MINING KNIFE RIVER FLINT IN NORTH DAKOTA

The Alkali Creek site near Hallday, North Dakota, is a lithic-quarry locale that has been used since Paleolithic times for the acquisition of Knife River flint. The unique record of mining and workshop activities produced by the site is the focus of recent investigations by Metcalf Archaeological Consultants, a cultural resource management firm based in Eagle, Colorado.

When principal investigator Michael Metcalf describes the Alkali Creek site, he compares its stratigraphy to a piece of Neapolitan Swiss cheese. "There are depositional units that consist of different materials. They don't contrast all that much like the colors in a Neapolitan layer. Nevertheless, they're different and can be identified in the stratigraphy..." The site was used for extracting flint for probably 11,500 years, and the holes that the (prehistoric miners) dug in going after the flint, we listen to the holes in the cheese." Knife River flint, which Metcalf describes as rootbeer-colored, is a fine-grained silica-based stone, well suited for flint knapping. The flint is located in secondary gravel deposits that washed down the Spring Creek valley during glacial times.

Throughout the time that human beings intermittently excavated the site, Alkali Creek and nearby Spring Creek periodically flooded their banks, depositing layers of silt that filled in the open mines and increased the distance between the surface of the ground and the flint deposits below. Every time people mined the site, they had to dig deeper holes to reach the flint. At the time of the most recent occupation, 1600 to 2000 years ago, people dug shafts 5 m deep in order to extract the flint. "There's a fascinating evolution to the site," observes Metcalf. "It shows changing quarrying techniques as the distance down to the flint increased." He notes that some shafts have evidence of having been re-dug and re-filled two and three times by successive excavators. The flint deposits are an average of 2.2 m below the present-day surface.

Located on an old gravel bar in a meander bend at the convergence of Alkali Creek and Spring Creek, the site is being protected.

LIVING CELLS UNLOCK ANCIENT MYSTERIES

Where did the First Americans come from? How many separate groups crossed the Bering Strait from Asia, and when? And how are the modern-day descendants of these early immigrants in North, Central, and South America related?

Until recently, the possibility of finding a definitive answer to all of these questions seemed remote. But biochemist Dr. Douglas Wallace has turned a DNA research technique into a powerful anthropological tool. Wallace says "We now have the potential to do just that."

Wallace, a researcher in genetics at Emory University School of Medicine in Atlanta, is using current advances in his field to study the origins of three modern, geographically diverse Amerindian tribes. Wallace's work indicates that a single migration across the Bering land bridge eventually gave rise to all three tribes. The results suggest that the earliest Americans shared a common, Asiatic origin. Wallace and his team are now working on a date for this first migration.

In the last 20 years, genetics research has experienced a breathtaking number of breakthroughs, allowing scientists to discover and study increasingly smaller structures in greater and greater detail. One new area of study has been research on mitochondrial DNA (mtDNA), a small circular form of DNA produced in genes called mitochondria that lie outside the nucleus of a cell.

Unlike nuclear DNA (the DNA found in the nucleus of a cell), the mitochondrial DNA of both parents do not recombine to form new gene arrangements for each offspring. Instead, mtDNA is transmitted only by females and is passed down intact to each daughter. "That means that the mtDNA has been transmitted from mother to daughter throughout all human history," Wallace says.

Wallace's group recently looked at the mtDNAs of native Americans from three tribes in North, Central, and South America, and the results are now working on a date for this first migration.
NEW REFERENCES & RESOURCES


UPCOMING CONFERENCES

May 20–24, 1991 14th International Radiocarbon Conference, Tucson, Arizona. Contact: Dr. Austin Long, Department of Geosciences, University of Arizona, Tucson, AZ 85721; Fax: (602) 621–2672.


June 15–19, 1991 American Society of Mammalogists, Annual Meeting, Manhattan, Kansas. Contact: M. E. Hight, Department of Biological Sciences, Marshall University, Huntington, WV 25755.


October 6–11, 1991 8th International Congress on Human Genetics, Washington, DC. Contact: John I. Manoli, Secretary-General ICHG, 9650 Rockville Pike, Bethesda, MD 20814.


October 27–November 1, 1991 Soil Science Society of America Annual Meeting, Denver, Colorado. Contact: SSA, 677 S. Segoe Road, Madison, WI 53717; (608) 273-8080.

SUGGESTED READINGS

On Living Cells Unlock Ancient Mysteries

On Mining Knife River Flint
In North Dakota


On Interview with Ben Waller

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EARTHWATCH BRIDGES THE GAP

The era of glasnost in the USSR has given Soviet scientists previously unknown freedom to receive visits from, and even collaborate with, their foreign counterparts. Earthwatch, an internationally known organization based in Watertown, Massachusetts, that works to match scientists with willing volunteers, is taking on a new kind of match-making. If all goes well, the first collaboration between Soviet and American archaeologists will take place in the summer of 1991.

Exchanges will go two ways: Soviet archaeologists will study and work at sites in North and South America; and American archaeologists and Earthwatch volunteers will excavate sites in the USSR.

There has always been intellectual contact between Soviet and American archaeologists. For example, research by Soviet archaeologists is sometimes translated into English and published. In addition, there has been an any kind of agreement like this that encourages volunteer, lay-person participation.

exchanges between American and Soviet scientists have been known for a long time. What remains unknown, says Earthwatch's Jim Chiarelli of the Center for Field Research, is the Smithsonian Institution's IREX (International Research Exchanges) program, which has supported exchanges between U.S. and Soviet personnel for the last twenty years. "There are many archaeologists in the United States," Chiarelli says, "who know their Soviet counterparts very well, and vice versa. They've been traveling back and forth quietly over the years." It is the chance to work together on a project—instead of simply visiting each other's sites and laboratories—that is new.

"There's never been a specific move like this one to encourage collaborative research," Chiarelli says, "and there's certainly never been any kind of agreement like this that encourages volunteer, lay-person participation."

The time the Soviet archaeologists arrive in the United States in 1991, years of planning will already have taken place. The project got underway in 1987 when Brian Roshorough, the president of Earthwatch, attended the Chauchau Conference on U.S.-Soviet Relations in New York State. At the conference, Soviet scientists broached the idea of collaborative research with American scientists.

Roshorough immediately got in touch with the Soviet Academy. Together, he and the Soviets made tentative plans for an exchange program to be called Mission to Earth. This exchange would have involved scientists in all disciplines, not just archaeologists.

In 1989 events sped up when Margaret MacLean of Earthwatch met Anatoli Derevyanko at an archaeological conference in Seattle on the prehistory of the Pacific Rim. MacLean and Derevyanko, director of the Institute of History, Philosophy, and Philology in Novosibirsk, Siberia, discussed the possibility of an exchange. Ten days later, while visiting colleagues at Harvard University, Derevyanko stopped at the Earthwatch office in Watertown and delivered a proposal for a long-term program of collaborative research. As part of the plan, Derevyanko suggested a two-person panel of advisors, consisting of five Soviets and five Americans. Each scientist would review proposals for research based on his or her area of expertise.

The Soviet scientists suggested by Derevyanko represented four regions of the USSR—Central Russia, Soviet Georgia, Uzbekistan, and Siberia (both Derevyanko and his wife, also an archaeologist, represent this region). Each of these advisors has control over the archaeological research that occurs in his or her region.

The American advisors and the Earthwatch staff met at the Earthwatch Principal Investigators' Conference, in March, 1990. There, they signed a

detailed, ten-page agreement that spelled out the research to be undertaken in each of the regions represented by the Soviet panel members. The proposals included a large variety of site types in the Soviet Union, ranging from Neolithic locales in Eastern Europe to paleolithic sites in Siberia. Excavations at Greek, Roman, and Viking sites have also been proposed. With regard to paleolithic sites, the Soviets would like to study cultural continuities between Siberia and North America, and evidence of the peopling of the New World. "They're as interested in those questions as we are," Chiarelli says.

The next major planning step occurred in late July and early August, 1990, at a conference in Novosibirsk. Chiarelli and several other American archaeologists, including Robson Bonnichsen of the Center for the Study of the First Americans, attended this conference and examined some of the proposed Siberian sites. The Soviets have also identified research they would like to undertake in other parts of the world. They have expressed a particular interest in New World sites that have produced evidence of pre-Clovis occupations.

Chiarelli explains that there are no archaeologists in the Soviet Union who are experts in the prehistory of every part of the world. "They have experts on Mesoamerica (Mexico and Guatemala), another on Peru. They are very interested in going to,,. , sites that they have never been allowed to work on."

The scientists have been unable to work abroad not only because of restrictive Soviet travel policies, but also because in the past, many countries have refused to allow Soviet citizens within their borders. "Just as the Soviets were strict about allowing foreigners into their country to work on archaeological sites, many counties in the West have been just as restrictive about letting Soviet archaeologists into their countries." For example, until recently, Soviet citizens were not even allowed into places like Mexico or Peru. "Their expert on Andean prehistory has never been to Peru... Now that things have opened up a little bit politically, we're hoping that we can interest people in visiting other countries, in working collaboratively with Soviet archaeologists as well."

The idea of lay people working alongside scientists is alien to the Soviets. Unused to working with non-scientists, Chiarelli explains, a Soviet scientist might say, "I trained for so long to do this, how can I possibly show somebody who's never done it before what to do and why we do it?" Earthwatch staff members have worked hard to communicate their belief in the value of lay participation in scientific research.

Chiarelli expects a total of five to eight projects to be undertaken this summer in the USSR. This is the largest number of projects the limited number of Earthwatch volunteers can support. He hopes to increase the number of collaborations (in both the Soviet Union and in the rest of the world) by two per year throughout the 1990s.

Summing up, Chiarelli says, "It isn't as if we're giving the Soviets their first contact with the outside world, that isn't the case at all.

"What we're trying to interest them in is the things that Earthwatch is about, above and beyond the actual support of scientific research. Our agenda is two-fold: supporting scientific research, and education. Not only the kind of education where people go out and learn things, but also... forging bonds of better understanding between scientists and lay people."

—Nancy Allison

The Soviet archaeologists and some of the Earthwatch staff members involved in the exchange project. From left to right, the individuals shown in the photograph are: Brian A. Roshorough, President of Earthwatch; Dr. Valeri Gullasev, Deputy Director, Institute of Archaeology, USSR Academy of Sciences, Moscow; Academician Anatoli P. Derevyanko, Director, Institute of History, Philosophy, and Philology, Siberian Division of the USSR Academy of Sciences, Novosibirsk; Sally A. Evans, USSR Program Coordinator, Earthwatch; Professor C. C. Lamberg-Karlovsky, Department of Anthropology, Harvard University; Dr. Tatiana Chikheeva, Physical Anthropologist, Institute of History, Philosophy, and Philology, Siberian Division of the USSR Academy of Sciences, Novosibirsk; Academician Valer P. Alexeev, Director, Institute of Archaeology, USSR Academy of Sciences, Moscow; Dr. Otar Lordkipanidze, Director, Center for Archeological Research, Academy of Sciences of Georgia SSR, Tbilisi; James A. Chiarelli, Associate Director for Social Sciences, The Center for Field Research, Earthwatch. (Note: The fifth member of the Soviet delegation, Academician Akmadali Ashurov, Vice President, Academy of Sciences of Uzbekistan SSR and Secretary, Institute of History, Linguistics, and Literary Criticism, Academy of Sciences of Uzbekistan SSR, Tashkent, returned to the Soviet Union before this photo was taken.) (Photo courtesy of Jim Chiarelli.)
Mining Knife River Flint

The site was used for extracting flint for probably 11,500 years.

In the summer of 1990, Metcalf's team worked at the site for almost three months. The most complex work involved in the investigation, Metcalf says, was determining the stratigraphic levels in the quarry pits. "The history of the site, both natural and cultural, was extremely complex because there are a lot of mechanisms for filling the mine shafts and pits. Once prehistoric workers abandoned a mine, there were different ways the hole could be filled in from the periodic flooding of the creek could fill in a hole naturally, or sometimes a human being might fill in a hole with back dirt from an adjacent pit, either sequentially in the same occupation, or, as Metcalf notes wryly, 'a few thousand years later' Geoarcheologists Julians Van Nest of the Department of Geology, University of Iowa, and Anne McBibbin of Metcalf (archaeological consultants) worked with Metcalf to distinguish natural deposits from the disturbances made by human beings.

The site included evidence of three periods of intensive quarry use and occupation. During the early Paleoindian period, when the flint deposits were very close to the living surface, people dug up the material from the site. During the next phase, the site was used for flint extraction. Each pit was 3 to 4 m across, big enough for several people to work in at one time. Typologically, remains from this earliest period range from about 14,000 to 11,500 B.P. to perhaps as old as 17,000 to 11,500 B.P. Archaeological deposits from the Paleoindian horizon have produced a vast quantity of debitage—the flakes of stone that occur when a piece of flint is shaped by chipping. Living surfaces and quarry deposits that produced these artifacts are clearly defined and occur at depths ranging from 1.2 to 2.7 m below the present surface. They can be traced across a good part of the site.

The earliest projectile point found in the Paleoindian stratigraphic level is a Goshen point, a broken piece of a finished flake. "Somebody did some reshaping and discarded the broken base. That's unusual," Metcalf notes. Goshen points, named by the late Henry Irwin, have been found in the central and northern Great Plains region. George Frison of the University of Wyoming, who has studied several Goshen sites, believes that the Goshen culture existed between the time of the Clovis and Folsom cultures, at about 10,800 to 11,500 years ago.

The Hell Gap point found at this level dates from the first half of the Paleoindian big-game hunting period, 10,000-10,000 B.P. "This point was worn out," Metcalf says. It has been reworked—typical for Hell Gap—"down to almost nothing. It wasn't broken—it was a complete specimen—but it had been re-sharpened so many times the blade part was short and stubby, with a high edge angle. It wouldn't be useful for much." Both the Goshen and Hell Gap points are made of Knife River flint.

The second occurrence occurred during the early plains Archaic period, at about 8000 to 7000 B.P. This occurrence level was found at a depth of 1 m. During this period, the site was not mined as intensively as it has been during later periods. Like the Paleoindian occupation, the early plains Archaic-level produced a large quantity of debitage. Only a few points were found, including one broken point and one in pristine condition. No radiocarbon dates are yet available, but Metcalf suspects the points will date from about 6000 to 7000 years ago.

The third level of occupation involved intensive and varied use of the site. During this occupation, at a depth of 30 to 40 cm below ground surface, people excavated hundreds of mines and left behind extensive numbers of artifacts, including finished points and large amounts of debitage. They also reused abandoned mine shafts in several ways. In addition to the use of raw shell, the surface of these late miners developed more complex mine shafts to reach the flint. Although only one person would have been able to dig inside a shaft at a time, probably several others would have been present to load the dirty away. Digging these deeper shafts was a cooperative activity. In many instances, the miners dug roughly hourglass-shaped mine shafts. Although the shafts varied considerably from one another, they followed a general pattern. The mouths of the shafts were from 1 to 1.5 m in diameter; at a depth of about 1 m they narrowed to a diameter of 1 m; and the lower portion of the shafts bordered out to a diameter of 2 to 2.5 m. In a few instances, the miners dug short lateral tunnels under a paleosol that formed a stable ceiling.

So far, Metcalf's team has not been able to identify the culture of this most recent occupation. Bison bones recovered from this level in 1988 produced dates of 1000 to 2000 B.P. The dates correspond with a complex known as Besant, which occurs in the northern Great Plains. Because of the radiocarbon dates and because of the large number of Besant sites in surrounding areas of North Dakota, Metcalf suspects that the latest quarries at the site were the work of Besant people. One Besant point has been found in this horizon, along with other late Prehistoric-period points.

In addition to intensive mining, River Creek's most recent occupants made secondary use of quarry shafts. The researchers found parts of 13 bison in abandoned shafts, including one intact bison. This animal may have been a natural death; it was then put into the pit and died there. "If it was a cache, they cached the whole animal," Metcalf says. Other bison clearly had been butchered. Because all the remains, the team has hypothesized that some of the pits were used for meat caches during the cold season.

In addition to the bison remains, pits also have yielded the remains of three dogs that seem to have been intentionally buried. One pit contained a dog skeleton and most of a bison skeleton; a second pit contained a dog skeleton and a lone bison skull; and a third pit contained a dog skeleton and part of a bison skeleton, including a skull. The dogs had not been butchered.

"Whether it was just a place for dumping dead dogs or whether there was a ceremonial connotation between associating the dog skeletons with bison skulls, we're just not sure at this point," Metcalf says. "It is quite rare to isolate workshop activities at this stage and trace them to a defined component. There's no place that I know of where you can say 'This is a Goshen quarry workshop. This is true of Hell Gap and early Archaic components.'

In addition to analyzing the debitage, a multidisciplinary team of researchers will investigate other aspects of the site, particularly the relationships between the interplay between climatic change and changing human activities during the past 11,000 years. Holmes Semion, the University of Iowa is studying microvegetation. Nancy Allison, the University of Wyoming is exploring the site for artefacts. Anna Woods and John Dugan of the University of North Dakota are assisting with the project. The team is also analyzing the flora and fauna recovered from the site. Alan Cavcara is using a pollen analysis. And Van Nest and McBibbin are analyzing the soil development and geomorphology of the site area.

In addition, the information the site has yielded on early Paleoindian activities, Metcalf finds the extent of activity in the Besant horizon particularly arresting. "They [the Besant people] dug almost as intensively as the early Paleoindians... there are over 1,100 butts that have been sunk into the site... people working in cooperative, organized fashion to go after flint. At this site, it appears to me, that we're looking at what we would term an industrial level of activity. Obviously we're dealing with cooperative teams that are going after flint as more than just a casual endeavor... I think this occurred at many other quarries...

"We're not just looking at some of the models of prehistoric behavior."
and South America. Wallace explains, "We wanted to ask the question of whether the tribes of those three continents were genetically similar to each other or very different. One of the big debates in the linguistics of American Indians has been whether the Paleo-indians have multiple origins, or only one or a few."

"The reason is that there are multiple major American Indian language groups. There are about 200 different languages, which group down to something on the order of 17 language groups. The question is does each of these language groups represent a separate migration and an independent origin, or did they in fact derive from an even more ancient protolanguage?"

Joseph Green of Stanford University has proposed the hypothesis that all of the Paleoindians shared an original protolanguage, which he calls Amerind. Now if the WAS a protolanguage, then it would suggest a single migration. So we argued that if that were the case, then if we looked at North, Central, and South American Indian populations, they should all have mtDNA derived from a common female origin."

Wallace's work on mtDNA began in 1971. As the technology for looking at the structure of mtDNA advanced, Wallace was able to study its mutation rate and its sequencing—strings of molecules called nucleotide that are arranged in a certain order.

And, because mtDNA never recombines, "the only way it can change is by progressive mutations. Therefore, you can look at the changes because they're cumulative, sequential. One is added to the next."

This is known as a sequential mutation. Another interesting feature of mtdna is that it changes its sequence about 10 to 20 times faster than nuclear DNA. Since changes can only be caused by sequential mutations along the female lineage, scientists can compare the mtdna sequences of two modern individuals to directly measure the time that has passed since they shared a common maternal ancestor.

The key to tracing ancient migrations lies in this unique sequential mutation. To illustrate this, Wallace describes a simplified example of a lineage.

"We'll start with the first mtdna in human beings. That mtdna gets transmitted to a number of women, and then a mutation occurs at, let's say, position A in one of those women. So now she has a mtdna that differs from all the others by a change of site A, a single nucleotide change."

"Then let's say this woman's mtdna at site A has many offspring. A new mutation occurs in one of those offspring that gives a new site B. So now that lineage has site A plus site B."

"Now let's go back to where we had the first individual with the mutation A. She has a lot of daughters in addition to the one that got B. Let's say another daughter gets mutation E. Now that means that daughter has A plus E. Then if she goes on and has daughters, and one of those has a mutation, let's say F, then that individual would have A plus E plus F."

"So, because the changes [are] cumulative and sequential, the record is unambiguous; it's not complex."

Statistically, these mutations occur at a set rate. As a result, Wallace is able to identify and count the differences between the mtDNA of any two modern individuals. The time that has passed since they had a common maternal ancestor is equal to the total amount of differences between them, multiplied by the mutation rate. This is because each change is a single nucleotide, and it is independent of any other change that has occurred before it.

"Since the mutations occur along sequential and maternal lineages, you can literally track migrations as women move from place to place. But this is only if we can also track the relationship between populations, as well as calculate the times that different populations became separated from each other."

"So," says Wallace, "by comparing the mtDNA of different people around the world, we can build a tree of the female lineage, which basically makes the mtDNA a biological history book of women."

"In the laboratory, the differences in individuals' mtDNA show up as patterns, called morphs, which are precise enough to discriminate between even closely related groups. A morph for a particular individual is formed by a restriction enzyme, to digest the mtDNA obtained from a sample of that person's blood. The enzyme cuts the circular mtDNA at a specific site, in a specific number of places. This results in two or more pieces of mtDNA, depending on the number of cuts that the enzyme made. The basic pattern when two fragments are created by the same enzyme is called morph 1.

"When the same enzyme is used to digest the mtDNA from a different individual, that individual might have either the same pattern or an altered pattern related to the number of additional mutations in the mtDNA. One additional mutation would produce an additional site change, and cause the mtDNA to break into three fragments instead of two. This pattern of three fragments is called morph 2 for that enzyme; still another mutation or site change would produce a pattern called morph 3, and so on."

"Each morph then differs from the previous morph by a single site change, owing to a single mutation. So a difference of morph 2 to morph 3 for an enzyme would indicate a single mutation that occurred in a direct lineage between two individuals."

"Researchers may use this as a 15 or 20 different restriction enzymes to look at a single individual's mtDNA, with each enzyme making a characteristic number of cuts in the mtDNA."

"Since many mtDNA morphs have been found to occur highly with geographic and ethnic origins, these data can be used to trace the origins of the group being sampled. Wallace emphasizes that one of the strengths of this method is that "the data seems to be reliable. Anyone can do this kind of study on any kind of population they want to, as long as it's a well-defined population; that is, aboriginal, not just something like New York City. [You] will get a well-defined set of data that can easily be integrated into a world phylogenetic tree, or world population."

Wallace and his colleagues began with the Pima, a tribe in the southwestern U.S. They found that 40.5% of the Pima individuals had HincII morph 6, a specific pattern for the enzyme HincII, while 55% of them had HincII morph 2. Since HincII morph 6 primarily occurs only in Asia, this confirmed the hypothesis that the ancestors of this group originally came from there.

According to Wallace, HincII morph 6 "happens to differ from morph 2, the most common pattern, by a single site change. So HincII morph 2 goes to morph 6 by a single site loss. And that site loss, or site change, is the marker for the Amerindians."

"To represent South America, the group chose the Ticuna, a linguistically distinct and geographically isolated tribe from the western Amazon rain forest in Brazil. Blood analysis had previously shown that the Ticuna were relatively free of genetic mixture with non-Amerindians."

For Central America, Mayan Indians in a remote area of the Yucatan Peninsula were chosen. Blood type analysis revealed a European ancestry of about 10%.

The DNA of each individual was extracted from blood samples taken from members of the tribe. The mtDNA was then digested with six different enzymes, and the resulting morphs for each enzyme were compared with those of the Pima and with morphs from Asian populations. As with the Pima, the results for the enzyme HincII were the most significant, with 11% of the Maya mtDNAs and 42% (44%) of the Ticuna mtDNAs identical to HincII morph 6. The remaining samples in both tribes for HincII were morph 2. The high frequency of HincII morph 6 in all three tribes suggests that it was characteristic of a single founding Paleoindian population.

"In addition, the incidence of morph 6 among the populations that were studied was almost 20 times higher than it is in Asia. This indicates to Wallace that the "ancestral population of the first Paleoindians was composed of a small number of maternally lineages."

"We did indeed find that all of the mtDNAs of North, Central, and South American Indians that we looked at were derived from four founding female mtDNAs, or four founding lineages. Each of the three tribes had at least three of the four mtDNAs, so those four had in fact been members of the founding population."

"Therefore it looks like a single migration came across the Bering land bridge carrying these four mtDNA types. Otherwise, if each came in a different migration, you would expect different percentages—that is different tribes would have different inputs."

"Those individuals radiating out from the first migration then gave rise to the North, Central, and South American Indians. Therefore, our data would be consistent with... Greenberg's hypothesis."

If a significant concentration of HincII morph 6 could be found in a population elsewhere, it would suggest a specific place of origin for the First Americans. To date, none has been found. So far the occurrence of HincII morph 6 in Asia is scattered and rare, rather than in any significant frequency.

However, Wallace says the team will soon be able to look at Siberian populations. "We have an agreement with the Soviet Union for them to sample people, and that will help to piece things together. We go forward to that cause that might be a possible origin."

What are the larger implications of this work if Wallace's findings are confirmed? To begin with, when migrations are established it can help to settle some controversial over whether the Americas were populated earlier than 15,000 years ago. Further tracing of the American Indian mtDNA tree could also clarify more of the overall migration patterns of early populations throughout the Americas, perhaps tying in with archaeological and linguistic data.

Finally, this technique allows scientists to trace the genetic lineage of our species as a whole, and the mtDNA's studied throughout the world can be traced back to a single mtDNA—suggesting that modern humans share a common female ancestor. It also appears that the Homo sapiens mtDNA was young, with an age of less than 200,000 years. "The implications," says Wallace, "are that Homo sapiens is a very young species."
AN INTERVIEW with BEN WALLER

Editor's Note:
Sports divers Ben Waller, Bill Royal, and Don Serbovask were among the first to bring the importance of underwater archaeological and palaeontological resources to the attention of the scientific community. Ben Waller has a broad and thorough knowledge of sites throughout the state and has shared this information with the scientific community. He has long been a vital link between amateur divers and the field of archaeology.

The following discussion was taken from an interview with Mr. Waller conducted by Dr. James Dunbar for the Florida Anthropologist (1983 Florida Anthropologist 36(3):313). We thank the Florida Anthropologist for permission to republish selected excerpts of this conversation.

On January 15, 1983, James Dunbar conducted an interview with Ben Waller, a local underwater archaeologist in Ocala, Florida. Mr. Waller has more practical experience investigating and observing inundated Clovis/Swaneeage Paleo-Indian sites than any other underwater archaeologist in the state (professional or avocational). He has spent thousands of hours of dive time pursuing this endeavor. Mr. Waller's experience as a former animal trainer with Ross Allen's Reptile Institute has added his varied experience as a diver have him insight and a field savvy which has led to numerous important discoveries.

FA: When did you first begin to Scuba dive?
BW: I started diving in the late 1960s as a spear fisherman. Then I stopped spear fishing and began photographing fish. Eventually, I became interested in clear water photography, which led me to cave diving. We started finding things that were unique in the caves—stalacites that shouldn't have been there, animal remains—the kinds of things that sparked my curiosity.

FA: How did the early Scuba equipment compare to today's standards?
BW: My first regulator I made from instructions in Popular Science magazine with the knowledge I had learned on my first trip and regulator in 1959. It was the very last part of 1959 and finally several of them came in at the same time. I wanted to buy the first one I ever saw and as I remember that first regulator was $25.

FA: When did you first begin to notice and investigate underwater sites in Florida?
BW: We were interested in and trying to explore caves, when a man with the State geological survey asked me to let him know where the caves were and what was in them.

One of my early dives was at Little Salt Springs. I can remember we were decompressing from that dive when I began to hear a metal-like sound—drum, drum, drum. I watched the other divers clanking two boxes together. Gosh, that's embarrassing to think of now with all the very good work that is being done on the site recently.

Soon after, we began finding more and more things underwater and we contacted Dr. Clayton Ray, then with the Florida State Museum in Gainesville. Dr. Ray convinced us that we should be working with the Museum recording the things that we were recovering underwater.

I eventually worked on diving expeditions with Bob Allen and Dr. Goggins of the University of Florida. Since then I have worked with Dr. Webb, Dr. Johnson, Riley Bulken, and a little with Dr. Purdy, even though the latter two were not divers.

FA: What are your major interests in the field of archaeology?
BW: I'm interested in the animals that were hunted by the first people that came here—the Paleo-Indians. I'm torn between palaeontology and archaeology, but I don't think I have to be what it boils down to is that I am most interested in the time when now-extinct animals and man coexisted. There is more and more evidence being discovered to indicate that Paleo-Indians were close to the extinct animals that lived here. That is most pleasing to me because it creates a situation where palaeontology and archaeology become a bit of the same.

FA: What kinds of experiences have you had which have helped you to interpret underwater sites?
BW: I was part of a body recovery team for a long time and there was a rule of thumb that if you knew where a victim had entered the water, the body could be found within one and one-half times the depth of the water. If a Victim dropped in 30 feet of water you could expect to find the body within 45 feet from where he originally fell in.

FA: Did you begin to notice the same kind of things in underwater sites?
BW: Yes, I kept hearing a theory that artifacts dropped in at point A and washed down to point Z; therefore, they had meaning context. I didn't feel that was true because normally when we found sites we would find concentrations of points and artifacts within a confined area. If artifacts had washed randomly down river they would have been scattered up and down the river and not concentrated. I worked on a project with the Department of Paleontology of the Florida State Museum where we uncovered two-million-year-old antelopes (that were) still partially articulated. Now that's a pretty good argument against the idea of downstream washing of the much later period artifacts.

We did another thing that was interesting and it's something that needs to be followed up. We took 500
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The Center for the Study of the First Americans has initiated a consignment program to facilitate the distribution of publications relating to the peopling of the Americas. Over the last decade, the Center has developed a computerized distribution network to place publications in the hands of interested individuals on a worldwide basis. The purpose of our new consignment program is to make our distribution network available to individuals and organizations who develop quality publications important to understanding America's earliest cultural heritage. We have established working arrangements with the Smithsonian Institution's Paleoindian Program, the Hot Springs Mammoth site, Arizona University, the Department of Anthropology at the University of Pittsburgh, and the Buffalo Museum of Science and Technology. Some of the most important new publications, included in the listing below are: Megafauna and Man: Discovery of America's Heartland, edited by J. A. Wilgus, C. M. Akens, and J. Lapans; and Clovis Origins and Adaptations, edited by R. Bonnichsen and K. Tunncre. If you have limited-edition publications relating to the peopling of the Americas and would be interested in developing a consignment agreement with the Center, please contact us.

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continued on page 8
**Interview with Ben Waller**

**FA:** Do you think they may have been used as projectiles?

**BW:** I am uncertain of their use; however, I would like to say that the people who have seen the Steinheil's elephant sites agree that bone pins were common in early tool kits. However, there are a lot of people that just won't buy the idea. I guess years ago the earliest date for their manufacture was believed to be five to six thousand years ago; therefore, even the obvious can be questioned. But I believe that the bone points are in sites on Paleo sites and are part of the Paleo tool kit.

**FA:** Do the double-pointed bone pins have any distinctive features like basal roughening that might separate them from those of a later age?

**BW:** I don't know, but the ones I'm speaking of are made of the cannon bone of the deer. I think four pins can be made from each cannon bone. I think they cut off the epiphysis of the bone, split the remaining long shaft into four sections, and sharpened both ends of each of the sections.

**FA:** You also mentioned butcher-marked Pleistocene bone from one of the river sites; how many have you seen from Florida?

**BW:** Well, I think it's safe to say that there are at least eleven Pleistocene animal bones displaying butcher marks. I was fortunate to have discovered the first one to be reported [see Bullen, Webb, and Waller, 1970, *American Antiquity* 35(2):203-205]. The specimen was a vertebral spine of a large mammal recovered from the Santa Fe River. What was most significant, as Dr. Webb was quick to realize, is that the cut marks were in strategic places; for example, ligament attachments were cut away to separate the meat from the bone. Since then, there have been other specimens found with even more distinctive cut marks.

**FA:** What are some of the traits that you would look for that would characterize a river bottom Paleo site?

**BW:** Well, as I mentioned earlier, the occurrence of manatee rib and flint spalls is diagnostic. In the Santa Fe River you quite often notice and come across a site that has chert which is not extremely translucent, nor of the highest grade. I don't know my stone that well, so just bear with me in this poor definition of it, but sometimes the chert has multicolors that go through it, like white, yellow, etc. Anyway, I think that type of stone is frequently found at the early sites.

**FA:** How frequently do you find good bone preservation at the river Paleo sites?

**BW:** Very often. Many paleontologists feel that some of the best preserved bone in the United States has come out of the Florida rivers. I think the river's tunic acid is one of the big reasons for this excellent preservation.

**FA:** What about preservation of the fragile organic materials, such as wood, etc., that date to the Paleo-Indian period?

**BW:** The objects that I really consider to be wooden artifacts are rare and are generally more recent. I do think it is possible to find early wood artifacts because of the wood preservation at the 100,000 year-old sloth site in Daytona Beach. At that site, logs were strewn throughout the area and had to be removed to get at the fossil remains.

**FA:** Have you ever seen a component of a Paleo river channel site eroding out of fresh-water marl other than the Guest Site?

**BW:** In the Santa Fe there is a fine-grained white sand, usually up next to a bank, and I have seen Paleo material come from that type of sediment. There is usually very little bone at these sites and I would not call them kill sites. Near Wilson Springs is a good area to find this stuff. You can go up near the bank adjacent to a channel site and find bones and find points in this extremely fine-grained sand.

**FA:** Do the river channel sites occur at great depth or are they shallow or do they vary from site to site?

**BW:** I've never seen any at great depths in the river; although, we've seen Paleo points in deep holes in the river.

**FA:** Deep holes?

**BW:** Yes, 60 feet or more. One of these had several points. Of course, not many rivers have sixty-foot deep holes. Most of the hole in rivers that we think of as so deep are only 25 feet deep when checked with a depth gauge.

**FA:** What is the average depth of the Paleo-Indian river channel sites?

**BW:** Most of the Paleo sites are in 12 to 20 feet of water, but probably averaging closer to 12 feet.

**FA:** Have you ever investigated an offshore Atlantic or Gulf Paleo site or fossil locality?

**BW:** Yes, I have visited fossil localities. We found elephant remains considerable distances out in the Gulf of Mexico—six miles out. Usually you get into an area where you just see fragments of bones that are highly covered with barnacles. There is a lot of terrestrial material, for example, off Venice.

**FA:** Late Pleistocene age fossil bone?

**BW:** Yes. One nice Paleo point came from the beach as well.

**FA:** What avenues of research would you like to see take place in the future?

**BW:** First of all, I think that many people need to get over the idea that Florida rivers wash artifacts great distances downstream. The classic argument that modern refuse—like Coke bottles—can be found together with Paleo points does not negate the fact that artifacts from a river site were originally deposited within that site's boundaries and not ten miles upstream. I think the river banks adjacent to the extra good sites should be tested. Sometime in the future the sites we have all been waiting for will be found. Unfortunately, no systematic search effort has ever been attempted.

Personally, I would like to continue plotting the distribution of these early sites. I think there will be a staggering number of sites eventually plotted once more people start sharing that kind of information. People need to share this information and professional and avocational archaeologists need to do more active field work because I think we're going to flip when we see the amount of material and good information that is retrieved.

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