MAMMOTH TRUMPET

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Center for the Study of the First Americans
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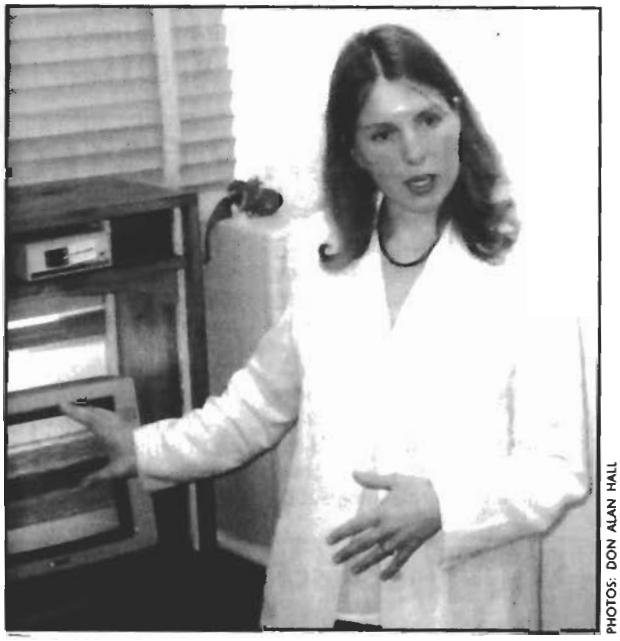
The Biological Connection

Human biologists recently gathered at Oregon State University to discuss research bearing on the question: Who Were the First Americans? Participants included genetics researcher Theodore Schurr, left, who described evidence for human migration found in living peoples of Asia and North America (Page 16). Graduate student Misty Weitzel, pictured with a computer image of human hair, is part of a CSFA team studying a variety of hair recovered from archaeological sites (Page 1).



PHOTOS: DON ALAN HALL

The Center for the Study of the First Americans fosters research and public interest in the Peopling of the Americas. The **Center,** an integral part of **Oregon State University,** promotes interdisciplinary scholarly dialogue among physical, biological and social scientists. The **Mammoth Trumpet,** news magazine of the **Center,** seeks to involve you in the late Pleistocene by reporting on developments in all pertinent sciences.

MAMMOTH TRUMPET

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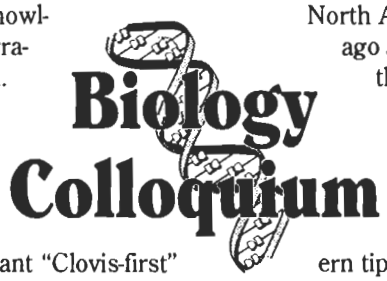
PALEOBIOLOGY FOCUSES ON FIRST AMERICANS

CSFA Scientists Begin Research on Hair of the Dog

Leading human biologists gathered in Corvallis, Ore., April 24 to describe and explain research that is revolutionizing study of the peopling of the Americas. About 350 people attended the day-long conference organized by the **Center for the Study of the First Americans** and sponsored by Oregon State University as its 58th Annual Biology Colloquium.

CSFA Director Robson Bonnichsen opened the event with an overview of the status of archaeological knowledge about the human migrations into the New World. He said there are five questions about the migration: when, where, how, why and by whom?



Dr. Bonnichsen declared that the long-dominant "Clovis-first" model of the peopling of the New World is being replaced by the more-complex "early entry" model. After reviewing evidence from a number of archaeological sites in North and South America, he concluded that the early-entry model appears to be correct.

"But there are enormous unanswered questions." Those questions, he emphasized, are the focus of a new frontier in human biology. "We now have new scientific methods coming on line that will allow us to look at the paleobiology of the first Americans." Methodologies to which he referred are being refined by conference speakers Anne Stone of the University of Arizona, Theodore Schurr of Emory University, Katharine G. Field of Oregon State University, Douglas Owsley of the Smithsonian Institution, Richard Jantz of the University of Tennessee, and D. Gentry Steele of Texas A&M University.

Bonnichsen reviewed archaeological evidence for the Clovis-first model, which posits that a small group of hunters entered North America about 11,500 years ago and found abundant food in the form of a variety of large mammals that had never known human predation. Raising an average of 2.1 children each generation, they swept to the southern tip of South America within a thousand years. In the process, he said, the theory states that they brought about the extinction of 33 genera of animals in North America and more than 50 in South America, and left their tools in sites across both continents.

The theory predicts that the oldest Clovis

continued on page 9

INSIDE

New Leadership for CSFA Board

Marvin Beatty, University of Wisconsin soil scientist, was elected chair of the **Center for the Study of the First Americans** Advisory Board during a meeting April 25–26 at Oregon State University. Dr. Beatty succeeds Anne Stanaway of Boulder, Colo., and Alan Schneider of Portland, Ore., who had served as co-chairs. Jay Shapiro of Baltimore, Md., was elected secretary, succeeding Joanne Turner of Boulder, Colo. Gerry Fritts of Kalispell, Mont., is continuing as vice chair, and Jo Ann Harris of New York City is member at large of the executive committee.

Four individuals with strong interests and backgrounds in archaeology and the **CSFA** were appointed to the Advisory Board. They are John R. O'Brien of Salem, Ore.; Michael Randall of Mitchell, S.D.; and Larry and Sandy Tradlener of Forest Grove, Ore.

"We owe enormous debts to outgoing officers," said Beatty. He complimented Stanaway, Schneider and Joanne Turner for tireless work for the **Center.** The Advisory Board's continuing challenge, he added, is "to sustain the momentum of support for research, build the endowment and enhance the full integration of the **Center** into Oregon State University."

Board members heard reports by three graduate students on their research. Kevin Goodrich described studies of Clovis-type tools from Maine's Munsungun Lake chert site. Dustin White summarized stratigraphic analysis of the Cremer site in Montana. Misty Weitzel discussed her research comparing hair samples from five human populations and demonstrated her work using the computer-imaging technology for analyzing hair.

CSFA Director Robson Bonnichsen told the board that significant progress has been made in methods for mounting, sectioning and imaging hair. The **Center** has a backlog of hair from archaeological sites that awaits processing and identification using the new methods. **CSFA** researchers are still analyzing questions about the preservation of ancient hair. Katharine Field, Walter Ream and Bonnichsen described progress on the analysis of hair at the Biology Colloquium at OSU the day before the Advisory Board meeting.

DON ALAN HALL

Graduate student Kevin Goodrich presents details of studies of Clovis-type tools from Maine's Munsungun Lake chert site for CSFA Advisory Board members.

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DON ALAN HALL

Workers excavate faunal material from scoops of peat strata laid out by a backhoe. The field crew at Mammoth Park included students from Saturday Academy, Portland Community College and Oregon State University. Experienced, well-trained volunteers from the Oregon Archaeological Society served as team leaders for groups of individual students.

–UPDATE–

Bog Holds Details of Pleistocene

Excellent Preservation Means Opportunity for Archaeologists

Continuing investigation of a deeply buried bog on public school grounds in Woodburn, Ore., is revealing an environmental record that extends back to the time of the last Ice Age. Woodburn is an agricultural community in the Willamette Valley between Portland and Salem.

The site, known as Mammoth Park because of the bones that were discovered there a decade ago, was the focus of a testing program in 1996. Excavations revealed a variety of well-preserved faunal material ranging from insects to small and large mammals, and plant remains including pollen, seeds, and wood. Additionally, some lithic flakes, leftovers from the manufacture of stone tools, were found in lower levels of extensive peat deposits suggesting early presence of humans.

The character of the site that has as-

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Preservation of bones of the site's many small animals is remarkable. Delicate sutures and other details in this rodent's cranium are readily available for study. The scale is centimeters.

DON ALAN HALL

Left, Archaeologist Chuck Hibbs examines a student's discovery that has been carefully washed, bagged and labeled to record the provenience of each object. Students were taught to document all observations before removing any specimens.

Below, archaeologist Alison T. Stenger, right, examines materials remaining after field washing on public school grounds in Woodburn, Ore. With her are, from left, Alan Schneider, Gene Edinger, and Charlene Stevens of the Oregon Archaeological Society.

OREGON ARCHAEOLOGICAL SOCIETY

sured excellent preservation of plant and faunal materials makes archaeological investigation of Mammoth Park extremely difficult. A seasonal stream flows through the site between banks of earth that were filled in as part of drainage and landscaping work. Because of the depth of the deposits—some more than 20 feet below the surface—and the wet, unstable nature of the peat soil, excavations are unsafe for field workers to enter. Therefore, last season's field work involved the examination of materials brought to the surface, stratum by stratum, by backhoes. Traditional in-the-pit archaeology would require shoring of side walls and pumping.

Below approximately three feet of fill, there is a layer of heavy blue clay that has sealed approximately eight or nine feet of peat. Beneath this stratified peat lies two or three feet of organic silty sand, and below that is a stratum of very fine, light-gray sand, that could be evidence of one or more catastrophic floods caused by the failure of ice-dams that had retained enormous glacial lakes far to the east in the Rocky Mountains and Great Basin.

Alison T. Stenger, project instructor of the investigation that is being sponsored by the **CSFA** at Oregon State University, the City of Woodburn, and the Woodburn School District, is enthusiastic about the variety of animal and plant remains and the high quality of preservation. Paleontologist William Orr says it is the best-preserved peat site he has ever seen. Orr, director of the Condon Museum of Natural History at the University of Oregon, supervised the study of the site's megafauna brought up during installation of a sewer line in 1987. He notes that the plant remains and small animal remains can reveal more about the Pleistocene environment than the bones of megafauna that the site has yielded.

In exploratory excavations made during 1996, teams carefully recovered samples of biological materials from the sediments. Continuing analyses of the site are being made by paleontologists, paleoecologists, entomologists, and archaeologists.

The lowest of the site's three peat levels proved to be richest in bones of small

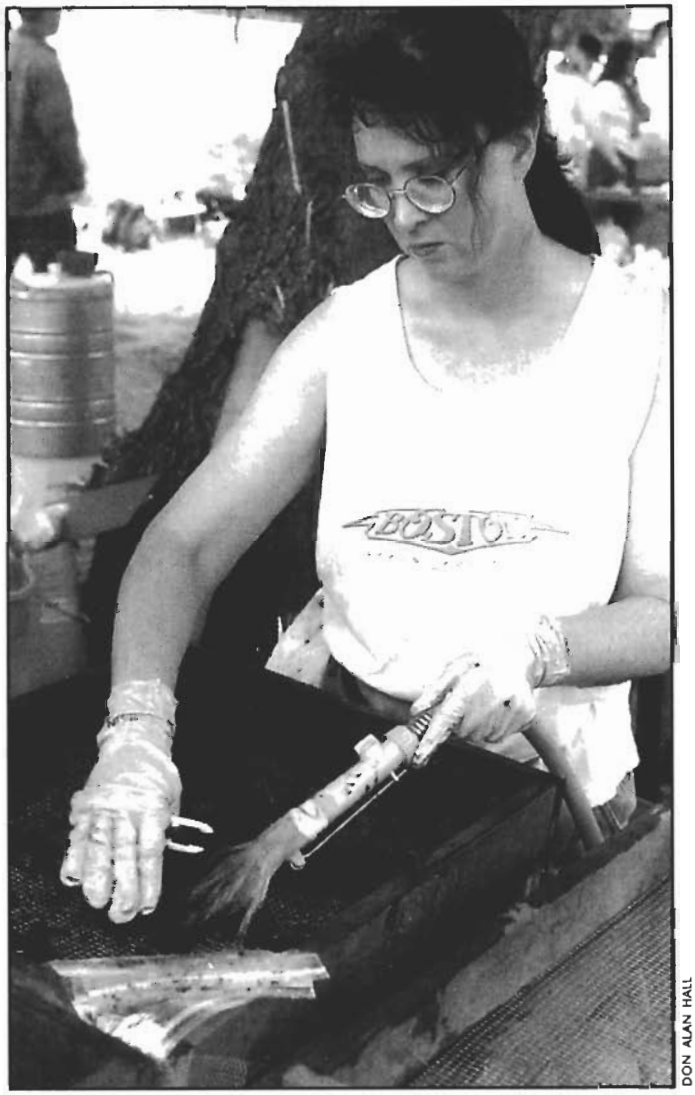
mammals and birds, while the upper peat level was rich in woody materials, some bearing the tooth marks of beavers. Field workers found little or no bone in the upper two peat layers, but the lowest layer yielded many bones, and the fine silt below that was even richer in bones.

The biggest backhoe employed in 1996 could dig no deeper than about 19 feet, which reached approximately the top of the fine gray sand. The excavations brought up no bones of megafauna and only fragments of the bones of large animals. Field volunteers and students jokingly suggested that the site should be renamed "Rodent Park." Investigators, including Stenger and archaeologist Robson Bonnichsen, director of the **Center for the Study of the First Americans,** are confident that there are more bones of megafauna to be found deeper in the Pleistocene sediments.

Paleontologist Orr: "It's the best-preserved peat site I've ever seen."

Neither the precise location of megafauna unearthed in 1987 during installation of a sewer line, nor the depth of that excavation is known for certain. At least some of the large animal bone is believed to have come from deep beneath the highway immediately south of the site. And though Orr studied much of the material, sewer workers are believed to have taken some as souvenirs before scientists were notified. A teacher at the nearby high school and city officials noticed and saved some of the bones for scientific examination.

Orr soon identified mammoth, mastodon, giant sloth, dire wolf, and bison. Several of these bones are on display at Woodburn's City Hall along with some found in the 1996 excavations, including the perfectly preserved skulls and jaws of rodents. Though faunal analysis is continuing, tentative identifi-



DON ALAN HALL

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Above, a student learns how to water-screen soils and extract small specimens that would be easy to miss.

Left, archaeologists exposed clean surfaces of excavated strata near the backhoe trenches to document the microstratigraphy of each stratum. Because of the nature of the soils, stratigraphic context remained evident. The surface of the chocolate-brown peat gradually turned black in the summer sun. Woody stems preserved in the peat appeared quite fresh.

This jasper flake, shown approximately actual size, was one of a few artifacts that transformed Mammoth Park from a paleontological to an archaeological site.

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DON ALAN HALL

In the shade of a willow tree, students learn how to water-screen blocks of soil to achieve maximum recovery of small specimens.

cation of small mammals includes squirrel, shrew and rabbit. Bird species seem to include migratory species as well as birds of prey.

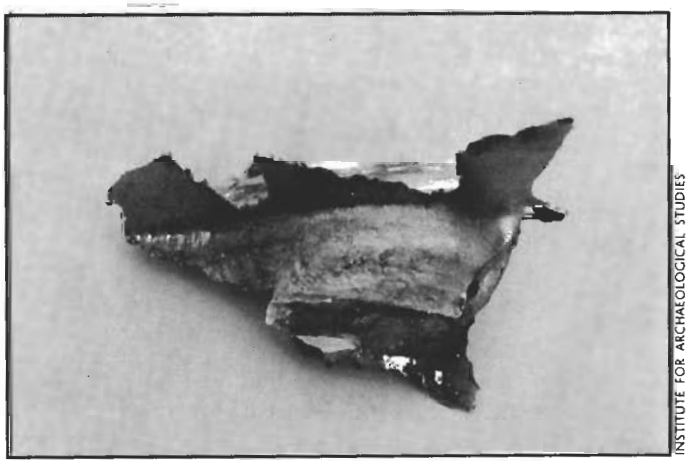
More than 20 species of extinct animals have been identified, and bones of deer and elk have been found in the most-recent Pleistocene deposits.

Paleoecologist Cathy Whitlock of the University of Oregon has already found abundant evidence of bog birch (*Betula glandulosa*) in samples from the lower levels of peat. This is a bushy shrub now found in mountain meadows; but elevation in Woodburn is less than 200 feet above sea level. Dr. Whitlock found that the upper peat bears evidence of dogwood (*Cornus stolonifera*) and bigleaf maple (*Acer macrophyllum*), trees common to the region as well as common wetland plants such as sedges, buckbean, spatterdock and spirea.

Remains of insects from the site are being analyzed in cooperation with Donald Schwert and Jennifer Lundberg of the Quaternary Entomology Laboratory at North Dakota State University. The preservation of chitin, skeletal remains of the many arthropods recovered, is excellent; coloration and sculptural details are intact. Dr. Schwert says the site represents one of the richest sites in North America in terms of the quality of chitin. "Remains of insects, particularly beetles (*Coleoptra*) are visible on almost every peat surface." Most are marsh-loving varieties, although Schwert and Lundberg have found a carrion beetle and a fly pupa.

Most of the archaeological material at the site is associated with a stratum that has been tentatively dated to Pleistocene time.

Below, the delicate sternum of a bird is almost perfectly preserved in Mammoth Park's peat. The specimen is approximately 10 cm in length.



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Workers at the site in 1996 included many volunteers from the Oregon Archaeological Society and Saturday Academy, as well as students from Portland Community College and Oregon State University. Work at Mammoth Park is continuing this summer.

–DAH

–NEBRASKA FOLLOW-UP–

Flaked Bone Suggests Americans Used Mammoths As Tool Materials

ARCHAEOLOGIST STEVEN R. HOLEN is convinced that paleo-Americans used mammoth carcasses almost as if they were stone quarries. Holen, Public Archaeologist and Research Assistant Professor with the University of Nebraska State Museum in Lincoln, says mammoth sites he has studied indicate that as long as 18,000 years ago people were breaking the thickest, strongest bone of the biggest mammoths into flakes to utilize as tools.

Speaking to an audience in Corvallis, Ore., in March, Holen reported on his continuing analysis of several High Plains mammoth-processing sites including La Sena and Jensen sites in southwestern Nebraska ("Bones of Nebraska Mammoths Imply Early Human Presence," **Mammoth Trumpet** 10:1).

"They wanted the lower half of the femurs," Holen said of the ancient Plains people. His analysis of flaked mammoth bones uncovered at the La Sena site revealed that the lower parts of femurs, the animals' thickest and heaviest bones, were missing. The sites are virtually devoid of stone tools, indicating to Holen that people did not hunt or butcher the mammoths, but merely mined the largest dead mammoths for their bone. Though remaining bone provides clues to flaking, it is possible that some of the thick bone was used for making foreshafts for spears and for shaft straighteners. Tool-grade stone is a scarce commodity at the sites, especially at La Sena and Jensen, which are buried in fine, windblown deposits of Pleistocene age known as Peoria loess.

Only humans could have flaked the mammoth bones in the manner of these found in the five sites in Nebraska and Kansas, Holen explained, because through a process of elimination, all natural agents such as trampling by other animals or scavenging by carnivores can be ruled out. Lighter, more delicate bones such as ribs and vertebrae remained intact though the heaviest bones, especially femurs, were broken by strategically placed, crushing blows made by tools that left impact scars larger than the teeth of any carnivore. The blows could only have been made by hammerstones, says Holen. Further, one site has yielded a vertebra that served as an anvil. It was left standing on edge with wear on the upper broken surface, and evidently had been socketed into the ground to hold one end of a long bone off the ground during the breaking process.

"There's good evidence for humans," he said. "You don't need stone tools for evidence."

Holen says the sites he's analyzed are very different from the elephant-bone sites that taphonomist Gary Haynes has analyzed in Africa. Haynes's analyses of elephant "graveyards" greatly influenced analysis of North American Pleistocene-mammal sites because he found that gnawing carnivores and trampling elephants can break elephant bones in ways that make them appear to have been worked by humans. Haynes, however, examined bones of many animals scattered near African watering holes where elephants and other animals congregate, whereas each of Holen's Jensen and La Sena sites consists of a single large male mammoth. Further, Holen's mammoth bones were broken only at mid-shaft. Ends of bones were intact and not gnawed away, and the most delicate bones were largely unscathed.

KEVIN GOODRICH

These bone flakes at the La Sena site, approximately 18,000 years old, indicate that people were utilizing the thickest, strongest bone of the biggest mammoths for making tools.

In fact, one of the biggest mysteries of the sites is the lack of carnivore evidence. The bones were buried in loess without indications that they had been chewed by large carnivores, such as dire wolves. After Holen's lecture, Director Robson Bonnichsen of the **Center for the Study of the First Americans** questioned him about this mystery. "It's difficult to keep a secret of a dead mammoth," Bonnichsen noted.

"I can't explain why," Holen replied. Other scientists, such as Oklahoma's Leland Bement, also have noted a puzzling lack of carnivore gnawing at some kill sites, for example, the Cooper site bison kill ("Folsom Bison Kill Offers Challenges," Mammoth Trumpet 10:3). Blowing dust that accumulated through the late Pleistocene to form the extensive Peoria loess deposit buried the mammoth bones relatively rapidly, but presumably not so rapidly that hungry predators couldn't have found them.

Paleo-American toolmakers wanted the lower half of the femurs.

Holen doesn't think the big mammoths had been hunted by the people who mined the bone. The sites contain little or no evidence of lithic tools, which would be expected at butchering sites, although the animals were definitely dismembered. "I think if they were killing them, they would have left stone tools behind," Holen said. He added, however, that bone flakes found at the sites would have made "expedient" or temporary tools quite adequate for cutting meat. Further, he noted, people may well have utilized the marrow contained in the crushed mammoth bones; fat is important to hunter-gathering peoples.

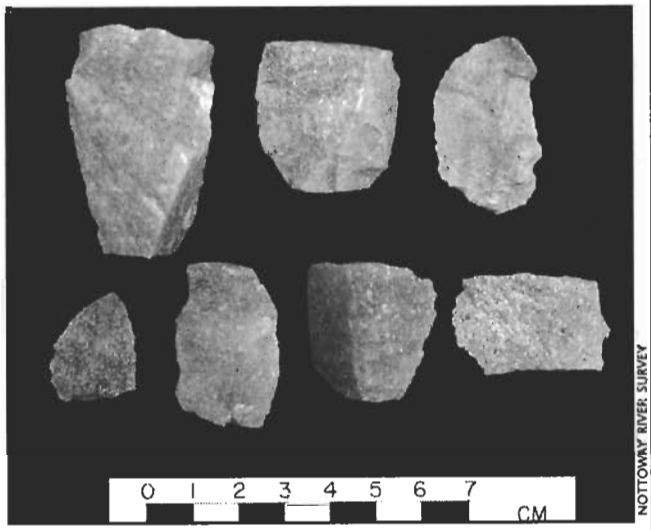
Scientists who have studied Peoria loess note that this widespread formation coincides with the last glacial advances of late Wisconsinan time. The precise age of Holen's sites within the Peoria loess have been determined by radiocarbon dating of mammoth bone and soil deposits. Thus mammoth bone at La Sena and Jensen sites can be dated with considerable precision—approximately 14,000 years B.P. at Jensen and 18,000 B.P. at La Sena. The Lovewell site in Kansas also has been dated at about 18,000 years B.P.

Holen's analysis has shown the bones were broken while still "green," that is, still moist. Research by Bonnichsen and other researchers has established that green-bone fractures are readily distinguishable from fractures in dry or weathered bone. Holen believes mammoth bone might have remained green for as much as three or more years in the cooler, moist Pleistocene climate.

Holen told his Oregon audience that without Bonnichsen's pioneering research more than 20 years ago on bone-fracture patterns, recognition of sites such as La Sena would not have been possible. Such fracture patterns could only have been made by humans. "Because of Rob's research I was able to recognize the significance of these sites," Holen said.

–DAH

New Dates at Old Site



These artifacts from the Cactus Hill site in southeastern Virginia (**Mammoth Trumpet** 11:4 "Simple Tools, Hearth Found Beneath Clovis Horizon") are from a level that has been recently dated to 16,670 ± 730 (Beta 97708) radiocarbon years, based on a flotation sample of very fine carbon particles from a possible hearth. The cluster of quartzite blades was among those found beneath Clovis-type occupation levels at the site. Previously, a pre-Clovis level at Cactus Hill had been dated to 15,070 ± 70 years B.P. The site is being investigated by J. M. McAvoy and the Nottoway River Survey.

Hair of the Dog

continued from page 1

sites would be nearest Siberia, and that all other cultural traditions would be younger in age. However, Bonnichsen noted that neither prediction is holding up. The oldest sites with Clovis-type tools aren't in Alaska or the Northwest. Further, he outlined a number of cultural traditions that archaeologists have found to be contemporary with Clovis. "Not only is there variability in the Clovis pattern itself, but we also have a number of co-traditions."

Bonnichsen went on to describe archaeological sites that predate the Clovis occupation, beginning with the Monte Verde site in Chile, where a wealth of archaeological evidence, including human footprints, many items made of wood, cordage, and even food remains including a piece of mastodon *(gomphothere)* meat, have been recovered and analyzed. "Tom Dillehay found the type of site the rest of us had dreamed of finding," said Bonnichsen of Monte Verde's principal investigator, a University of Kentucky archaeologist. "Tom found a waterlogged site buried beneath peat deposits." Radiocarbon analysis proved the village site is about 12,500 years old, more than a thousand years older than predictions of the Clovis-first model. What's more, the site has a 32,000-year-old level containing lithic materials that Bonnichsen says look like artifacts.

"So I'm going to conclude that the Clovis-first model is defunct," he said and went on to review evidence from a number of other sites that support the early entry hypothesis. Showing slides of archaeological sites and artifacts, Bonnichsen described evidence that humans—or their ancestors—were living in northern Siberia 300,000 years ago. He went on to describe North American sites including Pendejo Cave in New Mexico, Varsity Estates near Calgary, Alberta, Cactus Hill in southeast Virginia, La Sena in Nebraska, and the Chesrow complex in southeastern Wisconsin.

"Stone artifacts may not be a very good indicator of human population movement," Bonnichsen said. The archaeological record, he concluded, supports the early-entry model, but it can't answer the question of who. "Rather than using stone artifacts to try to find out how humans migrated, we have for the first time the potential to use human biological materials to try to answer questions such as, How did humans move through the Americas and how many migrations were there?"

DON ALAN HALL

Misty Weitzel, an Oregon State University graduate student, demonstrates her use of the CSFA's computer-imaging system for analyzing hair. A hair magnified by the video microscope on the right is depicted as a photomicrograph on the computer monitor at the left.

'I'm going to conclude that the Clovis-first model is defunct.'

Bonnichsen's analysis of archaeological evidence for the peopling of the Americas was followed by reports on the status of genetic evidence presented by Stone and Schurr **(article, Page 16).** Dr. Stone outlined theory and methods of analysis of ancient human DNA, and Schurr described evidence of human migrations found through studies of DNA of modern humans. Then Dr. Field explained Oregon State scientists' analysis of hair from prehistoric American settlements.

CSFA archaeologists became interested in hair several years ago when a field worker excavating deep in a unit at the Mammoth Meadow site in southwest Montana discovered a 30-centimeter-long hair. "That hair turned out to be human," said Field, who proceeded to explain how scientists analyze hair.

"There are two ways of identifying hair," she said. "First and probably the best way is based on the DNA sequences," which can reveal genus and probably species of the animal. "But long before you get the DNA, you can identify hair based on its morphology," she continued, showing illustrations of the morphology of hair.

There are three other important advantages to studying hair from archaeological sites: it contains carbon and thus can be radiocarbon dated; it is plentiful because animals and people naturally shed

DON ALAN HALL

After Biology Colloquium presentations, Donald R. Tuohy of the Nevada State Museum, left, talks with Katharine G. Field, an Oregon State University molecular biologist and D. Gentry Steele, far right, a Texas A&M anthropologist. Behind them is Walter Ream, another OSU molecular biologist.

a great number of hairs; and it is readily recoverable from many types of archaeological sites. **CSFA** teams have recovered hair from dry caves, open-air sites, permafrost, anaerobic clays, and other environments.

Field, a molecular biologist in OSU's microbiology department, acknowledged that hair also presents disadvantages. First, it is not easy to collect because it is easily overlooked and requires archaeologists to use special techniques. Second, hair contains extremely small amounts of DNA. "If you were to ask me what is the worst type of human tissue to use when you are going to do DNA work, I would have to say hair," Field told the colloquium audience. By the time a hair is hundreds or thousands of years old its DNA can be extremely difficult to recover. Degradation is a problem working with ancient DNA. "We don't always know when we get a set of hairs how well they're going to work."

Contamination, a constant challenge for DNA researchers, is particularly a problem when one is dealing with extremely small amounts of DNA. Field described laboratory procedures she and OSU molecular biologist Walter Ream have developed to recover and analyze DNA from hair. She, Dr. Ream, and workers in their laboratories must take elaborate precautions to prevent contamination by modern human DNA. "Any single molecule of modern DNA will be amplified preferentially if you give it a chance,"

For now, Ream and Field are concentrating on animal hair to ascertain if it can be recovered from all kinds of archaeological sites and to refine methodologies for analyzing it. Field outlined procedures the Oregon State team uses to recover and analyze hair (**Mammoth Trumpet** 12:1 "1996 **CSFA** Field Work Retrieves Ancient Hair"). After careful separation from other small biological

DON ALAN HALL

Forensic anthropologist Douglas Owsley of the Smithsonian Institution, right, and Francis P. McManamon, chief archaeologist of the National Park Service, chat with a visiting archaeologist during the Oregon State University Biology Colloquium in April.

Despite Obstacles, Conference Panelists Hopeful about Paleo-American Research

Biology Colloquium

ADVANCES IN BIO-MOLECULAR and anthropological research have armed archaeologists with revolutionary new tools in their search for the First Americans, according to a panel of speakers who summarized scientific advances described at a First Americans conference at Oregon State University in April.

When linked to the cultural record, the new methods and tools can, researchers believe, shed light on population movements across the landscape. Research also can pinpoint causes of death and types of disease as well as shed light on early human diets. And emerging new techniques offered by computers can provide worldwide databases of knowledge about human populations and revise and update the past's scientific misinterpretations.

But researchers still must leap bureaucratic, legal, and communication hurdles to realize the full potential of procedures such as genetic and DNA research on ancient hair and human skeletons, panel members said. Politics and public relations, panel members suggested, have become as important as science when tracing the First Americans.

The panel's conclusions came at the close of the colloquium, which **CSFA** Director Robson Bonnichsen opened by declaring that the once-popular "Clovis-first" model for peopling of the Americas about 11,500 years ago has been replaced by the "early entry" model. The new model shoves aside the long-prevailing theory that a single group of hunters swarmed into North America near the end of the last Ice Age.

"The last few months have been exciting in archaeology," Dennis Stanford, Smithsonian Institution Archaeologist, told the conference audience. He cited the acceptance of 12,500-year-old antiquity of the Monte Verde site in Chile by scientists whom he termed "the Clovis police," because they have been the strongest critics of the early-entry model.

"Clearly, the former models do not work anymore, and textbooks will soon be changing for the better," Stanford said. He noted that genetic models described at the conference suggest people may have reached the Americas as early as 30,000 years ago, and physical anthropological evidence suggests that many groups of people populated the North American Plains. The origin, timing, and number of colonizations of the Americas constitute an arena of ongoing research riddled with questions that have yet to be answered.

The picture is extremely complex, Stanford said, "but it will be fun over the next decade to unravel that complexity. I look forward to having more data."

Getting access to that data can be difficult; archaeologists have discovered few ancient human skeletons that geneticists and physical anthropologists can analyze and use to refine theories about the peopling of the Americas. And it is becoming more difficult to study ancient human bones because of the Native American Graves Protection and Repatriation Act (NAGPRA), panel members agreed. The 1990 law is designed to allow Indian groups to claim their ancestral remains. Disputes arising from the act, such as one involving the 9,000-year-old skeleton known as Kennewick Man, often create a stalemate between agencies, tribes and scientists. Bones may be locked away to prevent their analysis or may be reburied, which would halt all research on them.

"Human skeletons are necessary for the next generation of scientists to

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materials such as seeds, plant particles, and charcoal, **CSFA** lab workers wash each hair, make casts of its scales, mount it on a microscope slide, and take computerized images of it. Then the molecular biologists take over.

"We have a protocol we got from the FBI to extract DNA," Field explained. The technique, known as polymerase chain reaction, is used to amplify the particular bit of mitochondrial DNA (a gene) they wish to study. "We sequence the amplified gene," she said, "and compare it with sequences in the database to identify what the species was."

Field showed results of a number of DNA studies including those of mastodon tissue from a site near Corvallis, of a mountain sheep hair from a site older than 10,000 years in Nevada, and of a squirrel hair from the Mammoth Meadow site in Montana. The **CSFA** team analyzed 25 animal hairs from the Mammoth Meadow site and successfully recovered gene sequences from 14 of them. One was squirrel and the other 13 were from dogs.

Dogs? Field said the team had the same results from hairs recovered at a site in central Washington from which 40 animal hairs were analyzed. They got DNA sequences from 24 and all were identical to *Canis familiaris*, domestic dog. "So we asked ourselves," Field said, "is it likely that we could have dog hairs all over our sites?" The team concluded the hairs they analyzed are more likely from dogs than from gray wolves, which are genetically identical. "It seems very unlikely that people in settlements would have had wolves."

–DAH

DON ALAN HALL

Amy Dansie of the Nevada State Museum, where 9,000-year-old human remains are curated, talks with Biology Colloquium speaker Francis P. McManamon, chief archaeologist of the National Park Service, center, and James Chatters, the Richland, Wash., anthropologist who made the initial examination of the 9,300-year-old Kennewick Man skeleton.

study," said Douglas Owsley, curator and division head for physical anthropology at the Smithsonian's National Museum of Natural History. Locking up human bones may be a bureaucratically expedient approach but it is a shortsighted one, he said.

"The loss to science will be incalculable, and we will never have the data necessary to help us understand the peopling of the Americas," Owsley said. "Human skeletons should be carefully curated so we can progress through our contributions and our mistakes."

Using the recently uncovered colonial settlement of Jamestown, Va., as an example of how research can be conducted, Owsley described how a human skeleton there was removed intact and taken to a museum laboratory, where it was analyzed in full view of the public.

New techniques also helped properly identify another Jamestown-era skeleton, found in the 1940s, of a man who apparently died from terrible infections. Thoroughly analyzed by the best scientific standards of the time, the bones were judged to be those of a Native American. Owsley recently examined the skeleton with today's superior technology and determined the individual was an African. Further, Owsley noticed a previously undiagnosed gunshot wound. This diagnosis, assisted by computerized analysis, revealed a scenario of a suffering man dying in the American wilderness being put out of his misery by a fellow colonist.

He was one of the first African colo-

In Situ Ignorance?

PANELISTS summarizing the Biology Colloquium at Oregon State University examined the question of in-situ preservation—protecting archaeological material by not excavating sites or by preventing development. Lawyer Alan Schneider stressed the importance of collecting more data about the past rather than less, and he criticized cultural resource managers for acting to limit research. Francis P. McManamon, Chief Archaeologist with the National Park Service who functions somewhat as America's chief cultural resource manager, agreed that there is a problem.

"The only thing it seems we do *not* allow an archaeological excavation for now is simply to excavate an archaeological site," Dr. McManamon said. "It's OK if somebody wants to build a highway or somebody wants to build a sewage-treatment plant or build something else, because it's required. . . .This makes it more and more difficult simply to find out more about the past. There's something logically wrong with that."

McManamon said, "We do want to be parsimonious about how we use the archaeological record," but he added that probably there should be a more active effort to recover data.

–DAH

nists to the New World, Owsley said—a remarkable discovery that would have been missed if the bones had not been properly curated and available to today's researchers. He said several other misidentified skeletons from the early colonial era have been found to be Africans. "Using the standards of their day previous researchers had not been able to recognize them for what they are."

Unless proper analysis of human remains can be conducted, said panelist Alan L. Schneider, a lawyer, the cause of objective science in research on early Americans will receive a death blow. Schneider represents several scientists in their suit against the U.S. Army Corps of Engineers over disposition of the Kennewick Man skeleton. Initial analysis of the remains intrigued scientists because it indicated the man did not look much like today's Native Americans.

Schneider told the audience that NAGPRA needs to be administered in an "intelligent and nonpartisan manner." He added that that isn't always happening now because some cultural resource managers are assuming Kennewick Man must be an ancestor of today's Native Americans.

"From what we have seen here today, that is not necessarily the correct assumption," Schneider said. "Science without data is impossible." Human remains, he suggested, should not be placed off-limits for research, for they can help answer key questions today's crop of researchers are just beginning to ask.

"We need to gather more data rather than less data" if the important questions related to ancestral tribal affiliation inherent in NAGPRA are to be properly answered, Schneider said.

Francis P. McManamon, chief archaeologist of the National Park Service, agreed on the desirability of more knowledge about the past. He urged scientists and Native Americans to cooperate on research. "There is a need for civility and respectful relationships when interpreting the past," he said. He went on to stress the importance of not stereotyping anyone in respect to their attitudes. "There's no such thing as all Native Americans," he said, and added that there often is a wide variety of opinion about the value of science within individual tribes. Further, he said some managers of cultural resources are very eager to encourage science, and scientists also come in various political colors.

Dr. McManamon, after acknowledging that he probably was invited to the conference because of his role in implementing NAGPRA, agreed that the act does place constraints on archaeological research. But those constraints, imposed by Congress, do not prohibit that research. Rather, he said, NAGPRA seeks to reach a compromise between "Native American concerns of long standing about how human remains and important objects associated with their ancestors are treated" and "legitimate educational issues" raised by archaeologists, physical anthropologists and others.

Politics and public relations have become as important as science when tracing the First Americans.

McManamon urged scientists to interest Indian tribes in research and interpretation, "particularly in the responsibilities and rights for objects that are repatriated to them." He noted that the word "reburial" does not appear in NAGPRA nor in any regulations pertaining to it. "Once items are repatriated, the tribe has a full range of options."

He said that the issue of "culturally unaffiliated" is still under consideration "in terms of how we go about implementing the statute." Culturally unaffiliated remains and objects are those for which there is no easily identifiable modern group, for which a group no longer exists, or for very ancient remains. "This might hold promise for resolving the kinds of issues we have heard about today."

McManamon believes that in some cases it may be appropriate for museum administrators to place on research some restrictions that differ from those used in the past, even though they may not be legally required. Researchers, he said, need to communicate explicitly how they intend to use a collection. The key to working with NAGPRA, he suggested, is to approach the issue with "civility and respect for relationships." Cooperation can be obtained, he implied, so that all sides can be involved in exploring the complexity inherent in answering a central question explored during the colloquium: Who Were the First Americans?

–George Wisner

Suggested Readings

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DON ALAN HALL

D. Gentry Steele of Texas A&M University stands on the Oregon State University stage before a slide of an Asian skull of late-Pleistocene age as he describes research on America's earliest human fossils.

Anthropologists Stress Human Diversity

Ancient Peoples Do Not Fit into Today's Categories

THREE PROMINENT physical anthropologists explained the enormous scientific value of human skeletal material in understanding the biological heritage of current and ancient peoples during the Oregon State Biology Colloquium, "Who Were the First Americans?" in April.

D. Gentry Steele of Texas A&M University described research on the Americas' earliest human fossils, and emphasized that earliest-known American peoples differ from all contemporary populations and thus should not be categorized by traditional terms such as "Caucasoid" or "Mongoloid." Douglas Owsley of the Smithsonian Institution and Richard Jantz of the University of Tennessee described their extensive skeletal analysis program (**Mammoth Trumpet** 12:1 "A Database on Humanity's Past").

Both Dr. Jantz and Dr. Steele stressed that there was much diversity in prehistoric American populations, but noted that as recently as the 1970s influential anthropologists were teaching that Native American peoples were homogeneous. Steele reviewed the development of physical anthropology studies of aboriginal people in North America.

"Early skeletal remains, historically, have not played a major role in our models for the peopling of the New World," said Steele. The quest for "early man" in the Americas began in the 19th century as a parallel with discoveries such as Neanderthal people in Europe. By the early 20th century, influential scientists such as Aleš Hrdlička were convinced that people had been in the New World for no more than a few thousand years. The fossil record showed that prehistoric Americans were anatomically modern humans, and before the advent of radiocarbon dating, antiquity could only be inferred from geological context.

The discovery of unmistakable evidence associating humans with extinct Pleistocene fauna in the 1930s led to the belief that people had been in the Americas for many thousands of years, but the duration was tempered considerably when radiocarbon dating, which became available in the 1950s and 1960s, showed that the last Ice Age ended only 10,000 years ago. Steele noted a change in emphasis, beginning in the 1950s, that turned physical anthropologists away from developing typologies—classification of groups based on a few attributes—to interpreting diversity as due to adaptations to lifestyles and climates. There was much less study of human skeletal materials, and physical anthropologists grew to focus more on factors such as blood

groups to infer relationships between populations. Eventually, DNA became a focus.

The 1970s brought widespread use of computers and statistical analysis to physical anthropology. Complex problems, previously impossible to analyze, could be studied by new methodological approaches. Steele credits Christy G. Turner with initiating the contemporary period of studies of Native Americans with his long-term, detailed investigation of human dentitions from Asia and Europe as well as North and South America. By analyzing features of individual human teeth, Turner, of Arizona State University, saw evidence of three separate waves of migration into North America from Asia.

Next, Steele cited Harvard University's W. W. Howells, who pioneered multivariate analysis, highly sophisticated computer methodology, for analyzing 57 separate measurements in studying human skulls. Following the Howells methodology, any skull could be compared with a large, worldwide database of human skulls. Similarly, C. Loring Brace of the University of Michigan developed a procedure for using 28 cranial and facial measurements in his study of Asian peoples.

Data generated by Howells and Brace tended to agree with Steele's own multivariate analysis of North America's rare paleo-American skeletons: early-Holocene Americans did not look much like modern Native Americans. Steele, looking specifically at fossils known to be older than 8,500 years, found they resembled some prehistoric and modern Eurasians or Pacific islanders more closely than they did later American peoples. Steele also cited the analysis of Brazil's Walter Neves and Argentina's Hector M. Pucciarelli, who studied South America's oldest human fossils. Their study, and a later one by Neves and other investigators, agreed with other recent research indicating that the earliest Americans looked different from contemporary Native Americans.

"Early American populations are distinctive from later Americans," said Steele, illustrating his remarks with slides depicting results of multivariate analysis he has conducted with Joseph F. Powell of the University of New Mexico. Early-Holocene Americans looked less like recent Native Americans and north Asians and more like recent southern Asians, Pacific Islanders and others, including Europeans, he concluded.

Dr. Owsley told the conference audience—who included tribal members, students, amateur archaeologists, as well as scientists—his personal perspective of studying human remains. "I am a forensic anthropologist who has worked with law-enforcement agencies," he began. "I work on cases where you can't use facial appearances or fingerprints to identify individuals." He has worked on well-known cases identifying victims of mass murderers and human remains—Branch Davidians near Waco, Texas; soldiers killed in Desert Storm; victims recovered from mass graves in Croatia.

"So when I work with human skeletons, I know, in a very personal sense, that I'm dealing with human remains, and it doesn't make any difference whether they are the remains of somebody who was alive just a few weeks ago or remains of somebody from 500 or 5,000 years ago. We recognize that those remains come from settings that care about them. And I also care about them in the sense that I feel that they have a very important story to tell—if we know how to listen."

Owsley said that bones and teeth constitute a very special kind of scientific testimony about the lives of individuals. Besides attesting to an individual's identity, including age, sex, and health, they can reveal much about a person's ancestry, afflictions in life, cause of death, and clues to the type of work performed in life. They provide clues to diet, diseases, and sociocultural background. Further, bones and teeth can attest to the time since the person's death.

Owsley and Jantz explained how the Smithsonian Institution's long-term studies of human skeletal remains have added to a wide array of scientific knowledge about human health and prehistory. "My work with Dr. Richard Jantz has helped us refine this approach by intensively collecting osteological data from numerous groups from different time periods and different geographical areas," said Owsley. "Data have been collected for well over 6,000 Euro-American, Afro-American, and Native American skeletons from North America with special emphasis on prehistoric and historic populations of the Great Plains, the Great Basin, and also the eastern United States.

"This database includes detailed information on some extremely rare early-Archaic and Paleo-American skeletons including ones from Minnesota, Nevada, and Nebraska." He believes the study's specific objectives contribute significantly to the mission of this conference.

Jantz described specific parts of the database that apply to cranial analysis, compiled from measurements taken with specialized instruments. He said that quantitative analysis demonstrates wide variability among and within Native American populations, contrary to conventional anthropological wisdom that Native Americans are quite homogenous.

Jantz focused on North America's few ancient skeletons, specifically the Spirit Cave man (**Mammoth Trumpet** 12:2 "Remarkable Discovery"), illustrating, as had Owsley, that the earliest-known American skeletons are different in appearance from skeletons of later Americans. Using Howells's data and a computer program for categorizing ethnically unidentified cranial remains that he was instrumental in designing, Jantz compared measurements of the Spirit Cave man with those of other world populations. He displayed diagrams linking the Spirit Cave man to a wide array of peoples. A chart summarizing craniofacial complexes referred to as "vault profile" placed Spirit Cave man near the Ainu people of northern Japan; "facial forwardness" puts him closer to European people; "face and vault breadth" put him near the Atayal of Taiwan; and "face" data again placed him near Europeans.

These depictions of statistical data describe physical similarities, but they cannot classify an ancient individual such as the Spirit Cave man. Data analysis suggests that ancient North American skeletons represent a unique population, in some ways similar to other populations of ancient and later times. Authorities such as Jantz and Steele believe that ancient Americans more closely resembled some of their Eurasian contemporaries than they would resemble any modern populations.

–Don Alan Hall

Reconstructing Human Societies with Molecules Ancient & Modern

ARCHAEOLOGISTS have long studied tiny fragments of human material culture. Studies of small chips of stone, bone, wood and pottery, seeds, and even the minute particles of pollen left behind by the activities of ancient humans make up the "stuff" of archaeological analysis. But could artifacts get any smaller?

Yes, they can. Recent technological advances have made it possible to study the molecule of life itself. Deoxyribonucleic acid (DNA) has been successfully extracted from ancient animal tissues since 1984, when University of California scientists extracted DNA from the preserved skin of a quagga, an extinct zebra. The following year, Svante Pääbo of the University of Munich achieved another first when he recovered human DNA from a 2,400-year-old Egyptian mummy. By 1989, several researchers had extracted DNA from bones and teeth—hard and commonly preserved tissues. Nevertheless, ancient DNA was so rare and fragmentary that it was difficult to study. Then, another advance made it possible to produce numerous copies of each rare fragment. In the late 1980s, a process was developed that had the effect of creating a Xerox machine for DNA. The process, called polymerase chain reaction (PCR), separates the double-stranded DNA molecule, isolates the segments to be copied, then produces strands of DNA identical to the original. The process can be repeated almost indefinitely, doubling the amount of DNA with each repetition and producing enough DNA for any number of molecular analyses.

Where did all this discovery lead?

Anne Stone, a leading DNA researcher and a post-doctoral fellow at the University of Arizona, provided a good example at Oregon State University's 58th Annual Biology Colloquium in April. She illustrated the process of studying ancient DNA by describing her work on a pre-Columbian population of Native Americans from the Norris Farms site in central Illinois. Norris Farms was excavated in 1984 and 1985 by the Illinois State Museum, which removed approximately 260 well-preserved skeletons from a cemetery area within the site. The site and cemetery have been dated to about A.D. 1300.

Dr. Stone, working with Mark Stoneking (both then at Pennsylvania State University), sampled 152 individuals and successfully extracted DNA from 106 of them. Their work represented the first population-level genetic study of ancient Native Americans. Stone and her colleagues studied what is known as mitochondrial DNA (mtDNA). Mitochondrial DNA is different from the DNA found in the cell's nucleus, which contains an organism's genes on chromosomes. In humans, nuclear DNA exists as 23 paired chromosomes within the nucleus of the cell, and contains something on the order of 30,000 to 100,000 genes arranged on a series of very long doubled-stranded helices—relatively complex molecules. On the other hand, each mtDNA molecule contains only 37 genes arranged in a circular pattern. Mitochondrial DNA is found not in the nucleus of the cell but in another cellular structure called the mitochondrion. Because each cell contains many mitochondria but only one nucleus, mtDNA is much more common than nuclear DNA and thus is more likely to be preserved and extracted by the genetic archaeologist. Its shorter sequence of genes also makes it much easier to map. In fact, the genetic information of the whole mtDNA has been completely sequenced, making the analysis of other mtDNAs much easier.

Mitochondrial DNA has other advantages over nuclear DNA. It is inherited only through the maternal lineage—meaning we get our mtDNA only from our mothers—and thus lineages are less confusing to trace (although we do lose information on male ancestry). There is also no recombination—the shorter mtDNA does not rearrange itself as do nuclear genes on the chromosomes. Finally, the mtDNA has a high mutation rate compared with nuclear DNA. This rapid rate of change makes mtDNA a good evolution-

BOON ALAN HALL

Genetics researcher Theodore Schurr of Emory University tells of finding genetic affinities across the Bering Sea. He has been studying population genetics in living Native American and Asian populations for more than eight years.

ary clock in that it is easier to measure the genetic changes of an mtDNA lineage through time.

Stone found the Native American population from Norris Farms was similar in genetic makeup to modern-day Native American groups, whose mtDNA has also been analyzed. As it turns out, most all modern Native American populations have mtDNAs belonging to only four primary mtDNA lineages that were brought to the New World by their founding Asian ancestors. These lineages are distinguished by four different "markers" along the mtDNA genome, designated haplogroups A, B, C, and D. The Norris Farms population contained all four haplogroups, which were distributed among the individuals studied. Two individuals appeared to represent a fifth founding mtDNA lineage, one which is now being detected in recent studies of Native American mtDNA variation. Stone found that the frequency distribution of individuals within each lineage was similar to that of modern Native American populations, but not to that of modern Athapaskan groups (Athapaskans or NaDene Indians are believed to have arrived later). Because the Norris Farms group is a pre-Columbian population, Stone is confident that they descended from only the ancestral Amerindian genetic stock.

Interestingly, all four of the modern Native American mtDNA lineages are found in Asia. There are quite a few additional mtDNA lineages found in Asia as well. In fact, the fifth lineage found by Stone actually clusters statistically with a known Asian mtDNA lineage when compared with Asian samples.

Genetics researcher Theodore Schurr, a doctoral candidate at Emory University and another speaker at the Biology Colloquium, has been studying population genetics in living Native American and Asian populations for more than eight years. By examining DNA from various populations, he has evidence of genetic affinities across the Bering Sea.

Schurr has studied more than 800 Native American samples and more than 500 Siberian and Asian samples. Looking at both mtDNA and Y-chromosome markers, he has found several lineages occurring in various populations across Siberia, East and Southeast Asia. In general, all four of the mtDNA lineages occurring in Native American groups have been found in Asian groups, while only three of them appear in Siberian populations. Haplogroup A is concentrated in northeastern Siberia, but also found in East Asia; haplogroups C and D are widespread across Siberia and are also found at low frequencies in East Asia; and haplogroup B is seen in East and Southeast Asia but not in Siberia. Another Siberian haplogroup, still under investigation and thus described as "X," may cluster with the fifth lineage reported by Stone.

Schurr also sees geographic variation among the groups in the New World. Haplogroup A shows a north-to-south clinal relationship; the highest frequencies of these mtDNAs occur in the north. Conversely, haplogroups C and D increase in frequency toward the south. Haplogroup B remains somewhat constant in frequency wherever it is found, but is absent in NaDene populations in Northwestern North America as well as in some groups in southern South America.

Looking at variations within each haplogroup and between haplogroups, and using known mutation rates as an evolutionary clock, Schurr's group at Emory has estimated dates of origin for each mtDNA lineage. Haplogroup A appears to have originated sometime between 35,000 and 25,000 years ago; haplogroup B between 15,000 and 11,700 years ago; haplogroup C between 43,000 and 33,100 years ago; and haplogroup D between 26,300 and 20,000 years ago.

These, he stressed, are dates of origin for the haplogroup, but they do not tell us the exact time of migration to the Americas, which must have taken place at some time after each haplogroup's origin.

Research by Stone and Schurr suggests a possible reduction in mtDNA diversity associated with the early colonization of the New World. In other words, not all Asian genetic haplogroups moved in this direction. Stone told the **Mammoth Trumpet** that her data and Schurr's data support the idea of one migration to the New World, not several.

"If there were more than one migration, you would expect different Asian lineages to enter the New World each time," said Stone. "The four primary lineages are rather rare in Asia, so you would not expect this subset of Asian

DON ALAN HALL

Anne Stone, a leading DNA researcher and a post-doctoral fellow at the University of Arizona, told the Biology Colloquium audience of her work with the DNA of ancient people.

Biology Colloquium

Genetic Clues Point to One Early Migration

DON ALAN HALL

After his Biology Colloquium presentation, Theodore Schurr discusses migration theories with Alan L. Bryan, left, University of Alberta archaeologist who has long argued that people entered the Americas before Clovis time. Dr. Bryan has published data on his work at pre-Clovis sites in both South and North America.

lineages to be present repeatedly in different groups of migrants." Further, she said that it is likely that a group of migrants would have many different lineages. As an example, she noted that many Native Americans with a genetic trait known as the nine base-pair deletion (haplogroup B) aren't thought to have migrated as a group.

"The scenario that seems the most likely to me," said Stone, "is one wave of migration into the New World with some individuals going past the glaciers while others may have been trapped behind the glaciers in Beringia during peak glaciation." These people, she added, later expanded into Canada when the glaciers receded and now make up the peoples known as NaDene Indians and Eskimo-Aleut. "This scenario was proposed by [Canadian geneticist Emőke] Szathmary a few years ago." (See **Mammoth Trumpet** 8:2 "A Geneticist Looks at the Peopling of the Americas.")

When Stone applies known mutation rates for mtDNA, she concludes that New World populations separated from Asian populations between 16,000 and 26,000 years ago—that's a rather fast mutation rate; a slower one probably is more likely. "If a slower rate is used, the dates range from 23,000 to 37,000 years," Stone said.

Schurr's data indicate an entry somewhere in this range but also a possible later entry by haplogroup B, which originated sometime after 15,000 years ago. In summary, the analysis of ancient (and modern) DNA provides a strong new tool for answering questions about the earliest colonization of the New World. Continued analyses should provide many insights into the genetic, demographic, and archaeological aspects of the earliest New World populations.

–David Stepp

DNA Links Teacher to Ancient Skeleton

Oxford University scientists have found a genetic link between a 9,000-year-old skeleton and at least one current resident of the area where the skeleton was discovered in 1903, according to *The New York Times*. The skeleton is considered the oldest complete one ever found in Britain, although human bones dating much earlier in the Pleistocene have been found there.

Bryan Sykes, head of the cellular genetics group at Oxford's Institute of Molecular Medicine, told the newspaper that it is likely that 1 to 1.5 per cent of Britain's entire population are related to the skeleton, known as the Cheddar Man because it was found in a cave near the Somerset village of Cheddar, the place that gave its name to cheese. The cave is now a tourist attraction; the bones are curated in the Natural History Museum in London.

While doing research for a series on the archaeology of Somerset, a documentary film maker asked scientists if there might still be descendants of the Cheddar Man living in the region, *The Times* reported. Dr. Sykes and his team had recovered a bit of mitochondrial DNA from one of the skeleton's molars. Inquiring into the film maker's question, team members took tissue samples from inside the cheeks of 20 Cheddar volunteers and recovered mitochondrial DNA to compare with samples from the skeleton. One man, a high school history teacher born in nearby Bristol, proved to be a descendant, Sykes told *The Times*. "You go back and eventually you come to someone who is a direct ancestor of both of them, perhaps even Cheddar Man's mother or grandmother," he said.

Sykes's team at Oxford is making a genetic map of all of Europe.

COMING CONFERENCES

Aug. 28–Sept. 3 IV International Conference on Geomorphology, Bologna, Italy.
Contact: International Conference on Geomorphology, Planning Congressi s.r.l, Via Crociali 2, I-40138 Bologna, Italy.

Sept. 18–21 3rd Biennial Rocky Mountain Anthropological Conference, Bozeman, Mont.
Contact: Ken Canon, NPS Midwest Archaeological Center, Federal Building, Room 474, 100 Centennial Mall North, Lincoln NE 68508-3873, 402-437-5392, ken_cannon@nps.gov.

Sept. 22–26 XII Congreso Nacional de Arqueologia Argentina, Buenos Aires.
Contact: Facultad de Ciencias Naturales, Universidad de La Plata, Paseo del Bosque S/N 1900 La Plata, Buenos Aires, Argentina. 5421-25-6134. museo@isis.unlp.edu.ar.

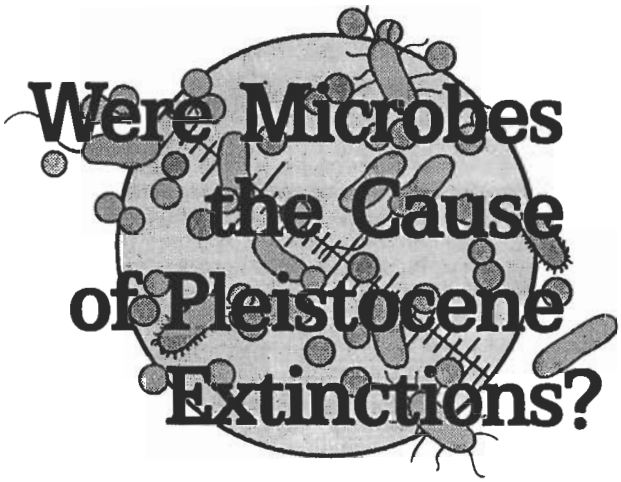
Oct. 20–23 Annual Meeting, Geological Society of America, Salt Lake City.
Contact: Vanessa George, Geological Society of American, 330 Pentrose Place, Boulder, CO 80301. 303-447-2020. Fax 303-447-1133.

Nov. 13–16 30th Annual Chacmool Conference, Calgary.
Contact: Nancy Saxberg, Conference Committee, Dept. of Archaeology, University of Calgary, 2500 University Dr NW, Calgary AB T2N 1N4. 403-220-5227. 13041@ucdasvm1.admin.ucalgary.ca

Nov. 19–23 96th Annual Meeting, American Anthropological Association, Washington, D.C.
Contact: AAA Meetings Dept. 4350, N Fairfax Dr. Ste. 640, Arlington, VA 22203. 703-528-1902 ext. 2. liz@aaa.mhs.compuserve.com.

Send conference notices to Mammoth Trumpet, 355 Weniger Hall, Oregon State University, Corvallis, OR 97331-6510.

Were Microbes the Cause of Pleistocene Extinctions?



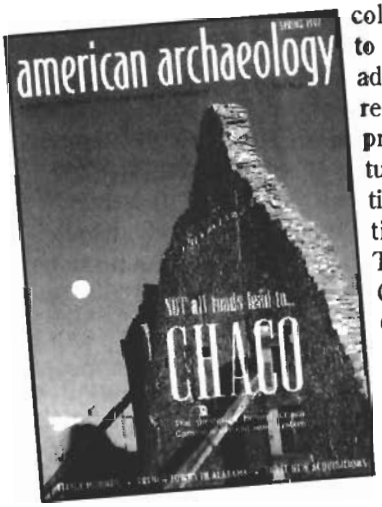
A rapid change in climate, or blitzkrieg by newly arrived humans?

For decades scientists have been arguing that one or the other process, or both in combination, were responsible for the extinctions of the Pleistocene megafauna. Now a well-known mammalogist has offered a third theory. Ross D. E. MacPhee of the American Museum of Natural History suggests that disease may have been the controlling force that drove mammoths, mastodons, and dozens of other great Ice Age beasts over the brink to oblivion. The theory suggests that migrating people may have killed off the animals with microbes rather than spears.

Dr. MacPhee, who is collaborating with virologist Preston A. Marx, offered the hypothesis in April at a symposium sponsored by the museum's Center for Biodiversity and Conservation. Their hypothesis, as reported in an article in *The New York Times* in April, posits that animals were infected by introduced lethal pathogens. Disease would have traveled across the continent "in the wake of humans." One of the attractions of this theory is that it is susceptible to testing. The investigators plan to examine mummified remains of Pleistocene animals to see whether there are genetic traces of disease organisms. Their assumption is that the virulent disease is still present, but that it has adapted into a less virulent or non-virulent form.

New Magazine

The Archaeological Conservancy, which is based in Albuquerque, has begun publishing *American Archaeology*, a colorful quarterly devoted to a variety of features in addition to Conservancy research and projects to preserve America's cultural heritage. Information on the new publication is available from The Archaeological Conservancy, 5301 Central Ave. NE, Suite 1218, Albuquerque, NM 87107. Rob Crisell is managing editor.



Communication

Eastern Hardwoods in Percussion Flaking

I am responding to your inquiry about wooden billets in **Mammoth Trumpet** 10:3 (July 1995), p. 11. The articles about the Peruvian Paleoindians were provocative. [Jacques] Pelegrin's experimental study is exemplary, and the first in recent times to tout wooden percussors. Experimental archaeologists, researchers and flintknappers, including yours truly, have discovered the beauty and efficiency of wood in shaping stone.

I have been using wooden batons (billets) for over 20 years. Errett Callahan first demonstrated to me the usefulness of wood in the early 1970s, and I have been experimenting with it ever since. I am very close to publishing a treatise on wood-baton percussion-thinning technologies.

Although almost any hardwood will suffice, certain woods have a distinct advantage over others. I don't have much experience with the Western woods, including mesquite, but I do know that mountain mahogany (a shrub-like tree that grows in higher elevations) works quite well. I have a small billet of this material that I have been using on occasion for more than 10 years.

Of the eastern hardwoods, most with a specific gravity of .60 or more will work. Specific gravity relates to hardness—the higher the number the harder the wood (in general). I have conducted extensive experiments with most of the Eastern hardwoods in this category including dogwood (.73), hickory (.72–.75), hornbeam (.70), Kentucky coffee tree (.60), locust (.66–.69), red mulberry (.66), oak (.68–.88), Osage orange (.81), pear (.73), persimmon (.74) and sycamore (.60). The best of these were dogwood, hickory, Osage and persimmon. Even though Osage performed very well due to its weight, it had a tendency to splinter and abrade quickly, which shortened maximum use life. This was also found to be a major drawback with the East's heaviest wood, live oak (.88), yet it is still a viable species type. Dogwood and persimmon are comparable as the very best—most durable and efficient wood species. Pignut hickory *(Carya glabra)* (.75) is almost as good. Like other raw materials, certain hardwoods may have been tied to trade and exchange networks during key episodes of large-biface production. Certain lithic technologies were absolutely dependent upon this medium for thinning tasks in most coarser-grade stones.

Conclusions developed through prehistoric lithic technology using flake geometries and fracture characteristics (the language of flakes) suggest strongly that only soft percussors (hardwoods) could have been used to produce some of the biface technologies found in the eastern Appalachian Mountain Province, the source of all the coarse-grained, lower-grade stone that many prehistoric groups were so skilled at using.


Replicating Ancient Artisans' Expertise

French authority achieves quantitative, qualitative results from local materials by following a carefully devised

Understanding the Work of Paleoindian Flintknappers

Only wood can produce the distinct flake geometries and platform types found in the lithic technologies associated with these sources. This is clearly apparent in the broad-spear technologies of the region. Distinct differences are evident in the application of force, motor skills and social/economic organization between prehistoric groups.

Wood is an optimum percussor material in that it delivers a less shocking force. It has greater loading capabilities and lower velocity advantages in flake detachment.

Why wood?

- Accessible (suitable wood is nearly everywhere)
- Superior to other mediums for certain technologies
- Archaeological evidence supports the use of wooden billets in reduction processing of meta-sediment and volcanic materials.
- Limited manufacturing and maintenance tasks
- Delivers loaded force with minimal shock.

Wood may be softer than stone, but its power lies in its magic, like no other substance, to shape stone.

—Jack Cresson
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