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CLOVIS ADAPTATIONS AND PLEISTOCENE EXTINCTIONS

Edgar B. Howard, of the University of Pennsylvania's museum, had been ambushed before, so this time he moved fast. He caught a westbound train on November 12, 1932, alerted to the news a road crew mining gravel from an old pond on the high plains of eastern New Mexico had struck bones. Lots of them apparently, and big ones, too: mammoth and bison. That summer, Howard had seen scraps of the bones and Folsom-like fluted points ranchers had been finding in wind-scoured "blowouts" in these old ponds. The road crew had hit the mother lode.

Howard knew the stakes. Earlier, his cordial relationship with paleontologist Barnum Brown had soured when Brown stole credit for a fluted point found in Pleistocene bone-bearing sediments in Burnet Cave near Carlsbad, New Mexico. Howard, who had made the find while Brown was far away in Montana, had not been happy. Nor was Howard pleased to learn his idea for a national committee to investigate potential late Pleistocene archaeological sites had been scooped, and the committee formed without him. In the years after the Folsom discovery, everyone wanted in on the action at early sites, Howard most of all. He was, a disapproving Loren Eiseley observed, "addicted to the pursuit of terminal ice-age man."[1]

Four days later, from the small town of Clovis, New Mexico, Howard flashed a telegram back east: "Extensive bone deposit at new site. Mostly bison, also horse & mammoth. Some evidence of hearths along edges. Will tie up permissions for future work & spend a few more days investigating." But only a few more days. Back in

Philadelphia the next week, he announced in the journal *Science* the finding of evidence of humans "at a very remote period," and staked his claim to the Clovis site.[2]

The following spring, Howard and his crew began excavating at Clovis. They had to work quickly. That summer the world's preeminent geologists would descend on Washington, D.C., for the International Geological Congress. There would be field trips out west afterward. Howard wanted Clovis to be one of the stops, but that meant having something to show: a fluted point in undisputed association with mammoth bones would do nicely. Finally, by late July, he had several, "scattered around like a dog buries bones," just what was needed to give his visitors "something substantial to think about."[3]

On August 3, in a scene that harkened back to the landmark visit to Folsom six years earlier, American and European scientists descended on Clovis, including the eminent Sir Arthur Smith Woodward of the British Museum (whose keynote address to the congress triumphantly reviewed the proof "Piltdown Man" was an early Pleistocene human). When they arrived, the visitors saw spear points, fluted but larger and less refined than those at Folsom, amid mammoth skeletons (Figure 45). That evening a

FIGURE 45.
E. B. Howard removed some of the more significant finds from the Clovis site as large blocks, in order to bring them back to Philadelphia for more careful excavation and cleaning. In the midst of that work, he posed, pointing to a beveled mammoth bone rod next to the ulna (lower forelimb) of a mammoth. (Photograph courtesy of The Academy of Natural Sciences, Ewell Sale Stewart Library, Philadelphia.)

jubilant Howard telegraphed the museum to say "Drs Merriam Stock Woodward and Vanstraelen have examined excavations here today [and] they agree evidence obtained indicates association of artifacts with extinct elephant and bison."[4] Howard couldn't sleep that night, happily playing over the events of the day.

Back in Philadelphia the next week, Howard issued another statement in *Science:* Clovis, with its artifacts and "matted masses of bones of mammoth,"[5] showed America was inhabited some 15,000 years ago. Not to be outdone, two weeks later Jesse Figgins (of Folsom fame) announced in *Science* he, too, could report on a recently completed excavation of mammoth bones near Dent, Colorado, which had also yielded two large, fluted spear points like those at Clovis. But he was too late to snag the naming rights that came with priority of discovery. We speak of Clovis points and the Clovis culture—not Dent points and the Dent culture.

Coincidentally, that same summer delegates to the Fifth Pacific Science Congress in Vancouver, Canada, were presented a volume of essays on the origin and antiquity of American Indians. The lead chapter, by W. A. Johnston of the Canadian Geological Survey, for the first time suggested that during the Wisconsin glacial period, lower sea levels meant a "land bridge probably existed" between Siberia and Alaska, and that a migration route south from Alaska through the Mackenzie River Valley had opened in the wake of ice retreat.[6]

Within just a few months, Howard and geologist Ernst Antevs put all the pieces together: 20,000 to 15,000 years ago, the Bering Strait was dry land, and a corridor was open along the east side of the Rockies, removing all obstacles to migrations from Central Asia to the Great Plains. Given how neatly this corresponded to their estimated age of the Clovis site, it seemed a route and a timeline for the peopling of the Americas was emerging. The precise ages on that timeline, of course, would not be nailed down until the advent of radiocarbon dating, still several decades off (Chapter 3).

No matter. The geological evidence of a Pleistocene human antiquity was secure, and Howard, pleased by what he'd accomplished at Clovis but anxious to follow the first Americans' trail back to Asia, soon handed over the reins of the Clovis site to a graduate student and began planning an ambitious field program. He would search for sites along an arc from New Mexico, up along the flanks of the Rocky Mountains, through the ice-free corridor region, and he hoped, ultimately back to Lake Baikal in Siberia.

Howard's grandiose plans flopped. But at Clovis, his successor began to fill in the details of a culture that, within a decade, others would trace across the continent. Unlike Folsom Paleoindians, who mostly kept to the plains, Clovis groups were seemingly everywhere. Their sites have since been found across the continent and in a variety of environments, from the coniferous forests of the Pacific Northwest to the desert Southwest, through the rich grasslands of the western plains to the complex mixed forests of the American Southeast and near tundra of the Northeast. No subsequent North American occupation, Paleoindian or otherwise, was so widespread or occupied such diverse habitats, let alone amid the kind of climatic, ecological, and geological upheaval that was happening in the wake of continental deglaciation. And it wasn't long before Clovis peoples' sudden and widespread appearance was attributed to fast-moving big-game hunters—and blamed for the extinction of the mammoth, mastodon, and nearly three dozen other genera of Pleistocene mammals (Chapter 2). It would take another fifty years to realize matters were not as simple as they appeared. But that's getting ahead of the story.

MADE IN AMERICA

In 1935 Howard traveled to the Soviet Union via Europe, but got nowhere near Siberia. Soviet authorities forbid it. Forced to cool his heels in Leningrad, Howard visited museums, where he examined archaeological collections from across the country amassed since the time of Czar Peter the Great. None yielded any Clovis fluted points. That told Howard something. Fluting may just be an American invention—the *first* American invention. Knowing fluting's place of origin and how it spread would be vital to tracking Clovis movement. But where was that, and when?

The obvious place to start searching was between Alaska and the northern plains, and many archaeologists have done just that in the decades since Howard. All together, about fifty fluted points have been found in Alaska, but mostly in the state's far northern reaches (at or north of about 66°N latitude, about the latitude of the Arctic Circle), and only on the surface or in deposits with younger artifacts. About 60 fluted points also have been found in the one-time ice-free corridor.[7] Yet, few of these have secure radiocarbon dates, and those that do are fewer than 10,500 years old, as they ought not to be if they were left behind by Clovis colonizers moving south. Stylistically, the Alaskan and Canadian fluted points don't look much like Clovis points from the Lower Forty-eight either, but appear more akin to later fluted points. This gives reason to suspect fluting was invented *south* of the Laurentide and Cordilleran ice sheets, and spread from there—including to the north (a migratory backwash, as it were, which may have carried other types north as well, as discussed in Chapter 9).

The Great Plains and Southwest are likely places of origin; the oldest known fluted points occur there. Another possibility is eastern North America. Since more and more varied fluted points occur there than anywhere else, Ronald Mason long ago argued they were invented here, on the principle that diversity reflects age. (Sound familiar? It's the principle Greenberg invoked to fix the relative antiquity of his three language families.) Finding eastern fluted points that clearly predate those to the west would settle the issue, but so far none have been. In the meantime, Adovasio reminds us the unfluted Miller lanceolate from Stratum IIa at Meadowcroft would make a fine fluted point precursor.

Once invented, fluting spread over North America, and persisted through Clovis and subsequent Paleoindian cultures (Folsom points are fluted, as are a variety of eastern North American points). But it's hard to understand why. Fluting is a tricky technology to master, in many ways one of the most difficult steps in the sequence of making a point. It is estimated Clovis points broke while being fluted 10%–20% of the time (failure may have occurred nearly 40% of the time when fluting Folsom points[8]). Mistakes were costly, especially when stone supplies were scarce. And for what? Fluting thins and potentially weakens the point, and served no purpose . . . that we know of.

Early on, it was thought fluting enhanced bloodletting of the speared prey, not surprising since in the 1920s, when fluted points were first found, the memory of World War I bayonets was still fresh. But that idea fell from favor when archaeologists realized the flutes were sandwiched between bone (or wood or ivory) foreshafts, or embedded in a socket and *hafted* (attached) to the spear. Flutes on hafted points, wrapped with sinew and possibly coated in tree resin or tar to firmly anchor them, were too deeply buried to enhance bleeding. Others suggested fluting helped strengthen the bond of point to haft, or perhaps by thinning allowed the points to penetrate deeper and become more lethal. Yet, over the next 10,000 years of post-Paleoindian time, hunters managed to muddle through using unfluted points that were hafted and presumably just as firmly anchored to a spear or arrow shaft, and equally effective as penetrating weapons. Maybe, George Frison and Bruce Bradley argue, the reason we cannot show that fluting directly enhanced the performance of the point is because it didn't.

If that's so, why did the technique endure for at least half a millennium? Part of the answer may be inertia: tradition is a potent force to dislodge. But for a process so risky, so costly, and by consensus so useless, there must be more to it. Perhaps fluting was style or art, a symbolic representation of hunting prowess (showing off!), or part of a pre-hunt ritual: could it be mere coincidence some fluted points preserve traces of staining by red ocher, a blood-red mineral paint? In the ritual realm, as we know, costs don't matter. Admittedly, these possibilities are not easily put to the test, but are more the sort of explanations we fall back on when we cannot see purpose in prehistory. As Stanley Ahler and Phillip Geib say, we "sometimes characterize the unknown as unknowable, just to put our busy minds at ease."[9]

Art or ritual it may have been, but whatever fluting was, a great many Paleoindians employed it. Still, not all fluted points are alike, save in a most general sense: all share a lanceolate shape, are ground smooth along the base and partway up the sides (which ensured the edges did not cut the sinew binding or socket haft), and have flutes that extend from the base partially up one or (more commonly) both faces of the point (Figure 46). On a "classic" Clovis point, the sides are parallel, the flutes travel usually less than one-half the length of the face, and the points are relatively long and thick, though deliberately made Clovis miniatures are known (children's toys, some suspect). A freshly minted Clovis point, based on a sample from Texas (and, no, the points are not necessarily bigger in Texas), would be slightly over 10 centimeters long, 3 centimeters wide, and 7.5 millimeters thick.[10]

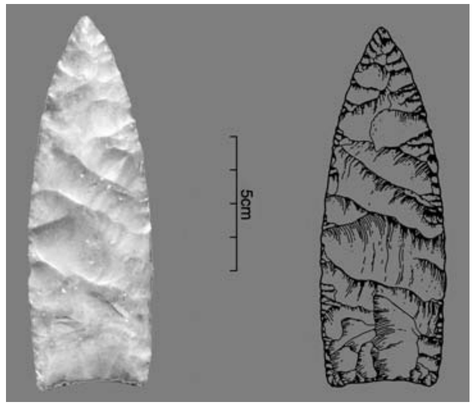

FIGURE 46.
Clovis point from the Clovis type site in New Mexico, displaying the type's diagnostic features, including fluting and *outre passé* (overshot) flaking. This particular specimen is made of Edwards Formation chert, likely from an outcrop source near Big Springs, Texas, approximately 300 km southeast of the site. It was found near the vertebra and ribs of a mammoth. (Photograph by David J. Meltzer; line drawing by Frederic Sellet; arranged by Judith Cooper.)

There is often surprising uniformity in the size and shape of the lower portion or base of a Clovis point, where it would have been inserted into a haft. It appears the aim was to fit the points to a haft, and not vice versa. That implies the hafts were more difficult or time-consuming to make, or perhaps the haft material was harder to come by. Regardless, broken points had to be unwrapped and ejected when they broke, as they inevitably did, and the haft reloaded.

Beyond that, fluted points vary considerably in their size and shape, and in the length and depth of the flutes, the number of flutes (though three flutes per face is about the limit), the kind of chipping used to fashion the point, the finishing of the edges, and a host of other minutiae that delight archaeologists. This is true with Clovis, and especially between Clovis and immediately post-Clovis fluted points, of which there are many styles (especially in eastern North America [Chapter 9]). That sometimes makes it difficult to decide what's Clovis and what's not, particularly in the absence of accompanying radiocarbon ages. Much of the variation results from the effects of use and resharpening of the points, but also from the divergence of people, knapping styles, and techniques over time and space. Think of it as a kind of "cultural drift," as kin and descendants experimented with and introduced their own variations on the Clovis theme.

PACKING THE TOOLBOX

Fluted points are certainly the most recognizable artifact in the Clovis toolkit, but assuredly not the only important one. It's a generalized toolkit: suitable for many tasks, not built specifically for any one (see Plate 8). It includes large bifaces, which could be readily transported and from which flakes could be struck for use, or from which points could be obtained. There were also end and side scrapers for cleaning hides; gravers or flakes with carefully formed small projections or spurs, possibly used to engrave bone or wood; spokeshaves, or notched pieces, which may have been used to shave wooden or bone shafts; and a variety of knives or flake-cutting tools. There is a certain monotony to the Clovis toolkit, with variation expressed more in the presence or frequency of certain tools (end scrapers, for example), or the kind of stone used, than in the types of tools. That sort of pattern tells us more about what was done than who did what.

However, a few distinctive stone-tool types are known to occur primarily in some regions but not others. Long, curving stone blades (their length twice their width) and the multifaceted (polyhedral) cores from which they were struck, were fashioned by stone workers on the southern plains, and perhaps into the Southeast: a particularly rich haul comes from the Gault site in central Texas. Christopher Ellis and his Great Lakes colleagues show that backed bifaces (perhaps themselves hafted) were common, and fluted drills absent, in the eastern Great Lakes, while the reverse seems true in New England.

Where preservation permits, bone and ivory artifacts are occasionally found. These include ivory hammers or billets, and a mammoth bone shaft "socket" wrench, possibly used for straightening ivory or bone rods, from the Murray Springs site (Arizona). No bone or ivory rods accompanied this particular specimen, but examples have been recovered in a dozen other sites scattered across the West, and from underwater sites in Florida.

These bone and ivory rods are usually about 30 centimeters long but fewer than 2 centimeters wide, and are often beveled at one or both ends. A glimpse at how these were made comes from the Clovis site, which yielded a section of mammoth tusk, V-notched at one end as though felled by a beaver, which at the time it was lost or abandoned was on its way to being further reduced and fashioned into one of those ivory rods. These rods have been variously interpreted as spear points, foreshafts for joining stone points to a spear, tools for fine flaking of stone, pry bars for dismembering carcasses, sled shoes, or wedges for tightening up loose haft bindings.[11] There's no reason to limit their function to just one of these possibilities.

Unfortunately, their scarcity reveals little about how bone and ivory were used by Paleoindians, since these were almost certainly used more frequently and in more ways than we can infer. The spotty distribution, however, does say a great deal about how poorly bone and ivory are preserved in the archaeological record.

Which also explains the virtual absence of what may have been their "perishable" artifacts, those made of plant fibers, or animal hide and fur. Such items vanish quickly, save in unusual circumstances, such as where it's extremely dry or perennially wet (recall the string tied around the tent stakes at boggy Monte Verde). James Adovasio reports Clovis-age twined bags, mats, burden baskets, and trays, mostly from Great Basin dry caves (such as Danger Cave, Utah). No Clovis nets have been found. Yet. Adovasio expects they will, since net hunting has deep roots in prehistory, as well we might expect: it requires relatively little expertise, it's effective and nonconfrontational, and animals trapped in nets (even ones as large as elk) can be killed safely at close range by stabbing or clubbing by individuals without great physical strength. Consequently, it's a method that routinely involved "females, juveniles, and the old."[12]

Not all Clovis tools and artifacts appear in all Clovis sites, and more differences in their toolkits and technology will likely emerge as we learn more of the archaeological record. At present, we lack sites and assemblages from many geographic areas, and have found relatively few of their habitation sites where, by virtue of longer periods of occupation and greater number of activities that took place, a wider range of tool classes would be expected.

BUT IS IT ART?

A number of Clovis bone and ivory rods are scored with zigzags; parallel lines; small, curved incisions; and in one instance, zipper-like markings. The markings are far too systematic to be merely accidental. They could be art for art's sake, some other symbolic decoration, or more prosaically, ownership or use marks.

Engraved stones, too, though no more than a few dozen, have also been found in Clovis-age sites. These are incised with cross-hatched, parallel, intersecting, or converging lines. All but two were recovered at the Gault site, and had been made on the locally occurring limestone (Figure 47). That's not the best artistic canvas to be sure, and what

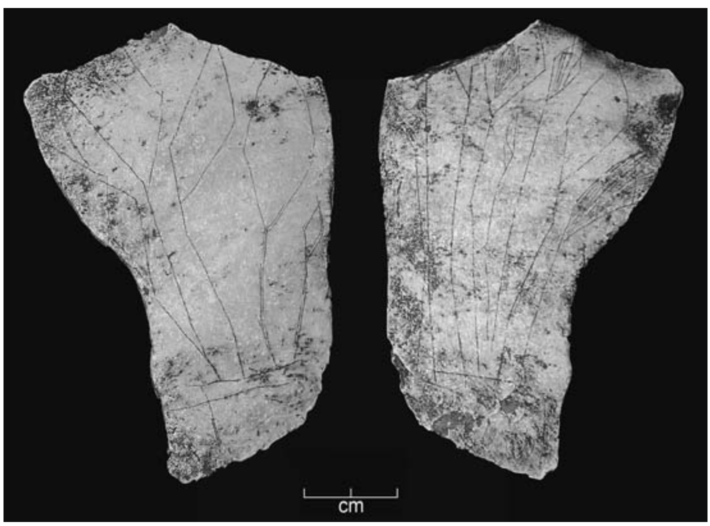

FIGURE 47.
Clovis art: two faces of a piece of engraved limestone from the Gault site, Texas. The meaning of the lines is unknown. Among the interpretations: they represent plants, or perhaps a map of rivers and tributaries. (Photograph courtesy of Michael Collins and the Gault Project, Texas Archeological Research Laboratory, University of Texas–Austin, of a cast made by Pete Bostrom of Lithics Casting Lab, Troy, IL.)

those scratches represent is anyone's guess. But if one applies a bit of imagination, some of the Gault engravings appear to represent stick-figure plants or, letting the imagination go full throttle, maps depicting rivers and their tributaries.

Clovis-age cave or rockshelter art is rarest of all, if indeed we've ever seen any. We're never sure we are looking at what we think we're looking at, as it is often difficult to determine the age of an image on a rock wall. Even so, Larry Agenbroad and colleagues have recorded half a dozen rock panels on the Colorado Plateau in eastern Utah that display paintings and engravings of what appear to be mammoths. Agenbroad worries some of these are modern fakes (shades of Hilborne Cresson!), and none are dated to late Pleistocene times.[13] As noted earlier, the extraordinarily rich and expressive art routinely found in Paleolithic Europe—cave paintings and sculpted figurines of extinct animals and humans appearing in both natural and abstract forms—is absent from late Pleistocene North America. Perhaps by then the animals were already extinct, or possibly people had other things on their minds (or their walls).

STONE FOR THE TAKING

Which is not to say Clovis people lacked appreciation for the finer things. In making their stone tools, they relied almost exclusively on very-high-quality chert, jasper, chalcedony, and obsidian (volcanic glass) (see Plate 9). All are fine grained and lack cleavage planes or other natural fault lines, making them easy to chip into a desired form, and capable of holding razor-sharp edges. Other kinds of stone can be serviceable, but Clovis (and, for that matter, later Paleoindian) knappers only went for the best. Why? Higher-quality stone is less failure prone, which would have been of no small concern to hunters going after large game at a time when hunting was very much an up-close and personal activity: no safe firing from long range here. If a point broke at the wrong moment because of a flaw that weakened the stone's tensile strength, it was not just a bad day at the office. As Frison says, it could mean injury or death.[14] Further, a point made of higher-quality stone lasts longer and can be readily resharpened, thereby prolonging its use. That would be important to wide-ranging hunter-gatherers, who could not predict when they would next be able to resupply at a stone source.

We benefit, too: because these high-quality stone types are often distinctive in color, fossils, chemistry, or composition, we can frequently pinpoint where they were obtained and how. It appears Clovis peoples mostly acquired their stone directly from bedrock outcrops (Figure 48), where it could be quarried in large blocks, rather than from picking through the gravels of a river bed or a glacial moraine in hopes of finding cobbles of suitable size or material. Size was critical to Clovis knappers since some of the bifaces they made were upwards of 20 centimeters in length and width, and more than 600 grams in mass, requiring the starting blocks of raw material—*cores,* they're called—to be of even greater size.[15]

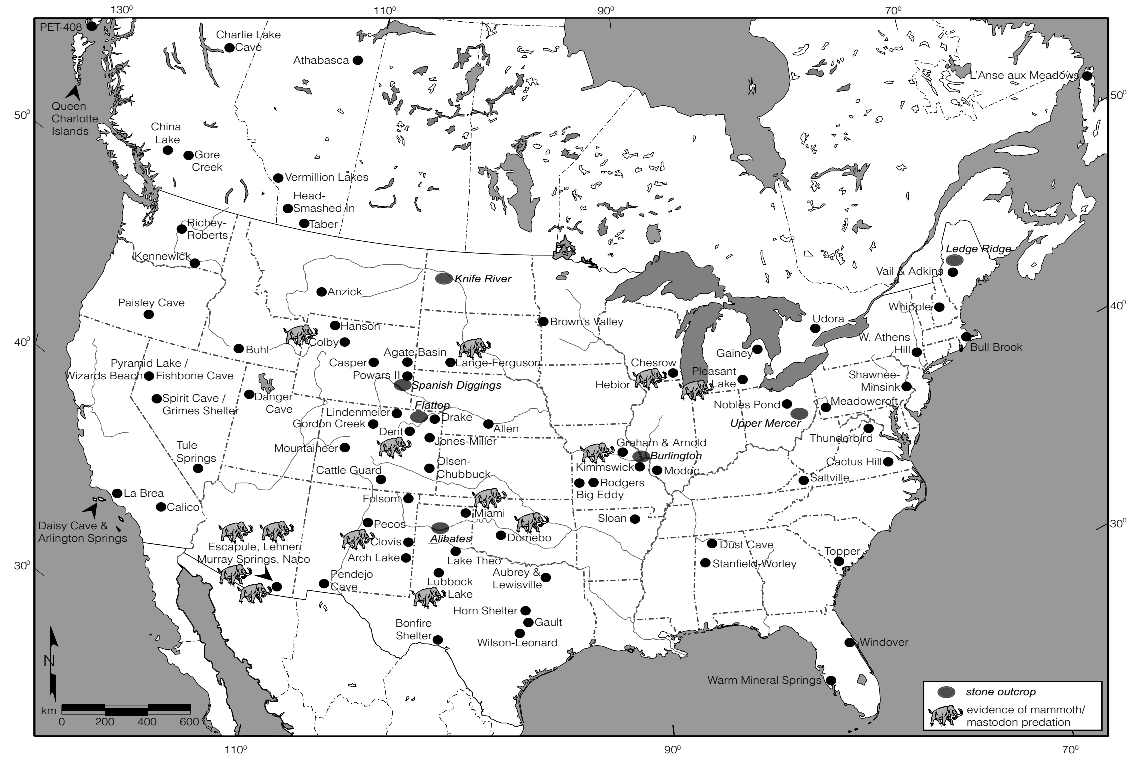

FIGURE 48.
Map of Canada and the United States showing the location of pre-Clovis, Clovis, Late Paleoindian, and more recent sites discussed in the text. Only some of the stone sources used by Paleoindian groups are located on the map; the symbol for the outcrops should not be taken as indicative of their size or shape, but only as indicating an approximate location.

The Clovis knappers' preference for specific stone outcrops reveals the depth of their geological knowledge: they found sources we never have. And they went directly to those sources themselves. No trading was apparently involved, but then what self-respecting hunter-gatherer wants to rely on others to supply a material so essential to survival, or needed in bulk? As open as territories were on this landscape, stone sources were accessible to all, leaving little incentive for a Clovis entrepreneur to schlep double the usual amount of stone, one-half for personal use and the other half for exchange, across great distances on the off chance of finding a trading partner. That said, their sporadic encounters on the landscape likely resulted in an exchange of gifts to mark the occasion and the bonds forged, which may explain why sites occasionally yield a Clovis point or two made with an unusual style or material.

Because stone can often be identified to the outcrop from which it was obtained, the distances between where it was quarried and where it was abandoned serve as an odometer of Paleoindian travels. Sometimes those distances were great. Alibates agatized dolomite from the Texas Panhandle, just outside of Amarillo, was used to fashion Clovis points left in the Drake cache in northeastern Colorado, 585 kilometers away. Although we routinely use the straight-line distance from quarry to site as a measure of Paleoindian mobility, that takes no account of side excursions, return trips, or any other archaeologically invisible travel. Actual mileage may vary.

It certainly did in Clovis times across the continent, the scale depending on the nature and density of resources being exploited. Distances of 300–400 kilometers are common on the treeless western plains, and on the open parkland and tundra of northeastern North America, where resources were locally clumped but widely separated. In the closed, ecologically richer forests of northeastern North America—where, we suspect, groups did not have to be as wide-ranging (see below)—the sites are dominated by locally acquired stone (picked up within 50 kilometers of the site, say), though occasionally contain specimens of more distant or *exotic* material.

In most sites, exotic material occurs as finished artifacts, or at most, as prepared bifaces or cores, rather than as raw blocks of stone (at the Gainey site in Michigan, for example, cores were hauled in from east-central Ohio's Upper Mercer chert outcrops, some 380 kilometers away). Mobile hunter-gatherers without benefit of beasts of burden (save, perhaps, for dogs) would have had their hands full carrying food, hides, tools, children, and the like. Stone artifacts were heavy enough on belts or slings without the extra weight of blocks of stone, much of which was destined only for discard when later flaked into a point or tool.

How they fashioned their points and tools is captured in the manufacturing debris left behind, particularly at sites situated close to stone outcrops, including Gault, Thunderbird (Virginia), and West Athens Hill (New York). These sites are dominated by the vast numbers of flakes *(debitage)* that fly off as a stone tool is chipped. At Thunderbird, a single, three-inch excavation level of a 10 x 10 foot square excavation unit (this was the 1970s; we were slow to go metric) often yielded more than 10,000 pieces of debitage, along with tools that broke in the process of manufacture, and even glimpses of discrete moments in time: among them, flakes piled up as though they had rained down on the sides of a knapper's crossed legs, and the tip of a nearly finished Clovis point found dozens of feet from its broken base (Figure 49). That point had been just a few flakes away from being perfect, and one can only empathize with the knapper's frustration when it broke *(why did I have to hit it that one last time?)*—and readily imagine seeing the broken pieces flying across the site.

Occasionally, if the stone wasn't of the highest quality, it might be slowly heated in sand beneath a hearth to enhance its "flakeability." Experimental studies by Philip Wilke and colleagues show that the optimal method for heat-treating stone is to slowly raise it to a temperature of 165°C–300°C for several hours, then bring it back down slowly (heat or cool it too quickly, and the stone will craze or shatter). Heat-treated stone gains a waxy luster, and depending on its chemistry, can change color: specimens of the yellow green jasper at Thunderbird turned pink and red from heating.[16]

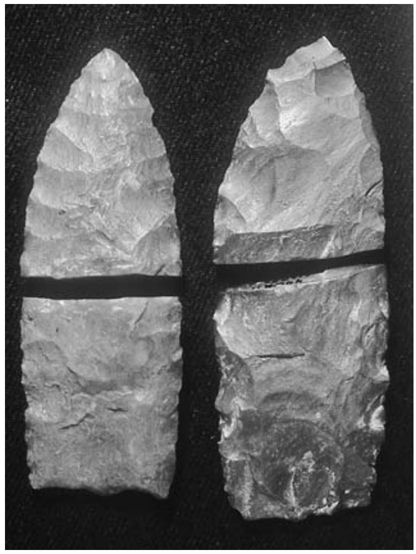

FIGURE 49.
Two fluted points from the Thunderbird site, Virginia, which failed en route to manufacture. The specimen on the left was nearly complete when it broke during final thinning. Its two parts were found some distance from one another, hinting that a healthy pitch followed the fatal break. (Photograph by David J. Meltzer.)

After groups departed the quarry, they looped around the landscape, and over time, artifacts were used or broken, and the stone supply dwindled. When far from a quarry, the groups conserved their resources: fluted points that dulled or broke were carefully resharpened, but if broken beyond repair or whittled to a useless nubbin (say, 4–5 centimeters in length, barely long enough to peek out from beyond the binding of their haft), the point might see new life by being recycled into other tools like scrapers, drills, or wedges.

Just so, groups venturing far into unknown terrain surely kept a watchful eye for new outcrop sources to replenish their toolkits. And perhaps, hedging their landscape learning bets, they also had the foresight to lay in resupply depots along the way.

CACHING ACROSS THE LANDSCAPE

The Clovis-age archaeological record includes a number of stone artifact caches containing bifaces and blades (see Plate 10). Although these could have been used "as is," more likely they were chipped into those forms for easier transport, and with the idea that from these forms, they could readily be made into one of a variety of useable tools. These caches rarely occur at Clovis camps or kills (though there are exceptions), but instead often turn up in otherwise isolated spots, giving the appearance of having been stashed, presumably with the intent of being retrieved later. The cache pieces are generally fashioned of stone from outcrops several hundred kilometers distant.

We now know of at least twenty Clovis caches scattered throughout North America, but mostly in the West. A prime example is the Richey-Roberts site, discovered in the late 1980s by workers installing a sprinkler system in an apple orchard near East Wenatchee, Washington.[17] Full excavations revealed some forty Clovis artifacts, including projectile points, preforms (unfinished points fashioned into a broadly lanceolate shape), bifaces, scrapers, other stone tools, and a dozen or more bone and antler rods. The Richey-Roberts Clovis points, some of which are 21 centimeters long and 6 centimeters wide, are among the largest ever found. Here, as in other Clovis caches, some artifacts were sprinkled with red ocher. Were they being symbolically infused with life-giving blood, or was this a blood-colored warning: but to whom—or what? Or was it something else? No one can say.

At the Anzick cache in Montana, over 100 Clovis stone artifacts, and bone and ivory rods, accompanied the uncremated, ocher-covered remains of a child (Chapter 5).[18] Here, the term cache is surely inappropriate, since the collection of artifacts is likely grave goods, not intended for later use, at least not in the corporeal world. But for those caches that are not obviously burial offerings, a more utilitarian explanation may be sought.

On its face, an artifact cache represents a handy solution to the logistical problem faced by highly mobile peoples: the gap between where a stone could be acquired (which is predictable), and where it was to be used (which is not always predictable, and in any case may be very far away). Annual moves might bring mobile peoples past quarries occasionally, but they can only haul away a limited amount of stone. And yet that stone is "spent" all over the territory, sometimes exhausting supplies far from the source. One solution to that logistical dilemma would be to cache supplies of stone in convenient places around the landscape. When tools broke, wore down through resharpening, or were lost, as all tools inevitably were, resupply at a cache could save a long trip back to the quarry. Seems self-evident.

Later Paleoindian groups were just as mobile as Clovis groups and just as reliant on high-quality, distant stone sources. By that reasoning, we should also see their caches as well, but we don't. Late Paleoindian caches are extremely rare.[19] There are now enough Clovis caches and few enough from the millennium that followed to suggest this pattern is real and not an accident of sampling. How, then, can we explain the preponderance of Clovis caches, and the scarcity (if not absence) of later ones?

Michael Collins sees an explanation in the predictability of Clovis movement: he suggests they knew in advance where they were headed, knew they would be returning to particular spots with perilously exhausted tools in need of replenishment, and in anticipation, left stone behind for future use. Later Paleoindians, he argues, could not predict their future movements with enough confidence to benefit from caching stone. Perhaps. Yet, the stone used by Folsom groups (Clovis successors on the plains) comes from a greater diversity of sources, sometimes from even greater distances. The more complex pattern of Folsom stone acquisition suggests that however unpredictable their movements, they certainly knew where sources were, and were highly adept at scheduling their visits. Moreover, if Clovis groups knew they were returning to a spot and would need and use the stone, then why were the caches still there 11,000 years later?

I suspect a different strategy might have been in play: Clovis groups were so new to the landscape they didn't know and couldn't predict where or when they were next going to find a suitable stone outcrop. By depositing caches about the landscape as they moved away from known sources, they created artificial resupply depots, and thus anticipated and compensated for that lack of knowledge. If they found no stone in the area where they were headed, they at least would not have to double back completely to the original outcrop to refurbish their current tools when those were used up. And if they did find a new stone source, the cache could be ignored and abandoned.

Is it then a mere accident of sampling that most of the Clovis caches found so far are on the Great Plains and in the Northwest, far from stone outcrops? Or could this be telling us that the challenges of exploring those areas were different? Time and more caches will tell.

Stone is especially suitable for caching, since unlike meat or other food, it won't spoil, won't be attractive to scavengers, and barring massive tectonic activity, won't move before you return. A stone cache has a fixed and predictable location. As such, it serves a useful role in wayfinding (Chapter 7), for now one's "map" of a landscape includes not just the natural resources, but some artificially placed ones as well. This helps make it possible to venture further across otherwise unknown terrain. Over time, as new sources of suitable stone are located, and as groups are better able to predict where and when they will be able to replenish their supplies (presumably in the post-Clovis period), then caches become less critical to movement, and ultimately unnecessary.

The obvious flaws to this theory are the occasional caches found close to a raw material source—like the deGraffenreid cache (see Plate 11), apparently stashed in the vicinity of the stone-rich Gault site[20]—and the likelihood there were multiple purposes for caching stone. And, of course, one cannot use the absence of caches in later Paleoindian periods as proof landscape learning was complete by then, at least not without getting dizzy spinning in a logical circle. That said, I think there is independent evidence—albeit circumstantial—to indicate that might have been the case, though that's for the next chapter, when other clues to the process become apparent.

MOBILE HOMES

Befitting their mobile lifestyle, the dwellings Clovis people built were temporary shelters made of wood or materials that quickly degraded and disappeared (none were made of stone). Their traces are often little more than hard-to-spot circular stains in the soil marking where wooden posts were once planted *(postmolds)*. William Gardner reports one such structure at Thunderbird, a line of postmolds forming a rough oval 9×12 meters in size.[21] Other evidence of structures can be as subtle as slightly hardened earth, or artifacts concentrated around darkened soil or burned areas.

Although such clues reveal little of the habitations once standing there, they do hint at site use and the scale of the occupation. In the Upper Midwest and northeastern North America, for example, a dozen or so Paleoindian sites include discrete artifact concentrations, perhaps 4–6 meters in diameter, yielding a like range of tools. These are thought to be individual family households and the remains of their domestic activities. Occasionally, broken artifacts from different concentrations can be fit together, a strong hint that the households were occupied at the same moment in time. At Nobles Pond (Ohio), the concentrations were even neatly arranged in a semicircle.[22]A Pleistocene mobile home park, as it were, but again with the emphasis on *mobile*. In other sites, the concentrations are less well defined and overlap, which bespeak successive occupations in the same spot.

Evidently, these groups did not stay for long in any one place, nor always return to it: most of their sites were used but once. With a continent to themselves, the only incentive to revisit a spot was if it offered a prized resource, whether permanent (the quarry-related sites of Gault, Thunderbird, and West Athens Hill) or temporary (the Vail site in Maine seems to have been established alongside a migratory game trail). Such is the advantage to colonists on a landscape with few other people and no territorial borders. But as discussed in the previous chapter, there was also strong incentive for separate families to gather and socialize, exchange items and information, maintain old kin ties, and establish new connections through marriage. So far, however, no Clovis "rendezvous" has been found.

POINTS ON LAND

But Clovis people left behind more than sites; they also scattered their distinctive points across North America. There has long been something of a cottage industry among archaeologists devoted to tallying Clovis points by state (we're approaching 550 in Texas). David Anderson and colleagues have compiled those into a continent-wide total: it's currently at over 13,000 points from some 1,500 locations.[23] The great majority of these are *isolates,* unaccompanied by other Clovis tools, bones, or trappings of a site. As David Brose remarked (tongue-in-cheek), from the looks of it, these groups ate nothing and lived alone. Yet, where these isolates are found might just tell us something interesting.

A map of their distribution and density reveals isolates are particularly thick on the ground across much of the eastern United States, especially around the Tennessee, Ohio, and Cumberland river valleys. In contrast, many areas have only sparse and widely isolated occurrences, including much of the Great Basin, the Columbia and Colorado plateaus, the northern Great Plains and northern Rockies, and the uppermost and lowermost reaches of the Mississippi Valley.

Anderson interprets the high concentrations of isolates in the Midwest and Southeast as "staging areas," spots on the landscape where groups slowed down and settled in for a time, before pushing still deeper into the continent.[24] Possibly so. However, these are also regions rich in high-quality stone outcrops. Is the density of Clovis points there merely a reflection of the unusually large amounts of archaeological debris that routinely surround such sources, or were such areas indeed magnets for longer-term human occupations by virtue of their being resource-rich and predicable spots on the landscape? It could be both. And what of the scarcity of Clovis points in places like the lower Mississippi Valley? Does that mean there were few Clovis inhabitants, or is it merely a reflection of the last 10,000 years of the river's floods deeply burying any Pleistocene-age remains?

The distribution of Clovis points is not a map of Clovis people on the landscape (as Anderson well appreciates), but a complicated result of many things, including modern land-use patterns (point densities often correlate with the amount of plowed acreage); deposition, erosion, and surface age; archaeological activity (not all states have had systematic surveys for Clovis points); and the presence of high-quality stone outcrops.[25] Few Clovis points does not necessarily mean few Clovis people.

A more representative sample will surely change the geographic details of the Clovis distribution, but probably not the essential fact that the Clovis presence on the landscape was broad and not deep. It's the archaeological footprint of highly mobile people at low population densities, further testimony that movement was tied to topography and terrain, and likely involved leapfrogging across the landscape, rather than proceeding as a wave of human settlement washing across the land.

IT'S ABOUT TIME

The chronology of the Clovis occupation shifts through time and across the continent. The oldest sites are those on the Great Plains and in the Southwest, which range in age from 11,570 BP (the Aubrey site, Texas) to about 10,800 BP. Significantly, the earliest appearance of Clovis follows the opening of a viable ice-free corridor (Chapter 2).

There are reliable radiocarbon dates on only a dozen or so Clovis and Clovis-like (Gainey type) points in the eastern United States, but despite the long-held suspicion Clovis and fluting originated in this area, the oldest of these (Shawnee-Minisink, Pennsylvania) is only 10,940 years old. Most of the others fall between 10,600 and 10,200 BP, a period contemporaneous with Folsom on the Great Plains. Clovis-like materials occur in the Great Basin and far West, although their ages are even less certain, and the cultural chronology is confused by the contemporaneous occurrence of the large, unfluted Western Stemmed points.

A recent radiocarbon study by Michael Waters and Thomas Stafford shows that nearly a dozen Clovis sites from Montana (Anzick) to Arizona (Lehner) to Pennsylvania (Shawnee-Minisink) date to 10,900 BP, give or take a century. That makes them essentially contemporaneous, at least within the bounds of radiocarbon dating.[26] The styles of Clovis points at these sites are quite different (though all are still recognizably Clovis). When the ages of more sites are pinned down as tightly, we'll finally be able to get a precise gauge of the timing of the stylistic change and, by extension, the cultural drift (Chapter 7) that occurred as Clovis people spread across the continent.

In the meantime, the radiocarbon record supports the long-held suspicion Clovis people radiated rapidly across North America, the process taking perhaps no more than 500 radiocarbon years. It may have taken longer in real time. The Clovis period overlaps the early portion of the Younger Dryas, with its radiocarbon plateaus that defy easy calibration (Chapter 2). Although more and tighter-calibrated radiocarbon ages may ultimately change the apparent speed of the Clovis dispersal, perhaps "slowing" it to, say, 1,000 calendar years, it nonetheless will remain one of the fastest expansions of any culture known in prehistory (Chapter 7).

MURDER IN THE PLEISTOCENE?

The traditional explanation (Chapter 7) for how or why they moved so far so fast has been that Clovis people were specialized hunters who pursued wide-ranging big game, including the now-extinct Pleistocene megafauna. Latching on to prey that paid little mind to ecological boundaries ostensibly enabled Clovis groups to do likewise, and thereby speed across the continent without having to learn new adaptive tricks to survive in different environments. After all, a mammoth was a mammoth, no matter where it lived, but if the mammoth happened to be a mastodon, horse, or camel instead, that only required minor adjustments to the hunting strategy. Or so the argument went.

Gary Haynes (no relation to Vance Haynes) proclaims that nowadays "very few if any rational archaeologists want to argue that Clovis people exclusively specialized in megafauna everywhere and at all times."[27] I wholeheartedly agree (and consider myself rational). Besides, specialized hunting was rare enough among known foraging groups. A specialized hunting adaptation that transcended a continent as large and diverse as Late Glacial North America in less than a thousand years would be unique. And yet continent-wide hunting is said to have driven thirty-five genera of mammals to extinction. Specialized, or not, that certainly makes pressing demands on human hunters. Are Clovis people guilty as charged?

There is no doubt they co-existed with some of these now-extinct mammals. Their overlapping distributions place people at the late Pleistocene crime scene, and at least in some instances, Clovis points have been found embedded in large mammal skeletons. We have motive, method, even the occasional smoking gun. Best of all, if Clovis groups were big-time big-game hunters, that accounts for how they moved so far and so fast, and why all these animals went extinct.

The idea humans caused late Pleistocene extinctions is not new, but goes back more than a century. The modern version is due to ecologist Paul Martin, who attributes extinction solely to human hunting: Pleistocene overkill, he calls it. That the animals lost were mostly megafauna (with an adult weight of at least 45 kilograms [about 100 pounds]) he thinks no coincidence: "Large mammals disappeared not because they lost their food supply but because they became one." Their massive size was their death sentence. Yet, what of the small Aztlan rabbit and the diminutive pronghorn? Martin supposes these were "large enough" to have been attractive to Clovis hunters.[28] Otherwise, he believes smaller prey were of no interest to Clovis hunters and were tossed back (Clovis catch-and-release?).

As Martin envisions the overkill process,[29] animal fates were sealed when a band of 100 highly skilled Clovis hunters emerged out the southern exit of the ice-free corridor just over 11,500 years ago. Before them was a vast expanse of territory empty of people but teeming with immense game. All that meat on the hoof, Martin says, was irresistible to Clovis hunters, who liked megafauna so much they ate them to extinction.

Martin crafted an elaborate and imaginative scenario to show how this could have been accomplished (whether it actually happened that way is another matter, of course). The way he figures it, overkill was inevitable: these animals had never before peered down the shaft of a spear, and would have been fatally ignorant of the danger posed by humans. Killing such naïve and vulnerable prey in this target-rich environment was easy, he figures, and if just one hunter in four bagged a trophy a week, it would decimate local animal populations. Slow breeders, as most of the Pleistocene megafauna likely were, would not have been able to reproduce fast enough to replace the animals killed, even if only a third of them were slaughtered by hunters. The hunters would make short work of the animals in an area, then turn their attention to the targets in front of them, and ignore the growing pile of meat and carcasses behind. Martin supposes this gluttonous human population doubled in size every twenty years, an annual growth rate of 3.4%, and made fast time, fanning outward in a killing wave from which no animal could escape, and which washed across the continent at a rate of 16 kilometers a year.

At that rate, within 350 years, Clovis people would have numbered 600,000 and would have reached the Gulf of Mexico. Just 1,200 years after entering North America, they got to Tierra del Fuego. In their hemisphere-long wake were tens of thousands of fluted points (smoking guns?), the rotting carcasses of more than 100 million herbivores, and carnivore populations that would have boomed with the sudden fortune in freshly killed meat on the landscape—and then the wave went bust when the supply ran out (Martin doesn't think the Clovis hunters targeted carnivores, or needed to in order to cause their extinction: killing off their prey would do the trick).

A chilling scenario, Pleistocene overkill, and one that has achieved a celebrity few academic theories enjoy, perhaps not least because this grim homily of wanton slaughter can be (and often is) preached as a sermon of our species' sins. Granted, the human rap sheet is a long one, but this may be one crime against nature we didn't commit. Overkill seems unlikely for many reasons, among them:

- It took modern humans over 100,000 years to reach Alaska. Could it have taken only 1,000 more years to get to Tierra del Fuego? There were vast stretches of unexplored and highly variable environments to be traversed, each of which posed radically different adaptive challenges to groups that were there to make a living and raise families; lacked maps, convenience stores, and transportation; and had to find water, other food, shelter, stone, and other resources critical to their survival. That takes time.
- Essential pieces of the overkill scenario ring hollow: most hunter-gatherers reproduce at relatively low rates, generally less than about 1.5% per year. Is it reasonable to suppose Clovis groups multiplied at 3.4% in order to reach a population size of 600,000 in just a few centuries? That's an unusually high rate that Martin plucked from the *Bounty* mutineers on Pitcairn Island, who apparently shed their inhibitions along with Captain Bligh.
- Likewise, it's doubtful Clovis spread in a wave across the continent, ignoring environment and topography. Armies, not hunter-gatherers, come in waves. And indiscriminate hunting of nearly three dozen genera of megafauna continent-wide demands a comprehensive knowledge of places and animal behavior few hunters—especially hunters new to a landscape—could possess. Besides, as Frison explained, no one hunting strategy would work on all mammoths, let alone all megafauna (Chapter 7).
- For that matter, when a foraging group's return rate begins to decline, they move, doing so long before they've burned through all the available resources in their original habitat (Chapter 7). They stay put only under unusual circumstances, notably, being hemmed in on all sides. That was hardly a problem on a late Pleistocene landscape devoid of other people, with a choice of productive habitats in which to hunt and gather, and where one could leave a habitat long before its animals were gone. Its highly unlikely Clovis hunters behaved like Sherman's army in its scorched-earth march across Georgia.
- The Pleistocene fauna may have been naïve, but studies have shown that even naïve prey populations "process information about predators swiftly," and their populations quickly rebound from an onslaught of predators.[30] The Clovis hunters' advantage would not have lasted long. Besides, even if unfamiliar with humans, the Pleistocene fauna were already well familiar with the likes of saber-toothed cats, short-faced bears, and dire wolves, and could shift their defensive behaviors to respond to their new threat (humans) just as did African elephants.
- Finally, overkill requires there were no humans in North America prior to Clovis times, for then the megafauna surely would have become accustomed

to and developed defensive behaviors to respond to human hunters, or perhaps would have gone extinct before Clovis times. And as we now know, there is evidence for a human presence in the Americas (Monte Verde) that predates 11,500 BP.

Reasonable points all, but by themselves they are not sufficient to reject overkill. After all, it is possible people could have moved that fast through the hemisphere. They could have reproduced at near rabbit-high rates and spread in an expanding, earth-scorching wave. And, they might have chosen to hunt animals well beyond the point foraging theory suggests they should have abandoned the patch and prey.[31] America's colonizers may simply have been unlike any hunter-gatherers we know (admittedly, I'm skeptical, but it's not completely outside the realm of possibility). And perhaps the Pleistocene fauna were asleep at the evolutionary switch, and failed to learn how to cope with predation. That's highly unlikely too, as any zoologist will tell you, but let's grant the point for the sake of discussion. Nor can we reject overkill on the grounds people were here in pre-Clovis times. Martin observes that Clovis "is the time of unmistakable appearance of Paleoindian hunters using distinctive projectile points,"[32] and he's right. It is only then that we have evidence people did, in fact, prey upon now-extinct large mammals.

For that matter, there is ample evidence that the arrival of humans can signal the death knell for native animals. David Steadman and others have shown that the grim reaper of extinctions followed the landings of the peoples who colonized the islands of the Pacific. The most famous (or infamous) case comes from New Zealand, where eleven species of moas, large, flightless birds that ranged in weight up to 500 pounds, went extinct soon after humans arrived. In fact, at least twenty-five other species—lizards, frogs, birds, and bats—were also lost. Yet, these losses are not the result of hunting alone, as Donald Grayson argues, because in this and in all other island extinctions, multiple causes were in play. The first New Zealanders hunted, but also set forest-destroying fires, introduced competitors and predators (rats and dogs), and even brought in diseases (such as European bird viruses). It was some combination of these that caused extinctions.[33]

Besides, island life is highly susceptible to extinction. Most Pacific islands are tiny (often no larger than Manhattan), their ecosystems are easily destroyed (forests can be felled in a matter of years or decades by humans needing fuel or construction material), and their native animal populations are small, vulnerable, and cannot be replenished from distant continents because they had evolved into new species since their arrival. This was especially true of birds, which on remote, predator-free islands commonly lost their ability to fly, an evolutionary change that proved fatal when predators arrived.[34]

Stuart Fiedel and Gary Haynes proclaim that a continent is "ultimately just a gigantic island," but that's true only in the narrow sense that it's also surrounded by water.[35] None of the factors that make island life vulnerable to extinction apply to North

America, which supported vast animal populations (100 million animals by Martin's own estimate) and a formidable array of predators (no species could afford to let down its evolutionary guard), and for which there is absolutely no evidence Clovis people caused massive (or even minimal) environmental destruction. No New Zealand moa had to contend with a *Smilodon;* no North American mastodon ever had its forest habitat defoliated. If humans drove North American animals to extinction, it had to have been by their spears, as Martin said. Is there evidence of that?

CROSS-EXAMINING THE FACTS

For many years, those of us who worked with the archaeology of late Pleistocene North America confidently asserted there was no widespread evidence of Clovis megafaunal hunting. Yet, none of us ever demonstrated that was so. There was no systematic scrutiny of the archaeological and fossil records to see which—if any—of the thirty-five genera of now-extinct mammals had been found in Clovis-age sites in such a way as to suggest they were killed by hunters. Recognizing it was time to stop arm waving and start analyzing, Grayson and I did just that.[36] The results surprised us.

We began by amassing as comprehensive a list as possible of all alleged Clovis kills, even ones that offered little more than a fluted point found in the same vicinity as some fossil bone. There were seventy-six such sites. However, the mere occurrence of artifacts and animal bones in the same site or even on the same surface is not by itself testimony of a predator-prey relationship. Therefore, we evaluated each case to see if the fluted points or other tools were found in such a way as to suggest they caused the death of the animal, or if there was compelling evidence of butchery (cutmarks or pry marks on bone) (Figure 50), or if the remains were stacked or otherwise arranged in ways that could not be explained by natural causes. That's the sort of evidence we routinely find in kill and butchery sites from other times and places in the past.

FIGURE 50.
A telltale sign of human butchering: cutmarks (the two roughly parallel lines just left of center, and the nearly straight line above and to their right; the irregular lines to their right are from root etching of the bone) on a portion of a bison jaw from the Folsom site, presumably made while removing the tongue. Not all butchering activities result in cutmarks, but when present, they provide secure evidence of human activity. (Photograph by David J. Meltzer.)

Vetted in this manner, humans proved to be the agents of death or dismemberment in only fourteen of those seventy-six sites. And several of those were unsuccessful kills (animals that were speared, but which managed to escape), while others appeared to be the result of opportunistic scavenging of animals perhaps already near death at a water hole (more on these sites below). Humans undeniably hunted big game on occasion, but they didn't make a habit of it. In fact, a single band of hunters may have disproportionate influence on what we see archaeologically: four of those fourteen sites (Escapule, Lehner, Murray Springs, and Naco) are within 30 kilometers of one another in Arizona's San Pedro Valley, and the artifacts found in them are so similar as to appear to be the work of the same group.

Measure it any way you like, fourteen sites is a tiny number, especially set against the wanton slaughter of 100 million animals envisioned under Pleistocene overkill.

But it's not just that it's a pitiful number. In those fourteen sites, only mammoth and mastodon remains occur. What of the other thirty-three genera of extinct Pleistocene mammals? There are no Clovis horse kills, no camel kills, no sloth kills, no *Hemiauchinia* kills, no tapir kills, no giant beaver kills, no kills of any of the other genera of megafauna that went extinct. And it's not because their bones are rare: horses are the most abundant late Pleistocene fossil we have. That a few horse and camel bones, or dermal ossicles of the ground sloth *Paramylodon,* occasionally end up in archaeological sites is intriguing, but does little more than show they co-existed with Clovis people.[37] If there was a continent-wide slaughter, someone did a superb job of hiding the evidence.

WHEN ABSENCE OF EVIDENCE BECOMES EVIDENCE OF ABSENCE

In a brazen bit of rope-a-dope reasoning, Martin insists the scarcity of Clovis big-game kills *proves* overkill. This is so, he claims, because overkill ostensibly occurred in just a few centuries in any one area, and hence the odds are against a kill site being preserved in the geological record. And, secondly, because he believes Clovis people were tidy: after they made a kill, they cleaned up after themselves, carefully retrieving any stone points buried in the mass of flesh and gore of the carcasses (having excavated several large animal kills and the artifacts found in them, I can attest that Paleoindian hunters were not that tidy, but grant the point for the moment).

It is a rare hypothesis that predicts a *lack* of evidence, but as Grayson and I observed, we have one here, and we have it only because evidence for this hypothesis is, well, lacking.[38] But perhaps there is reason to accept Martin's point that kill sites might be rare. After all, in areas such as eastern North America, where high rainfall and heavy vegetation conspire to increase soil acidity, bone is quickly destroyed. Maybe poor preservation accounts for the lack of kills. Or it might be for want of looking in the right places: Pleistocene-age surfaces are buried now, deeply in some places—eight meters deep, as Reid Ferring discovered at the Aubrey site. Large mammal carcasses shot full of Clovis points lying on those surfaces are often beyond notice or reach, and are usually encountered only by chance. Gary Haynes would add that African elephants have been hunted for centuries, yet their kill sites are rare.

But remember New Zealand's moas? They were slaughtered in far greater numbers than African elephants, and in an even narrower time slice than attributed to Pleistocene overkill. With no hint of hypocrisy, Martin points to the *abundance* of moa kill sites as proof human hunting played a role in the extinction of these birds.

And consider this: bison were hunted on the Great Plains of North America for the last 11,000 years, starting in Clovis times. There is abundant archaeological evidence of planned hunts, bone beds containing hundreds of slaughtered animals, impact-fractured projectile points, and skinning and butchering tools. Bison hunting was often highly wasteful. At Olsen-Chubbuck, 190 animals were stampeded into an arroyo and died, and fully 25% of the animals on the bottom of the carcass pile were only slightly butchered or simply untouched, the meat left to rot in the ground (Chapter 9).[39]

Yet after 11,000 years of this archaeologically well-documented, intense, and often wasteful hunting, culminating in the merciless slaughter of bison by commercial Euroamerican hide hunters in the late nineteenth century armed with deadly, large-bore Sharps rifles ("buffalo guns"), bison are still very much alive today—and even on the bill of fare at many restaurants.

So an animal relentlessly hunted for millennia failed to go extinct, while thirty-five genera of mammals that were never or only rarely hunted did. Perhaps, Martin suggests, bison were not as vulnerable to extinction, because they became "wilier at avoiding hunters."[40] Alas, bison are not that wily: an estimated 10,000–20,000 were trapped and killed over several centuries in Late Prehistoric times by hunters who repeatedly stampeded them (at intervals as close as four years) into the *very same* 30 meter diameter, 15 meter deep sinkhole on the plains of northeastern Wyoming (the Vore site).

The widespread slaughter envisioned by Pleistocene overkill should have left equally unmistakable traces. With 100 million megafaunal victims, kill sites should be more the rule than the exception. And there's no hiding behind poor preservation, even in eastern North America. There and elsewhere thousands of megafauna fossils have been found, yet only two have associated artifacts. Nor, as noted, could Clovis groups possibly be that tidy; after all, they must have had teenagers.[41] Kill sites are genuinely scarce, and not just in North America but in South America as well (where Clovis, strictly speaking, does not occur).

There is no small irony in this. Martin cheerily dismissed pre-Clovis for want of multiple sites; Monte Verde alone wasn't enough. "It is true," he said of pre-Clovis, that "the absence of evidence is not evidence of absence—but there are limits to how long and how strongly one can keep believing when supporting evidence is lacking."[42] Agreed. But doesn't it seem only fair Martin should apply that same standard to finding evidence of Pleistocene overkill?

IS OVERKILL DEAD?

In the early 1980s, at the annual national gathering of the archaeology clan, Jim Mead and I organized a symposium devoted to late Pleistocene environments and extinctions in North America. We invited many of the aficionados of extinction, including, naturally, Paul Martin. It was a well-attended session, and so Martin began his talk by taking a poll of the couple hundred archaeologists in the audience. How many, he asked, thought climate change was to blame for Pleistocene extinctions? About a third raised their hands. He then asked how many believed climate change combined with human hunting was the cause: another two-thirds did. Then he asked how many thought overkill alone was to blame. His own hand shot up. Out in the audience a single hand was partly raised, fluttered briefly, then disappeared—despite Martin's pleading to keep it up. We never figured out whose hand that was.

Science is not a matter of counting votes, of course; it's a matter of evidence. Still, there's nothing wrong with polling a room of individuals at least somewhat familiar with the evidence (though not all in the audience were Paleoindian specialists). Martin was surprised by the results. I was too: overkill almost got one more vote than I expected (I knew Martin would vote for it). I would have guessed more would see climate as the sole cause, and fewer climate plus humans. There's a curious element in this debate: archaeologists and vertebrate paleontologists familiar with the archaeological and fossil record tend to pin extinctions on climate change, while ecologists and zoologists familiar with climate's impact on animals tend to suspect and blame humans. The grass is greener on the other side.

But that's not always the case. Recently, on the heels of our examination of supposed megafaunal kills, Donald Grayson and I published a follow-up paper, "Requiem for North American Overkill," which declared overkill dead. Apparently our report of its death was premature. Stuart Fiedel and Gary Haynes, both archaeologists, shot back with a vigorous defense of overkill.[43] Although they applauded our "scrupulous" vetting of the list of megafaunal kill sites, they snarled we had "grossly misrepresent[ed] the overkill debate," and provided "outmoded data and interpretations and ignore[d] or deliberately omit[ted] the most recent chronological, archaeological and climatic data." In a later paper Haynes went on to denounce our "attack" on overkill as "doubletalk." Lest there be any confusion, here's a dictionary definition of what we're accused of: \'dəb-bəl,-tok\ *n*. deliberately unintelligible gibberish.

Misrepresentation and doubletalk. Harsh words, these. Leaving aside the rhetorical posturing (who isn't guilty of that?), the essential issues at hand are uncomplicated. This dispute is not about speculations about who might have killed what, when, how fast, and how quickly they reloaded, but about kill sites and chronology.

Like Martin, Fiedel and Haynes believe an *absence* of kill sites is to be expected, and consider fourteen kill sites a "phenomenally rich record" of human predation in view of the length of time they think it accumulated—the 300 years Clovis and megafauna ostensibly overlapped on the landscape. In fact, fourteen is indeed a large number, but not for the reasons they suppose: given how many of these sites were found bones first (Chapter 3), fourteen probably inflates their actual importance! That aside, our point was not just that there were only fourteen sites, but that there were only two genera in those fourteen sites, and no horse kills, camel kills, sloth kills, musk ox kills, glyptodont kills, and so on down the list of the other thirty-three extinct genera.

Haynes immodestly proclaimed he could "speak with authority on this matter, having devoted 25 years to neotaphonomic studies[44] of large-mammal skeletons in Africa, Australia, and North America." On his self-appointed authority, he declared that "kill sites of any animal smaller than a mammoth are *never* well preserved." He even tacked a number to his pronouncement: "kill sites of animals that weigh less than 250 kg will not be preserved and fossilized except in special depositional 'traps.'" Ignoring the many kill sites of, say, pronghorn antelope or mountain sheep that are found on the northern plains (animals that tip the scales at 70 kilograms maximum),[45] and not just in the special traps Haynes lays for them, it is still fair to ask again, where are all the horse kills, camel kills, sloth kills, musk ox kills, glyptodont kills, and on down the hefty-animal list? All of them surpass Haynes' minimum body mass requirement.

Fiedel and Haynes shift the ground toward smaller animals. Look at eastern North America, they suggest. There is not a single site with "the remains of any butchered carcasses of elk, deer, bear, or woodland bison of Holocene age." In fact, the remains of deer are extremely abundant in those sites, as has long been recognized. Unless their already-dead carcasses were scraped off the landscape and dragged into archaeological sites (possible, one supposes), they *must* have been killed by hunters. If only the bones of the peccary, tapir, Aztlan rabbit, and other lighter-than-250 kilogram Pleistocene animals were as widely represented in Clovis-age sites, Fiedel and Haynes's point would be well taken.

And consider this: North America once had its own flightless bird—the sea duck, *Chedytes lawi*—which inhabited the islands and mainland of coastal California and Oregon. It was hunted by people, even in Paleoindian times (by the inhabitants of Daisy Cave), and ultimately went extinct. But the sea duck's extinction is a problem for overkill: it took 7,000 years of human predation before this vulnerable prey succumbed—hardly the near-instantaneous demise overkill assumes. As important, human predation of this animal produced an unmistakable archaeological record: its bones are well preserved in sites along the coast.[46] In case there is any question, the sea duck was *much* smaller than a mammoth.

Haynes complains it is unfair for critics of overkill to call for "more and more kill sites." No one is calling for more and more exactly; rather, the request is for more of the genera (of the thirty-five) to have secure evidence of human predation. It's that glaring gap that needs to be closed, and again one cannot entirely blame the fossil record here. Horses, camels, and musk ox (all big beasts) are extremely well represented in the fossil record of North America, far more so than either mammoth or mastodon, and yet there are no secure kill sites of these animals.

As for the chronology, Fiedel and Haynes rightly note there have been great strides in our radiocarbon dating of the extinct animals. Some fifteen years ago, only seven genera were known to have lasted until Clovis time. Nowadays, there's more than twice that number (here's where we stood accused of "deliberately omitting" evidence, ostensibly ignoring radiocarbon ages produced by Russell Graham and colleagues. Since we discussed Graham's chronology in detail and explicitly acknowledged his help, we could only be perplexed by their accusation). More terminal Pleistocene dates may yet come for other genera. Or they may not. The point we were making was straightforward: the chronology of extinctions is yet unsettled. We still don't know whether all animals disappeared simultaneously or not.

Haynes and Fiedel then accuse us of ignoring the Signor-Lipps effect, which is the proposition that rare animals tend to disappear from the fossil record before they go extinct. Thus, the rarer the animal on the late Pleistocene landscape, the harder it will be to find a latest Pleistocene age for it. Haynes draws from Signor-Lipps the message that "the youngest radiocarbon dates on species do not come from the very last members of those species." But of course; we're well aware of that (I use the mirror image of Signor-Lipps in the argument made earlier about why the earliest *dated* site in the Americas is not likely to be the earliest site in the Americas, though it could be, if we get very lucky [Chapter 4]).

We are also aware, though Fiedel and Haynes are not, that if radiocarbon dates are indeed scarce on Pleistocene fauna from the 300 years they shared North America with humans, then that also suggests these animals were already in decline before or by the time Clovis arrived. To test this, we need to more fully understand the extinction process. We need to know when the process began, how long it lasted, and the rate of population decline over that time.

More to think about: if all 100 million animals of those thirty-five extinct genera lasted until the very end of the Pleistocene, only to be suddenly dispatched by human hunters, then why would Signor-Lipps come into play at all? There ought to be *plenty* of terminal Pleistocene ages to go around. There are not.

Haynes portrays critics of overkill as engaging in postmodern meta-narratives, a "constructed reality." In some circles, those are fighting words. Not here. I agree with his point that *all* the arguments in this dispute need to be read carefully and critically, and I would add another: although it's terribly old-fashioned to say, I also think evidence matters.

Paul Martin in his *Twilight of the Mammoths,* a long look back at his and overkill's career, and the vigorous debate over the cause of Pleistocene extinctions he and it engendered, breathed a sigh of relief that at least there is agreement about what was *not* a cause of those extinctions. Perhaps the one thing most specialists can agree upon, he explained, "is that the near-time [Pleistocene] extinctions had nothing to do with a space rock" or asteroid impact, unlike in the case of the dinosaurs' demise 65 million years ago. That was too bad, he mused, since "one would find a highly receptive audience among astronomers and their public had mammoth extinction shared similarities with dinosaur extinction."[47]

As they say, watch what you wish for. (Chapter 2, Sidebar).

TIMING WAS EVERYTHING

Overkill helped Martin solve a vexing problem: what could cause thirty-five very different animal genera living in very different habitats to go extinct simultaneously? Let's briefly turn to the radiocarbon record since the timing of extinctions is often a point of departure in talking about their cause. Without putting too fine a point on it, the reasoning here is that if all the megafauna disappeared at the same time, that suggests a cause that could strike down animals of very different physiology and adaptation across diverse habitats and do so instantaneously. Changes in climate and environment, Martin supposed, varied too much in timing, by area, and in severity to kill off so many animals at once—but he thought voracious, fast-moving hunters could. But if humans were not the cause of extinction, then why did all these animals go extinct at the same time? Or did they?

We often assume as much, but after years of radiocarbon dating fossils of Pleistocene fauna, we cannot say these animals went extinct simultaneously. All were certainly gone by 10,800 BP, but Russell Graham and Thomas Stafford have shown that only sixteen of the thirty-five genera were alive as recently as 12,000 years ago—that is, up to the doorstep of Clovis times. The other nineteen genera lack radiocarbon dates showing they survived until then. In some cases (the Aztlan rabbit, for example), the latest occurrence predates the Last Glacial Maximum. Whether that means these animals were already extinct by then is not clear, since many of those genera are relatively rare in the fossil record, and we know that the number of radiocarbon dates available for a particular animal is strongly determined by how many of its fossils have been found.

Additional radiocarbon dates might bring their terminal dates closer to 12,000 years ago, but then they might not. Until we possess more radiocarbon dates, we cannot assume all genera disappeared simultaneously or gradually, or let assumptions about the timing of extinctions be used to support arguments about its cause.

Perhaps more important, it's not enough to know when the extinctions process ended; we also need to know when it *began*, and what was occurring on the landscape at that time to cause populations to decline.[48] That's no easy task with radiocarbon dating. But here, too, ancient DNA—this time from mammoths, horses, camels, and other fossils—can potentially yield valuable insight: changes in genetic diversity over time can reveal population histories. This work is in its infancy, but it is already yielding results: genetic evidence compiled by Beth Shapiro and colleagues has shown that Alaskan bison populations underwent a significant decline starting about 37,000 BP, neatly coinciding with a warm stretch prior to the LGM, when tree cover peaked, reducing grazing land and serving as a barrier to movement.[49]

If North American extinctions were, in fact, smeared over many millennia, this would be no different than the timing of Pleistocene extinctions elsewhere in the world, and in other New World regions. North of the ice sheets in Alaska, Dale Guthrie has shown that one species of horse disappeared by 31,000 BP, another survived until 12,500 BP, and mammoths lasted until 11,500 BP. For the record: there is no evidence of human hunting of horse or mammoth in Alaska. In fact, and as noted in the previous chapter, everything else seems to have been on the menu at Alaska's Broken Mammoth site *except* mammoth.[50]

CONSIDERING CLIMATE

If different genera disappeared at different times, that opens the possibility extinctions resulted from a more complicated cause: perhaps the complex climate changes taking place at the end of the Pleistocene, which played out across North America over thousands of years in different ways with different consequences for different species in different environments.

Indeed, often unspoken in discussions of Pleistocene overkill is the fact that extinctions were not limited to the very largest, mouth-watering mammals, though those dominated this particular extinction episode, but also included storks, vultures, eagles, jays, and blackbirds, as well as a snake, several genera and species of turtles, and a spruce tree.[51] Likewise ignored is the fact that extinctions were merely one element of much larger, sweeping, end-of-the-Pleistocene changes that, extinctions aside, dramatically altered the ranges of plants and animals.

Against this backdrop of other ecological changes, megafaunal extinction seems less an aberration for which a human cause is necessary, and more a part of larger, natural changes in climate and environment. Paleoecologists are busy exploring how these changes may have impacted habitats, forage, and animal physiology and/or reproduction.

Already, there are several hypotheses, though at the moment (and here Martin is exactly right), these are not well developed. The reason, as Grayson and others have emphasized, is that far more needs to be known about the responses of individual genera and species to the changes that came with the end of the Pleistocene.[52] That's not easy, given the limits of the fossil record and the fact these animals are extinct: our knowledge of what climatic and environmental changes they could (or could not) tolerate is limited. We do not know how changes from equable to seasonal climates, changes in grassland composition, increasing temperature and decreasing rainfall (especially in western regions), or changes in growing-season length (it got much shorter in the far north) would affect each.

We suspect many of the very large mammals had long gestation periods (comparable to the approximately 22 months in modern elephants), as well as low and slow reproductive rates (births came late and infrequently, and rarely produced more than one offspring).[53] If successive offspring died when a long-established birth season suddenly became harsh and inhospitable, the limited reproductive capacity might leave the animals unable to respond (indeed, this is one reason large animals have a high risk of extinction). And it would make them vulnerable to a coup de grâce by hunters who, if they targeted breeding females or young animals (as they did at the Colby mammoth kill in Wyoming), would have sped an already-diminished local herd toward extinction.

Further, biotic communities in place for tens of thousands of years dissolved, and plants dispersed in different directions at different speeds (Chapter 2). How did that upset the delicate balance of animal and plant life, and how did each animal respond to the new forage hand it was dealt? What effect did this have on competition for resources? All of this has to be understood for each animal genus as it changed in numbers, range, and distribution across space and through time.[54]

After the LGM, for example, Guthrie shows that Alaskan horses diminished markedly in body size, shrinking steadily until their extinction around 12,500 BP. Horses are obligate grazers, and as cold, arid, and treeless northern grasslands gave way to a wetter landscape, with more lakes, bogs, and tundra vegetation, the horse suffered from lack of food, and faced increased competition from other large animals such as woolly mammoth. Mammoth was less of an obligate grazer and outlasted the horse by a millennium, but ultimately it, too, succumbed to the disappearance of the northern grassland.

The Alaskan cases are among the few for which we have evidence of animal populations under stress, and good evidence of possible environmental causes for their demise. Even though overkill is wrong, there is still much work to be done to show climate-based explanations are right.

But if Clovis hunters weren't overkilling megafauna, what role did these animals play in their adaptations? And what was the nature of Clovis adaptations? A closer look is in order.

BACK TO CLOVIS

At the time of its initial occupation by people 11,300 years ago, the Clovis site in New Mexico was a spring-fed pond feeding into nearby Blackwater Draw. The springs attracted plants, animals, and people for many thousands of years, even into the twentieth century, when the springs were finally tapped out by irrigation. But just about the time the site's archaeological riches caught the eye of E. B. Howard, a quarry company moved in to mine the site's deeper, commercial-grade gravels. As giant bulldozers dug for the gravel, they ravaged the overlying layers of artifact and bone. In an awkward dance that satisfied neither party, bulldozer operators would temporarily suspend work if they happened to spot bone-rich deposits, and archaeologists would rush in to salvage what they could. Much was saved, but more was lost.[55]

Yet, what was found is remarkable, for the late Pleistocene springs watered frogs, turtles, snakes, mammoth, bison, horse, camel, peccary, deer, and antelope, as well as saber-toothed cat, bear, and dire wolf. Not all of these were food. Ironically, bison, and not mammoth, were one of the most abundant species in the Clovis-age deposits; seven were found, and at least one had been speared, a Clovis point found lodged against its scapula (shoulder blade).

Even so, mammoth remains attracted the greatest attention. Over the years, nearly a dozen were excavated by archaeologists called to the scene; more probably passed unnoticed through the quarry machinery (it was *very* large machinery; one can scarcely imagine how many rabbit or roasted small-animal skeletons were overlooked).

There is no compelling evidence humans killed all or even most of the mammoths found here; we know only that the animals died at this spot. That said, at least three mammoths were found with projectile points and the tools used to butcher them. They died at different times, some on the pond's margins, others in its center. Their skeletons were nearly complete and articulated (the bones lay in proper anatomical position), suggesting the carcasses were carved where they fell, but only partially so. Flesh was stripped from the upper skeleton (forelimbs, shoulders, and ribs) and skulls were smashed to obtain brains, but the remainder of the carcasses were left to rot.

This pattern of partially butchered mammoth bones in marshy, pond, or stream settings recurs in many Clovis sites, from Lange-Ferguson on the northern plains of South Dakota, to Lehner in the San Pedro Valley.[56] The pattern is so persistent it looks purposeful, as though Clovis hunters lurked in such places, looking to drive the mammoths into shallow water, or waiting in ambush for the animal to get stuck in the mud and become an easier target. But appearances may be deceiving. As Frison observed, mired animals that large are difficult to butcher and nearly impossible to extract, as the articulated skeletons at Clovis clearly attest. For that matter, healthy animals (especially full-grown adults) are not easily mired. Skilled hunters, Frison argues, would take mammoth elsewhere and on their terms, perhaps by quietly isolating a juvenile away from the herd's protection, wounding it, then patiently waiting for it to become disabled or die—all the while preventing the animal from staggering to a waterhole to die.

OPPORTUNITIES FOUND

If that's so, why are many Clovis-stabbed mammoths at water holes? In studying African elephants, Gary Haynes saw that a disproportionate number of younger animals frequented water holes when ill (as their body temperature rose) or during drought, often dying there without human help. Such conditions force animals, especially ones with large, water-cooled engines like elephants, to gravitate to water, even if they have to dig to reach it (humans are not the only species that digs water wells; elephants can, too).

Vance Haynes, in fact, sees hints of a brief but severe drought in Clovis times across the American West. His evidence is strongly disputed by others, including Vance Holliday, and at the Clovis site itself: many artifacts, including three Clovis points, were found in spring conduits at Clovis. They were placed there, Haynes believes, as offerings. Were that so, presumably the springs were active at the time or had flowed in recent memory. Regardless, if there had been a drought, it was nowhere as severe as the one that for nearly 2,000 years of the Middle Holocene laid waste to much of the American West. That was a time when humans were forced to dig deep wells for water, and shift their diet to more drought-resistant animals and plants. A pit at the Clovis site resembles such a well, but it was excavated in the 1960s, and observations made at the time (and when it was reopened in 1993) cannot demonstrate its purpose.[57]

Drought or no, sick and enfeebled animals of a species teetering on extinction that wandered into ponds may have become mired, and thereby became risk-free targets for passing (or patiently waiting) hunter-gatherers, who took what meat they could, then moved on. Less danger was involved since the animals could be patiently monitored from a distance. Killing might even be unnecessary if death was inevitable and predictable.

James Judge calls this *opportunistic scavenging,* and thinks it, more so than deliberate big-game hunting, characterizes Clovis.[58] That would explain all those partially butchered animals mired in the mud, and why so many Clovis mammoth "kills" look like animals that died of natural causes, but with a few foreign objects (Clovis points) stuck in their carcasses.

Opportunistic or not, Clovis groups were occasionally quite adept at snaring big game. In the San Pedro Valley, bones of thirteen mammoths, mostly calves or young adults, were excavated on the Lehner Ranch by Emil Haury (Figure 51) and (later) Vance Haynes.[59] Scattered among mammoth ribs, hindquarters, and jaws were thirteen Clovis points made of locally available chert, chalcedony, and quartz crystal, along with stone scrapers, knives, and a chopper. The wide scatter of mammoth bones, their unequal

FIGURE 51.
Excavations at the Lehner mammoth kill site, Arizona, ca. 1959. Lehner is one of a dozen sites for which we have secure evidence of human hunting of mammoth. (Photograph courtesy of Fred Wendorf.)

preservation, their vertical distribution over about 1 meter of deposits, suggest the serial killing of animals isolated from their herds, then dispatched, butchered, and consumed in the centuries around 10,950 BP.

The San Pedro Valley was a ripe field. At Murray Springs, 16 kilometers north of Lehner and at virtually the same moment in time (around 10,900 BP), at least one mammoth and, nearby, eleven bison were killed. The Clovis groups camped close by, hauling in a mammoth drumstick (one of the leg bones) and bison filets, and overhauling broken weaponry. Vance Haynes recovered Clovis points, a variety of tools (including the afore-mentioned mammoth bone shaft wrench), and nearly 15,000 flakes from tool manufacturing and resharpening. Many flakes littered the kills, evidence of the constant resharpening of tools that dull easily when carving animal flesh. As was the case at Clovis, the mammoth carcass was only partially disarticulated (and only the bison bone was burned). The dead mammoth may have had other visitors, too: Haynes found mammoth tracks leading up to the skeleton. Perhaps, as elephants do today, curious mammoths came over to take a look at their dead kin.[60]

The Clovis points used against the bison at Murray Springs were far the worse for wear. Two of them had flakes driven backward off the point tip (impact fractures). One point was found in the kill, and its impact flake in the camp (carried there in the meat, presumably), while the reverse was true of another. Impact fractures occur when stone hits bone at high velocity. Such fractures are rare on Clovis points from mammoth-bearing sites (only one of thirteen points at Lehner was impact fractured, for example), yet common on points in bison kills of all ages. The scarcity of impact damage on Clovis points suggests at the very least that those aimed at mammoths were not penetrating deep enough to hit bone, and those found as isolates may not have been used as points (a possibility for which there is some evidence).

At Clovis, Lehner, and Murray Springs, and localities like Colby and Lange-Ferguson, there were mammoth opportunities found.[61] At Colby, hunters took full advantage: eight mammoths, mostly immature animals (one a fetus), were killed at intervals by hunters some 10,900 years ago, who then carefully stacked their leftovers into two piles, set roughly 33 meters apart. The first pile had remains of three immature mammoths and a few tools. The second yielded the remains of four mammoths, mostly articulated ribs and shoulder bones, along with an innominate (pelvic bone), all topped by a skull. Directly underneath the innominate was a fluted point (an offering, perhaps?). Frison, who excavated Colby, believes these were meat caches, with the one reopened and the meat used, but not the other. Stone caches had been placed on the landscape for use after the hard work; in northern latitudes, meat was cached for the hard times.

THE BIG ONES THAT GOT AWAY

There were mammoth opportunities lost, too. Just down the San Pedro from Lehner and Murray Springs was the Naco mammoth, found eroding out of the sidewalls of Greenbush Creek. Most of the skeleton was there, save the hindquarters, which had eroded and disappeared. Eight Clovis projectile points, variable in size, were found with this one animal (a mammoth pincushion): one lay at the base of the skull, another near the left scapula, two were wedged between ribs, and one against the surface of the atlas vertebra. Yet, no butchering tools were found, nor did any bones show signs of filleting. The Naco mammoth evidently escaped its killers and died quietly of its wounds with hide intact. But escaped from whom? The stone by which the Naco points were fashioned was the same as that used by the hunters who stabbed the Lehner and Murray Springs mammoths.

Nor is Naco alone. Relatively close by (and still in the San Pedro Valley) was the Escapule mammoth, a single animal found with two projectile points. Judging by the stylistic and stone similarities to the points at the other Clovis sites in the valley, it appears to be another escapee of the Lehner and/or Murray Springs carnage.

Out on the Great Plains, there's further evidence of less-than-successful predation. Dent, which sits at the base of a terrace of Colorado's South Platte River, yielded two fluted points, a knife, and a dozen mammoths. Found with them were a great many boulders (some half a meter in circumference), prompting the engaging scenario that a group of hunters came upon the herd and, for want of adequate weaponry, grabbed the closest weapons at hand—cobbles from the terrace—and stoned the animals to death. An engaging scenario, but probably wrong. More recent work at the site revealed that bones, boulders, and fluted points all came washing 10–15 meters downslope from the terrace top about 200 years ago, though the bones themselves date to 10,990 BP.[62] The boulders were probably not late Pleistocene missiles, but cobbles that fortuitously came to rest with the mammoth remains. If there had been a hunt, it was at best unsuccessful, the two points perhaps coming from the carcass of an animal that had carried them around for some time, a thorn in its elephant-thick hide.

So, too, the case of Domebo (pronounced like the name of Disney's big-eared elephant), a mammoth found in south-central Oklahoma. With the bones (dated to 10,960 BP) were two fluted points, and three small flakes. The points, though found near the skeleton, did not cause its death, and there were no signs of butchering. The coroner ruled the cause of death unknown.[63]

And then there's the Miami site in the northern panhandle of Texas, discovered in the 1930s when Dust Bowl drought forced farmers to plow deeper than usual, thereby exposing an ancient pond bed containing remains of five mammoths, three of which were mature or nearly mature individuals. Oddly, there were no bones of other animals in the pond, but there were several projectile points and a scraper. Yet, there's no evidence of butchering, so it may be the Miami mammoths were enfeebled by natural causes or were already dead when a Clovis group came upon the carcasses and began salvaging what they could, losing a few artifacts in the process. Or perhaps it was an unsuccessful kill. Two of the points were found with one of the mature mammoths: could she have staggered to the basin to die and been followed by her young, who lingered there after her death until their own?[64]

EAST MEETS WEST

Mammoth altogether eluded the fluted spear points of eastern Paleoindian groups, but then these open-ground, gregarious herd animals were relatively rare in heavily wooded Pleistocene eastern North America. Their distantly related, forest-dwelling kin, the mastodon, was far more abundant in this region, and yet it was even more successful at avoiding being on the Clovis menu. Except at Kimmswick.

Since 1839, many mastodon skeletons have been mined from this spot, now the Mastodon State Historic Site along the Mississippi River, south of St. Louis, Missouri. There was talk early on that ancient artifacts were there, too. William Henry Holmes himself excavated here in 1901–2, to lay that dangerous talk to rest. It didn't work. In the 1980s, a team directed by Russell Graham reopened Kimmswick, and in ancient pond settings reminiscent of Clovis sites further west, found the remains of two mastodon, a cow and calf, along with a few fluted points, butchering tools, and several thousand tiny flakes. The site is undated, but is assuredly within the Paleoindian age range.

There are hints of mastodon being taken at other eastern Paleoindian sites,[65] but those are strong only at Michigan's Pleasant Lake, where mastodon bones show cut marks, striations, and polishing suggestive of human knife work. Curiously, not a single stone artifact has come from the site (there's that Clovis tidiness again!).

It has not escaped notice that most megafauna kills are found on the Great Plains and in the Southwest. That most of them are of mammoth partly explains the pattern: that's where this animal was especially abundant. Yet, it fails to explain why their forest relatives (the mastodon) were not taken in comparable numbers. It's not because we haven't look for mastodon kills in the east. The search has been ongoing since the 1930s. Nor is it for want of mastodon remains of the proper age. George Quimby and Ronald Mason long ago pointed to the overlap in the distribution of fluted points and mastodons in the Upper Midwest (the Mason-Quimby line, Paul Martin called it).

Rather, the answer lies in the ecological stage on which these adaptations played out. Late Pleistocene environments in the East were more complex and changing more rapidly than those in the West (Chapter 2). In turn, plant and animal species and communities were correspondingly richer in the East, and that made a difference in Clovis-age foraging. As Michael Cannon and I found, the diets of early Americans in eastern North America were broader and less dominated by large mammals than were those of their western contemporaries.[66]

JUST SHOWING OFF

Armed with stone-tipped spears, Clovis hunters could take big game. Occasionally they were successful, other times not. And sometimes they got lucky and took advantage of a bad situation—bad for the prey, at least. That Clovis hunters did not pursue mammoth or mastodon more regularly or ruthlessly comes as no particular surprise.

Hunting big game has more than its share of risks. Like coming home empty handed. Or not coming home at all. And if elephants, their modern, highly intelligent, unpredictable, and vengeful relatives, are any indication, hunting mammoth or mastodon was especially risky. Elephants, as Hadza hunters told James O'Connell, do not behave like animals; they behave like enemies. Yet the Hadza, O'Connell adds, hunt rhinoceros and sometimes even lions. As George Silberbauer observed, it is "admirable common sense not to shoot a flimsy arrow into dangerous prey like elephant and [water] buffalo unless you know exactly what the prey will do next; both species take their annual toll of hunters [even when] armed with high-powered rifles and give rise to innumerable tales of narrow escapes."[67]

Indeed, when elephants are hunted nowadays, it is at a distance with high-powered rifles or up close with metal broad swords, both far superior weapons to Clovis-pointed spears. Spear-toting archaeologists experimenting on recently deceased zoo and circus elephants have shown that bone and stone points can penetrate elephant hide (Frison reports that Siberian freeze-dried woolly mammoth hide was equally thick, if not thicker, and of course there was hair to contend with, too). A spear thrust would be most lethal in those spots where the hide thins or, say, if plunged deep into a lung. Those are easy to target when the animal lies dead before you, but not so easy after you miss your first shot at a live and suddenly very angry elephant. As Frison learned during a cull in Africa, no Clovis point could drop a charging elephant in its tracks. Teddy Roosevelt, after his own frighteningly close encounter with a raging bull elephant while on a post-presidential romp through Africa bagging animals large and small, well understood why smaller prey made up the majority of the diet for African hunter-gatherers.[68]

In fact, big-game hunting can be a very inefficient means of feeding a family. Bird and O'Connell record that despite substantial effort, Hadza men "manage to acquire large carcasses on average only about once every 30 hunter-days,"[69] a daily failure rate of 97%. When big game is bagged, most of the meat is shared, producing more for the group than for the hunter's family. So what's in it for the hunter and his kin? Why would one specialize in the risky and inefficient pursuit of large animal prey?

Kristen Hawkes and Rebecca Bliege Bird suspect big-game hunting and the finely fashioned weaponry that goes with it may be a form of *costly signaling,* or showing off, by which hunters gain prestige among peers and competitors. Hunting success confers status, and marks a hunter as a powerful ally, a dangerous adversary, or an attractive mate. One key piece of evidence in favor of their hypothesis: the children of skilled Hadza hunters do not have better survival odds than other children (indicating they were not eating any better, despite their father's success), but they had more siblings, revealing that skilled hunters had much higher fertility.[70] (It's hard to ignore the coincidence that excavating a big-game kill site confers considerable *archaeological* status; I'll leave to others to judge its rewards.)

It was long ago suggested, tongue-in-cheek, that each Clovis hunter probably killed one mammoth, then spent the rest of his life talking about it.[71] An exaggeration, perhaps. Still, there's a nugget of truth to it. Humans talk. And as Hawkes and Bliege Bird observe, reputations are crafted through storytelling. Roosevelt saw the kernel of one such story emerging just hours after the bull that sideswiped him was killed. "The gunbearers, as they walked ahead of us camp ward . . . began to improvise a song, reciting the success of the hunt, the death of the elephant, and the power of the rifles," one that was soon added to the stories already told. The elephant, like "no other animal, not the lion himself, is so constant a theme of talk, and a subject of such unflagging interest round the campfire . . . " Yet, at the core of each story there had to be a kill, for "as in other domains of male contest," Hawkes and Bliege Bird add, "'trash talk' may have its uses, but reputations for delivering the goods cannot be built upon it."[72]

ROUNDING OUT THE CLOVIS DIET

Smaller game and plants likely do nothing for bragging rights, but they certainly help fill in the bulk of the diet. That is true among modern hunter-gatherers, and was likely true in Clovis times as well. But what else may have been part of the Paleoindian diet has only recently come into view, albeit slowly, as one might expect given how few sites there are, the traditional attention given to large animal kills, and the problems of preservation of smaller animal and plant remains—and perhaps even of the artifacts used to harvest those. A study by Christopher Ellis revealed that when pursuing small prey, hunters the world over commonly used throwing sticks; snares; or bone, wood, or antler points, since those readily stun the animal, do no damage to its skin, nor cause it to sink (if hunting waterfowl or fish).[73] These would leave little archaeological trace (save under circumstances like those at Monte Verde, where wooden lances were preserved).

In the far West for all appearances, Clovis-age groups ate nothing, or at least nothing that's been left behind. There are hints (a few bones here and there) that mountain sheep were taken at higher elevations in the Great Basin. These are animals that can be captured and subdued readily with drop nets, which were available by this time in prehistory. Another hint of their adaptations comes from mapping the distribution of early fluted and stemmed points in the Great Basin: they cluster along the edges of now-dry Pleistocene pluvial lakes, marshes, and springs. Whatever these Clovis and other Paleoindians were doing, Grayson points out, they were doing near shallow water. If later sites in the same area bear witness, what they were doing was exploiting small mammals, birds, fish, and mollusks.

Confirmation that fish were part of a Clovis-age diet in the far West comes from a study of the bone isotopes from the Buhl skeleton, found in Idaho and dated to 10,700 BP. The isotope chemistry of bone can reveal the type and relative proportion of plants and animals in the diet. As the old saying goes, you are what you eat (to which those who study prehistoric coprolites are wont to add, "except what you excrete"). In the Buhl case, her diet consisted of meat and fish—probably salmon, the isotope signature being that of marine rather than freshwater fish. There must have been long, lean periods in her life, too, judging by episodes of arrested bone growth evident in her x-rays.[74]

Moving onto the Great Plains, George Agogino reported finding a turtle roasting pit at the Clovis site: six or seven Pleistocene terrapins stacked one atop another and apparently cooked in their shells. Turtles appear frequently in other Great Plains Clovis-age sites, including Lubbock Lake in far west Texas, and at Aubrey and Lewisville in north-central Texas, where turtles were among the most common vertebrate fossils recovered (at Lewisville they comprised about 90% of the animal remains). So frequent were turtle bones at Lewisville that many "were donated to visitors and to Boy Scout groups as mementos"[75] ("guest goodie bags" are hardly the norm at archaeological sites, but then Lewisville was excavated in the late 1950s by amateurs, innocent of archaeological protocol).

Often larger than their modern relatives and always slow moving, Pleistocene turtles, many now extinct, were the best kind of game. One genus, *Geochelone* (Figure 52), was nearly a meter long, 75 centimeters wide, and 60 centimeters tall. That's a lot of meat under the hood of a prey species that could be pursued (leisurely, of course) without threat to human life or limb. Ultimately, we may discover turtles were a Paleoindian staple, a menu item rivaling faster and bigger game, which may explain their occurrence even at big-game kill sites like Clovis and Kimmswick.

A staple, perhaps, but these were not turtle-hunting specialists. At Aubrey and Lewisville, hunter-gatherers foraged up and down the food chain: bison and deer are present, as well as a variety of small animals, including snakes and lizards, frogs and birds. Some of these

FIGURE 52.
An intact shell of the extinct North American tortoise, *Geochelone,* excavated from the sediments of a Pleistocene pluvial lake bed in west Texas. The putty knife is 18 cm long. (Photograph courtesy of Richard Rose.)

smaller remains could be mere background noise, animals that wandered into the site and died of their own accord. It happens. Yet, many of their bones were also burned, a sign they were consumed by humans. But why would hunters on such a rich landscape stoop so low for forage? Were they that "unfocused," as Gary Haynes put it?[76] To be sure, resource ranking matters to hunter-gatherers, but food is food, and the lower-ranked items could be collected readily while out on the hunt, or gathered by other members of the group.

Archaeologists have long supposed deer or elk were targeted by groups in the complex forests of southeastern North America, as they were by virtually all subsequent hunter-gatherers of that region. The evidence is meager, though deer bones are abundant just across the academic border separating the Paleoindian and subsequent Archaic period (Chapter 9).

Caribou (a member of the deer family) were apparently prey at several northeastern sites, although their bones have only been found at Bull Brook (Massachusetts), Udora (Ontario), and Whipple (New Hampshire); also apparently consumed at Udora were hare and arctic fox. These confirmed and suspected caribou kills date to the centuries around 10,600 BP, and are located in what would have been a swath of more open terrain stretching from Nova Scotia to the Great Lakes. Why caribou in this setting?

These animals historically moved in great herds, wintering in the forest and summering on the tundra. In immediate post-glacial times, tundra was not so extensive (Chapter 2), and caribou ranges and numbers were probably smaller. Even so, however, their migratory habits and herd instincts made them a prime resource in northern forests and parklands.

At Maine's Vail site on the Magalloway River, Michael Gramly found a killing ground, a sandy patch littered with twelve fluted points, some complete and others with shattered tips, but no other tools.[77] Some 250 meters away and across the river (Figure 53) was a camp marked by more projectile points (bases this time), scrapers, knives, gravers, drills, and wedges, the latter for splitting bone and retrieving marrow. Kill and camp literally can be joined: seven point tips from the former re-fit onto bases at the latter, reuniting what had come apart in a split second of impact 10,500 years earlier (see Plate 12).

No bone is preserved in the acidic soils of this site, but Gramly observes the Vail killing ground is at a topographic pinch point in the valley, an ideal spot for waiting hunters to intercept caribou on their seasonal migrations between tundra and forest. He thinks hunters positioned themselves here for several years running, since the camp contained multiple artifact concentrations, possibly from different stints on-site. And they may have cached their leftovers, both in shallow pits on the site and at the Adkins site, just a kilometer away, where Gramly spotted half a dozen boulders, each weighing 100 kilograms (220 pounds) or more. These were arranged around a pit, creating a storage chamber about twice the size of an average household refrigerator (and in Maine at the end of the Pleistocene, easily as cold). Having a food cache is handy when waiting on the unpredictable arrival of a migratory herd, especially given how far the hunters had come.

Their points were made of stone acquired 300 kilometers away in the Hudson River valley. Not surprisingly, the points were intensively used, resharpened, and recycled. The hunters must not have found, or had the time to visit, the outcrop of high-quality Ledge

FIGURE 53.
Aerial view of the Vail camp and kill sites, Magalloway Valley, Maine, ca. 1980. The clusters of artifacts marking the camp were found on the sandy beach of what is now (artificial) Lake Aziscohos, just along the central portion of the tree line; the killing ground was on the prong of land in the approximate center of the image 90 m away from the camp. (Photograph courtesy of R. Michael Gramly.)

Ridge chert just 30 kilometers distant, where they might have refurbished their weaponry. But then, hunter-gatherer mobility is not just a matter of the distance from outcrop to site; it's also about time: the time elapsed since the last visit to the quarry, say, or perhaps the time it might take one away from an ambush spot and chance missing the herd as it passed through. Ultimately, however, they did miss it when, Gramly believes, the caribou chose another valley for their seasonal trek. Caribou can be fickle. With that, Vail was abandoned (though not the valley, as Gramly and his team's subsequent discoveries have shown).

WHEN HUNTERS GATHER

It has been proclaimed plant foods were "neither a provable nor logical part" of Paleoindian diets.[78] That's a bit excessive. It is fair to say the *degree* of plant use among Paleoindians remains unproven. It is both provable and, as Lewis Binford and others have shown, eminently logical. Finding that proof requires good recovery techniques since seeds, berries, and other traces of plants (or even small animals) are not easily detected, even if they are preserved. A little luck helps, too.

Luck and technique came together at Shawnee-Minisink, Pennsylvania. During the excavations (Figure 54), 10% of all excavated sediment was poured into large, water-filled

FIGURE 54.
Excavations in the main block of the Shawnee-Minisink site, Pennsylvania. The three individuals in the deepest part of the excavation are just above the Paleoindian-age stratum. (Photograph courtesy of Richard J. Dent and the Department of Anthropology, American University.)

washtubs; minute organic remains (bits of bone, wood, charcoal, seeds) floated to the surface and were collected with a tea-strainer, while the remainder of the sediment was passed through fine mesh screens. Flotation captured acalypha, hackberry, blackberry, chenopod, hawthorn plum, and grape seeds, as well as tiny fish bones, from meals 10,900 years ago. Shawnee-Minisink, however, is an exception. Most other Paleoindian sites were excavated before flotation became customary, and even today, flotation or some form of water screening is not always incorporated in fieldwork.

Indirect evidence of plant consumption comes from Paleoindian teeth (what few there are), some of which, Gentry Steele reports, are heavily worn—a sign of the grit that gets chewed along with the greens. Wandering into more circumstantial territory, there are possible seed-grinding stones at Clovis, and cutting tools with polished edges at several other sites (including Gault). The polish appears to be "sickle sheen," which develops when tools are repeatedly used to harvest grasses, which are suffused with tiny silica bodies (opal phytoliths) that abrade and burnish the stone.

Although this is a meager record of recognizable plant-processing tools, a bit of context is helpful. First, many plant-processing implements recorded historically (for example, among the Iroquois) are biodegradable. Second, the scarcity of tools might reflect the intensity or, better, the lack of intensity of plant use. Plant foods are routinely lower-ranked resources, since harvesting and processing them is time consuming and difficult (Chapter 7). Consequently, they are added to the diet mostly in times of stress (such as during drought), and become a staple only later in prehistory, when human populations increase and opportunities to move to new territories decrease. At those times, plant use becomes more intensive, and with it comes the heavy-duty tools for large scale plant processing: earth and rock ovens, bedrock mortars, and grinding stones (manos and metates). The absence of these tools from Clovis sites may only indicate plant use was not intensive, not that plants were unused. Collecting nuts, berries, fruits, and green vegetables requires little more than a basket or skin pouch. The chances of building up a visible archaeological record from exploiting such resources is vanishingly small.[79]

Finally, it may be the evidence is right in front of us. Gary Haynes believes Clovis sites show "no attraction to nut-tree-wooded areas or seed rich grasslands."[80] Of course, we cannot say exactly where nut-rich woods or seed-rich grasslands were over 10,000 years after the fact, but we can say that a vast number of Clovis isolates do occur in what were the complex forests of Late Glacial eastern North America, which included nut-bearing trees such as walnut and hickory. Like prehistoric Swiss Army knives, Clovis points were useable for various tasks, whether skinning rabbits, prying open turtle shells, or even digging out stubborn, edible roots. Many isolates examined in eastern North America show wear patterns indicative of use as multipurpose, hafted knives, while very few display impact fractures from hunting damage.

Haynes, in fact, inadvertently (and probably unintentionally) underscores the importance of plant collecting, suggesting it was the trigger to Clovis settlement mobility. He reasons that since the men were off hunting while the women stayed close to camp to gather, the women must have had a strong voice in making the "executive decisions" about when camp should be moved. This was so, he surmises, "because they were the most sensitive to the exhaustion of resources that were within reasonable walking distance of camp."[81] As plant gatherers, they would be.

And move they did. Within a few centuries, Clovis groups were scattered throughout North America. So why did Clovis groups radiate so far and so fast? It's surely not because they were chasing mammoths (or being chased by mammoths!), or because the extinction of those animals left Clovis people with so little to eat they had to constantly press on. More likely, it was because they found themselves on a vast and empty landscape that was unknown and unpredictable, yet rich and untapped, in which there was a great adaptive incentive and benefit to ranging widely.

As they dispersed cross-country, and their knowledge of the landscape and its resources became ever-more detailed, their foraging systems became more stable, their populations increased, and their odds of vanishing diminished. And with that, broad changes were in the offing.