



Midlands Archaeology

Yes, it's time again for chili and archaeology. At next Thursday's meeting (5-17-07 at 7:00 PM at SCIAA see map on last page) our president, Dr. Chris will talk about his recent visit to the Gault site which is located in Texas. Below is an article about Gault. See you Thursday; I'll be the one with the biggest chili bowl! By the way, Dr. Goodyear is digging at Topper all through this month. Let's carpool and visit Topper next Saturday (5-19-07). Email me at wmcamis@bellsouth.net or call me at 779-5628 after 6:00PM and we'll work out a place to meet and leave from.

The Gault Site (from Texas Beyond History)

For most students of archeology, "Clovis" conjures up a vision of a distinctive spear point like the one shown on the left and of small groups of "big game" hunters killing Ice-Age elephants as they migrated across North America. For over five decades the Clovis-first hypothesis—the idea that Clovis hunters were the first people to explore the New World—has been a fundamental part of the story of the peopling of the Americas. Clovis peoples with their remarkably sophisticated hunting technology were seen as the first pioneers, highly mobile hunters who walked to North America via the Bering Land Bridge. Once below the Ice Sheet, small groups of Clovis hunters and their families expanded rapidly across the continent killing mammoths so effectively that the species was pushed over the brink of extinction. Or so the standard story goes.



Clovis points from the Gault site. (Click to see full image.) The yellow staining is caused by iron-rich groundwater, while the white encrustation is calcium carbonate, which is also carried by groundwater. In some areas of the site, the lower Clovis deposits are beneath the water table and can only be reached during dry spells and with the aid of pumping.

In the past decade, the Clovis-first hypothesis has come under attack from many directions. There have been multiple claims of earlier, pre-Clovis sites in North and South America, none totally accepted, but several very credible. And then there are the early skeletal remains found in North America, such as the controversial Kennewick Man, whose features are said to more closely resemble certain Caucasian populations than later Native Americans. Adding to this, some stone tool experts have made a case for a close resemblance between Clovis technology and that of Late Paleolithic Europe. In the last few years these claims, pro and con, have been reviewed in Time, Newsweek, New Yorker, National Geographic and on the Discovery Channel, among others.

Meanwhile at the Gault site deep in the heart of central Texas, Clovis culture is being reconsidered week by week, midway through a planned five-year dig. The emerging view hardly resembles the Clovis story known to generations of archeology students. Instead of a new group of people exploring an unknown land, we seem to see a people thoroughly familiar with their surroundings. Instead of highly mobile elephant hunters, we see what looks like a full-blown generalized hunting and gathering culture living in the same kind of places and doing many of the same kinds of things that characterized Archaic-era life all across the continent a few thousand years later. This is more than a new spin, this is a whole new way of thinking about what is still, to many, America's earliest recognizable culture.

The evidence we are about to share with you is so new that most of it has yet to be reported, at least not in a proper scientific sense. Excavations at the Gault site are in full swing with many months to go. The analyses have just barely begun

and most will take years to be completed and fully reported. Several of the nation's leading Paleoindian experts and specialists in various subfields and dozens of their undergraduate and graduate students are working on different aspects of the site. In other words, what follows is merely a glimpse of what is to come, a peek behind the scenes and into the head of Dr. Michael B. Collins, the lead researcher who heads up the project. This is what he now thinks Clovis life may have been like based on the emerging evidence. Like any good scientist, he reserves the right to change his mind. Collins fully expects the next few years will bring even more surprises at Gault and elsewhere that will help paint a more complete and accurate picture of the Clovis past. Born and raised in Texas, Collins knew in high school that he wanted to become an archeologist. The Gault Project brings together the three principal themes of his career: lithics, early Paleoindians, and geoarcheology. His interest in the early peoples of the New World started when he first found Paleoindian artifacts around the playa lakes near Midland, Texas, while still a teenager. He studied archeology and geology at the University of Texas and then went on to get a Ph.D. from the University of Arizona. As a stone tool expert he is well known for his work with



Gault Project Director Dr. Michael B. Collins introduces volunteers to Clovis lithics.

Tom Dillehay on the extremely early Monte Verde site in Chile as well as a recent book, *Clovis Blade Technology* (1999, UT Press). His interest in geoarcheology, the marriage of archeology and geology, developed as a natural outcome of his interest in Paleolithic cultures. Collins has worked on archeological projects in many states, countries, and continents, none (with the possible exception of Monte Verde) more exciting or important than the Gault site. Being able to investigate a world-class archeological site less than an hour's drive from either his Austin home or his Williamson County farm is a dream come true for "Dr. Clovis."

Ecotones and Endless Flint

To understand why Clovis peoples repeatedly came to Gault and apparently stayed for quite some time, you first have to know where it is and what it had to offer. The Gault site is located in central Texas about 40 miles north of Austin, halfway between Georgetown and Killeen (Ft. Hood). It sits near the head of a small creek in a small wooded valley just at the point where stream that has never gone dry in historic times. This valley is one of three spring-fed brooks



Clovis blade cores. These distinctive artifacts are blocks of chert (flint) that have been carefully prepared ("set up" by chipping and edge grinding) for the removal of prismatic blades. This highly specialized technology allows a skilled flintknapper to maximize the amount of useful cutting edge that can be generated from a single chert cobble.

many that cut through the eastern flank of the vast limestone Edwards Plateau that stretches far to the south and west. The Gault site is in the northern part of the Texas Hill Country within the Lampasas Cut Plain, where, as its name implies, the limestone plateau is somewhat flatter and "cut" by many incised stream valleys.

A three-hour walk down the creek valley, the limestone country ends abruptly at the Balcones Escarpment and the Black Prairie begins. This geological fault zone is one of the most impressive ecotones in North America, places where different environments come in contact. Moving east along the creek, almost everything changes in just a few miles—geology, hydrology, soils, plants, and animals. The Black Prairie, so named for its rich black "gumbo" clay soil, was a grassland for at least the last 15,000 years and still would be today if the grazing, fire control, agriculture, and concrete had not all but spelled its doom. Spanish explorers in the early seventeenth century rode their horses through grass so thick and deep in many places that only the mounted riders could see where they were going. They found plenty of buffalo and antelope to hunt on the Black Prairie but when they turned west and entered the rugged up and down world of the Texas Hill Country, they had to rely on deer and turkey. They found dense, towering bands of hardwood forest along the streams and an oak savannah in the uplands with mixed grasses and trees, many of them stunted and confined to mottes by periodic range fires.

Moving from the grand scale to the local, the Gault site itself sits on a smaller scale ecotone that is still obvious today even to the casual visitor. The road to the site leads through the typical rocky limestone rolling hills with very little soil and lots of cedar (juniper), live oak, mesquite and prickly pear. As you approach the

site, the road drops off into the valley—only about 45 feet lower, but what a difference. The deep, well-watered soils provide habitat for huge hardwood trees—burr oaks, walnuts, pecans, ash, elm, bois d' arc, and a dozen more species including willow and cottonwood. In a word, it is lush. While we don't have an accurate idea of what the local vegetation was like in Clovis times, the contrast between valley bottom and the surrounding uplands would have been just as stark. So the Gault site was located on ecotones, large and small, in a small, protected wooded valley with a spring-fed stream. But it had one other important thing going for it—a nearly inexhaustible supply of extremely high quality flint (chert). The flint occurs as stream-worn cobbles along the creek and it weathers out of the bedrock along the valley slopes and in the uplands surrounding the site. For over 13,000 years people have been picking up flint here and yet modern flintknappers have hauled away pickup loads of it. And still you cannot walk 10 feet without seeing pieces of flint. Some of the larger nodules are the size of a fat watermelon.



Incised stones. These may be the earliest examples of representational art in North America. Several dozen have now been found including several that seem to depict animals.

They Came To Stay

Most known Clovis sites fall into one of four categories. By far the most numerous are places where isolated finds of Clovis points are made. The next most common are kill sites, places like Lehner and Murray Springs in southeastern Arizona or Domebo in south-central Oklahoma where



Clovis point and Clovis biface

elephant bones and Clovis artifacts were found together. And then there are Clovis caches, isolated places where Clovis points, bifaces, blades, or blade cores are found in tight piles thought to represent hidden stashes. Finally, there is the rarest category, camps—places where Clovis peoples stayed long enough for considerable debris to build up. Some camps occur in rockshelters and others in open settings, but most known Clovis camps appear to be the result of fairly brief stays. In contrast, the Gault site is clearly a major base camp, a place where people returned repeatedly and probably stayed for lengthy periods of time.

How do we know? Well for one thing it is a very large site. Imagine a football field. Now add a second one beside it. Now add two more pairs of fields end to end. And this is only the core area of the site measuring about 80 by 300 yards where Clovis materials are known to be concentrated. The entire Gault site covers an area about 90-100 yards wide by about 650 yards long. Not all of this area has been tested yet, but enough to get a fairly good idea of what lies beneath the surface. The evidence is not spread uniformly; some areas have much greater artifact densities than others. And it is also clear that some of the deposits have been washed away by floods—concentrations of Clovis artifacts have been found within gravel deposits along the creek. It is not just large, but incredibly rich. The Clovis deposits average about 40 centimeters (16 inches) thick but are sometimes twice that or more, and in places the deposits contain unbelievably large numbers of Clovis artifacts. Collins guesses that the Gault site may have already yielded as much as a third of all excavated Clovis artifacts known today.

Base camps, as the name implies, are places where people stayed for a while and ventured out from, repeatedly. One characteristic they have is "assemblage diversity"—lots of different kinds of artifacts. The diversity already recognized at Gault is astonishing. There are Clovis points—finished points, worn out points, half-made points, resharpened points, and lots of fragments. And Clovis bifaces—big heavy bifaces, small thin bifaces, bifaces broken in



One of many fluted preforms that have been found at Gault. Most of these preforms were broken when their makers attempted to flute them.

manufacture, and several kinds of specialized bifaces. There are also Clovis blade cores and blades—hundreds of them—large ones, small ones, crested outer blades, thin inner blades, broken blades, and used blades. Then there are the blade tools—end scrapers made on blades, serrated blades, blades with sharp graver-like beaks, and blades with incredible use-wear traces. The finding of several adzes or wood-working tools was quite unusual—this tool form was not known previously from other Clovis sites, although it occurs more commonly at later sites. Another odd artifact from Gault is a bone or ivory rod, found in the ancient gravel deposits of the creek amid definite Clovis artifacts. It is very similar to specimens found in other Clovis sites.

And then there are the incised stones—smallish, smooth limestone rocks that have various patterns and designs formed by shallow lines almost certainly made with sharp flint flakes. Several dozen of these "mobile art" objects are known from Gault and may represent the earliest examples of representational art in North America. They were clearly made at the site out of local limestone pebbles from the stream gravels.

The artifact diversity obviously means that many different tasks were carried out at the site and probably elsewhere by work parties who returned to Gault. The Gault researchers are not ready to enumerate these tasks in much detail, but some patterns are already clear. First and perhaps foremost, the Gault site was a major tool-making locality—a lithic workshop where a great many stone tools were made, most out of flint. All stages of tool-making were carried out from the first stages of "primary reduction" (breaking up large cobbles into usable pieces) to the final stages of putting the finishing touches on a completed artifact. And beyond—there are many resharpened and broken tools at Gault that show people were "retooling"—taking the time to replace broken and



For over 13,000 years people have been picking up flint at the Gault site. And yet, modern flintknappers have hauled away pickup loads of it. Still, you cannot walk 10 feet along the edge of the valley without stepping on flint.

worn parts (such as the tips of spears) with sharp new ones. While evidence is less direct, a great deal of wood working, binding, and so on must have taken place there as well. Tiny gravers—very small, delicate stone tools with sharp beaks—hint at some sort of specialized work—scarifying (scratching the skin to draw blood or allow tattoo pigment to absorb)?

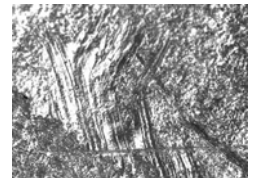
Although bone preservation is generally poor in the Clovis deposits, there are enough bones of mammoth, horse, and bison to suggest that these animals were killed not too far away and at least partially butchered at the site. Many tools speak to hunting and butchering—Clovis points, bifaces and sharp blades with meat polish, and heavy choppers probably used to dismember large animals. Endsrapers made on blades suggest that hide working was another typical activity.

One of the most promising avenues for documenting the daily activities of the Clovis peoples who stayed at Gault is through use-wear analysis of stone tools. Using this approach, Gault staff researcher Marilyn Shoberg has already identified two very different tasks that Clovis blades were used for: butchering and grass-cutting. She looks at individual stone tools under 200x magnification using a binocular microscope with polarized light and special eye pieces designed just for this kind of work. At 200x, the edge of a Clovis blade looks like an alien world complete with craters and mountains. These micro-topographic features are the actual surface of the stone tool.

When stone tools are used repeatedly, once-sharp edges become dull and rounded and polish forms. Different kinds of contact materials create different kinds of polish—high polish, dull polish, domed polish and more. And when hard particles, such as sand grains adhering to a hunk of mammoth, come into contact with the polished edges, they leave striations—scratches and gouges. The orientation of these blemishes tells Shoberg which direction the tool was being pulled (or pushed).

The patterns seen on archeological specimens must be compared to experimental tools used for known purposes on known materials. These serve as control or reference samples.

Magnified surface of a serrated Clovis blade. This 200x view shows well-developed polish and intersecting striations thought to result from cutting up meat. Photo by Marilyn Shoberg.



The picture above is the surface of a serrated Clovis blade. The shiny polish is the kind that is associated with cutting meat—butchering. Notice the criss-crossed striations. The triangular pattern left by the intersection of the striations is very characteristic of a tool used repeatedly to cut the meat of a large animal. The different striation directions imply that the blade was held in different ways or at least at different angles.

Now compare this with the first picture on the right showing the magnified edge of a Clovis blade with obvious polish. Notice that most of the surface is completely smooth and the edge heavily rounded. The polish is continuous, smooth, and has numerous small pits and medium-sized comet-shaped pits. This kind of polish is consistent with use in processing plant material high in silicates, and is often referred to as "sickle gloss." The edge (at the bottom of the picture) is heavily rounded, which means that this tool was used for quite some time.

Finally, compare the first two photos with the second (lower) picture on the right showing the magnified edge of an experimental blade used to cut Little Bluestem grass, the kind that formerly covered much of the Black Prairie. After 2000 strokes, characteristic silica polish is just forming in a continuous band along the edge of the blade, and pockmarked areas of polish extend back from the edge. The areas of polish are not as large and continuous on the experimental blade when compared to that on the archeological tool, suggesting that the experimenters have many more thousand strokes to put in. But the characteristic form of the polish on the replica tool, with small pits and linear features parallel to the edge of the blade, is very similar to that found on the archeological tool. This comparison supports the hypothesis that the prehistoric blade was used to harvest and/or process grass or reeds.

Shoberg has just begun to look at the Clovis tools from Gault. She and other researchers will spend hundreds of person-days staring under the microscope, taking notes and photographs, and comparing archeological tools with more experimental ones. Tedious work to be sure, but the result will be a much more complete view of what Clovis peoples were doing with their finely made stone tools.

Magnified surface of a serrated Clovis Blade. This 200x view shows well-developed polish and intersecting striations thought to result from cutting up meat. Photo by Marilyn Shoberg.

How Long Did They Stay?

Among the things that are missing from the Gault site are organic remains, especially charred plant remains. The preservation conditions are such that so far not a single charcoal fragment has been found (although many matrix samples have been saved for further analysis). Charred plant remains could reveal many important clues and they could be used for radiocarbon dating. At present there are no radiocarbon assays of Clovis age from the Gault site. This makes it difficult to figure out the time span of the Clovis occupation. Several lines of evidence suggest that Clovis peoples visited the site over a long period of time and may have stayed here for prolonged periods.

The stratigraphy of the Gault site is very complex. Because it lies within a narrow stream valley with deep deposits, permanent springs, and multiple channels coming together, the character of the deposits can change dramatically over the space of a few meters (6-10 feet). It was a "dynamic" environment, meaning that things could and did change quickly. Major floods, for instance, changed the stream course repeatedly, ripping up old deposits and creating new ones. As the continuing excavations connect now-isolated excavation units and as various geological and soils experts study the many samples that have already been taken, entire books will probably be written about the stratigraphy of the Gault site. But based on what we know today, there are at least three distinct Clovis "components" at Gault.

That is, in various places in the site there are at least three distinct layers containing Clovis artifacts. Their nature implies that these formed over extended periods of time, decades at least and probably centuries. In the lowest and hence earliest Clovis deposits, there are the bones of mammoth, horse, and bison, all species that became extinct at the end of the last Ice Age. In the later, upper two deposits the only large bones that have been found are those of extinct bison. Given this, it is possible that mammoth and horse became extinct (at least locally) during the Clovis era at Gault. Without securely dated deposits, precise dates cannot be given. It is obvious that a considerable period of time elapsed during the Clovis occupations at Gault, several hundred years at least and probably more. Based on dates from other sites, the Gault site could have been occupied as early as 11,600 RCYBP (or about 11,600 B.C.) and as late as 10,900 RCYBP (or about 10,900 B.C.). (RCYBP = radiocarbon years before present)

Textbooks will tell you that Clovis points were specifically designed for mammoth hunting. Yet, in the upper (and latest) Clovis deposits at Gault it appears that no change in weaponry was made after the extinction of the mammoths. The Clovis points are still the classic form and they are found with bison remains. Collins thinks this is another indication that Clovis technology was a generalized rather than specialized one. The prevailing concepts are ripe for reconsideration. This still leaves the question of the nature of the occupations: were these intermittent, as seems most likely, or continuous? Researchers aren't sure yet and may never be certain, but there are indications that the occupation(s) may have been lengthy. The most obvious is the sheer quantity of materials and size of the site—this must have taken either lots of visits or a fair number of people over lengthy spans of time.

Another clue is the amount of exotic lithic materials. One of the most characteristic aspects of the stone tools at most Clovis sites is that the discarded, worn-out-stone tools are more often than not made of exotic non-local materials. Many studies have shown that Clovis peoples routinely carried or traded flint and other stones hundreds of miles from their sources. But at Gault, exotic materials are very uncommon, even among the worn-out tools such as Clovis points that were broken and dulled and resharpened until they were too small to be useful. Although no counts are yet available, the overwhelming majority of all stone tools and tool-making materials at Gault are made of the local flint. This strongly suggests that Gault hunters commonly started and ended their trips at Gault and that they did this throughout the history of the site.

Putting It All Together: Clovis Reconsidered

Based on the evidence just reviewed and on arguments and data presented by many other researchers in recent years, a new view of Clovis culture is taking hold. Clovis peoples may not have been the pioneers who first settled North America. Leaving aside the direct evidence for preClovis sites, there is this: Clovis artifacts are known from all 48 of the lower states plus southernmost Canada, Mexico, Costa Rica, and Guatemala. These continent-wide localities occupy a tremendous range of environments, from coastlines to mountains and almost everything



Scapula (shoulder blade) of an Ice-Age horse from the lower Clovis deposits at Gault.

between. The inescapable conclusion from these facts alone is that most Clovis peoples were NOT highly mobile, specialized mammoth hunters—they were generalized hunter-gatherers who must have relied on animals of all sizes and a great many plants. The emerging data from the Gault site lend very strong support to this interpretation.

In addition to what has already been mentioned, here are several more examples of the kinds of evidence from Gault that reinforce this view. Among the bones found in the Clovis deposits are turtle bones, burned frog bones, burned bird bones, and small mammals yet to be identified. In Clovis faunal assemblages across North America, the most commonly identified animals are not elephants—they are turtles. And the Clovis diet was not based on animals alone. This, of course, is obvious anyway because humans can't live for long on just meat. But at Gault, use-wear studies are already finding evidence of a wide range of contact materials including the stunning example of the Clovis blade with the highly developed use-wear signature of grass cutting. While grass-cutting may not have been for food (the tall grasses of the Black Prairie are ideally suited for thatching and bedding), it is another indication of the diversity of behaviors that are being documented at the Gault site.

It should not seem surprising at all that Clovis peoples were more than one-dimensional. They were, as we are learning at Gault and elsewhere, much more interesting people who adapted to a wide range of environments and climates and behaved like generalized hunters and gatherers of the later Archaic cultures of North America. Contrast this with Folsom culture, the quintessential specialized big game hunters of the Plains. All known Folsom sites occur within or near the Great Plains and prairies of the midcontinent. And all of the Folsom sites with animal bones have extinct bison bones. No Folsom caches are known, suggesting perhaps that Folsom peoples were so mobile and so focused on "encounter" hunting strategies, that they did not plan ahead by caching materials for the future. Folsom peoples did not make much use of the prismatic blade technology, perhaps because blade cores are heavy things that don't travel well. The ultra-thin Folsom bifaces are light and the thinning flakes struck from them well suited for making Folsom points and other artifacts. Clovis is anything but Folsom-like.

For now, this is where we leave the story of Gault and of Clovis reconsidered. Clovis culture will never be seen again in the same light, as it has for so long. The Clovis-first hypothesis—with all its implications of specialized big-game hunters—is all but shattered. While it hasn't been proved beyond doubt that preClovis peoples existed in North America, Clovis peoples weren't anything like those described by the long-held ideal. If they were the first pioneers, as many archeologists still believe, they were exceptionally adaptable and extremely fast learners (not to mention prolific breeders) for whom killing mammoths was just one of many successful strategies. The results of work at the Gault site in central Texas will help lead researchers, students, and the public to a much more sophisticated and accurate understanding of Clovis culture.

Supernova Explosion May Have Caused Mammoth Extinction

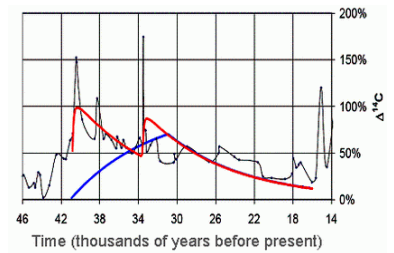
Berkeley Lab staff

A distant supernova that exploded 41,000 years ago may have led to the extinction of the mammoth, according to research that will be presented tomorrow (Sept. 24, 2005) by nuclear scientist Richard Firestone of the U.S. Department of Energy's Lawrence Berkeley National Laboratory. Firestone, who conducted this research with Arizona geologist Allen West, will unveil this theory at the 2nd International Conference "The World of Elephants" in Hot Springs, SD. Their theory joins the list of possible culprits responsible for the demise of mammoths, which last roamed North America roughly 13,000 years ago. Scientists have long eyed climate change, disease, or intensive hunting by humans as likely suspects.



Now, a supernova may join the lineup. Firestone and West believe that debris from a supernova explosion coalesced into low-density, comet-like objects that wreaked havoc on the solar system long ago. One such comet may have hit North America 13,000 years ago, unleashing a cataclysmic event that killed off the vast majority of mammoths and many other large North

American mammals. They found evidence of this impact layer at several archaeological sites throughout North America where Clovis hunting artifacts and human-butchered mammoths have been unearthed. It has long been established that human activity ceased at these sites about 13,000 years ago, which is roughly the same time that mammoths disappeared. They also found evidence of the supernova explosion's initial shockwave: 34,000-year-old mammoth tusks that are peppered with tiny impact craters apparently produced by iron-rich grains traveling at an estimated 10,000 kilometers per second. These grains may have been emitted from a supernova that exploded roughly 7,000 years earlier and about 250 light years from Earth. "Our research indicates that a 10-kilometer-wide comet, which may have been composed from the remnants of a supernova explosion, could have hit North America 13,000 years ago," says Firestone. "This event was preceded by an intense blast of iron-rich grains that impacted the planet roughly 34,000 years ago."



In support of the comet impact, Firestone and West found magnetic metal spherules in the sediment of nine 13,000-year-old Clovis sites in Michigan, Canada, Arizona, New Mexico and the Carolinas. Low-density carbon spherules, charcoal, and excess radioactivity were also found at these sites. "Armed with only a magnet and a Geiger counter, we found the magnetic particles in the well-dated Clovis layer all over North America where no one had looked before," says Firestone. Analysis of the magnetic particles by Prompt Gamma Activation Analysis at the Budapest Reactor and by Neutron Activation Analysis at Canada's Becquerel Laboratories revealed that they are rich in titanium, iron, manganese, vanadium, rare earth elements, thorium, and uranium. This composition is very similar to lunar igneous rocks, called KREEP, which were discovered on the moon by the Apollo astronauts, and have also been found in lunar meteorites that fell to Earth in the Middle East an estimated 10,000 years ago. "This suggests that the Earth, moon, and the entire solar system were bombarded by similar materials, which we believe were the remnants of the supernova explosion 41,000 years ago," says Firestone.

Image: Radiocarbon peaks in Icelandic marine sediment samples, indicated by the black line, coincide with three supernova-caused events that Firestone and Wells believe led to the extinction of the mammoth

In addition, Berkeley Lab's Al Smith used the Lab's Low-Background Counting Facility to detect the radioactive isotope potassium-40 in several Clovis arrowhead fragments. Researchers at Becquerel Laboratories also found that some Clovis layer sediment samples are significantly enriched with this isotope. "The potassium-40 in the Clovis layer is much more abundant than potassium-40 in the solar system. This isotope is formed in considerable excess in an exploding supernova, and has mostly decayed since the Earth was formed," says Firestone. "We therefore believe that whatever hit the Earth 13,000 years ago originated from a recently exploded supernova." Firestone and West also uncovered evidence of an even earlier event that blasted parts of the Earth with iron-rich grains. Three mammoth tusks found in Alaska and Siberia, which were carbon-dated to be about 34,000 years old, are pitted with slightly radioactive, iron-rich impact sites caused by high-velocity grains. Because tusks are composed of dentine, which is a very hard material, these craters aren't easily formed. In fact, tests with shotgun pellets traveling 1,000 kilometers per hour produced no penetration in the tusks. Much higher energies are needed: x-ray analysis determined that the impact depths are consistent with grains traveling at speeds approaching 10,000 kilometers per second. "This speed is the known rate of expansion of young supernova remnants," says Firestone.

The supernova's one-two punch to the Earth is further corroborated by radiocarbon measurements. The timeline of physical evidence discovered at Clovis sites and in the mammoth tusks mirrors radiocarbon peaks found in Icelandic marine sediment samples that are 41,000, 34,000, and 13,000 years old. Firestone contends that these peaks, which represent radiocarbon spikes that are 150 percent, 175 percent, and 40 percent above modern levels, respectively, can only be caused by a cosmic ray-producing event such as a supernova. "The 150 percent increase of radiocarbon found in 41,000-year-old marine sediment is consistent with a supernova exploding 250 light years away, when compared to observations of a radiocarbon increase in tree rings from the time of the nearby historical supernova SN 1006," says Firestone. Firestone adds that it would take 7,000 years for the supernova's iron-rich grains to travel 250 light years to the

Earth, which corresponds to the time of the next marine sediment radiocarbon spike and the dating of the 34,000-year-old mammoth tusks. The most recent sediment spike corresponds with the end of the Clovis era and the comet-like bombardment. "It's surprising that it works out so well," says Firestone.

Editor's note: the following is an abstract of a paper Dr. Al Goodyear presented at a recent Paleooceanography and Paleoclimatology meeting. Please notice that Midlands Chapter member Dr. Mike Dewey was a consultant for this abstract

Changes in Paleoindian Projectile Point Densities as Possible Evidence of a Clovis Demographic Collapse in the Southeastern U.S.

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The point on the left side is a classic Clovis point while the point on the right is a classic Redstone. The difference between them is the shape of their respective bases (ends). Clovis bases are never wider than their blades (tops) while Redstone bases are always wider than their blades.

Recent evaluation by the author of the South Carolina Paleoindian point database indicates the substantial presence of a suspected Middle Paleoindian point historically known as Redstone (Cambron and Hulse, 1964; Mason, 1962; Perino, 1968; Williams and Stoltman, 1965). Because of recent discoveries in South Carolina of large fluted points typical of the Redstone, it became clear that the Redstone had a straight to trianguloid blade configuration from the earliest stage of its use life. Lanceolates with extremely long prominent flutes heretofore had been classified as Clovis (Charles and Michie, 1992; Goodyear et al., 1990; Michie, 1977). Accordingly, a review of all fluted points yielded a total of

48 Redstones that had previously been misclassified as Clovis. Reclassifying the South Carolina database resulted in approximately four Clovis points for every one Redstone. Using Clovis and Redstone fluted points made from coastal plain Allendale-type chert and high-quality metavolcanics, a total of 179 Clovis were found versus 40 Redstones (4.5 to 1). Within the Allendale chert cases, 115 were Clovis versus 24 Redstone (4.8 to 1). Within metavolcanics, it was 64 Clovis versus 16 Redstones (4 to 1). Assuming Redstones date from 10,800 to 10,500 RCYBP, and Clovis dates from 11,300 to 10,900 RCYBP, a precipitous decline in post-Clovis fluted points is indicated. No other Paleoindian points are known for this area of the Southeast to fill in this time period, since Daltons presumably began later around 10,500 RCYBP (Goodyear 1982). For the Allendale County region of South Carolina, there are an estimated 20 Dalton points for every Redstone. This apparent decline in Redstone projectile points occurs during the Younger Dryas, a time thought to be colder and dryer than Clovis times, and therefore, less hospitable. The strong presence of Dalton points throughout the Southeast would suggest any demographic problems were ameliorating by Dalton times. As a cross-check on the South Carolina database, the North Carolina Paleoindian point survey was also reclassified searching for Redstones. It resulted in a Clovis to Redstone ratio of 3 to 1 (Daniel and Goodyear, 2006). This pattern of a high Clovis to Redstone ratio apparently is not restricted to the Carolinas. In his survey of the Nottaway River drainage in

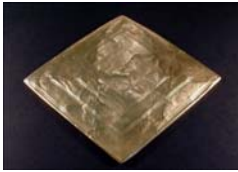
southeast Virginia, McAvoy (1992) found a dramatic post-Clovis drop in what he calls deep concave based fluted points and sites. He postulates a major population reduction in this region after Clovis times. For the entire Virginia data base, Johnson (1996) notes that the proportion of concave base to presumably Clovis points is 11 percent. Based on these results, more attention should be paid to a possible post-Clovis, pre-Dalton decline in Paleoindian points in the Southeast, and perhaps elsewhere, to determine the archaeological reality of this suggested pattern.

Stonehenge Amulets Worn by Elite

Jennifer Viegas, *Discovery News*

Forget dressing for success: Clothing ornaments thought to confer supernatural power were all the rage among chiefs and other important people in England 4,000 years ago, say scholars. A recent find indicates some of these fashion trends might have originally been designed by Stonehenge leaders. While working two months ago in South Lowestoft, Suffolk, British archaeologist Clare Good excavated a four-sided object made of the mineral jet. It closely matches a geometrically designed gold object found far away at a burial site called Bush Barrow near Stonehenge in Wiltshire.

The match is so close that experts believe the black artifact is a skeuomorph, or a copy in a different material. Good, who is with the Suffolk County Archaeology Service, told *Discovery News* that she made the discovery while investigating the remains of a probable funeral pyre



Striking Gold
This gold object was unearthed at a Stonehenge burial site. Archaeologists believe the ornament and others like it were once worn by powerful individuals who believed they held magical powers.

dating to 1900-1700 B.C. The funeral pyre, she said, is “a normal sort of feature we come across every day while out digging.” She thinks someone placed goods, including a flint knife, pottery and the jet object, inside the pit after the body was burned. The findings are documented in the current issue of *British Archaeology*. Editor Mike Pitts describes the jet object as having “two parallel lines around the edge, supporting 12 pendant semi-circles inside with a double circle and dot in the center. Small floating lines of rocker decoration, some on the side facets, complete the design.”

“Rocker” refers to the rocking motion that the artist likely used when carving, drawing or chiseling out the design. Like Stonehenge itself, the meaning of the design remains a mystery, but the material — though not as flashy and precious as gold — held significance for the ancients, according to Alison Sheridan, head of early prehistory in the Department of Archaeology at National Museums Scotland. “Lots of substances are likely to have been ascribed magical powers, and were used as amulets,” she explained. “Jet is a classic example, as it’s electrostatic, as well as being rare and beautiful, and has been used by many people around the world and over time as an amulet.” She added that this particular piece was made from a “large lump of jet” so it would have been “extra-precious.” It might have even been a commissioned “studio piece,” perhaps copying the Stonehenge wearer’s overall design.

Sheridan analyzed the jet piece and found traces of copper in 4 holes that were cut into the object. She said “it’s likely that the lozenge had been fitted onto a garment by copper pins. This would suggest to me that we’re thinking leather.”

Put together with the position in which the Bush Barrow object was found, she thinks both the jet and gold pieces probably were fitted onto leather garments at the chest. Sheridan, who came up with the term “supernatural power dressing,” said these objects, and other evidence, indicate the Stonehenge-era elite were extremely “status and fashion conscious.” While no one knows who these people were, she theorizes they probably were wealthy individuals, local leaders, or even maybe some kind of early royalty. She said, “(We) wouldn’t want to conjure up images of Prince Harry, or maybe we would!



Supernatural Stone?
While working two months ago in South Lowestoft, Suffolk, British archaeologist Clare Good excavated this jet amulet, which matches a geometrically designed gold object found far away at a burial site called Bush Barrow near Stonehenge in Wiltshire. The match is so close that experts believe the black artifact is a skeuomorph, or a copy in a different material.

The Mystery of Easter Island: *New findings rekindle old debates about when the first people arrived and why their civilization collapsed*

By Whitney Dangerfield for *Smithsonian*

Hundreds of years ago, a small group of Polynesians rowed their wooden outrigger canoes across vast stretches of open sea, navigating by the evening stars and the day’s ocean swells. When and why these people left their native land remains a mystery. But what is clear is that they made a small, uninhabited island with rolling hills and a lush carpet of palm trees their new home, eventually naming their 63



square miles of paradise Rapa Nui-now popularly known as Easter Island. On this outpost nearly 2,300 miles west of South America and 1,100 miles from the nearest island, the newcomers chiseled away at volcanic stone, carving moai, monolithic statues built to honor their ancestors. They moved the mammoth blocks of stone- on average 13 feet tall and 14 tons- to different ceremonial structures around the island, a feat that required several days and many men. Eventually the giant palms that the Rapanui depended on dwindled. Many trees had been cut down to make room for agriculture; others had been burned for fire and used to transport statues across the island. The treeless terrain eroded nutrient-rich soil, and, with little wood to use for daily activities, the people turned to grass. "You have to be pretty desperate to take to burning grass," says John Flenley, who with Paul Bahn co-authored *The Enigmas of Easter Island*. By the time Dutch explorers, the first Europeans to reach the remote island, arrived on Easter day in 1722, the land was nearly barren. Although these events are generally accepted by scientists, the date of the Polynesians' arrival on the island and why their civilization ultimately collapsed is still being debated. Many experts maintain that the settlers landed around 800 A.D. They believe the culture thrived for hundreds of years, breaking up into settlements and living off the fruitful land. According to this theory, the population grew to several thousand, freeing some of the labor force to work on the moai. But as the trees disappeared and people began to starve, warfare broke out among the tribes.

In his book *Collapse*, Jared Diamond refers to the Rapanui's environmental degradation as "ecocide" and points to the civilization's demise as a model of what can happen if human appetites go unchecked. But new findings by archaeologist Terry Hunt of the University of Hawai'i may indicate a different version of events. In 2000, Hunt, archaeologist Carl Lipo of California State University, Long Beach, and their students began excavations at Anakena, a white sandy beach on the island's northern shore. The researchers believed Anakena would have been an attractive area for the Rapanui to land, and therefore may be one of the earliest settlement sites. In the top several layers of their excavation pit, the researchers found clear evidence of human presence: charcoal, tools, even bones, some of which had come from rats. Underneath they found soil that seemed absent of human contact. This point of first human interaction, they figured, would tell them when the first Rapanui had arrived on the island.

Hunt sent the samples from the dig to a lab for radiocarbon dating, expecting to receive a date around 800 A.D., in keeping with what other archaeologists had found. Instead, the samples dated to 1200 A.D. This would mean the Rapanui arrived four centuries later than expected. The deforestation would have happened much faster than originally assumed, and the human impact on the environment was fast and immediate. Hunt suspected that humans alone could not destroy the forests this quickly. In the sand's layers, he found a potential culprit, a plethora of rat bones. Scientists have long known that when humans colonized the island, so too did the Polynesian rat, having hitched a ride either as stowaways or sources of food. However they got to Easter Island, the rodents found an unlimited food supply in the lush palm trees, believes Hunt, who bases this assertion on an abundance of rat-gnawed palm seeds.

Under these conditions, he says, "Rats would reach a population of a few million within a couple of years." From there, time would take its toll. "Rats would have an initial impact, eating all of the seeds. With no new regeneration, as the trees die, deforestation can proceed slowly," he says, adding that people cutting down trees and burning them would have only added to the process. Eventually, the degeneration of trees, according to his theory, led to the downfall of the rats and eventually of the humans. The demise of the island, says Hunt, "was a synergy of impacts. But I think it is more rat than we think." Hunt's findings caused a stir among Easter Island scientists. John Flenley, a pollen analyst at New Zealand's University of Massey, accepts that the numerous rats would have some impact on the island. "Whether they could have deforested the place," he says, "I'm not sure."

Flenley has taken core samples from several lakebeds formed in the island's volcanic craters. In these cores, he has found evidence of charcoal. "Certainly there was burning going on. Sometimes there was a lot of charcoal," he says. "I'm inclined to think that the people burning the vegetation was more destructive [than the rats]." Adding to the civilization's demise, European explorers brought with them Western diseases like syphilis and smallpox. "I think that the collapse

happened shortly before European discovery of the island,” Flenley says. “But it could be that the collapse was more of a general affair than we think, and the Europeans had an effect on finishing it off.” Flenley, who initially surveyed Easter Island in 1977, was one of the first scientists to analyze the island’s pollen, a key indicator of foresting. The island’s volcanic craters, which once housed small lakes, were ideal sites for his research. “The sediment was undisturbed. Each layer was put down on top of the layer before,” says Flenley, referring to core samples from one crater’s lakebeds. “It’s like a history book. You just have to learn to read the pages.” The samples showed an abundance of pollen, indicating that the island had once been heavily forested. The pollen rate then dropped off dramatically. “When I dated the deforestation at that site, it came starting at about 800 A.D. and finishing at this particular site as early as 1000 A.D.,” a finding in line with other radiocarbon dates on the island. Since this was one of the first settlement sites, Flenley says, it makes sense that deforestation would have occurred even earlier than it did on other parts of the island. This crater, Flenley believes, would have been one of the only sources of freshwater on the island, and therefore one of the first places the Polynesians would have settled. “It wasn’t only a site of freshwater, it was also a very sheltered crater,” he says. “It would have been possible to grow tropical crops.” Anakena, the beach where Hunt did his research, would have been a good place to keep their canoes and to go fishing, but not a good place to live. Hunt, Flenley says, “has definitely shown a minimum age for people being there, but the actual arrival of people could have been somewhat earlier.” Other scientists who work on the island also remain skeptical of Hunt’s later colonization date of 1200 A.D. Jo Anne Van Tilburg, founder of the Easter Island Statue Project and a scientist at the University of California, Los Angeles, is one of the island’s leading archaeologists and has studied the moai for nearly 30 years. “It’s not logical that they were constructing megalithic sites within a few years of arrival on the island,” she says. Van Tilburg and her colleagues have surveyed all 887 of the island’s statues. “By 1200 A.D., they were certainly building platforms,” she says referring to the stone walls on which the islanders perched the moai, “and others have described crop intensification at about the same time. It’s hard for me to be convinced that his series of excavations can overturn all of this information.”

Despite these questions, Hunt remains confident in his findings. Many scientists, he says, “get a date, tell a story, invest a lot in it, and then don’t want to give it up. They had a very good environmental message.” Hunt, Lipo, and their students continue to do excavation work on the island. They have recently moved on from Anakena to do work on the northwest coast. They also plan to date the earliest rat-gnawed seeds. “We keep getting a little more evidence,” says Hunt, who has published his findings in *Science*. “Everything looks very consistent.” Scientists may never find a conclusive answer to when the Polynesians colonized the island and why the civilization collapsed so quickly. Whether an invasive species of rodent or humans devastated the environment, Easter Island remains a cautionary tale for the world.

Lost City of Powhatan: *The Algonquian settlement crucial to the survival of Jamestown 400 years ago has been found, Finally!*

By Andrew Lawler

Trudging through swamp mud on a cold February day in 1608, Capt. John Smith and a small band of armed men approached a rickety wooden bridge. On the other side of a sluggish creek was the capital of the powerful Algonquian chief Powhatan, who ruled a vast territory across the Virginia tidewater. Smith, a canny mercenary who once did time as a Turkish slave, had reason to be wary. The first time he had seen Powhatan’s capital, two months before, he had been a captive. Only the intervention of Powhatan’s young daughter Pocahontas, as the English explorer would dramatize the scene years later, had saved him from execution. This time, Smith was an invited guest at the Algonquian settlement, Werowocomoco. He was escorted by Powhatan’s son into the chief’s longhouse, built of saplings, reeds and bark and set apart from the village. He promised to help subjugate Powhatan’s enemies to the west, and Powhatan formally declared the pale-faced foreigner a weroance, or Algonquian chief.

The survival of Jamestown-established 400 years ago next month-hinged on this encounter at Werowocomoco. The English had unknowingly built their small rude settlement just a dozen



**Captain
John
Smith
meets
Chief
Powhatan**

miles from the center of Powhatan's confederacy. In the midst of their first long winter, with insufficient food supplies, the foreigners were depending on exchanging copper ware, glass beads and iron hatchets for Algonquian corn. But the peace did not hold, and within a year Powhatan relocated his capital farther west. Werowocomoco was abandoned, and the location of the dramatic confrontations between Smith and Powhatan that ensured the English foothold in North America was lost to history. Until Lynn Ripley got a dog. Walking her Chesapeake Bay retriever on her York River property a decade ago, Ripley noticed potsherds sticking up from the clay. "They seemed to jump out at me," she recalls in her garage turned laboratory as she opens a large safe and pulls out drawer after drawer of broken pottery, arrowheads and pipestems. In 2001, two archaeologists who had visited Ripley told Randolph Turner at the Virginia Department of Historic Resources about her collection. Turner, also an archaeologist, has spent three decades trying to find Werowocomoco, poring over John Smith's writings, examining a map of the site made by a Spanish spy in the English court and driving the back roads of Gloucester County looking for clues to its location. Even before hearing of Ripley's finds, Turner's search had led him to her long driveway, but he had never found anyone home. When he saw her artifacts, he was convinced they came from the place where Powhatan ruled. For one thing, Smith had described Werowocomoco as situated on a shallow bay along the York River and bounded by three creeks within a mile of each other. "Everything fits-there's no [other] place where it all comes together," Turner says as we stand on the Ripleys' pier surveying the creeks and river. "This is Werowocomoco."

With the blessing of Lynn Ripley and her husband, Bob, Turner and other archaeologists set out in 2003 to uncover Powhatan's town. They examined 20 small copper pieces, a cache larger than any ever found at a Native site in Virginia. The chemical signature of the copper matched that traded by Jamestown settlers between 1607 and 1609. Other metal items and glass beads found at the site also dated to the Jamestown era, as did at least one building. But most surprising were the faint remains of two great parallel ditches, each longer than two football fields. On the 1608 map made by Don Pedro de Zuniga-the Spanish ambassador to England and a spy for King Philip III - is an odd double "D" shape at the site marked as Werowocomoco. The marking had been dismissed by many scholars as a misprint, but the archaeologists argue that it described the ditches, with the long stretches visible today forming the straight edges of the "Ds," which then curved in an arc following nearby creeks. The ditches may have set off religious or ritual spaces from day-to-day activity. Radiocarbon analysis revealed that they were created in the 13th century-predating Jamestown by some 400 years.

Since historians long assumed that Powhatan founded Werowocomoco, the age of the ditches astonished archaeologists- and changed their understanding of Algonquian culture. They now believe that Powhatan, who came from a village to the west, placed his capital at what was already an ancient settlement. Walking with me to the river's edge, Martin Gallivan, an archaeologist at nearby William and Mary College, points out the spots-now green with new grass- where excavations first revealed an occupation centuries before Powhatan. "This was a big village," he says, encompassing 45 acres. He estimates that hundreds of people may have lived here, working the fields and orchards that the digs show existed just inland.

On his 1608 visit, Smith and his men walked through the village and the fields, and then into the chief's impressive residence. We know this because the explorer, with his eye for detail even in a moment of extreme tension, noted in his journal that the distance from the shore to Powhatan's longhouse was "some thirtie score." Accounting for erosion of the shoreline, Gallivan walked off about 1,500 feet-and found himself standing just inside the sacred area. David Brown, a William and Mary graduate student working with Gallivan, is trying to make sense of a jigsaw puzzle of building post molds found in a large trench dug by the archaeologists. One of them has been radiocarbon dated to 1600. "We may have a structure here that is roughly 15 feet by 45 feet," he says. Its large size, its location within the ditches and the shards of fine pottery and a fragment of copper found here hint that the building was part of Powhatan's royal compound, though neither Brown nor Gallivan will go so far as to say this is the place where Smith met Powhatan and Pocahontas.

Smith and Powhatan parted friends after their winter meeting in 1608, but soon the two peoples would be locked in a spiral of violence that doomed Werowocomoco and ultimately Powhatan's

entire empire. Though he lived until 1618, the chief's power would decline steadily. Oddly, the abandoned but fertile fields and orchards around the village do not seem to have immediately drawn English settlers. Perhaps a few Algonquians continued to live there or returned to bury their dead. "Or it may be a case of bad juju," Brown says, speculating that whites might have been reluctant to inhabit an area once occupied by those they regarded as devil-worshipping savages.

Now, four centuries later, two of the archaeologists working at the site are Virginia Indians, several Native Americans have constructed a traditional house of saplings for education purposes, and a council of Virginia tribes keeps a close eye on the project to ensure proper treatment of any human remains. As Americans celebrate the 400th anniversary of the first permanent English settlement next month, it's a good time to remember that earlier Americans had built a nearby village twice as old.

DNA traces Aboriginal Australian history

Anna Salleh, ABC Science Online

Scientists are still arguing about how modern humans first arrived in Australia. Aboriginal Australians are descended from the same modern human ancestors who left Africa to populate other parts of the world, says a new genetic study. The study supports the Out of Africa theory about the dispersal of modern humans, but scientists disagree over how many entry points people used to reach Australia.

Georgi Hudjashov, of Tartu University in Estonia, and colleagues report their study online (May 8th) in the Proceedings of the National Academy of Sciences. The team analysed samples of Y chromosome and mitochondrial DNA, previously collected from Aboriginal Australian and Melanesian people. "All these lineages trace back to the same Out of Africa migration," says co-author Dr Toomas Kivisild, an evolutionary geneticist at the UK's University of Cambridge.

The researchers say modern humans dispersed from Africa somewhere between 50,000 and 70,000 years ago, travelled along the coast of India and down through Southeast Asia before splitting off into Papua New Guinea and Australia. "Australia would have been settled by only one migration," says Kivisild. "This is the hypothesis that we see is most consistent with the data."

The study provides further support for the Out of Africa model, in which a single wave of modern humans fanned out from Africa, replacing early humans as they went. And it counters the alternative 'regional continuity' model that suggests there was more complex interbreeding among humans, who had evolved in different parts of the world.

According to this model, there were multiple waves of migration to Australia, which helps explain the diversity in appearance of Aboriginal communities today.

One entry point?

Dr Sheila van Holst Pellekaan, an Australian molecular anthropologist from the University of New South Wales, agrees that genetic evidence supports the Out of Africa theory for modern humans. Samples of her collection of human DNA were used in the analysis. But she disagrees with the conclusion that modern humans only entered Australia at one point. "They've been a bit selective in their conclusion," says van Holst Pellekaan. "Their data does not exclude the possibility of people having come down from a more northern route and across different island crossings."

Kivisild says there are not enough samples from Australia, New Guinea and Indonesia to be able to identify more than one entry point. "Given the data that is available now, it seems there was one major migration," he says. Debate continues on the merits of the regional continuity model, even among geneticists. "Unless DNA signatures from early humans are discovered in modern humans, this debate is likely to continue," says van Holst Pellekaan.



Scientists are still arguing about how modern humans first arrived in Australia (Image: NASA)

Inca Leapt Canyons With Fiber Bridges

MIT Students Plan to Stretch 60-Foot-Long Fiber Bridge Between Campus Buildings

By John Noble Wilford, THE NEW YORK TIMES

CAMBRIDGE, Mass.—Conquistadors from Spain came, they saw, and they were astonished. They had never seen anything in Europe like the bridges of Peru. Chroniclers wrote that the Spanish soldiers stood in awe and fear before the spans of braided fiber cables suspended across deep gorges in the Andes, narrow walkways sagging and swaying and looking so frail. Yet the suspension bridges were familiar and vital links in the vast empire of the Inca, as they had been to Andean cultures for hundreds of years before the arrival of the Spanish in 1532. The people had not developed the stone arch or wheeled vehicles, but they were accomplished in the use of natural fibers for textiles, boats, sling weapons and even keeping inventories by a prewriting system of knots.

So bridges made of fiber ropes, some as thick as a man's torso, were the technological solution to the problem of road building in rugged terrain. By some estimates, at least 200 such suspension bridges spanned river gorges in the 6th century. One of the last of these, over the Apurimac River, inspired Thornton Wilder's novel "The Bridge of San Luis Rey." Although scholars have studied the Inca road system's importance in forging and controlling the pre-Columbian empire, John A. Ochsendorf of the Massachusetts Institute of Technology here said, "Historians and archaeologists have neglected the role of bridges."

Ochsendorf's research on Inca suspension bridges, begun while he was an undergraduate at Cornell University, illustrates an engineering university's approach to archaeology, combining materials science and experimentation with the traditional fieldwork of observing and dating artifacts. Other universities conduct research in archaeological materials, but it has long been a specialty at MIT. Students here are introduced to the multidisciplinary investigation of ancient technologies as applied in transforming resources into cultural hallmarks from household pottery to grand pyramids. In a course called "materials in human experience," students are making a 60-foot-long fiber bridge in the Peruvian style. On Saturday, they plan to stretch the bridge across a dry basin between two campus buildings.

In recent years, MIT archaeologists and scientists have joined forces in studies of early Peruvian ceramics, balsa rafts, and metal alloys; Egyptian glass and Roman concrete; and also the casting of bronze bells in Mexico. They discovered that Ecuadoreans, traveling by sea, introduced metallurgy to western Mexico. They even found how Mexicans added bits of morning-glory plants, which contain sulfur, in processing natural rubber into bouncing balls. "Mexicans discovered vulcanization 3,500 years before Goodyear," said Dorothy Hosler, an MIT professor of archaeology and ancient technology. "The Spanish had never seen anything that bounced like the rubber balls of Mexico." Heather Lechtman, an archaeologist of ancient technology who helped develop the MIT program, said that in learning "how objects were made, what they were made of and how they were used, we see people making decisions at various stages, and the choices involve engineering as well as culture. From this perspective, she said, the choices are not always based only on what works well, but also are guided by ideological and aesthetic criteria. In the casting of early Mexican bells, attention was given to their ringing tone and their color; an unusually large amount of arsenic was added to copper to make the bronze shine like silver. "If people use materials in different ways in different societies, that tells you something about those people," Lechtman said. In the case of the Peruvian bridges, the builders relied on a technology well suited to the problem and their resources.

The Spanish themselves demonstrated how appropriate the Peruvian technique was.

Ochsendorf, a specialist in early architecture and engineering, said the colonial government tried many times to erect European arch bridges across the canyons, and each attempt ended in fiasco until iron and steel were applied to bridge building. The Peruvians, knowing nothing of the arch or iron metallurgy, instead relied on what they knew best, fibers from cotton, grasses, and saplings, and llama and alpaca wool. The Inca suspension bridges achieved clear spans of at least 150 feet, probably much greater. This was a longer span than any European masonry bridges at the time. The longest Roman bridge in Spain had a maximum span between supports of 95 feet. And none of these European bridges had to stretch across deep canyons. The

Peruvians apparently invented their fiber bridges independently of outside influences, Ochsendorf said, but these bridges were neither the first of their kind in the world nor the inspiration for the modern suspension bridge like the George Washington and Verrazano-Narrows Bridges in New York and the Golden Gate in San Francisco.

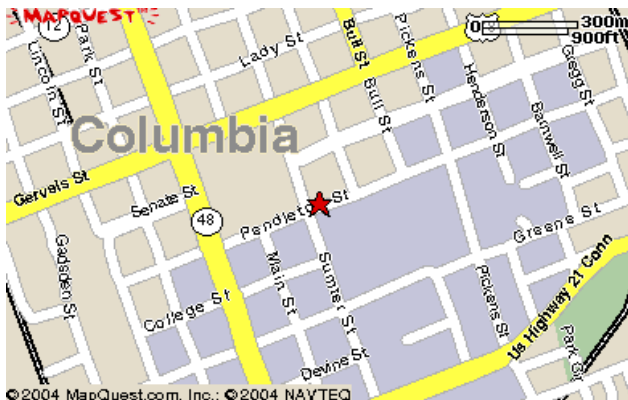
In a recent research paper, Ochsendorf wrote: "The Inca were the only ancient American civilization to develop suspension bridges. Similar bridges existed in other mountainous regions of the world, most notably in the Himalayas and in ancient China, where iron chain suspension bridges existed in the 3rd century B.C." The first of the modern versions was erected in Britain in the late 18th century, the beginning of the Industrial Revolution. The longest one today connects two islands in Japan, with a span of more than 6,000 feet from tower to supporting tower. These bridges are really "hanging roadways," Ochsendorf said, to provide a fairly level surface for wheeled traffic. In his authoritative 1984 book, "The Inka Road System," John Hyslop, who was an official of the Institute of Andean Research and associated with the American Museum of Natural History, compiled descriptions of the Inca bridges recorded by early travelers. Garcilasco de la Vega, in 1604, reported on the cable-making techniques. The fibers, he wrote, were braided into ropes of the length necessary for the bridge. Three of these ropes were woven together to make a larger rope, and three of them were again braided to make a still larger rope, and so on. The thick cables were pulled across the river with small ropes and attached to stone abutments on each side.

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The red star marks the location of the May 17th (7:00 P.M.) Midlands Chapter meeting (SCIAA) 1321 Pendleton Street

