MAMMOTH TRUMPET

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Center for the Study of the First Americans
355 Weniger Hall, Oregon State University
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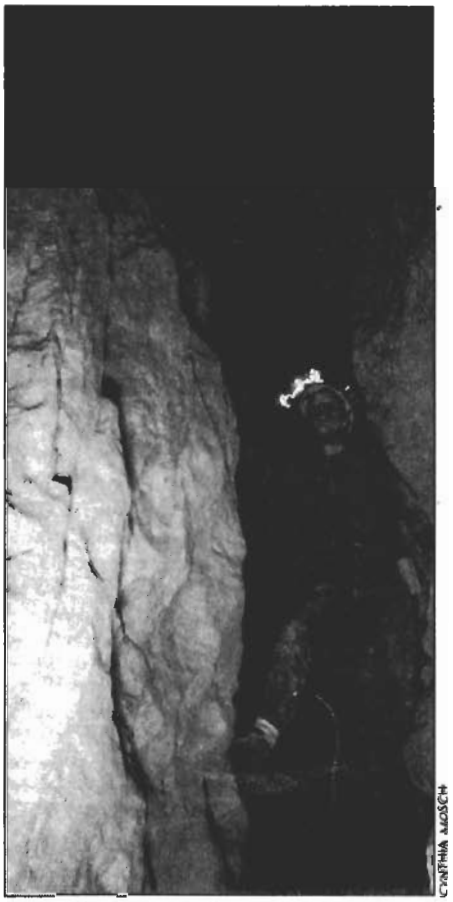
Scientists Analyze Bones of Ancient Humans



A cave scientist in Hourglass Cave high in the Colorado Rockies negotiates a passage near where the 8,000-year-old bones of an ancient cave explorer were recovered (page 10). Those bones have been analyzed and buried, but scientists are busily analyzing other human remains and adding their findings to an extensive Smithsonian Institution database (page 1).

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.

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A DATABASE ON HUMANITY'S PAST

Smithsonian Team Races the Clock with Repatriation

CARSON CITY, Nev.—As the Olympic Games got under way in Atlanta last summer, a scientific contest of sorts was under way here at the Nevada State Museum. A team of forensic anthropologists had come to Nevada's repository for historical and scientific information to analyze human skeletal remains.

Like Olympic athletes, members of this team brought years of intense training and practice to their undertaking, and like Olympic runners, they, too, were competing against time. Much of the material they are analyzing here and at other museums may be subject to repatriation under the Native American Graves Protection and Repatriation Act, commonly known as NAGPRA. Their primary goal is to secure as much knowledge as possible about the human past while it is available.

The team also hopes to assure various Native Americans who seek return of human remains that they can, indeed, receive the bones of their ancestors and not simply any human bones. While the anthropologists race against time, the quality of their analysis is necessarily foremost, and they employ teamwork to gain the maximum of individual talents. Don Tuohy, curator of anthropology at the Nevada State Museum, secured money to support the team in Carson City with a grant from the James W. Calhoun Foundation.

Douglas Owsley of the Smithsonian Institution is team leader. He has devoted much of his professional life to the study of human skeletons, especially those of the peoples of the American Plains, although he has also studied the skeletal remains of numerous European Americans and African Americans. His career has carried him beyond North America, too, most recently to help in the identification of victims of the genocidal violence in Croatia.

Working here with Dr. Owsley is veteran physical anthropologist Richard Jantz of the University of Tennessee, who also has lengthy experience in the study and analysis of Great Plains peoples. Here Dr. Jantz is specializing in the team's cranial analysis. Completing the team are Kari Sandness of the Smithsonian, Shannon Novak of the University of Utah, and Parvene Hamzavi and Chip Clark of the Smithsonian. These workers compose a team that is highly trained, skilled, and experienced in the analysis of America's human skeletal material.

"We process all skeletons as a team," says Owsley, taking a brief break to explain the project to the **Mammoth Trumpet**. "We do the same thing for the prehistoric remains that we do for the colonial burials that I've been working on." Their system, which focuses on specific variables, has been in operation for fully a decade.

One team member analyzes each individual, carefully detailing her observations

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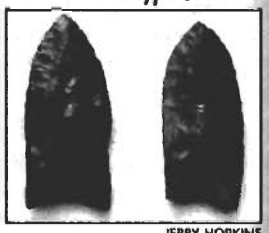
California lake site rich in Clovis-type tools



JERRY HOPKINS

Biology Colloquium Focus: First Americans

First Americans Studies will be the focus of Oregon State University's 55th Annual Biology Colloquium, which brings leading scientists together to discuss their research before an audience of teachers, researchers, students, and public. One of the university's most prestigious scientific programs, the Biology Colloquium examines a specific and timely biological theme each year.

The all-day program will be April 24 at the LaSells Stewart Center on the Oregon State campus in Corvallis. Experts from across North America will present evidence gathered using new approaches in molecular archaeology and physical anthropology that are broadening perceptions of who the first Americans were. Scientists will present archaeological, skeletal, and DNA findings essential to understanding America's cultural and biological heritage.

Long-accepted scientific theory holds that the first people crossed into North America from northeast Asia more than 11,000 years ago. Thus it has been generally assumed that today's Native Americans are the descendants of those first Asian travelers. However, research in skeletal morphology suggests that people in the Americas before about 9,000 years ago may have looked different than later peoples. Did the earliest Americans come from somewhere other than Siberia?

Scientists who will present recent research findings at the Colloquium include Robson Bonnichsen, Director of the **Center for the Study of the First Americans**, Oregon State University; D. Gentry Steele, Department of Anthropology, Texas A&M University; Douglas Owsley, Department of Anthropology, Smithsonian Institution; Anne Stone, Department of Anthropology, Pennsylvania State University; Walter Ream, Department of Agricultural Chemistry, Oregon State University; Katharine Field, Department of Microbiology, Oregon State University; and another presenter who is yet to be determined.

Dr. Bonnichsen will present an overview of the archaeological record for northeast Asia and North America and will discuss what the archaeological record has to say about the first Americans. Dr. Steele is the author of a number of papers on skeletal remains of the early Americans. Dr. Owsley is a forensic anthropologist at the Smithsonian Institution who has developed an extensive database of human skeletal observations. Dr. Stone will give an overview of the molecular biology approach. Dr. Ream and Dr. Field, who are gathering evidence as part of Oregon State's Molecular Archaeology Project, will talk about their research on ancient DNA and what they are learning about the prehistory of human genetics in the New World. A final speaker will provide an overview as to where we are in the development of our understanding of prehistoric human genetics in the New World.

A closing panel discussion is expected to involve representatives from the National Park Service, Smithsonian Institution, National Academy of Sciences, and attorneys with expertise in cultural resource law.

The annual Biology Colloquium is sponsored by Oregon State University's Research Office, and its colleges of Agricultural Sciences, Forestry, Science, and Veterinary Medicine. Bonnichsen, Ream, and Field are organizing this year's event.

If you'd like to attend the colloquium, contact the Corvallis Convention and Visitors Bureau for information: 541-757-1544 (fax 541-753-2664), or visit the bureau's site on the World Wide Web at WWW.visitcorvallis.com/ccvb. The bureau's mailing address is 420 NW 2nd St., Corvallis OR 97330.

–Carol Ann Lysek

MAMMOTH TRUMPET

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1996 CSFA Field Work Retrieves Ancient Hair

Strategy Seeks New Information from Old Sites

Completion of the 1996 field season found the **Center for the Study of the First Americans** well-launched into molecular archaeology, its trail-blazing analytical approach. Summer excavations at new and old archaeological sites produced hundreds of bags of washed sediments that are presently undergoing analysis by researchers at Oregon State University.

The three summer field projects were in Montana, Wyoming and Nebraska. Robson Bonnichsen, Professor of Anthropology at Oregon State and Director of the **CSFA,** is confident that the **Center**'s molecular archaeology strategy will result in more precise and hitherto unobtainable information about Paleo-American people.

Goal of the summer's excavations was to recover new samples of small-scale biological and inorganic material by using fine-screen washing. In addition to seeds, small-mammal remains, plant macrofossils, fossil insects, lithic flakes and charcoal, the washed sediments contain ancient human and animal hairs that can be subjected to DNA analysis.

On two of the summer's field projects, the **CSFA** worked in collaboration with other archaeologists on previously excavated and well-studied archaeological sites. Dr. Bonnichsen says the collaboration allows the **Center** to draw on a significant body of previous research and tie its work to known stratigraphic, chronological and artifact records.

ANNE STANAWAY

Reflecting on trenching work at the Cremer site, CSFA director Robson Bonnichsen wears reflected images of backhoe and team members in his glasses.

Hell Gap Site, Wyoming

The National Endowment for the Humanities recently awarded archaeologist George Frison and his colleagues at the University of Wyoming funding to analyze chipped stone, faunal remains, and other data from the Hell Gap site near Guernsey in southeast Wyoming. It was at Hell Gap in the early 1960s that the Goshen cultural complex was identified. The original Hell Gap archaeological excavations were conducted by Harvard University and the University of Wyoming from 1959 to 1966. These investigations disclosed the most complete sequence of cultural remains yet recovered in the Great Plains region. The early field work collected a massive amount of data and revealed six cultural layers, including Goshen and Folsom, but only a minimal amount of this material ever underwent laboratory analysis and was described in publications.

The aim of Dr. Frison's new analysis was to characterize the hunter-gatherer adaptations represented at this significant site. Supporting analyses included chronometric dating by accelerator mass spectrometry, geology, geomorphology, and paleoenvironmental reconstruction through pollen and phytolith studies. Geoarchaeologist C. Vance Haynes worked on a reassessment of the site's stratigraphy.

JO ANNE HARRIS

"Not *MY* hair!" Molecular anthropology field workers must take precautions not to shed hairs that might be confused with ancient hair recovered from the excavations. This bewhiskered member of the CSFA team at Hell Gap was taking no chances at contaminating samples.

The **CSFA** team worked closely with the project archaeologists, geoarchaeologist and stratigrapher. Members collected fine-scale samples of sediments from two 50-centimeter-square columns for screen washing. This resulted in 300 six-liter bags of sediments that were brought back to OSU for further analysis.

Preliminary field analysis of the sediments revealed a hair record that crosscuts the occupation levels and even extends below the known archaeological record by about a meter, says Bonnichsen.

La Sena Site, Nebraska

La Sena, along with its neighboring sites of Jensen and Shaffert, has produced flaked mammoth bones that appear to have been altered by humans. To date, no flaked stone artifacts have been found at these locations. Steve Holen, archaeologist for the Nebraska State Museum, and David May, geoarchaeologist from

Volunteers Play Crucial Role

VOLUNTEERS play an integral role in what the **Center for the Study of the First Americans** is able to accomplish on its field projects. Without their help much less would get done and the work of the **Center** would suffer for it. As is true with almost all volunteer work, both the volunteer and the organization the volunteer works for often benefit in unexpected ways.

Shannon Dillon, a 23-year-old graduate from Sonoma State University, found her two weeks at La Sena particularly meaningful because, though she is blind, she feels she was treated as a regular member of the team. She says **CSFA** Director Robson Bonnichsen and principal investigator Steve Holen integrated her effortlessly into the work of making a cast of a mammoth bone as well as digging and screening the soil column.

Lab work was the only thing she didn't get to do; working in the field laboratory required looking through a microscope to sort hair and other organic material from the soil matrix.

Working with people with physical limitations, Dr. Bonnichsen says, opens your eyes to what is possible. He has known that blind people could operate in archaeology ever since observing his college advisor who was blind. Bonnichsen was quick to accept Dillon for the project, but was not sure how to integrate her into it until they were actually on the site. Then it became self-evident.

Dillon says that in her experience having a visual limitation requires a process of problem solving, just like many other aspects of life. So it often is not possible for her to say ahead of time how she proposes to deal with a problem. Once she has the opportunity to face a particular situation then the way to deal with it usually becomes clear.

ANNE STANAWAY

Henry Katz, retired lawyer and insurance executive, volunteered two weeks of his summer to work at the Cremer Ranch site. A member of the CSFA Advisory Board, he has been interested in archaeology since high school.

Her previous archaeological experience included the initial investigation of a Guatemalan Mayan site and the historical archaeological excavation of writer Jack London's home in northern

the University of Northern Iowa, have dated these and other late-Pleistocene sites to 20,000 to 14,000 years ago. The sites suggest that people were processing mammoths during the last glacial maximum, when the ice sheets were as far south as the South Dakota–Nebraska border along the Missouri River (**Mammoth Trumpet** 10:1 "Bones of Nebraska Mammoths Imply Early Human Presence").

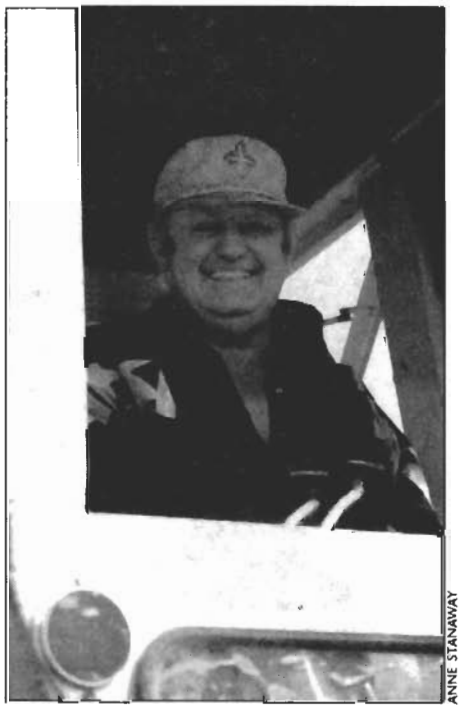
The La Sena site was discovered in 1987 by Bob Blasing and Brad Coutant during a survey of Medicine Creek Reservoir. The mammoth bones were exposed by lateral erosion from the reservoir. Excavations extend to about 3.5 meters below the surface, and so far about 25 percent of a single Columbian mammoth (*Mammuthus columbi*) has been exposed. Collagen from the mammoth bone has been dated to 18,000 years ago.

The **CSFA** crew processed over 600 six-liter bags of sediment from La Sena, Jensen, and Shaffert sites, recovering a hair record from all three. Sediments from the sites are being analyzed in **Center** laboratories.

Cremer Site, Montana

Work at the Cremer site, about 100 miles west of Billings, Mont., was a continuation of fieldwork done in 1995. The site, near the Crazy Mountains, is at the head of a spring and is partially sheltered by a shallow sandstone canyon. Fortunately, this area has never been glaciated; it contains Holocene and late-Pleistocene archaeological deposits that are likely to be greater than 10,000 years old, says Bonnichsen.

Fresh water and a sheltered camping area would make the site appealing to ancient as well as modern hunters and gatherers. Little information has been gathered on this part of Montana, so the



ANNE STANAWAY

California. But since her main interest is in American prehistory, Dillon was quite pleased to have the opportunity to work on this Nebraska Paleo-American site.

Henry Katz, from Simsbury, Conn., a retired regulatory lawyer and former vice-president of The Hartford Insurance Group, volunteered two weeks of his summer to work at the Cremer Ranch site. His interest in archaeology, dating from high school, led him to participate in other digs including one in Belize where he helped excavate the foundation of a Mayan temple.

Katz, a member of the **CSFA** Advisory Board, said that in addition to four graduate students from Oregon State University and a soil scientist from the University of Wisconsin, the team contained four volunteers. Besides himself and a retired California businessman in his early 70s who is also a **CSFA** board member, there were two women—a special-education teacher from Oregon, and a rancher from northern Montana.

He said the excavation procedure at the Cremer Ranch began by using a backhoe to dig a trench. Next, a one-square-meter column of soil was dug out of the side of the trench to a depth of three meters. This soil was put into three-liter bags that were later dumped on a four-sided screen and washed with water pumped from the nearby creek. Whatever was left on the screen—rocks, hairs, bones—was then placed in bags and brought back to OSU for further analysis.

Care was taken, said Katz, to avoid contaminating the samples with modern human hair. Each worker wore a hair net under his or her hat, long-sleeved clothing, and gloves. During the washing phase, each wore rain gear. He said a hair sample was collected from each member of the team to be analyzed along with any hair from the dig as a further precaution to alert against inadvertent contamination.

KEVIN GOODRICH

Shannon Dillon works at the Jensen site, near Nebraska's La Sena site. The Rhonert Park, Calif., resident has a bachelor's degree in anthropology; her main interest is American prehistory.

Katz says that all the volunteers were familiar with Bonnichsen's work in molecular archaeology. He thinks volunteers would probably need to have some archaeological experience under their belts to appreciate the subtlety of searching for ancient hair as opposed to something more self-evident such as shards of pottery or lithic tools.

Katz enjoyed the overall experience of working in a group in which everyone contributes something different. He found the quiet beauty of the location was memorable. Among the highlights of his experience was seeing three rattlesnakes, wild turkeys, a doe and fawns, sandhill cranes, antelope, and brook trout. Getting in on the ground floor of a new analytical archaeological process was particularly exciting for Katz.

–CAL

ANNE STANAWAY

Montana rancher George Cremer in his backhoe, opposite, digs a trench at the Cremer site for CSFA researchers who are studying the stratigraphy and depositional history and collecting hair and other biological evidence. Cultural deposits extend more than two meters below the surface. Dustin White, above, examines soil profiles while Misty Weitzel takes notes. Weitzel and White are graduate students at Oregon State University. Property owner Cremer is a member of the CSFA Advisory Board.

research here is focused on understanding the initial colonization of the region and its history of human adaptation. The goal is to understand the depositional and environmental history of the site.

A drilling program conducted in 1987 revealed that cultural deposits extend at least 2.5 meters below the present surface and date back to the end of the last Ice Age. At least three buried soils and four occupation levels were exposed.

A large charcoal sample and an associated flake buried with it at the bottom of a section are awaiting radiocarbon dating. The screen-washing process from the 1996 fieldwork resulted in 256 six-liter bags of sediment that are undergoing laboratory analysis.

A variety of personnel worked on the various field projects this summer including scientists, graduate students, allied professionals and volunteers.

–Carol Ann Lysek

Editor's Note: The **Mammoth Trumpet** *has published many articles focused on the contribution of genetics to the study of the peopling of the Americas:*

1:2 "Russian-American Team Links Ancient Population Genetics"
2:3 "Assessing Eskimo and Indian Affinities"
6:1 "Studying Ancient American DNA*"*
6:3 "Living Cells Unlock Ancient Mysteries"
7:1 "Paleoindians and DNA*"*
8:2 "A Geneticist Looks at the Peopling of the Americas"
8:3 "Team Traces Four Trails from Asia"
9:2 "New Wave in Archaeology: Hair"
11:2 "New Focus, Molecular Archaeology"
11:3 "Viruses May Offer New Line of Evidence"

In this article, we review recently published research articles; references are included.

Genetics: A Review

Scientists Follow Various Trails In Search of the First Americans

RECENT WORK ON HUMAN DNA and related genetic topics has two Janus-like faces, looking in opposite directions. The more engaging of the two vistas to **Mammoth Trumpet** readers is the new research on the peopling of the Americas. For the other vista, difficulties persist in deciding which facts are "true facts" and which are "false facts," presenting a foggier landscape. Both conceptual and technical questions plague this field of research, still in its infancy, and it is important for those interested in the peopling of the Americas not to assume that genetics can, by itself, answer *most* of the questions concerning human dispersal into the Americas. But genetic studies can help to develop new models as well as help to test models devised from other fields.

Researchers study human DNA from two sources: DNA of living peoples taken from samples of blood or other tissue, and DNA of ancient peoples recovered from hair, teeth, bones, or mummified tissue. These two categories offer quite different approaches to an understanding of the peopling of the Americas.

By studying living people it is possible to obtain enough genetic material to be certain that the DNA is properly identified. If ambiguous results from an analysis occur, it is possible to go back to the subject, obtain additional samples, and try again. In addition, the cultural as well as the geographic provenance of a living subject can be ascertained. In theory, living populations can be sampled in scientifically appropriate designs, and studies can meet usual scientific criteria: the studies should be repeatable by other scientists, and the results should be the same. In practice, however, ethical considerations make it essential to obtain the permission of subjects for analysis of their DNA, and it is difficult to take a truly random statistical sample of a population. Investigators using living subjects do have the advantage of knowledge about their sample and its cultural group; such information makes it possible to evaluate the sample's representativeness.

On the negative side, living populations cannot be expected to represent past populations perfectly. Native Americans, for example, are many, many generations away from the earliest immigrants, and microevolutionary processes undoubtedly have had significant impacts upon any population. In a period of 10,000 to 20,000 years, it is likely that many genes have been lost due to natural selection or to chance events affecting small, mobile bands. Epidemics of European diseases took a heavy toll of Native American peoples, theoretically altering the genetic character of the surviving populations. The extent of intermarriage over the past 500 years between Americans and immigrants from Europe, Asia, Africa, and the Pacific cannot always be ascertained in cultural or biological surveys, so genes from outsider peoples could skew results.

By contrast, data on ancient DNA, especially if obtained from remnant materials dating to 9,000 or 10,000 years ago, would avoid the possibility of skewed results from intermarriage with recent immigrants. And ancient DNA may inform us about traits of people who lack living descendants. On the negative side, using ancient DNA to ascertain clues to the earliest Americans raises sampling problems because it is not possible to know how representative a single individual was of his or her population. And there are technical problems, too, because ancient DNA tends to be degraded and there may not be enough remaining in a sample of ancient bone, hair, or tissue to test or to allow a second test if initial lab results are ambiguous.

DNA Studies with Contemporary People

For many years, anthropologists have examined the relationships among language, culture and biological features of populations and have studied the affinity—and sometimes the lack of affinity—between language and genealogy. A number of recent scientific publications have addressed genetic and linguistic issues about the first Americans, but it is still unclear whether major linguistic groupings coincide with biological populations that represent ancestral migrations—a topic

discussed in an article in the Oct. 4, 1996 issue of *Science* [*References,* Gibbons].

Questions scientists are asking include:

- How many ancestral populations colonized the Americas?
- Do these populations correspond to current linguistic groups?
- What was the timing of the colonization(s)?

Some early data pertaining to these questions led to controversies, and newer data are not sufficient to answer these questions fully. Still, recent developments add spice to the issues involved.

To consider contemporary Native Americans, what does recent research tell us about their unity over a long period of time?

R. H. Ward and coworkers reported in a 1993 article that languages appear to have changed faster in North American peoples than have their genes (DNA). They suggest that linguistic differences, such as those between Amerindian and NaDene language groups, do not coincide with genetic differences. This position tends to discount the "three wave" theory of linguistically distinct groups: first the large Amerind language group, then the NaDene peoples, and lastly the Aleut-Eskimo peoples (**Mammoth Trumpet** 7:3 "Linguist Finds Evidence for Early Peopling of the Americas"). Joseph Lorenz and David Glenn Smith, in a well-illustrated November 1996 article, review mtDNA studies from many populations in North and South America, examining geography and language family as possible factors explaining the distribution of the four commonly studied genetic features (referred to as lineages or haplogroups). Maps summarizing their findings are helpful in convincing readers of the authors' conclusions that both factors appear to affect genetic distributions to some extent, in some areas. The biggest weakness of the three-wave language category appears to be in the putatively oldest, least specific, and most widely distributed group, known as Amerind; the authors (page 318) say that their data "do not support" Joseph Greenberg's concept of "the unity of Amerind."

In contrast to the three-wave theory, D. A. Merriwether and colleagues have supported a single-wave of migration (or migration from a single source) into the Americas. They have identified nine different founding types (so-called haplotypes) of mitochondrial DNA. Although the frequencies of these types turn out to differ between contemporary and ancient DNA samples in some regions, the nine types are widespread throughout the Americas and also exist among East Asian populations. The nine types do not demarcate American linguistic subdivisions and thus do not support a two- or three-wave model of successive migrations.

The discovery of nine founding types (or even more than nine, as suggested by Bianchi and Rothhammer), supports the idea of substantial genetic diversity in the original American colonizers. This contrasts with the "four lineage" model put forth previously by other workers such as Torroni and Wallace in their 1995 article.

Further, Merriwether and colleagues tend to reject Siberia as being the source of the first Americans, despite its eastern edge facing the Bering Sea. There are two reasons. Siberian groups generally have only a small subset of the founding types, and two of the nine founding types do not occur in any Siberian group studied so far. (Of course, the Siberians have other haplotypes, as do Europeans and Africans.) Because their Mongolian sample possesses a larger proportion of the founding types than does any Siberian sample, these authors favor Mongolia or a nearby area as the source of Native Americans.

Findings of geneticist James Neel and others also point to Mongolian populations as relatives of Amerindians. In a 1994 paper, they described the geographic distribution of a human virus (HTLV II). Neel's group and other workers have found HTLV II in native North and South Americans and in Mongolians, but not in Siberians; Neel's group concluded that the Mongolia/Manchuria region was a very likely source area for the founding population of Americans.

But various viewpoints exist concerning the number of source populations and the points of origin. In their 1995 paper, Torroni and Wallace voiced skepticism about there being more than four founding haplotypes, although Forster and coworkers have now modified this view somewhat. And others have remained skeptical about the only entry point to the Americas being Beringia.

Rebecca L. Cann and J. K. Lum have studied the DNA of Pacific populations and compared their results with those on the DNA of native Americans. Several mitochondrial DNA "lineages" occur both in the Pacific area and in Amerindian samples. This finding is consistent with two differing interpretations. Either it signals the retention of very old lineages in both areas, or it signals direct oceanic contact. Cann and Lum

argue that their results leave open the possibility of direct, seafarer contact (presumably pre-Columbian). In contrast, S. L. Bonatto and coworkers regard the former possibility (a remote, shared Asian origin) as being more likely.

As to the time of the first colonization of the Americas, geneticists are far from agreement [*References*, Cann 1994]. K. M. Weiss wrote in a 1994 article that an estimate of 22,000 to 29,000 years ago, for example, may actually derive from a much-earlier or a much-later arrival, depending on assumptions about the number of migrant groups, their genetic heterogeneity, their group size(s), and other matters.

Much of the recent research in living populations focuses on mitochondrial DNA, which is inherited primarily through the female lineage, but newer research is focusing on genes on the Y chromosome, transmitted universally from father to son. Researchers in Brazil and their collaborators (Santos et al.) are using this approach to develop models concerning migrations into the Americas. They report that for their samples of Native American males from Central and South America, 78 percent have the Y-chromosome DNA variant called haplotype IIA, while only 38 percent of males of the Muskoke (Creek) of Oklahoma have the same variant. Researchers attribute the latter group's lower frequency to outbreeding, presumably with people from Europe, in the last few centuries. In contrast, only 10 percent of Brazilian Euro-Americans have haplotype IIA. The authors see their findings on the Y chromosome as supporting the idea, first reached on the basis of maternally inherited mitochondrial DNA, that both North and South Amerindians came from the same Asian Pleistocene population, with haplotype IIA being the predominant, or only, founding Y chromosome for Amerindian populations.

In addition to mtDNA and Y-chromosome genes, HLA alleles (variants of immunological genes) are being used to study relationships between living American Indians and Asians in an attempt to infer the former's origins. In a recent report, a group of Japanese researchers (Bannai et al.) compared HLA alleles in Ainu people of northern Japan with those in American Indians and several Asian populations. Bannai's team found that the Ainu, who are believed to have descended from a pre-agricultural culture in Japan known as Jomon, have frequencies for some HLA traits similar to those of Native Americans and very different from those of the majority Japanese population. They inferred that the Ainu and the American Indians have ancestors in common. Like the article arguing for a Mongolian origin of American Indians, this one is convincing in regard to the possibility of a common origin, but does not answer the question of where those common ancestors lived before they diverged.

The Ainu ancestors may have been in Japan for 10,000 years, but where were they before that? Where did the ancestors of today's Mongolians live 10,000 to 20,000 years ago? These questions must be addressed to trace back the movements of the earliest migrations to the Americas, and to answer them, studies of ancient DNA could prove useful.

Ancient DNA Studies

For Handt and coworkers, what started out as a routine study of DNA from Arizona mummies turned into a searching reassessment of general methods and results on ancient DNA. They extracted mitochondrial DNA from tissue samples taken from Ventana Cave mummies, dated to A.D. 1000–1400. Ancient DNA molecules are typically highly degraded—in bits and pieces. The DNA in the extracts was amplified to a high yield using standard methodologies (based on PCR, the acronym for polymerase chain reaction). In cases where DNA was very dilute in the extracts, the results were ambiguous and not reproducible. When DNA recovery from a tissue

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sample was good ("a few thousand molecules"), the amplification results were reproducible and believable.

This finding is important because ancient DNA research has been particularly plagued by technical snafus in PCR applications, as well as more mundane problems (such as contamination by the DNA of lab workers). It seems that there is no such thing as too much care when it comes to painstaking procedures for analyzing ancient DNA. The team concluded that, since ancient DNA molecules are difficult to extract in large numbers, "most archeological samples do not contain DNA molecules that are amplifiable with current techniques" [Handt et al. p. 372]. A similar conclusion was reached by Ramos and coworkers, whose 1995 publication in *Human Genetics* describes their search for variation in ancient DNA from the cell nucleus.

D. H. O'Rourke, S. W. Carlyle and R. L. Parr, in a recent review of ancient DNA research, enumerate technological problems in some detail, but also discuss solutions that are being applied to overcome problems of degradation and contamination. They note, "Despite the challenges and frustrations . . . numerous scholars have met the challenges and made substantial contributions to the field" [p. 563]. In addition, they discuss their work with DNA samples from Anasazi populations.

Anne Stone, in a paper given at the annual meeting of the American Association of Physical Anthropologists in April 1996, reported that she successfully recovered mtDNA from a large percentage of 170 14th-century skeletons from Illinois. In some cases, however, the DNA was too degraded to yield results.

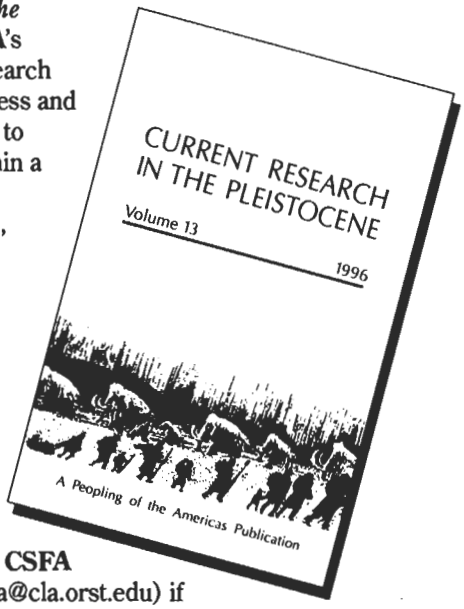
Stone's large sample of a relatively recent prehistoric population had a distribution of mtDNA lineages similar to that found in modern Native Americans—including, but not limited to, the four founder types described by other researchers. Her finding contrasts with results in a study from a pre-Columbian population in Brazil, dating to from 500 to 4,000 years before present, reported by A. K. C. Ribeiro-dos-Santos and others. In their sample, a wider variety of genetic founder types was identified, and 39 percent of the individuals did not have any of the four major types. The authors concluded that demographic changes brought about by the European colonization changed the gene frequencies. Their small sample of only 18 individuals makes this conclusion premature, but their work suggests the importance of South American studies. Like Stone and others, these researchers were successful in obtaining DNA from a majority—but not all—of the skeletons attempted.

Mark Stoneking, a pioneer in using DNA to infer the origins and migrations of modern humans, emphasized the importance of understanding the cultural context of the subjects whose DNA is examined in a 1995 article. His article mentions some of the long-term goals of genetic analysis both of ancient and contemporary DNA: "Who were these people? Where did they come from? How long have they been here? How did they get here? How much variation is there in this population? How are they related to surrounding populations?"

Stoneking conveyed some hope concerning the use of ancient DNA to answer these primary questions. But he also expressed concern that the restricted samples in ancient DNA may make it difficult to develop a meaningful story of migration history. Similar views have been stated by other researchers, such as Cann, who have worked primarily with DNA from living populations. Cann's 1994 article stressed the need for careful attention to how and where living populations are sampled, when doing comparisons over time. Similarly, Weiss cautioned that eventually genetic, archaeological, geological, and other data will have to be placed correctly in the jigsaw puzzle, before a realistic picture can emerge. Weiss's comments indicate the need to see DNA studies within the context of other anthropological and paleoenvironmental research. As Bianchi and Rothhammer wrote, DNA methodology is not a panacea that will resolve all anthropological doubts.

The origin, timing, and number of colonizations of the Americas constitute an arena of ongoing research strewn with conundrums about both ancient and modern DNA. While connections between results from DNA studies of living and ancient populations are being attempted, it is probably much too early to expect a synthesis of such data.

Annual Journal Goes to Press



Current Research in the Pleistocene, the **CSFA**'s annual journal of research notes, has gone to press and should be in the mail to *CRP* subscribers within a few weeks. With the production of *CRP* 13, can *CRP* 14 be far behind? Scientists on the *CRP* mailing list will be receiving editor Bradley Lepper's call for papers soon. If you want to submit a paper and if you have not received his letter, contact the **CSFA** office, by e-mail (halla@cla.orst.edu) if possible. Deadline for submissions is March 15.

The journal publishes brief papers on research in a variety of disciplines focusing on late-Pleistocene time. *CRP* offers Pleistocene researchers a chance to report on their recent findings and work in progress, and to read about research in other, related, disciplines.

If you have not yet ordered the 1996 issue, it's not too late. And many back issues are still available. Use the order blanks in this issue of the **Mammoth Trumpet.**

8,000-year-old Cave Explorer Challenges Research Team

VERY FEW PHYSICAL REMAINS of the earliest residents of the Americas exist, despite a substantial and growing archaeological record attesting to their presence. All the biological, chemical and geological forces that make the record of other species of the past rare are working against preservation of physical remains of early humans. The late Pleistocene and early Holocene were particularly tumultuous times climatically and geologically, initially producing environments unfavorable to preservation of bone, and ultimately assuring that any that were preserved are nearly impossible to find.

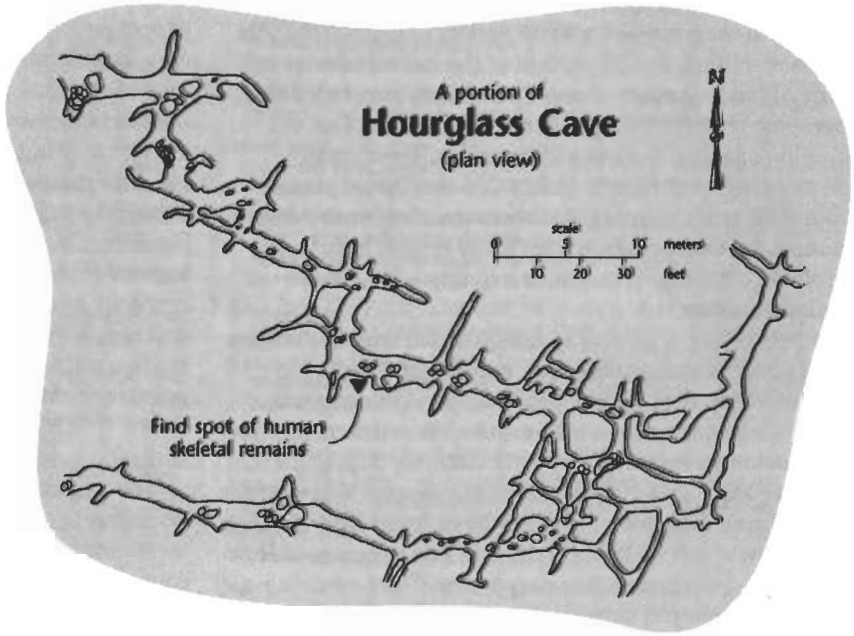
One environment that possesses special advantages for preservation is a high-altitude cave. Such an environment could not be a permanent dwelling site, with the accoutrements of daily living, nor would there ever be large numbers of prehistoric people in such a place. However, a discovery high in the Rocky Mountains suggests that archaeologists seeking clues to the earliest North American people might do well to consider caves as investigation sites, with the assistance of qualified cave explorers. Though relatively few archaeologists have expertise in cave environments, Patty Jo Watson of Washington University in St. Louis is a notable exception.

Because of her long involvement with cave archaeology, Dr. Watson was contacted in 1988 when three cavers discovered skeletal remains of an ancient cave explorer in Hourglass Cave at an altitude above 10,000 feet in the southern Rocky Mountains. The cavers, Cynthia Mosch, Tom Shirrell and Richard Wolfert, began to map Hourglass Cave soon after they discovered it. In what had appeared to be an untraveled passage, they found disarticulated human bones, and the nature of their exploration immediately expanded. They contacted Watson, who came to the site and brought along Charles Hildebolt, a physical anthropologist at Washington University who also is a caver. Dr. Hildebolt, along with Watson and the discoverers of Hourglass Cave, documented the remains, and invited other experts to help them understand the man who died there.

The first members of the interdisciplinary team were Kenny Frost, Native American Cultural Heritage Representative, who is the Forest Service Liaison with the Ute Tribe; and William Kight, the local U.S. Forest Service archaeologist. Team members directly concerned with providing a biological analysis of the Hourglass Cave man were Anne Stone of Pennsylvania State University, who analyzed DNA extracted from the left tibia; A. M. Haeussler of Arizona State University, who studied the dentition; Tab Rasmussen and Ellen Miller of Washington University, who made casts of the bones; Sam Stout of the University of Missouri-Columbia, who performed histological analyses on a sample of bone from the midshaft of the femur; William Murphy of the Anderson Cancer Center, who did radiologic analysis of the bones.

In addition to physical anthropological researchers, the interdisciplinary team includes a cartographer (Michael Goar), a paleontologist (Rickard Toomey III), a geomorphologist (Fred Nials), speleologists (Tom Shirrell and Neil Shirrell), a cave-gating specialist (Marion Vittetoe), a speleologist and data manager (Richard Wolfert), a stratigrapher (Harvey DuChene), a pictograph/petroglyph-dating expert (Alan Watchman) to attempt to date possible ancient torch smudges on the cave walls, and project coordinator and assistant coordinator (William Kight and Sue Struthers of the White River and Routt National Forests respectively).

Dating of any North American prehistoric remains is always crucial to their interpretation. Beta Analytic and the University of Arizona provided radiocarbon dates that took the Hourglass Cave skeleton back to what many scientists con-



Hourglass Cave as mapped by Michael Goar and Jim Railley.

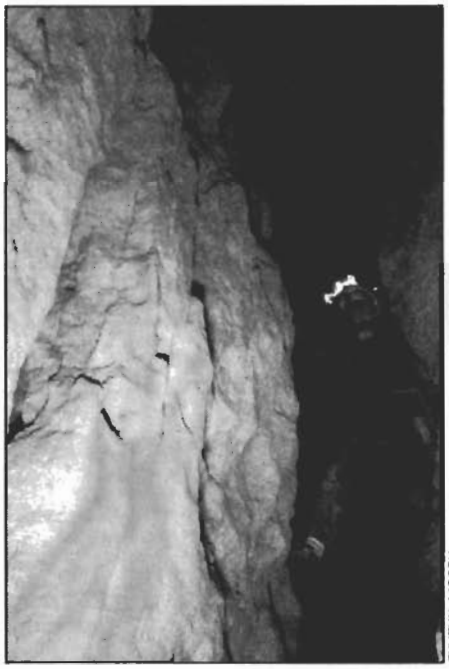
sider the border between Archaic and Paleoindian. Samples of a rib yielded an Accelerator Mass Spectrometry date of 8,170 ± 100 radiocarbon years (uncalibrated: Beta 38554/ETH 6765), and a sample from the left tibia yielded dates of 7,714 ± 77 radiocarbon years and 7,944 ± 84 radiocarbon years (AA11808). The Hourglass Cave skeleton thus joined an elite fraternity of ancient North American human remains (**Mammoth Trumpet** 11:3 "As Scarce As . . .").

The first report on the find was made at the First Biennial Rocky Mountain Anthropology Conference in 1993, while a paper presented at the 1994 meetings of the American Association of Physical Anthropologists summarized basic findings on the skeletal remains. The bones were gnawed and scattered by animals; pack rats and porcupines now inhabit the cave. Facial bones, mandible, and cranial base were missing, but much of the upper, side and posterior portions of the skull were found, as were 11 severely worn, but otherwise healthy, teeth. The team also found the right humerus, two ribs, both femurs, the seventh neck vertebra, portions of the right and left innominate bones of the pelvis, and four phalanges.

Hildebolt determined that the ancient cave explorer had been male because of the shape of the pelvis bones, and he estimated the age (early 40s) based on features of the pelvis bones, status of the sutures of the skull, tooth wear, and, with Stout's data, long-bone histology. He based his stature estimate of 5 feet 4 inches on lengths of the leg bones. The scientific team performed conventional radiography on all bones and teeth and compared the findings with current clinical standards to assess the man's age and skeletal health. They analyzed some bones by computed tomography, the technique of medical X-ray imaging commonly called a CAT scan.

The good preservation of bone mineral content and thick ridges of the cortex of the tibia and femurs indicated to the research team that the ancient cave explorer had no nutritional deficits. They saw no evidence of arthritis in the ribs, although the next vertebra showed osteophytic lipping that was consistent with the estimated age. The condition would have caused little or no arthritis, however.

The team recovered both nuclear and mitochondrial DNA from the bones; researchers believe that the cold and the constant environment of the cave enhanced preservation. DNA analyses produced no surprises. They confirmed the sex estimate made from the pelvic bones, and the features of the DNA linked the Hourglass Cave man to living Amerindian populations, but to no specific tribe. Molecular studies of the mitochondrial DNA indicated the presence of a nine-base-pair deletion in the lysine tRNA region, a feature found in a number of contemporary American Indian populations. Examination of the mtDNA control region sequence from nucleotide position 16048 to 16400 indicated other mtDNA features that also have been reported in the modern Nuu-Chah-Nulth, Maya, Yakama, and Yanomama populations, but not in many of the other peoples of the world.


CYNTHIA MOSCH

Cartographer Michael Goar in Hourglass Cave's maze area not far from where the bones were found.

The Hourglass Cave man, while not the earliest human skeleton from North America, is one of very few from the early Holocene. He lived approximately 500 years after the time—8,500 years ago—that physical anthropologists Gentry Steele and Joseph Powell have defined as the youngest age for Paleoindians (**Mammoth Trumpet** 7:2 "Paleoindian Skeletal Data Re-examined"). Powell and Steele would consider this skeleton in the general cultural period known as early Archaic. Time periods and cultural associations are provisional, however, and some investigators use a later time period as a border, one closer to the Hourglass Cave man's age.

Too little is known of these early North American cultures and of the physical features of the people of both eras for any definite distinctions between them, and thus any information concerning the physical features adds considerably to our understanding of these First Americans. His presence high in the mountains, deep in a cave, offers some interesting information and poses questions regarding his purpose and use of the high-altitude resources.

Mosch, who is an expert cave explorer as well as a cave scientist, says that entering the cave requires crawling and "wiggling" in a prone position for the first 18 meters before one can stand upright. She says the way is difficult—full of twists, turns, climbs, crawls, and dead-end side passages. Geological analysis indicates the general aspect of the cave has not changed since the time of the ancient explorer. Today's entrance, crawlways and chambers are as they have been for thousands of years. Because the ancient explorer was found about 320 meters from the cave entrance, he must have had a strong determination to go into the cave where passage was so difficult, dark, cold and damp.

Smudge marks have been noted along the passageway, apparently the marks of a torch or torches used by prehistoric visitors. Radiocarbon dates on charcoal found near the cave entrance indicate an age of about 2,000 years, six millennia after the man died there. The research team hopes to date smudge marks they found farther back in the cave and also charcoal fragments gathered from the floor below the smudges. These may help to tell the story of the Hourglass Cave man's trip into the cave, or reveal whether there were other visitors, earlier or later.

Watson reports that available evidence in the cave does not indicate whether this visitor had been there previously or had been out alone and simply discovered the cave opening and decided to explore it on a whim, afterwards perhaps becoming

continued on page 18

Racing Repatriation

continued from page 1

on one of nine printed forms. Unlike physicians, who can question their patients about problems and symptoms, these physical anthropologists necessarily gather their information from observation and measurement. After Sandness, Novak and Hamzavi record specific measurements and traits, Owsley discusses with them each individual skeleton. They work toward consensus on details such as the person's age, and include any number of distinguishing characteristics such as the cause of death, physical traits, pathology, and morphology.

Respect and Enthusiasm

Two things are evident to one watching Owsley and his team at work: each member's personal regard for the individuals they are analyzing, and enthusiasm for the intellectual challenges each skeleton offers.

At times, Owsley seems to be conducting a postgraduate seminar in osteology or taphonomy. He challenges certain details of the observations that another team member has made and explains reasons for his doubt; he also notes points of agreement. She argues her point. However slight, differences in observation or interpretation become points of intense interest because team members agree on the vast majority of elements. Before analysis of one particular individual is complete, they reach consensus.

They obviously empathize with each individual whose remains they are examining. Extensive experience witnessing the marks of fatal illnesses and injuries, and nonfatal disease and wounds does not prevent team members from relating to the pains, and admiring the strengths of the people whose bones they study. As they work, team members remark on troubling dental problems such as unusually heavy wear or painful abscesses. They speak of the obvious strengths of the individuals who had lived with the pain of diseases, injuries and deformities.

They remind the observer of a team of medical doctors paying professional visits to hospitalized patients. The museum repository set in desert scrub land near the base of the Sierras becomes their hospital, and bones arrayed on tables become their patients. Words they use are often too technical to be understood by one not intimate with anatomical terms; periods of intense discussion are followed by periods of quiet punctuated only by an occasional murmur of puzzlement or enlightenment.

Jantz's work station includes several instruments for making delicate measurements of crania. Much of the time he works quietly, making the many intricate observations that can provide detailed descriptions of an individual's physical heritage, life, health and, possibly, death. Occasionally his gentle Southern voice joins a discussion regarding some particular aspect of an individual.

All the while, Clark is photographing bones, aware that the images he makes may soon be all that scientists will have to see of the individuals being analyzed. Operating a small portable studio of his own design, the Smithsonian photographer

DON ALAN HALL

The Smithsonian Institution's research team pauses from work at the Nevada State Museum. From left are Kari Sandness, Chip Clark, Parvene Hamzavi, Shannon Novak, the museum's Amy Dansie and Sue Ann Monteleane, Douglas Owsley and Richard Jantz of the University of Tennessee.

The Smithsonian Team

CARSON CITY, Nev.—Smithsonian anthropologist Douglas Owsley regarded his osteological team working at the Nevada State Museum at full strength last summer with the presence of longtime colleague Richard Jantz, professor of anthropology at the University of Tennessee. Dr. Jantz focused primarily on crania of the 57 individual skeletons the team examined.

"Shannon Novak came to us three years ago," says Dr. Owsley, introducing other team members. "She came to train with us, and she's a very fine osteologist." Novak's work was part of her graduate studies, and was done in connection with the University of Utah Museum of Natural History. As part of the team, Novak has worked with collections at the Smithsonian as well as at museums at Texas Tech University, Harvard University, Brigham Young University, Utah State University and the University of Utah.

"Kari Sandness has worked with me at the Smithsonian for four years now. Parvene Hamzavi is the newest one on the team. She got her master's degree in 1995 under Dr. Jantz and then he talked to me about her doing additional work with us for training." In addition to learning the system, she has provided general support for the project.

"The way it works is I have different people collecting the basic information on each skeleton and I float among all of them and we talk about it and we come to a consensus as to the different observations. She will take a skeleton 80 percent through," Owsley said, gesturing toward Novak, "and then I'll come along and talk to her about it. Kari will do the same thing and Parvene is quickly getting to the same stage."

DON ALAN HALL

Richard Jantz uses a notebook computer to demonstrate his program that compares skull measurements with statistical averages of ancient skulls from a variety of peoples around the globe. Dr. Jantz is a University of Tennessee physical anthropologist. Among those watching during a break from work at the Nevada State Museum is Kari Sandness, right, of the Smithsonian.

places each item from the smallest bone fragment to the largest skull or femur in position to be perfectly illuminated by his diffused strobe lights. When he's satisfied with the placement, he photographs them with fine-grained film, both for color transparencies and black-and-white negatives. He usually sees precisely what must be depicted, but occasionally he questions one of the anthropologists about the significant aspect of the bone to be photographed.

Remains Cataloged

The team's starting point is an inventory of the skeletal material. Here at Carson City, Amy Dansie, anthropologist at the Nevada State Museum, had previously prepared a detailed listing of the 492 human remains cataloged here and at the Nevada Historical Society and Lost City Museum. This inventory was not merely a tally of skeletons, but a highly detailed accounting of each individual set of remains organized in a sophisticated computer database program. Dansie had devoted much of her time during the past year to compiling the list and assuring that it complies with the terms of NAGPRA, which requires museums to identify all fragments of human remains and associated funerary objects, describe how and when each was acquired, and to identify tribal origins, or likely tribal origins of each.

Before Owsley's team arrived, Dansie had painstakingly worked through the museum's NAGPRA database three times, entering all available information about each individual. Preparing for the Smithsonian team, she designated all the individuals she knew would be the most valuable, for example, ones for which there were good records of provenience, ones that were of known antiquity, and ones that were relatively complete. These included two individuals that date to Paleo-American times, a group of skeletons representing the Lovelock culture dating back to about 4,000 years, and a group of more-recent remains of Paiute

Words Supplement Numbers

CARSON CITY, Nev.—On a table beside the 9,000-year-old skeleton of a man, a notebook computer displays a popular word-processing program. One member of the Smithsonian team moves her chair in front of the keyboard and writes some observations, then returns to her measurements.

The extensive statistical data the team records for the Smithsonian Institution's multiple databases cannot convey the considered impressions of experienced workers. Thus, in addition to numerical measurements and other quantitative observations, team members also write their observations.

"We want them to go into an archive," Douglas Owsley says of the written notes. "We want them to have a life beyond us in case somebody does want to look at them—including the Indian child who grows up to be a physical anthropologist."

The team seems to take the written notes as seriously as the numbers. While going over a skeleton with another team member, Dr. Owsley asks to hear details she's written about it. He looks at a bone through the lens of a magnifying desk lamp while she finds the appropriate passage on the computer screen and reads aloud. ". . . Bones are large and dense. . . ."

"Yes." And: "Anything else on the femur?"

She reads a technical description as he looks at the thigh bone, then he describes additional details that she types. Later, the computer is moved to a different table where another team member is analyzing another skeleton.

Owsley explains that an important aspect of their analysis is the functional morphology they observe. Indications of muscle development give evidence of habitual activities. "Horseback riding, for instance, shows up in many different features in the pelvis and in the legs."

"This guy here," he says taking an arm bone from a table, "is using his right elbow more—or he's got more physical strain on this right elbow and that's showing up in terms of greater arthritis." He asks museum anthropologist Amy Dansie if the man would have thrown spears with an atlatl. "He's using this arm much more than that one."

"He was probably hunting with an atlatl," Dansie confirms, "every day."

Owsley also notes evidence that the man did much twisting motion with the arm. He points out tiny but distinct ridges on the bone. "We don't have a form where we code that," he explains. "We talk about it and try to describe it."

Watching team members at work, one can easily get the impression that scientists a century or two from now might well find their written notes even more interesting than all the numerical data they are recording.

–DAH

peoples. Most of the individuals are from the western Nevada region where archaeologists have conducted many investigations. Dansie says the remainder of Nevada's great expanses are represented by very few individuals in the museum's collection.

With Dansie's report in hand, the visiting team went to work entering Nevada individuals into the Smithsonian inventory, which Owsley estimates to be at least 5,000 individuals. "It's a bone-by-bone inventory so we know exactly what we have," he explained. "Most of our focus has been on the Plains, which is sort of my center of the universe." Now the team is gathering Great Basin data for comparative analysis. He noted that the Smithsonian inventory contains considerable skeletal data from European Americans and African Americans.

From the inventory, a scientist can bring forth very specific data for study. "You could, for instance, tell exactly how many right ulnas are recorded," Owsley says, "and if you wanted to find out how many fractured right ulnas there are, you could get that by any age group, any sex, or any specific age."

Taphonomic Observations

The inventory of bones is only the beginning of a series of increasingly complex sets of data the Smithsonian team records. "From there we make certain generalized taphonomic observations," he said. "Although it isn't very detailed, in terms of NAGPRA, this form covers a lot of different things that actually have tremendous value in identifying a population or an individual within a population. Taphonomic observations recorded on Form 2 immediately distinguish Plains scaffold burials from Great Basin subsurface burials and provide information on a variety of cultural modification resulting from warfare or certain mortuary practices. The form also records stains. "Stains tell you about artifact associations. With historic burials we frequently see green staining caused by brass or copper."

Third and fourth of the team's forms pertain to teeth. "We spend a lot of time on the teeth. Like the bone, it has an inventory that indicates which teeth are present." The team also scores caries, their location on each tooth, and the size of each lesion; calculus deposits; tartar deposits; and whether there is evidence of abrasion. "Sometimes you see task-related activities. We watch for those and we score them. We score alveolar bone resorption or periodontal disease."

After the basic dental form, the team records detailed information of tooth wear, a task Owsley says is particularly difficult to train team members to perform to a uniform standard. "Kari has worked with me so long that she more or less thinks along the same lines that I do on how to score wear. Shannon's also fairly standardized; everyone on the team is exceptional." Taking a mandible from the table in front of him, Owsley indicates an obviously worn-down molar. "This is 'Stage 8' wear on these teeth right here." That degree of wear is not unusual, but

Honoring Ancestors...

Analysis by Don Alan Hall, Editor, **Mammoth Trumpet**

ALTHOUGH UNITED STATES federal law and some state laws call for return of Native American remains and grave goods to the appropriate tribal groups, physical anthropologist Douglas Owsley and many other scientists see human bones as a repository of information on the human species that is available nowhere else. Further, human skeletal material provides data on specific groups through time and across the continent. They're solid evidence of the great array of human diversity.

"When you bury these collections, you're reinforcing the view that American history began with Columbus," Owsley says. "As they rebury their past, they're really reburying a source of information of the past."

North American scientists who specialize in the study of that information face a serious public image problem. Historically, Native Americans have been oppressed peoples; public policy may seek to right past wrongs. Further, traditions and religions typically frown on taking scientific rather than spiritual responses to human remains. The public may not be particularly sympathetic to science when anthropologists are portrayed in news accounts as trying to wrest bones of ancestors from the descendants. Much of the human skeletal material from archaeological sites predates the arrival of Europeans, and some of it is linked directly to existing tribal groups. Even scientific evidence that there is no biological affiliation between an ancient skeleton and a tribal group may not seem important to government agencies when tribal groups plead to be the guardians of all past peoples in their present-day territories.

The challenge to scientists is to convince Native Americans and the general public as well that the knowledge available to humankind from extensive collections of ancient bones far outweighs the value of the remains of a single individual.

It's a hard sell. But in a sense, scientific collections of human remains are libraries of information on our species. Physical anthropologists are acutely concerned about the possibility of losing the knowledge contained in that library. Even the most careful analysis and recording of data cannot be the same as preservation of the bones themselves. Some might regard the analyses of physical anthropologists as rather like reading the books and taking notes about them before the library is burned.

Rapidly improving technology probably means that ancient human remains will have increasing—not decreasing—scientific value in the future. As new techniques are developed and applied, collections are reanalyzed. If collections are no longer available for study, obtaining more complete information about the past will not be possible.

"We are learning all the time about functional morphology and how different activities are registered in terms of the muscle development," says Owsley. Scientists' ability to glean information from skeletal material has gotten stronger and stronger in recent years. "And we still have a long way to go."

or Burning Libraries?

Just as molecular biologists have developed new means to recover and analyze DNA from ancient bones, osteologists who examine the bones are using new techniques of measurement. "The way we look at a skeleton today is radically different than Howells," he says, referring to Harvard University's W. W. Howells, the physical anthropologist who pioneered sophisticated techniques for statistical analysis of human crania. "I think we are better able to identify and understand how different activities are affecting the skeletons."

And Owsley is confident that cranial morphology reveals obvious differences among various populations. "Through carefully designed statistical comparisons, we can answer historical questions. We *can* look at the relationships between groups. It's not going to tell us everything, but DNA's not going to tell us everything either."

Given sample skulls, he says, "We can often recognize describable metric differences between populations." Within Plains groups, for example, he can observe features that differentiate a Mandan individual from an Arikara individual. There are complications, however. Any collection from one ethnic group might contain one or more individuals from a totally different group.

"We're interested in questions that DNA isn't going to tell you." For example, skeletal collections are providing a great deal of information about differences in interpersonal violence between groups. Scientists are collecting hitherto unknown details of warfare. And Shannon Novak, the team member from Utah, is doing her dissertation on domestic violence, using data from contemporary populations in the Salt Lake City and Baltimore areas as well as from prehistoric skeletal material.

Historically, the quest for scientific knowledge about the Americas' past began about two centuries ago, a time when dedicated amateurs were collecting all manner of antiquities. A majority of skeletal remains in museum collections were excavated in the last century. Many were excavated as salvage operations, sometimes with the aid of Native Americans. Many sites were being looted or were about to be destroyed by reservoir construction or other developments.

Owsley notes that earlier scientists were often pursuing fundamental questions such as, Who were the mound builders? "Without their baseline research, we might still think of the mound builders as the people who came before Indians." Scientists such as Aleš Hrdlička (1869–1943), who served as Smithsonian curator, collected skeletons because they were probing the question of human diversity.

"There certainly were remains that shouldn't have been recovered—that should be returned," Owsley says. An example would be burials from late in the last century that had been excavated over the protest of descendants. "But when we get into taking *all* the prehistoric material and putting it in the ground—and when we get into the realm of even pushing it to *this* age," he continues, gesturing to the remains of a man who lived in Nevada more than 9,000 years ago, "we're destroying the past."

the angle of wear was puzzling because it was on the lingual slope rather than on the buccal—these jaw teeth were worn down more on the tongue side than on the cheek side. "This is exactly opposite of what you normally see."

Not Time Enough for Everything

Owsley regrets not being able to measure the angle of the plane to which teeth are worn. "It takes time. It's one of those things I wish we could do as we score these wear planes. I feel badly about the opportunity we're missing because there is such tremendous difference between time periods and groups. What we do now is so labor intensive that if we measured the angle we'd just never get done."

The detailed scoring of tooth wear, however, is providing future researchers with a vast store of data. There are big differences in tooth wear from population to population. "When you get into historic groups that had a European diet, the wear cuts down tremendously." Archaic peoples of the Great Plains, however, exhibit a rapid rate of wear.

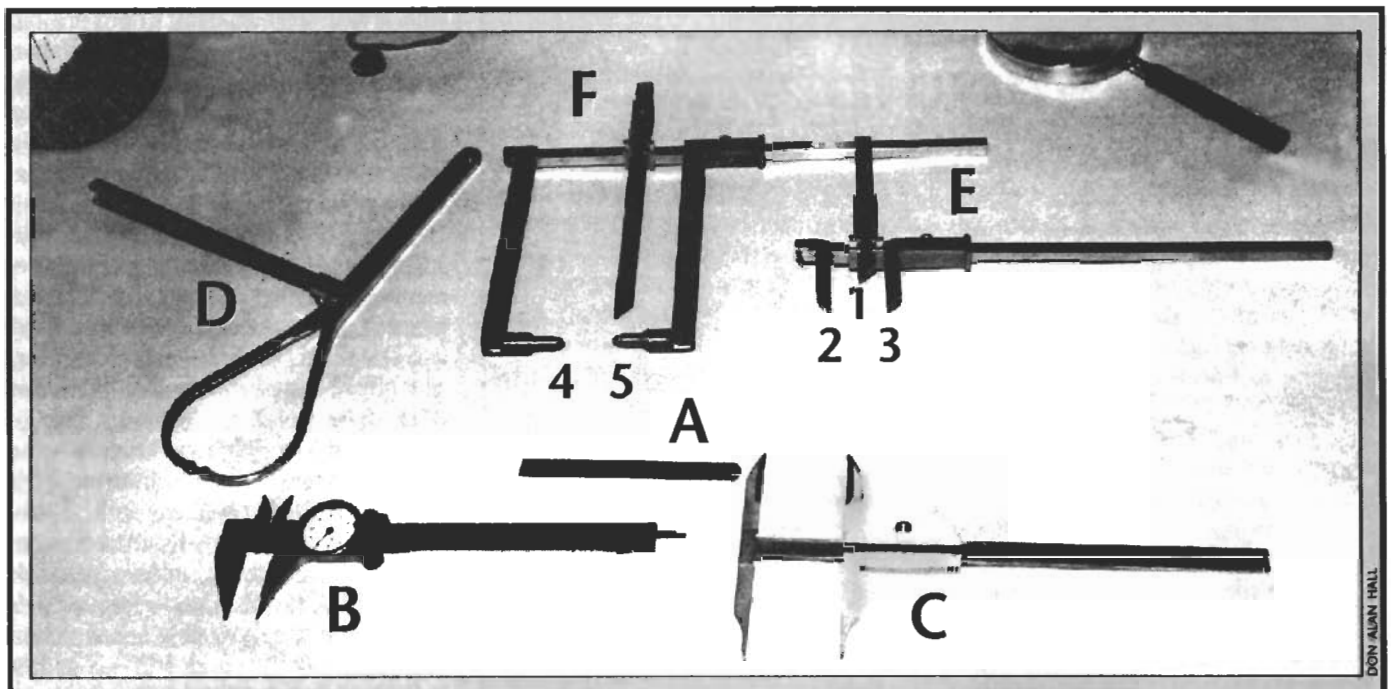
Form 5 records the team's cranial measurements. Besides standard measurements, it employs a system of complex measurements and angles developed and used by W. W. Howells, Harvard University physical anthropologist. "We have worked for years to develop a craniometric database that includes all the Plains groups. Dr. Jantz has worked on it ever since his dissertation, and his students, such as Pat Key, have carried on, and I've assisted in that endeavor as much as possible."

To illustrate how the shape of an individual's skull can identify his or her individual's group, Owsley moves to another table and points out obvious differences between the skull of a person from a Numic-Paiute group and one from a Shoshoni site. "You can often identify these populations by the craniofacial proportions," he said. "That is not to say that they wouldn't have a general set of features that you'd say, 'That's Native American,' but there are very distinct differences among populations."

Cranial studies make it obvious to Owsley that some groups have completely replaced other groups. He cites work Novak has done with Utah collections that chronicles a difference between peoples identified as Archaic and later people known as Fremont: "Archaic and Fremont are not the same. One does *not* come out of the other." The team's studies also find microevolutionary changes within a population through time, and there are regional differences. Fremont, for example, has a distinctive morphology with recognizable differences through time and by region. But Fremont individuals appear totally unrelated to Numic speakers such as Paiute and Ute.

Postcranial Measurements

Postcranial measurements—all bones except the skull—are covered by the Smithsonian team's Form 6. "We have been taking this series of measurements for years. This is the same set we take at the Smithsonian on our repatriation



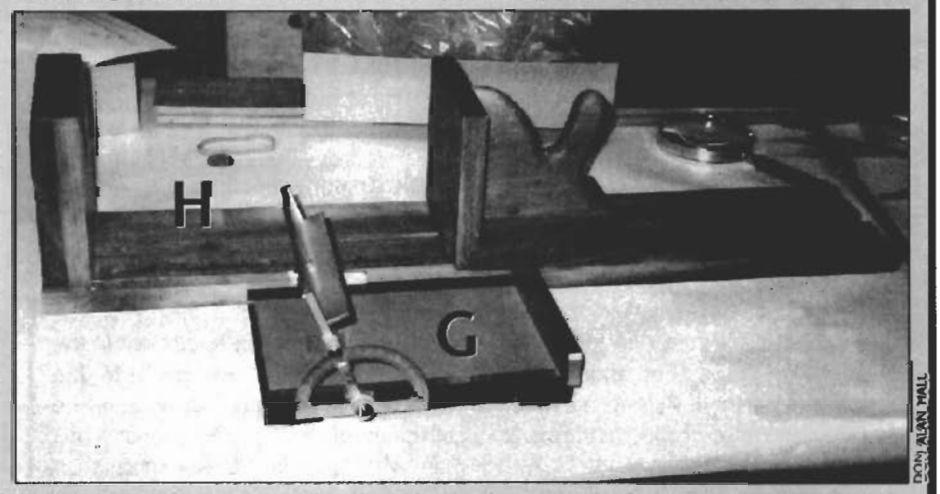
DON ALAN HALL

The Basic Tools

BASIC MEASUREMENT TOOLS Richard Jantz uses in his osteometric studies are pictured on his work table at the Nevada State Museum. These tools include generalized measurement instruments and tools developed specifically for the study of human bones. Skulls in particular require special devices because they have complex curved surfaces; individuals and groups differ in shape as well as size.

A is simply a short metric rule that is used simply to measure short distances. **B** and **C** are sliding calipers that give precise measures between any two points that can be touched in a straight line and differ in the way the measure is shown—on a dial (**B**) or a line on the scale (**C**). **D** is a spreading caliper that can go around a curved surface, for example, to measure the breadth of a skull. **E** is a coordinate caliper, which adds to the sliding caliper a rule (**1**) that calibrates the distance from, for example, the surface of the skull to the line between the two measured points (**2** to **3**). A specialized version of the coordinate caliper is the radiometer (**F**), which has round, bullet-like structures (**4** and **5**) that insert into the two auditory meatuses (ear-holes) of a skull. This allows the investigator to make a number of measurements of positions on the surface of the skull to the same central point within the skull.

Instrument **G** is a mandibulometer used for making several measurements of the lower jaw, or mandible. A movable vertical surface that hinges along the calibrated surface of a half-circle allows the researcher to measure the angle of the jaw; calibrations along the vertical surface allow measurement of the height of the jaw, and a horizontal sliding surface makes it possible to measure the depth of the jaw. **H**, an osteometric board, is the only anthropometric device normally made of wood. A long bone (for example, humerus or femur) is positioned between the fixed vertical surface on the left and the sliding vertical surface on the right; the measurement is read on the metric rule on the surface of the board.



DON ALAN HALL

Excellent descriptions of basic measures and how to make them are given in the book *Data Collection Procedures for Forensic Skeletal Material* by Peer H. Moore-Jansen and Richard L. Jantz (1969; Report No. 48, University of Tennessee Department of Anthropology, Knoxville). *Cranial Variation in Man* by W. W. Howells (1973; Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University, Vol. 67, Cambridge), explains more specialized measurements of the cranium.

forms." In addition, Jantz takes certain observations of discrete characteristics on the team's Form 7.

Form 8 records pathology—the team's most complex set of data. "It is a very hard one," says Owsley, because it must record more than 1,500 variables describing the structural changes left by disease. At the time of the team's visit to the Nevada State Museum, computer software needed to manipulate this difficult data set remained untested. "It's a monster program," said Owsley. A retired computer programmer has worked on it for about two years using Paradox, a relational database software for personal computers.

The Smithsonian's pathology form looks at three general categories of information available from the analysis of how an individual's bones responded to diseases and injuries.

The team searches for micro-evolutionary changes in a population over time.

- Did the pathology cause destruction of bone, addition of bone, or a combination of both?
- How severe? And was it localized or widespread; healed or active?
- Exactly where are the pathological markers? Each portion of each bone has a separate set of variables.

Reading Ancient Ills

For an example, Owsley turns through several pages of a pathology form for one individual and points to a line of numbers. "That's saying that he's got periostitis (inflammation of the bone surface), it is moderate in severity, it's located on the distal third of the right tibia diaphysis. Its 'state' is Code 1, which means that it is active, so it's got porosity that is actively remodeling and it's localized."

Data on growth are the subject of Form 9, the final questionnaire the team employs to record details from human skeletal remains. It takes advantage of the melancholy fact that more than 1,700 of the individuals the Smithsonian group has analyzed died as children. "We look at dental calcification," Owsley explained. "Each tooth is scored as to its stage of development. And in relation to that, we have long-bone lengths."

He points out an example on one form indicating a particular child's right radius was 203 mm long. Having determined the child's age at death from tooth development, the size of bones provides information on rate of growth. "We're building a database that will look at growth in different regions through time," he says, noting that big differences in growth and size of various populations already is evident.

X-rays and CAT Scans

Although it's a monumental task, recording scores of measurements on forms that will be entered into computer databases is not all the Smithsonian team does. "When we have the opportunity, we take standardized X-rays," says Owsley. The X-rays include dentitions, which provide information on dental calcification, necessary to determine the age of children. The Smithsonian has an X-ray machine available, but "I have to buy whatever X-ray film I use." In addition to X-ray analysis, the Smithsonian recently acquired a CAT (computerized axial tomography) scanner that produces three-dimensional images of bones.

Money, however, is always a problem for Owsley. "I'm always short of cash." Funds that are available often can't be spent on analysis of the most interesting individuals. One of his current studies involves a series of 18th-century burials. "It's easy for me to get money to analyze those because they've been hit by construction projects or whatever, but," he says, gesturing to the skeleton of a 9,000-year-old Nevada man, "it's very difficult to get money to support our studies on prehistoric people like this.

"We're doing it out of sincere interest in it, and we piece together whatever little bit of funding we can get. We are anthropologists and in that sense we are good scroungers."

During their week here in Carson City, the Smithsonian team studied 57 individuals. They hope to return in March to analyze approximately 20 more they believe offer good research potential.

–Don Alan Hall

Who Was It? Murder Victim? Police Ask

When human skeletal remains are accidentally encountered outside the context of an archaeological excavation, the discovery is dealt with as a police matter. Seldom are the circumstances of death obvious, and law-enforcement officials must suspect foul play until assured otherwise. After some examination of the "crime scene," police and coroners gather the bones and contact an anthropologist. Some law-enforcement agencies have forensic anthropologists on their staff or on call at the state medical examiner's office, but many rely on physical anthropologists employed in teaching or research.

Inevitably, the first question involves categorizing the person whose remains were found as a recent homicide or a prehistoric burial. Bones from ancient individuals appear obviously old, stained and weathered to the consulting scientists, and in such cases the police quickly lose interest in the case. In the past, skeletons determined not to be those of modern missing persons were left with college anthropology departments or museums. They could remain boxed in store rooms and closets because neither governmental officials nor nearby tribal groups have been interested enough to take them. Scientists have neglected such skeletons because they lack information about provenience, and often there is neither money nor time for detailed analysis.

Forensic anthropologists initially specify for police whether the individual was male or female, the approximate age at death, and the probability that the primary parentage of the individual was European, African or Native American. Humans are a diverse, mobile species and often the ancestry isn't obvious. Recent Asian and Native American populations, for example, share enough physical traits that both are often labeled as "Mongoloid." However, anthropologists who specialize in police cases become highly skilled at reporting the physical characteristics of murder or accident victims. Often they can pinpoint the geographical or ethnic origin of a victim.

Anthropologists are expected to em-

ploy traditional racial terms when dealing with the justice system. Police want to know the "social race" of the victim—the group into which he or she was categorized by society. Was the victim "Black," "Caucasian," "Indian," or "Asian?"

Physical anthropologists, however, prefer statistical information to labels, because people are quite variable and may have multi-ethnic ancestry.

Archaeology brings an entirely new dimension to the quest for identity of skeletal remains—time. Racial labels are based on 20th-century observations, and the older the skeletal remains the less likely terms such as "Mongoloid" or "Caucasian" are relevant. Physical anthropologists who have studied skeletal remains of Americans dating back to the 8,000- to 10,000-year range have found them different from remains of later Native Americans. (See **Mammoth Trumpet** 11:3 "Who Were the First Americans?" and "Brazilian Scientists Challenge 3-Wave Theory of Migration.") Complicating scientific analysis of the physical features of the early Americans is the extreme rarity of individual skeletons. Analysis of a skull less than, say, 2,000 years old can draw on a large statistical base for comparison and categorization, but such a database simply does not exist for a skull more than 8,000 years old.

–DAH

Mochanov Proposes International Effort

Russian archaeologist Yuri A. Mochanov is calling for an international effort to consider human origins and study Paleolithic sites including Diring Yuriakh on the Lena River. Dr. Mochanov, Academician of the Russian Academy of Science, visited the United States three years ago to describe discoveries at Diring, where he has recovered more than 5,000 pebble artifacts in 37 toolmaking areas (**Mammoth Trumpet** 7:3 "Siberian Site Defies Theories on Peopling," 9:2 "Mochanov Shows, Tells on U.S. Tour").

A veteran of 30 years of field work, he remains convinced that the pebble tools at Diring, where he recently completed his 15th field season, date to between 3.2 and 1.8 million years ago. If so, they are at least as old as the most ancient tools in Africa.

He would like to contact fellow archaeologists who are working on human origins and is proposing a series of exchanges that would allow him to visit Paleolithic sites in Europe and Asia and bring other authorities to Yakutsk.

Could humans have originated simultaneously in Siberia and Africa? "Let us work together to solve the mystery of the origins of man," says Mochanov. Defending his theory on Siberian origins, he says: "Let the experts come in and prove me wrong."

Mochanov can be reached by e-mail, ogai@nauka.yacc.yakutia.su, or fax, 011-7-095-230-2919.

Cave Skeleton

continued from page 11

disoriented or succumbing to an injury that his partial skeleton does not reveal. Frost believes that the Hourglass Cave man was familiar with the region, including the cave, had been inside the cave previously, and made his last trip into it intending to die there, as he did.

Because Hourglass Cave is on U.S. Forest Service land, and because the remains of a Native American were found inside it, the Forest Service declared the cave a sacred site and closed it to the public. Watson says that provisions of the 1990 Native American Graves Protection and Repatriation Act apply to the cave and the remains, which meant that the decision about final disposition of the bones was made by the Native American representative to the Forest Service in consultation with the regional Forest Service officials.

The remains of the Hourglass Cave man have been laid to rest by the Southern Ute tribe, but the interdisciplinary research team gathered and preserved a substantial amount of information regarding this early resident of the Americas. Their research will be valuable for comparison with existing data on early Archaic as well as Paleoindian peoples and cultures.

The discovery itself suggests the importance of cave sites, high in the mountains, as protectors and preservers of rare physical and cultural information concerning the First Americans.

–DAH

SUGGESTED READINGS

ON Human Morphology

Owsley, Douglas W. and Richard L. Jantz, editors 1994 *Skeletal Biology in the Great Plains: Migration, Warfare, Health, and Subsistence.* Smithsonian Institution, Washington.

Steele, D. Gentry and Joseph Powell 1993 Paleobiology of the First Americans. *Evolutionary Anthropology* 2(4):139–146.

ON Hourglass Cave

Brothwell, R.D 1981 *Digging up Bones: The Excavation, Treatment and Study of Human Skeletal Remains* (3rd ed.). Cornell University Press, Ithaca.

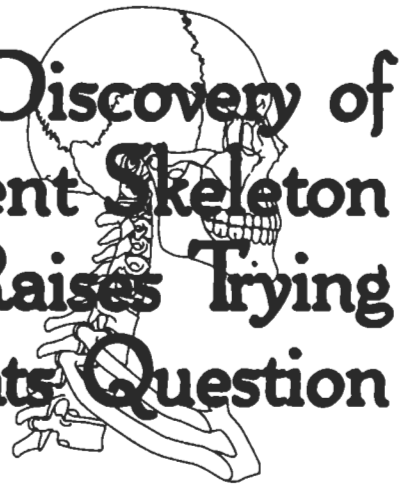
Crothers, George M. and Patty Jo Watson 1993 Archaeological Contexts in Deep Cave Sites: Examples from the Eastern Woodlands of North America. In *Formation Processes in Archaeological Context,* edited by Paul Goldberg, David Nash, and Michael Petraglia. Prehistory Press Monographs in World Prehistory vol. 17. pp. 53–60. Madisonville, WI.

Krogman, William, and M.Y. Iscan 1986 *The Human Skeleton in Forensic Medicine* (3rd ed.). Charles C. Thomas, Springfield, IL.

Mosch, Cyndi, and Patty Jo Watson In press An Ancient Rocky Mountain Caver. In *Cave Archaeology in North America,* edited by Janet Steele. Special Issue of the National Speleological Society Bulletin.

Stone, Anne C., and M. Stoneking In press Genetic Analyses of an 8,000-Year-Old Native American Skeleton. *Ancient Biomolocules* 1(1).

Discovery of Ancient Skeleton Raises Trying Rights Question



THE 9,300-YEAR-OLD BONES of a man found last summer in a park along the Columbia River in Kennewick, Wash., are the center of a controversy swirling around Native American rights and inquiry into the origin of the first Americans. Unless an amicable solution to the deadlock is reached it appears likely the skeleton will have its day in court in a renewed collision of science and religion.

Meanwhile, the skeleton that is described in news reports as "Kennewick man" or "Richland man" remains in federal custody at the Battelle Pacific Northwest National Laboratories in Richland, Wash., according to James Chatters of Applied Paleoscience. A forensic anthropologist and archaeologist, Dr. Chatters was called by local officials after the skeleton was found on July 28 by two men attending a boat race. The area is administered by the U.S. Army Corps of Engineers.

Native American tribes are demanding that they be allowed to bury the bones before further scientific analysis is done. "Our tribe was not properly notified," said Armand Minthorn, religious leader of the Confederated Tribes of the Umatilla Indian Reservation. "And if we had been, this difficult situation might have been avoided."

The skeleton, missing only a few foot bones, is practically the oldest ever found in the Pacific Northwest, according to Chatters, who adds that the only older skeletal material in the region consists of fragmentary human remains of cremated skeletons from the Marmes Rockshelter on the Palouse River in southeast Washington that date to 10,300 years B.P. The Kennewick bones, Chatters has told reporters, hold secrets to human life as it was being lived when the last of the Ice Age glaciers were retreating from the continent. Such ancient bones offer a rare opportunity, he says, to learn more about the early inhabitants of North America, where they came from and how they got here.

The skeleton has undergone only limited analysis. Dating of bone collagen from a little finger, the left fifth metacarpal, done by the University of California at Riverside yielded an unadjusted radiocarbon date of 8,410 ± 60 years (UCR 3478). The adjusted age indicates the skeleton is about 9,300 years old, far older than Chatters had initially believed. He agrees that further dating would be advisable. "One test sample is not ordinarily sufficient for something this old," Chatters said in a recent telephone interview.

Preliminary analysis by Chatters and two other anthropologists provided intriguing information, however. This ancient American apparently died from infection caused by a basalt projectile point imbedded in his right side. Chatters says it was a Cascade point, a willow-leaf projectile two inches long and one inch wide with rounded base and serrated edges. The radiocarbon age of the skeleton would be consistent with the oldest temporal boundary ascribed to the Cascade-point tradition.

Until the wound and its cause were found, the skeleton seemed to belong to a historic-era man of European heritage. In a letter to the local coroner, Catherine J. MacMillan of the Bone-Apart Agency in Ellensburg, Wash., wrote, "I was stunned when I examined the pelvic bone and the projectile point associated with it." After reexamining the skull, however, she agreed with her initial identification: "Caucasian male." Dr. MacMillan is professor emeritus at Central Washington State University.

Grover S. Krantz, physical anthropologist at Washington State University, reached a similar conclusion after studying the skeleton at Chatters's place for an hour on Aug. 30. "The skeleton would be almost impossible to match among any of the western American Indian tribes," he wrote in a Sept. 2 report to Chatters. But, he said, the tall body type does match that of recent Native Americans on the Great Plains and older derivations east of the Mississippi River. Dr. Krantz said scientists have evidence that the entire Columbia Plateau was depopulated shortly after 9,000 years ago and repopulated a few thousand years later by people from elsewhere.

"The descendants of the Richland man did not move out and return," he told Chatters. "Clearly the Richland man belonged to a native culture that no longer exists, and one that has no living descendants." He expressed the opinion that the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) has no more applicability to the skeleton than it would to the remains of a Chinese individual left behind by some ancient expedition. "The racial affiliation of the skeleton continues to be a problem that should be studied, not ignored, if we are to fully understand the early prehistory of America," said Dr. Krantz.

Other details revealed by initial analysis indicate that the man:

- was 5 feet 9 inches tall and between 45 and 50 years old;
- had a long, narrow head and face and a very long nose;

- did not have a flat place on the back of his skull that might suggest he had been carried on a cradle board as an infant;
- had suffered severe rib fractures that left bones unable to knit and caused his left arm to be atrophied;
- had no arthritis in his legs and lower spine indicating he had not carried much weight.

Study of the skeleton stopped abruptly when the Corps of Engineers locked it up after the Confederated Tribes of the Umatilla, Colville Confederated Tribes, Nez Perce Tribe, and Yakama Indian Nation claimed it under the terms of NAGPRA. The Colville tribe indicated a willingness to have the skeleton studied further, but the others wanted it reburied immediately.

When it appeared that the skeleton was in immediate danger of being lost to all further study, several scientists filed a lawsuit to seek authority to examine the skeleton and to block implementation of NAGPRA pending a complete review of all relative evidence, according to Portland lawyer Alan L. Schneider. As part of the suit, the scientists have secured a court order saying that the Corps of Engineers must give them 14 days' notice before turning the remains over to Native Americans. Such notice, said Schneider, would push the matter into court for further hearings.

Dutch Meier, chief of public affairs for the Corps of Engineers in Walla Walla, Wash., says both sides appear polarized on the issue. "There doesn't feel like a lot of middle ground," Meier told National Public Radio.

Individual plaintiffs in the suit are Robson Bonnichsen, director of the **Center for the Study of the First Americans;** C. Loring Brace, University of Michigan; George Gill, University of Wyoming; C. Vance Haynes, University of Arizona; Richard Jantz, University of Tennessee; Douglas Owsley and Dennis Stanford, Smithsonian Institution; and D. Gentry Steele, Texas A & M University. Their institutions are not involved in the suit.

The issue, Dr. Bonnichsen told *The New York Times*, is a battle over who controls America's past. And many Native Americans believe the past should remain with them and not with scientists.

In an op-ed column in the Nov. 2 *New York Times*, novelist M. Scott Momaday wrote that Indians must, as a matter of "identity, dignity and spirit," use the powerful legal tool of NAGPRA to fight back at previous injustices.

Minthorn told *The New York Times* that Umatilla oral history goes back 10,000 years. "We know how time began and how Indian people were created. They can say whatever they want, the scientists. They are being disrespectful." In a tribal position paper, Minthorn added that many Indians of the Columbia River Plateau do not believe that their ancestors migrated from another continent. "From our oral histories, we know that our people have been part of this land since the beginning of time."

"We also do not agree with the notion that this individual is Caucasian," Minthorn continued. "We believe that humans and animals change over time to adapt to their environment. And our elders have told us that Indian people did not always look the way we look today." Besides urging immediate reburial, Minthorn said that tribal policies, procedures, and religious beliefs prohibit scientific testing of human remains. "We have a responsibility to protect all human burials, regardless of race."

While the debate swirls, the Corps of Engineers is reviewing a growing number of requests from other individuals and groups seeking standing in the case, according to Meier. He would not say how many such applications are being reviewed, but he indicated that it could take "weeks or months" to reach a determination.

Chatters would like to see more non-invasive tests of the skeleton, such as detailed skull measurements and documentation of skeletal and dental pathology. A complete DNA study could add to understanding of the genetic history of North Americans, and dietary information would be available from isotope studies. Chatters also notes that radiographs and photographs for later study would be useful.

"I don't see why we can't have it worked both ways so that we could get the knowledge and they could get the skeleton," said Chatters, frustration evident in his voice. "This was not to be a polarizing issue. I looked at it as bringing us closer together."

Minthorn is skeptical of those who speak of compromise. "We remind them that not only has this individual already been compromised, but our religious beliefs have once again been compromised."

–George Wisner

COMING CONFERENCES

March 26–29 20th Annual Ethnobiology Conference, University of Georgia, Athens.
Contact: Sylvia Scudder, Dept. of Anthropology, Florida Museum of Natural History, University of Florida, Gainesville FL 32611-7800. 352-392-3698. scudder@flmnh.ufl.edu.

April 1–2 Annual Meeting, Human Biology Association, Adams' Mark Hotel, St. Louis.
Contact: Ralph M. Garruto, National Institute of Health, Bethesda MD 20892. 301-846-1186. Fax 301-846-1569.

April 2–5, 66th Annual Meeting, American Association of Physical Anthropologists, Adams' Mark Hotel, St. Louis.
Contact: Charles Hildebolt, Washington University. 314-362-8410. hildebolt@mirlink.wustl.edu

April 2–6 Annual Meeting, Society for American Archaeology, Opryland, Nashville TN.
Contact: SAA 900 Second Street NE, Suite 12, Washington, D.C. 20002. 202-789-8200.

April 17–19 50th Annual Northwest Anthropological Conference, Ellensburg, WA.
Contact: Steven Hackenberger, Dept. of Anthropology, Central Washington University, 400 E. 8th Ave. Ellensburg, WA 98926-7544. hackenbe@cwu.edu.

May 22–24 Third International Conference on Soils, Geomorphology and Archaeology, Luray, VA.
Field trips to Thunderbird Paleoindian site and several marl locations. Abstracts due Feb. 15. Contact: Joan Walker, Thunderbird Archeological Associates, 126 E High St, Woodstock VA 22664.

Send conference notices to the Mammoth Trumpet, 37112 Moss Rock Drive, Corvallis OR 97330.