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Stones and bones are the fundamental building blocks of prehistory, especially the deep hominin prehistory. The only thing that survives from the earliest humans, except in rare instances of the humans themselves, is stones and bones in that order. It was in this context that the late archaeologist Glynn Isaac (1977) characterized the archaeology of the earliest humans as “squeezing blood from stones.” Stones and bones must, however, be placed in context, and that largely comes from profiles or rather stratigraphy. Stones, bones, and profiles thus constitute the three building blocks of much of the early archaeology from the appearance of earliest humans to the advent of the Neolithic or its equivalents on various continents.

So it is no wonder that this book, dedicated to two prominent scholars whose careers focused on the earliest Americans, the Paleoindians, is about stones, bones, and profiles. In fact, tools and tool making from raw stone material and the remains of food residues, or one of these, are what we find at nearly all Paleoindian sites in western North America. Where we find them and in what contexts are key to understanding the implications of these remains for reconstructing the lifeways of ancient peoples. And by and large, other items are rare or absent, except in a few cases, and often these are likewise made of either stone or bone. We are referring to such things as bone tools (needles, awls, gaming pieces, and others), ornaments (beads), and possibly in a few instances

Stones, Bones, and Profiles
Archaeology and Geoarchaeology
of C. V. Haynes Jr. and
George C. Frison

MARCEL KORNFELD
AND BRUCE B. HUCKELL

representational art. As the research on the earliest Americans has expanded, heating facilities, structures, and even settlements have been described, but such occurrences are even sparser than the rare objects just mentioned. Thus by and large our understanding of Paleoindian period is built from remains of stones and bones and their context.

George Frison and C. Vance Haynes Jr. have been the leaders in North American Paleoindian studies for the past 60 years and have made significant contributions to the understanding of the stones, bones, and profiles. In the remainder of this chapter we chronicle the remarkable careers of these two scholars, followed by an introduction to the papers in the rest of this volume, which focus on the approaches judiciously followed by Frison and Haynes during their careers.

It is sometimes the case in archaeology that certain scholars have a disproportionate impact on the development of knowledge about the past. The impact of their efforts can be seen in multiple realms of the discipline, ranging from fundamental empirical contributions to bringing to bear new methods for investigation and analysis or even developing them as well as training students and providing them with opportunities to be active participants in their research, and by their efforts, helping to define key questions that provide focus and direction for the efforts of other scholars. Over the past five decades George C. Frison and C. Vance Haynes Jr. have pioneered the investigation of North American Paleoindian archaeology and Quaternary geoarchaeology (see Appendix I and Appendix II). The contributions of these National Academy of Science members have created foundations upon which their students and colleagues continue to build and have stimulated the development of new ways of perceiving and investigating the early prehistory and ecology of North America.

At the 2012 Society for American Archaeology meetings we organized a symposium to honor and celebrate the many accomplishments of Haynes and Frison by inviting contributions from their students and colleagues that address topics that have loomed large in their careers. It seemed to us that “Stone, Bones, and Profiles” captured in a few words the principal realms to which each has devoted attention, although, to be sure, this does not exhaust the list of topics. The chapters in this volume are grouped into three parts: “Peopling of North America and Paleoindians,” “Geoarchaeology,” and “Bison Bone Bed Studies.” Before we introduce the chapters, it is perhaps appropriate to begin with short biographical sketches of George Frison and C. Vance Haynes Jr.

GEORGE C. FRISON

George Frison was born in 1924 in Worland, Wyoming, and grew up on his grandparents' ranch at Tensleep, Wyoming (Figure 1.1). His interest in prehistory began as he found dinosaur and mammoth bones in the area and was further stoked by a visit to Barnum Brown's dinosaur excavations near Tensleep in the 1930s. Brown, the great dinosaur hunter, had found one of his most famous sites in the Bighorn Basin, one of the densest known concentrations of sauropods (Brown 1935). As a boy Frison enjoyed collecting arrowheads and asking questions about prehistory, but his visit to the dinosaur quarry exceeded all his expectations. George was also influenced by a relatively constant flow of Crow peoples through his grandparents' ranch on the way from Crow Agency to western reservations (George Frison, personal communication 2014). In addition, George grew up hunting and developed keen insights into animal behavior. The detailed knowledge of animal behavior that human hunters had to have to be successful steers Frison's thinking about prehistoric animal procurement (Frison 2004). His budding interest in prehistory was interrupted by World War II, and he served a four-year stint in the US Navy, mainly in the South Pacific. As his interest grew, he excavated a few sites on his own and joined the Wyoming Archaeological Society (Frison 1962).

Frison's early focus was on the Bighorn Basin rockshelters, and in 1952 he discovered a cave with many atlatl dart fragments (Frison 1965). As with many Great Basin shelters, these occasionally yielded perishable materials that fascinate amateurs, which he was at the time. Importantly, he took these materials to William Mulloy of the University of Wyoming, establishing contact with a professional archaeologist. It was Mulloy who convinced him, in 1961, that if he wanted to become a professional archaeologist, he would need formal university training. By 1962 the family ranch operation had ceased, and he made the commitment to pursue archaeology (Frison 2014). In 1962 he enrolled at the University of Wyoming, earning his bachelor's degree in 1964. He attended graduate school at the University of Michigan and received his master's degree in 1965 and his doctoral degree in 1967. That same year he was appointed head of the new Department of Anthropology at the University of Wyoming.

When Frison entered the field, William Mulloy's (1958) published dissertation was the only prehistory of the Northwestern Plains. Although that monograph set out the basic chronology of the region, it remained a work in progress. Hence stratified sites, datable sites, and chronologically diagnostic objects formed much of Frison's research universe and culminated in a comprehensive cultural chronology of the Northwestern Plains and the adjacent Rocky Mountains (Frison 1978). Once established in Laramie, he returned



FIGURE 1.1. *George C. Frison visiting the Lindenmeier site in northern Colorado (courtesy Margaret Jodry)*

to the Bighorn Basin area, often for rockshelter and other research throughout his career. George's other principal focus, starting with his association with the Wyoming Archaeological Society (WAS) in the late 1950s, became bison bone beds (Frison 1968a). With the WAS and later through his research agenda at the University of Wyoming, he excavated a number of these types of sites and began understanding differences between them. The list of bone beds that Frison investigated reads like a who's who in bison bone bed studies as well as the contemporary zooarchaeology (Frison 1970, 1971, 1996; Frison and Todd 1987). With bone beds also came the focus on interdisciplinarity. An early geologist working on the Powder River Basin bone bed identified it as being in an arroyo, a determination of importance that could not have been made without a specialist (Mann 1968). Arroyo traps versus bison jumps versus

corrals and how these facilities were used as well as how animals were manipulated could not have been done without the “geo” and, we might add, without the understanding of animal herding and hunting experience that Frison had. Other specialists who collaborated with George to understand prehistoric cultures were paleontologists, geochemists, and taxonomists, among others (Graham 1986; Walker 1982, 1987).

Frison devoted considerable effort to building the anthropology department at the University of Wyoming and shortly afterward the Office of the Wyoming State Archaeologist (OWSA). Both were new institutions. The department soon introduced a master's degree in anthropology, and OWSA conducted numerous field and lab studies. Most remarkable in forming the state archaeologist office was that Frison managed to introduce a statute requiring that the state archaeologist be a member of the anthropology department. As a result, the state site records and archaeology repository were consolidated and incorporated into the department at the University of Wyoming, a rare case in which records, surveys, the primary state repository, and academic archaeology can be found under one roof.

Finally, Frison served on boards of and as president of both the Plains Anthropological Society and the Society for American Archaeology, on numerous editorial boards, and local, regional, and national committees concerned with archaeology and preservation. He frequently helped local museums in developing displays and gave numerous presentations to various civic groups throughout North America. In this way he truly contributed to raising public awareness about archaeology and the past.

FRISON'S CONTRIBUTIONS

Frison and his students introduced new methods, developed and refined existing methods, and made significant contribution to zooarchaeology and the study of bone beds, animal population structure, seasonality, butchering, tooth eruption, and taphonomy (Frison and Reher 1970; Reher 1970, 1973, 1974). The bigger picture of this focus speaks to prehistoric economies. Frison, a student of Leslie White and Marshall Sahlins, was certainly influenced by the role of energy in the culture process and by Sahlins's (1972) book *Stone Age Economics*. Although often couched in subsistence terminology, Frison's contribution is clearly broader and considers economy as a whole.

Another of Frison's major contributions was to technology, not completely divorced from economy, where both his experimental and analytical approaches brought cutting-edge results. In his dissertation Frison refit a



FIGURE 1.2. *C. Vance Haynes Jr. at the Lehner Clovis site, June 1974 (photo by Helga Teiwes, used with permission of the Arizona State Museum)*

handful of edge sharpening flakes, and it became immediately clear that this small exercise had mega implications for contemporary theoretical discussions (Frison 1968b). Because this was the time of the Binford/Bordes debates, in which tool morphology was king (e.g., Binford and Binford 1966; Bordes 1953), George clearly showed that tool morphology changes with implement use. It took only a few years to have his former professor, Arthur Jelinek (1976), dub this the “Frison Effect.”

C. VANCE HAYNES JR.

Vance Haynes was born in 1928 in Spokane, Washington, the son of a pioneer US Air Force officer (Figure 1.2). He grew up in a variety of places, moving as his father’s career dictated. His first exposure to archaeology came

while he was living at Langley Field, Virginia, when he and a friend found a demolished historic site. Later he was an Air Force officer stationed at several bases, including Kirtland Air Force Base in Albuquerque, New Mexico, between 1950 and 1954. During those years he was bitten by the archaeology bug and discovered numerous Paleoindian and Archaic sites in the Estancia Basin, work that resulted in his first publication (Haynes 1958). By the end of his time at Kirtland he was interacting with University of New Mexico archaeologists, even test excavating a rockshelter near Socorro for the university. After leaving the Air Force, he earned a geological engineering degree from the Colorado School of Mines in 1956. He realized that while geologists such as Kirk Bryan and Ernst Antevs had collaborated with archaeologists to investigate sites (Antevs 1955; Bryan and Ray 1940), there was no one who combined expert knowledge in both the “geo” and “archaeology” fields. A discussion with Marie Wormington convinced him that this was a critical role someone with his skills could fill, and he decided to attend graduate school at the University of Arizona.

Vance’s first geoarchaeological project was Hell Gap (Haynes 1965a). Having hooked up with George Agogino through Emil Haury, Vance joined Agogino’s Raiders to test the new site in 1959 and 1960 and continued as the site geologist through the Harvard/Peabody Hell Gap Expeditions of the period 1962–66 (Knudson 2009). Agogino’s Raiders also tested several Agate Basin site localities, Sister’s Hill, and other potential Paleoindian sites (e.g., Agogino and Galloway 1965). Haynes was particularly interested in the recent advances in radiocarbon dating and devoted himself to the problem. He worked at the newly established (1958) University of Arizona Carbon-14 Age Determination Laboratory while a graduate student. In 1962 he was invited to participate in new research in the Blackwater Draw area, which almost became his dissertation project. Ultimately, at the invitation of Richard Shutler, he served as project geologist in 1962–63 for the Tule Springs project in Nevada, his first involvement with assessing a site at which possible evidence for pre-Clovis occupation had been reported (Haynes 1965b).

Upon completion of his doctoral degree in 1965, Haynes embarked on his lifelong career of studying Paleoindian chronology and peopling of the Americas and soon became the go-to person to consult regarding Quaternary stratigraphy, radiometric dating, Clovis archaeology, and geochemistry. In the process he has worked with colleagues from North and South America as well as overseas. The Pleistocene/Holocene Transition has been a principal focus of his research, and hence the nature of the Younger Dryas and its characteristic “Black Mat” has been identified throughout the continent as a marker

horizon (Haynes 2008). The process has led him to question geologic context of samples for radiocarbon assays as well as specifics of analytical protocols for dating various organic materials, specifically bone (e.g., Haynes 1991, 1999).

Vance spent the years 1965–68 on the Arizona faculty. In 1966 he and Pete Mehringer discovered the Murray Springs Clovis site, setting in motion six seasons of fieldwork at that remarkable San Pedro Valley locality. Murray Springs remains the only Clovis site in the San Pedro Valley to be discovered by professional academics and one of the few in North America not found by members of the public (Haynes and Huckell 2007). In the midst of that project he moved to Southern Methodist University, where he worked from 1968 to 1974. He was instrumental in starting up the SMU Radiocarbon Laboratory in 1972, and in addition to continuing work at Murray Springs he began geoarchaeological research with Fred Wendorf in Egypt's Western Desert and with Bruce McMillan in the Pomme de Terre Valley in Missouri (Haynes 1980, 1985). Other research included Malawi, Borax Lake (California), and Arroyo Cuervo (New Mexico). In 1974 he returned to Arizona and inaugurated new research at the Lehner Clovis site (1974–75). He continued his Egyptian and Missouri research, returned to Blackwater Draw, and investigated Indian Wars battlefield archaeology in Montana. He retired (but only from teaching, as he is quick to point out) in 1999.

While most archaeologists are cognizant of his many contributions just mentioned, many may be unaware that he is one of the leading experts in US military shoulder arms during the late nineteenth century. He has been involved as well in the investigation of several Indian Wars battlefield sites on the Plains, including the Custer and Allen Creek battlefields.

HAYNES'S CONTRIBUTIONS

Among the many threads that can be identified in Vance's career, certainly the most prominent is a critical approach to context in the broadest sense. This is perhaps most obvious in his detailed studies of site stratigraphy and investigation into the geomorphic processes by which the archaeological record is created and modified. It extends equally to his geochronological work, his dedication to advancing the precision and accuracy of radiocarbon dating, and his development of methods for the reliable dating of bone (Haynes 1992). A third aspect of his focus on context is the critical scrutiny of archaeological sites, particularly on the association of archaeological materials, geological deposits, and radiometrically dated materials (e.g., Haynes 1965a, 1991, 1999, 2009).

A closely related focus of Vance's research is the reconstruction of past environments, perhaps most prominently featured in his interest in the nature of the geographic extent and impact of the Clovis drought, the ensuing Younger Dryas, and the implications of environmental changes for the late Pleistocene extinctions. In addition, understanding environmental conditions is critical for suggesting the route by which the First Americans entered that portion of North America south of the ice sheets. And throughout his career Vance has been intrigued by Clovis mammoth hunting and the extinction of the Pleistocene megafauna.

Finally, as those who have taken a course from him can attest, Vance has long impressed upon his students the utility of T. C. Chamberlin's (1890) method of multiple working hypotheses. It is this approach to using science that has guided Vance's career, and it is one that can benefit all of us. Both George and Vance have a strong commitment to good science and recovery of copious facts to demonstrate their interpretations.

Although Haynes's and Frison's interests overlapped for a number of years and they read each other's research with gusto, it was late in their careers that they actually started to collaborate. Ultimately, it was the Goshen or Goshen/Plainview problem and its Hell Gap site origin that brought them closest together during the mid-1990s investigation of the Mill Iron site and continues to bind them through the still ongoing investigations of the Hell Gap site (Frison and Haynes 1996; Haynes 2009, 2014).

STONES, BONES, AND PROFILES

The remainder of this volume is organized into three sections that reflect the research domains in which Frison and Haynes have made some of their most lasting contributions. Each section contains chapters written by colleagues and former students who have taken their inspiration from George and Vance.

Part I, "Peopling of North America and Paleoindians," is dedicated to these topics, in particular a critical scrutiny of the pre-Clovis archaeological record, the nature and character of the Alberta Corridor (a critical region for peopling), the earliest well-defined occupation of a critical area (northern Mexico) for reaching South America, the role and importance of experimental archaeology in the making of proper inferences about the behavior of the First Americans, and the latest results from the study of a late Younger Dryas component of Paisley Cave (a unique look at early Great Basin culture ecology).

The focus of the second section of the book is geoarchaeology. The current state of geoarchaeological understanding of the Lindenmeier site, one of

the most significant Folsom localities of North America that looms large in a number of theoretical perspectives on Paleoindians, is considered in the first chapter. The Union Pacific Mammoth site in central Wyoming, which represents one historically troubling early locality providing ambiguous evidence of early humans, is reevaluated. The section concludes with significant contributions to geoarchaeology in a region of relevance to the works of both George Frison and Vance Haynes, the Bighorn Basin of the Central Rocky Mountains.

The third section of the book considers zooarchaeology and particularly bison studies and taphonomy, topics virtually synonymous with George Frison. A number of his students have carried this research on and with great success expanded our knowledge of subsistence behavior of Paleoindians and other prehistoric groups. Such studies have a variety of axes, as exemplified by models of bison hunting on the Southern Plains, bison taxonomy and evolution, bison herd control at drive sites, and bison utilization in the Old World. *Stones, Bones, and Profiles* is not only a tribute to Haynes and Frison, but offers valuable new data on the peopling of the Americas, Paleoindians, bison studies, lithic studies, earliest Plains and Great Basin prehistory, and a retrospective on our current state of knowledge

PEOPLING OF NORTH AMERICA AND PALEOINDIANS

Of all of the topics covered by chapters in this volume, it is safe to say that the peopling of North America remains the subject of considerable disagreement with respect to timing, cultural identity, ancestry of the founding populations, and how the process of colonization played out. Several volumes on this general topic have appeared over the last several decades, along with numerous articles in a host of journals (e.g., Adovasio 2003; Dillehay 2000; Haynes 2002; Kornfeld and Politis 2014; Meltzer 1993; Pitblado 2011). As with peopling, Paleoindian prehistory is still in its infancy, and controversies abound regarding even such basics as cultural chronology and more fundamentally subsistence strategies, settlement strategies, and other aspects of behavior of the First Americans (e.g., Byers and Ugan 2005; Kornfeld 2007a; Sellet 1999). The five chapters that make up this section of the volume consider colonization and other aspects of Paleoindian prehistory.

Stuart Fiedel's chapter, "Confessions of a Clovis Mafioso," takes its title from some of the polarized positions staked out by partisans in debates over North American colonization. As he describes, contrary to an archaeological "urban myth," Vance Haynes is not the godfather of a sinister Clovis Mafia

that has ruthlessly suppressed evidence of human occupation of the Americas before 13,500 cal BP. In fact, researchers touting supposed pre-Clovis sites enjoy the support of major public institutions, wealthy private donors, and a credulous media. Nevertheless, Haynes has always insisted that each pre-Clovis claim must withstand skeptical scrutiny. Using such critical consideration of the published data, Fiedel argues that even the most plausible recent candidates (including, in North America, Cactus Hill, Virginia; Paisley Caves, Oregon; the Debra L. Friedkin site, Texas; the Schaefer and Hebior mammoths in Wisconsin; and Miles Point, Maryland) remain dubious.

The third chapter is by Andrea Freeman, who evaluates a pathway into North America south of the ice sheets that has seemingly fallen from favor as a route for colonists. "Why the Ice-Free Corridor Is Still Relevant to the Peopling of the New World" takes the position that we should not prematurely discard the corridor in favor of a coastal entry model (Fedje et al. 2004; Mandryk et al. 2001). As she points out, patches of desirable land in the mountainous regions and surrounding basins of Alaska, the Yukon, British Columbia, and Alberta formed a more complex habitat than simplistic reconstructions of retreating ice would suggest. Prehistoric people traveling through these areas carried with them technologies similar to what appear as Clovis and Goshen complexes on the High Plains and American Southwest around 13,000 cal BP. Establishing whether connections exist among these technologies and archaeological manifestations is still a relevant aspect of how early people moved into and colonized these landscapes, irrespective of possible earlier technologies. Her chapter explores the chronology and environmental conditions in the ice-free "corridor" and examines the technology of early Paleoindian presence within it.

Without question the portion of Canada south of the ice sheets and what is today the United States are often the sole archaeological focus of investigations of the colonization process; Mexico and Central America are either left out of the discussion or are seen only as a migratory ramp to South America. However, as Guadalupe Sanchez and John Carpenter argue in chapter 4, "Tracking the First People of Mexico: A Review of the Archaeological Record," the geographical location occupied by Mexico in the Americas identifies it a significant region among those paradigms that attempt to explain how the First Americans reached the tip of South America so early in the New World sequence. The Paleoindian period in Mexico remains poorly known and understood, and many of the sites proclaimed to be early are problematic. Sanchez and Carpenter organize and present the relevant data used in elaborating a synthesis of this important period of Mexican prehistory. Currently available

evidence is grouped into four classes: (1) directly dated human bones; (2) the occurrence and distribution of Clovis, Folsom, and Plainview points; (3) sites containing mammoth and other Pleistocene fauna associated with humans; and (4) miscellaneous archaeological records found across the country. A critical review of the records and propositions for future research are also discussed.

A key focus of the careers of both Frison and Haynes has been Paleoindian lithic analysis. Frison pioneered the study of flaked stone tools from Northern Plains sites of all ages and was the author of a seminal 1968 paper on tool resharpening and its effects on tool morphology. This subsequently became one of the inspirations for Harold Dibble's (1988, 1995) studies of technological and morphological changes in Mousterian scrapers as a function of resharpening. Frison's and Dibble's studies promoted the now standard vision of stone tools as morphologically dynamic over the course of their use lives. Frison has also been deeply interested in actualistic, experimental investigations of stone tools in the hunting and butchering process. Perhaps most famous is his experimentation with Clovis point-tipped spears on recently killed elephants in Zimbabwe (Frison 1989). Haynes, too, has examined ways to evaluate morphological variation in projectile points and the implications that point typology can affect the perception of similarity or difference among Paleoindian cultural traditions. Among other investigations, he has been concerned with the degree to which Plainview, Goshen, and Midland points represent distinct types, or are sufficiently similar to defy easy separation on either morphological and technological grounds (Haynes 2014). Finally, Haynes has devoted considerable attention to the environmental changes that occurred during the Younger Dryas climatic interval as a means of assessing the challenges and opportunities that Paleoindian groups faced with the arrival and termination of this millennium of cooler, effectively wetter climate (Haynes 1993). He has documented the geographic extent of stratigraphic manifestations—rising water tables that promoted the formation of black mats and soils—of the Younger Dryas and has proposed that the environmental causes behind the stratigraphic signatures must have affected subsistence choices available to Paleoindian groups. Chapters 5 and 6 in this section highlight these approaches (Haynes 2008).

“Use-Wear Analysis of Clovis Bifaces from the Gault Site, Texas,” by Ashley M. Smallwood and Thomas A. Jennings, owes much to George Frison's experimental research with African elephants and replicated Clovis artifacts as well as similar studies done with bison (Frison 1979). In this chapter they present two experimental programs that feature the replication and use of Paleoindian tools with the goal of distinguishing wear produced by cultural use of these

tools from wear that results from unintentional or natural damage. Smallwood and Jennings begin by discussing a use-wear analysis that documents wear traces acquired on Clovis point replicas; they then compare intentional tool production with core reduction and trampling (McBrearty et al. 1998). These studies highlight the importance of experimental approaches to understanding Paleoindian technology and underscore the importance of detailed analysis of the lithic artifacts recovered from archaeological contexts.

The nature of climate and human response to the Younger Dryas interval has become an important—and debated—topic in Paleoindian studies. The final chapter in this section is “Younger Dryas Archaeology and Human Experience at the Paisley Caves in the Northern Great Basin,” by Dennis L. Jenkins, Loren G. Davis, Thomas W. Stafford Jr., Thomas J. Connolly, George T. Jones, Michael Rondeau, Linda Scott Cummings, Bryan Hockett, Katelyn McDonough, Ian Luthe, Patrick W. O’Grady, Karl J. Reinhard, Mark E. Swisher, Frances White, Robert M. Yohe II, Chad Yost, and Eske Willerslev. They describe the discovery and contents of a unique lens of coarse white hair, hide, grass, bulrush, shredded sagebrush bark, stone, bone, wood, and fiber artifacts that covered roughly six square meters of floor near the bottom of Paisley Cave No. 2 (Cressman 1940). Dated between 10,160 and 10,365 ¹⁴C yr BP, this 5–8 cm thick, organic cultural lens is sandwiched between culturally sterile upper and lower compact alluvial silt lenses, providing an unusually discrete and accurate picture of late Younger Dryas Western Stemmed cultural ecology in the northern Great Basin.

GEOARCHAEOLOGY

No volume honoring Vance Haynes would be complete without a section focused on geoarchaeology, but George Frison has himself devoted considerable attention to the topic in his research (e.g., Frison 1978). Stratigraphic studies provide the contextual basis for understanding past human occupations within the framework of geomorphic and pedological processes as well as past environmental conditions and chronological placement, which have long been a key component of archaeological research (Antevs 1955; Bryan and Ray 1940). Vance has certainly played a major role in refining the application of geological methods to archaeological research, moving geoarchaeological investigations well beyond the foundational work done by pioneers in the field. The three chapters in this section—one of which Vance himself contributed to—are excellent examples of contemporary geoarchaeology focused on Quaternary stratigraphy at scales small and large.

Chapter 7, titled “Soil and Stratigraphy of the Lindenmeier Site,” is by Vance T. Holliday. The well-known Lindenmeier site in northern Colorado was among the first stratified Paleoindian sites subjected to careful geological scrutiny, including work done by Vance Haynes and George Agogino (1960) that produced the first radiocarbon date for the site. Holliday presents additional geoarchaeological data focused on the Folsom soil-stratigraphic record. He demonstrates that soils are important at Lindenmeier because (1) they are a significant component of the stratigraphy, (2) they may have affected the distribution of artifacts, and (3) they indicate local environments when they formed. Haynes and Agogino (1960) identified seven lithostratigraphic units (A–G, bottom to top of the section) and nine unconformities (Z₁–Z₉), to which Holliday adds seven buried soils (b₁–b₇, top to bottom of the section) formed on these lithostratigraphic units. The Folsom artifacts were found in upper B, on Z₄, and in lower D (Haynes and Agogino 1960:11–12). A well-developed soil (b₇) formed in Unit B. Unit D represents the A-horizon of a soil (b₆) that formed across the valley following Z₄ erosion and which is welded to the b₇ soil. The color, thickness, and lithology of the b₆ soil suggest that it was slowly aggrading on the valley floor, likely under a dense, continuous grass cover. The artifact assemblages probably represent multiple Folsom occupations in the valley on top of Stratum B and continuing through the early phases of D formation.

Chapter 8 addresses new research underway at the Union Pacific Mammoth site in south-central Wyoming. “Mammoth Potential: Reinvestigating the Union Pacific Mammoth Site, Wyoming,” by Mary M. Prasciunas, C. Vance Haynes Jr., Fred L. Nials, Lance McNees, William E. Scoggin, and Allen Denoyer, tackles this enigmatic, possible Clovis site. Excavations at the UP Mammoth site near Rawlins, Wyoming, during the early 1960s unearthed the remains of a Columbian mammoth along with stone and bone tools interpreted as butchering and processing implements (Irwin et al. 1962). The stratigraphy at the site was very complicated, a situation made more challenging by the fact that much of the skeleton lay below the water table. The site was described as a mammoth kill site, and a summary of the project written by Cynthia and Henry Irwin and George Agogino appeared in the June 1962 issue of *National Geographic* magazine. However, the results of those excavations were never fully reported, and the association of the artifacts—none of them Clovis diagnostics—with the mammoth skeleton was subsequently questioned. This paper describes recent field investigations and analyses conducted to help resolve whether the mammoth remains are part of an archaeological site or are part of a late Quaternary paleontological locality.

Rockshelters are central to the long history of archaeological research in Wyoming's Bighorn Basin, and their well-stratified records form the basis for much of the region's archaeological history (Frison and Walker 2007; Kornfeld 2007b). Judson Byrd Finley explores the records in these shelters in chapter 9, titled "Late Holocene Geoarchaeology in the Bighorn Basin, Wyoming." Among George Frison's many archaeological contributions to rockshelter research is the investigation of early Paleoindian settlement strategies, the origin of the Foothills-Mountain Paleoindian tradition in response to post-Pleistocene climate reorganization, and Late Archaic connections with the eastern Great Basin. Finley's chapter builds on Frison's work by examining the geological history of rockshelters, focusing on the biogeomorphic responses to postglacial climate change that structured local and regional sedimentation processes. Recent geoarchaeological evaluation of Bighorn Basin alluvial history provides critical complementary data to a growing regional paleoecological record that highlights the linkages between continental climatic systems, geomorphic processes, and human adaptive strategies.

BISON STUDIES

Unquestionably George Frison has played a key role in revolutionizing how bison recovered from archaeological sites can be studied, how prehistoric hunters procured and processed bison, and how bison evolution played out on the Northern Plains over the last 10,000 years (Frison 1970, 1971, 1991). George has approached this topic not only as an archaeologist, but also as a hunter with a lifetime of observations of bison behavior. Combining the two allowed him to develop a much more holistic perspective on the utilization of bison by ancient societies. His studies have in turn inspired generations of students and set a high bar for contemporary investigators of bison (e.g., Hill 2008; Reher and Frison 1980; Todd 1983; Wilson 1975).

Chapter 10, the first chapter in this section, is titled "Folsom Bison Hunting on the Southern Plains of North America," by Leland Bement and Brian Carter. As they observe, landscape evolution, site stratigraphy, animal behavior, and hunting technology highlight and help define archaeological investigation of Paleoindian sites across the North American Plains and constitute part of the critical expertise and topics contained in the legacies of George Frison and C. Vance Haynes Jr. Bement and Carter show that the methods developed and applied by Frison and Haynes continue to shape archaeological inquiry of Paleoindian sites, in this particular case focused on Folsom bison hunting adaptation along the Beaver River in northwest Oklahoma. Reconstructing

the timing, environment, and distribution of arroyo development is integral to improving our understanding of the Folsom bison hunting adaptation.

Chapter 11, “Bison by the Numbers—Late Quaternary Geochronology and Bison Evolution on the Southern Plains,” is by Eileen Johnson and Patrick J. Lewis. They use postcranial morphometrics within a stratigraphic and chronological framework to examine bison evolution on the Southern Plains during the late Quaternary. Timing of the changeover from archaic to modern form and the driving force behind the changeover are explored. A rapid body size decrease, reflected in decreasing metapodial size, occurs in the early Holocene, and transition to the modern form is complete by 6400 ¹⁴C yr BP. The decrease is accompanied by a slight change in shape but a later decrease in robusticity. This diminution and shift appear correlated with the rise and spread of the shortgrass ecosystem between 8000 and 6400 ¹⁴C yr BP. The timing and rapidity of the change appears to have been swifter on the Southern Plains than on the Northern Plains. Understanding the evolutionary pressures on bison through time may provide insight into the impact of those pressures and resultant changes on the people who relied on bison for subsistence and economic purposes (e.g., Smiley 1979).

George Frison pioneered the recognition of stone-lined systems as integral features of communal bison hunting (Frison 1967); however, drive lanes have received little attention by archaeologists (Carlson 2011). In chapter 12 Jack W. Brink presents this topic in “Stone Drive Lane Construction and Communal Hunting Strategies at the Ross Buffalo Jump, Southern Alberta, Canada.” Study of a network of rock drive lanes at the Ross site provides insight into aboriginal manipulation of aspects of bison biology and behavior. The placement and density of drive lane rocks at the Ross site exhibit distinct patterns that must have been grounded in intimate knowledge of bison habits with respect to travel, flight response, predator avoidance, vision, smell, stampede behavior, and other traits. Assessment of rock density indicates greater loading of rocks at the terminus of the drive and on the tops of ridges and hills. In contrast, hillsides and level ground have lower rock density.

Old World bison studies have also benefited from the advances made in North America (e.g., Hoffecker et al. 2010; Olsen 1989). Chapter 13, “Bison Utilization at the Amvrosievka Campsite, Ukraine,” by Oleksandra Krotova, Iryna Snizhko, and Vitaliy Logvynenko, reflects some of the global impact of these methodological advances. The Epigravettian Amvrosievka site complex, located in the steppe zone of the southeastern Ukraine, dates to approximately 19,000–18,000 BP. The complex consists of bone bed and camp localities separated by 200 m. Faunal remains at the camp are dominated by bison. Analysis

suggests that upper and middle portions of young bison limb elements with attached smaller elements were transported to the camp from the kill. Some cut marks from the camp evidence indicate primary butchering at the kill site, while others are the result of secondary butchering at the camp. The patterns of butchering at Amvrosievka are compared with those of some North American sites and show similarities in human approaches to bison utilization across space and time.

Stones and bones and the context from which they and other archaeological material are recovered are the backbone of Paleoindian prehistory as well as the prehistory of other stone age epochs. George Frison and C. Vance Haynes Jr. have made major contributions to all three fields, and their work and approach have particularly affected the understanding of the First Americans. The chapters in this volume highlight the current state of knowledge and approaches to the studies of stones, bones, and profiles.

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