# DOLORES ARCHAEOLOGICAL PROGRAM

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Volume VI, Chapter 4

Photography - 1979

by John P. Nylander

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16. Abstract

The Photography Section of the Dolores Archaeological Program implemented a system for organizing the large volume of photographic material generated during the 1979 field and laboratory operations. This system involved the acquisition of photographic information and the integration of that information, via computer-aided storage and retrieval mechanisms, into the general project data bank. The Photography Section also explored two remote-sensing methods, including bipod and component mapper techniques. These alternatives to conventional photography were tested and tentatively evaluated in view of their potential use as valuable archaeological tools in future project investigations.

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TABLE OF CONTENTS


| | Page Number |
|---|---|
| LIST OF FIGURES | ii |
| LIST OF TABLES | iii |
| ABSTRACT | v |
| EDITOR'S PREFACE | vi |
| INTRODUCTION | 1 |
| ORGANIZATION OF D.A.P. PHOTOGRAPHIC WORK | 3 |
| Background | 3 |
| Utilization | 4 |
| Data Management and Production Design | 6 |
| COMPUTERIZATION OF PHOTODOCUMENTATION | 13 |
| Goals of Documentation | 13 |
| Need for Documentation | 13 |
| Purpose of Documentation | 14 |
| Documentation Format | 17 |
| IMAGE ACQUISITION | 25 |
| Issue of Materials and Equipment | 25 |
| Receipt of Film | 28 |
| Film Processing | 28 |
| Proofing | 28 |
| Review of Computer Coding | 29 |
| Evaluation of Photographs | 30 |
| Input of Codes | 30 |
| Verification of Computer Data | 30 |
| Chipping | 31 |
| Government Review | 31 |
| Filing | 32 |
| Storage and Maintenance | 33 |
| IMAGE INTEGRATION | 36 |
| Need Definition | 37 |
| Draft Printout | 37 |
| Issue of Topical Package | 38 |
| Review of Coding | 39 |
| Supplementation | 39 |
| Index Printout | 40 |
| Mechanical Production | 41 |
| Negative Production | 41 |
| Plate Production | 41 |

Page Number

Topical Index. . . . . 42

PHOTOMETRIC RESEARCH AND DEVELOPMENT . . . . . 43

Bipod Operation. . . . . 44
Component Mapper Operations. . . . . 47

GLOSSARY OF TECHNICAL TERMS. . . . . 52

APPENDIX A - CODING AND DICTIONARY FOR PHOTOGRAPHY RECORD. . . . . 53

REFERENCES CITED . . . . . 62

## LIST OF FIGURES

Page Number

Figure 4.1 Example page from Acquisition Log . . . . . 8

Figure 4.2 Photographic Record Form . . . . . 9

Figure 4.3 Example page from Topic-Specific Integration Log. . . . 11

Figure 4.4 Example page from Topical Index . . . . . 12

Figure 4.5 Dog burial (Feature 16), Site 5MT2854 . . . . . 49

## LIST OF TABLES

Page Number

Table 4.1 Occurrences of Letter-code Triplets/Film Observations in 1979 Image Catalog. . . . . 23

Table 4.2 Positive/Negative Film Lines . . . . . 27

ABSTRACT

The Photography Section of the Dolores Archaeological Program implemented a system for organizing the large volume of photographic material generated during the 1979 field and laboratory operations. This system involved the aquisition of photographic information and the integration of that information, via computer-aided storage and retrieval mechanisms, into the general project data bank. The Photography Section also explored two remote-sensing methods, including bipod and component mapper techniques. These alternatives to conventional photography were tested and tentatively evaluated in view of their potential use as valuable archaeological tools in future project investigations.

# EDITOR'S PREFACE

This report describes the organization and achievements of the Photography Section during 1979, and is included in the Dolores Archaeological Program report series for that year. The author was no longer associated with the program when the report was edited for final submission; as a result, the necessary alterations in text were made without his knowledge. In addition to extensive editorial revisions, several contributions from the current Photography Section Crew Chief have also been included. Because the author was not available for consultation on these changes, the responsibility for the final version of this report rests with the Dolores Archaeological Program editorial staff.

# INTRODUCTION

Until the introduction of the computer, the camera was the most complex instrument used by archaeologists. Archaeologists are familiar and comfortable with photography and consider it an essential tool. General references for archaeological photography are Aschmann et al. [1], Cookson [2], Harp [3], Matthews [4], and Simmons [5].

Frequently, phenomena encountered in archaeological investigations are degraded products of cultures and are not well understood. Photographic records of the appearance of these phenomena are highly desirable. Many cultural remains are destroyed during excavation, and photographic records are at least as useful as verbal descriptions, measurements, drawings, and maps (DiPeso [6]) in the preservation of information about these remains.

The photograph is an objective, permanent, material counterpart to the visual perception of the archaeologist. Photographs are used as records of archaeological activity and can be used in searches for additional information during study and analysis (Schiffer [7]). Photographs are also used to communicate information about past cultures (Dechert [8], Pratt and Ropes [9]).

The photographic section of the Dolores Archaeological Program (D.A.P.) spent 450 person-days during 1979 as a support service to the program. Four separate 1978 collections were integrated, copied on internegative film, and computerized. Approximately 10,000 photographs were processed and cataloged. Fifty-five percent of the photographs were disseminated for use. Computerized input and output of photograph codes by subject matter was designed, tested, and proven

operative for immediate use. All whole or reconstructed ceramic vessels and all whole projectile points in the artifact collection were photographed, in over 2,000 views. Photogrammetry of field sites was demonstrated to be feasible and effective. Progress was made on limited research with remote sensing within excavated sites.

# ORGANIZATION OF D.A.P. PHOTOGRAPHIC WORK

The D.A.P. presents a challenge in the management of photography due to the volume of acquisition and the rapid integration of photographic records required. Consequently, traditional archaeological photographic techniques have been modified to incorporate approaches to serve large, rapid-turn-around enterprises. The D.A.P. has borrowed heavily from remote-sensing methodology (Gumerman and Kruckman [10], Lyons and Scovill [11]), motion-picture postproduction technology, and visual-communications research in anthropology (Ruby [12]).

## Background

### Photographic Information

Photographs differ in significant ways from other types of information. First, photographic image information is nonsequential and need not occur as a stream of connected and meaningfully sequenced symbols. Photographs may be studied in an unstructured manner, starting anywhere on a two-dimensional surface and working in any direction. A photograph is an integral unit, limited by its frame. Therefore, information derives primarily from comparing two or more photographic images.

Second, photographs are nonsymbolic and there is no conventional system for interpreting the information they contain. Consequently, photographic information must be presented more accurately than other types of information.

Third, through the recording of shades of gray or colors, photographs present information in such a way that it can be perceived multidimensionally both qualitatively and quantitatively (Irish [13]). Color information may be used to determine the atomic, molecular, and macromolecular composition of objects (Colwell [14]), a potential which is useful to scientific research.

Information Retrieval

Two retrieval methods may be used to gain access to photographic collections: browsing and computer filing. The former involves sorting until acceptance criteria are met or amended to fit available images. For this use, photographs need not be grouped or sorted by common attributes; they need only be arranged sequentially for repeated inspection.

The data-processing or analytic method involves a computer catalog listing of coded photographic image information. This method is best used when specific photographs must be selected for use as study tools for a research topic. The research topic defines the selection criteria and the computer searches the catalog for photographs meeting these criteria. This method provides coherent, sequenced groups of related high-quality images which provide detailed information on which to base interpretations and the visual documentation to support those interpretations.

## Utilization

The organization of the D.A.P. photographic section is based on the common and unique requirements of the potential users of the system. These needs are best considered in light of the system's

proposed goal: to provide information to decision makers in management, research, and public education.

The common requirements of users of the system have been defined and met as follows:

1. Integrity - First-generation negatives and slides are protected from damage, deterioration, and theft in the archives.

2. Accuracy - Each negative is referenced by a unique number.

3. Consistency - Two image formats are standard: each image appears on a standard proof, and each usable image appears in a standard-size film chip.

4. Cost - All user requirements have been met at reduced cost.

Individual requirements for specialized users of the system have also been identified and addressed. Management information has been provided for day-to-day project decision-making. The Photography Section has sought to allow for testing and quality control and to provide quick, inexpensive access to difficult-to-handle artifact collections and their original archaeological contexts. Photographs have been used to monitor the changing condition of sites and conservation techniques. In 1979, proofs were kept in office areas to void long retrieval times. Production of chips has minimized volume (approximately 10,000 frames have been acquired). Management personnel have easy access to the catalog of proofs, which will serve as a permanent publishable reference.

Technical and scientific information in a standard 35 mm format was continually provided to the project during 1979. At least one image of every subject photographed has been used in some form, and in the fall of 1979, 5,269 photographs were prepared for researchers.

The use of negative film has permitted variation in reproduction, and numerous chips have been produced and then filed for reuse when applicable.

Educational goals, such as dissemination of educational information through mass media and displays, have been met by providing high-quality, inexpensive images. Publishers, producers, and other outside users can be provided with chips allowing them to make negatives for their own files and to produce custom-printed enlargements to their own specifications.

## Data Management and Production Design

The design adopted by the photography section for data management and production was based upon two functions: acquisition and integration of photographic information. The role of the Photography Section has been to acquire visual documentation of the project in scope and detail; that is, to produce a collection of secure and accessible photographic images. In addition, this visual documentation has been applied as follows: for research, in periodic progress reports; for audio-visual presentations at conferences and in communities; for publicity, in government records and reports; for interpretive planning and display, in synthetic reports of investigations; and for education (training for careers in cultural resource management).

The operating principle behind photographic information management in this program is based on the concept of photography as a graphic resource. Photographic resources must be understood and shared. Documentary information explaining the photographs has been

computerized. The computer thus links photography to the other information sets used by the project, and documentation for photographs is contained within the total project data base as a integral part of this larger information system.

Photographic procedures are simplified by formalized packaging of materials and information for acquisition or integration. There are four procedures, two for each function. Acquisition requires use of the Acquistion Log (Figure 4.1) and the Photographic Record Form (Figure 4.2). The Acquisition Log reflects the daily location of materials measured in units of 80 $in^2$ of negative film. Each roll of film is assigned a number as it is prepared for issue. Numbering allows accurate determination of costs and measurement of production efficiency on a continuing basis. Each page of the acquisition log becomes a permanent table of contents for each volume of the Image Catalog. Because each completed activity is recorded in the catalog, the status of an individual roll may be continually monitored.

The exposure-specific Photographic Record Form, packaged with each roll of film, stays with the film throughout the acquisition process. Descriptions of the various entries on this form are given in the section entitled "Computerization of Photodocumentation" in this report; instructions for completing this form are presented in Appendix A. After the film has been processed and images proofed, copies of the record form are placed in the catalog for permanent reference. Computer coding is done immediately upon exposure of each frame of film. After computer processing, a computer output is added to the Image Catalog.

| Roll Index | Film Type | Camera # | Issued To | Site MGR | Site # | Issued | Recd | Procs | Proof | Edit | Eval | Input | Verify | Macro | Trans Burec | Trans BLM | Trans D.A.P. | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | |
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Figure 4.1 Example page from Acquisition Log.

DOLORES ARCHAEOLOGICAL PROGRAM
Water and Power Resources Service

## GRAPHIC CATALOG

P_____ of _____

Year

Image Type

Film Speed __________

Proof No.

Format

Camera

| IS | RC | PR | PF | REV | EVAL | IN |
|---|---|---|---|---|---|---|
| | | | | | | |

| IMAGE CONTENT | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Context | | | Subcontext | | | Subject | | | | | | | | | | | |
| Theme | County | Site | Area | Sub- | Code 1 | Type | Number | Code 2 | Type | Number | Code 3 | Mat. I.D. | Number | Framed | Phase | Image No. | Value | Direction | Station | Band | Month | Day | Recorder |

Figure 4.2 Photographic Record Form.

Two integration forms, the Topic Specific Integration Log and the Topical Index, record the second function (integration). The Topic-Specific Integration Log (Figure 4.3) tracks the process of integrating images in topical packages. A topical package consists of all chips that pertain to a specific subject and or topic (e.g., a particular site, a specific feature type, a specific artifact type). Regardless of the intended use, all integration activity performed by the photographic section of the D.A.P. is logged for each topic upon completion of the activity. The Topic-Specific Integration Log becomes a permanent table of contents for the Image Catalog. The Topical Index either lists image numbers in numerical sequence to inventory the photographs in a package or, if in computer-printout form, lists photographs in coherent groups sequenced from general to specific relationships to the topic of the package (Figure 4.4). The Topical Index may be used for work pertinent to the topic after it enters the permanent D.A.P. catalog index volume.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Topic |
| | | | | | | | | | | | | | Author |
| | | | | | | | | | | | | | Department |
| | | | | | | | | | | | | | Year |
| | | | | | | | | | | | | | VOLUME |
| | | | | | | | | | | | | | CHAPTER |
| | | | | | | | | | | | | | SITE CLOSED |
| | | | | | | | | | | | | | PRINTOUT REQUIRED |
| | | | | | | | | | | | | | PRINTOUT ISSUE 1 |
| | | | | | | | | | | | | | PRINTOUT ISSUE 2 |
| | | | | | | | | | | | | | PRINTOUT ISSUE 3 |
| | | | | | | | | | | | | | PACKAGE ISSUE |
| | | | | | | | | | | | | | PRINTOUT TRANSFER |
| | | | | | | | | | | | | | PRINTOUT REVIEW |
| | | | | | | | | | | | | | ARTIFACT REQUIREMENTS |
| | | | | | | | | | | | | | ARTIFACT PHOTOGRAPHER |
| | | | | | | | | | | | | | INDEX |
| | | | | | | | | | | | | | PACKAGE RETURNED |
| | | | | | | | | | | | | | LAYOUT |
| | | | | | | | | | | | | | MECHANICAL |
| | | | | | | | | | | | | | NEGATIVE |
| | | | | | | | | | | | | | PLATE |

Figure 4.3 Example page from Topic-Specific Integration Log.

| STUDIO | SITE | CONTEXT | SUBCONTEXT | SUBJECT | USE | IMAGE NUMBER | QUALITY | EDGE | FILM TYPE | DATE |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2858 | Z 00000 | Z 00000 | X 840010 | 4 | 7011321• | 5 | 37 | 0 | 62279 |
| 1 | 2858 | Z 00000 | Z 00000 | X 870000 | 7 | 011034 | 0 | 0 | 0 | 61579 |
| 1 | 2858 | Z 00000 | Z 00000 | X 870000 | 7 | 011033 | 0 | 0 | 0 | 61579 |
| 1 | 2858 | Z 00000 | Z 00000 | X 870000 | 7 | 011036 | 0 | 0 | 0 | 61579 |
| 1 | 2858 | Z 00000 | Z 00000 | S 110001 | 4 | 0234 9 | 3 | 10 | 0 | 90479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 110001 | 4 | 023410 | 3 | 11 | 0 | 90479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 110001 | 4 | 0234 6 | 3 | 7 | 0 | 90479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 110001 | 4 | 0234 7 | 3 | 8 | 0 | 90479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 110001 | 4 | 023411 | 3 | 12 | 0 | 90479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 110001 | 4 | 0234 8 | 6 | 9 | 0 | 90479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 110001 | 4 | 023412 | 7 | 13 | 0 | 90479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 3 | 10020132• | 5 | 33 | 21 | 81679 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017510 | 1 | 11 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017529 | 1 | 30 | 0 | 72479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017530 | 1 | 31 | 0 | 72479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0179 9 | 2 | 10 | 0 | 73079 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017910 | 2 | 11 | 0 | 73079 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017924 | 2 | 25 | 0 | 80179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017926 | 2 | 27 | 0 | 80379 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 016624 | 3 | 25 | 0 | 62879 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 016627 | 3 | 28 | 0 | 70979 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 016625 | 3 | 26 | 0 | 70979 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 016636 | 3 | 37 | 0 | 70979 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017934 | 3 | 35 | 0 | 80379 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 020135 | 3 | 36 | 21 | 81679 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 020134 | 3 | 35 | 21 | 81679 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 020133 | 3 | 34 | 21 | 81679 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 016611• | 5 | 12 | 0 | 62679 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 016622• | 5 | 23 | 0 | 62879 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0175 1• | 5 | 2 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0175 2• | 5 | 3 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0175 7• | 5 | 8 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0175 4• | 5 | 5 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0175 9• | 5 | 10 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0175 3• | 5 | 4 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017512• | 5 | 13 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017515• | 5 | 16 | 0 | 71879 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017516• | 5 | 17 | 0 | 71879 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017532• | 5 | 33 | 0 | 72479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017528• | 5 | 29 | 0 | 72479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0201 4 | 5 | 5 | 21 | 80779 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0201 2 | 5 | 3 | 21 | 80779 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0201 1 | 5 | 2 | 21 | 80779 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017511• | 6 | 12 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0175 6• | 6 | 7 | 0 | 71179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017923• | 6 | 24 | 0 | 80179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 017925• | 6 | 26 | 0 | 80379 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 016626• | 7 | 27 | 0 | 70979 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 0201 3• | 7 | 4 | 21 | 80779 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 021633• | 8 | 13 | 0 | 82879 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 4 | 011723• | 8 | 23 | 20 | 61179 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 5 | 011727 | 1 | 27 | 20 | 71379 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 5 | 0166 4 | 2 | 5 | 0 | 62679 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 5 | 011728• | 5 | 28 | 20 | 71379 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 5 | 0166 5• | 7 | 6 | 0 | 62679 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 5 | 011725• | 8 | 25 | 20 | 71379 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 5 | 011726• | 8 | 26 | 20 | 71379 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 7 | 017517 | 1 | 18 | 0 | 71879 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 7 | 017531 | 1 | 32 | 0 | 72479 |
| 1 | 2858 | Z 00000 | Z 00000 | S 210001 | 8 | 0166 1 | 2 | 2 | 0 | 62679 |

Figure 4.4 Example page from Topical Index.

# COMPUTERIZATION OF PHOTODOCUMENTATION

## Goals of Documentation

Archaeology cross cuts many disciplines, and all scales of documentation from the macroscopic to the microscopic. Because the D.A.P.'s images cover multidisciplinary themes, the system must be comprehensive and useful to all departments on the project. Therefore, rather than establishing a system which works within the Photography Section only, the system involves all project departments as they create, collect, edit, study, and otherwise share a package of images relevant to one topic.

## Need for Documentation

A scientific photograph may be defined as a permanent record of the fleeting observation. Certain information must accompany an image if it is to become a record of this observation and if it is to be understood by anyone other than the original researcher. This is the essential concept of Researchable Film Observation (Feld and Williams [15]). Also, quite naturally, when a photographic collection becomes extremely large, the need for a system of retrieval and distribution of images becomes extremely important.

An important relationship exists between the scientific observation and the photograph which documents it. A nearly infinite number of observations may be referenced to, or arise from, a perception recorded in a single photograph. Documentation may be referenced to photographs at the time of exposure and after the photograph is processed and studied. Both the concept of graphic archives in libraries

and museums, and the concept of image interpretaton in remote-sensing practice, are based upon this fundamental concept of photography as a research tool. Thus, one photograph may have a number of lines of computer documentation associated with it. Each computer data line corresponds to a single observation of a scene.

## Purpose of Documentation

The photographic/computer information system uses photography to record perceived stimuli and the computer to document observations. The observations can be limited to a simple level of identification. The computer will link the image to information recorded in different states in the other computer files through these simple identifiers. Therefore, the purpose intrinsic to the computer file is retrieval and captioning over both the short and the long term.

### Short-term Documentary Purpose

No photograph can be justified as being simply "for the record." Photographs must be sufficiently documented to allow selection and arrangement within months after collection. For retrieval of photographs which relate to topics of study, the subjects portrayed in photographs must be precisely identified. Subject identifiers can be assigned as attributes of photographs and allow machines like the computer to select, sort, and sequence pictures automatically. Full documentary recording of photographs should explain the context of subjects and define points of interest in the photographs.

### Long-term Documentary Purpose

The short-term need for documentation adequately addresses the the of images by highly trained specialists working with the archival

records. Organizing the Topic-Specific Integration Log by subject matter guarantees a complete inventory of all images related to a research subject. Because of its synoptic quality, the photographic information system may be used as a window to access, review, and evaluate the entire project data base.

The photographic information system identifies nearly every subject of investigation. It is this summary identification in captioning photographs that serves as a synopsis of the entire research program. Although the mechanical nature of photography is limiting in many ways, photographic images have several advantages:

1. Reproducibility
2. Mechanical objectivity
3. Extraordinary information content
4. A synoptic quality which transmits information to the user at great speed requiring little analytical effort

For the above reasons, the photographic collection can function well as a synoptic layer for the entire project's information system. Specialists may use the graphic information system as a way of rapidly reviewing, evaluating, and locating more detailed information. This synoptic layer may be sufficient for specialists in other disciplines with a wide range of primary interests.

If photographs are available for use by researchers in the short-term, an extraordinary opportunity for long-term retrieval presents itself. This potential allows the photographic system to act as a computer-aided learning system. Groups of image numbers are listed as the topic is selected and presented for various research themes (one-half of these topics are now individual sites). These

image numbers may be used at some time in the future to link thematic attributes for the retrieval of the most useful and desirable images. Thus, from the tracks created by previous users as they browse through the image data bank, the system may calculate the most appropriate information to be presented to the next user. Film chips on file may be the most useful medium for this synoptic integration because they can be packaged to go between research workers and the photographic collection. With topical indexing, each time the data is used, it is improved. There is also a possibility that at some time in the future, file linkage will allow coded photographic documentation to pull information off of other forms and write an (albeit rough) paragraph of explanation on a computer printout listing images for any desired topic. This extended caption could be similar to an abstract file.

## The Infrastructure for Photodocumentation

To properly address the purpose for photographic documentation, computer coding must facilitate the organization of images into topical packages. For efficient, timely, and meaningful integration of photographs, the computer indexing approach must be spatial in character.

The spatial information system that exists as the project's provenience scheme arises from the need to understand environmental and cultural phenomena in the not-always-so-evident archaeological record. The levels of selection, simplification, and abstraction required to create models of the past are implicit in the spatial organization of information. The acquisition and integration of data

to produce these models (the research process) uses an explicit spatial framework (Steiner and Salerno [16]). All observations can be attached to points, lines, and areas within this framework.

Areas represent a nominal scale of locational measurement. The areal designations used by the D.A.P. are of three kinds: (1) natural, (2) cultural, and (3) arbitrary. Confusion of these different areal designations may cause difficulties during data integration because of the problem of getting different kinds of areal designations to "nest" hierarchically when mixed together.

## Documentation Format

The Photographic Record Form (Figure 4.2 and Appendix A) was the format selected for image documentation in 1979. This format was based on experience with museum cataloging and the research potential of archaeological photography. It is not known whether the general literature contains case histories of computerized photographic documentation for archaeology; however, a major treatise on the reduction of photographic interpretive theory to practice may be found in the handbook for Proxemic Research (Hall [17]). This manual suggests a methodology for the archaeological use of photography and computers as tools, and was used to select attributes which would be tested against the documentation and production requirements anticipated for the 1979 field season and preparation of reports through the winter. Selected attributes have been used for topical integration with a large degree of success. The testing of variables for use in defining parameters for placing an individual photograph in the general program has proven to be far more useful than one-shot taxonomic classification.

Descriptions of each of the major headings found on the Photographic Record Form are presented in the following sections.

Cataloging Variables

Two variables, proof number and image number, were the primary means used to organize the large and rapidly growing photographic collection during 1979.

Proof number. Acquisition control was well served with the assignment of a Roll Index Number for each 80 $in^2$ unit of negative film. Since inclusion of the four separate 1978 photographic collections into the computer indexed catalog, the Roll Index Number is more universally and accurately termed "Proof Number."

Image number. Because assignment of individual exposure numbers by camera film counters has been reliable, the term "Image Number" has been given to these last two digits that permanently specify a unique image.

Production Variables

A major component of image documentation addresses the day-to-day running of a project-wide support service in a large research program. These codes are used to track both the short-term and long-term status of individual units of film.

Camera number - Camera number is essential for production controls, avoiding confusion and providing information for long-term maintenance and troubleshooting.

Image type - Image type is required for proper interpretation of images. This variable specifies both the hardware and the software for images, including sensiometry and emulsion type. When it is necessary to include photographs of drawings and maps for presenta-

tions, and for macrofilm records with quality "blow-back" (reenlargement) or rescaling, the image type can assist in retrieval of specific types of line graphics. This designation can allow for computer coding of maps according to subject matter in the same manner as for photographs.

Film speed - Film speed is indicated in image-type coding--a write-in entry is provided to avoid mishap, although general purpose films are standardized at ASA 100.

Format - Format defines the number of exposures as a consequence of film frame size. All 35 mm rolls of film consist of 36 exposures.

Production tracking - Production tracking is the most important and complex task of data integration. These codes are "for office use only" and substitute critical temporal attributes for the former, highly redundant "date started/finished" attributes.

Variables Used to Orient Scene in Time and Space

Variables used in the image content section of the 1979 documentation format have proven to be highly sensitive to the integration of images into comprehensible topical packages. These variables allow the computer to place any selection of images in a coherent sequence imitating the following parameters of natural experience:

1. Equal-time sequencing
2. Sequence of major events
3. Photographic station
4. Direction (e.g., north, south, east, west)
5. Magnification of subject matter upon approach
6. Perceptual bias of individual observer
7. Color perception

8. Potential for subject matter to interest or disinterest specific viewers

Image Content Variables

After the 1978 field season, it became apparent that a means of integrating a vast number of photographs into the D.A.P. Image Catalog was needed. The system needed not only to document pertinent information about the photograph, but also to record the provenience of the subject and be compatible with other D.A.P. data recording systems. The image content variables were developed in response to these needs.

The image content section of the Photographic Record Form contains three subsections: Context, Subcontext, and Subject. Each subsection is further broken down into a code box, two type boxes, and four number boxes. Appendix A lists the definitions and guidelines for filling in the image content variables. The number or letter that is put in the code box becomes the individual subject identifier and, because all three subsections must be filled out, the three individual subject identifiers become a triplet. The triplet then, is the means by which all photographs are documented. Appendix A lists all standard triplets and their associated meanings.

The short-term documentary purpose for coding image content is well served by subject identification codes used on the Field Provenience Forms (cf. Kane et al. [18]). The subject identifications indicate hierarchical level, subject class, and subject number. However, there has been a potential for confusion between the use of the Photographic Record Form and the field provenience files.

Like a Field Specimen (FS) designation, a framed image defines an area of investigation. The numbering of FSs and photographs is arbitrary, but the Field Provenience Forms and photographic emulsions are technologically distinct methods for recording information. The Field Provenience forms record textual, mathematical, and diagramatic kinds of information. A photograph is a photomechanical record of an existent pattern of light. Commonly, the only way to alter that pattern of light is through choice of frame and orientation to the scene. These two factors, plus subject identification, are critical parameters that must be documented for each photograph.

The Field Provenience Forms and files are used to record information about highly complex phenomena in the archaeological context so that they may be simplified, selected, generalized, and generated into abstract models of the cultural system. The field provenience records are used to record associations, inferences, recognized patterns, and other attributes of observed context. Since photographs are distinctly different kinds of records, photographic coding should supplement and not duplicate FS records.

Ideally, the use of subject identifier codes on the photographic form would only designate image content; that is, if something can be seen in the camera viewfinder and in the printed photograph, it should be written down on the form. Since the FS form is already used to record the hierarchical nesting of subjects, computerized documentation of photographs should be free to identify picture elements precisely enough to allow visualization of the unique appearance of an image from the coded data line alone. The context for a subject, the subject itself, and the main point of interest would suffice both as



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"photodescription" and as variables for access in a three-part definition of scenes as they are recorded by cameras. Because certain subjects (point locations, for example) are not given unique numbers except within encompassing spatial provenience locators (surfaces, for example), a two- or three-stage linkage (e.g., a point location number and its associated surface and study unit) is required to identify many subjects even when the encompassing subject is not present in the image. Given that under the general program procedure for recording of spatial systematics, unique subjects are identified by rather long strings of codes, the refinement of the Photographic Record Form provides for a frame indication code which designates which of the subjects is the full-frame major subject of the photograph. This provision will allow visualization of images from coded captions and provide for coding of necessary linkages.

Table 4.1 lists the frequencies of image content letter-code triplets recorded on the Photographic Record Form during 1979. Several generalizations regarding the occurrence of some of the codes can be made. Letter code "Z" accounted for 38 percent of potentially documentable subjects, and letter code "Q" occurred more frequently than any other subject with the exception of study units. Within sites, the same set of triplets tended to be used repeatedly, possibly as a result of excavation methodology.

Approximately 70 percent of the 8,845 letter code triplets were fit into 14 categories of image content. If the sole purpose of image content (disregarding the identification of retrieval of specific individual subjects) was to designate standardized categories of

Table 4.1 Occurrences of Letter-Code Triplets/ Film Observations in 1979 Image Catalog

| Triplet | Observation | N | % | Cummulative % |
|---|---|---|---|---|
| ZZX | General site | 1353 | 17.4 | 17.4 |
| ZZS | Study units | 1227 | 15.8 | 33.2 |
| SEF | Surface feature in study unit | 832 | 10.7 | |
| ZSF | Study unit features | 554 | 7.1 | |
| ZSV | Study unit profiles | 461 | 5.9 | 56.9 |
| ZZZ | Voids | 367 | 4.7 | |
| ZZQ | Miscellaneous | 318 | 4.1 | |
| ZSE | Study unit surfaces | 285 | 3.7 | |
| Z2F | Features in 2 by 2 m grid squares | 242 | 3.1 | |
| ZQQ | Miscellaneous | 163 | 2.1 | |
| Z9S | Bipod photographs of study units* | 139 | 1.8 | |
| ZSS | Study unit within study unit | 133 | 1.7 | |
| ZAJ | Reconstructed ceramics | 111 | 1.4 | |
| _(Z)_(Z)_(Z) | Voids (miskeypunched) | 108 | 1.4 | |
| ZZN | Environmental studies | 94 | 1.2 | 82.1 |
| SKF | Locus feature in study units | 93 | 1.2 | |
| SKE | Surface loci in study units | 90 | 1.1 | |
| ZDG | Collections (FLT, NFLT)** | 80 | 1.0 | |
| SEP | Surface PLs+ in study units | 74 | 1.0 | |
| ZZF | Features (no context) | 74 | 1.0 | |
| XZS | General site (excavated) | 72 | 0.9 | |
| XSF | Excavated site showing features | 68 | 0.9 | |
| ZLQ | Misc. maps of localities | 65 | 0.8 | |
| ZZL | Locality overviews | 62 | 0.8 | |
| ZZ2 | 2 by 2 m grid squares | 58 | 0.7 | |
| Z2V | Profiles of 2 by 2 m grid squares | 56 | 0.7 | |
| SFE | Feature surfaces in study units | 51 | 0.6 | |
| Z(Q)QQ | Miscellaneous | 50 | 0.6 | |
| ZSK | Study unit loci | 47 | 0.6 | |
| SEK | Surface loci in study units | 44 | 0.6 | |
| Z2D | FSs in 2 by 2 m grid squares | 41 | 0.5 | |
| S1D | FSs in 1 by 1 m grid squares | 40 | 0.5 | |
| ZSP | Study unit PLs | 39 | 0.5 | |
| SFJ | Special specimens in study unit features | 39 | 0.5 | |
| DPG | Lithic artifacts | 35 | 0.4 | |
| SES | Study units on surface in study units | 34 | 0.4 | |
| ZSJ | Special specimens in study units | 34 | 0.4 | |
| SFF | Two features in study units | 32 | 0.4 | |
| SFV | Feature profiles in study units | 29 | 0.4 | |
| ZS9 | Bipod photographs of study units* | 28 | 0.4 | |
| Z1F | Features in 1 by 1 m grid squares | 26 | 0.3 | |
| SVF | Features in study unit profiles | 25 | 0.3 | |

(There are 225 occurrences of distinct letter code triplets on file--the occurrences above account for 87.9 percent of the variation.)

*See bipod discussion in "Photometric Research and Development" section of this report.

**FLT - Flaked lithic tools.
NFLT - Nonflaked lithic tools.

+PLs - point locations.

photographs, the entire formula for subject designation could be collapsed into two blocks on the form.

## IMAGE ACQUISITION

For operational effectiveness, technical flexibility, and quality at reasonable expense, 35 mm roll film has been used almost exclusively by the D.A.P. Labor costs in 1979 for photographic acquisition have been estimated at approximately fifty cents per frame, including all cataloging, archiving, and administrative costs.

Acquisition consists of 12 activities:

1. Issue of materials and equipment
2. Receipt of exposed film
3. Processing of photomaterials
4. Proofing of individual sets of images
5. Review of computer coding
6. Evaluation of images
7. Input of photodocumentary codes
8. Verification of computer data
9. Chipping of usuable images from the catalog
10. Review for publicity purposes
11. Filing of chips for research purposes
12. Permanent storage of photomaterials in archive

### Issue of Materials and Equipment

Issue occurs in the following order: purchasing of film, paper, and chemicals; bulk loading and cataloging of film; assignment of equipment and materials; and changing film. Camera assignments are made according to the following criteria: type of research, subject matter, skill of photographer, and film line employed. Each camera

is provided with a dust-proof steel case and accessories such as markers, filters, film, and coding forms.

To eliminate common exposure problems, measures were instituted during 1979 for photographic quality control. Sensiometry, or quality control of photographic production, has become an integral part of the D.A.P. catalog in test proofs. The measures adopted resulted in the production of accurate and repeatable exposures specifically for archaeological subject matter through a modified zone technique (Adams [19], Eastman Kodak [20], White et al. [21]). Time, temperature, agitation, and concentrations and life of chemical solutions must be taken into consideration during film processing. Plotting of characteristic curves for film lines requires density measurements provided by the Mesa Color Laboratory in Cortez, Colorado, and shows film response by indicating the image resolving power as a function of film granularity and the optical characteristics of D.A.P. lenses. The assignment of films and cameras is made according to this detailed information.

Film lines are scientifically controlled. Most film lines are in negative form. Reversal films or "slides" require approximately half-stop accuracy (Eastman Kodak [22]), while general-purpose negative films can tolerate 10 to 15 stops overexposure for a total latitude of as much as 17 stops (Eastman Kodak [23]). The exposure latitude of negative film, as compared to reversal film, is so great as to make it nearly impossible for an exposure not to "turn out." Film lines are listed in Table 4.2.

Table 4.2 Positive/Negative Film Lines

| | Emulsion | Process | Color Code | Application |
|---|---|---|---|---|
| **Film Lines For Field** | | | | |
| Panchromatic (black-and-white) | Kodak Plus X Pan 2147 | Microdol-X(1:3) | blue | general purpose |
| | Kodak Recording 2475 | DK-50 | gray | low light |
| | Kodak High Contrast Copy 5069 | H & W Control 4.5 | orange | high resolution |
| | Kodak High Speed Infrared 4143 | D-76 | black | multispectral |
| Multichrome (color) | Kodak Vericolor II Professional S 5025 | C-41 | yellow | general purpose |
| | Kodak Kodacolor II | C-41 | yellow | general purpose |
| | Kodak Kodacolor 400 | C-41 | brown | low light |
| | Kodak Vericolor Slide 5072 | C-41 | red | saturation |
| **Film Lines For Laboratory** | | | | |
| Panchromatic (black-and-white) | H & W VTE Ultra | H & W Control 4.5 | orange | continuous tone copy |
| Monocromatic (black-and-white) | Kodak Kodalith Ortho 6556, Type 3 | Kodalith | purple | line copy drawings density slicing edge enhancement |
| | Eastman Fine Grain Release Positive 5302 | Ektaflo Type 1 | white | chip printing |
| Multichrome (color) | Kodak Vericolor Slide 5072 | C-41 | red | chip printing |
| | Kodak Vericolor Internegative 6011 | C-41 | green | copy and specimens |

## Receipt of Film

Exposed film is treated as part of the D.A.P. artifact collections and defined as a special specimen when received in the laboratory. Rolls are placed in labeled paper bags and forms are completed or verified. A copy of each paper bag is placed immediately in the permanent project records with the date of receipt.

## Film Processing

Development of film is done according to standarized processing instructions for each film line. Tolerances are 1 degree/1 second/ 1 millimeter, and three rolls are processed at a time for efficiency. Steps required for processing include the following:

1. Preparation of chemical solutions
2. Loading of film onto reels
3. Development, drying, cutting into six strips of six exposures with reference to the photographic record form
4. Numbering negatives in ink
5. Entering negatives in sleeves for further work

## Proofing

The contact printing, or proofing, of negatives on silver print paper permits the standardization of phototechnical and archival information. The proof creates a uniform, raw positive rendition of all images. Phototechnical standardization is possible because problems with exposure and development show up immediately and permanently. Proofs, therefore, present immediate feedback to photographers

and act as a permanent reference to technicians for the chipping or printing of negatives.

Archival standardization is achieved by cutting negatives into six strips of six exposures which correspond to the camera film counter numbers recorded on the Photographic Record Form. For example, the first strip contains exposures 01 through 06, the second strip holds exposures 07 through 12, and so forth. The glass platten of the contact printer is permanently numbered to correspond to this scheme, making the proof unchangeable. Therefore, it is the prime reference for the proper numbering of each image. One copy of the proof is placed immediately in the reference catalog; the second is for succeeding steps and is submitted to the archive with the negative. Proofing consists of setting up laboratory equipment, printing, processing, labeling of proofs with roll number, punching holes for binders, and filing.

## Review of Computer Coding

During 1979, the laboratory supervisor reviewed photographic forms for consistency with other forms as part of processing and proofing. This computer data check precedes proofing. When proofs have been prepared, a dry copy is transferred to the laboratory supervisor who forwards it and its forms to researchers as a working reference for the field notebook records. After original forms have been turned over to the photographic section for evaluation, the review is considered complete and logged.

## Evaluation of Photographs

Evaluation is comparable to preliminary artifact analysis. Each image is considered on the basis of both documentary need and communicative potential. A value is placed on each image reflecting the significance of the observation, the technical quality of the negative, and communicative effectiveness. Values are ranked from 0-9. Images with an assigned value greater than four are marked for quantity and type of finishing, as color or monochrome film chips, and occasionally as paper enlargements. Commonly, three chips are produced for value 9 images, two for value 8 images, and only one for for value 5, 6, and 7 images. Since evaluation completes the last block for the form, a photocopy of the form is now placed in the catalog and original forms are filed for data-processing input. Evaluation is the preliminary step toward photographic integration in the form of study packages.

## Input of Codes

All computer input of photodocumentary information has been accomplished through government keypunch time-sharing. Original forms are packaged in roll sequence, a copy of the transfer note listing photographic forms is placed in the Acquisition Log, and the date of this transfer note is entered in the log for each roll. After keypunching, original forms are mailed back to the D.A.P.

## Verification of Computer Data

Before it is merged into the general photographic computer file, each new mass of data is sorted by roll and exposure sequence. The

new data are dispatched for printout. When placed in the catalog, these are single-page listings of all photodocumentation for the facing proof. Lines of data are split into groups corresponding to each strip of negatives. These pages contain all of the current data for each photograph as it appears in the proof.

## Chipping

Chipping is modeled on the operations of the Earth Resources Observations Systems Data Center in Sioux Falls, South Dakota. The production of positive film chips borrows materials and techniques from motion-picture postproduction technology to reduce finishing material and labor costs to less than 10 percent of that needed to make silver print enlargements. During 1979, 5,269 photographs, or 55 percent of all photographs, were chipped for various applications. The majority of these photographs were finished on Eastman Fine Grain Release Positive Film 5302, through a high-quality optical printer. The printer has the capability for enlarging and reducing negatives, color balancing, contrast control, and automated exposure control. Any negative emulsion in any format may be selected, and an infinite number of copies may be produced with original copy quality. Film chips are used with 2 in square protective sleeves for topical package dissemination and without sleeves for mechanicals for plate production.

## Government Review

Before topical packages were compiled in 1979, the D.A.P. provided interim copies of all valued photographs to the contracting

agency for review for publicity purposes. Proofs and coding forms for 247 rolls of film were sent to the Bureau of Reclamation (BOR) office in Cortez, Colorado. Of the approximately 5,000 chips accompanying these transmittals, the agency chose 73 (or 1.5 percent) for duplication. The assistance of the government in the development of the topical package as a means for integration has been invaluable. Now that procedures for acquisition have been formalized, any interested party has full access to a complete graphic resource on project facilities to review acquisition on a day-to-day basis. Topical package formation has automated the selection of photographs through addressing each user's specific needs; searching the entire file eliminates the need for time-consuming browsing.

## Filing

Immediately after chipping is complete for any unit of work, photographs are placed in numerical sequence in cabinets. Each cabinet contains nearly 50 drawers providing access to any chip in the same manner as the card catalog found in libraries. Every drawer corresponds to a contact proof and may contain any type or number of selected chips for the proof. By this means, a first-generation quality transparency can be available to any party for immediate inspection or use within 10 seconds of determining the number of the desired image.

Any chip may at any time be removed permanently for any application. Periodically, the chip file may be replenished with original-quality replacement materials to maintain this accessibility. The main purpose of the chip file is to insure that chips can be

recycled. When refiled after one application, the chip may be used over and over again. The chip file is arranged in proof and exposure sequence to correspond with the entire collection of negatives as represented in the catalog of proofs and to facilitate the technical task of replenishment. Chips appear in a topical sequence in topical packages. This system avoids the expensive alternative of making duplicates without regard to likelihood of eventual use.

## Storage and Maintenance

According to the Supplement to the Memorandum of Understanding (U.S. Government [24]), the Bureau of Land Management (BLM) has responsibility for the archiving of all D.A.P. collections. The laboratory supervisor has responsibility for the transfer of all materials to the agency. The BLM has been helpful in identifying the long-term opportunities for data application. Through mutual efforts toward making the graphic resource accessible for the long-term, short-term retrieval has been implemented, enabling researchers to use retrieval mechanisms with an acquisition-integration turn-around-time of three months. Researchers have been able to verify the accuracy of the photographic collection during study of materials for immediate application in periodic reports. Thus, the collection has been tested for usefulness, and flaws in design have been rectified.

### Storage of Negatives

Although negatives are useless for direct viewing of a photograph they provide the highest-quality positives because they record at least twice as much information as reversal film (Eastman

Kodak [25]). Although D.A.P. negatives vary in size, the standard size for a negative is a six-exposure strip of 35 mm format film.

Permanency of all negatives should be insured by freezing in acid-free archival envelopes (Eastman Kodak [26]). Although frost-free freezing will preserve color dyes for 1,000 years, black-and-white materials are favored (color recording is best controlled during exposure when photographers use color filters with panchromatic black-and-white film).

Negatives are stored in a fireproof vault at the D.A.P. laboratory. Access to negatives is limited to authorized personnel, and all negatives are tracked by the archivist. Through arrangements with local color laboratories, all negatives are hand-carried from the time of purchase by trained workers. Storage-space estimates for negatives are 8 $ft^3$ per 10,000 exposures. Negatives are referenced by an archival set of proofs and forms which duplicate working materials and assist in archival reference and retrieval.

The 1978 method of cataloging negatives included use of the manufacturer's edge number. This method was continued in 1979 but proved to be unworkable. The primary difficulty was with negative retrieval. With no additional expenditure of effort, the negative-numbering procedure has been improved by writing the unique image number on the negative edge. Image numbers designate both roll and exposure numbers and will make identification, filing, retrieval, and use of negatives for printing easy and direct.

Cataloging

Much like an encyclopedia, the D.A.P. Image Catalog is a permanent, continuously assembled, and comprehensive record of all

film purchased by the D.A.P. for photographic documentation. During 1979, 14 volumes were added to the two 1978 volumes.

Each volume contains 25 proofs representing negatives in storage; these proofs are organized according to roll and exposure number. Since all film issued will ultimately be placed in the catalog, the catalog provides total control of rolls of film during high-volume acquisition periods.

Each proof is accompanied by copies of the field record forms and verification of computer input. Both of these refer directly to the facing proof and insure the safety of documentation should computer data be accidentally purged. Also included with the proof is a copy of the receiving label.

Each volume begins with the appropriate 25-roll page of the D.A.P. Photographic Acquisition Log. This log is a one-page summary of the information to found at the top of each Photographic Record Form in the volume. This table of contents is provided for permanent reference. The entire catalog will have a topical index volume which binds together the study package index computer printouts.

## IMAGE INTEGRATION

The D.A.P. has formalized a means for circulating photographic images for use. This procedure functions much like a library's check-out system for books. The vehicle for image integration is the topical package. The scope of work of the Photography Section goes beyond collection, categorization, storage, and provision of photographs, to dissemination and tracking of both photographs and documentation, thus providing direct assistance to researchers using photographs. This approach makes certain that the common graphic resource is thoroughly searched for all graphic information related to a topic of interest. The chips which make this possible are the highest quality, least expensive, most flexible, and most widely applicable medium known to exist for research use of photography.

The process of integrating image information consists of 10 separate and essential activities:

1. Need definition
2. Draft printout of computer index
3. Issue of topical package
4. Review of draft coding and selections
5. Supplementation of package with additional images
6. Index printout for final package
7. Mechanical production for camera-ready layout
8. Negative production
9. Plate production of final positive printing medium
10. Compilation of topical package for permanent reference

## Need Definition

Integration of a topic begins with an interview with the photographic Task Specialist. Needs should be realistic, meaningful, productive, and consistent with other program needs.

The study package is a research tool used as an aid in descriptive writing; as an explanatory record for consultation with other researchers during interpretive work; as permanent documentation for independent verification of verbal, measured, and drawn information sets; and as an illustration of complex or indistinct subjects.

Topical packages are the vehicle for planning for anticipated needs and organizing images into a coherent end-product which becomes a permanent, highly accessible, and meaningful reference for future review and research.

Needs for photographs are defined by selecting attributes of images in the Image Catalog. Generally, the more attributes chosen to define a topic, the smaller the selection of graphic materials will be.

## Draft Printout

The draft index is a working copy of all photographs for a given topic. Choices for sorting and sequencing the data lines in this list are automated. Before printout of the selected photographs, the entire file is sorted so that the list will represent all photographs in a sequence of groups from general to specific. This sequence imitates a successson of events in the actual research process. Standard output of site-specific topics for the 1979 study packages

was completely automated, requiring the selection of only one variable, site number. Because subject matter of photographs was coded in the field, photographs could be automatically sorted by image content for any number of purposes. As a consequence, each study package is arranged in the same manner as the next.

## Issue of Topical Package

The draft index and photographic materials are packaged together before issue to users. The packaging guarantees that any necessary error correction can be recorded directly on the draft index and returned for review and data editing.

The draft index is bound in portfolio and is first used as a packing list. Each line of the printout with a value greater than 4 is numbered in sequence. This package sequence number is then written on the cardboard chip jacket next to the image number.

Although it is possible for packages to be assembled without viewing a single picture, photographs of suspected relevance to the topic are usually encountered during the work of packaging. All additional photographs recommended for inclusion in the package are listed at the end of the index. Nonetheless, all photographs of a value greater than 4 on the draft index are prepared for package issue to insure thoroughness of selection.

At this stage of integration, photographs are fully prepared for review. The package is inspected and any comments or recommendations for use are written on the draft index. A letter of transmittal accompanies each package to provide formal instructions and a statement of liabilities for improper use of the package.

## Review of Coding

Reviewing photographic materials in a study package is similar to intensive analysis of artifacts. At this stage, selected images of significant value are reviewed when arranged in a comprehensible order. In one operation, users have the opportunity to study photographs and check the relationship of the lines of computer data with the photograph. Any errors in numbering, keypunching, mixing images, or other possible mistakes in integration will appear at this stage. Topical restructuring for error-checking works much like double-entry bookkeeping in finding problems.

It is also at this juncture that the researcher is able to attach additional observations to the scenes described in the images. All corrections and additions are made in red pencil on the draft index. Upon return to the photographic section, all changes are reviewed and translated into edit statements for computer-file corrections upon approval.

## Supplementation

After review of the draft index and first-issue photographs, researchers may see the need for additional pictures. Since there is little opportunity to acquire field photographs after site closure, most supplemental camera work is with laboratory collections. Laboratory photography requires special techniques (Sanger [27]). During the 1979 winter season, over 2,000 artifact photographs were taken, including all whole projectile points and all reconstructed ceramic vessels in the D.A.P. inventory. The platform for all artifact photography was an artifact stand developed by the author at

the Quaternary Studies Center of the Illinois State Museum. When needed, an ammonium chloride surface treatment was used (see Knudson [28], Weide and Webster [29]). All artifacts were photographed individually on a dark field in one or another of a geometric progression of scales. Consequently, any arrangement of specimens may be chosen for publication or presentation, and chips of these individual specimens may become part of the study packages. Supplementation may also involve color-saturation enhancement, edge enhancement, color-additive coding, density slicing, contrast enhancement, or any number of photo-optical-chemical manipulative techniques.

## Index Printout

Upon completion of file editing and supplemental photography, a final index is printed out from the computer using refined instructions from the draft-index selection activity. The finished index is added to the package with supplemental photography for final review by the users. If fully correct, this index becomes a permanent reference section of the photographic catalog. During prior review stages all photographs are reevaluated for need, and as a result, all useful pictures are listed as greater than 4 in value at this stage. Thus, for economy and convenience, the final version of the index is an abridgment. The alternative to the finished index is a filed copy of the preliminary draft. Future refinement of the integration methods may well lead to the use of file linkages and value labels to write an English-language paragraph of information for each valued photograph.

## Mechanical Production

The mechanical is a camera-ready layout in which all images appear exactly as they will appear in the final form. As a consequence, the greatest expenditure of materials and effort is made at this stage of integration. Mechanicals may be paste-ups of silverprints for camera copy or a sequence of fully finished slides prepared for final audiovisual program evaluation. Each mechanical is presented for editorial and/or administrative review. For future reference, all mechanicals are stored in paper envelopes bound in the portfolio of the study package.

## Negative Production

Mechanicals are not suitable for mass production. They are often pasted together and highly fragile. Therefore, the mechanical must be copied onto negative film and transferred to a durable printing medium. The production of a negative also makes it possible to preserve the configuration of the mechanical for future uses. Since plates made up for publication of preliminary reports may be reused in other applications, the negatives are entered into the catalog and become a part of the graphic resource.

## Plate Production

The plate is the technical medium for mass production. For lithography, a plate is made of a durable material, such as metal, and ink is transferred repeatedly from the plate to paper pages for high-volume printing of book pages. For dry-copier mass production,

the plate is a durable photoprint which can withstand repeated copying and may be replaced from the negative if worn out or damaged.

## Topical Index

The topical index provides a permanent reference file for photographs according to topics developed by the program. This file of materials is accessed by the topical index volume of the photographic catalog and consists of trays of fully integrated chips in the sequence listed in the topical index. These trays may be inserted in a slide projector for research, management, or educational purposes. This final product of image integration is amenable to microfiche publishing. The finished product will make data applications for public education quite feasible, particularly for the proposed Heritage Center.

## PHOTOMETRIC RESEARCH AND DEVELOPMENT

Just as hand-held photography best derives its significance from explicit conceptualization as an instrumental mimicry of the psychophysiological perception of the human eyes and brain (Walls [30]), "locked-off" or remote-sensing methods can be understood most clearly in terms of human perception. Engineering drawings and specifications for the instruments used are to be found in disclosures published by, or under consideration by, the United States Patent Office.

The extended recording power which encourages the interpretation of photographs in the same manner as primary experience also enables the use of photography as a remote sensor. Cameras may be sent to places a human does not normally go and record things a human does not normally see. This capability, nonetheless, requires analysis of the photograph itself as first-hand experience. Photographed information requires special kinds of verification and translation (Estes and Simonett [31]). However, with proper technical controls, photography may be used as a mapping tool and as an investigative probe. If cost-effective, such use is as much needed in archaeology as in any endeavor.

The overriding purpose for any research and development of photographic technology, methodology, and interpretive techniques must depend on its function as a tool for the acquisition, integration, and communication of information. Consequently, the pursuit of any potential uses of photography must primarily address the prevailing

needs of information-management characteristic of a program such as the D.A.P. Doszkos et al. [32] have stated:

> The increasing amount of scientific and technical research will create a volume of information so large as to frustrate the very purpose for which it was created. A larger percentage of the resource now expended on scientific and technical information must clearly be invested in research on how to handle the mass of information being generated.

All photographic research and development at the D.A.P. is conducted to organize the large volume of information so as to avoid the above-stated danger.

All effort has been made to fit photometric research into the documentary operations of the working program. As expected, applications have been limited and largely experimental. The results of these experiments, rather than being directly relevant to the problem domains of the Research Design (Kane et al. [33]), provide indirect operational assistance in all areas of investigation.

## Bipod Operations

The bipod is a 10-m-high, A-shaped camera platform (Whittlesey [34], [35]). A variant which predates the bipod is Nylen's Turret (Nylen [36]). During the 1979 season, 226 bipod negatives of 15 sites were acquired with two instruments.

The need for a high camera platform is intrinsic to the excavation of large areas. Platforms for oblique-angle photography at sites were apple-picking ladders. Safety precautions precluded the use of manned platforms over 6 m high. Therefore, the need to provide overviews of sites required unmanned platforms which could be used to photograph large areas in piecemeal fashion and permit piecing together of photograph segments. (Image detail is gained from proximity

to subjects. This factor is the basis of the multistage concept in remote sensing.) Effective photosegmentation requires a stable camera platform that can be placed in precisely determinable sequences of stations (camera positions) in relationship to the subject. A safe and inexpensive means of achieving an overview is with a camera tower such as the bipod.

Stereoscopic Modeling

The selection of camera stations allowed three-dimensional viewing in normal or hyper-intensity. To maximize this potential for viewing, nearly all coverage was effected with color negative film.

Metric coverage. Enlargement of bipod negatives into black-and-white prints allowed mosaic formation (after rectification of camera tilt). Photomosaics thus compiled at a common scale of 1 m per in provided an estimated cartographic accuracy of 2 to 3 percent for critical areas (see Ebert et al. [37]). Only four site areas were worthy of priority for mosaic formation. Although not yet tested by the D.A.P., these negatives have the potential for enlargement to 9-in square diapositives for analytical stereo-plotting of close-interval contour maps (Pouls et al. [38]). Preparation of map-accurate orthophotomosaics is possible at greater expense using standard photogrammetric methods.

Multispectral coverage. Just as photography mimics and interacts with the human eye and brain to provide information about three-dimensional space with binocular vision, multispectral coverage gives the viewer color information. Color photography in its simplest form uses three-color dye in imitation of the visual pigments in the retina of the human eye. In an application which uses photography as an

investigatory probe, chemical dyes can be chosen to synthetically provide visual pigments. The use of infrared and ultraviolet sensitive films allows recording of information which the human eye cannot ordinarily perceive.

Site 5MT2853, a tested site, was completely documented using multispectral bipod coverage in six bands of the electromagnetic spectrum. As of this date, no assessment of the methodology or of its usefulness has been undertaken because of priorities for research integration.

Saturation coverage. Multispectral coverage has a high liability for interpretation. Obviously, darkroom enhancement is much easier to accomplish than recording subjects in the field with three separate cameras using different film and filter combinations. Site 5MT2848, another tested site, was photographed with a single tripack high-contrast color-saturation film. The experiment was designed both to document a tested site and to control for the invisible, spectral coverage used at Site 5MT2853. Although the results of the saturation experiments are encouraging, color-balancing work must be further refined as laboratory research priorities allow.

The 1979 bipod operations have yet to be fully evaluated. The major drawback has come from subordination of completion to much more fundamental research and development of the D.A.P. image-integration system.

Summary

During 1979, bipod operations were most successful in low-accuracy black-and-white phase photogrammetry of Anasazi roomblocks. Further development of this technique will allow higher accuracy and

greater aereal coverage through use of more flexible and efficient instruments. The bipod should be adapted to include the capabilities of a turret to avoid problems of uneven terrain.

## Component Mapper Operations

The component mapper (photometric sensing module) is a small-scale sensor platform developed during investigations of sites at the Truman Reservoir, Missouri, between 1976 and 1978 (Kay [39]). This approach to photographic mapping was first implemented during expeditions of the Underwater Archaeology Section of the Museum of the University of Pennsylvania in the early 1960's (Rosencrantz [40]). During the 1979 D.A.P. field season, 600 mapper exposures were attempted with one instrument on five sites.

### Modular Coverage

The component mapper is a lightweight, portable instrument. The area in which an excavator works is frequently a 2 by 2 m grid square. The component mapper is designed to fit into this area of observation and control photography to the extent that photographs may be joined together in checkerboard fashion to present freshly excavated cross sections of an entire site. The component mapper provides metric controls to replace manual measurement and drawing with an instantaneous photographic record.

Estimates of 1979 floor excavation progress at Site 5MT2854 were 1 $m^2$ per person per day (J. Studer, personal communication). At this same site, a dog-burial feature (Feature 16) was recorded with the mapper in five narrow bands of the electromagnetic spectrum (from 300-900 nm, effectively doubling the normal human color perception),

in hyper-stereo, with less than 5 percent mapping error. This coverage was completed in 30 minutes. The four photographic tiles were matched edge-to-edge (Figure 4.5). The entire site, had it been similarly recorded, could have been rendered in a series of both horizontal and vertical, multispectral, color, scaled photomaps.

A major advantage to modular recording with the instrument is that objects may be left in situ and uniformly photographed. The various remote platforms require that objects on extended surfaces be removed and marked with tags. A second advantage of the mapper is the ease with which it may be operated. Requiring only one minimally trained operator, full recording may be achieved in minutes of field time. The third major advantage to the use of the mapper is the elimination of the need for rectification. This savings in production costs more than compensates for the greater number of images required for extended coverage.

Stereoscopic Modeling

The first phase of development of the D.A.P. component mapping operation included an experiment in stereo-modeling of the surfaces being photographed. In prior case histories using the mapper, it was felt that the use of stereo-modeling would help in understanding the meaning of false-color renditions of invisible spectra. The testing of stereo-modeling with the instrument could provide data for testing the practicality of in situ bio-stereometrics (Karara [41]). In addition, stereo-modeling could be used to test the feasibility of creating stereo-views of extended, edge-matched surfaces.

Multispectral coverage. While the component mapper was specifically designed for multispectral coverage, the provisions of a single

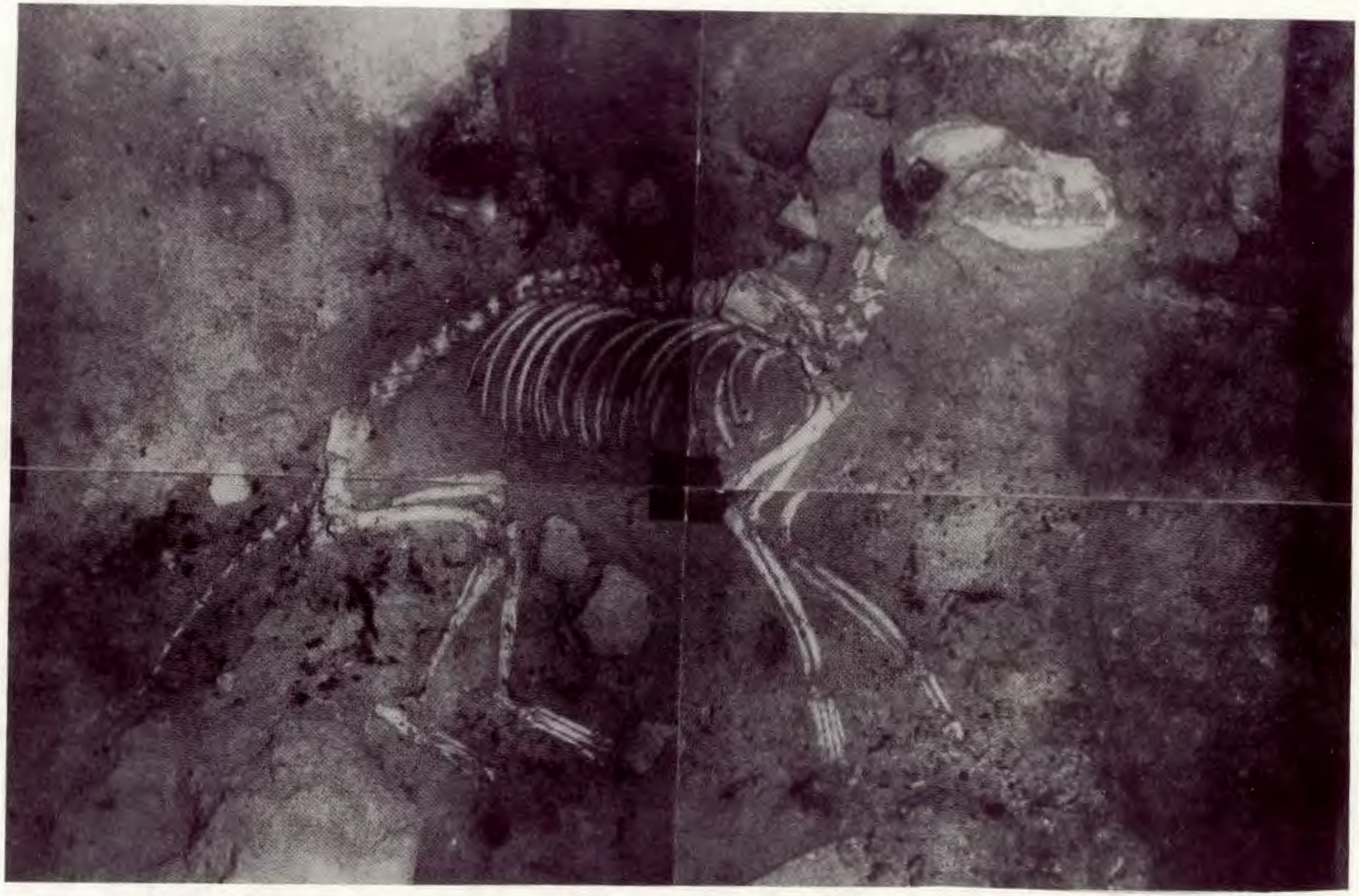

Figure 4.5 Dog burial (Feature 16), Site 5MT2854. The feature was recorded stereoscopically with multispectral aperture spanning the 300-900nm range (twice visible color). Infared bands seen here (D.A.P. 077833).

electronic flash power source required the use of ASA 4000 film for ultraviolet negatives. This resulted in extremely grainy ultraviolet photographs suspected of having infrared leakage. The use of infrared bands, however, was highly sensitive in the recording of bone. For a discussion of multispectral macroscopic sensing of archaeological specimens, see Gibson [42].

Since three separate rolls of film were required for each multispectral record, the cataloging and retrieval of negatives was complicated. Further development of the method should, therefore, utilize a single emulsion and separate band with filtration. This modification requires the use of infrared cut-off filters.

In Situ Chemical Testing of Soils

Photographing phosphorous content and distribution of soil matrices was suggested as a use for the mapper. Although an electronic flash was ideally suited for this purpose (Blaker [43:48]), the phosphorene dyes used in biomedical photography were determined to be too expensive for implementation at this time.

Digital Analysis

It is reasonable to expect that all mapper images will be suitable for computerized image analysis using standardized remote-sensing analytical instrumentation. The BOR remote-sensing laboratory in Denver has been consulted, and a pilot program appears to be feasible. The goal of computer analysis would be to identify spectral signatures (or super-fine color subtleties) of substances in context. Iso-classification of well-controlled photographs acquired with the component mapper would be the first step toward an eventual capability for automated recognition and analysis of archaeological site

contents. With capability for overlay of thematic information, the approach could greatly increase the efficiency of archaeological site mitigation.

Evaluation

The component mapper operations at the D.A.P. revealed the following considerations during 1979:

1. The use of three excellent, but 17-year-old, cameras caused image attrition estimated at 50 percent.
2. The need for three separate emulsions overwhelmed the cataloging system of the photographic section.
3. The deficiency in artifical illuminant power produced ultraviolet negatives of marginal utility.
4. While the intensive documentation of Site 5MT4644 called for coverage of 50 $cm^2$ units, the version of the mapper employed during 1979 had no provision for adjustable legs and would not fit into place due to numerous obstructions. For this reason, Pitstructure 1 at Site 5MT4644 was sporadically "sampled" with the mapper. Although the floor of the structure was photographed with over 100 hand-held photographs, cropping, rectification, color and exposure correction, and edge-matching are expected to be so expensive as to preclude a mosaic of the floor.

Initial component mapper operations succeeded in producing selected documentation of subjects encountered in working excavations, and indicated which flaws prevented the cost-effective implementation of automated and replicable instrumental perception, recording, and analytical assistance for modern cultural resource management.

## GLOSSARY OF TECHNICAL TERMS

| | |
|---|---|
| chip | a 35 mm transparency, created from a negative and mounted in a 2 by 2 in cardboard sleeve |
| diapositive | a transparency formed from either negative or reversal film |
| emulsion | a mixture of gelatin and light-sensitive silver halides which is coated over a base to form films and printing papers |
| exposure | the product of the intensity of light and the duration the light is allowed to act on the film |
| granularity | describes the extent to which the silver halide grains in the emulsion have clumped together |
| half-tone | a pattern of dots, formed by screening an image, which gives the appearance of being continuous tone |
| image | the representation of a real object formed on the photograph from exposure to light |
| negative | a developed photographic image with the tones reversed: subject highlights are dark and shadows appear light |
| photograph | 1. the act of allowing light to strike a light-sensitive film<br>2. the most generalized term for the resulting product of exposing film to light |
| print | an image fomed on paper coated with a light-sensitive emulsion |
| proof | an 8-1/2 by 11 in contact print of all images contained on one roll of film |
| remote sensing | technique which involves photographing a subject from an overhead perspective; includes aerial photography and photography from unmanned platforms |
| resolution | the quality of an image judged by the ability to determine fine detail |
| resolving power | the ability of the film to determine fine detail |
| slide | a transparency formed from reversal film and mounted in a 2 by 2 in cardboard sleeve |

# APPENDIX A

## CODING AND DICTIONARY FOR PHOTOGRAPHIC RECORD FORM

## CODING AND DICTIONARY FOR PHOTOGRAPHIC RECORD FORM

The top of each form is filled out by the photographic laboratory before and after issue and receipt of film. The same information is recorded in the photographic acquistion log to track and account for photographs.

YEAR: Two digits; year in which image is formed from subject.

IMAGE TYPE: Two digits; 01-19 are black-on-white films, 20-39 are color.

Film Speed: Noncoded entry. ASA setting for the camera meter.

PROOF NUMBER: Every frame of each roll of film purchased for use in the program is destined to a place in the permanent catalog. Proof number is the first four digits of image number. Proof number is the same as roll number until film is cut. Do not make a "roll I.D." exposure - all film rolls should be labeled. Be sure that the proof number is written on the outside of exposed rolls of 120 film.

FORMAT: All proofs are 80 $in^2$ of film. Format (size of frame) determines sharpness of photographs and number of exposures.

| | | |
|---|---|---|
| 1 digit | 0 | Indeterminate format |
| | 1 | 8 x 10 in sheet film (1 exposure) |
| | 2-3 | Unassigned |
| | 4 | 4 x 5 in format (4 exposures per proof) |
| | 5 | 120 format (12 exposures) |
| | 6 | 35 mm format (36 exposure) |
| | 7-8 | Unassigned |
| | 9 | Other format |

CAMERA NUMBER: Two digits, number appearing on label of camera.

LABORATORY USE CODES: Leave blank.

THEME: Field of multidisciplinary investigation. Research specialization of camera worker. This code defines both academic discipline and computer language for the rest of each computer line.

| | | |
|---|---|---|
| 1 digit | 0 | Inapplicable |
| | 1 | Prehistoric excavation |
| | 2 | Historic excavation |
| | 3 | Prehistoric inventory survey |
| | 4 | Historic inventory survey |
| | 5 | Unassigned |
| | 6 | Botany |
| | 7 | Zoology |
| | 8 | Geology |
| | 9 | Other |

## CODING AND DICTIONARY FOR PHOTOGRAPHIC RECORD FORM
## THEME I, PREHISTORIC EXCAVATION

THEME: All lines of coding must have code "1" in the theme space to tie codes on the Photographic Record Form with the other form codings for prehistoric excavation.

COUNTY: This code determines in one block the MT, DL, etc. site codes.

| | | |
|---|---|---|
| 1 digit | 0 | County indeterminite |
| | 1 | Montezuma County, Colorado |
| | 2 | Dolores County, Colorado |
| | 3-8 | Unassigned |
| | 9 | Other county (write in full site designation) |

SITE: Four-digit code for site associated with photograph.

AREA: From field provenience designation form key; 0 = general site.

SUBAREA: From field provenience designation form key; 0 = general area.

IMAGE CONTENT "CODES": For prehistoric excavation, the following letter "code" triplets have been standardized. These letters are placed in Codes 1, 2 and 3 columns on the form.

| | |
|---|---|
| ZZX | General site views |
| ZZS | Study unit subjects |
| SEF | Surface features in study units |
| ZSF | Study unit features |
| ZSV | Study unit profiles |
| ZSE | Study unit surfaces |
| Z2F | Features in 2 x 2 m grid squares |
| Z9S | Bipod photographs of study units |
| ZSS | Study unit within study unit (pithouse and antechamber) |
| SKF | Features within loci within study units |
| SKE | Surface loci within study units |
| SEP | Point locations on surfaces within study units |
| ZZL | Locality overviews |
| ZZ2 | 2 x 2 m grid squares |
| Z2V | Profiles of 2 x 2 m grid squares |
| ZSK | Loci within study units |
| SED | Loci on surfaces within study units |
| Z2D | FSs within 2 x 2 m grid squares |
| S1D | FSs within 1 x 1 m grid squares |
| ZSP | PLs within study units |
| SFJ | Special specimens within features in study units |
| ZSJ | Special specimens within study units |
| SFV | Profiles of features within study units |
| Z1F | Features in 1 x 1 m grid squares |

The letter codes for prehistoric excavation have the following definitions:

| | | | |
|---|---|---|---|
| A | Activity area | 1 | 1 x 1 m |
| D | FS number | 2 | 2 x 2 m |
| E | Surface | 4 | 4 x 4 m |
| F | Feature | 8 | 8 x 8 m |
| H | Household cluster | 9 | Bipod coordinates |
| J | Special specimen | | |
| K | Locus | | |
| L | Locality | | |
| P | Point location | | |
| R | Fill/assemblage | | |
| S | Study unit | | |
| U | Use area | | |
| V | Vertical surface | | |
| X | General site | | |
| Z | Not applicable | | |

| CODE | TYPE | NUMBER |
|---|---|---|
| A | 01-99 coding from Activities Recording Form guidelines | 0001-9999 (from consecutive site series) |
| D | | 000001-99999 (from consecutive site series) |
| E | 01-99 from Surface Description Form guidelines) | 0001-9999 (from consecutive study unit series) |
| F | 01-99 (from Feature Form guidelines) | 0001-9999 (from consecutive site series) |
| H | 01 | 0001-9999 (from consecutive project series) |
| J | 01-99 (from FS Form guidelines Special Specimen Type) | 0001-9999 (from consecutive site-sample series) |
| K | 01-99 (Datum of Study Unit subgrid | 0011-9990 (from consecutive study unit series); in first three blocks of the four "number" blocks, the last digit of the "number" for the "K" code has the following significance: |

| | | |
|---|---|---|
| | | 0 Whole locus<br>1 Transect A<br>2 Transect B<br>3 Transect C<br>4 Transect D<br>5 North half<br>6 East half<br>7 South half<br>8 West half<br>9 Other part of locus |
| L | 01-99<br>(from FS Form guidelines) | 0001-0099 (from FS Form guidelines Locality) |
| P | 01-99 (from FS Form guidelines - Material Identification Class) | 0001-9999<br>(from consecutive surface series)<br>series) |
| R | 01-99 (from FS Form guidelines - Fill Assemblage Type) | 0100-9900<br>Fill/Assemblage position<br>(from FS form guidelines) |
| S | 01-99<br>(from FS Form guidelines) | 0001-9999<br>(from consecutive site series) |
| U | 01-99<br>(from Use Area Form guidelines) | 0001-9999<br>(from consecutive site series) |
| V | 00 Not applicable<br>01-09 Unassigned<br>10 Structure wall A<br>11 Structure wall B<br>12 Structure wall C<br>13 Structure wall D<br>14-18 Unassigned<br>19 Structure wall: indeterminate<br>21 Structure corner 1<br>22 Structure corner 2<br>23 Structure corner 3<br>24 Structure corner 4<br><br>(The above "V" codes come from the Architecture Form guidelines - structure description.)<br><br>25-39 Unassigned<br>40 Stratigraphic profile: indeterminate<br>41 Stratigraphic profile: north wall<br>42 Stratigraphic profile: northeast wall | 0000-9999<br>(profile description number for 40-49 types) |

43 Stratigraphic profile:-
east wall
44 Stratigraphic profile:
southeast wall
45 Stratigraphic profile:
south wall
46 Stratigraphic profile:
southwest wall
47 Statigraphic profile:
west wall
48 Stratigraphic profile:
northwest wall
49-99 Unassigned

| | | |
|---|---|---|
| X | 00 | 0000 |
| Z | 00 | 0000 |
| | TYPE/NUMBER | |
| 1-8 | 000/000-999/999 | |
| | meters S/meters E | |

FRAMED: This code designates which of the three codes of image content fills the frame of the photograph. For example, a SEP coded photograph (point locations on surfaces within study units) may be a close up of a point location. If the point location fills the frame, Code 3 designates what subject fills the frame. However, a photograph which shows the same point location from afar to record its general location within the study unit and orientation to other subjects in the study unit will have the S code as the subject filling the frame and consequently Code 1 is the framed subject for that type of photograph.

| | | |
|---|---|---|
| 1 digit | 0 | Inapplicable |
| | 1 | Subject letter code in Context block fills the frame |
| | 2 | Subject letter code in Subcontext block fills the frame |
| | 3 | Subject letter code in Subject block fills the frame |

PHASE: (Condition) Photographs document a sequence of operations upon a particular subject. The condition code records what stage of investigation a subject was undergoing when photographed.

| | | |
|---|---|---|
| 1 digit | 0 | Indeterminate |
| | 1 | First appearance (unexcavated) |
| | 2 | Brushing (during and after vegetation clearing) |
| | 3 | Cleared of overburden |
| | 4 | Weekly progress |
| | 5 | Excavation strategy - cross sections, profiles |
| | 6 | Fully excavated subjects (aboriginal appearance) |
| | 7 | Natural aspects - without people |
| | 8 | Work techniques - people in picture |
| | 9 | Other condition |

IMAGE NUMBER: The exposure counter of each camera assigns the last two digits of the unique six-digit image number (proof number supplies the first four digits). After cocking the camera for the picture to be shot and coded, the image number is seen on the exposure counter and this number for the photograph will never change. Always code for the frame counter - not for the next available exposure number on the form (someone may not have coded preceeding photographs on the form). Only 36 images are allowed.

2 digits 00-36 Number on frame counter of camera immediately after exposure, but before recocking the camera.

VALUE: Each of the photographs is evaluated after processing and proofing. Leave the value block blank except to indicate particularly needed photographs with an "X".

1 digit
- 0 No image, wasted frame
- 1 Error in camera work (useless duplicate exposures)
- 2 Minimal research potential
- 3 Possible research potential
- 4 Laboratory or camera breakdown
- 5 Technical quality sufficient for special treatment
- 6 Sufficient communicative effect
- 7 Good communicative effect
- 8 Excellent communicative effect
- 9 Museum quality

DIRECTION: Compass direction camera is facing during exposure.

1 digit
- 0 Indeterminate
- 1 North
- 2 Northeast
- 3 East
- 4 Southeast
- 5 South
- 6 Southwest
- 7 West
- 8 Northwest
- 9 Looking straight down (vertical photograph)

STATION: Camera positions used repeatedly for convenience to show subjects to good advantage. Weekly progress photographs are always taken from predetermined and permanent camera positions. All camera stations are to be marked with a labeled wooden stake at the site and are to be designated by plotting with a camera station symbol on the site map.

1 digit 0-9 Sequential site camera stations per area (i.e., nine stations are available for the overall site; nine stations are available for each individual area).

BAND: Cameras loaded with black-and-white film can use colored filters to drastically improve photographic quality. Color film must not be used unless multiple colors are present in the subject.

| | | |
|---|---|---|
| 1 digit | 0 | No filter |
| | 1 | Skylight protective/ultraviolet blocking filter |
| | 2-3 | Unassigned |
| | 4 | Blue filter |
| | 5 | Green filter |
| | 6 | Red filter |
| | 7 | Near infrared filter |
| | 8 | Far infrared filter |
| | 9 | Other filter |

MONTH: Two digits; month in which image is formed (01-12).

DAY: Two digits; day in which image is formed (01-31).

RECORDER: Initials of researcher using camera to make photograph.

NOTES ON CODING LABORATORY PHOTOS

THEME: In order to link with the codes for prehistoric excavation on other forms and in other files, all laboratory photography of prehistoric artifacts must be coded Theme 1.

AREA AND SUBAREA: May be coded 00 (inapplicable).

IMAGE CONTENT CODES: Have been standardized as DPG.

CONDITION: Has been standardized as formal exposure if artifacts are fully prepared.

DIRECTION:
0 Indeterminate (ventral surface)
1 North (full frontal view)
3 East (view of right side)
5 South (view of back)
7 West (view of left side)
9 Looking down (view of top or dorsal surface)

STATION: For laboratory subjects (indicated by "G" code in image content), station means stage. A stage comes from the scale of the image in relationship to the original subject size.

0 Indeterminate (1:32 or over)
1 1:16 scale
2 1:8 scale
3 1:4 scale
4 1:2 scale
5 1:1 scale
6 2:1 scale
7-8 Unassigned
9 Other scale

| | | | |
|---|---|---|---|
| BAND: | 1 digit | 0 | No filter |
| | | 1 | Ultraviolet blocking panchromatic (flourescence) |
| | | 2 | Color balancing filter |
| | | 3 | Ultraviolet narrow band |
| | | 4 | 47b filter |
| | | 5 | 61 filter |
| | | 6 | 29 filter |
| | | 7 | Near infrared |
| | | 8 | Far infrared |
| | | 9 | Other filter |

ALL OTHER CODES are the same as for the general field use.

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