MAMMOTH TRUMPET

Volume 3, Number 4
October, 1987

Center for the Study of Early Man
495 College Ave. Orono, Maine 04473

University of Maine
ISSN #8755-6898

BLOOD FROM A STONE

The public has always been amused at the scientist's willingness to devote himself to details that seem trival to common sense. At their first meeting, Sherlock Holmes asked Watson whether he has read his monograph on the different varieties of cigar ash. Aristophanes, tongue in cheek, portrays the Greek scientific philosophers measuring how far a flea can broadjump and arguing which end of a gnat emits its noise. In **Gulliver's Travels,** Swift satirizes the Royal Society for examining under the microscope substances that a gentleman should not be willing even to mention in polite society. Yet the public has come to recognize that the scientific researcher, like the detective, can sometimes—if he or she is patient enough, lucky enough—make startling inferences from the *most insignificant*-seeming of clues.

Since 1980, Tom Loy of British Columbia has been looking at the blood residue that has often been left, he has discovered, upon prehistoric stone tools. The analysis "was intended to be part of a dissertation that never quite made it," in his phrase, because what he began to discover was "eminently more interesting." For Loy, working entirely alone, without students or assistants, has developed a technique for crystallizing the hemoglobin in blood scraped off of knives and projectile points by dissolving the residue in a solution of various salts and other chemicals. As the solution dries, the hemoglobin forms crystals that vary according to the species of animal it derived from.

In other words, Loy can not only ascertain that a certain implement was employed to kill or carve, but he can tell what species of animal it was used upon. Furthermore, by measuring differences in the blood's oxygen isotopes, he can sometimes pinpoint which drainage basin the animal lived in; with a mass spectrometer he can say something about the mean annual temperature during the month the animal died. Holmes himself could do no better, and indeed his successors, the forensic specialists, are becomeing interested in Loy's methods as archaeologists and anthropologists are.

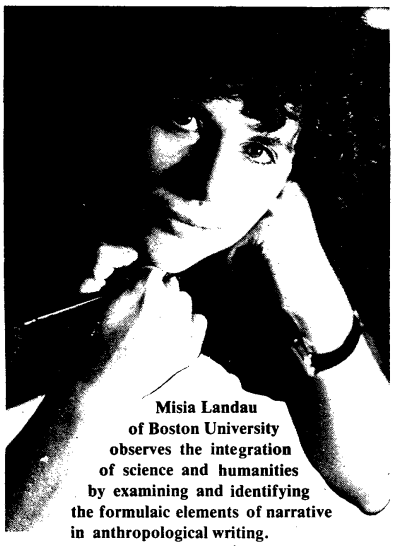
But how is it possible for blood protein to resist water and bacteria for 1000 years, not to mention surviving the process of cleaning? Loy explains: "As the blood comes out and gets onto the tool" when an animal is killed or butchered, "chemical reactions in the blood initiate clotting: at the same time, the blood begins to dry immediately. Anybody who's actually butchered with stone tools knows that the blood starts out being very slippery, but pretty soon your fingers begin to stick together and you can't peel your hands off the tool. That's both from the drying and a certain amount of the clotting process. But the blood doesn't clot all the way, because it runs out of the mediating chemicals.

Tom Loy of the Australian National University reaches into the past with his innovative method for examining and identifying blood residue on prehistoric stone tools.

"What's happening is that the serum albumin molecule, the major constituent of the colorless part of the blood, is very sensitive to changes in its environ-

(Continued on page 3)

TRUTH - NO STRANGER TO FICTION



Misia Landau of Boston University observes the integration of science and humanities by examining and identifying the formulaic elements of narrative in anthropological writing.

"I think it was always the imaginative aspect of paleoanthropology that drew me in, and the almost *un*imaginable aspects of human evolution that I found so compelling: the idea that we once really were different kinds of creatures was something that captured my imagination even as a child," speculates Misia Landau.

Landau is a physical anthropologist and Assistant Professor at Boston University. Recently, in a series of articles and lectures (see suggested readings), she has put forth an idea that has captured the interest of fellow anthropologists as well as of those who study the history and philosophy of science. The idea? . . . that scientists are storytellers to a much greater degree than they have imagined. In particular, when formulating theories of human evolution, paleoanthropologists have not only had recourse to such storytelling devices as analogy and metaphor, but also to various narrative patterns—above all the story of the hero as it appears in myth, folktale, and literature.

An example can be drawn from a paper concerning *Australopithecus afarensis,* who is therein described as "very close to what can be called a 'missing link.' It possesses a combination of traits entirely appropriate for an animal that had traveled well down the road toward full-time bipedality, but which had retained structural features that enabled it to use the trees efficiently for feeding, resting, sleeping or escape" (Stern and Sussman 1983). Here we not only have a metaphor with powerful historical associations, the "missing link," but something else as well. In her article "Human Evolution: The View from Saturn," (Landau 1985) Landau observes: "When these authors say that '*A. afarensis* had travelled well down the road toward full-time bipedality,' not only do they speak in metaphor, they also tell a story."

A story. And a very traditional story at that—indeed, one of the oldest in the world, that of an adventurous journey, an odyssey, perhaps even a quest. Behind the foreground discussion of locomotor apparatus, a reader sensitive to such things can discern the dim outlines of a literary shape. Not only has *A afarensis* been fitted into the *theory* of evolution, but the latter has been assimilated to a traditional *story* type in which a hero strikes out upon a new path, has many adventures, and in the end succeeds in transcending his humble origins.

In her early exploration of paleoanthropological literature, Landau was sensitive to such connections. But the scratch on the glass, so to speak, was Vladimir Propp's classic study, **Morphology of the Folktale** (1928).

Propp worked in the context of a Russian literary movement known as formalism, akin to what later became structuralism. His central insight was that folktales that seemed quite different on the surface

(Continued on page 5)

INSIDE . . . .

CENTER NEWS

CURRENT RESEARCH IS IN. ARE YOU?

Current Research in the Pleistocene has really taken off! The phenomenal growth of this groundbreaking publication in its brief four-year history is certainly satisfying to us here at the Center. It is an impressive demonstration of the growing interest in the earliest peopling of the Americas and related topics in the Quaternary sciences. This year's issue will include 74 papers from around the globe; *almost 50% more than a year ago.* We are glad so many people find it worthwhile to participate in this journal, both as writers and as readers.

This increase has not been without growing pains, however. Every additional paper we print has multiplied the time and expense of getting the volume from us to you. We have realized that this issue is as large a publication as we can manage and still stick to our stated goals of quick turn-around of 'current research' and an affordable price. As it is, the unforseen delays attendant to the larger volume this year have pushed our delivery date into October. We apologize to you for this, and are adopting new guidelines to keep **CRP** on track for future issues.

The new guidelines for contributors to **CRP** are directed at the two specific goals: limiting the journal to its current size, and speeding up the turn-around time. Starting with volume 5 (1988) absolutely no late papers will be accepted; the editor must recieve all papers in Flagstaff, AZ (not Orono, ME) no later than January 31, 1988. No more than 65 unsolicited papers for the regular sections and 5 solicited papers for the Special Focus section will be accepted for each issue. Each contributor will have no more than two papers published in any issue, and only one paper as senior author. Time being of the essence, the earlier a paper is received, the better its chance of being published in the next issue. If you plan to submit to **CRP**, please request a printed copy of the Call for Papers from the Center for the Study of Early Man if you do not regularly receive one.

And, yes, now the bad news. We have increased the price of **CRP** this year from $12.00 to $17.00 for individual subscribers and from $15.00 to $20.00 for institutions. This is necessary to pay for the increased costs associated with producing and distributing a larger issue of **CRP**. We will, of course, honor any prepaid orders at the previous price received before September 15, 1987.

We hope you think the increased size of the journal is worth paying for. If you would like to insure receiving future issues of **CRP** at this price, please consider subscribing for up to three years at the current price when you order this year's issue. You can order **CRP** by using the order form inserted in this paper or simply sending us the subscription cost and your name and correct address. As another timely publication frequently says: "Subscribing to our principles is not enough."

GLOSSARY

Amino Acid An organic compound consisting of an acidic carboxyl group and a basic amino group. Amino acids are the building blocks of proteins.

Breeding Population A group of organisms sharing a common gene pool.

Cellulose A complex polysarccharide. The principal structural material of plants.

Diatom A type of microscopic algae occurring in fresh or salt water. This organism is an important part of the aquatic food web when living; when dead it forms fine, abrasive deposits known as diatomite.

Gene Pool The total genetic information of a population.

Geographic Isolates A population geographically separated from other populations of the same species.

Hemoglobin An iron-containing protein pigment in vertebrates which carries oxygen.

Hermeneutics Originally related to Biblical interpretation; now a linguistic and philosophic theory of perception and understanding, with an emphasis on the role of context.

Isotope Atoms of the same element having different masses due to a variation in the number of neutrons.

Mass Spectrometer An instrument which uses electric and magnetic fields to separate and identify atoms of different masses.

Nanogram A unit of mass equal to one billionth of a gram.

Neutral Substitution A change in genetic material which does not alter the organisms adaptability.

Paleoanthropology A branch of anthropology concerned with fossil humans.

Polymer A large chemical compound of repeating subunits formed by condensation or a similar reaction.

Precipitate Out of Solution After a solution reaches its saturation point, material dissolved in it will form a solid and fall out of solution, often as crystals.

Random Mutation A spontaneously occurring change in the structure of a gene; the driving force of evolution.

Structuralism A theory of linguistics and anthropology which explores the formulaic aspect of phenomena, especially folk narrative.

FIRST ALBERTANS PROJECT

The Archaeological Survey of Alberta is undertaking an important effort. The Director, Dr. John W. Ives, has recently informed the Center that: "1987 marks the first year of a proposed five-year project dealing with the initial people of Alberta. As you know, Alberta at one time was the location for the most part of what has come to be known as the "Ice-Free Corridor," and North American archaeology stands to gain a tremendous amount by a concerted effort to investigate late Pleistocene-Early Holocene occupations in this area. Thus this year crews will be surveying in the Upper North Saskatchewan River and Grande Prairie regions, in a search for archaeological materials in the 12,000 BP to 10,000 BP range. At the same time, a crew will be undertaking an initial assessment of the Fletcher site, a Cody Complex bison kill site in the southeast part of the province. The research at Fletcher this year will attempt to delineate the site boundaries and address some logistic difficulties such as groundwater seepage, and mineral contamination of bone deposits.

"In a most promising opportunity, the Archaeological Survey of Alberta has initiated a scientific exchange with Heilongjiang Province of northern China. The aim of this exchange is to provide assistance with archaeological research regarding sites in this province of China with remains which appear to date between 25,000 BP and 12,000 BP. During the month of May 1987 myself and Alwynne Beaudoin, Paleoenvironmental Researcher with Archaeological Survey of Alberta, spent three weeks touring various sites in Heilongjiang, meeting researchers and viewing collections. We are currently planning a return visit by members of the Provincial Relics Committee which will involve the Chinese researchers in our First Albertans Project."

Dr. Ives will strive to keep the Center posted on the results of these investigations, which will be passed along to **Mammoth Trumpet** readers.

SUGGESTED READINGS

On Truth - No Stranger to Fiction

Stern, J., and R. Sussman 1983 The Locomotor Apparatus of *Australopithecus afarensis.* **American Journal of Physical Anthropology** 60(3):279-317.

Landau, Misia 1985 Human Evolution: The View from Saturn. In **The Search for Extraterrestrial Life**, edited by M. Papagiannis, pp. 213-221. Reidel.

Landau, Misia 1984 Human Evolution as Narrative. **American Scientist** 72:2662-268.

Landau, Misia 1987 Paradise Lost: The Theme of Terrestriality in Human Evolution. In **Rhetoric of Inquiry: Language and Argument in the Sciences and Humanities**, edited by J. Nelson, University of Wisconsin, in press.

On the Blood from a Stone: Interview with Tom Loy

Loy, Tom 1983 Prehistoric Blood Residues: Detection on Tool Surfaces and Identification of Species of Origin. **Science** 220:1269-1270.

CORRECTIONS AND BRIEF COMMENTS

OOPS . . . Due to an inadvertent editing error, the paragraph describing Tom Lynch's talk at "The Human Story" conference in Orono last February did not properly reflect what he said. The paragraph should have read:

Dr. Thomas Lynch from Cornell University then took the podium and firmly restated his belief that human beings will not prove to have been present in the Americas before about 15,000 years ago. In Brazil, for instance, he thinks that the dates of more than 30,000 years are not in true association with the elaborate cave art and indubitable tools made on flinty rocks. The quartz and quartzite "artifacts" attributed to an earlier stage may not be human artifacts. Likewise, he questioned the reality and associations of artifacts with very early, pre-Paleoindian dates at Monte Verde, Chile. Challenging even pre-Clovis human occupation in North America, he reviewed problems with the claim of 19,000 to 13,000 years for the lowest levels of Meadowcroft Rockshelter in Pennsylvania. "The fauna and flora are modern, lack extinct species, and are appropriate to the late Paleoindian or early Archaic appearance of the stone tools," he said. Layers of coal in the cave walls probably contaminated the ground water and samples from the lower strata with fine particles of ancient coal. Lynch called for testing the ground water near Meadowcroft, to see if it contains colloidally suspended coal that might have been slowly and progressively caught up by the charcoal samples acting as filters.

MAMMOTH TRUMPET

The Mammoth Trumpet (ISSN #8755-6898) is published quarterly by the Center for the Study of Early Man, University of Maine, 495 College Ave., Orono, ME 04473.

POSTMASTER: Send address changes to **Mammoth Trumpet**, 495 College Ave., Orono, ME 04473.

Robson Bonnichsen	Director General Editor
Marcella H. Sorg	Associate Director **Mammoth Trumpet** Editor
Jim I. Mead	**Current Research in the Pleistocene** Editor
Karen Hudgins	Executive Secretary
Judith R. Cooper	Publications Manager Art and Design
Barbara Harrity	Circulation Manager

The Center for the Study of Early Man is a non-profit organization. Subscription to the **Mammoth Trumpet** is by membership in the Center. Regular membership $9 (10 foreign), Contributing membership $25, Sustaining membership $50, Patron $100, Lifetime membership $1500, Institutional membership $10.

BLOOD FROM A STONE

(Continued from page 1)

ment. As the blood loses water vapor and the concentration of salt in the blood increases, the serum albumin sort of gives up the ghost. Normally a molecule made up of a long chain of amino acids bound into a roughly spherical shape, it falls apart into a long strand of amino acids. As it unravels, it comes into contact with other serum albumin molecules which are also in the process of coming apart. Often there is a kind of unorganized rebonding taking place. As the drying process continues, this whole interlinked network of serum albumin molecules begins to look like an unwashed pan of glued-together spaghetti."

Once the molecule is torn apart, binding sites become available that once had bound the molecule to itself, and these attach the "molecular spaghetti" to the surface of the stone tool. "So the thing is firmly anchored on the bottom," Loy continues, "and is intertwined going up to the top of the layer. Then, when the tool is abandoned, the soil rehydrates the surface layer to a degree. Dust, clay, and soil particles impinge on the surface of the polymer; because they too have reactive surfaces, they also bind with the exposed binding sites. So you have a kind of sandwich," soil above and tool beneath, with the blood protein preserved in between. "The bonding between the albumin and the soil particles is strong enough so that most bacteria don't have the energy to break those bonds in order to attack the proteins." Decay is thereby prevented; for normal decay is merely a continuation of what goes on regularly while the body is alive: the resident bacteria that do away with old blood cells and the like simply keep going when the entire body dies. But on the stone tool, the protective layer of soil keeps that from happening.

Initially Loy was able to use high magnification to do only rough identification: "It was possible to go through and screen a whole collection of tools and pick out those that had been used cutting meat and those used cutting roots and other things. I felt that I had some way of distinguishing at least the gross functions of tools. I spent quite a long time investigating various stains that would identify different classes of materials: for example, ones that could tell cellulose from other proteins or blood from cellulose. Normal biological stains are not that discriminating."

From there, Loy was led to seek methods for making subtler distinctions, not only between blood and other materials but between various kinds of blood. He says, "On a few tools, I found fragments of hair; you could still see the scale pattern of it. I phoned a researcher in the Fish and Wildlike Department and asked whether they had a collection of hair that I could photograph" to use for comparison. By chance, the woman who brought the collection included with it a pamphlet put out by the San Diego Zoo describing a technique for crystallizing hemoglobin in order to identify the species of animal from which it came: each species produces its own distinctively-shaped crystal.

"So I got in contact with the authors and went down to the University of California at Davis," Loy says. "One of the authors, Dr. Robert Washino, was an entomologist. He had been using this tehcnique to study the detectors for equine encephalitis . . . so he was crystalizing mosquitoes full of hemoglobin." Loy combined Washino's techniques with those he recovered from an old book published in 1909. Reichert and Brown, the book's authors, had to wait 70 years for their study of hemoglobin crystallization to acquire a new use. Loy compared their black-and-white photographs of over 100 species of crystals with a similar-sized catalogue published by Washino in 1976, and began trying to crystallize residue, at first off of tools that he had used himself, so that he knew what species he was looking for.

So began "what turned into almost 2½ years of chasing down blind alleys," as Loy puts it. "The main problem I was contending with was very small sample size, in terms of the amount of protein I could routinely crystallize: in the area of a nanogram of protein . . . . What I had to do was find the most useful series of chemicals, salt concentrations, etc., that would precipitate each different species. For each animal's hemoglobin, there would be an optimum solution for crystallizing the most material."

How does one pinpoint that optimum? Patiently, my dear Watson. After adding a series of salts and other chemicals to each sample, Loy "would slightly warm the slide and begin evaporating the solution to increase concentration, then apply a cover slip under which the sample would eventually crystallize." "Eventually" turned out to be a radically varying period of time for different species. Says Loy, "Some animals' hemoglobin is only slightly affected by the chemicals, so it either doesn't form many crystals or takes a very long time to form them. For example, the hemoglobin from buffleheaded duck crystallizes almost the second you put the final solution on the microscope; you have to look at it really fast because the crystals are gone within 10 minutes. On the other hand, with caribou, to get the final crystalline solution takes upwards of 3 days."

"There are approximately 600 amino acids in each of 4 chains that are bent, distorted, and arranged to make the roughly globular or spherical hemoglobin molecule. In the case of hemoglobin—or any other such molecule—there are certain amino acids that have to be in just the right spot to make a certain kind of bend or to hook onto another molecule at a particular location. If they aren't there, either the molecule can't assemble itself properly, or it simply doesn't function. But there are also a large number or silent of neutral amino acids that are merely there as spacers; you can substitute one for the other and it won't do anything much to the molecule." And in fact such substitutions do occur as a result of random mutation. "There are beneficial mutations and lethal ones, which are generally not carried in the gene pool for very long. But in this case there is a whole series of neutral substitutions, neither particularly good nor particularly bad.

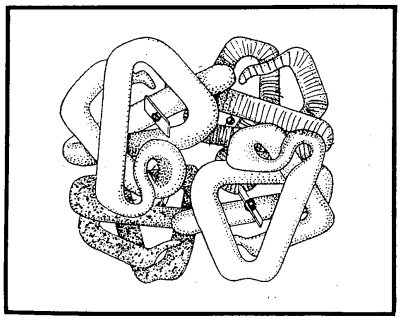
So you have a kind of sandwich, soil above and tool beneath, with the blood protein preserved in between.

"It's this that affects both the actual formation and the development of the crystal, because each animo acid carries with it a slightly different electrical charge, a chemical charge surrounding it and possessing a distinctive shape. As you have different substitutions, they may be genetically neutral, but they *do* affect the actual distribution of electrochemical charge around the molecule. And that *does* affect its shape to a certain extent.

This is one pot that will never boil unless it *is* watched carefully, and even then, it is a slow business. According to Loy, "It's possible to analyze as many as 25 samples in a very long day. But if you're going to do a series of samples you have to be overlapping. What you have to do is go through and monitor all the slides on a regular basis; once very 20 minutes you have to go back and look at them all again. So it's a matter of keeping track." And there are other drawbacks and complications. First of all, conditions must be precisely monitored: open your windows on a hot, humid, day, and the change in temperature and moisture content may prevent crystals from growing.

Second, artifacts are highly portable: Loy notes that "Just because you may have found one or two artifacts with sheep's blood on them doesn't necessarily mean that sheep were in the immediate area."

Third, there is a need for an extensive catalogue of reference samples. "I often look at a crystal," Loy says, "and say, 'Oh, that resembles the crystal preference for the deer family, or for all sheep.' But if you *don't* recognize it, you can't identify an unknown crystal unless you've got one like it in a reference collection." On top of that, some of the buffer salts produce crystals of their own, so that the analyst also needs a vast catalogue showing what non-hemoglobin crystals look like; this can take years to accumulate. One obvious way to deal with this problem is a centralized collection available to the whole community of researchers. The Australian Museum in Sidney wants to set up a national reference sample collection there, which in time could quite easily become international.



Schematic drawing shows the 4 chains that make up a hemoglobin molecule. The shape is determined by the arrangement of amino acids on the chains, each pattern being the "fingerprint" of a particular animal species.

Fourth, even with a reference catalogue there is, Loy points out, "a certain amount of interpretation involved," and the interpretive skills may take years of practice to develop. Loy himself has only managed to train a couple of people. Andre Wood at the Oriental Institute and Winston Tennant, who works with a consulting group in Silver City, Nevada, will be the only ones whom Loy knows of to be doing such analysis in North America after he departs; he understands that there are others, but he has not heard of them directly. Indeed, one of his future aspirations is to "get anybody who's ever tried this or is interested in it together for a symposium somewhere and try to give them some encouragement."

For the study of early humans, Loy hopes that hemoglobin crystallization will offer advantages to outweigh its disadvantages of tedium and time. It may help to clinch the identification of dubious early sites by proving that a certain piece of stone is not just an eolith but a stone tool with blood on it. It may help to identify fauna, as Loy recently did at a site on the Olympic Peninsula of Washington State, where he was able to establish not only the former presence of a type of fish, the *Ammodytes hexatteous* (sandlance), unmentioned in any documentation of recoveries, but its use as a food resource in prehistoric times. This type of information can considerably alter our picture of early human economics and life style.

Blood crystal analysis may even shed light—or at least heat!—on the much-debated question of mammalian extinctions in the late Pleistocene. "What we're looking at in terms of extinctions of mammoth, I think, is not some widespread, singleminded pursuit of mammoth by fluted-point users, but a process of hunting a whole range of animals simultaneously, *one* of which happens to be the mammoth. In that sense, man could seem to be an agent in extinction, but not solely—I would say he made very little difference, really," muses Loy.

Incidentally, the subject of mammoth points to another complication in the analysis of crystallized hemoglobin: namely how do you recognize the crystal pattern for extinct mammals? Loy is in the middle of working with dessicated tissue to figure out what mammoth crystals look like, as well as those of extinct bison. As for the former, he has not done his own comparison studies of elephant hemoglobin, but older photographs published by others look quite different from those of the crystals he has produced from mammoth.

Loy remarks of his method that, "It appears to be most sensitive at the level of species. There are in fact local family and territorial differences from somewhat isolated breeding populations: in themselves, they're not species or even sub-species, just geographic isolates. In the human population, for example, there are something like 300 different variants of hemolobin that all reflect local breeding populations. The interesting thing is that for animals, at any rate, and for the humans I've looked at, it's the species level that's

(Continued on page 8)

Dennis Stanford at Blackwater Draw

TASTING A HERO SANDWICH

The archaeological significance of the Blackwater Draw site, near the eastern border of New Mexico, has been recognized for over half a century. It was here that E.B. Howard in the 1930s distinguished what is still the continent's oldest documented and undisputed layer of habitation, the level of Paleoindian culture known as Clovis. After decades of investigation, Blackwater Draw continues to yield new information, as recent excavations in 1983 and 1984 by Dennis Stanford and Vance Haynes, among others, demonstrate. Last issue, Vance Haynes discussed the geological and stratigraphic aspects of the site, along with a little of its history. In the following, Dennis Stanford of the Smithsonian Institution, reflects on the potential for ongoing archaeological research at this important site.

For those who need to refresh their memories since our previous issue, the Blackwater Draw Locality #1 was a spring-fed pond during the late Pleistocene. This pond would periodically overflow to the south into an outlet channel that ultimately carried the water into Blackwater Draw proper. Much of the time, Stanford imagines, "it was marshy all the way down the overflow channel. Of course, it would attract many animals." For while there were lots of ponds in the area, most were pretty saline; "this was cool spring water. And everything under the sun would come in for it, including mammoth." And people. In successive waves, cultural groups such as Clovis, Folsom, Cody, Agate Basin, and others came for water and to hunt the animals that gathered there.

So the Draw became both a kill site and a primary preparation site; bones of bison and mammoth are strewn about by the thousands, many in association with stone artifacts. What makes it unique, however, is the way these remains are deposited in clear stratigraphic sequence. "From time to time, shifting sand dunes would blow over the overflow channel and leave a layer of sand. As the pond built up over the new sand, a new level of diatomite would form," Stanford observes. Diatomite is earth composed of the remains of diatoms (microscopic, single-celled plants which grow in marine or fresh water) and pond algae. "Then sand, then diatomaceous earth, then sand—gorgeous stratigraphy!"

One of the special features at Blackwater Draw is its great hero sandwich of cultural levels piled one atop the other.

It was the stratigraphic separation between Clovis and Folsom levels at the Draw which enabled E.B. Howard to distinguish them, and to learn that Clovis was indeed older than Folsom. Up to that time, Clovis had been regarded as a contemporary variant of the Folsom culture.

Between the early excavations by Howard and the recent ones by Haynes, Stanford, and others, there was a chaotic middle period in the 50s and early 60s in which the site resembled some sort of parody of the Darwinian competitive struggle for existence. Archeologists competed with bulldozer operators working for a gravel-mining business; the bulldozers, like mechanical saurians, plowed bones under; one of the operators claimed to have bulldozed over a human skeleton. At a crucial site, where human skeletal remains have yet to be found, this is like lighting one's pipe with the Declaration of Independence. To make matters worse, the scientists appear to have been possessed by their own version of the territorial imperative. Stanford says, "You have to remember that there were in the neighborhood of 17 institutions that worked out there over the years, many of them at the same time. Sam Sanders, who owned the mining operation and the property itself, tried to accommodate all the archeologists as best he could; but finally decided to allow only the local university to work there.

Dennis Stanford of the Smithsonian Institution talks with Center Director Rob Bonnichsen on a recent visit to the University of Maine.

Then in the 1960s, Sanders retired and sold the site to that university, Eastern New Mexico University, or to the state of New Mexico, to be more exact. George Agogino became the curator of the site. "In the 1960s, they decided the site had been pretty much destroyed, except for a small amount left on the south wall," Stanford says. "We knew there were some cultural remains left on the south wall, but we didn't know the extent, and that was the main thing we wanted to determine: how much of the site was still there? That's when I got involved . . . Vance, George, and I decided we ought to core it, to see if we could trace the stratigraphic horizon down the south wall. In other words, we wanted to work south from the area of earlier excavations," to explore from the south wall and the overflow channel opening down the once-marshy run into the Draw itself.

"We received funding from National Geographic Society . . . . We cross-sectioned the overflow channel from the top of the ridge across the channel to the top of the other side, drilling holes every so many feet, and the stratigraphy continued right on down the Draw," Stanford explains. "As we pulled these cores up, Vance would map the geology. We found that indeed the stratigraphic levels went a long way down the overflow channel, probably about 500 meters. In a high percentage of our core holes we found bone, in multiple levels . . . . That was in 1983. We hope to be able to get back in there someday and excavate. But the problem is that it's deep: it takes a lot of time just to excavate down through the Archaic level to get to the early material. And it's not easy: a lot of it is hard clay and silts. It's like trying to chip through concrete."

So far as the overflow channel is concerned, then, Stanford, as archaeologist, was simply to assess the archaeological potential: what work may be in it for an archaeologist lies in the future. The other project of the summer of 1983 was the full cleaning of the south wall for the first time in the history of the site, so that Haynes, as the geologist, could begin doing detailed stratigraphic sections. For this, Haynes and Stanford were joined by George Agogino and Peggi Jodry, and in the summer of 1984 by Jeff Saunders.

Disappointingly enough, the spot, though prolific of animal bone, was miserly about its artifacts. "When we cleaned up the south wall for the first time, we were finding bone deposits at various levels. We tested the upper bone deposits, which turned out to be a badly disturbed Archaic-level bison bone bed with a few flakes interspersed but no diagnostic artifacts. Then we cut down into what would have been the Cody bison bone just very briefly, as well as into the Folsom level. We found another spring conduit; with mammoth bones, but no artifacts. In sum, we found no artifacts in the Folsom, Cody, or Agate Basin bone beds! We didn't have that much time: frankly, we were doing geology, trying to pin everything down." Artifactually speaking, therefore, the 1983 and 1984 seasons were not exactly spectacular. Indeed, "After we left (of course) a Folsom point eroded out of the bone bed. But it was further up the bank from where we were excavating."

The challenge with the paucity of cultural material is to match them with their precise stratigraphic levels, to correlate geology with archaeology. This is by no means as easy as it might sound. There are seven strata, labeled A-G by Haynes. The basal unit, level A, is what Glen Evans termed "grey-white speckled sand." This is possibly pre-Clovis: intriguingly, there is no bone included in it. "No one to my knowledge," Stanford states, "has ever found whether it's cultural or not. E.B. Sellards hit it at one point, and our core hole work also hit it. I hope someday we can excavate down to that bone level and find out just exactly what it is: is it Clovis or pre-Clovis, cultural or precultural, or what?"

Levels BCDE are Paleoindian-related, and, "theoretically, the Clovis material should be in the B (called by Evans the 'brown sand wedge'), or right on top of it . . . . Why I hesitate is that there is some disagreement between the geologists working there whether Clovis is in one unit or whether it was on *top* of that unit and settled into it. We haven't resolved that question yet . . . . So Clovis sits right on top of B—or *in* the B, depending on who you listen to."

Since the **Mammoth Trumpet** interviewed Haynes last issue, the research team has received at least 20 of the 60-some radiocarbon dates collected: so that a tentative chonology is possible, linking stratigraphic levels with periods of time as follows:

B: 12,300–11,300 years
C: 10,500 years (only date so far)
D: 10,700—9,500 years
E: 10,200–8,200 years

Stanford's task is to try to link these levels with the various cultural horizons; Crystal Morris at the University of Arizona is working on the various problems of the dates for her thesis. Roughly, Folsom is in D; Portalis (a Southern Plains Cody variant) and Agate Basin in upper D and lower E. The levels above that range from early Archaic on up to ceramic material that can be found right on the surface.

"We were doing geology, trying to pin everything down."

More work needs to be done on the area before the levels can be pinned down, though. "What we need to do is open up a reasonably large area where we think the concentration is good enough that we stand a good chance of finding diagnostic artifacts. That will help us sort it out," he says. But there is no money in sight for a full-scale operation. And it is difficult for Stanford to press for funding from his post in Washington D.C. at the Smithsonian; for the money necessarily must originate from the state of New Mexico, which owns the land. The Draw site remains under the direct supervision of Eastern New Mexico State University, which for years maintained a full-time curator. But now there is only a part-time curator. The university has a spokesperson representing its needs to the state legislature; "and they've tried—believe me, they've tried," Stanford sighs wearily.

(Continued on page 8)

TRUTH - NO STRANGER TO FICTION

(Continued from page 1)

nevertheless could possess an identical underlying narrative structure. Consider, he says, the plots of the four following tales:

1. A tsar gives an eagle to a hero. The eagle carries the hero away to another kingdom.
2. An old man gives Sucenko a horse. The horse carries Sucenko away to another kingdom.
3. A sorcerer gives Ivan a little boat. The boat takes Ivan to another kingdom.
4. A princess gives Ivan a ring. Young men appearing from out of the ring carry Ivan away into another kingdom.

It is obvious that what appears here is a single narrative pattern, or *function,* as Propp called it, with empty slots into which the storyteller can plug an eagle or a horse or whatever he pleases. "Even as a starting point that was interesting to me," Landau says; because as Propp was trying to see what all folktales had in common, she was trying to see what all writings on human evolution had in common.

"I sat reading it in the Sterling Library at Yale," she remembers, "thinking: 'My God, he's not just describing what goes on in fairy tales but what goes on in what I've been reading about . . . human evolution.' I had never really focussed on the fact that it was a story that was being told; but his putting it in such explicit terms made it clear to me that, first, these writers were all storytellers, and that, second, they were all telling different versions of the same story—and that the story was a hero story."

For Propp went on to say that all folktales were formulaic: all of them could be reduced to some combination of the same 31 functions, which always occur in the same order, so that a universal narrative paradigm crystallizes around the figure of the hero.

In 1984, Landau published an article called "Human Evolution as Narrative." Its most striking feature is a series of matrix diagrams. The first shows schematically how the narratives of early 20th-century paleoanthropologists utilize four major episodes: bipedalism, brain and language development, terrestriality (the move from the trees to the ground), and civilization (the development of technology, morals, and society). Because of differences in the order in which these four episodes occur, the theories seem quite different from each other.

However, in a second diagram, Landau shows how they share an underlying narrative paradigm built out of nine functions beginning with an initial situation of equilibrium, moving through departure, journey, trials, crisis, transformation, and resolution. In these earlier writers, the resolution follows the traditional division in literature between comic and tragic plots: between those that end with the hero's success and those that end with his failure. In the former, the emphasis often falls upon a special gift, sometimes bequeathed by a mysterious or magical donor, that enables the hero to triumph; this may be a weapon or talisman, an inherent character trait, or a combination of the two. One is reminded of the arguments about whether human intelligence enabled developing toolmaking or toolmaking enabled developing human intelligence.

The effect of recognizing the story element in theory is to make theory seem less definitive and more hypothetical, less absolutely "true" and more creative and imaginative. There is no doubt that this can seem threatening and subversive in the context of orthodox science; for science itself is often conceived as a hero myth, in which the hero, with his miraculous-seeming special gift of objective reason, progresses towards a final triumph in which disputes and conflicts will wither away.

This version of the hero myth is typically male; Landau notes dryly that "The male heroes in evolutionary theories (women are often not spoken of at all) are not just essential human beings; they are also the anthropologists themselves involved in projection and identification with their subjects." She points to the fact that paleoanthropology is a largely male field—in contrast with primatology, where there are plenty of women. Although not every scientific theory can be constructed as a hero tale, the "heroic" perspective fits with the frequent characterization of the sciences as somehow "masculine" and the humanities as "feminine." "Even today," Landau says, "the reluctance to discuss 'soft' issues, the big-picture, humanistic issues, derives I think from a kind of *machismo:* to do so would not be scientific. The belief that objectivity is always a superior form of perception or knowledge," along with the concommitent preference for the unequivocal and the measurable, for a hardheadedness that rejects "soft" unmeasurable things such as values or feelings, is something that a *rapprochement* with humanistic studies may begin to call into question.

The belief that objectivity is always a superior form of perception or knowledge is something that humanistic studies may begin to call into question.

"The hero strikes out upon a new path . . ."

Paleoanthropologists seems to realize intuitively that the study of fossils is an interpretive activity, Landau states elsewhere. It is remarkable how often they describe fossils as texts, using terms like "documents," "testimony," "deciphering," "hieroglyphics," "translating," "reading," and, most of all, "fossil record." They would not all be entirely pleased, no doubt, to hear that some of the more radical versions of hermeneutics, tracing their geneaology to Nietzsche and Freud, doubt that we can ever eliminate the subjective element entirely and arrive at utterly objective, universally valid interpretations, of fossils or of anything else. Still, everyone is aware of how quaint the earlier writers now sound who, because of preconceived notions, exaggerated everything apelike and brutish about Neanderthals. "A lot of paleoanthropologists are extremely hesitant these days about telling big stories, and it's due to an awareness that human evolution is a 'soft' science. There's a self-consciousness about that and a desire to make it more objective, on the model of chemistry and physics . . . I think that there's been progress if you can conceive of progress as taking the form of stepping back and saying less about what these things actually mean."

Are we going to be reduced to silence? At times, perhaps, it may be wise to admit that there are limits beyond which science as an objective discourse cannot speak. "I try to emphasize," Landau says, "that it's precisely because there *are* versions that the theory of human evolution is scientific—unlike, say, the Biblical account. But also that many of the things that scientists have said about human evolution are unscientific because there's no way to demonstrate them, no way to figure out whether they're true or false. It doesn't actually invalidate them, but there are many things you might like to know about human evolution that cannot be known."

"I start off my course on human evolution"—Landau recently received the Metcalf Award for teaching at Boston University—"with a questionnaire that I ask my students to do before I've even introduced myself. It takes the form of two questions: What does it mean to be human? and, How did we get that way? I say: These aren't exactly the kinds of questions you're ready for in the middle of the morning. Pretend it's midnight and you're lying on a field . . ."

"And the students have to give a story. It's very interesting what they often list as human qualities: being able to love, being able to destroy ourselves, expressing emotion. (Very few of them say 'being bipedal,' for example, or 'having a big brain.') Many of these things cannot be addressed through the fossil record. To some extent they may be explored using comparative studies of primates and other animals, but many of the questions of human origin can't be answered. That is a little frustrating to them; but I try to give them some sense of that in order that they might realize something about how science works, what is within the realm of scientific inquiry and what is not. For example, when scientists come out and tell us we are aggressive because we always were and it's biologically programmed into our genes, I tell them, 'you be careful of that kind of thing, of theories like that too; because such assertions are very difficult to prove from a scientific perspective.' "

Scientists are not emotionless compilers of data; nor do they live in isolation, doing science for science's sake. "Paleoanthropologists do not just talk to other paleoanthropologists; they're asked to talk to the public, and are aware of the kinds of questions that the public wants to know about—and they themselves want to know. They've been drawn to the field for a variety of reasons, but I can't help but think that the innate fascination of the subject itself, of those big questions, is part of the appeal," Landau says. "Before a human being becomes a scientist he or she is a child and a watcher of television and a reader of fairy tales. Science and the humanities are both human activities," she says, and practitioners on both sides have been formed by the same culture. What they derive from it both deliberately and unconsciously, is not only a set of values but a set of story patterns and common metaphors.

"My point now is: storytelling is not always a bad thing. In the beginning, I wondered, and said, 'Well, maybe what we should do is get away from storytelling, to try to capture moments.' I had this idea that we should turn to landscape art, to try to depict the world of eight million years ago, rather than how it changed. Yet that's what evolution is *about,* change through time . . . One of the problems in narrative is that you're aways trying to get to the ending, so the account becomes very teleological. In writing a story, you often have a sense of the ending even before you have the beginning."

It follows that "An awareness of narrative might even be a liberating tool for paleoanthropologists to explore other possibilities," other patterns than the diachronic and the causal. Scientists are normally trained to seek certainties, not possibilities; at the same time, it is conceded that the really creative scientists, like Darwin or Einstein, operate very much like creative artists: through an intuitive perception of similarity amidst differences, leading to the use of analogies and metaphors often borrowed from outside their immediate area of study.

Evolutionary theorists might at least consider the possibility of abandoning the search for single, absolute, either-or answers. Landau suggests an open-ended narrative like the stories by the South American writer Borges in which several possible endings are presented as what one story calls a "garden of forking paths." What Landau is suggesting is an exploration of the creative aspect of scientific thinking, which could lead to whole new ways of theorizing.

—Michael Dolzani

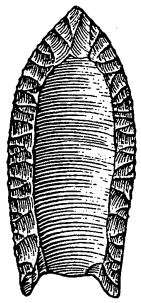
A PRIMER OF PALEO POINTS

CLOVIS

Type site: Clovis, New Mexico
Age distribution: 11,500–10,800 years B.P.
Size range: 35mm–154mm

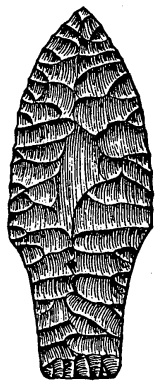
DEBERT

Type site: Debert Paleoindian site, central Nova Scotia
Age distribution: 11,200–10,000 years B.P.
Size range: 32mm–109mm



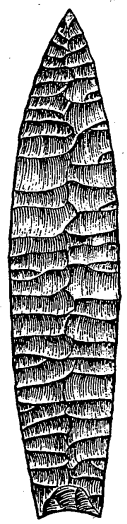
FOLSOM

Type site: Folsom, New Mexico
Age distribution: 10,800–10,000 years B.P.
Size range: 35mm–76mm



HELL GAP

Type site: Hell Gap Valley, east-central Wyoming
Age distribution: 10,500–9,600 years B.P.
Size range: 60mm–88mm



AGATE BASIN

Type site: Agate Basin, south-eastern Wyoming
Age distribution: 10,500–6,700 years B.P.
Size range: 60mm–150mm

Illustrations from Paleo Points by J. Bradford

NEW REFERENCES AND RESOURCES

*New materials received by the Center library.

ARTICLES

*Adovasio, J.M. and Ronald C. Carlisle 1986 Pennsylvania Pioneered. **Natural History.** December:20–27.

Agenbroad, Larry D. 1987 Factors in Extinction. **(Paper presented at the Earthwatch P.I. Conference.**

*Alden, John R. 1986 In Search of the Wooly Mammoth. **Natural History.** September:74–78.

*Allison, Marvin J. 1985 Chile's Ancient Mummies. **Natural History.** October:75–80.

*Ardila Calderon, Gerardo I. 1986 Fechados Y Bibliografia Sobre La Etapa Litica en Colombia. **Maguare.** 3(3):63–74.

*Bower, Bruce 1987 Flakes, Breaks and the First Americans. **Science News.** 131:172–173.

*Bray, Warwick 1986 Finding the Earliest Americans. **Nature.** 321:726.

*Bryan, Alan L. 1987 The First Americans: Points of Order. **Natural History.** 96(6):6–11.

*Davis, Les 1986 In Search of Early Elephants. **Montana Outdoors.** Nov./Dec.:27–31.

*Davis, William E. 1986 The Montgomery Folsom Site. **Utah Archaeology.** 24(2):14–18.

*Davis, William E. and G.M. Brown 1986 The Lime Ridge Clovis Site. **Utah Archaeology.** 24(2):8–13.

*Diamond, Jared 1987 The American Blitzkrieg: A Mammoth Undertaking. **Discover.** June:82–88.

*Diamond, Jared 1987 The Worst Mistake in the History of the Human Race. **Discover.** 8(5):64–66.

*Dillehay, Tom D. 1987 The First Americans: By the Banks of the Chinchihuapi. **Natural History.** 96(4):8–12.

*Dubois, Jean-Marie M. 1983 The History of Quebec and America Written by Stones. **The Ottawa Archaeologist.** 10(10):1–8.

*Dunbar, Maxwell J. 1987 Arctic Seas That Never Freeze. **Natural History.** 4:50–53.

*Fedele, Francesco 1980 Alla Ricerce Del Primo Americano. **Geodes, La Terra Che Vive.** 2(2):34–49.

*Gell-Mann, Murray 1987 First Word. **Omni.** :8.

*Godfrey, Laurie R. and John R. Cole 1986 Blunder in Their Footsteps. **Natural History.** August:4–12.

*Gould, Stephen Jay 1987 This View of Life: Bushes All the Way Down. **Natural History.** 96(6): 12–19.

*Graham, R.W. 1985 Diversity and Community Structure of the Late Pleistocene Mammal Fauna of North America. **Acta Zool. Fennica.** 170:181–192.

*Grayson, Donald K. 1987 Death by Natural Causes. **Natural History.** 96(5):8–13.

*Guidon, N. and G. Dilibrias 1986 Carbon-14 Dates Point to Man in the Americas 32,000 Years Ago. **Nature.** 321:769–771.

*Hill, Andrew 1986 The Gift of Taungs. **Nature.** 323:209.

*Ingram, Mrill 1987 Organization Man: Robson Bonnichsen. **Earthwatch.** April-May:8.

*Irving, William N. 1987 The First Americans: New Dates from Old Bones. **Natural History.** 96(2):8–13.

*Jacobson, George L. and Eric C. Grimm 1986 A Numerical Analysis of Holcene Forest and Prairie Vegetation in Central Minnesota. **Ecology.** 67(4): 958–966.

*Jefferson, George T. 1983 A Fragment of Human Skull from Schuiling Cave, Mojave Desert, California. **Bulletin Southern California Academy of Science.** 82(2):98–102.

*Johnson, Eileen 1986 Late Pleistocene and Early Holocene Vertebrates and Paleoenvironments on the Southern High Plains. **Geographie Physique et Quaternaire.** XL(3):249–261.

*Johnson, Eileen and Vance T. Holliday 1986 The Archaic Record at Lubbock Lake. Memoir 21, Part 2. **Plains Anthropologist.** :7–54.

*Klein, Richard G. 1985 Breaking Away. **Natural History.** January:4–7.

*Lahren, Larry and Robson Bonnichsen 1984 Bone Foreshafts from a Clovis Burial in Southwestern Montana. **Science.** 186: 147–150.

*Lewin, Roger 1986 Myths and Methods in Ice Age Art. **Science.** 234:936–938.

*Madsen, David B. 1986 Status of Silver Island Expedition. **Utah Archaeology.** 24(2):4–7.

*Narr, Karl J., G. Lass 1986 Spater Gebrauch von Steinwerkzeugen: Mikrospuren an Funden aus dem rheinischen Braunkohlenrevier. **Landschaftsverband Rheinland.** 3(4):36–37.

*Neal, Robert and Errol Stock 1986 Pleistocene Occupation in the South-east Queensland Coastal Region. **Nature.** 326:618–621.

*Patterson, L.W. and J.D. Hudgins 1985 Paleo-Indian Occupations in Wharton County, Texas. **Bulletin of the Texas Archaeological Society.** 56:155–170.

*Pfeiffer, John E. 1986 Cro-magnon Hunters Were Really Us, Working Out Strategies for Survival. **Smithsonian Magazine.** October:75–85.

*Railey, Jimmy A. and A.G. Henderson 1986 Middle and Late Woodland Occupations at Green Sulphur Springs. **West Virginia Archeologist.** 38(2):22–39.

*Riggs, Rodney E. 1986 New Stratigraphic Sequences from the Lower Little Miami Valley. **West Virginia Archeologist.** 38(2):1–21.

*Rossen, Jack and Cecil R. Ison 1986 Environmental Degredation at Green Sulphur. **West Virginia Archeologist.** 38(2):48–51.

*Ruhlen, Merritt 1987 The First Americans: Voices from the Past. **Natural History.** 96(3):6–10.

*Rukang, Wu and Lin Shenglong 1983 Peking Man. **Scientific American.** 248(6):86–94.

*Sepkoski, J. John Jr. and David M. Raup 1986 Was there 26-Myr Periodicity of Extinctions? **Nature.** 321:533–536.

*Stuart, Mark E. 1986 The Black Slough/Orbit Inn Site. **Utah Archaeology.** 24(2):32–34.

*Stuart, Mark E. 1986 Deer Dinner Dune: A Sand Dune Site in Southeast Weber County, Utah. **Utah Archaeology.** 24(2):35–61.

*Trinkaus, Eric 1986 The Neanderthals and Modern Human Origins. **Annual Review of Anthropology.** 15:193–218.

*Turner II, Christy, G. 1987 The First Americans: Telltale Teeth. **Natural History.** 96(1):6–10.

*Zegura, Stephen L. 1987 The First Americans: Blood Test. **Natural History.** 96(7):8–11.

BOOKS

*O'Neill, Brian 1981 **Kansas Rock Art.** Kansas State Historical Society, Topeka.

*Penny, James S. Jr. 1986 **The Prehistoric Peoples of Southern Illinois.** Center for Archaeological Investigations, Carbondale.

*Soffer, Olga 1985 **The Upper Paleolithic of the Central Russian Plain.** Academic Press, Inc., Orlando.

ARCHAEOLOGY IN THE CLASSROOM

Although still in its infancy, the growing field of K-12 archaeology education is showing vigor. Two recent contributions are worthy of note.

Discovering Maine's Prehistory Through Archaeology: An Interdisciplinary Curriculum Unit for Grades 5 - 8 was presented by author Diane Kopec in February, 1987 at a workshop in connection with the Center for the Study of Early Man's week-end conference, "The Human Story: Bringing Prehistory to Life."

Organized around a six-week unit plan, this 144 page document highlights activities, discussions, audio-visuals and tests about: "What is Archaeology?,"; "Doing Archaeology: The Archaeologist and Methods;" "Doing Archaeology: Prehistory;" "Doing Archaeology: Excavation and Interpretation;" "Living Archaeology;" "Native Americans Today;" and "You and Archaeology."

Diane Kopec, Curator at the Robert Abbe Museum, Bar Harbor, Maine, and Arthur Spiess, Prehistoric Archaeologist with the Maine Historic Preservation Commission first surveyed what other educational materials existed through the SHPO network. Diane has incorporated in her curriculum materials ideas developed in the following sources: **Studying the Prehistory of Man in Kentucky; Anthropology and Education Quarterly; Native American Source Book** (Concord Antiquarian Museum); **Frontiers in the Soil: The Archaeology of Georgia; A Teacher's Guide to Project Outreach: A Public Awareness Program in Vermont Archaeology;** and **Classroom Archaeology** (Louisiana), which is an outstanding resource in this field described below.

Nancy W. Hawkins, the author of *Classroom Archaeology,* has brought together under one cover the following: activities, games, and units on recording, interpreting and excavating a site, a listing of recommended books divided by elementary, junior high and high school levels, and three pages of vital information about "Materials That May Be Purchased from Other Sources." Addresses are included.

To order a copy of Diane Kopec's work, write Maine Historic Preservation Commission (under whose auspices it was developed), 55 Capitol Street, State House Station 65, Augusta, Maine 04333. Nancy Hawkins' **Classroom Archaeology** was produced by the Division of Archaeology, Department of Culture, Recreation and Tourism, State of Louisiana. It can be obtained by writing to: Division of Archaeology, P.O. Box 44247, Baton Rouge, LA 70804.

—Marilyn Roper

CONFERENCES

UPCOMING

October 22-25, 1987 NINETEENTH ALGONQUIAN CONFERENCE, Museum of Natural History, Smithsonian Institution, Washington, DC 20560.
Contact: Ives Goddard, NHB Rm 85, Smithsonian Institution, Washington, DC 20560.

October 26-29, 1987 GEOLOGICAL SOCIETY OF AMERICA, Annual Meeting, Phoenix, Arizona.
Contact: Jean Kinney, GSA Headquarters Box 9140, 3300 Penrose Place, Boulder, CO 80301: 303/447-2020.

October 30-November 1, 1987 MAMMOTHS, MASTODONS AND HUMAN INTERACTION SYMPOSIUM in conjunction with the Annual Meeting of the TEXAS ARCHAEOLOGICAL SOCIETY, Waco Hilton and Waco Convention Center, Waco, Texas.
Contact: Albert J. Redder, Central Texas Archaeological Society, 4229 Mitchell Road, Waco, TX 76710.

November 5-7, 1987 AMERICAN SOCIETY FOR ETHNOHISTORY, Annual Meeting, Claremont Hotel, Berkeley, CA.
Contact: George Collier, Prog. Chair, AES 1987, Ctr. for Latin American Studies, 582 Alvarado Row, Stanford University, Stanford, CA 94305; 415/723-4444.

November 12-15, 1987 CHACMOOL CONFERENCE, 20th Annual, University of Calgary, Canada.
Contact: 1987 Conference Committee, Department of Archaeology, University of Calgary, Calgary, Alberta, Canada T2N 1N4.

November 18-22, 1987 AMERICAN ANTHROPOLOGICAL ASSOCIATION, 86th Annual Meeting, Chicago Marriot, Chicago, IL.
Contact: Victor Golla, George Washington University, Washington, DC 20052: 202/676-6075.

March 17-23, 1988 11th Annual Conference of the Society of Ethnobiology, Mexico City, Mexico.
Contact: Robert Bye, Jardin Botanico, U.N.A.M., Apdo. Post. 70-614, 04510 Mexico, DF, Mexico or Jan Timbrook, Santa Barbara Museum of Natural History, 2599 Puesta del Sol Road, Santa Barbara, CA 93105.

March 9-12, 1988 Northeast Regional Meeting, GSA, Portland, ME.
Contact: Dr. Stephen Pollack, Dept. of Geology, University of Southern Maine, Gorham, ME 04038.

May 22-25, 1988 GEOLOGICAL ASSOCIATION OF CANADA - MINERALOGICAL ASSOCIATION OF CANADA - CANADIAN SOCIETY OF PETROLEUM GEOLOGISTS, Joint Annual Meeting, St. John's, Newfoundland.
Contact: John Fleming, Newfoundland Dept. of Mines and Energy, P.O. Box 4750, St. John's, Newfoundland, Canada A1C 5T7: 709/576-2768.

May 29-June 3, 1988 WORLD CONFERENCE ON WATER RESOURCES, Ottawa, Canada.
Contact: Secretariat, 6th World Conference on Water Resources, Univ. of Ottawa, 648 King Edward Avenue, Ottawa, Ontario, Canada K1N 6N5.

July 4-8, 1988 46TH INTERNATIONAL CONGRESS OF AMERICANISTS, Amsterdam, Holland.

July 24-31, 1988 12TH INTERNATIONAL CONGRESS OF ANTHROPOLOGICAL AND ENTHNOLOGICAL SCIENCES, Zagreb, Yugoslavia.
Contact: Linda Bennett, Amer. Prog. Coord., Dept. of Anth., Memphis State Univ., Memphis, TN 38152.

August 2-5, 1988 5TH INTERNATIONAL CONFERENCE ON PERMAFROST, Tronheim, Norway.
Contact: VICOP, Norwegian Road Research Laboratory, P.O. Box 6390 Etterstad, N-0604 Oslo 6, Norway.

September 1988 ARCHAEOLOGICAL WOOD SYMPOSIUM, Los Angeles, CA.
Contact: Dr. Roger M. Rowell, USDA, Forest Products Laboratory, One Gifford PinchotDr., Madison, WI 53705.

September 23-25, 1988 19TH ANNUAL BINGHAMTON GEOMORPHOLOGY SYMPOSIUM, Brock Univ., Ontario, Canada.
Contact: K.J. Tinkler, Brock University, St. Catharines, Ontario, Canada L2S 3A1: 416/688-5550, Ext. 3486.

October 31-November 3, 1988 GEOLOGICAL SOCIETY OF AMERICA, Annual Meeting, Denver, CO.
Contact: Jean Kinney, GSA Headquarters, Box 9140, 3300 Penrose Place, Boulder, CO 80301: 303/447-2020.

Mammoths, Mastodons, and Human Interaction

A national symposium on Late Pleistocene archaeological interpretations will be held in conjunction with the 58th annual meeting of the Texas Archaeological Sociey and is being sponsored by Baylor University and the Cooper Foundation of Waco, Texas. The symposium, to be held October 30 through November 1, will include on-site workshops at the Waco mammoth site and Horn Shelter, both in Waco, Texas, and a roundtable discussion. For more information, see UPCOMING CONFERENCES, this page.

Symposium participants will include:

James Adavasio (University of Pittsburgh) Meadowcroft Rockshelter, "Pre-Clovis"

Larry Agenbroad (University of Northern Arizona) Hot Springs, S.D.

Karl Butzer (University of Texas at Austin) Pleistocene Human Ecology, Peopling of the New World

Tom D. Dillehay (University of Kentucky) Mastodon Scavaging and Hunting: A View From Monte Verde, Chile

John Fox (Baylor University) Waco Mammoth Site

Joel T. Gunn (University of Texas at San Antonio) Clovis Site Distributions and Fluctuating Climates

Gary Haynes (University of Nevada) African Elephant Herd Sites As Behavioral Analogies

Ernest Lundelius (University of Texas at Austin) Paleofauna

Jeffrey Saunders (Illinois State Museum) Boney Springs and Blackwater Draw

Calvin Smith (Baylor University) Waco Mammoth Site

Dennis Stanford (Smithsonian Institution) Lewisville, Texas, And The Dutton And Selby Sites, Colorado

Gentry Steele (Texas A&M University) Duewall-Newberry Site

David Webb (University of Florida) Evolutionary Adaptations of Proboscidea

We now have all **Mammoth Trumpet** subscriptions on a rotating schedule that can begin and expire with any volume and issue. That means you will not receive any issues mailed between the expiration and renewal of your subscription. Don't miss any of the hot news of the Ice Ages the **Mammoth Trumpet** delivers in each issue. Why not renew now, even if your subscription doesn't expire this Fall? Remember, special offers are still available to subscribers at higher membership levels.

We will also be offering pre-publication discounts to members on three forthcoming books before the end of the year.

And if that isn't enough for you – Mammuthus Humerus has been contemplating the cosmic egg and will deliver words of wisdom in upcoming issues of the **Trumpet**.

Membership level	1 year	3 years
Regular worldwide	$ 9.00	$ 27.00
outside N. America	10.00	30.00
Contributing	25.00	70.00
Sustaining	50.00	140.00
Patron	100.00	280.00
Lifetime	1500.00	
Institutional worldwide	10.00	30.00

Date: October, 1987
To: All subscribers
From: Center publications staff
Re: New

Current Research in the Pleistocene (CRP) 4, 1987 has already been mailed to all prepaid subscribers. This volume has 75 papers and many illustrations, 2 indices, and a reference map. The Special Focus section features South America, with 7 papers from regional specialists.

Back issues of volumes 1, 2, and 3 have been reprinted and are now available. If you would like to have **CRP** 5, 1988 mailed directly to you as soon as it becomes available, fill out the card inserted in **CRP** 4 and return it with payment to reserve your copy.

Volume/year	inside N. America	outside N. America	institutional worldwide
1, 1984	$ 8.00	$14.00	$15.00
2, 1985	12.00	18.00	15.00
3, 1986	12.00	18.00	15.00
4, 1987	17.00	23.00	20.00
All four volumes	45.00	65.00	60.00

TASTING A HERO SANDWICH

(Continued from page 4)

"Jeff Saunders was able to get money from the National Science Foundation to prepare some mammoth bone that had been excavated in the 60s. That material had never been out of its jacket; most of it's now prepared. We hope to be able to publish an updated version of that earlier work as well as go back and test or, preferably, have a full-scale excavation."

Blackwater's biggest draw—so to speak—is that it is the most likely of known sites finally to disclose to us something more about the little-known people called Clovis. "We just barely know that Clovis existed, and that's about the state of our knowledge. We know they made Clovis points!" Most else is conjectural. "We know they probably hunted mammoths"—but even there Stanford qualifies. He thinks a mammoth feast was likely to have been quite a rare event: very possibly there were Clovis individuals who never tasted one. The usual Clovis diet was probably bison, deer, frogs, toads, snakes, lizards, etc.

Even at Blackwater Draw there is more speculation than evidence as yet concerning Paleoindian cultural patterns, partly because there are so few artifacts dating to Clovis times. One reason for the scarcity of stone tools, no matter what the period, is that people who made stone tools undoubtedly did not throw them away casually when they took so much trouble to make. In addition, sources for good-quality stone may have been quite distant. Hence, what is likely to turn up are the damaged projectile points, knives broken from processing game, and the like. Stanford infers that "Most of the tools are going to be where they pulled the animals or parts of animals out of the boggy swamp onto dry ground . . . . We know where those sites are, but by and large, most of the camp sites have been blown around and redeposited on the rock surface. There are some areas that might be promising, though."

However, the major reason for the dearth of cultural remains is surely that most of them were made out of perishable materials, particularly wood and bone. It surprises Stanford that so few bone tools are discovered even when bone is preserved. It leads him to think that the favored tool material might have been wood. For example, there are somewhere between 60–100 Folsom sites (90% of them surface sites); only about 4–5 of them have bone tools.

Disappearance of the perishable artifacts erases much of the individuality of a culture. That the various culture levels were very similar (based on their similar stone tools) is probably an illusion. As Stanford explains: "Stone is a limiting medium. There are only a few ways you can break it, and most groups discovered what those ways are. Except for fluting. That's unique, a real North American invention. It does not occur anywhere else in the world. But *everybody* makes end scrapers look about the same; the same for flake knives. Where we would really see cultural differences, and where we really need data, is with the perishable artifacts"

One of the special features that would justify ongoing work at Blackwater Draw is its great hero sandwich of cultural levels piled one atop the other: it is extremely rare to find substantial preservation of so many at once, and it is by no means only the Clovis and pre-Clovis possibilities that are attractive. There is significant and abundant material from the Archaic period, for example; "and it's also interesting," Stanford adds, "that during the Archaic times, when apparently the spring was pretty dry, seasonally at least, the Archaic people dug wells. These beautiful wells go right down through the earlier stratigraphy. Recently, David Meltzer found more of them at Mustang Draw, near Midland, Texas. And there are others which have been found in Texas by Glen Evans."

"We think the site is so special that what we would like to see happen there is a permanent structure with a museum and ongoing work, as at Dinosaur National Monument, where a visitor can come in and, from an air-conditioned building which is also a museum, watch excavators at work. That is a real possibility." Real, but distant at the moment: "What's needed is a large funding commitment, something difficult to achieve these days."

—Michael Dolzani

BLOOD FROM A STONE

(Continued from page 3)

being differentiated" by hemoglobin-crystal analysis. "The problem is that you can't go any higher on the taxonomic ladder."

That is why Loy has been looking into supplementary procedures. "There are other techniques for species identification that I've been using," he says. "Some of them take a longer time, but they're absolutely elegant in the sense that they give an absolute 'yes' or 'no' answer. I do a technique called isoelectric focusing that holds tremendous promise. It separates the proteins electrochemically and sorts them into small bands depending on their native pH. The gel that I do the separations through has a series of chemicals that set up a pH range from pH 10 to pH 3. As the sample migrates across the gel, it responds to the electric change and I end up with a ladder of bands that becomes a fingerprint identification. There are, admittedly, a lot of problems with sample preparation and elimination of contaminants. Also, I think that to be really effective, it will have to be computerized, because it's simply too tedious and time-consuming by hand."

In addition, Loy is delving below the molecular level into the analysis of blood on the atomic level. It is known that the blood's stable carbon and nitrogen isotopes can be used to look at an animal's diet distinguishing carnivores from herbivores. An Italian scientist a few years ago found that differences can be discerned in the stable oxygen isotopes as well, depending on the drainage basin from which the animal came; it thereby becomes possible to study the movements of animals or people from one drainage basin to another. Using a mass spectrometer, Loy can also determine something about the mean annual temperature in the month that an animal died, although he is careful to check it against other temperature indicators for that time before drawing conclusions. This reconstruction is possible because the blood's oxygen content is related to the animal's internal body temperature, which is in turn a function of the temperature of its external environment.

Where to go from here? "I'm going at it from 3 directions," is Loy's answer. "One is to establish the time depth." How far back in time will his techniques work? Well, they go back at least 75,000 years: that is the minimum date of a site in Iraq from wich he has processed both human and animal blood taken from 3 tools. He sees no reason the methods should not work on tools 1,000,000 years old, adding, "I'll be very happy to accept any samples from that time range that anybody wants to give me."

His second objective is to evaluate his techniques and to develop them further; and the third direction his work is taking will help enable him to do so. "The final thing is, people come to me and say, 'I've got a really hot topic here: What do you think? Could this be of any use?' " Two such approaches occurred recently. "One," Loy continues, "is a collaboration with Simon Frazer University. Using the accelerator, the radiocarbon dating unit there and I have come up with a good solid radiocarbon date on blood film taken from tools. That was published about a year ago."

It is fairly common to find blood on a tool from more than one species. "It's also common to find 2-4 different layers of residue, and especially interesting if we find 2-3 uses of a tool on the same species, suggesting that it was used exclusively on one type of animal.

If Tom Loy's hemoglobin crystallization technique becomes widely accepted after being duplicated by other researchers, it may mean a change in the way artifacts are prepared after excavation. He notes that "Most of the time when I talk to groups, there first conclusion is: 'Oh, gee, we'd better stop washing these things.' My advice is: Right. *Don't* wash them; simply air-dry them; and if you have to have a smooth surface, brush them with a soft camel-hair brush. Because most of the soil that will adhere to the tool is there for a reason: it's part of that protein-soil complex. The thing is, do all the residue analysis *before* you wash it. I think that we have to develop a slightly different standard for what we think of as a quality artifact: it can no longer be one that's squeaky clean. We don't really *need* absolutely clean artifacts."

How has Loy's process been received so far? "I find first a hope that this is really the answer that it seems to be; then a healthy dose of scepticism—in terms of the anthropologists and archaeologists partly because they're simply not exposed to the biochemistry that goes along with all of this. In fact, I've had more positive and immediate response from the biochemical community. But I'm not meeting with an extremely hostile or indifferent approach—just a good healthy scepticism." Scepticism and hope: as Loy and others continue working on hemoglobin-crystal studies, the balance should tip one way or the other in the near future.

Loy is on his way from the British Columbia Provincial Museum to a position in the Prehistory Department of the Research School of Pacific Studies of the Australian National University.

—Michael Dolzani