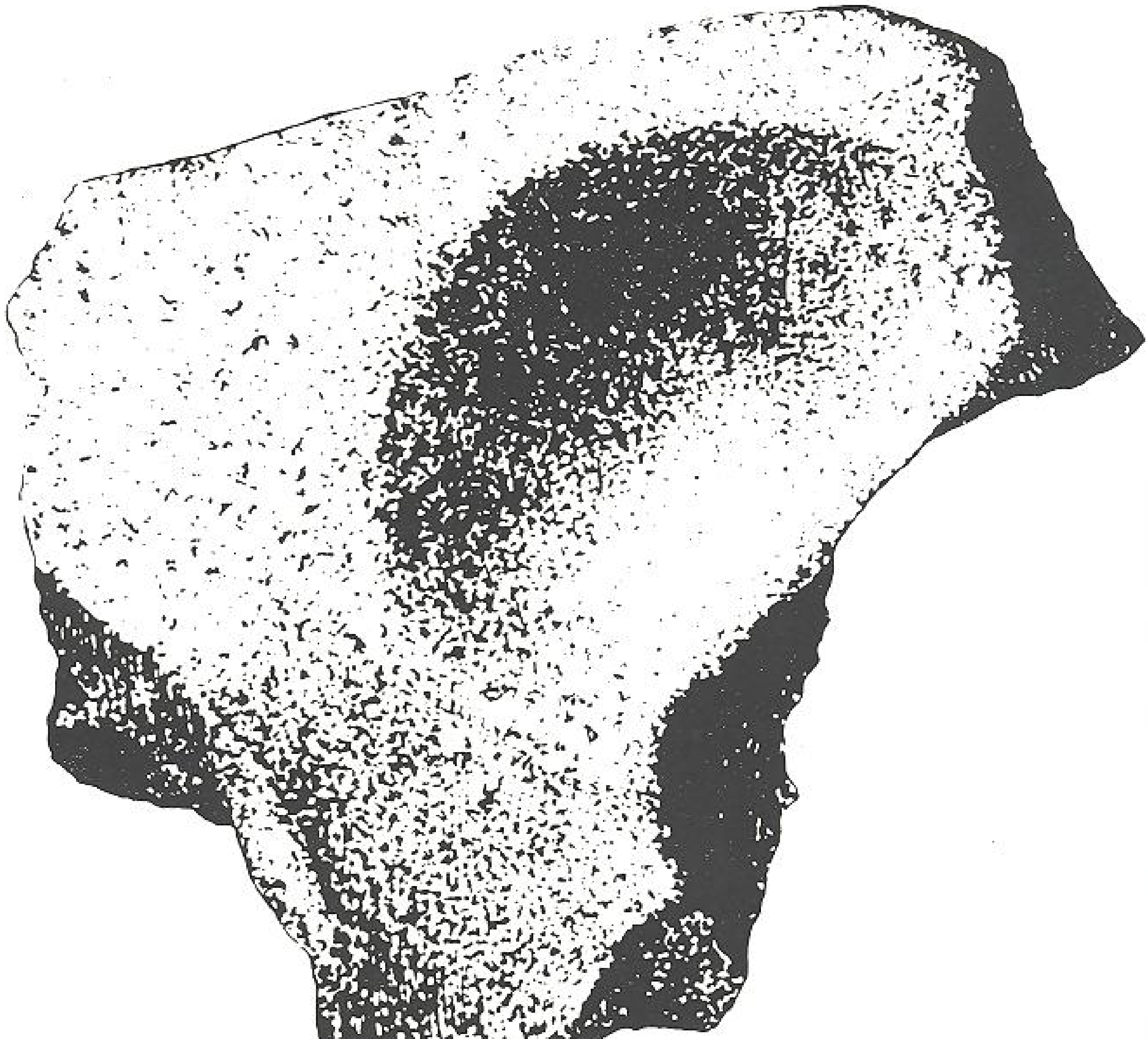
IDAHO ARCHAEOLOGIST



VOL. VI, No. 3 WINTER, 1983

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Cover: James Woods

NOTICE TO AUTHORS

All manuscripts should conform as nearly as possible with the style established by the Society for American Archaeology. (See page 13, Vol. III, No. 1 and page 1, Vol. II, No. 2, *Idaho Archaeologist).* Manuscripts should be typed double-spaced with 1½-inch margins and submitted in the original and two copies. The *Idaho Archaeologist* will publish articles concerning archaeology in Idaho and those parts of abutting states and provinces included in the Columbia drainage and the Great Basin.

The *IDAHO ARCHAEOLOGIST* is published Quarterly by the Idaho Archaeological Society, a non-profit association of professional and amateur archaeologists, organized under the Laws of the State of Idaho.

Subscriptions: $7.50 per year.

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STRATEGIES FOR THE PRESERVATION OF ARCHAEOLOGICAL SITES IN IDAHO

By

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Archaeological sites are important for the information they contain about the past. This information facilitates the reconstruction of the culture history and past lifeways of a particular area and allows the delineation and, hopefully, the explication of long-term cultural change. In addition, archaeological sites have educational and interpretative value for the general public and frequently they have special significance to the people whose history they represent, particularly the Indian peoples in Idaho. The citizens of Idaho and the United States have repeatedly affirmed their concern for the preservation of archaeological sites by the passage of various national and state laws protecting and regulating the excavation of archaeological properties. This paper briefly outlines the plans and the underlying philosophy of the Idaho State Historic Preservation Office to conserve and preserve archaeological resources in Idaho.

There are two levels of planning used for the conservation of archaeological properties in the state. One is broad-level planning aimed at conserving large numbers of sites in different parts of the state. The other is complementary and focuses on smaller areas in the state in an attempt to define priorities for archaeological conservation and research.

The broad planning perspective views the state as a whole and selects appropriate areas to establish archaeological districts eligible for the National Register. The National Register is an inventory, maintained by the National Park Service, of sites important to national, state, or local history. The placement of a site on the National Register will not assure its preservation. The legal protection provided by the National Register is that federal agencies have to assess the effects of their projects on National Register properties and obtain the comments of the Advisory Council on Historic Preservation if effects are anticipated. Nevertheless, placing a site or a district on the National Register acts as a red flag and helps in its preservation, if the district is properly located.

In Idaho the placement of National Register districts is guided by three principles: the districts should contain large numbers of sites and a variety of different types of sites; the districts should be complementary; the districts should be placed in areas where there is a reasonable chance for their preservation.

The districts should contain large numbers of sites because archaeologists have found the best way to understand past cultures is to study total cultural systems. As cultures and societies utilize large regions, archaeologists have to look beyond particular sites or settlements in order to describe the history and lifeways of any particular region. A thorough understanding of the types of different sites in an area, their overall distribution, and a knowledge of how they are related both chronologically and functionally is needed in order to understand how past peoples lived in a region. Hence, what needs to be studied and preserved for future generations of researchers is not individual archaeological sites but large numbers of sites that reflect past historic and prehistoric patterns of settlement.

It is important for the adequate preservation of the prehistory of an area to have the archaeological districts complement each other. For example, in Idaho the Snake River runs across the state from the Wyoming border to the Oregon border and then turns northward through Hells Canyon to meet the Columbia River in Washington. The river crosses a number of different environmental zones, and the character of the archaeological deposits changes as one follows the river from the mountains of Wyoming, across the Snake River Plain in Idaho, through Hells Canyon, and eventually into the Plateau of northern Idaho and eastern Washington. National Register districts are planned to reflect these changes. The Nez Perce archaeological district is located on the lower Snake River on the Washington-Idaho border. This district encompasses approximately thirty miles of river and contains eighty-six different sites in Idaho. The district is entirely within the aboriginal territory of the Nez Perce peoples and preserves an excellent record of the history and prehistory of these peoples. Moving up river a few miles from this district is the Hells Canyon Archaeological District, which is located in the Hells Canyon National Recreation Area. The district contains 293 prehistoric and historic archaeological sites in Idaho. The federal legislation establishing the Hells Canyon NRA specified that archaeological and historic properties were to be preserved, studied, and interpreted for the public benefit. The NRA and the National Register District protects seventy miles of the Snake River Canyon and the archaeological sites in the canyon. The NRA also protects the associated upland areas and side canyons in Hells Canyon which contain sites important in understanding the patterns of settlement in the area. In southwestern Idaho the Guffey Butte-Black Butte archaeological district has been established. This district includes 187 archaeological properties within a thirty-five mile length of the Snake River. There are four other districts planned for the Snake River—one in south central Idaho in the Buhl-Hagerman area, one at Eagle Rock near American Falls, one in the Fort Hall area, and one in the vicinity of St. Anthony.

Another example of how districts should complement each other is the placement of archaeological districts in the mountains adjacent to the districts located in the river valleys. We know that during the summer and fall the aboriginal peoples of Idaho moved to higher country to gather camas, bitterroot, and other plants and to hunt big game. Thus, to complement our Snake River districts and to preserve important information on settlement patterns, there is a need to establish districts in the upland and mountainous areas adjacent to the Snake River Canyon. Districts are planned for the Seven Devils, the Owyhee Mountains, and in the Camas Prairie and Bennett Mountains area.

Since the goal is to preserve the archaeological sites in these districts for future generations, an effort has been made to locate the National Register districts in areas that not only will provide essential archaeological knowledge but will also have a good chance of being preserved. The areas chosen have other resources important to the citizens of Idaho. For example, the Nez Perce archaeological district is located within a Wild and Scenic River Study Area. The Hells Canyon National Register District is in the National Recreation Area, designated as such because of its scenic qualities, wildlife habitats, and archaeological sites. The Guffey Butte-Black Butte archaeological district is in the Bureau of Land Management's Birds of Prey Natural Area, a critical nesting area for golden eagles, prairie falcons, and broad-wing hawks. The other districts will be located in similar areas. The rationale for these choices is that when large-scale destruction is planned for these areas, the archaeologists will be one part of a larger group of people lobbying for preservation.

In summary, the statewide planning effort is aimed at preserving large numbers of prehistoric and historic sites in complementary National Register districts placed in representative areas of the state. The goal is to preserve fossil cultural systems that can be discovered in the total archaeological record. As a practical consideration, the National Register districts are placed in areas having long-term land-use patterns favorable for the preservation of buried cultural deposits.

The second type of planning conducted by the State Historic Preservation Office is modeled after the Resource Protection Planning Process (RP 3) developed by the National Park Service (USDI 1980). This process divides the state into study units, and then analyzes the existing information about the archaeological and historical properties in order to identify preservation goals and strategies for the various study units. Planning at this level provides an orderly system for systematic survey, allows for better definitions of site significance, and develops a meaningful basis for determining the conservation and preservation needs in a region.

Our approach to this level of planning involves three stages.[1] The first stage is to define the study units. In Idaho these units have been defined, and they are very similar to the geographic units used in the Intermountain Antiquities Computer System (IMACS). (IMACS is a data retrieval system used in Utah, Nevada, and Idaho to record information about archaeological sites.) Drainage basins or parts of very large drainage basins are used for the study units because past archaeological research has demonstrated that small regional areas are the most useful units of study to achieve the goals of modern archaeology (see Binford 1964; Struever 1968; or O'Connell 1975 for just three examples).

Once the study units are defined, the next step is to prepare detailed overviews. These overviews critically review the past research in an area and assess current knowledge about the prehistory of the unit. They also identify specific research problems and develop proposals for solving these problems. Pure research-oriented documents are needed. The idea is to produce a document that identifies the basic research questions in an area and details ways to solve these problems unencumbered by the day-to-day problems of site destruction and the lack of sufficient funds. In addition to the geographically based overview, thematic overviews are also needed for particular topics that can be understood only in statewide perspective. Examples of such topics include rock art, lithic procurement, and rock alignment studies. In addition, specific time periods such as the very early prehistoric time periods may necessitate individual overviews.[2]

The third step is to evaluate the research goals in relation to the current and anticipated impacts to archaeological sites. Information on current land use and future projections of changes in land use is available from a variety of planning agencies. This information, coupled with the insights of local residents and amateur archaeologists, will identify the current and anticipated agents causing the destruction of archaeological sites. Once this is known, regional conservation goals can be determined, and immediate archaeological research planned which is based on the anticipated losses of particular types of sites or the anticipated losses of all sites in a given area. For example, if it was suspected that Native American salmon procurement became important only after 2000 B.P. and only one fishing site was known spanning the time period of 3000 B.P. to 1000 B.P., then this site would be of a paramount importance for solving questions concerning the increased use of salmon and, hence, the site should be preserved at all costs. Another example would be if an area with important sites was going to be used for a private housing subdivision, then arrangements could be made for the excavation of the sites before the construction begins.

This planning process is dynamic and continuous. Overviews and planning documents need to be written for many areas in the state and from different theoretical and methodological perspectives. The goal is not to produce one master preservation plan, but to produce a series of complementary plans.

The statewide placement of National Register Districts and the development of plans for specific areas of the state are dependent on sound archaeological research. The information needed to make intelligent decisions about the conservation of archaeological sites is the same information needed to make intelligent decisions about the direction of archaeological research in an area. There should be no division between cultural resource management and pure archaeological research. In today's world, you can't have one without the other.

NOTES

1. Many of these ideas are contained in a paper entitled "State Planning for Archaeology: the Idaho Example" by the author and published in the *1980 Proceedings*, American Society for Conservation Archaeology. Vol. 7, pp. 16-25.

2. Five archaeological overviews are completed or near completion. These include: The Clearwater Plateau by Kenneth Ames (n.d.); The Upper Snake and Salmon River Country by B. Robert Butler (1978); South Central Owyhee County by Mark Plew (1980); An Historic Overview of the River of No Return Wilderness by Mary P. Rossillon (1980); and The Middle Fork of the Salmon by Ruthann Knudson, *et al* (1982). The Middle Fork and River of No Return Overviews were completed in cooperation with the Intermountain Region of the Forest Service.

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A REPORT ON TEST EXCAVATIONS AT
10–OE–1838
SOUTH-CENTRAL OWYHEE COUNTY, IDAHO

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INTRODUCTION AND PURPOSE

Site 10-OE-1838 is an open site located on the west side of the creek near Indian Crossing, in southcentral Owyhee County. The site lies approximately 2 kilometers north of Nahas Cave (Plew, 1981) which is situated approximately 70 kilometers south of Grandview, Idaho, in the Southcentral Owyhee Uplands (see Figure 1). The site is located on property owned by the R. T. Nahas Company. With permission of the land owner, the site was collected and tested in July, 1980. The purpose of the test was to determine the chronological and functional relationship of the site to other sites (see Plew, 1979) in the southcentral Upland area.

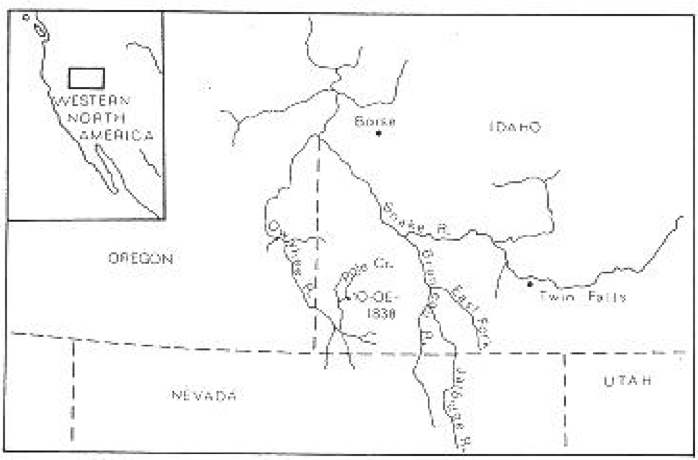

FIGURE 1
Map Showing General Location of 10-OE-1838

TEST EXCAVATIONS AND SURFACE COLLECTION

The site measures approximately 50 x 30 meters and lies north-south along the west side of Pole Creek. 10-OE-1838 is characterized by extensive debris and a variety of artifactual material. Four 1 x 2 and 21 x 1 meter test pits were located in area of material concentrations (see Figure 2). Sediments were largely alluvial and consisted of two major natural strata. A light sand-silt extended from ground surface to approximately 30 cm. below datum. This stratum was followed by a dark brown sand-silt extending to 60 cm. below surface. All excavation was discontinued at 60 cm. below datum (see Figure 3 and 4). The matrix is relatively uniform and contains few natural deposited rocks. No cultural features were encountered. Few artifacts and only small amounts of lithic debris were recovered. Most artifactual materials were found in the upper 30 cm. of the deposit. Classification of lithic debitage indicated substantial numbers of primary and secondary flakes (Table 2). Owing to the paucity of cultural materials, a non-systematic, intuitive surface collection was made.

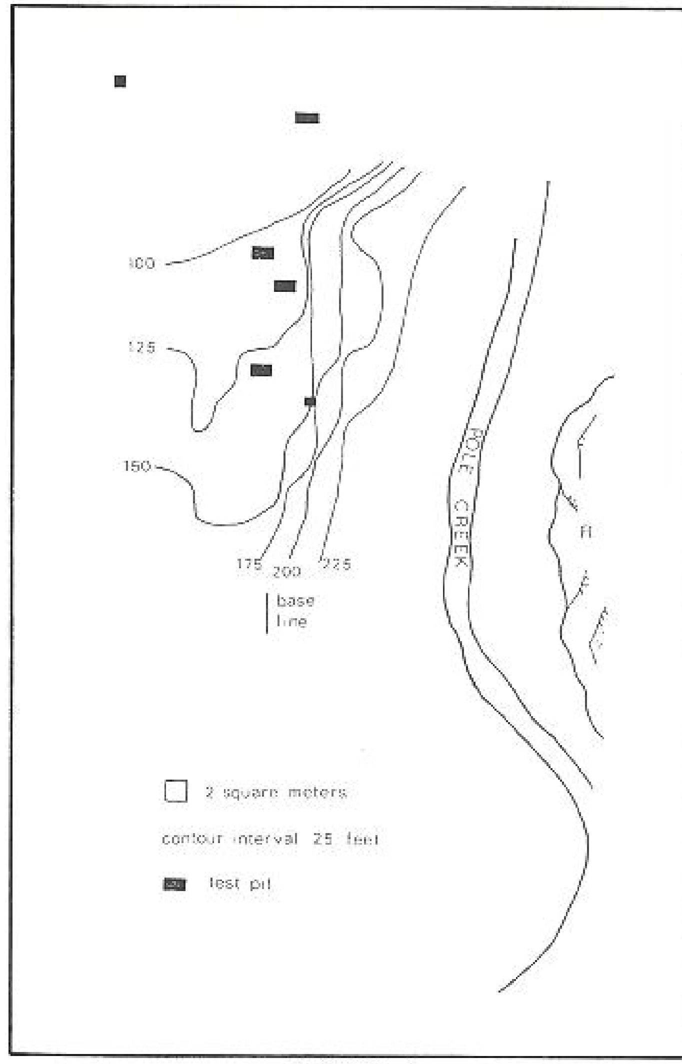

FIGURE 2
Plan Map Showing Location of Test Pits

CULTURAL REMAINS

Chipped and groundstone artifacts were recovered. No ceramic artifacts were found. Five Rose-Spring corner-notched and one Eastgate point were recovered during excavation. All are made of obsidian with the exception of the Eastgate point. Additionally, five projectile point tips were collected. Scrapers constituted the largest artifact category. Less diagnostic artifacts include eleven bifaces and fifteen retouched flakes. Bifaces are ovate to slightly lanceolate forms suggesting that some of the fragmented specimens may be knife remnants. Eleven cores were recovered. Five large cores were found on the surface and may represent multipurpose tools, e.g., choppers.

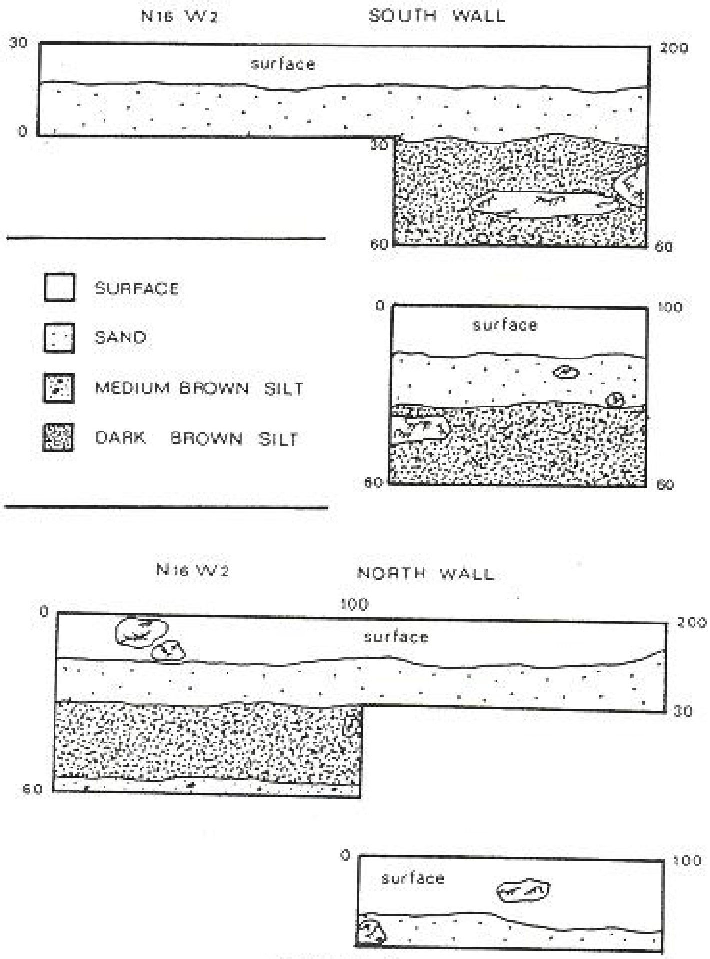

FIGURE 3
Wall Profiles of Unit N16W2

Numerous groundstone artifacts consisting of mortars and manos were observed. All groundstone implements on the surface were collected. Four fragmentary specimens are of a tapered cylindrical type common throughout the area (see Plew 1976, 1979). A single three-sides mano was recovered. Metrical measurements read as length, width, and thickness. Provenience data are provided in Tables 1 and 2.

PROJECTILE POINTS

1. *Rose Spring Side-Notched* (see Figure 5, b-d)
   Number of Specimens: 2
   Form: Specimens are small with triangular blade outlines and shallow side notches which slope into short stems. Both specimens are plano-convex in cross-section with slightly expanding stems.
   Technique: Pressure
   Size Range: 2.2-1.8 x 6.7-1.0 x 0.3 cms.
   Material: Obsidian
   Comparable Types: Lanning (1963); Plew (1979:36).

2. *Rose Spring Corner-Notched* (see Figure 5, a)
   Number of Specimens: 1
   Form: A small triangular blade element with shallow corner notches and slightly expanding stem which is convex. Plano-convex transverse section. Fragmentary specimen.
   Technique: Pressure
   Size: 2.4 x 1.9 x 0.3 cms.
   Material: Obsidian
   Comparable Types: Lanning (1963)

3. *Eastgate Expanding Stem* (see Figure 5, e)
   Number of Specimens: 1

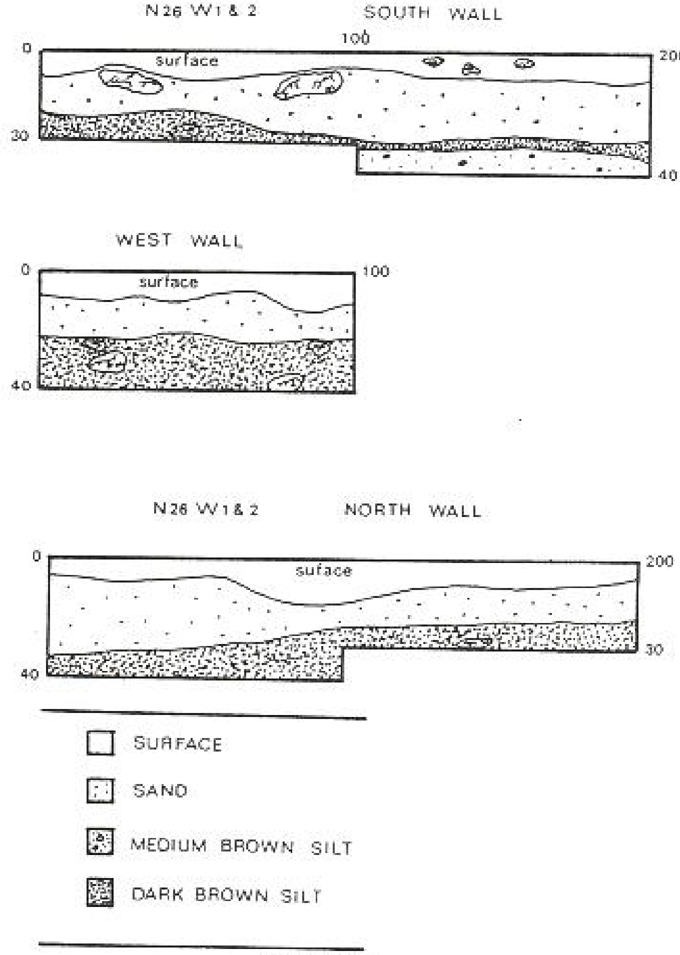

FIGURE 4
Wall Profiles of Units N26W1-2

   Form: Triangular blade element with deep corner notches and expanding base which is convex. Plano-convex transverse section.
   Technique: Pressure
   Size: 1.5 x 1.9 x 0.4 cms.
   Material: Obsidian
   Comparable Types: Heizer and Baumhoff (1961); Plew (1979:35-36).

4. *Camas Creek Corner Notched*
   Number of Specimens: 1
   Form: A small corner-notched point with broad triangular blade and short expanding base. The greatest basal width is approximately 3/4 of the greatest blade width. Specimen appears to have been thermally treated.
   Technique: Pressure
   Size: 2.1 x 1.3 x 0.3 cms.
   Material: Cryptocrystalline
   Comparable Type: Plew (1979:49)

PROJECTILE POINT TIPS

Five point tips belonging to triangular bladed specimens. Fragments represent approximately 1/3 of the points. All specimens are plano-convex and pressure flaked. Specimens are made of obsidian.

SCRAPERS

1. *End Scrapers* (see Figure 5, g-h; Figure 6, a and c)
   Number of Specimens: 1
   Form: Plano-convex flakes which have been modified by secondary retouch on distal ends. Cortex is visible on

the dorsal surface of one specimen which is slightly ovate in outline.
Technique: Percussion with pressure retouch
Size Range: 4.1-3.4 x 6.5-3.0 x 2.7-1.9 cms.
Material: Cryptocrystalline
Comparable Types: Plew (1973:28); Swanson (1964:7)

2. *Side Scrapers*
Number of Specimens: 2
Form: A plano-convex flake retouched on left laterial margin
Technique: Pressure
Size: 2.7 x 2.5 x 1.6 cms.
Material: Cryptocrystalline
Comparable Type: Plew (1980:46047)

3. *Combination End and Side Scrapers*
Number of Specimens: 2
Form: Relatively blade-like plano-convex specimens retouched on lateral and distal ends.
Technique: Pressure
Size Range: 5.2-2.8 x 3.0-2.0 x 1.0-0.6 cms.
Material: Cryptocrystalline
Comparable Types: Plew (1979:42,59)

THIN BIFACIAL KNIVES

Number of Specimens: 1
Form: Thin triangular specimen having been well thinned and retouched.
Technique: Percussion with pressure retounch
Size: 2.8 x 1.5 x 0.4 cm.
Material: Cryptocrystalline
Comparable Types: Plew (1976:28-29)

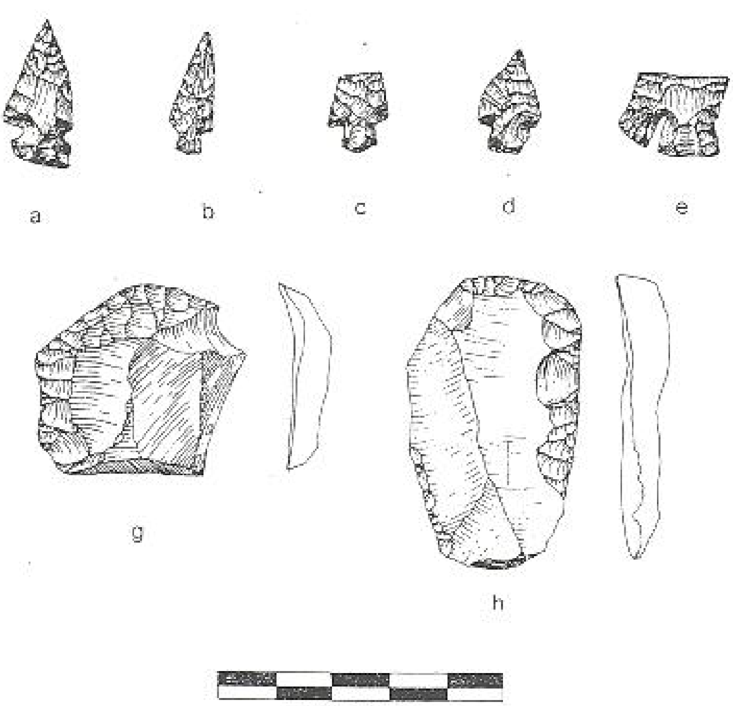

FIGURE 5
a - d Rose Spring Series Projectile Points
e Eastgate Point g - h Scrapers

GRAVER

Number of Specimen: 1
Form: Plano-convex flake which has been worked on both lateral margins with graving element fashioned from distal end. Broad flakes scars are visible on dorsal surface. The proximal end of the specimen has hinge factured.
Size: 4.1 x 2.7 x 0.6 cm.
Material: Cryptocrystalline
Comparable Types:

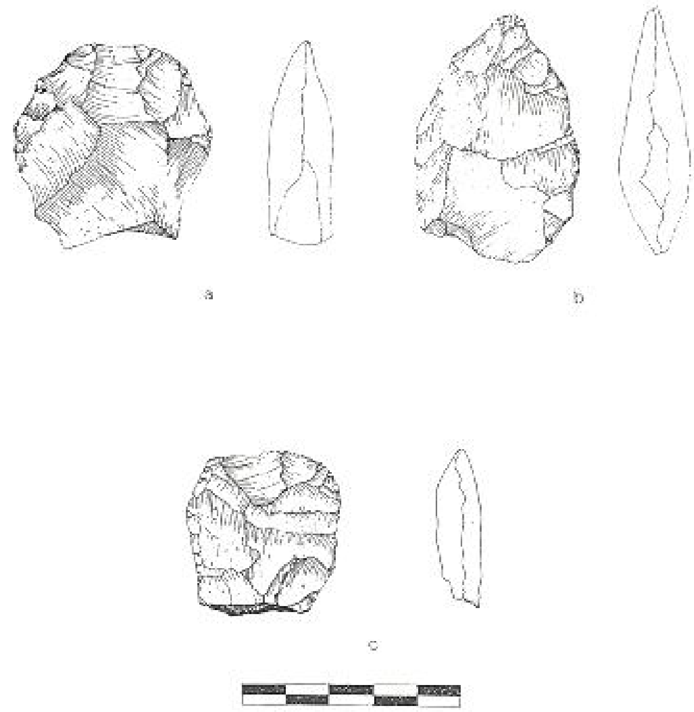

FIGURE 7
a Mano b Mortar c Incised Stone

BIFACES AND BIFACE FRAGMENTS

Number of Specimens: 11 (see Figure 6, b)
Form: Bifaces are plano-convex to biconvex in transverse section with large primary flake scars characteristic of dorsal and ventral surfaces. One specimen exhibits thermal alteration.
Technique: Percussion
Size Range: Variable, largest complete specimen measures 5.8 x 3. 9 x 1.7 cms.
Material: 4 Basalt, 5 Obsidian, 9 Cryptocrystalline
Comparable Types: (see Plew, 1980:50)

RETOUCHED FLAKES

Number of Specimens: 15
Form: Irregularly shaped flakes exhibiting various degrees of retouch.
Technique: Percussion
Size Range: 6.0-2.0 x 4.1-1.1 x 1.8-0.3 cm.
Material: 6 Basalt, 2 Obsidian, 12 Cryptocrystalline
Comparable Types:

CORES

Number of Specimens: 1
Form: Forms include conical ovate cores, irregular cores and a large tabular basalt core.
Technique: Percussion
Size Range: 13.0-4.0 x 7.2-3.6 x 8.0-2.2 cm.
Material: 8 Basalt, 5 Cryptocrystalline
Comparable Types: (see Plew, 1980:45)

MISCELLANEOUS ARTIFACTS

1. *Fragmentary Sandstone Abrader*
   Number of Specimens: 1
   Forms: Original specimen probably rectangular in outline. Lateral margin is rounded.
   Technique: Grinding
   Size: 4.0 x 3.2 x 1.7 cm.
   Material: Sandstone
   Comparable Types: Plew (1976:32-33)
2. *Notched Stone Cylinder/Incised Stone* (see Figure 7, c)
   Number of Specimens: 1
   Form: A fragmentary stone tube or cylinder which is broken and has been notched along the edges of the break. One side has five notches, the other nine. The stone has been smoothed.
   Technique: Grinding and Polishing
   Size: 1.6 x 1.3 x 0.2 cm.
   Material: Basalt (?)
   Comparable Type: None

GROUNDSTONE

Mortars (see Figure 7, b)
Number of Specimens: 2
Form: Basin Variety
Technique: Percussion/Grinding
Size: c. 15.0 x 15.0 x 8.0; Basin 9.0 diameter
Material: Basalt
Comparable Types: (see Plew 1980:51-52)

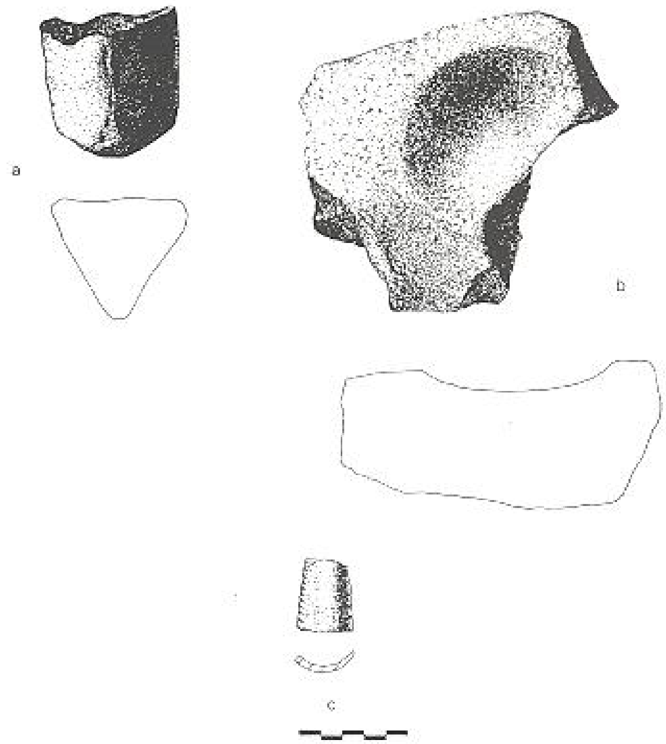

FIGURE 6
a - c Bifaces

TABLE 1
ARTIFACT PROVENIENCE, 10–OE–1838

	Surface	0-10	10-20	20-30	30-40	40-50	50-60
Rose Spring Series		3					
Eastgate		1					
Camas Creek Corner Notched		1					
Point Fragments	5						
Cores	5	3	2	1			
Scrapers	10	1	2	1			1
Knives		1					
Graver	1						
Bifaces/Biface Fragments	9		1	1			
Retouched Flakes	15						
Mortars	1	1					
Manos	6	1					
Notched Stone	1						
Abrader	1						
TOTAL	76						

TABLE 2

DISTRIBUTION OF LITHIC DEBRIS 10–OE–1838

Unit	Level	Basalt	Cryptocrystalline	Obsidian	Total
N13 E4	0-10	6	24	11	41
	10-20	8	22	6	36
	20-30	4	0	1	5
N16 W1-2	0-10	21	148	47	216
	10-20	39	211	95	345
	20-30	30	134	55	219
	30-40	4	23	19	46
	40-50	2	5	7	14
	50-60	3	18	15	36
N24 E2	0-10	7	51	17	75
	10-20	2	24	2	28
N26 W1-2	0-10	8	88	22	118
	10-20	15	123	8	146
	20-30	11	78	10	99
	30-40	3	12	4	19
N41 E4	0-10	6	34	8	48
	10-20	2	5	1	8
N42 W16	0-10	5	23	9	37
	10-20	10	116	11	137
	20-30	3	26	10	39

MANOS

1. *Cylindrical and Rounded*
   Number of Specimens: 5
   Form: Cylindrical and rounded manos having relatively plano grinding surface.
   Technique: Pecking/Grinding
   Size Range: (single complete specimen) 18.0 x 7.6 x 7.5 cm.
   Material: Basalt
   Comparable Types:
2. *Triangular Mano (Fragmentary)* (see Figure 7, a)
   Number of Specimens: 1
   Form: Triangular basalt mano pecked on three margins.
   Size: 6.2 x 6.3 x 5.2 cm.
   Material: Basalt
   Comparable Type: Plew (1976:34, 1979:66)

CONCLUSIONS

Archaeological test excavations at 10-OE-1838 suggest a temporary site, representing repeated use over a period of time. Extensive groundstone suggests possible use, similar to other sites on Camas and Pole Creeks, including Nahas Cave (see Plew 1979, 1981). This conclusion is tentative since it is not corroborated by other lines of evidence. The limited artifactual assemblage and absence of cultural features suggests that the site does not represent an extensive long term habitation. The site is, however, well known to amateur collectors, who may have caused a considerable loss of information. Chronologically, the site appears to date to the Camas Creek III Phase (c. A.D. 600-1,200) of the Owyhee Upland sequence and is contemporary with the upper levels of Zone III at Nahas Cave (see Plew 1981:5).

ACKNOWLEDGEMENTS

I wish to thank the field crew: Meg Pfoertner, Chris Venable, Rodger Harriett, and Brian Plew for their efforts and the Idaho State Historical Society for support. Jim Woods illustrated the artifacts and Helen Thornton prepared the maps and profiles and typed the manuscript.

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THE CONE AND ANVIL METHOD: A NEW TECHNIQUE FOR QUANTIFYING CERAMIC VESSEL WALL STRENGTH

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ABSTRACT

A new technique for quantifying wall strength of prehistoric ceramic ware is described. The method results in a psi (pounds per square inch) value required to fracture a specific sherd so that psi is a measure of wall strength in this test. Fracturing the sherd generally produces only two or three fragments which are easily mendable to restore the original outline. Preliminary results on a small sample of 11 pieces of Fremont and Intermountain ware from the Snake River Plain show a remarkable difference between the two groups, yet consistent values within each group. Among the Fremont ware, three subgroups were identified by an independent petrographic examination. Two of these groups are also distinguishable on the basis of wall strength values obtained. The simplicity of the test, apparent consistency of results, and the low level of actual destruction to the artifact are all attributes which combine to show promise for this new technique of quantitatively describing wall strength of ceramic vessels.

INTRODUCTION

The following report describes the results of a wall strength test developed during the analysis of a number of sherds of Great Salt Lake Gray ware from a site along the Snake River below American Falls, Idaho (Druss and Druss 1982). On the basis of visual inspection, it is apparent that the Fremont ware under consideration is much better made and of an obviously superior firing technology than the Intermountain ware of this region. This observation can be refined by approaching wall strength analysis quantitatively. Quantitative description will lead to an enhanced understanding of firing technology and ultimately to a further understanding of cultural process and affiliation (Willey and Sabloff 1980: 250-251).

Some authors have described ceramic vessel wall characteristics using Moh's mineral hardness comparisons (Coale 1963; Touhy and Palombi 1972) and ambiguous terms like "strong" and "friable" (Plew 1979:330), while others (Madsen 1977; Butler 1979) have apparently neglected the physical strength properties of the vessel walls altogether. Moh's mineral hardness comparison is a useful test of wall hardness (not strength), and may be somewhat indicative of past firing temperatures if the ceramics are made of a homogeneous clay paste (Shepard 1965:113-114). This is not the case with Intermountain or Fremont ware. Both exhibit highly variable temper type, and thus hardness, so the results of a scratch test are confusing and at best not very useful. The ambiguity of such general descriptive terms as "strong" or "friable" and the tendency for such terms to overlap further inhibits their utility. Therefore, if wall strength can be numerically described, a new and useful technique of ceramic analysis would be at the archeologist's disposal.

Some aspects of brittle materials testing technology can be applied to this study and shed light on the quantitative differences in wall strength of ceramics made using differing techniques. The wall strength test described here evolved out of an afternoon of discussion, including a quick "chalkboard" review of brittle material properties, with Dr. Lee Robinson of the School of Engineering, Idaho State University. Robinson described some standard techniques employed to test the strength of brittle materials but the available equipment was not adaptable to very small specimens. For a standard test, a sherd 15 cm long would be required. None of the sherds in this sample could be tested using standard techniques as these sherds averaged only 2 - 3 cm in length. Most ceramic sherds from this area are smaller than 15 cm so a sizable sample population meeting this minimum length criterion would be extremely difficult to obtain. After considering the small size of the sherds at hand, Robinson suggested the use of a tensile strength measuring device designed primarily for sheet metal, but adaptable to brittle ceramics as well.

Shepard (1965) employed similar techniques to quantify wall strength. Her method is nearly identical to that originally suggested independently by Dr. Robinson. Apparently she adapted similar apparatus to overcome the problem of small sherd size (1965:133-134). Shepard, however, did not extensively use "modulus of rupture" (wall strength) in her analyses, presumably because it was not a "practicable criterion for classification" (1965:136) but she does point out that "it is a basic property offering means of comparison that clarify relationships of types and point up questions regarding quality of paste and effectiveness of firing that would not otherwise be raised."

Although Shepard described and used a quantitative approach to ceramic wall strength 25 years ago, such techniques have not been systematically applied (Rye 1981:121).

METHODS AND TECHNIQUES

The technique of testing wall strength described and employed here is conceptually very similar to Shepard's (1965: 130-136), but markedly different in that Shepard uses a standard knife edge configuration in which the sherd forms a bridge over two knife edges, and a third edge between these two applies force to the center of the sample and fractures it. The technique described here simply uses a sharp steel cone to fracture the sherd which rests on a flat steel anvil (Figure 1). The cone and anvil configuration is very well adapted to pottery because there is no minimum span distance to consider, and therefore, sherds of very small size can be tested.

The cone and anvil system consists of a small box frame hydraulic press. The lower beam of the press contains the stationary anvil on which the specimen to be tested rests. The upper beam carries the hydraulic cylinder which moves down under hydrostatic pressure. At the bottom end of the cylinder is a steel cone which is forced down into the sherd when the pump is activated. At a certain penetration depth into the sherd, and at a certain stress load on the system, the sherd will fracture. The conditions at the moment of fracture are the foundations of this wall strength measuring technique.

The bottom end of the hydraulic cylinder has an accessory collar system which will hold a testing device measuring 0.25 inches in diameter with a head of approximately 0.375 inches in diameter. For ceramics, it is best to use a pointed puncturing device, or cone, with a 15 to 30 degree axial, or 30 to 60 degree surface, angle due to some theoretical aspects of the mechanics involved (Lee Robinson 1982:personal communication). In this test a 0.25 inch diameter bolt with a 35 degree axial angle was used because time did not allow the fashioning of one with the right dimensions. The effects of this larger than theoretically acceptable cone angle cannot be completely understood and are beyond the scope of this paper. In general, it probably inflated the values obtained because of the higher compression to tension ratio; however, the inflation was probably a quite consistent factor.

To arrive at a psi value for the wall strength of a sherd, the raw data of penetration depth and stress on the system must first be determined. The stress on the system is read directly off the dial on the pump (Figure 1) and recorded in pounds. This is made easy and free from observational error by the use of a recording dial that holds the value of the maximum load on the system after each test. Penetration depth is measured by attaching a dial micrometer to one of the vertical support posts on the press (Figure 1) and placing the end of its pivoting feeler arm underneath the accessory collar on the cylinder.

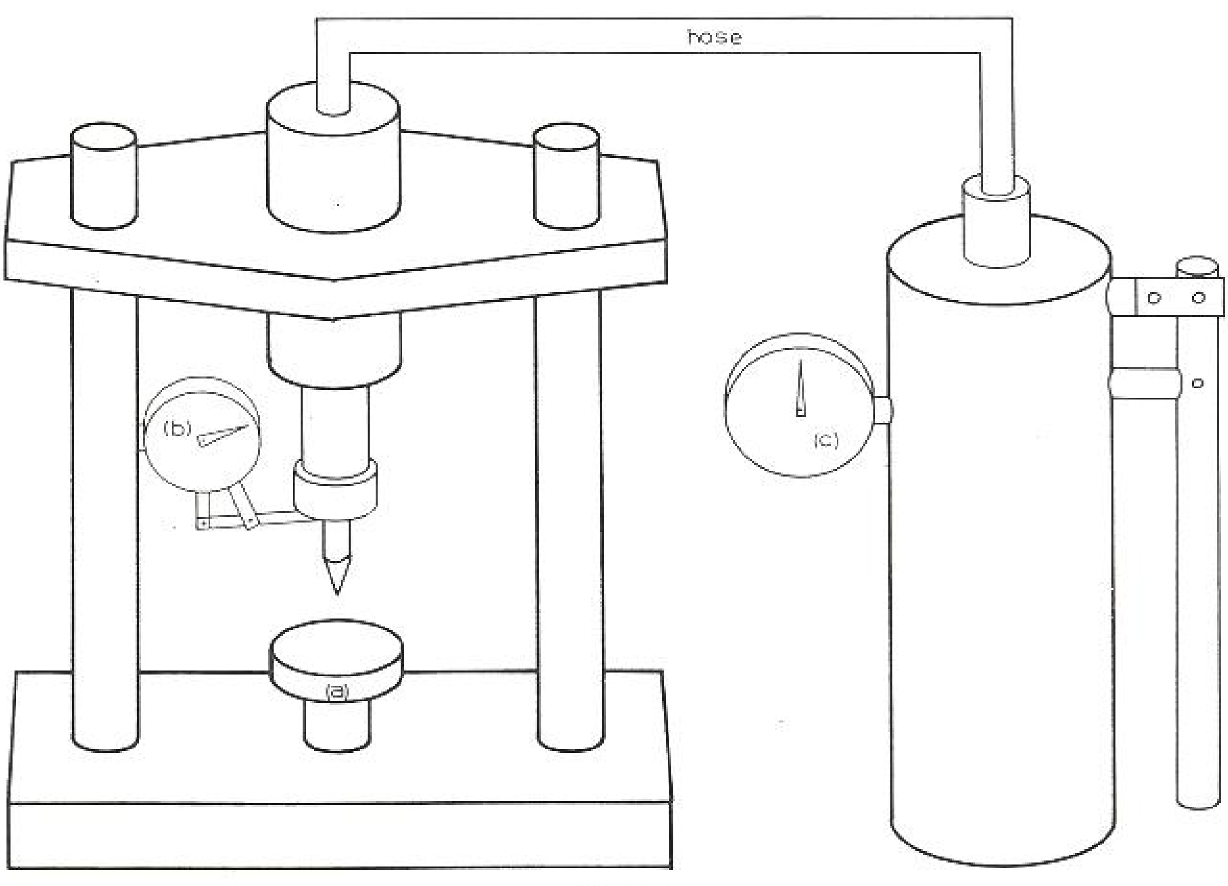

FIGURE 1

Components of the test system showing the pump on the right, press on the left and anvil (a), micrometer (b), and pressure gauge (c). Components are not to scale.

In this way, vertical motion of the cylinder, and consequently of the cone, can be measured. The cone is lowered to just make contact with the surface of the sherd and the dial is zeroed. Direct measurement of penetration depth can be obtained as the cone is forced down into the sherd during the fracturing process.

Because the surface area of a cone is proportional to its length (i.e. the penetration depth), it is of paramount importance that an accurate determination of this depth at the moment of fracture be made. Once the raw data of penetration depth and pounds of load have been determined, the wall strength in psi of the sherd can be calculated. The surface area of the cone in contact with the sherd at the moment of fracture must be calculated because psi is defined as pounds of load divided by surface area in square inches. The surface area on a cone is given by:

$$A = pi * r * S$$

A is the lateral surface area; pi is 3.1416; r is the radius on the circular section (Figure 2); S is the surface length; * is the multiplication symbol; and all lengths are in inches.

Lateral surface area is the area of the cone excluding the base. Since r, s, and P (the depth of penetration) are sides of a right triangle (Figure 2) some simple trigonometry can be applied to give the lengths of r and s from the measured length of P and the known angles between all of the sides. For example, consider a right cone with a 22.5 degree axial angle. Because it is a right cone the angle between r and P is 90 degrees. The angle between P and S is 22.5 degrees and the angle between r and S is the compliment of 22.5, or 67.5 degrees (Figure 2). S is most easily determined by application of the law of sines:

$$\sin 67.5 / P = \sin 90 / S$$

Since the sine of 90 degrees is one (1), the above equation reduces to:

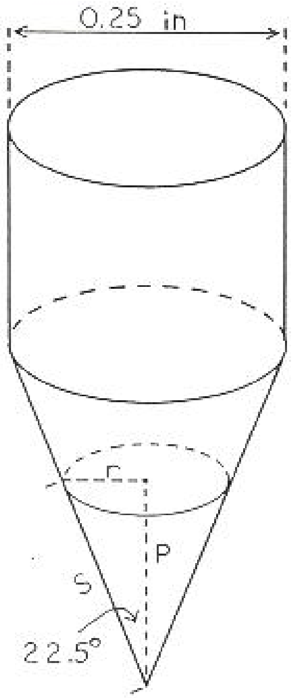

FIGURE 2

Geometry on the cone surface. S is the surface length, r is the radius of the circular section corresponding to the penetration depth P. Axial angle is 22.5 degrees.

$$S = 1 / (\sin 67.5 / P)$$

Where the sine of 67.5 degrees is a constant, approximately 0.924, and P is measured, this becomes a simple calculation with an electronic calculator. To determine the surface area on the cone, r of Figure 2 must also be calculated. Since this is a right cone we also have a right triangle and so the Pythagorean theorem may be applied:

$S^2 = P^2 + r^2$ or to simplify for our case:

$r^2 = S^2 - P^2$ which reduces to:

$r = \sqrt{S^2 - P^2}$

Now the lateral surface area can be determined and a psi value can be obtained. In the example: where psi = L / A and L is pounds of load, using a 45 degree right cone as in Figure 2 with a penetration depth of 0.025 inches at moment of fracture under 50 pounds load, the wall strength of that sherd would be, to three significant digits, 56,800 psi or 3990 kg/cm^2 (kilograms per square centimeter).

The basic equations above are standard and can be found in any text on elgebra, geometry and trigonometry or practical math. They have simply been arranged to apply to this specific experiment. To convert from pounds per square inch (psi) to kilograms per square centimeter (kg/cm^2), multiply psi by 0.070307.

PRELIMINARY RESULTS

Because of the lack of a data base for the wall strength of archeological ceramic ware, it was not possible to formulate a working predictive model for this experiment. Thus it was necessary to set up a control sample by which the procedure could be evaluated. This control sample consisted of two relatively large sherds of Intermountain ware (Steve Wright 1982: personal communication) which appeared to be in a good state of preservation (i.e. unweathered). The larger of the two sherds (Sherd no. 1) was a tan-buff colored piece averaging 8.8 mm in thickness and apparently typical of the regionally abundant "Shoshoni" ware described by Coale (1963) and Rudy (1953:94). The second and smaller of the two pieces (Sherd no. 2) measured 6.8 mm thick, was dark gray in color, and contained abundant crushed mineral and mica tempering agents. Detailed petrographic examination of the control samples was not undertaken. However, Sherd no. 2 may be Great Salt Lake Gray ware as described by Madsen (1977: 19-22). But, the identification of the control sample is not significant to this study. The significance of the control sample lies in the way it was used to evaluate the practicality of this procedure for measuring wall strength of prehistoric ceramics.

Sherd no. 1 was broken into three pieces of approximately equal size on which one test each was made. In this way the limits of intrasherd variation in test results can be defined. Each sherd fragment was fractured by positioning the puncturing cone in the center in an attempt to eliminate aberrant results from trying to fracture the sherd too close to its edge. It seemed that the crumbly nature of some of the sherd edges would give inconsistent results had they been fractured there, although this hypothesis was not tested. It should be pointed out here that only sherds exhibiting complete and unweathered interior and exterior surfaces were tested. The convex surface was placed in contact with the anvil so that a "bridging" effect would not result. Sherd no. 2 was prepared and tested in a similar manner except that it was broken into only two pieces because of its smaller size.

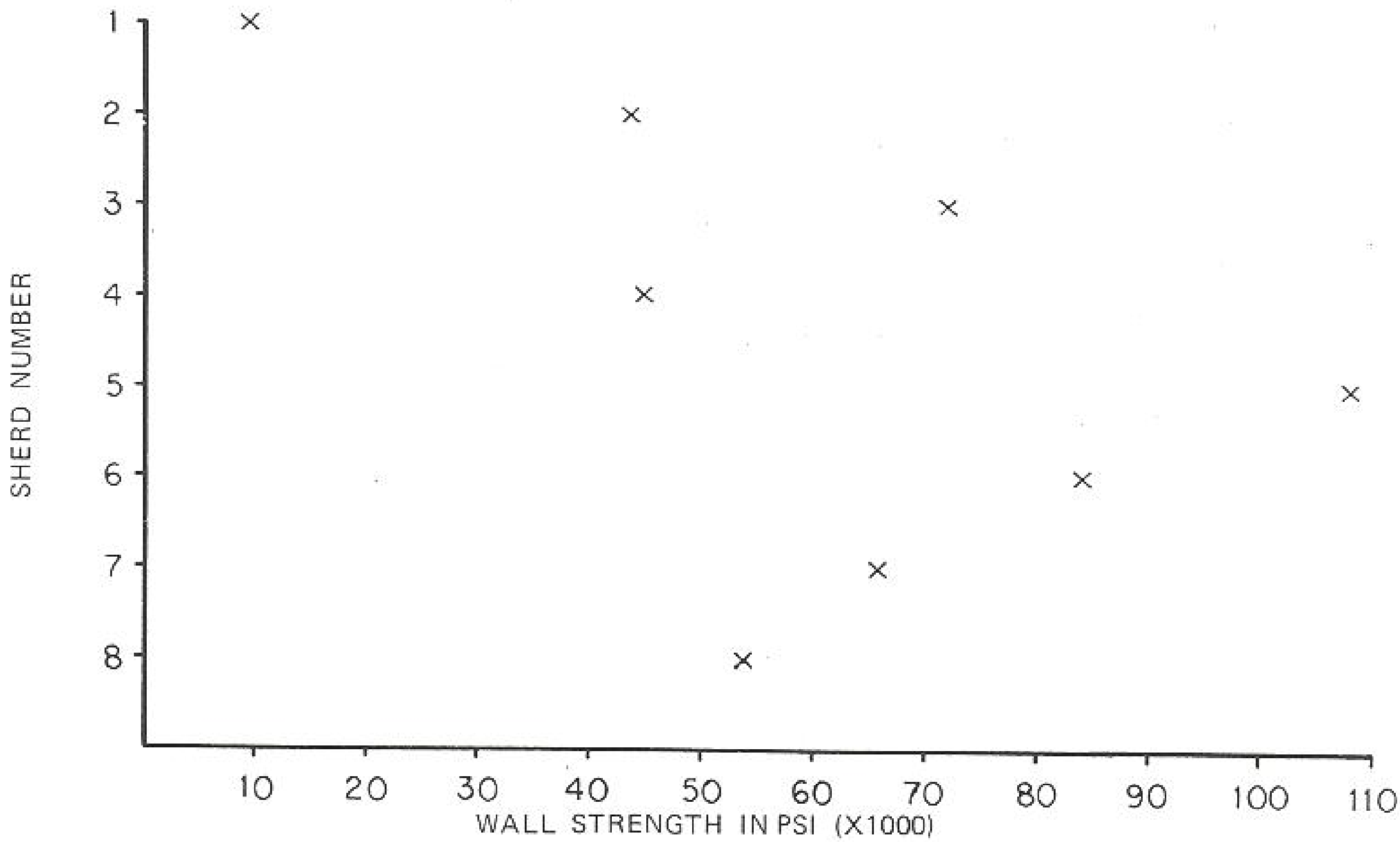

FIGURE 3

Graph of preliminary test results. Sherd numbers 1 and 2 are the control sample and the values plotted are averages for the specific sherd. Sherds 3 through 8 are Great Salt Lake Gray ware with numbers 3 and 4 being Group I; numbers 5 and 6 being Group II; and numbers 7 and 8 comprising Group III.

The results of the test on Sherd no. 1 indicated that very consistent intrasherd values could be obtained (Table 1). The three tests produced only slightly above a 10.5% variation from the mean value of 9,500 psi (670 kg/cm^2). Testing Sherd no. 2 produced an even tighter pair of values: a mean of 44,000 psi (3,090 kg/cm^2) and an intrasherd variation of slightly above 4.5%. Variation in these tests is determined by dividing half the range by the mean value for a given group and should not be confused with the statistics of variance (S^2) or standard deviation (S). Although the sample population was small, the sensitivity of the technique seems to be well illustrated.

The Great Salt Lake Gray ware had previously been divided into three groups (Groups I, II and III) on the basis of detailed petrographic examination by Mark Luther and the author (Druss and Druss 1982:18-19, 91-93). Since the entire sample of Fremont ware is represented by only 44 small sherds, the number of sherds in each group is small. Only two sherds from each group were tested. Again, only sherds with complete and unweathered interior and exterior surfaces were chosen. A total of six wall strength determinations were made on the Fremont sample.

The sherds in the Fremont sample are very small, generally less than about 4 cm^2, so each sherd could only be tested once. Because of this, intrasherd variation could not be determined. Presumably, intrasherd variation should be less than that displayed by the control sample due to the relatively greater homogeneity of the Fremont ware (Shepard 1965: 131).

Group I displayed high wall strength values (Table 1, Figure 3) with a mean of 58,500 psi (4,110 kg/cm^2), but also a high group variation of approximately 23%. The causes of the variation are not well understood, but some of the controlling factors will be discussed below. Testing Group II produced an even higher range of values with an average of 96,000 psi (6,750 kg/cm^2) but a much lower, 12.5%, group variation (Table 1). The sherds of Group III showed a high mean strength value of 60,500 psi (4,250 kg/cm^2) and quite a low variation of about 10.7% (Table 1). It should be stressed that these results are preliminary and that a much larger sample is needed for statistical validity. Results of the above tests can be readily compared by referring to Table 1 and Figure 3. It would, at this point, seem reasonable to assume that intersherd variation will normally be greater than intrasherd variation.

FURTHER CONSIDERATIONS

If intrasherd variation can be equated to intravessel variation and the values obtained from the control sample can be considered **normal**, then the values from Groups II and III fall quite close to the **normal** range of variation and thus, may in fact represent only two vessels. The variation with Group I is so high that there may be more than one vessel represented by the two sherds tested.

There is no clear relation between thickness of the wall and its strength. Firing temperature is one of the major controls on wall strength (Rye 1981:121; Shepard 1965:133), so if the much higher wall strength values of the Fremont ware, compared to the Intermountain ware, are, in fact, due to differential firing temperatures, then it may be concluded that the Intermountain ware was fired at temperatures less

TABLE 1

DATA FROM PRELIMINARY WALL STRENGTH TEST RESULTS

SAMPLE Control:	WALL THICKNESS IN MM	WALL STRENGTH IN PSI (KG/CM²)	VARIATION OF MEASUREMENTS	PERCENT VARIATION
Sherd no. 1: (Intermountain ware)				
test 1	8.8[1]	10,500 (740)		
test 2	8.8[1]	8,500 (600)	+ 1,000	+ 10.53
test 3	8.8[1]	9,500 (670)		
Sherd no. 2: (Great Salt Lake Gray or Intermountain ware)				
test 1	6.8[1]	46,000 (3,230)	+ 2,000	+ 4.55
test 2	6.8[1]	42,000 (2,950)		
Great Salt Lake Gray ware:				
Group I:				
sherd 3	7.0	72,000 (5,060)	+13,500	+ 23.08
sherd 4	6.8	45,000 (3,160)		
Group II:				
sherd 5	5.1	108,000 (7,590)	+ 12,000	+ 12.50
sherd 6	4.5	84,000 (5,910)		
Group III:				
sherd 7	4.5	67,000 (4,710)	+ 6,500	+ 10.74
sherd 8	6.8	54,000 (3,800)		

[1] *Denotes an average wall thickness for that sherd.*

than Great Salt Lake Gray ware, or less than about 775 degrees C (Madsen 1977:19).

While it is not certain exactly what parameters of wall strength are being measured with the above fracture analyses, it is clear that the results obtained are sufficiently consistent to say something about the relative, and possibly absolute, wall strength of ceramic wares. As long as consistent results are produced, it may be that a critical understanding of the mechanics involved is not necessary, although understanding those parameters would greatly increase the understanding of the material properties of archeological ceramics.

Considering that it takes only a few minutes and a minimum of equipment to perform each test and that the test breaks a sherd into only two or three fragments which are easily reassembled to preserve sherd outline, this method seems worthy of further pursuit. Considering also that, "fracture has not been systematically used to estimate firing temperature" (Rye 1981:121), this would seem like an attractive field for further research.

One of the major technical problems which needs to be overcome in the present equipment is the measurement of penetration depth. In the present system the penetration depth is indicated by the rotation of the micrometer needle. As the moment of fracture nears, the rotational movement of the needle begins to accelerate at such a rapid rate that an accurate depth measurement may be hard to obtain. This observational error could probably best be remedied by the use of a photo-optical sensing device to determine penetration depth but this type of apparatus has not been tried. Since psi is directly related to surface area and surface area is directly related to penetration depth, this source of error must be eliminated. The following example illustrates the effects of inaccurate depth measurements: if a sherd breaks under 50 pounds load (L) and with a penetration depth (P) of 0.045 inches its strength would be 17,570 psi (1,235 kg/cm^2). But, if only 0.001 inch error is made in measuring P, its strength values may vary by as much as 5%, and if 0.005 inch error is made, the strength value variation soars to over 22%. To limit psi variation to less than 2% it is necessary to measure P to within 0.0005 inches. Thus it is imperative that an accurate value for P be obtained.

There are many variables, or characteristics of prehistoric pottery of this region which, to an unknown extent, contribute to wall strength. Considering this complex picture, it is important to identify and describe as many of the following characteristics as possible: 1) wall thickness; 2) type(s) of matrix and aplastics (crushed material and/or sand grains used as tempering agents) determined by optical petrography and/or X-ray diffraction; 3) relative amounts of matrix, aplastics, and pore space determined by petrography and saturation techniques; 4) method of vessel construction indicated by visual and petrographic examination; 5) character of aplastics including: 1) particle size; b) particle sphericity; and c) particle roundness/angularity (see Folk 1980 for a concise, but thorough treatment of particle description and statistics); 6) degree of weathering; and 7) surface area of the sherd in the case of fracture analysis. This is not a complete list of characteristics and more should be added as a need for them arises.

Future research should concentrate on solving problems with, and refining, the above outlined techniques. Experimental ceramic tiles could be made replicating aboriginal techniques, using indiginous materials and fired under controlled and recorded conditions. The characteristics of: 8) firing temperature; 9) length of firing time; and 10) firing atmosphere (relative degree of oxidation or reduction) could then be coupled with characteristics 1 through 7 above. Finally, these experimental tiles could be fractured according to the above outline and their strength recorded as characteristic 11. Then computer analysis of characteristics 1 through 11 producing a graphic presentation would illustrate the relationships among those characteristics. In this way it would be possible to quantify characteristics 1 through 7 and 11 for archeological pottery and arrive at some conclusions about firing conditions and therefore ceramic technology employed.

CONCLUSION

The main purpose of this paper is to describe a new technique for quantifying wall strength of prehistoric ceramics and to illustrate that it could, in fact, be a useful technique of ceramic analysis. Further research producing technical and conceptual refinements will greatly enhance its utility. A secondary, but probably more significant aim however, is to generate discussion about this and other analytical techniques emanating from the physical and engineering sciences.

ACKNOWLEDGEMENTS

Mark Luther, field supervisor, Basin and Range Research, was coexperimenter in the initial stages of this project and has continued to show interest and support. Dr. Lee Robinson, School of Engineering, Idaho State University, enthusiastically discussed and offered solutions to the technical problems and secured for us the use of that department's Materials Testing Lab in which the experiments were performed. Tony Martin, Department of Art, Idaho State University, discussed the technical and stylistic determinants of wall strength, or vessel serviceability, and offered comments on contemporary and prehistoric (aboriginal) ceramic technology. Steve Wright, field supervisor, Basin and Range Research, kindly donated the pottery used as the control sample in these experiments. Paul Karl Link, Department of Geology, Idaho State University, critically read a previous draft of this paper. His many insightful suggestions have greatly improved the current draft and are most appreciated. Claudia Druss, Basin and Range Research, has also critically read a previous draft of this paper. Her eye for typos and help with style consistency are much appreciated. Mark Druss, Basin and Range Research, and Department of Sociology, Anthropology, and Social Work, Idaho State University, has read every draft of this paper and offered many helpful suggestions. His constant encouragement is very much appreciated. Pacific Northwest Generating Company of Portland, Oregon, funded the analysis which included the wall strength determinations of the ceramic ware found during the 1982 field season at Eagle Rock. Their interest in and permission to publish this paper is greatly appreciated.

All of the above mentioned people and organizations have been instrumental in the preparation and completion of this paper.

This paper is Contribution Number 2 of the Eagle Rock Archeology Project.

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ARCHAEOLOGICAL UPDATE

Minutes of the Spring 1983
Idaho Advisory Council of Professional Archaeologists
General Council Meeting
March 23, 1983
State Historical Museum, Boise

Historical Site Reports

Merle Wells (Idaho SHPO) provided copies of the latest historic site report prepared by the SHPO office. This report, on the Henry's Fork area, covers prehistory, architecture, and industry as well as general history. Wells stated that the reports are intended only as preliminary documents providing a brief historical outline and suggesting the cultural resource management possibilities for the particular area.

SHPO Funding

Wells described the funding situation as similar to years past. No money has yet been receved for the current fiscal year which began last October 1. This year for the first time, the preservation program is on continuing resolution. That money is expected sometime in April. Idaho will receive an appropriation that will be about $100,000 less than last year's amount of $400,000. Also, 10% of this year's appropriation will have to be spent through local governments. Wells explained that the cut in Idaho's appropriation is due to other states demanding a more equitable distribution of the federal monies.

Southwest Idaho Regional Archaeological Center

Green passed out copies of the Southwest Idaho Regional Archaeological Center Curatorial Standards and Guidelines. The standards for all three centers now are fairly uniform. The Southwest Center still has to draft a curatorial agreement for use with the federal agencies. The Southwest Center has also changed one former policy. Accession numbers will no longer be used as the primary catalogue number. The Smithsonian site number will be used instead.

ISHS Donation Policy

As standard policy, the Idaho State Historical Society will not purchase archaeological collections, nor will it accept as donations archaeological materials that have been obtained illegally from federal land. In order to provide tax benefits to people who donate collections, a value will be assigned to those collections based on what it cost to excavate them. This cost will not include the analysis, carbon-14 dating, etc.

Intermountain Antiquities Computer System

Site information on almost 5,000 sites, mostly on Forest Service and BLM land in southern Idaho, has been encoded by the SHPO office in fulfillment of a contract with the University of Utah. This information will be placed in the computer systems of the BLM and the Forest Service. Green said that the IMACS system has been adopted by his office and that a computer will eventually be purchased. The greatest problems with the system so far, according to Green, are the historic archaeology section and the topography/geography section. Paperwork is in progress for the remaining sites in southern Idaho to be encoded.

Lower Salmon River Cultural Resource Management Plan

David Sisson (Bureau of Land Management, Cottonwood) summarized the Lower Salmon River Cultural Resource Management Plan and gave some of its background. An interim protection plan formulated in 1981 for that stretch of the river included monitoring and interpretation of sites, and consultation with other professional archaeologists and interested people. The management plan continues and strengthens these efforts. Sisson emphasized a point made earlier that letters to the federal agency managers are very important in maintaining the manager's awareness of cultural resources. According to Sisson, the site monitoring efforts, which consist of frequency of visits to sites based on the kinds of use and misuse they are receiving, have paid off by providing concrete data to back up his recommendations for site protection. Sisson said that a recreation study made in 1979 indicated that the fifth and sixth reason people visit the river are for its historic and archaeological values. In 1981 those reasons for visiting the river had risen to third and fourth.

Bruce Womack (U. S. Forest Service, Hells Canyon NRA) mentioned the erosional damages to archaeological sites as a resujlt of the raising and lowering of the output of Hells Canyon Dam. The unwillingness of any agency to take responsibility for this was discussed.

Minutes of the Fall 1983
Idaho Advisory Council of Professional Archaeologists
General Council Meeting
October 7, 1983
State Historical Museum, Boise

River of No Return Wilderness

John Hoagland (wilderness planning team, Salmon) gave an update on the planning document for the River of No Return Wilderness. Two seasons of survey and archival work has produced an historical structures inventory which has been sent to Congress. The management directions in the historic structures document will be included in the management plan for the River of No Return Wilderness. The first draft array of the management alternatives is being sent out. After a period of review, a preferred alternative will be selected and then a draft anagement plan, including a cultural resource section, will be published and available for review. In the array of alternatives, it is proposed to place all artifacts and records in the Southeast Idaho Regional Archaeological Center for permanent storage. He added that B. Robert Butler (Idaho State University) had suggested that the curation be divided into two aspects with all prehistoric going to the Southeast Center and all historic to the Northern Center. A discussion resulted in a consensus that the materials should be placed in one center and not divided. Hoagland listed the research priorities of the River of No Return Wilderness: chronology, settlement patterns, the "pithouse question," artifact typology, impact studies, cultural affiliation, archaeological potential, oral history, documentation of private collections, geo-chronology, and paleobotanical studies. He said it is the policy of the wilderness to leave the door open to research, but the wilderness cannot fund it and must place certain limitations on research so that the wilderness maintains its unique quality as a wilderness. Jerry Wylie (Forest Service, Ogden) said that they are anticipating more testing of sites, especially in the main corridor, to obtain basic management information. Hoagland said that the management plan will probably be implemented in late 1984.

Interagency Archaeological Services

Ron Corbyn of Interagency Archaeological Services, National Park Service, San Francisco, described the functions of his office. The Park Service internally manages the parks and externally assists other federal agencies with cultural resources. IAS reviews FERC and Corps permits, some special case environmental impact statements, and regulations, guidelines and standards generated by the Washington office and federal agencies. The IAS is also involved in the RP3 process (resource protection planning) and in some emergency data recovery projects. If an impact is not being mitigated properly by a federal agency, anyone can notify IAS which will then approach the agency and help them work out a proper compliance procedure. Corbyn suggested that anyone having such a complaint give him a call (415-556-5190) and preferably follow up with a letter addressed to IAS at Box 36063, 450 Golden Gate Avenue, San Francisco, California 94102.

Hells Canyon

Slides were shown of a petroglyph that has been vandalized on private property at Buffalo Eddy in Hells Canyon. It was agreed that a news release should be put out and a $500 reward offered for information leading to the vandal's arrest and conviction. The reward money, if needed, is to be collected from the amateur and professional archaeologists.

Slides were also shown illustrating major erosion of sites downstream from Hells Canyon Dam as a result of high water releases. After some discussion it was decided to contact the state Department of Water Resources to ascertain who would be held responsible for the damage to cultural resources. On suggestion of Butler it was also decided to arrange a meeting of all involved federal agencies and state SHPO's to discuss the problem and work out a solution.

SHPO Funding FY 1984

Green announced that the funding for the current year will probably be about the same as last. The SHPO's office may be able to contract for small amounts for very specific projects.

Idaho Archaeologist

Bill Norquist (Idaho Archaeological Society) has resigned as editor of the *Idaho Archaeologist*. Reorganization of the journal's editorial board and "staff" is taking place. The next issue will have the temporary editors of Florence Schaertl (Idaho Archaeological Society) and Ken Ames (Boise State University).

Intermountain Antiquities Computer System

A meeting on IMACS was recently held in Utah. Wylie announced that the 1984 meeting will be held in Boise on the Tuesday and Wednesday of the first week in October. The BLM in Montana and Colorado are joining the IMACS system. The User's Guide is now available for $15 a copy. In the future it will include a cultural area map for Idaho. Green said that a proposed architectural section has been prepared by Jennifer Attebery (Idaho State Historical Society) and will be submitted for review.

Cataloguing

It was decided that individual flakes do not have to be labeled and catalogued but that the level bags, at a minimum, should be catalogued. Green suggested that individual catalogue cards be written up for each artifact. Pavesic pointed out that this is difficult without a work-study program like Swanson's; Joe Randoph (BLM, Washington) mentioned that it cost the Army Corps millions of dollars to do catalogue cards in their Columbia River project; and Butler said that the cards have to be done so hurriedly and by such lowly skilled people that they turn out worse than the catalogue.

Shipwreck Preservation

Sprague announced that the Shipwreck Preservation bill is in McClure's committee. He said that letters are needed from Idaho archaeologists and amateurs. A letter from an amateur is worth five from professionals in McClure's office, he said. Washington, D. C. also sees IACPA as instrumental in all archaeological legislation. Sprague also pointed out that this legislation does affect Idaho, since pothunting activities take place daily on Lake Coeur d'Alene. He suggested that a carbon of any letters to McClure be sent to him. Green said that he would also write a letter in behalf of IACPA as a group.

The meeting was adjourned.

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