

Progress & Challenges

Intriguing Questions Linger after 75 Years of Answers

by George C. Frison

We have come an incredible distance in the almost 75 years since a discovery near Folsom, New Mexico, proved that humans shared North America with a bestiary of extinct animals as the last Ice Age was ending. We have tools, techniques, and knowledge today that were unimaginable when Folsom threw open the door on Paleoindian research in 1927.

What a wealth of data has been collected since then; yet how many of the most basic questions still cry out for satisfactory answers. The next decade promises fascinating new details, hints, and hypotheses about the coming of the first Americans. What a wonderful time for young archaeologists to be entering the field of New World archaeology!

The years immediately after Folsom saw a steady flow of progress as outstanding investigators too numerous to men-

tion, but too often overlooked, turned their attention to the peopling of the Americas.

The research stream became a flood after World War II. H. Marie Wormington's groundbreaking first edition of *Early Man in North America* in 1939 cited 92 references in the bibliography; the 1957 edition listed 586. Last October's *Clovis & Beyond* conference on peopling the Americas drew more than 1,400 academics, private consultants, government regulators, avocationalists, and laypeople — all of them sharing an abiding interest in the puzzle of the first Americans.

The 1960s saw the emergence of the "New Archaeology," which was, unfortunately, perceived as a threat by many Paleo-indian archaeologists. Actually, however, this trend grew from the realization that excavation and analysis, as then conducted, were not up to the task of answering some fundamental questions. The data were coming from geologic contexts, but few archaeologists had the background in geology to interpret it.

A major change in the past few decades has been an increasingly multidisciplinary approach to Paleoindian archaeology. These humans were adapting to ecosystems much different than those we inhabit. Interpreting past subsistence strategies requires a deeper understanding of the flora, fauna, landforms, and climate of the time. To exploit the multidisciplinary approach to its utmost, data recovery and recording had to become more rigid. Site-formation processes and site integrity became all important in evaluating the quality of data.

Analyses of Paleoindian sites now rely strongly on faunal studies. Bone is intensively studied to determine whether marks and modifications were caused by humans, animals, or nature. Animal-population profiles at specific sites help differentiate between natural deaths and kills by hunters, which in turn yields information on the economic activities of human groups.

Lithic analysis (of stone implements) has gone far beyond simply replicating artifacts. Tracking the source of raw materials indicates group mobility, and use-wear analysis

reveals the specific tasks to which tools were applied. Accelerator mass spectrometry (AMS) radiocarbon dating dramatically increases the potential for more and better-calibrated radiocarbon dates, especially when only very small amounts of datable material are available.

The trail of the first Americans, which once seemed almost straight and clear, now twists and turns through the past, with unexpected dead ends and side tracks. The beginning of the trail — the first footprints in the New World — remains hazy at best.

The 1930s discovery at Blackwater Draw in eastern New Mexico of the first Clovis culture site provided a succession of Paleoindian cultural complexes (represented by distinctive tools and other artifacts) in well-defined geologic layers separated by layers of sterile deposits. This left little doubt of the chronological relationships between Clovis, followed by Folsom, and then the later Paleoindian cultures of the Southern Plains.

The Hell Gap site in southeast Wyoming provided a stratigraphic record of post-Clovis occupations on the Northern Plains. It also produced the first evidence of yet another early culture, a contemporary of Clovis called Goshen. After languishing for two decades, Goshen has been verified, but it also muddies the waters of Paleoindian research.

At one time, the ice-free corridor — a broad, green pathway between the great North American ice sheets from Alaska into the American Great Plains — was seen as the key to the timing and circumstances of Clovis' entry into North America south of the ice. After all, the time when the ice sheets retreated and rising sea levels inundated the temporary land bridge across the Bering Strait could be calculated. Both ends of the corridor were searched, but the hoped-for evidence has not materialized — and now both the breadth, even the very existence, of the corridor is being questioned.



A Sampling of Early American Sites

● Some Clovis-age archaeological sites; roughly 11,500-10,800 radiocarbon years ago (13,350-12,895 calendar years).

■ Some current candidates for pre-Clovis occupation sites.

Sources: Thomas R. Hester, E. James Dixon, Kenneth B. Tankersley.

Speculations on Clovis' origins have aroused more controversy than any single topic in Paleoindian studies. Given the number of putative pre-Clovis sites that have not held up under careful scrutiny, there is ample reason for caution in accepting claims of great age for any site. For example, Tule Springs in North Las Vegas, Nevada, was reported to have human artifacts and a radiocarbon date much older than Clovis. It turned out, however, that the radiocarbon samples were not dating cultural materials. Another example is the Lewisville site in Texas,



This fluted, fishtail projectile point (seen in three views), from Belize in Central America, may date to about the same time as Clovis culture sites in North America (roughly 11,000 radiocarbon years ago). Similar fishtail points have been found in Central and South America, leading some Paleoindian specialists to suspect that they may be related to the famous fluted points of the Clovis hunters; others disagree.

with radiocarbon dates many times older than those known from other Clovis sites. Later investigations revealed, however, that the occupants had been burning lignite, which produced dead carbon and erroneous dates. The list goes on.

But although many candidates for pre-Clovis have not weathered the intense scrutiny needed to validate their claims, others have survived the test. Questions still arise about Monte Verde in Chile and Meadowcroft in Pennsylvania, but their validity cannot be challenged on grounds of faulty data collection and analysis. The Miller Complex culture was proposed as a result of the Meadowcroft investigations and is now accepted by many as a pre-Clovis manifestation. The Cactus Hill site in Virginia and the Topper site in South Carolina also are strong contenders for pre-Clovis status on the basis of stratigraphy, radiocarbon dating or both.

DNA analysis and dental studies now offer promise for determining the source of New World migrants. Hair, if preserved under certain conditions, promises to be a source of ancient

DNA samples and can also provide material for AMS dating.

The scarcity of Paleoindian skeletal material, along with the reluctance of Native Americans to allow scientific study of these remains, is a serious obstacle to research. It seems inevitable that a Clovis skeleton will eventually be found. It would be a welcome change if both archaeologists and Native Americans could meet on common ground and satisfy the scientific interest of the former and the spiritual demands of the latter.

Looking back over these 75 years of Paleoindian research, I am reminded again of H. Marie Wormington, the matriarch of New World Paleoindian studies. Were she still with us, I believe she would wear a big smile and, in her inimitable and unflappable manner, sum up the decades of progress and roadblocks by saying simply: "Things are going quite well, but we need to work harder and solve all these problems that remain." □

GEORGE C. FRISON, a member of the National Academy of Sciences, is Professor Emeritus at the University of Wyoming. He was honored recently as the Paleoindian Archaeologist of the Century.

The Clovis Hunters

A Pragmatic & Skilled Culture Swept Across North America

by Jack L. Hofman

The Clovis people — for decades the prime candidates for the first Americans — were skilled hunters of huge animals, especially Ice Age mammoths and mastodons. But they were much more than that. They were botanists well-versed in the use of plants for food and equipment. They were geologists with a keen ability to seek out the best sources of New World flint for their finely crafted points and tools, and of ochre for use as a red pigment. They were zoologists with a deep knowledge of animal behavior.

They were certainly pragmatic, realistic, and able to live effectively — through their own ingenuity — in previously unknown territories. Clovis people were creative enough to make their technology work for many generations, so we should not be surprised if they did not always behave as we believe they should have.

Clovis settled successfully into a broad range of environments. And after half a century of research, questions and disagreements still surround this short-lived, but extremely widespread North American culture.

Robert Kelly of the University of

The "bone wrench" from the Murray Springs Clovis site is an enigmatic tool. Similar artifacts have been found in Russia and Ukraine. This is a cast of the original.

Wyoming and Larry Todd of Colorado State University have proposed that Clovis people focused on specific, "high-return" and well-understood resources, such as mammoth and mastodon, rather than learn to exploit a broad range of species encountered in newly colonized territories. In contrast, David Meltzer of Southern Methodist University



PHOTO BY A. WESTERHOLM/ISTOCKPHOTO.COM; CAST BY THE MUSEUM OF ANTHROPOLOGY, UNIVERSITY OF MICHIGAN, COLLEGE



COLLEGE/HOUGHTON MIFFLIN

This mammoth leg bone (humerus) shows clear cut marks of butchering. The bone, 109 centimeters (43 inches) long and weighing 30 kilograms (65 pounds), is from the Naco mammoth site in Arizona.

suggests Clovis hunters were broad-spectrum foragers tapping a diversity of resources that only occasionally included large animals. Multiple or diverse Clovis adaptations might be likely.

The wide distribution of Clovis artifacts may be taken as support for either model, and while each emphasizes distinctive overall behavioral patterns, they are not necessarily mutually exclusive or incompatible. Clovis economy was

almost certainly based on a diverse array of resources, which does not preclude an emphasis on large-game hunting.

Once thought to span thousands of years, the Clovis era is now dated to a few hundred, roughly from 11,400 to 10,900 radiocarbon years ago (13,325 - 12,975 cal BP). Much of the refinement in Clovis dating is a result of work by C. Vance Haynes of the University of Arizona. Clovis hunters are recognized by a few diagnostic artifacts, especially the famous fluted points, and a distinctive technology for making stone tools.

The projectile points, based on use-wear analysis, apparently served a variety of functions beyond their use as atlatl (spear-thrower) darts, including cutting and butchering. Another key Clovis diagnostic are beveled-based (tapered) bone points, some of which apparently served as projectile points and others as parts of segmented foreshafts of spears and darts. These distinctive bone and ivory artifacts have been found repeatedly in association with Clovis points and, along with a perforated "bone wrench" from Murray Springs, Arizona, show striking similarities to Upper Paleolithic assemblages of Europe and Eurasia.

Clovis' distinctive biface-flaking technology — the technique for shaping both sides of stone tools — was described in detail by Bruce Bradley and George Frison in 1982. Clovis flintknappers were adept at removing broad, flat flakes from large bifacial cores, typically removing a thin layer of flint

completely across one face of the stone.

Clovis artifacts are widely and unevenly dispersed in North and Central America, with the cultural range apparently limited primarily by continental and mountain glaciers, lakes, and associated inhospitable terrain features. Clovis people definitely were not limited to or focused upon any specific geographic areas. Yet, Clovis points are notably more common in the Southern and Central plains than in the Northern Plains, and more Clovis artifacts come from the



Prismatic blades (this one is shown in three views) were struck from large stone cores by Clovis flintknappers. This flake-blade, made of Green River Formation chert, is typical of Clovis-technology blades from other sites. The edges are dulled, possibly from use as a cutting or scraping tool. The blades, removed from a prepared core with a single blow, are razor sharp and can be used without reworking the edge.



northern Great Basin and northwestern United States than the Northern Plains.

The notion that Clovis originated in or spread throughout North America from a point of origin in the Northern Plains (within an ice-free corridor between the continental glaciers) is not supported by the distribution of finds. Clovis may actually have spread from south to north across the Great Plains.

This huge cleaver, made from the shoulder bone (scapula) of a mammoth, is from the Lange/Ferguson Clovis site.

Beyond economic pursuits, hints of Clovis art and ritual are appearing. Small, engraved stone tablets from the Gault site in central Texas have been reported by Michael Collins and others.

The purpose of these tablet pieces is yet to be established. The use of red ochre as a pigment and potentially for other uses is well-documented at several sites. Much remains to be learned about this intriguing culture that briefly ruled the North American continent. □

JACK L. HOFMAN is Associate Professor at the University of Kansas.

COURTESY OF THE UNIVERSITY OF KANSAS

How Old Is It?

The Power and Pitfalls of Radiocarbon Dating

by Thomas W. Stafford, Jr.

The fundamental question for possible first-American archaeological sites is this: How old is it? A single radiocarbon date can determine whether a site will be revered, ignored, or reviled. But the complexities involved in such crucial decisions are immense.

Exact tools from physics enable dates to be measured precisely on very small samples through a sophisticated process called accelerator mass spectrometry (AMS). However, less-exact geological measurements, complicated chemical alterations in the sample, and human biases in interpreting data make determining radiocarbon ages an extremely complicated process.

Even if the measurement physics is perfect, an age on charcoal associated with a stone tool could be erroneous if a burrowing rodent has moved the charcoal vertically, if the charcoal has been eroded out of older strata and redeposited against the artifact, or if a host of other geological processes have disturbed the original artifact-charcoal association.

The act of excavating a site disturbs the original association of artifacts and datable samples. Excavators can misinterpret stratigraphy or mistakenly group together artifacts whose

ages actually span thousands of years.

Substantial errors can be contributed by geochemistry at the time the artifact was formed and, later, while it was buried. Living animals and plants can ingest or photosynthesize carbon that is not in equilibrium with the atmosphere at the time of formation. These age errors, termed "reservoir effects," usually make an organic-carbon sample appear hundreds of years older than its time of origin.

Later chemical changes can make samples appear either older or younger due to the uptake of calcium carbonate, humic acids (from decomposed organic matter in the soil), or even petroleum that is added during the sample's burial in the earth.

A final consideration is the conversion of radiocarbon years to calendar years. These corrections are needed because the amount of radiocarbon in the atmosphere — the baseline against which radioactive carbon-14 in the sample is measured — is not constant. However, the history of these atmospheric carbon-14 variations can be reconstructed. The result is that the real-time duration of paleontological or cultural processes can be lengthened or shortened depending

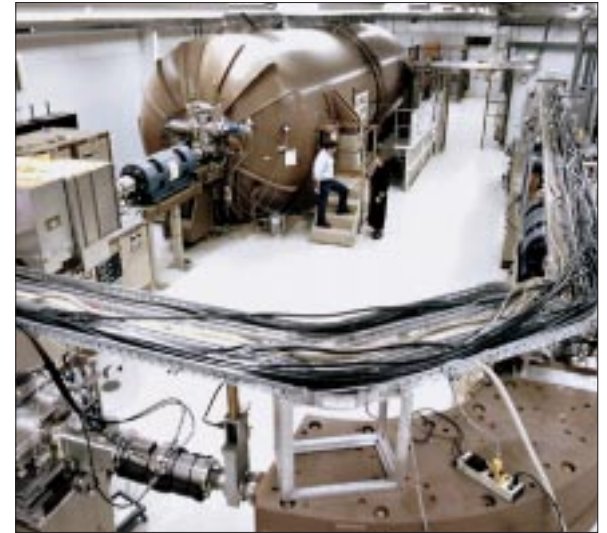
COURTESY OF LAWRENCE LIVERMORE NATIONAL LABORATORY

upon the calendar correction.

Human bias influences radiocarbon chronologies far more than is acknowledged. While human subjectivity should not be a factor, it may be one of the most intransigent problems in radiocarbon dating, and especially in the search and analysis of sites for the first Americans.

One prominent example is when data do or do not "fit" conventional wisdom. In one case, a mammoth with excellent, albeit not fully accepted, evidence of butchering was radiocarbon dated at 10,960 ± 100 years BP. This age was entirely consistent with the belief that Clovis-culture humans were associated with and killed mammoths at the end of the Pleistocene (the Ice Age). However, when the mammoth bone was redated after better chemical purification of the bone collagen, the correct age was found to be 12,310 ± 60 radiocarbon years BP.

The linear accelerator at Lawrence Livermore National Laboratory in California is used in AMS radiocarbon dating. It can count individual atoms of radioactive carbon in a sample.



The 1,350-year age difference was extremely significant, because it shifted the site from a "routine" Clovis-age locality, to one with strong evidence for pre-Clovis mammoth butchering.

Such situations exemplify why stratigraphy, complex chemical purifications, and numerous radiocarbon dates are needed to verify the ages of these and similar first-American sites.

Advances in radiocarbon dating are due to a successful combination of physics, chemistry, geology, and biochemistry. Whereas conventional radiocarbon dating, which counts beta particles (the decay product of radioactive carbon), requires approximately one gram of carbon, the modern AMS method uses no more than 1 milligram to 0.5 milligram (1/1000th to 1/2000th of a gram) of carbon.

The AMS method uses a high-energy accelerator linked to mass spectrometers to detect and count individual carbon-14 ions in a sample. AMS can date single plant fossils the size of one poppy seed, specific amino acids from fossil bone protein, a single rodent tooth identified to species, and even pigments from cave paintings.

Radiocarbon dating is an iterative (or progressive) process. The age of a site, an artifact, or a human skeleton should never be determined on the basis of a single radiocarbon measurement. The stratigraphic location of a sample must be

combined with the sample's biochemical origin, geochemical changes that occurred during burial, and the chemical purification of the sample, as well as the measurement of carbon-14. Errors invisible to one part of the investigation may be made obvious at another stage.

Misinterpretations of stratigraphy have been clarified by strenuous dating. Errors due to biochemistry in the radiocarbon dating of corn, for example, became evident only when dating results did not fit the archaeological observations. Undetected foreign carbon contamination that skewed bone and ivory dates went unnoticed until charcoal dating and stratigraphic observations confirmed that the ages

were too young and that chemical purifications had to be significantly improved.

The lesson from radiocarbon dating is that the technique is not a static method. Its accuracy depends upon an iterative approach that combines both the natural and social sciences. The use of these principles is all the more important when first-American sites are examined. These sites are slightly to significantly older than Clovis-age discoveries, and therefore stratigraphic, geochemical, and observational problems will be even more complex and difficult. □

THOMAS W. STAFFORD, JR., a geochronologist, isotope geochemist, and stratigrapher, is Founder and President of Stafford Research Laboratories, Inc., in Boulder, Colorado.

The Importance of Context

Documentation is the Key to Successful Analysis

by Stuart Fiedel

The Folsom finds of 1926-7 represented a turning point in Paleolithic studies because of the undeniably close, well-documented association of finely made spear points with the bones of an extinct form of giant bison. Even though radiocarbon dating was not yet available, the bison clearly dated to the late Pleistocene (Ice Age), and the points lying so close to the bones showed that humans had hunted and butchered these animals. A human presence at the end of the Ice Age was thus proven.

Yet in other cases, the associations of artifacts, dates, and geologic strata appeared tight, but their meaning eventually proved ambiguous. At the Double Adobe site in Arizona, for example, milling stones and other artifacts were found stratified beneath a layer that contained mammoth bones. Charcoal from this culture-bearing layer dated between 9,300 and 8,000 radiocarbon years ago (some 10,495-8,800 calendar years BP). For a while, this site was thought to demonstrate that Ice Age megafauna had survived to a late date in the Southwest. Re-analysis, however, showed that both the mammoth bones and the milling stones had been disturbed and redeposited from elsewhere; the association of the cultural material and the charcoal also proved spurious. That illustrates the importance of understanding "emplacement mechanisms" and verifying the context of a find.

As any novice archaeologist learns, an artifact without provenience (i.e., context) has lost most of its scientific value. If we don't know where it comes from, we may never know how old it is, what its cultural affiliations are, or what its function was.

Archaeological excavation is the controlled, systematic destruction of a site. After the deposits have been removed, the original relationships of artifacts and features will never be physically restored. Other researchers will be able to study the site only as an abstract entity, represented by maps, photographs, and detailed verbal and numerical descriptions. It is, therefore, the field archaeologist's primary

responsibility to record the precise horizontal and vertical positions of all significant objects (including stone artifacts, identifiable bones, etc.).

To facilitate this mapping, an arbitrary grid is laid out over the excavation area. It is common practice to lump together ubiquitous small items, such as tiny lithic (stone) flakes, within the arbitrary grid units, which are typically one-meter (3.3-foot) squares. More informative and/or rare finds, such as points, are often piece-plotted more exactly, with a precision of a few centimeters. These data will be needed both for stratigraphic analyses and for behavioral reconstruction, such as refitting the broken base of a projectile point to a tip recovered from a distant part of the campsite.

Although well-executed line drawings of finds *in situ* may provide more details than photographs, the latter have been a traditional element of site recording since the early days of archaeology. On some digs I've worked on, Polaroid photos were taken of significant finds, just in case the 35-mm photos didn't come out well. Perhaps we overvalue photo-

graphic evidence because of our gut feeling that "the camera doesn't lie," while we sense that drawings may be subtly influenced by subjective judgments.

Excavations are controlled by grids, typically squares one meter across. This team is working at the Kimmswick Clovis site in Missouri.

No amount of *post facto* computerized number crunching can compensate for poorly recorded field data. As the saying goes: "Garbage in, garbage out." Or, as more delicately stated by Philip Barker in 1977, "No statistical analysis ... can be better than the quality of its raw data, the true reflection of the nature and distribution of the samples used in the analysis. ... Statistical analysis of material derived from partial and inadequately recorded excavations will inevitably be misleading though unprovably so." □

STUART FIEDEL is Principal Archaeologist with John Milner Associates in Alexandria, Virginia.



COURTESY OF NIELS, OPENING DIGGING BOXES AT AN EARLY SITE

Proving Pre-Clovis

Criteria for Confirming Human Antiquity in the New World

by Michael R. Waters

Prior to 1927, most archaeologists believed humans had been in the Americas for only about 4,000 to 5,000 years. This perception was forever changed by a dramatic discovery near Folsom, New Mexico, where archaeologists found flint spear points tucked into the ribs of extinct bison in undisturbed deposits.

When experts visited the site and examined this evidence, they were convinced that people had, in fact, been living in the Americas since the end of the Pleistocene (about 10,000 years ago).

The timing of human occupation of the Americas was pushed back again in the early 1950s, when archaeologists agreed that artifacts, later to become known as Clovis, were found beneath the Folsom cultural horizon at Blackwater Draw, near Clovis, New Mexico. The Clovis occupation of the Americas was soon dated from 11,500 to 10,900 radiocarbon years ago (13,350 to 12,975 cal BP) and was considered the oldest New World culture for the next four decades.

Since the recognition of Clovis, many sites have been championed as proof of pre-Clovis habitation in the New World. Each of these sites has been rigorously evaluated, using the same criteria that led to the acceptance of Folsom and Clovis. Until recently, none of the proposed pre-Clovis sites (well over 40 dated sites) has withstood scientific scrutiny.

One site, Monte Verde in southern Chile, offers the most compelling evidence to date for a pre-Clovis human presence in the New World. It would push back the date for human occupation of the Americas to about 12,500 years ago (14,850 cal BP). Just as Folsom and Clovis held fast to scientific review, so must Monte Verde and any other site that would change our understanding of the first Americans.

To avoid being overwhelmed and confused by conflicting data from both legitimate and questionable sites, possible first-American sites must meet rigorous scientific requirements to unequivocally demonstrate pre-Clovis occupation of the Americas.

First, the artifacts at the site must clearly have been made by humans, or human skeletal remains must be present. Human remains, of course, remove any doubt of a human presence, but

problems sometimes arise over the possible human origin of artifacts. To meet the test, artifacts must show evidence of patterned manufacture — for example, multiple flakes removed from the edge of a pebble to create a worked edge. Debris left by stone-toolmaking must show the telltale evidence of human manufacture: bulbs of percussion and striking platforms.

At some proposed pre-Clovis sites, what were described as stone tools turned out to be "geofacts" — objects that appear to be artifacts, but were instead created by natural processes in high-energy depositional environments (such as landslides, debris flows, or at the base of fast-flowing rivers). In these environments, stones (especially easily flaked cherts and chalcidony) may fracture in ways that mimic human manufacture. But geofacts lack the patterning and flaking characteristics of human manufacture.

Second, artifacts or human remains must lie within undis-



This spear point, found in 1927 near Folsom, New Mexico, in direct association with the ribs of an extinct bison, proved that human hunters were not recent arrivals in North America.

ALL PHOTOGRAPHS: PHOTO BUCKLE DOWN/ARND BRONKHORST



COURTESY OF MICHAEL R. WATERS

turbed geologic deposits in which the relationship between the artifacts or human remains and the stratigraphy (the distinct layers of sediment) can be clearly demonstrated. When material is found in place within deposits, the finely detailed microstratigraphy of the site and the broader regional stratigraphic context must be recorded.

Microstratigraphic studies are necessary to understand the nature of site formation and later post-burial disturbance of the archaeological matrix, and to make proper correlations from one part of the site to another. It is equally important to place the site's microstratigraphy into the regional stratigraphic framework. For example, a site may be within flood-plain sediments on an abandoned river terrace, but this terrace must be placed within the sequence of terraces on either side of the valley in which the site is located.

Site-specific and regional stratigraphic studies strengthen the argument for great antiquity by providing a secure geologic context. The stratigraphy of the site is the framework on which hangs all the archaeological, geochronological, and paleoenvironmental data.

Third, reliable dating of a site is crucial to its acceptance. Radiocarbon dating is the most thoroughly tested and investigated method for dating sites in the New World. But it has both strengths and weaknesses, and we are constantly working to improve and test our knowledge of this technique.

While different types of materials can be dated by this method, wood, charcoal, seeds, and some organic portions of bones are the most reliable. But even dates derived from reli-

able materials must not be blindly accepted. Charcoal, for example, can be contaminated by older, soluble organics. And, because we can date very small samples by using atomic accelerators, we must demonstrate that our samples had not been moved in the sediments by insects or burrowing animals. Finally, because radiocarbon dates are statistical averages with standard deviations, more than one age determination is needed from a site to conclusively demonstrate its age.

Finally, it is highly recommended that the proposed pre-Clovis site be examined by a team of specialists, including archaeologists, geoarchaeologists, and dating experts. Preferably, the site visit should be made at the time of excavation, as at Folsom, when the relationship between stratigraphy and artifacts can be clearly seen. Such a team could provide an independent, unbiased evaluation of the site and its context.

If a discovery is to change the way we think about prehistory, it requires this level of independent review.

Each potential pre-Clovis site must be judged on its own merits. At the present time, Monte Verde provides compelling evidence for pre-Clovis occupation of the Americas. While some of the proposed artifacts from this site would not be accepted out of context, there are unequivocal stone and wooden artifacts. The stratigraphy and dating appear to be secure. Also, a team of specialists visited the site, examined the artifacts and stratigraphy, and presented their findings.

The "black mat," a stratigraphic layer deposited by an ancient marsh at Murray Springs, Arizona, was defined by Vance Haynes. Clovis artifacts are found beneath this boundary layer.

COURTESY OF JAMES H. MOORE

However, issues have recently been raised about the stratigraphic position of the unequivocal artifacts at Monte Verde, and alternative scenarios of site formation have been suggested (*Scientific American Discovering Archaeology*, November/December 1999). Thus, we must reserve final judgment on Monte Verde until these issues are fully resolved.

Several potentially early sites on the East Coast of the United States — among them Topper in South Carolina and Cactus Hill in Virginia — offer intriguing evidence of pre-Clovis occupation that deserves closer scrutiny.

In summary, we must not lower the bar for evaluating pre-Clovis sites. Any potential pre-Clovis site must meet the sci-

entific criteria by which Folsom and Clovis were judged. This is especially important now, as we begin to formulate new models for the peopling of the Americas.

We must keep an open mind to all potentially early sites and evaluate the evidence carefully. We do not have all the answers, and many surprises no doubt await us. This is a fascinating period of new ideas about the peopling of the Americas. But we must rigorously evaluate every site to sort the good from the bad, else we will only cloud the truth and our understanding of the first Americans. □

MICHAEL R. WATERS, a geoarchaeologist, is a Professor in the Department of Anthropology at Texas A&M University.

Clovis Second

Time is Running Out for an Old Paradigm

by Michael B. Collins

This is an exciting time in the long search for pieces to the puzzle of the first Americans. Old ideas are being challenged, and widely divergent new ideas are being explored. The debate is spirited.

The venerable "Clovis First" model, the dominating paradigm for nearly 70 years, is no longer satisfactory. The peopling of the Americas — a major event in human history — is an issue that can no longer find a consensus among archaeologists. Fundamental questions have been reopened: Where did the first Americans come from? When and how did they reach the New World? What material culture did they bring with them?

Clovis at about 11,000 radiocarbon years ago (13,020 calendar years) has long been considered the first cultural horizon in North America. Its presence was explained by a theory that people migrated out of eastern Asia around 13,500 calendar years ago, crossed a land bridge through the Bering Strait, threaded a narrow "ice-free corridor" between eastern and western sectors of the great Canadian ice sheets, and spread out to hunt big game in the interior of North America. Archaeologists' claims of earlier (pre-Clovis) cultural evidence were routinely rebuffed by proponents of the Clovis First point of view.

Yet, notions of a great antiquity for American prehistory had appeared long before the first of the now-famous, Clovis fluted projectile points was discovered near Clovis, New Mexico, in the 1930s.

Beginning in 1870, controversy raged for 30 years over crude, stone artifacts found near Trenton, New Jersey.



Advocates of an American Paleolithic — an "Old Stone Age" presence — believed the crudely flaked artifacts to be primitive and, therefore, ancient. Opponents saw the crude artifacts simply as unfinished attempts at stone-tool manufacture of comparatively recent age. The opponents prevailed. Many other finds in the late-nineteenth and early-twentieth centuries "proved" early humans had inhabited the Americas. But one after another, each succumbed to critical review.

The Meadowcroft Rockshelter in Pennsylvania, where this projectile point was found, may represent a pre-Clovis occupation.

The debates, however, generated an important result: They gave rise to criteria that had to be met by any claim for great antiquity. To prevail, a find had to consist of definite human artifacts or bones in secure stratigraphic context (that is, in earth that had not been disturbed by natural or human



PHOTO COURTESY OF JAMES BOONER

processes) with good evidence for its age (such as geological markers or remains of extinct animals).

A significant level of human antiquity in the Americas won wide acceptance in 1927, after the discovery of spear points with fossil bison remains near Folsom, New Mexico. Attention then focused on additional discoveries of kindred sites. Several were found, as at Lindenmeier, Colorado.

Then, at a gravel quarry near Clovis in 1935, older, larger fluted points and mammoth bones were found in stratified deposits beneath a level that held Folsom points and bison bones. After radiocarbon dating became available about 1950, the Folsom materials were dated to near 10,000 radiocarbon years ago (11,350 cal BP), and Clovis to near 11,000 years (13,020 cal BP).

Almost from that moment, finds believed to be older than Clovis began to surface. Objects thought to be artifacts were found in early geologic contexts. Unmistakably human artifacts were attributed great age on the basis of radiocarbon or other evidence. And the Trenton argument — crudeness equals great antiquity — was repeated.

Several substantial lists of probable pre-Clovis sites have been drawn up in the past 35 years. All were short-lived. Places or finds with names like Tule Springs (Nevada), Calico Hills (California), Tolchaco (Arizona), Friesenhahn Cave (Texas), Texas Street (California), Lewisville Lake (Texas), Old Crow Flats (Alaska), and Taber (Alberta) briefly lit up the

pre-Clovis radar screen, only to fade away after a time.

So many failed claims reinforced resistance to the possibility of pre-Clovis. However, like incomplete passes on the gridiron, these say nothing about the outcome of the next try. And there are two important recent developments to consider: Serious questions weaken the Clovis First model, and a few finds strongly indicate a pre-Clovis cultural presence in the Western Hemisphere.

If Clovis derived from roots in northeastern Asia, more evidence of those cultural antecedents should be found there. And the earliest human skeletal remains in the Americas do not have the Mongoloid traits that would be expected for a people who came from Siberia.

Moreover, conditions along the 1,600-kilometer (1,000-mile) ice-free corridor obviously challenged human survival. And even if people could survive there, why would they want to? If people entered North America only 11,500 years ago (13,350 cal BP), how did they overcome 16,000 kilometers (10,000 miles) of obstacles to reach Fells Cave at the southernmost tip of South America by 10,700 years ago (12,800 cal BP)?

The Clovis culture, its distinctive spear points mostly limited to North America, is found in all kinds of environmental settings from the Pacific to the Atlantic, and from the southern

The Meadowcroft Rockshelter records thousands of years of human use. These students are working at a level that postdates occupation by Paleoindians.

edge of the Canadian ice sheets into Central America. This is not what would be expected of the first peoples colonizing an entire hemisphere. The sites of the first colonists should be few in number, limited in geographic extent, and confined to a few optimum habitats. It was once thought that Clovis people were highly specialized hunters of big game — specialists who could reliably take familiar game wherever they found it. But evidence now suggests that Clovis was more generalized, with an assortment of regional adjustments to fit local resources.

Linguists cannot account for the great diversity found among Native American languages in the limited time afforded by the Clovis model. And, finally, an implied assumption of the theory is that people had to come to America on foot — yet humans had reached Australia more than 50,000 years ago by crossing open waters.

The first Miller lanceolate projectile point found at the Meadowcroft Rockshelter site shows evidence of having been resharpened.



A handful of sites dating to greater than 11,500 years ago (13,350 cal BP) in both North and South America also lead us to rethink our concepts on the peopling of the Americas. Monte Verde, with an array of perishable and nonperishable artifacts preserved under a layer of peat in southern Chile, is dated to 12,500 years ago (14,850 cal BP). Meadowcroft (Pennsylvania) has stone tools close to 14,000 years old (16,800 cal BP). Other sites in Virginia and Texas also indicate pre-Clovis archaeological components.

If small groups of people were occupying a few prime habitats in the Americas before the arrival of Clovis culture, then their presence pushes Clovis into second place in the race to people the Americas. Clovis technology may well have spread so widely and so rapidly because its bearers learned the landscape from people who were already established there. In that sense, "Clovis Second" has profound implications. □

MICHAEL B. COLLINS is Research Associate at the Texas Archaeological Research Laboratory of the University of Texas at Austin.

The South American Twist

Clovis First Doesn't Fit the Rich Prehistory of the Southern Continent

by Ruth Gruhn

South America may hold the key to understanding the initial settlement of the New World. The Clovis First model simply does not explain the abundant and varied archaeological sites in South America that are at least as old as North America's Clovis culture.

The South American evidence points to well-adapted populations with varied subsistence patterns who occupied all major environmental zones of the continent by at least 11,000 radiocarbon years ago (13,020 calendar years) — before Clovis had spread throughout North America. The diverse regional technological traditions of the south show no relationship to Clovis.

For South America, a model of mass-population movements into already-occupied territory is not necessary. Although invasions may be more dramatic than models of a slow, indigenous population growth and adaptation, the latter seems the best fit with the known archaeolog-

ical record from South America. The best explanation is an initial entry into South America well back in the Late Pleistocene — thousands of years before the Clovis culture came to the north.

To illustrate the regional diversity that was found throughout South America by the time the Clovis complex was

Archaeologists excavate the early occupation site of Quebrada Jaguay in southern Peru.



spreading across North America. I offer a sampling of sites with dates to Clovis age or several millennia earlier, plus two sites that apparently date to very early times:

- **Taima-taima:** In the Caribbean coastal zone of Venezuela, this site is at a water hole among low hills. The region is now a semiarid thorn forest, and paleoenvironmental evidence suggests roughly the same setting 13,000 years ago (15,350 cal BP), when hunters, using long, thick El Jobo points shaped like willow leaves, killed and butchered a juvenile mastodon there. José Cruxent initiated archaeological research at the site.

- **Tibitó:** High in the Andean uplands of Colombia, the Tibitó site revealed clusters of bone fragments and stone artifacts distributed in activity areas around a large boulder. Excavated by Gonzalo Correal and associates, it is radiocarbon dated to 11,740 years ago (13,700 cal BP). Faunal remains include extinct horse, mastodon, and deer. The stone artifacts are very simple, unifacial tools showing minimal retouching.

- **Pachamachay:** People may have lived even higher in the Andes. The cave of Pachamachay, excavated by John Rick, is at an elevation of 4,300 meters (13,000 feet) on the high, grassy *puna* of central Peru. The site provided evidence of camelid hunting with triangular and lanceolate (long, narrow) points and produced a radiocarbon age of 11,800 years (13,800 cal BP).

- **Quebrada Jaguay:** Evidence of a specialized maritime economy is found on the desert Pacific Coast of southern Peru. The oldest site known at present — labeled QJ-280 — produced a radiocarbon date of 11,105 years ago (13,025 cal BP). The site, excavated by Dan Sandweiss and associates, indicates intensive exploitation of fish, marine clams, crustaceans, and seabirds. Most of the tools, weapons, and utensils of the earliest occupants likely were made of perishable materials, as only flaking detritus and a few broken or unfinished stone tools were found.

- **Monte Verde:** In the very far south, the now-famous Monte Verde site, excavated by Tom Dillehay and associates, is in the temperate rain forest of south-central Chile. By 12,500 years ago (14,850 cal BP), there was a substantial settlement here, its organic remains preserved under a peat deposit. The abun-

dant floral and faunal remains indicate a subsistence economy built primarily on collecting a wide variety of plants over a large area, with some exotic materials brought or traded from the coastal zone and the Andes range. While a number of wood items were found, most of the stone artifacts are quite simple: naturally sharp-edged pebbles or simple flakes.

- **Los Toldos and Piedra Museo:** East over the Andes mountains, people had moved into the grasslands of Patagonia in southern Argentina. Augusto Cardich reported a radiocarbon date of 12,600 years (14,900 cal BP) in 1973 on the lowest occupation level at the rock shelter site of Los Toldos, with a unifacial stone industry and remains of extinct animals. Recent



Early Human Occupation Sites of South America

excavations by Laura Miotti and associates at a rock shelter in the Piedra Museo locality, not far from Los Toldos, produced a radiocarbon date of 12,890 years (15,200 cal BP) for a small assemblage of flakes and artifacts with extinct fauna.

- **Lapa do Boquete:** More than half a dozen archaeological sites have been radiocarbon dated to 11,000 years ago (13,020 cal BP) or earlier in the interior uplands of eastern Brazil. One example is the Lapa do Boquete, a large rock shelter excavated by André Prous and associates. The site is in a semiarid savanna-woodland with a variety of game and edible plants. Four radiocarbon dates between 12,070 and 11,000 years ago (14,000-13,020 cal BP) were obtained on charcoal from the lowest occupation level, which yielded remains of palm nuts, freshwater mussels, fish, and bones of small- to medium-sized mammals in association with an assemblage of unifacial flake tools.

- **Caverna da Pedra Pintada:** Foragers had also adapted to the tropical rain forest deep in the Amazon Basin. The lowest occupation level in this large rock shelter just north of the Amazon River has two radiocarbon dates of around 11,100 years ago (13,025 cal BP). The site, excavated by Anna Roosevelt and associates, suggests a foraging economy exploiting a variety of tropical fruits and nuts, stream fishing, mussel collecting, and small-game hunting.

If a variety of well-adapted, regional populations had become established in every major environmental zone of South America by the end of the last Ice Age, how early did people first arrive on the continent? Two sites suggest the initial entry may have occurred as much as 35,000 years ago.

The first is Tom Dillehay's Monte Verde site in Chile. A test pit, placed across a creek from the Monte Verde II settlement, found artifacts and features deeply buried in a sand stratum. The position of this stratum within the geological sequence in the region supports a radiocarbon age of 33,370 years on charcoal fragments from the features — lenses of clay within the sand that possibly represent hearths.

A total of 26 lithic (stone) specimens were recovered in direct association. One specimen is a basalt core with at least 11 flakes removed; close examination shows use-wear and a residue of mastodon blood. Of 20 flakes or faceted stones, six show use-wear. Further investigation is planned, but this is certainly a potential time bomb sitting under any model that maintains an initial entry of people into the Americas no earlier than 15,000 years ago.

The other South American archaeological site with comparable antiquity is the Toca do Boqueirão da Pedra Furada, a large rock shelter at the foot of a high sandstone cliff in north-

Shells and fish bones at the Quebrada Jaguay site prove heavy use of marine resources. The arrow indicates north.



east Brazil. It was excavated from 1978 to 1988 by Niède Guidon and associates. Within the rock shelter, up to five meters (16.4 feet) of sediment have yielded approximately 600 simple stone artifacts, pebble tools and flake tools, and a long, stratified series of finite radiocarbon dates on charcoal that range back to about 32,000 years ago. Several indefinite dates from lower levels hint at an age of over 40,000 years.

Some believe the validity of Pedra Furada was buried by a critique published by several North American researchers who attended a field conference at the site in 1993, but it cannot be so easily discounted. The essential issue at Pedra Furada is whether any real stone artifacts came from the Pleistocene deposits within the shelter. Critics of the site have suggested that the specimens classified as artifacts could have been flaked naturally in a high-energy depositional environment — but no such environment existed within the sheltered area where the specimens were found, as the sediments are mainly derived from slow weathering of the sandstone overhang. I believe the site of Pedra Furada is not to be dismissed so readily.

The evidence from South America suggests the Clovis phenomenon was a regional North American development — and a rather late one at that, especially if the really early archaeological sites in Chile and Brazil prove to be valid.

For decades, North American archaeologists have discounted the South American evidence because it hasn't met their expectations or fit their models. Now it is impossible to ignore the implications: A population with a simple lithic technology entered the Americas much earlier than is generally accepted. □

RUTH GRUHN, Professor Emerita at the University of Alberta, Edmonton, Canada, has pursued the first settlements of the New World throughout North and South America.

The Solutrean Solution

Did Some Ancient Americans Come from Europe?

by Dennis Stanford and Bruce Bradley

For half a century, archaeologists have assumed that ancestors of the Clovis people — long considered the first Americans — crossed the Bering Land Bridge from northeast Asia some 12,000 radiocarbon years ago (14,000 calendar years BP), then spread southward across the continent.

But there is something wrong with that picture.

Years of research in eastern Asia and Alaska have produced little evidence of any historical or technological connection between the Asian Paleolithic (Stone Age) and Clovis peoples. Also, the southeastern United States has produced more Clovis sites than the West, and a few radiocarbon dates suggest some of them may predate those in the western states. If correct, that hardly fits the notion that Clovis technology originated in northeast Asia or Alaska.

Over the years, various scholars have noted similarities between Clovis projectile points and “Solutrean” points, the

product of a Paleolithic culture on the north coast of Spain between 22,000 and 16,500 years ago. Little credence has been given to suggestions of a direct connection between these technologies because of the 4,500-year time gap between the last of Solutrean and the first of Clovis, and because of doubts that people of the Upper Paleolithic could navigate the Atlantic Ocean.

But indirect evidence for Paleolithic ocean travel has been mounting. Although no boats have been found, we now know that by at least 40,000 years ago, watercraft carried a founding population to Australia. By 28,000 years ago, flintknappers were collecting raw materials from islands far off the Japanese coast. And closer to

Similarities between Clovis points from North America (top row) and Solutrean points from Europe (bottom) support the hypothesis that early Europeans may have colonized the New World.



Spain, Paleolithic peoples inhabited some of the Mediterranean islands at least 14,000 years ago.

Solutrean peoples could have used this knowledge of watercraft to travel and exploit marine resources, which would have been especially important during the last glacial maximum, about 18,000 years ago, when most of Europe was covered with ice and competition for diminishing land resources must have been intense. Given these facts, we believe the hypothesis of a western Old World ancestry for Clovis should be reconsidered.

To determine whether the idea was worth additional study, we examined archaeological collections in Spain, France, and Portugal, looking for technological affinities between the European Upper Paleolithic and Clovis. Our cursory examination revealed an amazing correspondence between Solutrean and Clovis; in fact, Solutrean has more in common with Clovis than with Paleolithic technologies that followed it in Europe.

Solutrean and Clovis flintknappers used nearly identical stoneworking technologies. We observed a high degree of correspondence between stone and bone tools, as well as engraved limestone tablets, and caching of extra large bifaces and other tool stock. The Solutrean toolkit is, with a few exceptions, nearly identical to that of Clovis. Although some of the Solutrean concave-base projectile points are heavily thinned, none that we saw exhibited a well-developed Clovis-style flute. Clovis assemblages lack shouldered points and the

Solutrean laurel-leaf knife.

A Solutrean origin for the Clovis culture seems a more parsimonious explanation of the evidence than an Asian ancestry. Certainly, if Solutrean industries were found in Siberia, no one would question their historical relationship with Clovis.

Solutrean seafarers may have followed the edge of an ice sheet that covered the North Atlantic during the last Ice Age to reach the east coast of North America.

The ultimate test of this hypothesis may be found in genetic research on ancient human remains. Michael Brown and colleagues reported in 1998 that mitochondrial-DNA haplogroup X (a genetic marker of population groups) is found in low frequencies in both European and Native American populations, but not among Asians. This indicated to them that some of the American founders may have come from Europe between 36,000 and 12,000 years ago.

Regardless of whether a Solutrean-Clovis link is eventually proven, exploring this hypothesis should increase our understanding of the development of technological innovations and broaden our knowledge of early peoples of the New World. □

DENNIS STANFORD is Chairman of the Anthropology Department at the National Museum of Natural History, Smithsonian Institution. BRUCE BRADLEY is President of Primitive Tech Enterprises, Inc., in Cortez, Colorado, and Adjunct Professor at Augustana College in Sioux Falls, South Dakota.