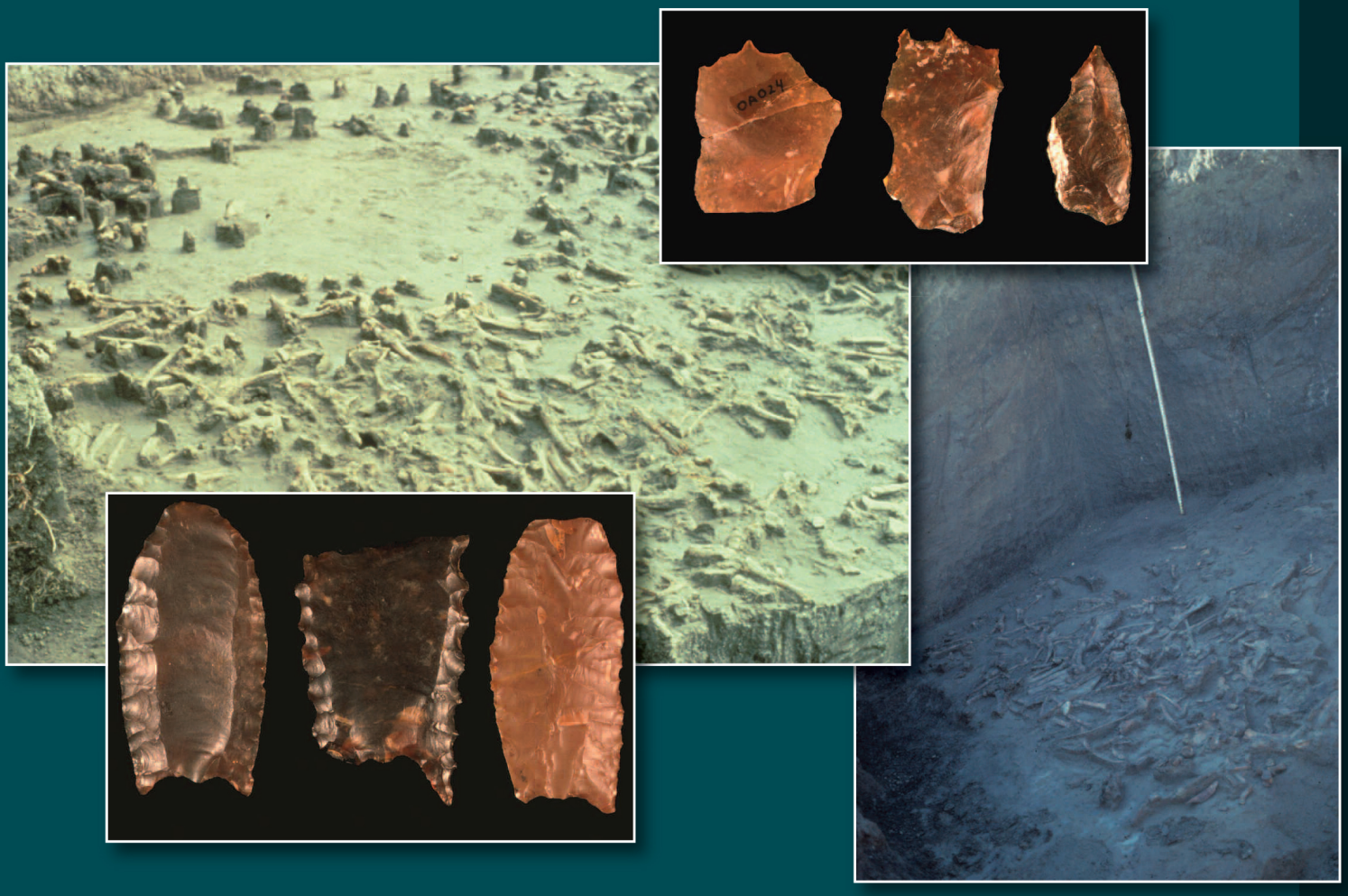
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THE AGATE BASIN SITE

A Record of the Paleoindian Occupation of the Northwestern High Plains



GEORGE C. FRISON
DENNIS J. STANFORD

With a New Prologue by Matthew G. Hill

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Right image: Main Hell Gap bison kill-butchery bonebed in Area III. George C. Frison.
Upper image: Gravers from Main Folsom component at Area II. Matthew G. Hill.
Lower image: Folsom point preform failures from Main Folsom component at Area II. Matthew G. Hill.
Back cover: Profile of hearth in Second Folsom component at Area III, August 1996. Matthew G. Hill.

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TO ROBERT E. FRISON AND WILLIAM SPENCER

who discovered the Agate Basin site
and recognized its value.

PROLOGUE TO THE PERCHERON PRESS EDITION

During the 1970s archaeologists generated a bonanza of foundational Paleoindian research on the Great Plains of North America. In Colorado Joe Ben Wheat was wrapping up important work on Olsen–Chubbuck and Jurgens, as were Edwin Wilmsen and Frank Roberts (Roberts by then was deceased) on Lindenmeier. Dennis Stanford was busy at Jones–Miller, Dutton, and Selby, while Eileen Johnson was directing research at Lubbock Lake, Texas. To the north, in Nebraska, Larry Agenbroad was occupied with the behemoth Hudson–Meng bonebed. And in Wyoming George Frison was beginning his prodigious career at the University of Wyoming, conducting extensive investigations at Casper, Agate Basin, Colby, Carter/Kerr–McGee, Horner, and Hanson (as well as work at other kill sites such as Hawken and Vore, and occupation sites that contained Paleoindian components such as Medicine Lodge Creek and Helen Lookingbill).

The Agate Basin Site, originally published in 1982, is the second in a series of six highly influential site monographs authored or edited by George Frison; the other five dealt with Casper (Frison 1974/2013), Hanson (Frison and Bradley 1980), Colby (Frison and Todd 1986), Horner (Frison and Todd 1987), and Mill Iron (Frison 1996). These monographs established the ground rules for the investigation and interpretation of the Paleoindian record on the Great Plains. Frison's coauthor for the *Agate Basin* volume was Dennis Stanford, his close colleague and friend since their days together as undergraduate students at the University of Wyoming. Widely regarded today as classics of the discipline, each of these volumes reflects innovative methods combined with insightful, clearly written presentations of remarkable evidence that cast light into previously dark corners. These books have significantly advanced our knowledge of Paleoindian culture history and adaptations, exposed analytical soft spots, and charted new courses for study. The fact that they continue to enjoy such regular use underscores their enduring scientific import and empirical utility, and why republication of *Agate Basin* is very much warranted.

FRISON'S PARADIGMATIC APPROACH

Traditional interpretations of the hunter-gatherer archaeological record on the Great Plains relied heavily on the rich ethnographic literature of the region as recorded by early Euro-American explorers, settlers, trappers, missionaries, and military personnel over the last few hundred years. Although well read in Plains Indian ethnography, Frison understood that such accounts were deficient as a framework for understanding Paleoindian adaptations or for investigating the formational history of the archaeological record. For him—and for students trained under his watchful eye—such evidence originated in the past and therefore artifacts, faunal remains, and sediments were (and are) the analytical keys to reconstructing past human behaviors.

Frison brought a unique blend of practical experience and technical knowledge to this research perspective (Frison 2004), not to mention tremendous energy, passion, and intellect. Together with his colleagues, he helped define the scope and substance of contemporary Paleoindian archaeology on the Great Plains. Four decades ago geoarchaeology, zooarchaeology, vertebrate taphonomy, experimental archaeology, and stone tool analysis were emergent fields of study. Today, due in large measure to his pioneering efforts, they are well-established subdisciplines. They have made Paleoindian archaeology strongly interdisciplinary and the future of Paleoindian research is exciting to contemplate.

Among Frison's many gifts, perhaps his most profound contribution involves his capacity to conceptualize and depict the ethos and decision making of the subsistence big-game hunter—incorporating aspects of animal behavior, grassland ecology, seasonality, weaponry, and tool technology—and to describe these insights in a cogent manner. This ability has garnered him multigenerational appeal and an international following. Written in this clear, conversational, yet scientific style, Frison and Stanford's *Agate Basin* offers the reader a rare combination of valuable quantitative information and interpretive insights on Paleoindian activities and adaptations on the High Plains. It links important discussions of bison exploitation and flaked-stone technology with features of the paleoecology.

THE AGATE BASIN SITE

The Agate Basin site actually refers to a series of eleven locations (designated Areas I–XI) straddling the Wyoming–South Dakota border along Moss Agate Arroyo, near the head of Moss Agate Creek, an intermittent tributary of the Cheyenne River. These localities have a lengthy and complicated history of investigation, culminating in work conducted by Frison and his colleagues—primarily between 1975 and 1980—around which the current site monograph is built. The composite archaeological record preserved here is special indeed, capturing a stunning sequence of Paleoindian occupation, including multiple bison kills and campsites coupled with exceptional stratigraphic and contextual integrity. But what makes the deposits truly extraordinary is the quantity, diversity, and preservation of artifactual, ecofactual, and paleoecological material contained therein. The diverse classes of evidence, including data on weaponry and tool manufacture, use, repair, and discard, as well as information on the procurement and use of animal prey, the use of site space, and paleoenvironmental data, are spectacular.

In order to manage this enormous corpus of information, the monograph is or-

ganized into six chapters, with Chapters 2–5 split into a series of 21 sections, written by Frison and a team of specialists in faunal analysis, lithic technology, and environmental reconstruction. In Chapter 1 Frison provides basic background information on the locality, from original discovery through the work done there under his supervision during the 1970s.

Chapter 2 is the most substantial in the monograph. Here Frison, Stanford, and Carolyn Craig document and describe the archaeology of what stands as the most important functional record of Paleoindian culture history, material culture, adaptation, and site activity published to date on the Great Plains. Several localities are especially noteworthy. Area I marks the location of original site discovery by William Spencer, a local rancher, occurring around 1916; in 1942 it produced the type collection for the Agate Basin projectile point (Roberts 1943). An extensive Folsom residential occupation is preserved beneath an Agate Basin bison kill-butchery bonebed at Area II. Area III, also known as the Brewster site, includes three Hell Gap components—one of which is a bison kill-butchery bonebed—overlying an Agate Basin component (Haynes 1985:201), as well as two Folsom components. And finally Area IX, also known as the Sheaman site, contains a Clovis component (Frison, Haynes, and Larson 1996:208).

Bruce Bradley and Frison detail Folsom, Agate Basin, and Clovis chipped stone technology and typology in Chapter 3. The discussion of material from the Sheaman site is of special significance, since it was here that distinctive features of Clovis biface manufacture were first described in detail.

The large faunal collection, consisting primarily of bison remains, is summarized in Chapter 4. Included are sections on the postcranial bison remains by George Zeimens; information on bison mortality, procurement, and taxonomy by Frison; and a section on pronghorn and other non-bison remains from the Folsom component at Area II by Danny Walker.

Chapter 5 focuses on the character of Moss Agate Arroyo during Paleoindian times, as revealed through geology and geomorphology, including discussions of pedology, plant pollen, phytoliths, and terrestrial gastropods, with contributions by John Albanese, Richard Reider, Clayton Marlow, Jane Beiswenger, Rhoda Lewis, and Emmett Evanoff. Walker's assessment of the microfauna in Chapter 4 offers valuable information along these lines as well.

Chapter 6 offers a humble nod to the provisional nature of scientific research, highlighting substantive "statements of progress, rather than conclusions" (p. 370) on the archaeology, zooarchaeology, and paleoecology of Moss Agate Arroyo. A careful reading of this chapter continues to be time well spent—as was the case in 1982—since it deftly summarizes Paleoindian activities, speaks more broadly about current issues in Paleoindian culture history and adaptations, and outlines new problems and future research directions.

CONTINUING CONTRIBUTIONS

The overall contribution of *Agate Basin* to the *process* of doing Paleoindian archaeology and to our understanding of Paleoindian adaptations on the High Plains is second to none. Simply put, it has served as a blueprint for conducting site-based research leading to substantive results, has provided fresh insights on Paleoindian

behavior, and has inspired countless subsequent projects. It is therefore worth mentioning several recent efforts tied to this seminal volume.

Perhaps the most interesting (and puzzling) development concerns the Sheaman site, which—on the basis of robust artifactual evidence—was originally inferred to preserve a single Clovis component. Support for this assessment gained traction upon reinspection of the stratigraphy, including most notably a series of radiometric determinations on charcoal and insoluble organic matter pointing to an age of around 11,200 B.P. (Haynes, Kornfeld, and Frison 2004). This situation was short lived, however. Three direct assays on a cervid bone/antler foreshaft (first thought to be made of ivory and thus consistent with the Clovis affiliation) indicate that this artifact dates to about 10,300 B.P., thus making it far too recent to be of Clovis age (Waters and Stafford 2007). At issue is the observation that this age estimate (as well as a date of just under 10,700 B.P. mentioned in passing by Frison, Haynes, and Larson) does not square with the collection of flaked-stone debris, which is "unquestionably Clovis" (Frison, Haynes, and Larson 1996:208). It seems increasingly likely that the Sheaman site preserves an as-yet-undated Clovis component and an elusive, later (Goshen?) Paleoindian component. Future fieldwork will be needed to resolve this matter.

The Agate Basin Complex is much better known today than it was three decades ago as a result of comprehensive investigation of a bison kill-butchery bonebed at Beacon Island, North Dakota (Mitchell 2012); analysis of the materials from Frazier, Colorado (Borresen 2002; Slessman 2004), including radiocarbon dates (Lee, Borreson-Lee, and Turnbull 2011); and research on the faunal remains at Hell Gap, Wyoming (Byers 2001, 2002, 2009). Unfortunately, the same cannot be said for the Hell Gap Complex. Since substantial new evidence has not come to light here, the Hell Gap components at Agate Basin and Casper (Frison 1974/2013; Todd et al. 1997) and, secondarily, at Carter/Kerr–McGee (Frison 1984) and Jones–Miller (Stanford 1999), remain the best sources of information about the activities of these people.

The extant collection of materials derived from the University of Wyoming investigations at Agate Basin is large and diverse; to date only a fraction of its research potential has been tapped. As such, work on these materials—employing updated methods to answer new questions—has supplied fresh insights on site activities, faunal exploitation, bison evolution, and behavior. Sellet (2004) demonstrated that no fewer than 38 new Folsom points were made during the course of the Folsom occupation at Area II. Since these once-present specimens are currently signaled only by the debris related to their manufacture, it follows that the "gearing up" of weaponry for future hunting trips was an important site activity. This finding has clear implications for broader patterns of Folsom subsistence practices, mobility patterns, and the organization of technology. And with Frison's generous support and encouragement I conducted a comprehensive, multiyear study of the bison and pronghorn remains—an effort that provided new insights on bonebed taphonomy, site formation, and faunal exploitation (Hill 1994, 2001, 2008). Several colleagues and I also used measurements on limb bones to explore the temporal and geographic dimensions of changes in bison body size (Hill, Hill, and Wigda 2008), while Lovvorn, Frison, and Tieszen (2001) employed stable isotopes extracted from many

of these same specimens to reconstruct aspects of grassland ecology, atmospheric circulation, and bison foraging patterns.

Not merely an important volume of the Frison canon, *Agate Basin* stands as a foundational document in modern Americanist archaeology and a major accomplishment in American science.

REFERENCES

Borresen, Jennifer A.

2002 *A Faunal Analysis of the Frazier Site, an Agate Basin-Age Bison Kill-Butchery Site in Northeastern Colorado.* Unpublished M.A. thesis, Department of Anthropology, University of Tennessee, Knoxville.

Byers, David A.

2001 *The Hell Gap Locality II Agate Basin Faunal Assemblage: A Study of Paleoindian Faunal Resource Exploitation.* Unpublished M.A. thesis, Department of Anthropology, University of Wyoming, Laramie.

2002 Paleoindian Fat-Seeking Behavior: Evidence from the Hell Gap Site, Locality II Agate Basin Faunal Assemblage. *Plains Anthropologist* 47:359–377.

2009 The Agate Basin Faunal Remains at Locality II. In *Hell Gap: A Stratified Paleoindian Campsite at the Edge of the Rockies*, edited by Mary Lou Larson, Marcel Kornfeld, and George C. Frison, pp. 135–156. University of Utah Press, Salt Lake City.

Frison, George C.

1984 The Carter/Kerr–McGee Paleoindian Site: Cultural Resource Management and Archaeological Research. *American Antiquity* 49:288–314.

2004 *Survival by Hunting: Prehistoric Human Predators and Animal Prey*. University of California Press, Berkeley.

Frison, George C. (editor)

1996 *The Mill Iron Site*. University of New Mexico Press, Albuquerque.

2013 *The Casper Site: A Hell Gap Bison Kill on the High Plains*. Percheron Press/Eliot Werner Publications, Clinton Corners, NY. (Originally published in 1974)

Frison, George C., and Bruce A. Bradley

1980 *Folsom Tools and Technology of the Hanson Site, Wyoming*. University of New Mexico Press, Albuquerque.

Frison, George C., C. Vance Haynes, Jr., and Mary Lou Larson
1996 Discussion and Conclusions. In *The Mill Iron Site*, edited by George C. Frison, pp. 205–216. University of New Mexico Press, Albuquerque.

Frison, George C., and Lawrence C. Todd (editors)
1986 *The Colby Mammoth Site: Taphonomy and Archaeology of a Clovis Kill in Northern Wyoming*. University of New Mexico Press, Albuquerque.
1987 *The Horner Site: The Type Site of the Cody Cultural Complex*. Academic Press, Orlando.

Haynes, C. Vance, Jr.
1985 Review of *The Agate Basin Site: A Record of the Paleoindian Occupation of the Northwestern High Plains*. *American Antiquity* 50:200–203.

Haynes, C. Vance, Jr., Marcel Kornfeld, and George C. Frison
2004 New Geoarchaeological and Archaeological Data for the Sheaman Clovis Site, Eastern Wyoming, U.S.A. *Geoarchaeology* 19:369–379.

Hill, Matthew G.
1994 *Subsistence Strategies by Folsom Hunters at Agate Basin, Wyoming: A Taphonomic Analysis of the Bison and Pronghorn Assemblages.* Unpublished M.A. thesis, Department of Anthropology, University of Wyoming, Laramie.
2001 *Paleoindian Diet and Subsistence Behavior on the Northwestern Great Plains of North America.* Unpublished Ph. D. dissertation, Department of Anthropology, University of Wisconsin, Madison.
2008 *Paleoindian Subsistence Dynamics on the Northwestern Great Plains: Zooarchaeology of the Clary Ranch and Agate Basin Sites*. British Archaeological Reports International Series 1756. Archaeopress, Oxford, UK.

Hill, Matthew E., Jr., Matthew G. Hill, and Christopher C. Widga
2008 Late Quaternary *Bison* Diminution on the Great Plains of North America: Evaluating the Role of Human Hunting Versus Climate Change. *Quaternary Science Reviews* 27:1752–1771.

Lee, Craig M., Jennifer Borresen-Lee, and Jocelyn C. Turnbull
2011 Refining the Chronology of the Agate Basin Complex: Radiocarbon Dating the Frazier Site, Northeastern Colorado. *Plains Anthropologist* 56:243–258.

Lovvorn, Marjorie B., George C. Frison, and Larry L. Tieszen
2001 Paleoclimate and Amerindians: Evidence from Stable Isotopes and

Atmospheric Circulation. *Proceedings of the National Academy of Sciences* 98:2485–2490.

Mitchell, Mark D. (editor)
2012 *Agate Basin Archaeology at Beacon Island, North Dakota*. Research Contribution No. 86, PaleoCultural Research Group, Arvada, CO.

Roberts, Frank H. H., Jr.
1943 A New Site. *American Antiquity* 8:300.

Sellet, Frédéric
2004 Beyond the Point: Projectile Manufacture and Behavioral Inference. *Journal of Archaeological Science* 31:1553–1566.

Slessman, Scott A.
2004 *The Frazier Site: An Agate Basin Occupation and Lithic Assemblage on the Kersey Terrace, Northeastern Colorado.* Unpublished master's thesis, Department of Anthropology, Colorado State University, Fort Collins.

Stanford, Dennis J.
1999 Analysis and Interpretation of Hell Gap Hunting Strategies at the Jones-Miller Site. In *Le Bison: Gibier et Moyen de Subsistance des Hommes du Paléolithique aux Paléoindiens des Grandes Plaines*, edited by Jean-Philip Brugal, Francine David, James G. Enloe, and Jacques Jaubert, pp. 437–454. APDCA, Antibes, France.

Todd, Lawrence C., Matthew G. Hill, David J. Rapson, and George C. Frison
1997 Cutmarks, Impacts, and Carnivores at the Casper Site Bison Bonebed. In *Proceedings of the 1993 Bone Modification Conference, Hot Springs, South Dakota*, edited by L. Adrian Hannus, Lynette Rossum, and R. Peter Winham, pp. 136–157. Occasional Publication No. 1, Archeology Laboratory, Augustana College, Sioux Falls, SD.

Waters, Michael R., and Thomas W. Stafford
2007 Redefining the Age of Clovis: Implications for the Peopling of the Americas. *Science* 315:1122–1126.

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PREFACE

The Agate Basin site is only one of many Paleoindian sties that have been investigated, but for which analysis and publication of results are lacking. It is the type site of the Agate Basin cultural complex and its data therefore should be made available to students of the Paleoindian. This book accordingly attempts to bring together all the known data from the Agate Basin site locality.

The authors have attempted to evaluate the Agate Basin site from the perspectives of a number of separate disciplinary approaches, with guiding principles being that paleoecological reconstructions are possible and that they can be used as a medium within which to observe human behavior. Because Paleoindian sites of the size and complexity of Agate Basin are rare, and because adequate protection seems assured, as much as possible of the site has been left intact for future investigators.

The book is primarily directed to professional archaeologists interested in Paleoindian studies. The avocational archaeologist with similar interests should also find it of use. Those interested in topics that include reconstruction of paleolandforms, stream transport, soils, and taphonomy should also find something of at least passing interest.

Illustrations are liberally provided, both to make the reader familiar with the site and the general area, and as a means for referring to complete cultural assemblages. It is felt that this type of presentation allows the reader to apply to the data whatever interpretive device or model he or she sees fit, and also facilitates comparison with data from other archaeological sites.

The book consists of six chapters. Chapter 1 introduces the reader first to the general area of the High Plains and then to the particular area of the Agate Basin site. The site has been known since the late 1930s. It actually consists of several sites, which are integrated by a common drainage system. These sites

have witnessed a number of investigations, ranging in character from legitimate to entirely predatory, in the years following their discovery. Chapter 1 also presents a history of these investigations and the collections known to have been taken from the site.

Chapter 2 deals specifically with the archaeological aspects of the Agate Basin site locality, which has produced Clovis, Folsom, Agate Basin, and Hell Gap components. These are presented in eight sections with topical titles beginning with the cultural stratigraphy and continuing with the evidence from the various cultural components. Bone and antler technology, raw stone flaking materials, and radiocarbon dating are also treated separately.

Chapter 3 is a technological study. The first section deals with observations on lithic technology. It is followed by a short section on fluting of Folsom projectile points.

Chapter 4 is a taphonomic treatment of the faunal remains. The first section describes bison butchering and is followed by a section on the dynamics of the bison population based mainly on dental observations. Bison taxonomy and procurement are considered in the two sections that follow and a short section is devoted to butchering of nonbison materials. Finally, the complete faunal list recovered and reconstruction of the paleoecology based on small animals recovered are presented.

Chapter 5 includes studies of a number of paleoecological components, including geology, soils, vegetation, pollen, phytoliths, and gastropods. The geological data were indispensable to the final interpretations of the site. The soil, vegetation, and gastropod data also aided in paleoecological studies; the pollen and phytolith studies, however, were inconclusive.

Chapter 6 is an attempt to abstract the preceding chapters into a statement describing Paleoindian lifeways based on the relatively disparate avenues of research involved in six years of fieldwork and laboratory analysis. This chapter also attempts to place the Agate Basin site locality within the framework of other, related, Paleoindian studies. These interpretations, it should be emphasized, are largely hypothetical and will be subject to constant revision as Paleoindian studies continue and methodologies improve.

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Testing, excavation, and analysis of the Agate Basin site and materials, during the period 1971–1980 was supported by the University of Wyoming, The Smithsonian Institution, the Wyoming Recreation Commission, the Wyoming Archeological Foundation, and the National Science Foundation (Grant No. BNS 7905852). The 1961 excavations were supported by a grant from the National Geographic Society.

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The senior author is deeply indebted to the Smithsonian Institution and particularly the Department of Anthropology for their support, which led to the granting of one of the first three board of regents fellowships and thus allowed a full year of research on the Agate Basin materials. Discussions with colleagues, in particular, Waldo Wedel, the late Clifford Evans, William Fitzhugh, T. Dale Stewart, and Gary Haynes, were of inestimable value to the completion of the project. Robert Stuckenrath gave special care to radiocarbon samples. Victor Krantz produced the excellent photographs of artifacts. Marcia Bakry illustrated the artifacts and bison dentitions, which are without question the finest in existence. George R. Lewis and Ellen Paige drafted the numerous excellent site maps. The laboratory staff of the Department of Anthropology at the Smithso-

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Reading and suggestions for revisions on the Agate Basin local fauna section were done by Holmes Semken. The same was done for the gastropod section by John Hanley, Kenneth Carpenter, and Alberta Settle.

The senior author is especially indebted to Mr. and Mrs. Thomas Beebe and Jesse and Kathy Schultz for the hospitality extended at their ranch during the years of fieldwork at the Agate Basin. Thanks are due also to Wayne Peterson and Robert Sheaman for the use of their private lands during this same period. Stan Renner, another nearby rancher, helped many times with the loan of tools and equipment. Josephine Spencer made the collection of the late William Spencer available for study. Adrian Hannus provided a helicopter and Jesse Schultz provided an airplane for taking aerial photographs.

The sources of raw material figured strongly in the Agate Basin site analysis. Many of these sources are on private land and many landowners, including Leonard Degering, Artie Joss, Rebel Coffee, and George Lynch were particularly cooperative in allowing access. Robert Alex and part of his staff offered their services for a day to visit quarry sources in South Dakota and provided samples from a number of others.

In other areas, "Bison Pete" Gardner provided innumerable samples of bison for biological study and allowed us the benefit of his superior knowledge of bison behavior. It was a privilege to share his many and varied experiences with bison both dead and alive. The Wyoming Game and Fish Department is also acknowledged for providing biological specimens that aided in faunal analysis of the Agate Basin materials.

June Frison, the senior author's spouse, typed numerous drafts of the manuscript during the period of residence at the Smithsonian Institution and, in addition, was cook, purchasing agent, and general camp manager for six years of field excavations at the Agate Basin site. Terri Craigie was largely responsible for typing and organizing the final draft of the manuscript. Laura Mai and Mary David also helped in typing the manuscript.

Laboratory workers over a period of years included Richard Blatchley, Dan Eakin, Karen Bridger, Caren Collins, and Carol Frison Grace. Field crew supervisors over the years include William Bass for the Smithsonian expedition in 1961, George Zeimens, Charles Reher, Bruce Bradley, and Danny Walker. Field crew members, in alphabetical order, included Evelyn Albanese, Dale Austin, Jean Bedord, Walter Birkby, Richard Blatchley, Manton Botsford, Cindy Bradley, Karen Bridger, Carolyn Buff, Susan Bupp, Caren Collins, Carolyn Craig, Dave Darlington, Zach Deiss, Bob Dunnell, Dan Eakin, Dave Eckles, Jodee Eckles, Julie Francis, Gene Galloway, Charles Gossard, Travis Gray, John Greer, Jeff Hauff, Dan Hayes, Ross Hilman, Jack Hofman, Pat Mansfield Hofman, Paul Hokenstad, Harold Howells, John Jameson, Junko Kawaguchi, Marcel Kornfeld, Larry Lahren, Mary Lou Larson, Thomas K. Larson, Sherry Landry, Merry Lang, Roy Larrick, Bill Latady, Rich Laurent, Rhoda Lewis, Julie

Longenecker, Gordon Marlatt, Dave McGuire, Donna McGuire, Judy Michaelsen, Mark E. Miller, Pete Milne, Ann Mitchell, John Mitchell, Steven Moore, Frances Mundt, Linda Nicholas, Bob Peterson, Grove Ohelan, Joe Pinner, Judy Pinner, Dave Reiss, Mary Ann Robeson, Richard Robrock, Paula Rosa, Paul Sanders, Lee Carol Scutt, John Seeger, Susan Schock, Gail Slutszky, F. E. "Kim" Smiley, Robert Swaim, Paula Ingram Tibesar, William Tibesar, Larry Todd, Sandra Myers Todd, Pat Treat, Larry Welty, and Sandy Zeimens.

Due to the length of time and the number of individuals involved in the Agate Basin project, some deserving of credit have inevitably been overlooked. To those, our sincere apologies and appreciation.

one
INTRODUCTION

george c. frison

The Agate Basin site is one of a number of Paleoindian sites on the Northwestern High Plains. These sites, found in late Pleistocene and early Holocene geologic deposits, are providing us with an ever increasing data base for the Clovis, Folsom, Agate Basin, and Hell Gap cultural complexes (Figure 1.1). Sites associated with the procurement of large herbivores are best known, largely because of their high archaeological visibility. At the Agate Basin site, for example, a large communal bison kill took place in an arroyo; its existence was revealed by bison bone and projectile points found eroding from the arroyo bank.

Site exposure is primarily the result of geologic conditions. High topographic relief, moderate amounts of yearly precipitation, and large seasonal extremes of temperature, common on the High Plains, provide situations that encourage erosion and deposition. The distribution of precipitation events and small increases or decreases in amounts can result in dramatic changes in vegetative cover over short periods of time. The disastrous effects of the 1930s dust bowl days on crop production and the animal carrying capacity of the High Plains provide a prime example (J. E. Weaver 1968). Changes in vegetation and in the water table, in turn, strongly affect the processes of erosion. Where these conditions prevail, the probability that archaeological sites will be exposed is high, but so is the probability of subsequent site destruction.

The shortgrass High Plains, although inhospitable in many ways, were and still are attractive to large herbivores. Even though the grasses are relatively short and sparse, they are high in protein and are available in some form all year. However, they are sensitive to changes in moisture, and animals depending on them would have to adjust their populations accordingly. A series of good grass years could witness significant increases in the populations of such animals as

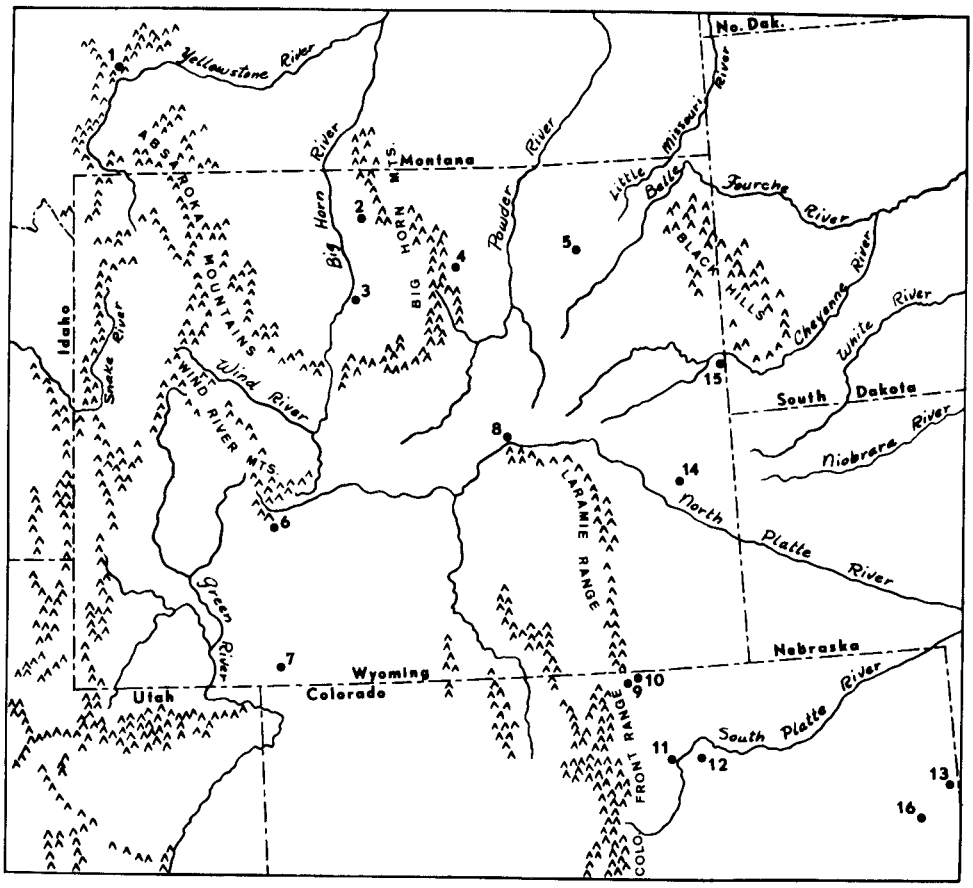


FIGURE 1.1 Clovis, Folsom, Agate Basin, and Hell Gap sites in Wyoming and adjacent areas: 1: Anzick; Clovis (Lahren and Bonnichsen 1974). 2: Hanson; Folsom (Frison and Bradley 1980). 3: Colby; Clovis (Frison 1976, 1978b). 4: Sister's Hill; Hell Gap (Agogino and Galloway 1965). 5: Carter/Kerr-McGee; Clovis, Folsom, Agate Basin, Hell Gap (Frison 1977). 6: Morgan; Folsom (Frison 1978b). 7: Mud Springs; Folsom (Frison 1978b). 8: Casper; Hell Gap (Frison 1974). 9: Johnson; Folsom (Galloway and Agogino 1961). 10: Lindenmeier; Folsom (Wilmsen and Roberts 1978). 11: Dent; Clovis (Figgins 1933). 12: Frazier; Agate Basin (Wormington, personal communication, 1976). 13: Jones–Miller; Hell Gap (Stanford 1978). 14: Hell Gap; Goshen, Folsom, Midland, Agate Basin, Hell Gap (Irwin-Williams *et al.* 1973). 15: Agate Basin; Clovis, Folsom, Agate Basin, Hell Gap. 16: Dutton; Clovis (Stanford 1979).

the bison, where females reproduce at 3 years of age. A combination of poor grass and hard winters, on the other hand, would quickly reduce animal numbers.

Small, nomadic human groups were able to survive on the shortgrass Plains in late Pleistocene–early Holocene times by systematically exploiting plant and animal resources, including the large herbivores. These groups possessed the knowledge and the technology necessary to trap and kill animals. They were familiar enough with animal behavior to take advantage of the natural topography in their procurement efforts, but they were also able to modify natural conditions to achieve the same ends. Even so, they were not able to perfect procurement techniques to the extent that the bison were threatened. The predator–prey relationships between man and other large herbivores, such as the horse and the camel, are not yet well understood. There is no question that the two species mentioned were present on the Plains in Paleoindian times, but the reasons for their disappearance are not yet known. The effect of human predation on animal populations is one of the major issues in Paleoindian studies today (see P. S. Martin 1967; P. S. Martin and H. E. Wright 1967). This study of the Agate Basin site deals mainly with bison procurement and utilization, however. It is the authors' belief, based on this and a number of other bison kills, that the site represents patterned human behavior rather than fortuitous encounters with animals in a favorable location.

The Agate Basin site epitomizes the Paleoindian bison kill preserved by aggradation in an arroyo shortly after deposition and exposed later by degradation. Its future would have been determined primarily by geologic processes had it not been observed after exposure. Further erosion might have destroyed the entire site, or a reversal of the process to a period of filling of the present arroyo might have once more sealed the remainder of the site for some time. One part of the site, in Area 3, was exposed and resealed in this manner, as the site profiles demonstrate.

The evidence from the Agate Basin site and several other bison kill sites (see, e.g., Frison 1974; Frison *et al.* 1976; Stanford 1974; Wheat 1972) indicates that much of the cultural activity of Paleoindian hunters engaged in communal large-animal kills occurred along and in streams and dry arroyos. The potential for destruction of these sites through geologic activity is high; in fact, the ones that are preserved, such as Agate Basin, are in reality accidents of preservation. Our methodology does not yet allow us to reliably predict how many Paleoindian sites have been destroyed, are exposed but not yet located, or are still sealed in undisturbed geologic deposits.

Since High Plains Paleoindian sites are contained in geologic contexts, archaeologists must use the heuristic potential of the full range of earth sciences in their investigations. Unfortunately, the interests of the Paleoindian archaeologist seldom coincide with the mainstream of studies in other disciplines. We cannot, for example, offer the botanist substantial parts of plants for identification and our use of the results may not be for taxonomic purposes. Faunal remains may have passed through cultural events that create unfamiliar situations for the paleontologist. The response of an animal population to predation by Paleoindian hunters selecting nursery herds is an alien situation for the wildlife biologist who is interested in the present-day response to the present-day hunting of male animals. Also, the late Pleistocene and early Holocene deposits in which the sites are found are not highly regarded by geologists. The deposits contain little in the way of resources with economic value and encompass a period of time too short to have witnessed what are generally regarded as great geologic changes. Consequently, their study is not in the mainstream of geologic interest, and anthropological archaeologists, who without exception lack adequate training in geology, find it difficult to obtain the kind of geologic expertise they need.

The archaeologist as a result must be innovative but extremely careful in interpreting the results obtained by using the methodology of an unfamiliar discipline. It is appropriate and fair to mention also that anthropologists observe the same phenomenon when persons in other disciplines attempt to use the methodology of anthropology in their interpretations. In the final analysis, however, the interpretation of archaeology is accomplished through the broader methodology of anthropology. The archaeologist must be able to interpret the results of other disciplinary efforts correctly or the input to anthropology will be in error. The development of better methods is essential.

As a direct result of natural forces, Paleoindian sites on the High Plains are severely limited in number. The investigation of one such site destroys a part of a very small and very valuable data base. The Agate Basin site has now witnessed nearly four decades of such destruction, most of it for the purpose of learning about Paleoindian archaeology but entirely too much for the selfish purpose of

individual ownership of artifacts. It is somewhat comforting to know that a significant portion of the site remains intact and in a situation that offers maximum protection. This constitutes a very important resource and one that deserves every effort at preservation so that future Paleoindian archaeologists will be assured of an adequate data base as the methodology of investigation is improved.

THE SITE LOCALITY

The north and south forks of Moss Agate Creek and their tributaries meander through a rough, deeply dissected area extending into the low hills south of the Cheyenne River along the Wyoming–South Dakota boundary, close to the southern end of the Black Hills. Moss Agate Arroyo is a short tributary of Moss Agate Creek, and it in turn has a number of smaller tributary arroyos. It begins as a shallow, flat-bottomed arroyo, becoming wider and deeper as it approaches its confluence with Moss Agate Creek (Figure 1.2). The bottom of the arroyo is matted with tall grasses and the channel meanders within the confines of the banks, which are low and gently sloping toward the head of the arroyo but become higher and more abrupt downstream. The original Agate Basin site consisted of two exposures of Agate Basin cultural levels toward the upper end of Moss Agate Arroyo (Figures 1.3 and 1.4). Elevation at the site datum at Area 2 is 1189 m (3900 feet) above sea level.

Site Areas. The Agate Basin site locality is in sections 10, 15, and 16, T 39 N, R 60 W, Niobrara County, Wyoming, and sections 7 and 18, R 1 E, T 8 S, in Fall River County, South Dakota (Figure 1.5). Within this area are 11 known Paleoindian site exposures (Figure 1.4). Some of these are in situ; others are redeposited. In section 15 Area 1, is the original discovery location and the site of the first systematic excavations, carried out in 1942 by the Smithsonian Institution. An in situ Agate Basin component was present. Area 1 was excavated by the Smithsonian again in 1961, and the University of Wyoming in 1975. Area 2 is split by the line between sections 15 and 16 and was discovered at about the same time as Area 1. It was badly disturbed before the 1961 Smithsonian excavations. In situ Agate Basin and Folsom components were present. The University of Wyoming tested Area 2 in 1972 and carried out annual field excavations from 1975 to 1980. Area 3, about 100 m west of Area 2 in section 16, was found in the late 1950s. A small excavation was conducted in 1959 by the University of Wyoming; this excavation became known as the Brewster site. Area 3 contains in situ Hell Gap and Folsom components, and Agate Basin components were mentioned in the original Brewster site report (Agogino and Frankforter 1960). The University of Wyoming continued excavations at Area 3 in 1977, 1979, and 1980. Area 4 is a small exposure a few meters west of Area 3. Tests were made there by the University of Wyoming in 1977 and 1980, but the material appears to be redeposited. The same is true of Area 5, which is several hundred meters west of Area 4. Tests of Area 5 in 1977 and 1979 by the University of Wyoming revealed small amounts of redeposited cultural materials. Area 6 is several hundred meters east of Area 1 in section 15 and to date has produced only redeposited materials. The Smithsonian Institu-

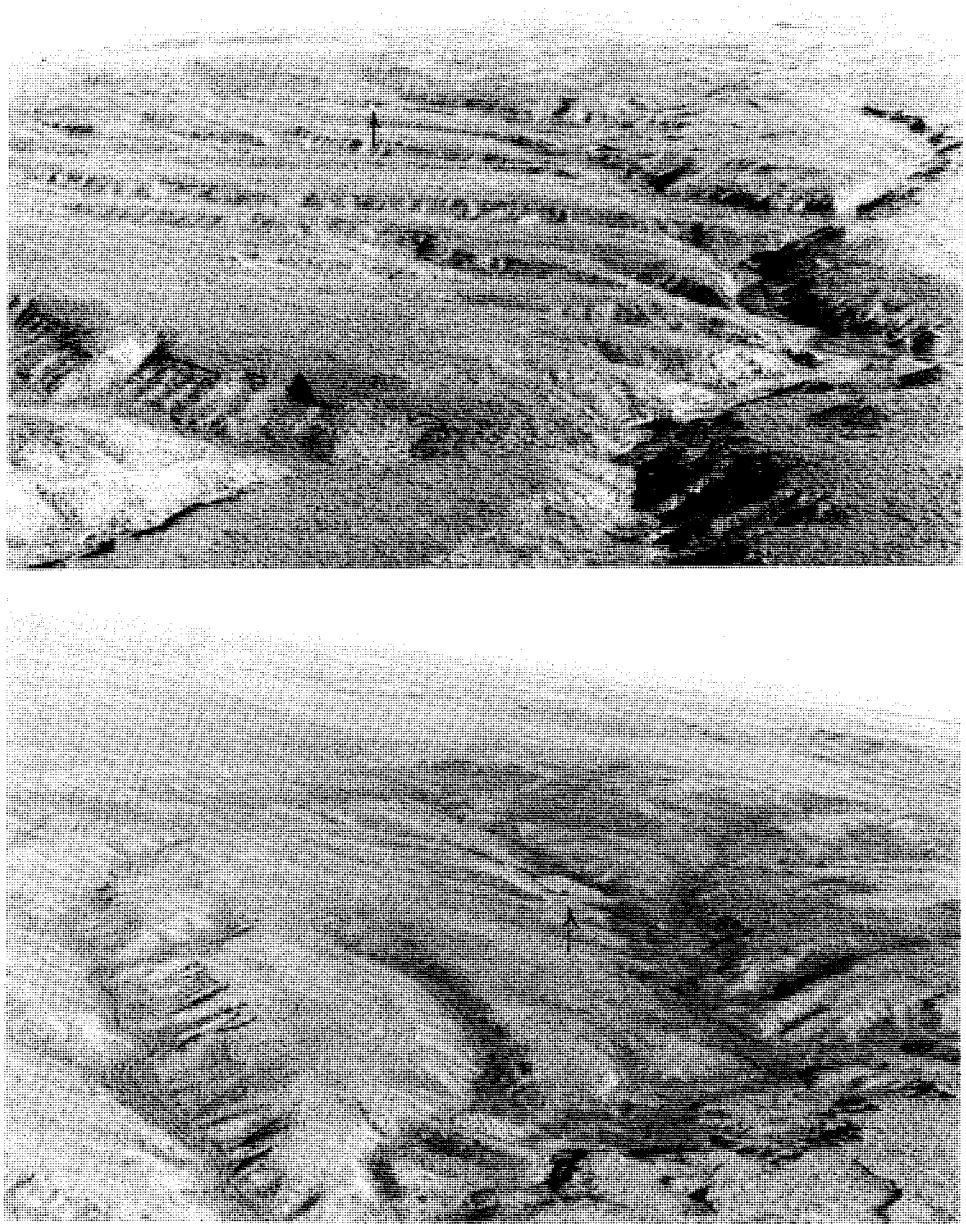


FIGURE 1.2 **Aerial views of the Agate Basin site looking northwest. Arrow in each indicates Areas 1 and 2.**

tion excavated this area in 1961, and the University of Wyoming excavated in 1975 and 1976, both with negative results. All six exposures discussed so far are located along what in Paleoindian times was the same arroyo.

Area 7 is on a present tributary arroyo about 150 m south of Area 6 and is manifest by three thin levels of apparently redeposited material, all containing charcoal, flakes, and bone. This was apparently some distance from the old arroyo in Paleoindian times and may have been associated with one of its tributaries. Area 8, the Schultz site, is several hundred meters southeast of Area 7, and it was also along the old arroyo in Paleoindian times. This site contains an in situ Agate Basin component, but has only been minimally tested. Area 9, in

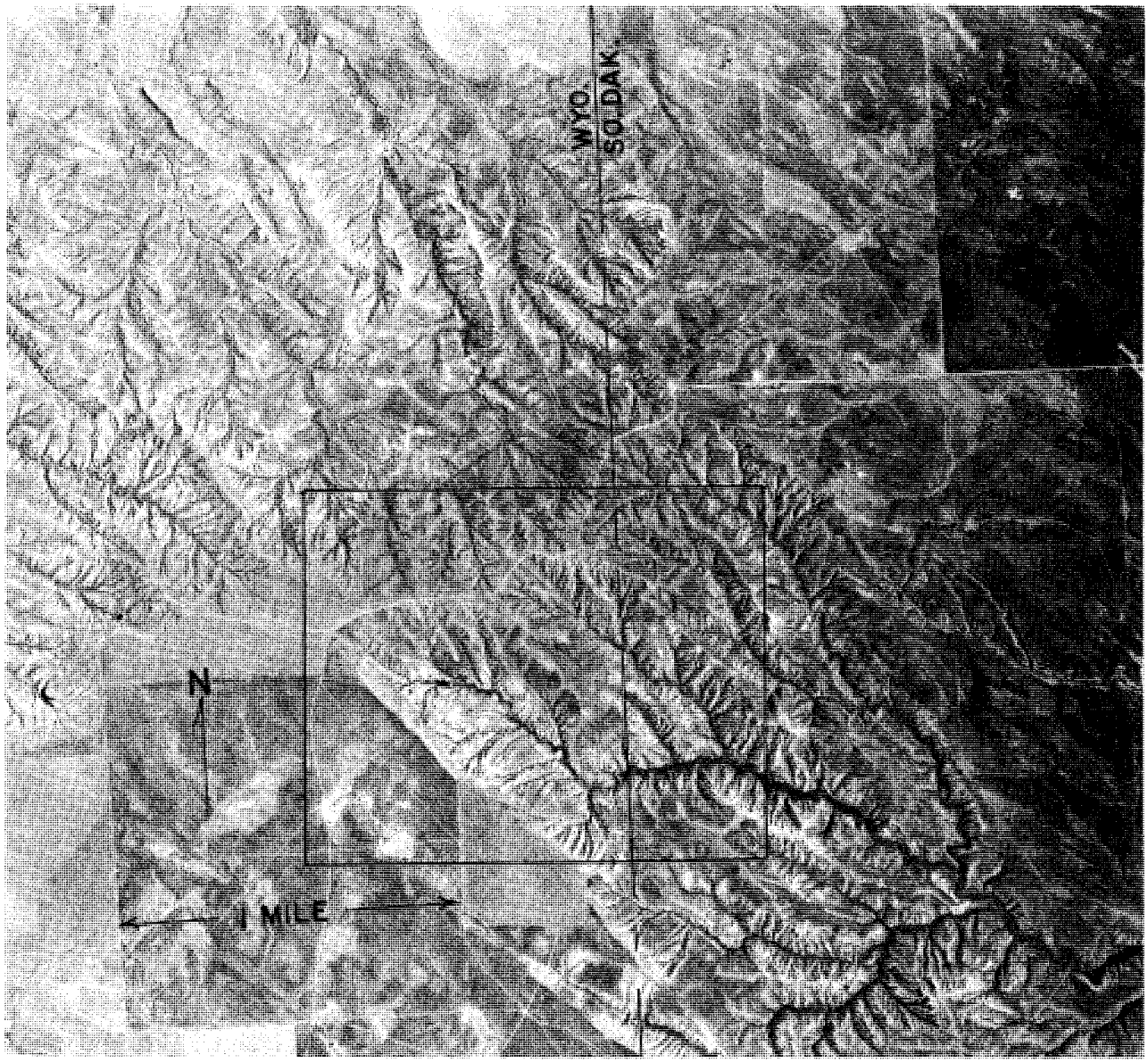


FIGURE 1.3 **Aerial view of the Agate Basin site area.**

another tributary of Moss Agate Arroyo, is the location of an in situ Clovis component. This has been named the Sheaman site, after the present landowner, Robert Sheaman of Gillette, Wyoming, and was excavated by the University of Wyoming in 1977, 1978, and 1979. The site is about 100 m from the Wyoming–South Dakota line in section 10. Areas 10 and 11 are exposures in arroyo banks in sections 7 and 18 in South Dakota. Both areas appear to consist only of redeposited cultural materials, but they have not been investigated thoroughly.

Physical Environment. In both Moss Agate Arroyo and Moss Agate Creek water flows only during spring runoff and heavy rains, although seepage

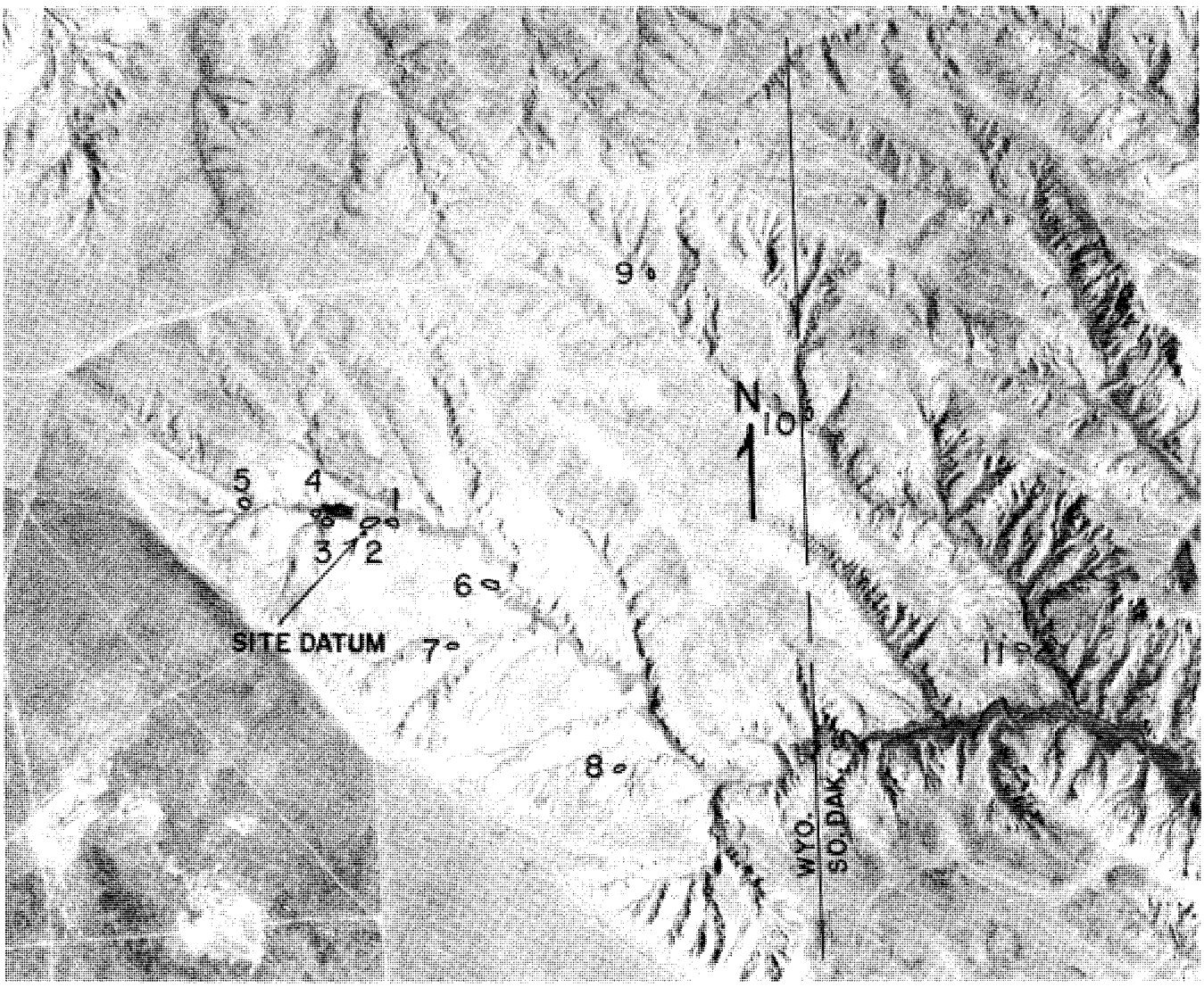


FIGURE 1.4 **Enlarged view of part of Figure 1.3 showing locations of Paleoindian site exposures.**

areas and stagnant ponds are common during spring and early summer. There is a flowing spring directly across the arroyo from Area 2, and another a few meters from the Sheaman site. The volume of water in both springs is low, and during extremely dry years they may cease flowing by late summer. Both springs draw water from deep snowbanks on the leeward side of the divide between Moss Agate Arroyo and the Cheyenne River.

Headward erosion of the Moss Agate Arroyo system has resulted in the rough, deeply dissected topography in the immediate vicinity of the Agate Basin site and over the low divide to the north separating Moss Agate Creek from the Cheyenne River (Figure 1.2). Past these rough areas or "breaks" are rolling hills, gentle slopes, and a more mature topography. Prominent also are horizontal sandstone and shale formations interbedded with softer materials, creating perpendicular bluffs and steep talus slopes in the more eroded areas. Particularly

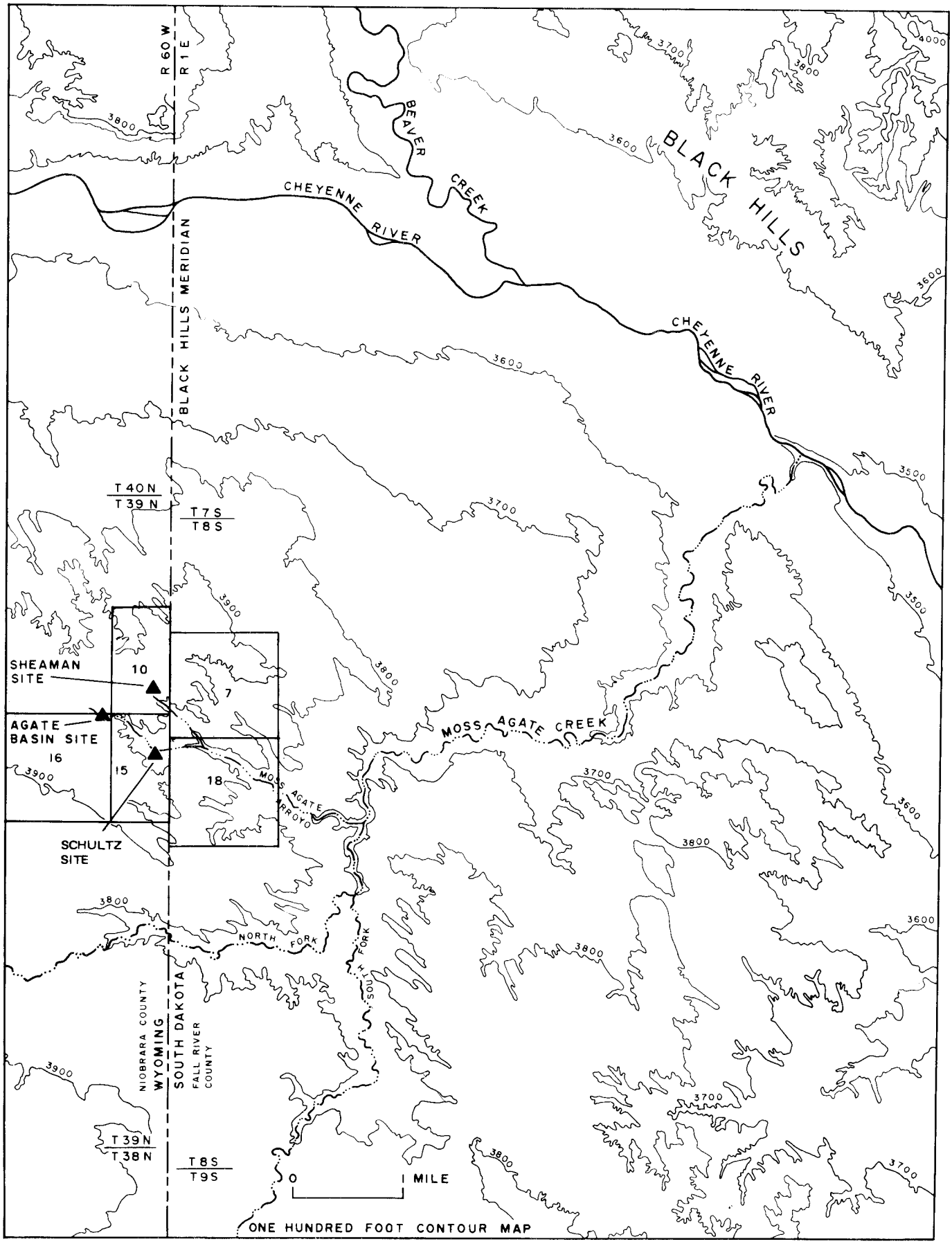


FIGURE 1.5 **Agate Basin site location and topographic map.**

noticeable is a long, narrow, flat-topped mesa known as the Twentyone Divide rising abruptly 60 m above the surrounding country about 10 km north of the Agate Basin site.

About 6 km north of the Agate Basin site is the Cheyenne River. This stream and its several branches begin about 100 km west of the Agate Basin site in the bandlands country of east-central Wyoming. Its headwaters do not reach the high elevations and no large, permanent springs are in the area. Consequently the flow of the Cheyenne River fluctuates greatly; the river may be nearly dry one day and bank full the next depending on runoff conditions. The stream has a low gradient and a wide floodplain.

The Black Hills extend about 100 miles from southeast to northwest across the Wyoming–South Dakota line, with about three-fifths in the latter state. They constitute a prominent uplift, reaching to 2207 m (7242 feet). They are rough and timber covered, but numerous wide, open, grass-covered corridors make travel through them not difficult. Several live streams flow east out of the Black Hills, but there are none to the west in the southern part. Water for humans and livestock has always been a problem historically in the Agate Basin area. The Cheyenne River flows southeast around the southern tip of the Black Hills and then bears northeast toward the Missouri River. The Agate Basin site is about 15 km from the southwestern edge of the Black Hills.

Climate. Yearly precipitation in the Agate Basin area averages 12–14 inches, which is sufficient for a continuous grass cover. Sagebrush also dominates the vegetation cover in well-drained areas; greasewood dominates in low, flat, saline areas along floodplains. Cottonwoods, brush thickets, and patches of tall, coarse ryegrass mark the Cheyenne River floodplain. Arroyo bottoms are covered with thick stands of grass, which attract all grazing animals. Ponderosa pine covers most of the Black Hills, but patches of quaking aspen are seen. Canyon bottoms within the Black Hills are lined with brush thickets.

Seasonal changes in this part of the High Plains are of considerable magnitude and often abrupt. Winter temperatures regularly drop below −30°F. Prevailing winds are out of the northwest and create even lower chill factors. The constant wind moves the snow, filling depressions and creating deep drifts on the leeward side of ridges. However, this keeps the windward sides of ridges bare, an important factor in the survival of the large, grazing animals. Winter chinook winds are not uncommon, but they can be a mixed blessing, since they often melt only part of the snow; a quick temperature reversal can create a solid ice sheet that seals the grass away from the animals. In late March the winter snows begin to melt, but spring blizzards are common well into May and are often deadly to all living things.

In normal years, the moisture and warmer weather that come in late April and early May combine to produce new grass, so that by June the entire countryside resembles a green carpet. Feed is abundant, and grazing animals rapidly gain weight and lose their rough winter coats. The young are born and grow rapidly. It is without doubt the most favorable time of the year for animals. Usually by the first part of July, however, the grass is forced into maturity by hot winds and dry weather. By August the country is brown and the fat hardens on the animals, which helps prepare them for winter survivial.

Snow and frost are to be expected any time after the first of September, although some of the best weather of the year comes during this month. By October, the snow begins to lie longer in the higher elevations and on north-facing slopes. By late November, winter is once more to be expected at any time, bringing below-zero temperatures and drifting snow.

There is a great deal of climatic variation from year to year on the High Plains. One winter may be mild or "open," whereas the next may be exactly the opposite. If spring rains do not materialize, the result is a shortage of summer feed. Open winters are enjoyed by humans and animals alike but the lack of winter moisture can have adverse affects on the growth of spring grasses. A dry spring and summer may not be too serious if an open winter follows. But if a hard winter follows, populations of grazing animals can be decimated. This has been demonstrated many times in the historic record and undoubtedly applied throughout prehistory also.

For all of the unfavorable comment on High Plains winters, they can be survived with relatively few problems even with a prehistoric technology. The human subsistence strategy has always been to prepare for and expect a bad winter regardless of past conditions. This is strongly suggested by the evidence recovered in the Agate Basin site investigations and in all High Plains archaeological sites.

The Paleoindian use of the Agate Basin site locality apparently spanned a time of significant climatic change, the late Pleistocene to the early Holocene. Temperatures, precipitation, growing seasons, and other climatic factors were undergoing great changes from around 12,000 to 10,000 years ago if the present body of data on climatology is correct (see, e.g., Bryson 1974). It would be a mistake to assume that present conditions at the Agate Basin locality can be used to describe those at the beginning of known human occupation there.

Some of these environmental changes are suggested by the small fauna recovered at the site (see Walker, this volume, Chapter 4, Section 6). That the landforms were quite different, at least with regard to the arroyo system in the immediate site locality, is demonstrated by the reconstructions of earlier landforms based on present remnants (see Albanese, this volume, Chapter 5, Section 1). Both pollen and phytolith studies were inconclusive, because the necessary elements were either lacking or poorly preserved (see Beiswenger and Lewis, this volume, Chapter 5, Sections 4 and 5). However, the charred remains of quaking aspen (*Populus tremuloides*) in the Hell Gap component suggest that there were stands of this species at the site around 10,000 years ago. In fact, a small stand of aspen was discovered in 1980 only 14 km east of the Agate Basin site (see Marlow, this volume, Chapter 5, Section 3).

If, as the geologic evidence indicates, Moss Agate Arroyo had a wide, flat bottom, steep, high banks, and fewer tributaries in late Pleistocene and early Holocene times, its past and present appearance contrasted sharply. If the vegetation consisted of less sagebrush, more brush, trees, and taller grasses, this also would have altered its appearance. That significant changes of this nature were occurring during late Pleistocene–early Holocene times is strongly suggested by the aggrading of the old arroyo as shown by site profiles, and by the loss of some fauna and the appearance of others as shown by the faunal remains.

HISTORY OF SITE EXCAVATIONS

More than six decades have passed since the historic discovery of the Agate Basin site. The exact date is not known, but it is believed that the site was discovered around 1916 by William Spencer, a livestock owner and operator living in the southern Black Hills near Edgemont, South Dakota. Many explanations—some pure conjecture, some based on the collection and analysis of data—have been presented to account for this phenomenon of bison bones eroding out of a stratum near the top of an arroyo bank along with projectile points of exceptionally fine workmanship. Excavations at the site have similarly ranged from artifact collection to serious undertakings whose purpose was understanding and explanation.

Spencer probably first noticed the site during a visit to the spring directly across the arroyo from the site. This spring was one of a very few sources of potable water in the area, and many homesteaders living nearby visited it regularly in the early part of the present century. Others besides Spencer must have noticed the bones, since they were quite visible and would have aroused anyone's curiosity.

Spencer collected several broken projectile points that had eroded out of the bone level and were exposed on the steep talus slope below. He recovered at least one more while removing bones protruding from the bank. He died in 1977, and whether he performed any serious digging into the site deposits is not known. From all reports, however, it is not believed that he did anything more than superficially probe the edge of the bone deposits.

R. E. Frison, an uncle of the senior author, was the regional game warden for this area of Wyoming during the early 1940s and had long been a collector of artifacts. He was also a longtime acquaintance of one of the discoverers of the Lindenmeier Folsom site, Roy Coffin of Fort Collins, Colorado. As a result, he developed an interest in Paleoindian studies and soon became knowledgeable enough to recognize a number of Paleoindian projectile point types.

In the spring of 1941, a chance meeting occurred between R. E. Frison and William Spencer at an informal gathering of persons interested in local historical phenomena. The gathering took place in a picnic area in a cottonwood grove on the wide floodplain along the Cheyenne River, a few kilometers north of the Agate Basin site. Spencer happened to have with him several broken projectile points from the Agate Basin site, which he showed to the group. Frison recognized these pieces as being unique and very likely quite old. It was the spring of 1942 before the two managed to visit the site together, and a small amount of probing into the bone bed yielded three broken projectile points. Frison sent one of these and some bison teeth from the site to Frank H. H. Roberts, archaeologist at the Smithsonian Institution. This resulted in test excavations in July 1942. The actual excavating was done by Frank H. H. Roberts, his brother, H. B. Roberts, and R. E. Frison, and occurred in what is here designated Area 1.

There are several extant photographs of the 1942 excavations. One of these (Figure 1.6) was taken at the beginning of the excavation. It is difficult to tell for certain, but it is believed that this represents the cleanup stage from earlier digging. If so, the amount of previous site disturbance was minimal. The excavation later in the season (Figure 1.7) reveals a large bone bed with bone well preserved compared to that found in subsequent excavations in Area 2. There

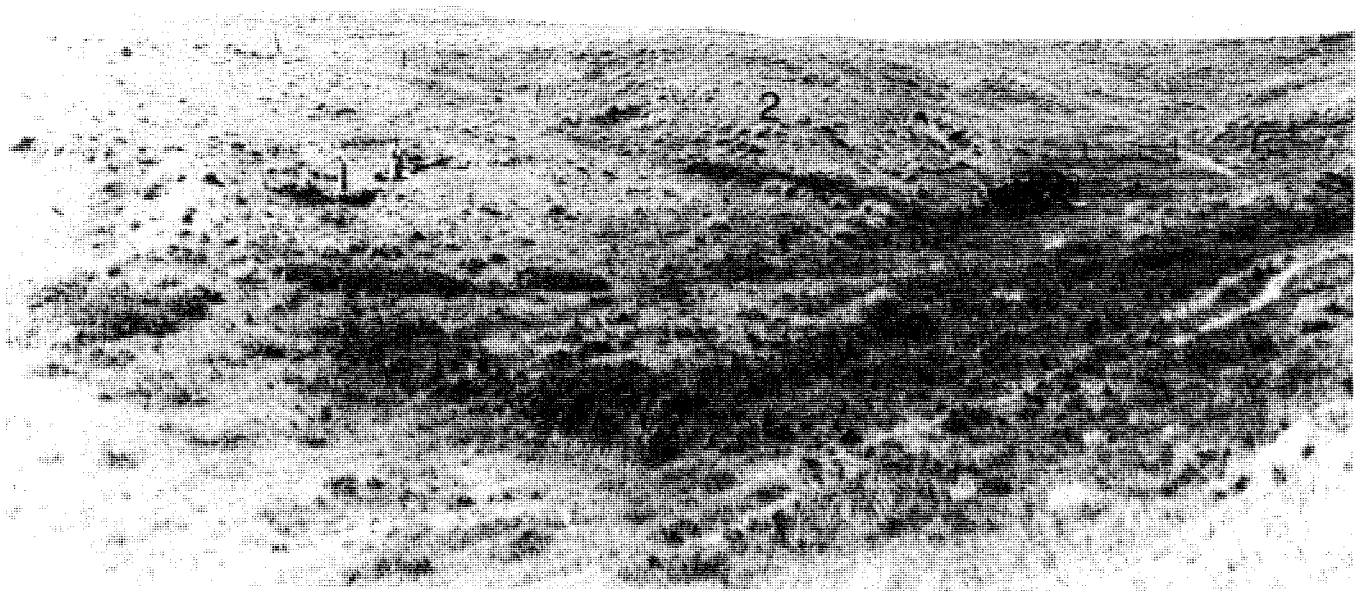
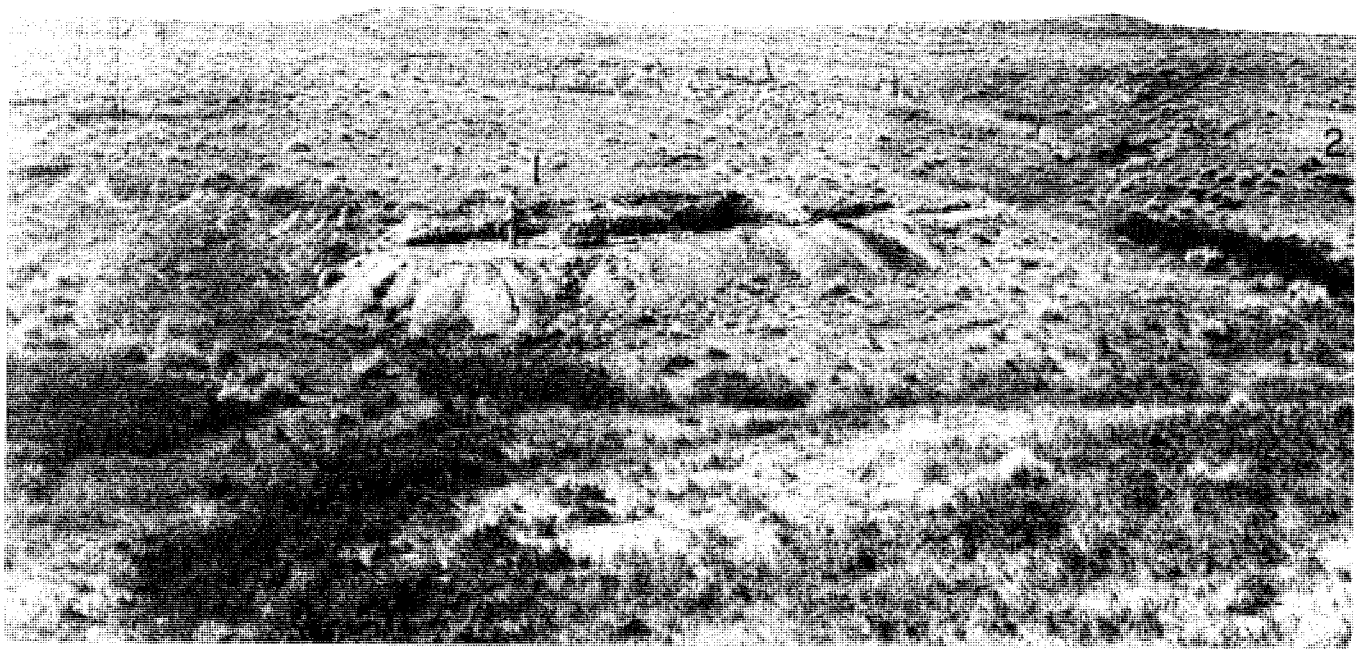


FIGURE 1.6 **Beginning of excavations at Agate Basin, 1942, in Area 1. Note that there is no visible evidence of digging at Area 2.**

FIGURE 1.7 **Excavations in Area 1, 1942. Note the highly visible bone bed and the large pile of bison bone on the arroyo bank.**



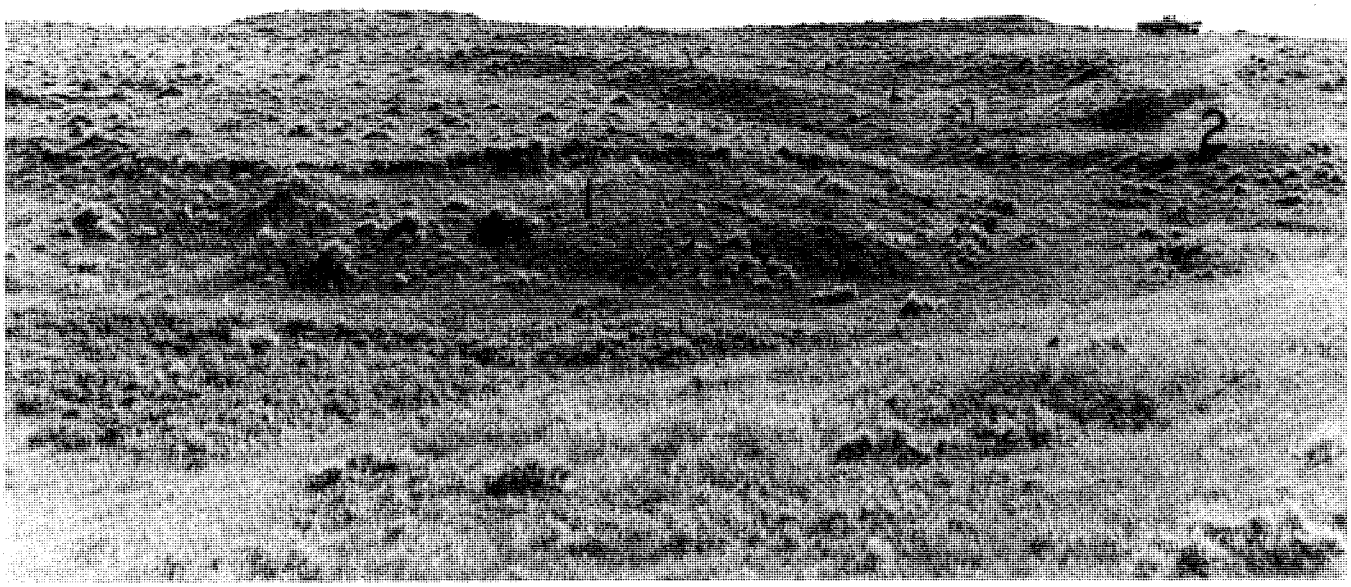


FIGURE 1.8 **Photograph taken in 1980 at the exact location shown in Figure 1.7.**

was no visible disturbance in Area 2 at this time (Figure 1.6). Little if any change can be detected in the general area between 1942 and 1980 (Figure 1.8), except for the removal of material for a dam to form a stock-watering pond during the 1960s, and the similar removal of material in the excavation of Area 2.

A brief note on the site was published by Roberts (1943). The work in 1942 was severely limited by World War II. Under normal circumstances a full-scale excavation would almost certainly have been initiated within the next few years. R. E. Frison did make some later visits to the site between 1942 and 1946, and he collected several more artifacts. Both he and Roberts were aware of similar materials eroding out of the arroyo bank now designated Area 2, and Frison collected the base of one Agate Basin projectile point from there between 1942 and 1945.

Further mention of the Agate Basin site and pictures of some of the projectile points did not appear in the literature until several years later (Roberts 1951). At that time there was insufficient evidence to assign either a reliable or absolute relative date to the Agate Basin cultural complex. However, a few years later (Wheeler 1954) the Agate Basin projectile point was described as a type on the basis of materials recovered at the Agate Basin site in 1942.

Roberts had also found Hell Gap projectile points at Agate Basin but at the time these were not recognized as either a point type or a cultural complex. The provenience of these specimens is lacking, so they may not have been recovered in situ. The Folsom components that would have clarified the stratigraphic relationships between the Folsom and Agate Basin cultural complexes still lay undisturbed in other parts of the site.

The technological excellence expressed in the Agate Basin projectile points

at the site proved irresistible, and consequently the site suffered continual depredation. Roberts' work was confined to the eastern end of the site (Area 1, Figure 1.4) although as has been mentioned he was well aware of another exposure of bone and artifacts (Area 2, Figure 1.4). Collectors dug to some extent in both site areas before Roberts was able to return to the site in 1961.

One of the persons who visited the Agate Basin site in the late 1950s was James Duguid, a geology student at the University of Wyoming, who noticed bones, charcoal, and artifacts eroding out of an arroyo bank about 85 m west of Area 2. Probing into the bone level, Duguid recovered two Folsom projectile points. This discovery led to a small excavation by the University of Wyoming in 1959, under the direction of George Agogino with W. D. Frankforter as paleontologist and C. V. Haynes as consulting geologist. This was the excavation that came to be known as the Brewster site (Agogino and Frankforter 1960), after an Iowa man who appeared and offered to do volunteer work there. The Folsom component was confirmed and found to underlie what were then believed to be Agate Basin components. The Brewster site was considered to be separate from the Agate Basin site, although today there is no question that it is part of the same site. This was also Roberts' opinion (1961a: 132); he was aware of the exposure of the cultural level that later became known as the Brewster site (now Area 3; see Figure 1.4).

The first major excavation at the Agate Basin site was conducted in 1961 by William M. Bass of the University of Kansas and Frank H. H. Roberts of the Smithsonian Institution. Funds were supplied by the National Geographic Society (Grant No. 329). At the beginning of the investigations, it was noted that extensive damage had been done by collectors to the Agate Basin components in Areas 1 and 2 (Figure 1.9). However, the major excavations during 1961 were in Area 2 (Figure 1.10). The remainder of Area 1 was excavated, but the artifact collectors had left little. Unfortunately, much of the effort in 1961 was expended in cleaning up the site so that proper excavation could proceed.

In addition, several areas along the south bank of the arroyo were tested in 1961; a small area adjacent to the Brewster site excavation was later proven to contain part of a Hell Gap component (Figure 1.10). Area 6, about 200 m downstream from the Areas 1 and 2, was also tested. Two short reports were published on these investigations (Bass 1970; Roberts 1961b); Roberts (1961a) also published a slightly expanded statement that presented Agate Basin as a cultural complex.

The 1961 excavation trenches were not filled and unfortunately provided ideal guide markers for the projectile point collectors. Consequently much of the site, especially in Area 2 and to a lesser extent in Areas 1 and 3, was lost to the collectors throughout the 1960s. James Duguid, who, subsequent to locating the Brewster site, had also discovered the Hell Gap site about 110 km south of the Agate Basin site, dug and collected materials from Agate Basin between 1961 and 1967, as did Louis Steege of Cheyenne, Wyoming, a member of the Wyoming Archaeological Society. All the material they collected at the Agate Basin site has been given to the Smithsonian Institution and is of some value, but exact provenience is lacking, bones were not mapped or saved, and the exact areas excavated were not carefully recorded.

Several hundred meters downstream from Area 1 is a livestock pond built in

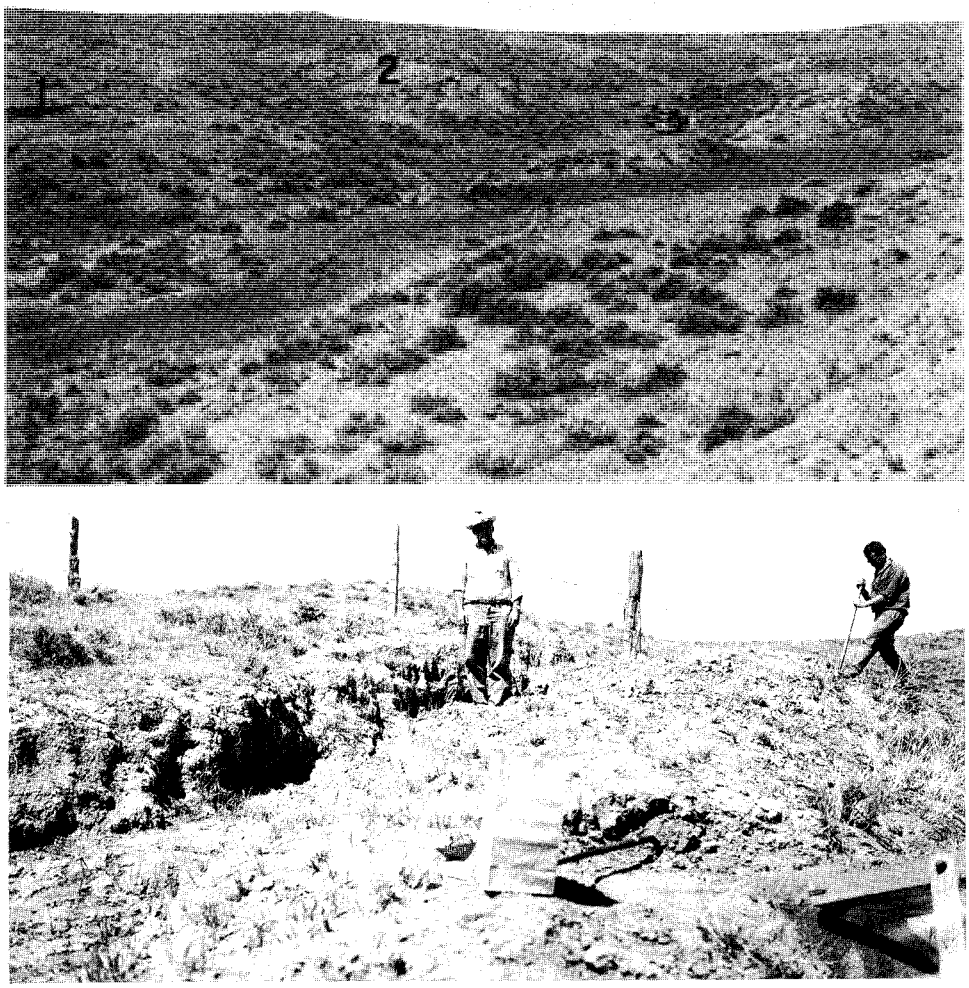


FIGURE 1.9 **The Agate basin site as it appeared at the beginning of the 1961 Smithsonian field season (top); extensive digging into the Agate Basin component in Area 2 (bottom).**

the 1950s. The dam was constructed from dirt scooped out of the arroyo bottom and from the south arroyo bank. This excavation exposed several dark strata containing redeposited charcoal and bone. Out of the deepest of these levels, Duguid recovered a toothed bone flesher thought to be of Folsom age (see Chapter 2, Section 6). It is now believed that this artifact was redeposited from upstream, since excavations in this site area in 1975 and 1976 revealed scattered bone fragments, small flakes, and charcoal but nothing that appeared to be in situ. Duguid also discovered and dug into the Paleoindian exposure known as the Sheaman site (Area 9), which is of Clovis age.

Shortly after the 1961 excavations by Roberts and Bass, another livestock reservoir was constructed in Moss Agate Arroyo at the Agate Basin site, this time at Area 2 (see Figure 1.2, bottom). Although the fill material was taken from both the bottom and the south bank of the arroyo, site components were not seriously disturbed by these excavations. However, some disturbance did result from the preparation of the base for the dam, and the water in the pond

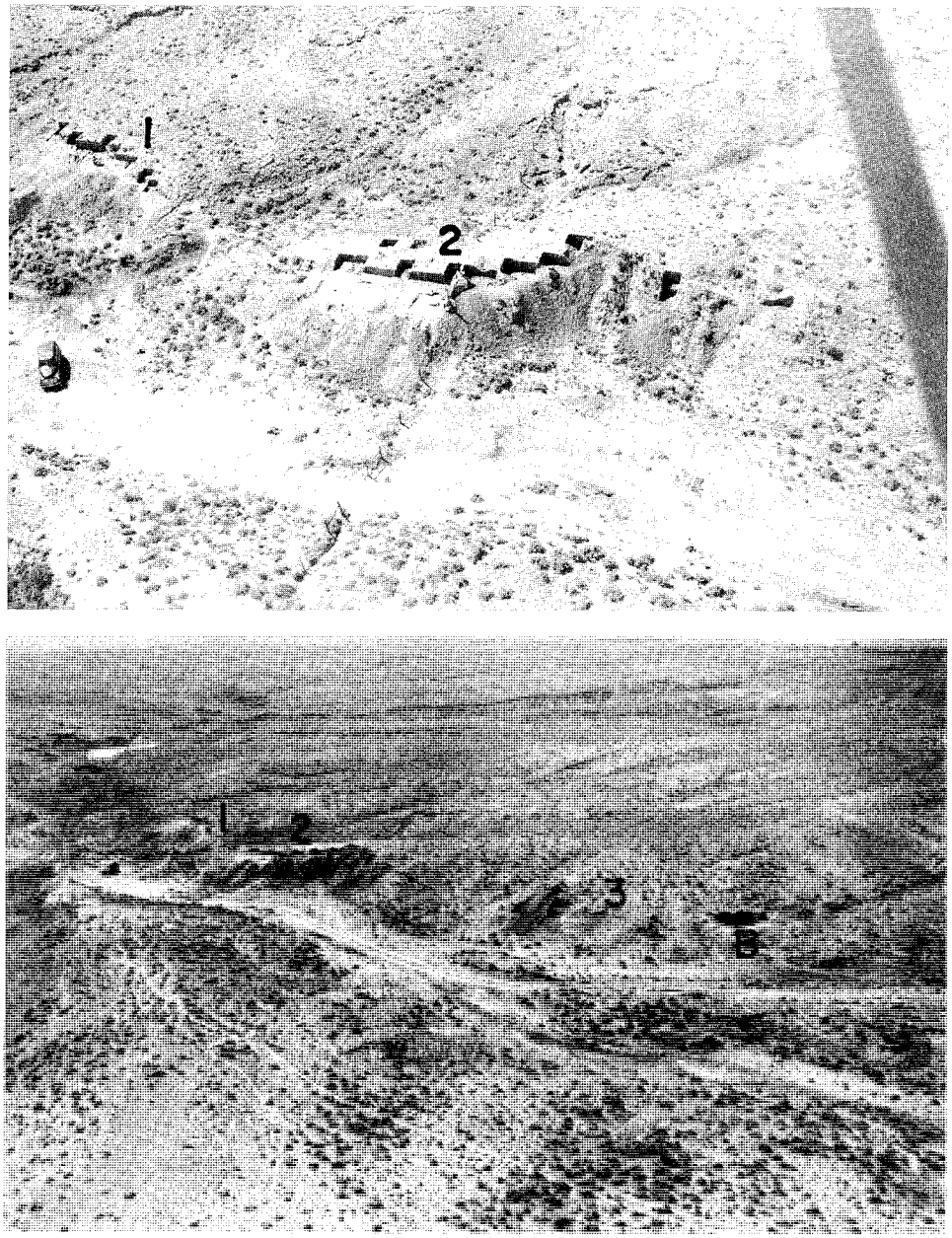


FIGURE 1.10 **Excavations in Areas 1 and 2 in 1961 (top), and tests in Area 3 (bottom). B indicates the Brewster site excavations in 1959. [*Photo by William Bass*]**

has backed up to the Brewster site area, causing considerable cutting into the south arroyo bank. This has been greatly accelerated by the increased use of the area around the pond by livestock. Fortunately most of the archaeological components are deeply buried well away from the edge of the stock pond, and their chances of destruction are minimal.

In 1972 the senior author was conducting archaeological work about 100 km to the north in the Wyoming Black Hills when he decided to test the Agate Basin site in order to acertain if any of the site remained. A 5 × 10 foot test of the Agate Basin component in Area 2 revealed that artifact hunters were still finding undisturbed deposits with considerable amounts of bone. It also indi-