

MAMMOTH TRUMPET



Volume 4, Number 4
September, 1988

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

University of Maine
ISSN 8755-6898

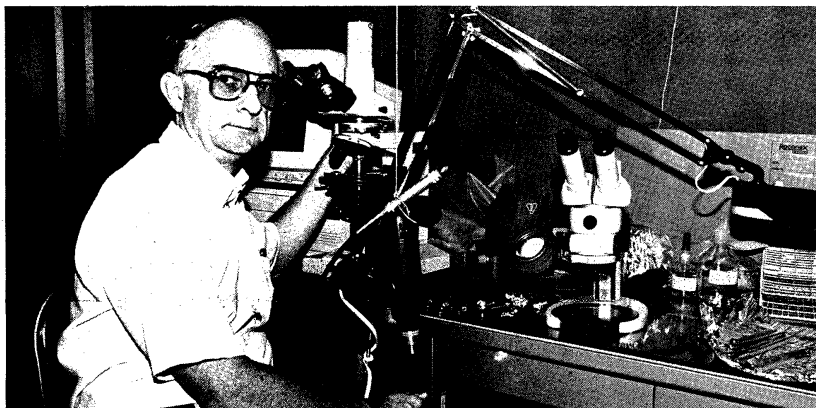
OLD BONES IN THE NEW WORLD

"Why would people want to date bone?" Dr. R. Ervin Taylor, director of the Radiocarbon Lab at the University of California at Riverside, asked this rhetorical question during a recent conversation with the *Mammoth Trumpet* concerning the radiocarbon dating of bone. Dr. Taylor has been a major participant in the C-14 dating of over a dozen supposedly very old New World skeletons, showing them to be no more than 11,000 years old.

"Bone is a difficult material on which to get accurate C-14 dates," Taylor notes. Various types of contamination—bacteria and organic substances in the soil for example—can alter the C-14 activity in bone. A radiocarbon researcher charged with dating bone, must perform extensive chemical pretreatments to remove organic contaminants before dating can even begin. Wood and charcoal, on the other hand, are usually much easier to work with. So why date bone?

"The reason," Taylor points out, "is that in many situations other sample types are simply not available." But bone is often preserved. A single human bone or, more frequently, a bone fragment, is often all the evidence that has survived. Wood or charcoal samples in the vicinity of a human bone can provide a date by "association." But many geological processes can disrupt the physical relationship between objects in sediment profiles. It is best to work with the bone itself.

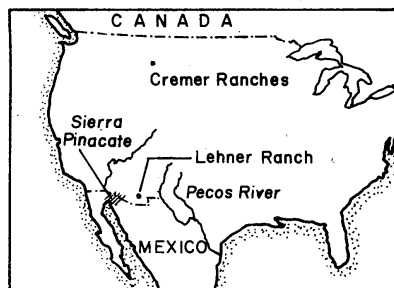
The bones that date back to the period of the arrival of humans in North America are not, however, stout white shafts with Marmadukian knobs, but are more likely to be dirt encrusted, ground-water stained fragments with much chemical and physical alteration. Taylor explains that in the radiocarbon dating game



Dr. R. Ervin Taylor examines skeletal specimens in the Radiocarbon Laboratory at the University of California, Riverside prior to dating them with the recently developed accelerator mass spectrometry technique. (Photo courtesy of R.E. Taylor)

"as sample size decreases, analytical problems multiply." In the conventional means of measuring radiocarbon by decay counting—inferring radiocarbon concentration by noting the decay events—up to several kilograms of material might be required.

"This," says Taylor, "is where accelerator mass spectrometry comes in." Accelerator (or atomic) mass spectrometry—referred to as AMS—can accommodate carbon samples on the order of 1/1000 the size of that
(continued on page 7)



Map indicates sites and regions mentioned in this issue.

INSIDE

Center News	2
Lehner Ranch Site	3
Crabtree Award	5
New References and Resources	6
Conferences	6
Suggested Readings	7

Interview with Julian Hayden

A BRIDGE OVER TIME

—Old men should be explorers.
T.S. Eliot, *Four Quartets*

"I'm a bridge, in a way, between the old-timers—the giants—and some of the grad students and younger archaeologists of today," says Julian Hayden, recipient of the third annual Crabtree Award, presented by the Society for American Archaeology to non-professional archaeologists of distinguished achievement.

In the past 50 years, archaeology, similar to other disciplines, has become more professionalized and institutionalized, with advancement and recognition increasingly dependent upon academic credentials. Yet, the foundations of North American archaeology were laid by people whose education was acquired in the field, through first-hand experience and the seasoned advice of mentors. These pioneers were seldom funded, let alone salaried and guaranteed job security by an institution. They often worked alone, supporting themselves through a depression and a world war by taking whatever jobs they could find, and doing archaeology whenever they could spare the money and the time. Most of these explorers are gone now; Julian Hayden is one of the few who remembers both

the people and the vision that fired them. Remembers because, indeed, at age 77 he is one of them, one of the last of a vanishing breed.

One of Hayden's few advantages when first entering the field was a father who was already an archaeologist. "My father got his master's in archaeology under Prof. F.W. Putnam at Harvard in 1909. For reasons of his own, he went to Montana and got a job in a sawmill, going on later to do many things, including being an editor, secretary of the chamber of commerce, and a Marine in World War I, and winding up eventually in southern California. In 1929, M.R. Harrington, of the Southwest Museum in Los Angeles, invited my father to go with him to Nevada to excavate Mesa House. My father did and took me along; he wrote the report on Mesa House and I illustrated it, having some small ability in drawing. So that's how I got into archaeology, though I'd heard about it all my life." Heard about it and become already drawn to it: "I found my first arrowhead and that cinched it—you know how that goes."

Although Hayden possesses no formal degree, the lack of it has affected him only in the matter of getting
(Continued on page 4)

C E N T E R N E W S

WORLD SUMMIT CONFERENCE ON THE PEOPLING OF THE AMERICAS

As announced in the last issue of the *Trumpet*, the Center for the Study of Early Man, as an affiliate of the Department of Anthropology and the Institute for Quaternary Studies, University of Maine, is convening a World Summit Conference on the Peopling of the Americas. This international gathering of scholars from more than a dozen countries will be held May 24-28, 1989 at the University of Maine campus in Orono, Maine.

The goals of this conference are: to synthesize current knowledge on early human colonization and adaptation in the western hemisphere; establish mechanisms to coordinate pertinent global research over the next decade; and foster public awareness of the need for conservation and preservation of archaeological sites.

Conference speakers and papers by topic include:

GENERAL:

- James Adovasio—*An Application of Nitrocellulose Membrane for the Identification of Blood Residues on Artifactual Material*
- David Young et al.—*Exploring the Usefulness and Validity of the Cognitive Approach to Lithic Analysis*
- Tom Stafford—*Accelerator 14C Dating of Human Fossils in the New and Old Worlds*
- R.E. Taylor—*Framework for Dating Human Bones Using C-14*
- Merritt Ruhlen—*Linguistic Evidence for the Peopling of the Americas*
- Emoke Szathmari—*Modelling Ancient Population Relationships from Modern Population Genetics*

ASIA:

- Christy Turner II—*Relating Eurasian and American Populations Through Dental Morphology*

WHAT'S NEW AT THE CENTER?

It has been said that the more things change, the more they stay the same. In many senses, that is very true here at the Center. In the midst of the many changes here, we neglected to send out renewal reminders to all the people whose subscriptions expire with this issue. Since these people will not have had adequate notice to resubscribe without missing an issue, we are sending this issue to those members in anticipation of their renewal. We apologize for any inconvenience or confusion our reorganization here may have caused you, and hope you will continue to support the Center by subscribing to the *Trumpet*.

Renewal notices will be going out shortly for all members whose subscriptions expired with volume 4, number 3 or 4. Please return your renewals by December 1, 1988 to guarantee that you will continue to receive the *Mammoth Trumpet* with no interruption. (An easy way to determine the period you are renewed through is to check your mailing label. The number in the top left corner indicates the last volume and issue you will receive with your current subscription.)

Some of the changes at the Center involved the departure of two staff members and the arrival of two new ones. Pat Leathers joins the Center as our business manager, as well as replacing Kathy Waters as the person in charge of *Mammoth Trumpet* subscriptions and distribution. Pat holds degrees in economics and business from the University of Maine at Farmington, and has several years of managerial experience. Louise Bennett replaces Karen Hudgins as the Center's secretary. Louise, who recently moved to Maine from Easton, Massachusetts, brings to the Center 20 years of expertise in the secretarial field.

Although changes have occurred, we are still here, publishing the *Mammoth Trumpet* and carrying forward research on the peopling of the Americas and making the resulting information available to an ever-widening audience. Please continue to feel free to correspond with us; we enjoy hearing from our readers.

- Wu Xinzhi—*Pleistocene Peoples of China and the Peopling of the Americas*
- Takeru Akazawa—*Pleistocene Peoples of Japan and the Peopling of the Americas*
- Yung-jo Yi—*Pleistocene Sites and Industries of Korea and Their Bearing on the Peopling of the Americas*
- Anatoli Derevianko—*The Mousterian and Early Palaeolithic of the Altai*
- Nikolay Drosdov—*The Projectile Point Tradition of the Late Paleolithic of Northern Asia and Its Coming to Northern America*
- Chen Chun—*Late Pleistocene Microblade Traditions in Asia and North America*
- William Roger Powers—*Peoples of Eastern Beringia*

NORTH AMERICA:

- Richard Morlan—*The Peopling of the Americas as seen from Northern Yukon Territories*
- Ruth Gruhn—*The Pacific Coastal Route of Initial Entry: An Overview* Michael Wilson—*Early People in Canada: An Overview*
- James Adovasio et al.—*Meadowcroft Rockshelter Radiocarbon Chronology: 1975-1989*
- George Frison—*Pleistocene Prehistory of the Northwestern Plains*
- Bradley Lepper—*Pleistocene Peoples of the Mid-Western United States*
- Michael Gramly et al.—*What is Known and Not Known about the Human Occupation of the Northeastern United States until 10,000 B.P.*
- Alan Bryan—*Early Occupations of the Great Basin*
- Albert Goodyear—*Pleistocene Peoples of the Southeastern United States*
- Dennis Stanford—*Humans and Late Pleistocene Environments in the Central Plains and American Southwest*
- David Meltzer—*The Discovery of Deep Time: A History of Views on the Peopling of the Americas*

CENTRAL AND SOUTH AMERICA:

- Lorena Mirambell—*Pleistocene Peoples of Mexico*
- Gonzalo Correal Urrego—*Early Man in Colombia*
- Gerardo Ardila-Calderon—*Pleistocene Peoples of Bogota*
- Ernesto Salazar—*The Early Peopling of Ecuador*
- Augusto Cardich—*Pleistocene Peoples of Peru*
- Pedro Ignacio Schmitz—*Pleistocene Peoples of Eastern South America*
- Lautaro Nunez—*Primeros Poblamientos en Chile*
- Henry de Lumley and Maria Beltrao—*Pleistocene Occupation of Toca da Esperanca, Bahia, Brasil*
- Niede Guidon et al.—*The Site Toca do Boqueirao do Sitio da Pedra Furada*
- Colagero Santoro—*Early Human Occupation in the South Central Andes*
- Wesley Hurt—*The Paleindian Cultures of Uruguay*
- Gustavo Politis et al.—*Pleistocene Peoples of Argentina*
- Thomas Dillehay—*Pleistocene Peoples of Monte Verde, Chile*

Special Conference features, activities, and symposia include: poster exhibits, key artifact collections exhibits, trade show, an awards banquet, world-class entertainment, special symposia, optional excursions into the beautiful Maine countryside, and much, much more.

This Conference is being co-sponsored by: the National Geographic Society; the US National Park Service; and the Canadian-American Center, University of Maine. For more information and registration materials, contact Conferences and Institutes Division, Chadbourne Hall, University of Maine, Orono, Maine 04473 USA. Phone 207/581-4092.

EDITOR'S COLUMN

This issue of the *Mammoth Trumpet* is a tribute to all the men, women, and children who have picked up a fragment of stone or bone and bothered to ask: "What is it?" "Where did it come from?" "Who made it?" "What were those people like?" Much of the richness and diversity of archaeological discoveries comes to us due to the work of those all-too-frequently unsung heroes of archaeology—the amateurs. Three articles in this issue will introduce you to the work of three outstanding individuals who, in their own way, have made significant contributions to the field of archaeology.

Julian Hayden is a noted Southwestern avocational archaeologist whose career spans nearly six decades. Hayden, a self-taught expert on early desert cultures, has established a sequence of cultural complexes which appear to date back an incredible 28,000 years!

Montana rancher George Cremer has fostered avocational archaeology in a different way. Each year the Cremer Ranches host a gathering of approximately 150 people, from local ranching families to professional archaeologists. Flint-knapping demonstrations, trips to archaeological sites on nearby ranches and a barbeque are part of this two-day event that is one man's way of bridging the gap between the interested public and professional archaeologists. It is a fine example of citizens becoming actively involved in the preservation of prehistoric sites on private land.

For nearly 35 years, Ed Lehner has also played host as scholars from around the world flocked to the site on his Arizona ranch. The Lehner site contains an extensive faunal and Paleoindian record which has been the focus of several extensive excavations. Throughout it all, Ed Lehner has remained deeply involved in all the studies of the site, serving as tour guide to the public, assisting in the excavations, and arranging for housing (and even medical care!) for the archaeological crews. Lehner, now 73, and his wife Lyn have decided to ensure the preservation of the site for future generations by donating the land to the Bureau of Land Management.

These three people, and many more like them, are the heart of archaeology. They share their time and their love of the land, past, present and future, with all who will take the time to listen and to marvel at what they have found. They point the way, not only to the actual sites, but to the future, as they share their interests and discoveries with their friends, neighbors and, most importantly, with the children who will inherit it all.



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

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

Copyright © 1988 Center for the Study of Early Man. Permission is hereby given to any non-profit or educational organization or institution to reproduce without cost any materials from the *Mammoth Trumpet* so long as they are then distributed at no more than actual cost. The Center further requests that notification of reproduction of materials under these conditions be sent to the Center.

Robson Bonnichsen	Director and General Editor
Karen L. Turnmire	Editor, <i>Mammoth Trumpet</i>
Jim I. Mead	Editor, <i>Current Research in the Pleistocene</i>
Patricia W. Leathers	Business Manager, Circulation and Distribution
Judith Cooper	Publications Manager, Production and Marketing
Louise R. Bennett	Secretary

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

SUMMIT '89
MAY 24-28, 1989

LEHNER RANCH SITE: OFFICIALLY ON THE MAP

On March 26, 1988, a ceremony was held in Hereford, Arizona, to celebrate the donation of an important archaeological site to the Bureau of Land Management (BLM). The Lehner Ranch site, one of the oldest early man sites in North America, was owned by Ed and Lyn Lehner for over 35 years. During that time, the Lehnerts preserved the site and gave generous help and encouragement to scholars from the world over who came to study it. In time, the Lehnerts decided to donate the land to the BLM to ensure that it would be preserved forever. Says Ed Lehner: "My wife and I both would like to see the site available to future generations."

Both the academic world and the government were well represented at the ceremony, which drew a crowd of more than 200 people. Speakers included Ray Brady, District Manager of the BLM; Dr. C. Vance Haynes, Jr., Professor of Geological Sciences at the University of Arizona; Dean Bibbes, BLM State Director; Arizona Congressman Jim Kolbe; and Robert Burford, Director of the BLM. At the close of the ceremony, a handsome plaque was unveiled. The plaque describes the discovery of the site, lists some of its major characteristics, and commemorates its donation to the BLM.

In his remarks, Dr. Haynes spoke of the generosity and vision displayed by the Lehnerts over the years. "Ed and his wife, Lyn, have hosted dozens of world-renowned scholars, hundreds of university students, and thousands of schoolchildren and other visitors. . . ." Dr. Haynes said. "There are many successful scientists . . . around today who have profited scientifically by their participation in the Lehner Ranch site excavations and philosophically by their association with the Lehnerts."

Dr. Haynes went on to explain that the Lehner Ranch site has yielded some of the most important data researchers have concerning the Clovis culture. The site was the first to produce radiocarbon dates for a Clovis site, showing it to be about 11,000 years old. It also contained the greatest number of Clovis projectile points and mammoths found in situ at a single site: thirteen projectile points and the remains of thirteen mammoths. In addition, the Lehner Ranch site was one of the first Paleoindian sites to yield fossil pollen, which enabled scholars to reconstruct the environment. And if all the foregoing were not enough, the Lehner Ranch site also produced the first evidence that Clovis peoples ate small game, such as rabbit, in addition to mammoth and bison.

Ed Lehner made the momentous discovery of the site one day in 1952, while inspecting the drainages on his newly purchased ranch. As he walked along the bank of an arroyo on the northwest corner of the property, Lehner noticed some bones protruding through a distinctive black layer of dirt or silt. After taking a closer look, he was able to identify the bones as the tooth plate of a mammoth. When asked how he knew what they were, Lehner explained that he has had a lifelong interest in archaeology and prehistoric cultures. "Part of my youth was misspent prowling Indian ruins and museums!" he says cheerfully. Recognizing the bones' importance, he carefully removed a few specimens and took them to Dr. Emil Haury, head of the Department of Anthropology, University of Arizona.

Dr. Haury immediately recognized that the bones were significant. By coincidence, archaeologists at the time were excavating the first Arizona mammoth site in Naco, 12 miles from the Lehner Ranch. A Naco crew which came to look at the Lehner Ranch site concluded that its geology was contemporaneous with that of Naco. For Ed Lehner, this was deeply exciting. "It's always been sort of a fantasy to discover something like this," he says. "Imagine having a dream of that nature come true. It's mind-boggling!"

Excavation of the site did not get underway until 1955, when resources became available. An element of urgency was added to the task when torrential rains drenched the region in August of 1955. Lehner, notic-



Ed Lehner, right, treads a path often taken as he leads a tour of the excavations on his Arizona ranch.

ing that more bones had been exposed by the rain, reported this to Dr. Haury. "He said that with another rain like that, we might lose a lot of the material," Lehner recalls. In the fall of 1955, digging began under the auspices of the Arizona State Museum. Says Lehner, "We've been having people from all over the world ever since."

Digging was performed in two separate phases during 1955-1956. In the fall of 1955, the excavation produced the bones of nine mammoths, as well as the bones of at least one horse, bison, and tapir. Positioned among the bones, although not embedded, were thirteen Clovis fluted projectile points, eight cutting and scraping tools, a chopper, and miscellaneous flakes and chips. Small amounts of charcoal were also found.

It was the discovery of bones and tools together that made this site so exciting. Researchers postulated that the site contained the remains of animals killed by human hunters. By examining the sand and gravel surrounding the bones and artifacts, the scientists determined that the kill had taken place on a sand and gravel bar in an ancient stream, a tributary of what is now the San Pedro River. They also concluded that the animals had been killed in a series of hunts that occurred over a fairly brief period of time.

Interestingly enough, no conclusively identifiable animal skulls were found. Although several masses of badly crushed flat bone were excavated, these could

***"The adults ask questions
to show off their knowledge,
and the kids ask questions
to find out. You tell me
which is the better question."***

not be positively identified as skull bones. In any case, these fragments were not enough to account for all the animal remains present at the site. Since a cranium had been found at the Naco dig, the absence of skulls at the Lehner Ranch site was puzzling. The researchers could find no reason to account for the absence of skulls and assumed that they simply did not survive.

In February of 1956, a second excavation was undertaken adjacent to the first. It revealed two charcoal hearths, also located on the sand and gravel bar. Charred bone fragments were found nearby, including a slightly charred fragment of a tapir jaw. Charcoal taken from the hearths for radiocarbon dating, yielded a date of 11,000-12,000 years B.P. The discovery of these hearths, complete with charred bone, enabled the researchers to create an overall picture of the ancient site: Prehistoric peoples stalked and killed their prey, butchered it and cooked the meat, all within a small area.

A small amount of trenching was done in 1965, but no other major investigations were undertaken until 1974, when the National Geographic Society funded several digs. These excavations uncovered the ribs, leg bones, and mandibles of two young mammoths, along with flake tools, charcoal, and other bone fragments. Another roasting pit was found, around it were the broken bones of a young mam-

moth, bison, jack-rabbit, tortoise, and bear. In addition, the remains of a mastodon were discovered.

The excavation also yielded a completely unexpected find: a prehistoric well, probably from a Cochise occupation. Radiocarbon dating of specimens indicated they were about 1,000 years younger than the Clovis occupation. No other Cochise artifacts were found.

The Lehnerts have been deeply involved in all studies of the site, acting as gracious hosts, as well as, volunteer labor. Summarizing their involvement over the years, Ed Lehner says, "Whenever I could spare the time I was there with a trowel or whisk broom or whatever. We arranged for outside labor and all sorts of things: housing, medical care for some of the diggers, that sort of thing."

In addition to working with scientists and students, the Lehnerts soon found themselves responding to the interest of the media. In particular, Mr. Lehner likes to recall an article called "The Arizona Hunt" published in 1956 in *Sports Illustrated*. "The mammoth made the centerfold," he says with a laugh. "I think that's somewhat of a distinction!"

In 1967 the ranch was put on the National Register of Historic Places. In 1974 the mammoth site was prominently featured in a documentary, produced by Shell Oil, called "The Early Americans."

The Lehner Ranch site now attracts hundreds of visitors each year. About four to five hundred school children visit on field trips every year, and about 200 adults. Ed Lehner personally takes many of the groups on tours around the ranch. He laughingly states that, "Since I'm retired I do most of the lying about the site!" When asked how the children's reactions differ from the adults', he says, "The adults ask questions to show their knowledge, and the kids ask questions to find out. You tell me which is the better question."

After listening to him speak with energetic enthusiasm about the site and everything related to it, it's hard to believe that Lehner, 73, suffers from what he calls "youth deficiency." Nevertheless, in view of that supposed deficiency, he and his wife Lyn decided to ensure the preservation of the site by giving it to the Bureau of Land Management. Of the ceremony held in March, Lehner speaks with his usual modesty and humor. He says, "C. Vance Haynes made a speech, Kolbe made a speech, Burford made a speech, Lehner made a speech—if that's not enough speechifying for one day, I'll eat my shirt!"

At the present time, the BLM's plans for the site are uncertain. The 6.1 acres donated by the Lehnerts about the 45,000 acre San Pedro Riparian National Conservation Area, also owned by the BLM. This conservation area includes the Murray Springs mammoth site. While no plans for the region have been confirmed, the BLM is considering projects that would enable the public to visit the Lehner and Murray Springs sites, and learn about the excavations and what they have revealed.

Proposed plans for the Lehner Ranch site include a visitors' center that would contain displays of bone and artifacts, dioramas, and maps. Outside, facsimiles of original bones and artifacts may be repositioned in the locations where they were originally found during the excavations.

In addition, plans call for trails to be built through the site with explanatory plaques and signs positioned along the way, thus enabling visitors to take self-guided tours. Eventually, guided tours may also become available.

—Nancy Allison

A BRIDGE OVER TIME

(Continued from page 1)

jobs. "And I've never worried about that anyway," he responds, "because I've always been able to do whatever I set out to do. My father used to say that the more things a man had done in life, the better archaeologist he would be, because he was dealing with people." By this standard, Hayden was well prepared indeed: it is not every archaeologist who can list among his publications *The Facts of Life with Septic Tanks*.

Hayden and his father later worked for the 1934/35 season at the Snaketown site for Gila Pueblo (a research organization), but were laid off for the summer. "Meanwhile, though, I met my bride there," he recounts. "I went home, put two Model Ts together to make a Model T pickup, and picked her up when she came back to Arizona. We went to Mexico and elsewhere on our honeymoon," during which time he claims to have taught her how to cook. More activities followed: a second season at Snaketown, and three and a half years for the CCC (Civilian Conservation Corps) at the great ruin of Pueblo Grande in Phoenix, Arizona.

In 1938, Hayden was asked by his friend, Malcolm Rogers, of the San Diego Museum of Man, to help excavate a site, and his career began at last to move in the direction in which it has traveled ever since. "I took leave from the Civilian Conservation Corps, went over and excavated the Harris site with him north of San Diego under a Carnegie grant. That's the first stratified early-man site that was ever done in this country, dating to 8,000 years B.P. which Rogers placed in Phase II of his San Dieguito Complex."

Rogers was, in Hayden's description, the grand old man of archaeology in the deserts of southern California, Nevada, and western Arizona. Unlike most others, Rogers did not devote himself to the three Ps of Southwestern archaeology: pueblos, pottery and projectile points. Instead, he concentrated on trying to identify the desert cultures which lacked pottery or

and the like. He worked in the Yuma area for two and a half years, later at Edwards Air Base in the Mojave Desert, somehow still managing to do a little desert archaeology on the side. "When the war was nearly over," he continues, "I was transferred back to Tucson, where I set up a couple of squad tents until we could get enough of an adobe house to live in, and brought the family over and started an excavation business."

Before the war, however, Hayden had worked at one of the three places that later enabled him to extend Rogers' series of cultural complexes back further into prehistory—so far back that, at the present hour, late in his career and long after his retirement from construction contracting, Hayden has become a controversial figure.

In 1942, Hayden assisted Dr. Emil Haury, of the University of Arizona, in excavating Ventana Cave in southwestern Arizona, the only stratified cave of its kind to be excavated in the Southwest. The strata, made by a permanent spring in prehistoric times, yielded in the two lower levels, the bones and tooth fragments of extinct horse, camel, dire wolf, and other animals. The cave also contained charcoal and bifacial tools. Rogers, examining the tools and flakes, identified the site as belonging to his earliest designated phase, the San Dieguito I (SD-I). All of Rogers' identifications were subjective; he worked before the advent of C-14 dating. Yet, 20 years later, the organic material from Ventana Cave was finally analyzed, the bone from the lowest level yielding a radiocarbon date of $12,600 \pm 600$ years B.P. and the charcoal from the second level a date of $11,300 \pm 200$ years B.P. Not only did this lend credence to Rogers' sequence of complexes, including the two early, pre-projectile point phases SD-I and SD-II, it also contributed to Hayden's gradually growing hunch that there might exist cultural complexes underneath and earlier than the San Dieguito. Rogers himself had theorized as much early on; even producing a name for them, the Malpais. But,



manent except for human disturbance. Tools dropped on the desert pavement remain lying atop it and are thereby identified as being more recent; tools *within* or *projecting through* the pavement are necessarily as old or older than it is, as the composition of the pavement prevents anything from sinking through it.

Although Hayden has been working in Sierra Pinacate since the 1950s, he could not begin to verify his more startling observations until he had acquired a dating technique: not radiocarbon, but the analysis of desert varnish, a technique pioneered by Ron Dorn, whose work was featured in a recent issue of the *Mammoth Trumpet* (Vol. 4, No. 2). Desert varnish is a black deposit of clay, manganese, and other substances formed by microbes upon both tools and other rocks in the desert pavement following extremely dry climatic periods.

"I first came across Ron Dorn," Hayden recounts, "when he asked me if I would like to read his bachelor's honors paper. He'd gotten interested in varnish, and had read some papers I'd written. So he took it from there, and we've worked very closely ever since." What Dorn developed was a method of dating the varnish through cation ratio analysis; when he had done so, various pieces of a puzzle began to come together.

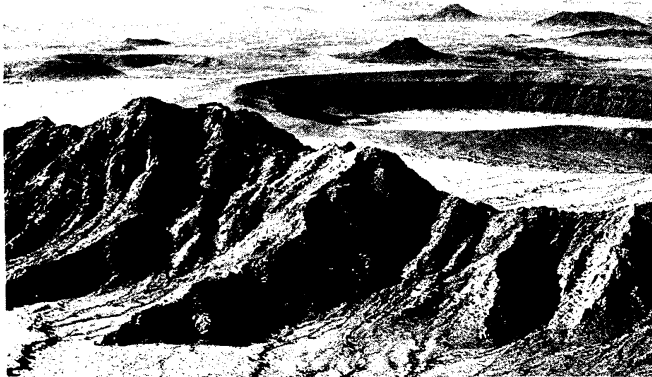
Rogers himself had noted in the Colorado desert back in the 1930s that San Dieguito I tools, bifacially flaked and thinly varnished, differed from other tools found in the same area which were unifacially flaked and heavily varnished. Indeed, it was the latter to which he had tentatively applied the name Malpais before abandoning the notion of a basal stage as untenable, in the absence of a reliable non-subjective technique of dating. Hayden had noticed a similar phenomenon at Ventana Cave.

When he got to Sierra Pinacate, Hayden not only found tools which differed in their amount of varnish, but observed that the SD-I tools, as well as those of a more recent culture called Amargosan, lay on *top* of the desert pavement. The heavily varnished unifacial tools either *projected from* the similarly varnished pavements or had been dropped upon still *older* pavements, establishing a sequence. Hayden therefore revived the name and theory of a basal Malpais Complex.

How much older you ask? As the San Dieguito I Phase at Pinacate and in Ventana Cave is roughly contemporaneous with Clovis, the Malpais Complex appears to be clearly pre-Clovis, or older than 11,500 years B.P.

At this time another piece of the puzzle fell into place. From Malpais times until recently, a number of tools were made out of shell brought inland from the Bay of Adair. East of the present shoreline, Hayden found aeolian dunes with food shell remains: occupied dunes. The weathered surface shell yielded a radiocarbon date of $33,950 \pm 1250$ years B.P., the lower level dates in excess of 37,000 years B.P. It has been only in the last few thousand years that the sea level has risen and brought the shoreline close enough to

At this time another piece of the puzzle fell into place. From Malpais times until recently, a number of tools were made out of shell brought inland from the Bay of Adair. East of the present shoreline, Hayden found aeolian dunes with food shell remains: occupied dunes. The weathered surface shell yielded a radiocarbon date of $33,950 \pm 1250$ years B.P., the lower level dates in excess of 37,000 years B.P. It has been only in the last few thousand years that the sea level



pueblos, eventually establishing a sequence of cultural complexes for the prehistoric Southwest deserts that Hayden has modified slightly but is still using.

"All I've done, if I've done anything," Hayden declares, "is to follow in his footsteps, using tools and methods which have been developed since he died." And indeed Hayden has inherited much of Rogers' predisposition toward the older and more "primitive" cultures. He actually does not even *like* pueblos, claiming they remind him too much of ghettos. "I like it down here where we have creosote bushes and mesquites and broad expanses of nothing, and you can see for 50 miles. That takes me back to the desert people, the hunters and gatherers," he says thoughtfully, "for that landscape is essentially the same as it was for the people who lived there 10,000 years ago and more."

By this time, World War II had come along. Hayden, who had been doing some building and road construction, eventually found himself working for the U.S. Engineer Department on what were called "highball" jobs, extremely fast construction of airports

lacking both hard evidence and a dating technique, and perhaps even a bit disconcerted at the remarkable age such earlier cultural complexes would have to be assigned of logical necessity, Rogers ended by merging the Malpais into the SD-I Phase. Hayden's advance upon his mentor's work has been, in one sense, actually a return: he has revived the Malpais theory by producing the hard evidence, and developing a chronological framework for it.

This evidence has turned up in the area of the Sierra Pinacate in the extreme northwest corner of the state of Sonora, Mexico. Arizona lies to the north of it, the Gulf of California and the Bay of Adair (in the Sea of Cortez) to the west. By "hard" evidence the word here is meant somewhat literally: the desert pavement. Sierra Pinacate is a volcanic complex composed of basalt left by the ejecta and lava flows of an ancient eruption.

When the soil is blown away during periods of drought, the basalt stones drop down upon a bed of clay, which will not support plant life. This is the desert pavement. Once formed, it is more or less per-



How long have human feet trod this trail as it winds through the desert pavement of the Sierra Pinecate region? It leads from the harsh volcanic regions (right) where Julian Hayden has found very old stone tools, past isolated waterholes still used by travellers today, westward to the inland sand dunes and the Bay of Adair at the northern end on the Gulf of California, where, for millennia, inhabitants of the region have gone to gather salt. (Photos courtesy of Julian Hayden; photo of craters by Dan Cassidy).

has risen and brought the shoreline close enough to harvest shellfish conveniently from the bay within traveling distance from the dunes. "I'm pretty satisfied with these dates," Hayden says, "but many people are not satisfied with my assessment, obviously. I've had quite good men ask me openly: 'Well, didn't seagulls carry those shells up there to those dunes?' I'd say: 'Did you ever see a seagull pile up shells of different species in segregated piles on wind-formed sand dunes? And punch holes in the walls of murex (a sea mussel) to remove the meat?' And I get a blank look and they say, 'Well, your dates are no good.' Standard reply. It doesn't bother me."

Since similar weathered shells are found in Malpais camps in Pinacate, Hayden's inferences from varnish thicknesses and the location of tools in relation to desert pavements have been corroborated concerning the impressive antiquity of the Malpais Complex. The final piece of the puzzle, completing the picture, came from Ron Dorn's dates from the Malpais varnish. They beautifully parallel the radio-carbon dates of the shell; they also helped Hayden to realize with some assurance that he was dealing with two stages within the Malpais Complex: Malpais II, older than 17,000 years B.P., and Malpais I, an earlier stage from 22,000 years B.P. to at least 28,000 years B.P., and quite possibly exceeding the 33,000–37,000

***"I like it here where we have
broad expanses of nothing.
It takes me back,
for this landscape is essentially
the same as it was
for the people who lived here
10,000 years ago and more."***

year old shell dates. Varnish ages are, of course, minimum ages marking varnish-forming periods, with no implication or indication of how long the artifact had been made prior to varnishing.

Dates are satisfyingly consistent between different sites in Pinacate: a Malpais I flake from one site was dated at 28,800 years B.P. (with a range of error of 25,500–32,600 years B.P.); a flake from a different site dated at 26,000 years B.P. (range 23,400–28,800 years B.P.). A Malpais II flake came out at 17,000 years B.P. (range 15,200–19,100 years B.P.), an SD-I flake at 9,500 years B.P. (range 8,200–11,000 years B.P.), and an Amargosan flake at 2,050 years B.P. (range 1,900–2200 years B.P.).

The Malpais I unifacial tools were made "with an utmost economy of motion," Hayden observes. "On the Colorado River terraces a bit north of Pinacate they're struck from cobbles. At Pinacate, they were preferably made from volcanic ejecta which had been thinned, smoothed, and polished in the crater throat before eruption." On the Colorado River terraces, the cobbles are interspersed with little Malpais microtools of chert, jasper, and chalcedony. But the small tools from Pinacate were made from dosinia shell, a very heavy bivalve like those we picked up on the beach at the Bay of Adair; these tools were made by percussion flaking. There are no projectile points whatsoever until we get up to Amargosan times in Pinacate, after the warming which occurred in the mid-Holocene that led to abandonment between 9,000–5,000 years ago."

In 1969, Hayden wrote a paper about a tool he has identified as a gyrotory crusher, a very sophisticated instrument for crushing mesquite pods consisting of a mortar with a hole in its bottom and a pestle with a nipple on the end of it which fits into a hole in the mortar. Hayden had long assumed that they were invented relatively recently. "So then I get over to Trans-Pecos, Texas," he recounts, "and I'll be damned if they didn't have gyrotory crushers in Malpais times. Now this is a scandal." Information he considers trustworthy indicates that gyrotory crushers were known all over South America as well: in Ecuador, Venezuela, northern Peru, all the way down to Patagonia.

Mention of Trans-Pecos region in southwest Texas raises the question of the geographic range of the various complexes. Though Hayden's work has been confined to a fairly limited area of the southwestern deserts, the San Dieguito Complexes stretch over the deserts of California, Nevada, Arizona, southern Utah, and, most of all, the area of Trans-Pecos. Here Dr. A. A. Andretta has, for years, followed in the tradition of Rogers and Hayden, working unfunded, and relatively unrecognized. Malpais I is now known there and Malpais II boasts a tool inventory considerably more sophisticated than Malpais II in Pinacate, including gyrotory crushers, mortars and metates. Hayden speculates that the Trans-Pecos was abandoned during the last glacial advance and that the Malpais II people returned from the South with innovations developed perhaps far to the south. Further extension of the complexes might be difficult to establish, as present methods of identification rely largely upon the pavements and varnish which are created only in a desert environment.

Asked to give his advice to those interested in getting into archaeology, Hayden replies simply and bluntly: "Tell them to get out and get into it. Join up with the local society. Many of them have excavations going on; they have their own courses and people get certificates. They do a great service. Many years ago, I was president of the local archaeological group here for several years, and we built it up pretty well; but now I would guess that it has three times as many people as we ever had. Because now the university attitude and rules have changed, and permit the society to involve the members in actual archaeological work, which was not true when I was in it. People love it; they have field trips and go all over the state, and even to Mexico."

The perspective of the avocational archaeologist shows itself in Hayden when he says: "This is probably much too simplistic; I've argued with the professionals ever since I was young, but—what are you looking down on us for? We don't have degrees, but we're doing the work!"

Nor is Hayden overly impressed by degrees in themselves. While the rationale behind them is that they regulate professional standards and impart an expertise that will enable the archaeologist to avoid methodological errors during the excavation of a site, in reality they tend to be much theory and little practice. Textbooks do not even try, for the most part, to teach field methods, and rightly enough. They cannot: too much has to be learned through hands-on experience.

When Hayden excavated the University Indian Ruin in Tucson for the National Park Service and the University of Arizona in 1940–41, his crew was composed of youths from the Civilian Conservation Corps. (Continued on page 6)

THE CRABTREE AWARD

The Crabtree Award was instituted in 1986 by the Society for American Archaeology to honor the distinguished careers of non-professional archaeologists. The first year's award went to Clarence Webb, an M.D. from Louisiana, now in his 80s, who is one of the foremost authorities on Southeastern archaeology. The second was awarded to Leonard Blake, a botanist at the St. Louis Botanical Gardens, who made significant contributions to understanding prehistoric corn agriculture of the Mississippi basin. This year's award was given to Julian Hayden, a Southwestern avocational archaeologist whose career spans nearly 60 years. Hayden is interviewed in this issue of the *Mammoth Trumpet*.

Ruthann Knudson, who first had the idea for the award, describes how she was inspired to invent it. "About 4 years ago, I was talking to a friend about the Society for American Archaeology awards, and I said, 'You know, they're all for professionals. We use this dividing line between professional and avocational, but the Society was originally organized or chartered for archaeology, no matter who does it. What we ought to do is create an award.' Well, I actually do these things every once in a while, so I sat down and put one together. I talked to people to get their ideas, then went of the SAA board and got their approval. Then we sent letters out to a number of SAA members soliciting funds for an endowment, which has supported the program for the first few years. Finally, I decided that, if I'd created it, I could name it, so I named it the Crabtree Award."

Don Crabtree, after whom the award is named, had little formal education beyond high school and never held an academic appointment. Yet he was, by common consent, one of the greatest experts on flint knapping to have lived. Knudson, his former student, recalls, "He spent his time being just fascinated with stone and with how to work it, and taught us so much about what questions to even ask when you work with stone. It's the doggedness, almost, of people who aren't doing something for a living, but are doing it because they're interested, that unravels more questions a lot of times, than the people who are just sitting in a university."

Knudson feels strongly that recognition should be granted to non-professional archaeologists. Not only have avocational archaeologists made significant contributions to scholarship and conservation, they frequently have a clearer sense of archaeology's relation to the public, including an awareness of the field's social responsibility. She remarks that "Somebody reviewed, in a professional journal, an article of mine on contemporary cultural resource management and said that they couldn't understand why I thought there was something called 'the public trust' that is part of archaeology. That's not that unusual an attitude; that archaeological sites are there to be dug up by archaeologists." Knudson holds firm the belief that archaeologists should justify their digging, within reasonable limits, to the public. "Archaeology is destructive; it's an extractive industry, much like mining. And the Clarence Webbs and Leonard Blakes and Julian Haydens often have a little better sense of that, even though we as professionals tend to lump a lot of them as 'pothunters.'"

The Crabtree Committee annually solicits nominations through the SAA Bulletin and elsewhere in November/December. One criterion is that nominees shall have made contributions of broad significance, of interest and benefit to more than just the local county. "There is an SAA Crabtree Award Fund," adds Knudson, "which always welcomes contributions. It is a dedicated fund, not contributing to SAA operations or anything else. We want to build up enough money in it as an endowment that generates sufficient interest every year to pay for the travel, and meeting expenses of the plaque, and so on." Further information on the Crabtree Award is available from Crabtree Committee Chairman Dr. Tom Hester, Texas Archaeological Research Laboratory, University of Texas, 10100 Burnet Road, Austin, TX 78758.

A BRIDGE OVER TIME

(Continued from page 5)

He remembers: "I had about 15-16 young men from South Philly and Scranton and what not, and they were tough guys. But they became interested very quickly. I taught them how to flake percussion tools the way Rogers had taught me, taught them something about various soil types and stratigraphy, and, by golly, you know, they knew more about any aspect of it than the master's classes from the University of Arizona that were brought in once a week to see what we were doing. It is only fair to add that lithics and soils were not studied in those days."

Of course, it could be argued that archaeologists with degrees, while they may be clumsier in the field for awhile, when they do eventually pick up experience they may outstrip those who have extensive experience but are limited in theory and textbook knowledge. Hayden is not so sure it actually works that way. Not only may some academics avoid the field for the most part, but academic and institutional politics can generate pressure to distort interpretations upon which careers are perceived to be hanging. "Another thing I tell graduate students: don't ever take any archaeological report at face value, mine or anybody else's. Because you don't know, and you cannot know, the intermural and intramural politics of the time. I know what lies behind a lot of our major reports because I was involved in them, or my friends were involved in them. And I wouldn't give you two bits for some of them."

But should not the universities beware of narrowing their intellectual perspective, of becoming simply job-training centers? Well, Hayden is not convinced that the stress and competitiveness of modern academic life is really conducive to serene Olympian

detachment and broad intellectual vision. "I've known so many promising young folks who have burned out, or have been driven out, for departmental reasons, for political reasons. . . ." If Hayden's view is not entirely beyond argument, neither can it be dismissed as simple job-hungry materialism. He and his wife never pursued money, and funded all their work out of their own earnings. "We even paid for our own C-14 dates and all the rest of it," he says. "We had graduate students when they were available, helping themselves through school by working in my laboratory out in one of my shop buildings. We managed to do it somehow."

Hayden's criticisms are hardly sour grapes: never involved in skirmishes for money and position, he spends his retirement enjoying archaeology full time, "traveling back and forth to Mexico and writing and talking shop." Nor is it necessarily biting the hand that feeds to express concern over the direction in which the discipline to which he has devoted his life appears increasingly to be drifting. Far from being eccentric, his concern is shared by many, and the Crabtree Award itself represents an effort on the part of the professional community to redress some perceived injustices, to address a problem symptomatic of some of archaeology's deepest tensions.

Hayden was taken by surprise when he won the Crabtree Award. "If it hadn't been for Carla Van West, who's working on her doctorate here, this would never have happened. She's the one who started this whole thing and got other people working on it, piling up a lot of information on me." The choice, however, seems a natural one. Hayden was not only a friend of Don Crabtree's but resembles him in a number of

ways. As Hayden explains, "We had a great deal in common. We were both non-degreed engineers of sorts, and certainly non-degreed archaeologists; both of us were silversmiths and jewellers; we both had lost our wives. As a matter of fact, we were planning a trip to Australia and Japan when he died."

When asked about his feelings on receiving the award, Hayden remarked that Don Crabtree once told him it was most interesting that a man should be honored for doing exactly what he wanted to do all his life. And he adds: "I feel that way myself. I'd have done this regardless—and I still do it regardless. I don't give a damn; I'm an independent old cuss and always was."

"One thing I always keep in mind from the days when I was digging Ventana cave and the Lockheed bombers were flying overhead to Britain, we field archaeologists are on the fringes of life, we are all escapists to a degree and not one of us has ever put a bean in a peon's pot. So let's enjoy to the fullest our most privileged lives."

—Michael Dolzani

MYSTERY OF THE RED PAINT PEOPLE

The Discovery of a Prehistoric North America Sea Culture Produced and directed by Ted Timreck; co-produced and written by Will Goetzmann, 1987. Color, 57 minutes. Available from Bullfrog Films, Inc., Oley, PA 19547, 1-800-543-FROG; to rent or purchase; film or video. Also available in 2 parts for classroom use.

Could North America have been colonized by a maritime culture from across the Atlantic? **Mystery of the Lost Red Paint People** explores this possibility and others as it examines the accumulating evidence from the western shores of the North Atlantic. Excavations from New England to Labrador have yielded the remains of an advanced maritime culture, known now as the Maritime Archaic, which flourished along those shores approximately from 8,000 to 3,500 years ago, vanishing at about the time Eskimo culture reached Labrador from the northwest.

The harsh conditions of the North Atlantic coast have left few traces of this once thriving culture. But new evidence and intense scholarly research of previous discoveries have given present-day archaeologists many tantalizing clues. From these fragments,

they have begun to reconstruct the lifeways of a people who built and sailed ocean-going boats and established vast trade networks long before the Vikings, erected monoliths before Stonehenge, and constructed elaborate burial mounds for their dead centuries before Hopewell. The film introduces some of the people involved in this fascinating research and takes the viewer to many of the remote sites mentioned, on both sides of the Atlantic.

Mystery of the Lost Red Paint People is beautifully filmed and edited, incorporating archive photographs and clear graphics. The blend of scientific investigation and speculation compliment each other well, and will appeal to a wide audience. It has already won three prestigious awards: a Bronze Apple at the National Educational Film and Video Festival, a Red Ribbon at the American Film Festival, and a CINE Golden Eagle in international competition for non-theatrical events. **Mystery of the Lost Red Paint People** aired twice on PBS' NOVA series and has done a great deal to arouse the interest of the public in the very early inhabitants of the Northeast.

UPCOMING CONFERENCES

November 4-6 1988 Fourth Annual California Indian Conference, Univ. of Calif., Berkeley.
Contact: William Simmons, Prog. Chair, Dept. of Anth., Univ. of Calif., Berkeley, CA 94720

November 4-6, 1988 17th Annual Conference on South Asia, Univ. of Wisconsin, Madison.
Contact: Conf. Coord., South Asian Area Ctr Conf Office, 1236 Van Hise Hall, U. of Wisconsin, Madison, WI 53706; 608/262-3384.

Nov. 11-13, 1988 American Society for Ethnohistory, Royce Hotel, Williamsburg, VA.
Contact: James Axtell, Dept. of History, C. of William and Mary, Williamsburg, VA 23185.

November 16-20, 1988 American Anthropological Association, Hyatt Regency, Sheraton Phoenix, Phoenix, AZ.
Contact: Program Chair: Harriet Klein, Montclair State C.

December 13-15, 1988 Theoretical Archaeology Group 10th Annual Conference, Sheffield, England.
Contact: TAG Organizing Committee, Dept. of Archaeology, U. Sheffield, Sheffield S10 2TN, England.

October 19-24, 1989 International Symposium on Paleoanthropology in Commemoration of the 60th Anniversary of the Discovery of the First Skull of Peking Man, Beijing, China, Sponsored by Institute of Vertebrate Paleontology and Paleoanthropology, Academia Sinica.
Contact: Organizing Committee, International Symposium on Paleoanthropology (P.O. Box 643, Beijing, the People's Republic of China).

May 21-25, 1990 Sixth International Conference, hosted by Smithsonian Institution, Washington, D.C.
Contact: ICAZ, Department of Anthropology, NMNH, Smithsonian Institution, Washington, D.C. 20560.

NEW REFERENCES AND RESOURCES

Agogino, G.A. 1988 The Lone Wolf Creek Discovery: An Example of Early Man Being Found in Association with Pleistocene Fauna Before Folsom. **The Chesopian** 26:2-3.

Ahler, S.A. 1988 Review of **Stone Tool Analysis: Essays in Honor of Don Crabtree**, Plew, Woods, and Pavesic, editors. **American Antiquity** 53:425.

Akazawa, T., S. Oda, and I. Yamanaka 1980 **The Japanese Paleolithic: A Techno-typological Study**. Rippu Shobo Publishing Co., Ltd., Tokyo, Japan.

Blumenschine, R.J., and M.M. Selvaggio 1988 Percussion Marks on Bone Surfaces as a New Diagnostic of Hominid Behavior. **Nature** 333:763-764.

Bobrowsky, P.T. 1988 Review of **Environments and Extinctions: Man in Late Glacial North America**, Mead and Meltzer, editors. **American Antiquity** 53:427.

Davis, S.A., and D. Christianson 1988 Three Paleo-Indian Specimens from Nova Scotia. **Canadian Journal of Archaeology** 12:190-196.

Ferring, C.R. 1988 Review of **Archaeological Geology**, Rapp and Gifford, editors. **American Antiquity** 53:427.

Fladmark, K.R., J.C. Driver, and D. Alexander 1988 The Paleoindian Component at Charlie Lake Cave (HbRf 39), British Columbia. **American Antiquity** 53:371-384.

Flenniken, J.J. 1987 The Paleolithic Dyuktai Pressure Blade Technique of Siberia. **Arctic Anthropology** 24:117.

Golla, V. 1988 Review of **Language in the Americas**, by Joseph H. Greenberg. **American Anthropologist** 90:434.

Goodyear, A.C. 1988 On the Study of Technological Change. **Current Anthropology** 29:320-322.

Gruhn, R. 1988 Linguistic Evidence in Support of the Coastal Route of Earliest Entry into the New World. **Man (N.S.)** 23:76-100.

Hester, T.R. 1988 Review of **Lithic Studies Among the Contemporary Highland Maya**, Brian Hayden, editor. **American Anthropologist** 90:476.

Hofman, J., and E. Inghar 1988 A Folsom Hunting Overlook in Eastern Wyoming. **Plains Anthropologist** 33:337-350.

Howard, C. D. 1988 Fluting Technology at the Lincoln Hills Site. **Plains Anthropologist** 33:395-398.

Kelly, R.L., and L.C. Todd 1988 Coming into the Country: Early Paleoindian Hunting and Mobility. **American Antiquity** 53:2231-244.

Laub, R.S., Miller, N.G., and D.W. Steadman, editors. 1988 Late Pleistocene and Early Holocene Paleoeconomy and Archaeology of the Eastern Great Lakes Region. **Bulletin of the Buffalo Society of Natural Sciences**, Vol. 33, Buffalo.

O'Connell, J.F., Hawkes, K., and N.B. Jones 1988 Hazda Hunting, Butchering, and Bone Transport and Their Archaeological Implications. **Journal of Anthropological Research** 44:2:113-162.

Odell, G.H. 1988 Addressing Prehistoric Hunting Practices Through Stone Tool Analysis. **American Anthropologist** 90:335-356.

Susman, R.L. 1988 A New Tool Maker in the Hominid Record? One Species . . . One Tool. **Science** 240:724-739.

Wilson, M.C. 1988 Frison and Todd: The Horner Site: The Type Site of the Cody Cultural Complex. **Plains Anthropologist** 33:420-424.

Young, D. 1988 An Osteological Analysis of the Paleoindian Double Burial From Horn Shelter Number 2. **Central Texas Archaeologist** 11:11-115.

OLD BONES IN THE NEW WORLD

(Continued from page 1)

typically required in decay-counting. AMS technology was made available for extensive archaeological dating in the early 1980s, and immediately produced interesting data for Paleoindian researchers.

To those of us interested in dating human bone, as well as the issue of dating the peopling of the New World, AMS came along at a most opportune time, Taylor says. "It lets us do rigorous chemical treatment on bone and still have enough sample left to obtain a date."

The source of the radiocarbon in our bones can be traced through the food chain and into the galaxy beyond. Cosmic radiation of very high-energy, traveling through space strikes and shatters air molecules in our upper atmosphere. Particles such as muons and neutrons are produced during these collisions. When one of these neutrons interacts with nitrogen, the most abundant component of our atmosphere, the result is the production of radiocarbon or C-14. This isotope of carbon quickly combines with oxygen in the atmosphere to produce a molecule of radioactive carbon dioxide. This gas molecule has the same chemical property as a regular carbon dioxide atom but it contains an unstable carbon atom that can disintegrate at any time.

Radioactive carbon is thoroughly dispersed across the planet by atmospheric mixing. Chemically indistinguishable from normal CO₂, it enters into plants through photosynthesis. Since humans eat plants, our tissues contain concentrations of radioactive carbon that are similar to any other participant in the terrestrial food chain. One out of every trillion carbon atoms in our bones is radioactive carbon.

This is the basis of radiocarbon dating. Once an organism dies, it no longer obtains radiocarbon from the food chain. The amount of radiocarbon within a bone slowly diminishes as individual C-14 atoms in the bone decay at a constant immutable rate. The age of the once-living object is determined by measuring the amount of radiocarbon that remains, and knowing how long it would take for the radiocarbon to decay from its living level down to the level observed in the sample.

In 1960, Taylor, then a first year graduate student, was hired into the isotope lab of Willard Libby at UCLA. Among other reasons, Taylor was attracted to UCLA by the recent arrival of Libby at the university. This was the year that Libby received the Nobel Prize in Chemistry for the discovery of the radiocarbon method. "It was a very unique experience to watch him in action."

While at the University of Chicago in the late 1940s, Libby and his associates had demonstrated that residual radiocarbon content could be used to determine the age of a once-living object without any reference to stylistic comparisons of artifacts or stratigraphic positioning of specimens.

In the case of radiocarbon dating applied to bone, however, the "Radiocarbon Revolution" had to await the development of extensive pretreatment approaches. Taylor states, "In bone that has been in the ground for any length of time, things happen. It is sometimes called diagenetic effects." Bone is composed of both organic and inorganic substances. Realizing that the inorganic or carbonates in a bone could be easily exchanged, and thus, "modern" carbon intruded into samples, labs in the 1960s began working with the organic fraction. In modern bone, most of the organic fraction is the protein collagen. What is collagen? "If you take a bone from a freshly killed cow and you place it in acid, CO₂ is released and what you have left is glue. This is mostly collagen which is the major fibrous protein of bone," explains Taylor.

Unfortunately, collagen breaks down or denatures (changes structure) due to hydrolysis (chemical reactions) and other mechanisms. "It turns out that the longer a bone is in the ground, the amount of organics sometimes decreases at a very rapid rate," Taylor continues. When the sample of bone is very small, very old (and thus having very low levels of C-14), or too valuable to be destroyed in whole, AMS is the only way to proceed.

AMS is sometimes referred to as the "direct counting" approach. While decay-counting determines the amount of C-14 in a sample by looking at the sample's

rate of radioactive decay, the AMS method measures the radiocarbon directly.

The basis of the approach is a particle accelerator, which serves as the "engine" in the AMS process. A small amount of carbon is ionized or charged, and then accelerated down a tube in a high-powered stream of ions. When the stream of ions curves through a magnetic field, it separates the ions out by mass. In the case of carbon, there are three different streams, C-12, C-13 and C-14. Radiocarbon (C-14), swinging wide through the magnetic curve because it is the heaviest carbon isotope, enters a measurement chamber through a strategically-placed slit and is measured via its interaction with a gas.

Armed with this method, Taylor and his colleagues approached a long-standing gray area in American archaeology—the question of the timing of the peopling of the New World. It has been determined that before about 12,000 years ago, the presence of great continental glaciers had lowered the sea level and created a land bridge between Siberia and Alaska. It is generally accepted that this was the means by which the initial human populations reached the New World. During the 1970s, several human skeletons were assigned ages in the 50,000 to 70,000 years B.P. range by a new dating method, amino acid racemization (AAR).

This method measures the percentage of amino acids that have spontaneously changed over to a different molecular form. Certain molecules have two forms, labelled L, or laevo, and D or dextrao, that are mirror images of each other. Living matter generally only contains L-type protein molecules. However, over a period of time, a number of these L-forms will spontaneously switch to the D form. One of the more celebrated skeletons dated by the AAR method was the Sunnysvale skeleton, a nearly complete female skeleton excavated near San Francisco. It's AAR-assigned age was 70,000 years B.P.

In 1983, Taylor and other researchers from Stanford University and the University of Arizona published a report in *Science* which reported an AMS date for the Sunnysvale skeleton at about 5000 years B.P. In 1985, a well-known list of AMS dates was published in *American Antiquity* which significantly reduced the ages of most of the supposedly Pleistocene age skeletons in the New World to less than 11,000 years. "That article probably has the largest number of co-authors of any appearing in *American Antiquity*," Dr. Taylor joked. "It represented the combined work of my lab group, and groups at Arizona and Oxford." In these instances, AMS technology was used to obtain C-14 ages on bone in situations where it would have been very difficult or, in some cases, impossible to obtain the C-14 results by decay counting. Although these redating efforts do not categorically disprove human habitation of the New World before 11,000 years B.P., the implied maximum limit of 11,000 years does fit with other observed evidence.

Currently, the C-14 AMS maximum age range is about 40,000 years B.P., a range similar to that of conventional decay counting. This limitation for AMS is not due to limitations in the measurement technique itself, but to the difficulties in removing modern contamination from sample preparations. The problem is particularly difficult in the C-14 dating of bone. "The main problem with bone C-14 dating," Taylor remarks, "is extracting an indigenous component of the bone for analysis and developing criteria by which you can critically ascertain that the organic fraction is actually indigenous to the bone."

"That has been the goal of all bone analysis ever since the beginning. The advantage of AMS analysis is that, since you can work with much smaller amounts of organics, you can be much more exacting and rigorous in the methods that you can use to extract a given fraction. Unfortunately, the older a bone gets, the greater the chance that you're looking at contamination."

However, with improvements in lab techniques, there is the expectation that eventually the C-14 dating range can be extended to as much as 80,000 to 90,000 years B.P. using AMS technology. "This will be of much interest because no other physical dating method can routinely and accurately cover this time period at the present time," Taylor states.

According to Taylor, now that AMS technology is available, the issue in bone dating is "What is the appropriate way to look at bones from a geochemical perspective? How do you maximize the chance that you're going to get an accurate estimate of age from an analysis of the C-14 content of a given organic extract?" Taylor's view is that "Each bone should be looked at as a potentially unique geochemical system. One examines a number of fractions in a bone—particularly with critical bones. It is often said that one date by itself means little in archaeological situations. It is necessary to obtain concurrent age estimates to be able to speak of the age of a bone sample with confidence. If you find that you pull out three or four fractions and they are roughly of the same age, the chances that all three were contaminated equally from an external source in the same manner is significantly decreased."

What's next for Taylor and his colleagues? "What we'd like to do in conjunction with Dr. Bonnicksen and the Center is to look at the remaining suite of bones from the New World that have been suggested to be of Pleistocene age." These samples, from such places as Florida, California, Nebraska, and Argentina, have been obtained from various museums and repositories across the country. "They represent what, some years ago, were thought to be human bones of possibly Pleistocene age. We are very interested in working on the ones Rob has collected."

The chemical lab work will be far from negligible. "I would suspect it will take us a good six to seven months once we get the samples to evaluate the bio-geochemical problems. It's going to take a while to do, because this type of work-up is very time consuming. Especially if you see each bone as a unique geochemical system. Those will be done very carefully, because these samples are one-of-a-kind." Another reason for the caution, he emphasizes, is "The fact that the first number will be the number people remember, so you want to make very sure it's right!"

Dr. Taylor and others are eagerly awaiting the opening of the new University of California AMS facility at the Lawrence Livermore National Laboratory. It is expected to become operational in late 1988 or early 1989. Because sample preparation time is still the main limitation on the rate of production of samples, they do not anticipate large increases in the amount of AMS dating. However, they do look for an increase of work focused on specific areas of research, specifically in the area of Quaternary studies. Someday, says Taylor, "I would like to see an AMS facility dedicated to Quaternary research. I believe that there is a real need for that."

—Jim Bonnicksen

SUGGESTED READINGS

On Old Bones in the New World.

Taylor, R.E., L.A. Payen, B. Gerow, D.J. Donahue, T.H. Zabel, A.T.J. Jull, and P.E. Damon 1983 Middle Holocene Age of the Sunnysvale Human Skeleton. *Science* 220:1271-1273.

Taylor, R.E., L.A. Payen, C.A. Prior, P.J. Slota, Jr., R. Gillespie, J.A.J. Gower, R.E.M. Hedges, A.T.J. Jull, T.H. Zabel, D.J. Donahue, and R. Berger 1985 Major Revisions in the Pleistocene Age Assignments for North American Human Skeletons by C-14 Accelerator Mass Spectrometry: None Older Than 11,000 C-14 Years B.P. *American Antiquity* 50:1:136-140.

Taylor, R.E. 1987 *Radiocarbon Dating: An Archaeological Perspective*. Academic Press, New York.

On The Lehner Ranch Site

Antes, E. 1959 Geologic Age of the Lehner Mammoth Site. *American Antiquity* 25:31-34.

Barnett, L. 1956 The Mammoth Hunt. *Sports Illustrated* Oct. 15:55-60.

Lance, J.F. 1959 Faunal Remains from the Lehner Mammoth Site. *American Antiquity* 35:1:35-42.

Haury, E.W., E.B. Sayles, and W.W. Wasley 1959 The Lehner Mammoth Site, Southeastern Arizona. *American Antiquity* 25:1-30.

Haynes, C.V., Jr., and E.W. Haury 1973 Archaeological Investigations at the Lehner Site, Arizona, 1974-1975. *National Geographic Society Research Reports* 14:325-334.

On A Bridge Over Time

Hayden, J.D. 1967 A Summary Prehistory and History of the Sierra Pinacate, Sonora. *American Antiquity* 32:335-344.

Hayden, J.D. 1969 Gyrotray Crushers of the Sierra Pinacate, Sonora. *American Antiquity* 34:2:154-161.

Hayden, J.D. 1970 Of Hohokam Origins and Other Matters. *American Antiquity* 35:1:87-93.

Hayden, J.D. 1976 Pre-Altiplano Archaeology in the Sierra Pinacate, Sonora, Mexico. *American Antiquity* 41:3:274-289.

PRIVATE HANDS HOLD PUBLIC TRUST



Above, Rob Bonnicksen, Director of the Center for the Study of Early Man, demonstrates the art of flint knapping to an interested group assembled at the Cremer Ranches' annual archaeology round-up. Below, Larry Lahren of An-

thro Research in Billings, Montana demonstrates the effectiveness of the stone tools Bonnicksen made as he butchers an antelope for the evening's barbecue. (Photos by Roy A. Gallant)

The place is Cremer Ranches near Melville, Montana. Every year a group of people interested in archaeology come together here for a two day event of barbecuing, dancing, flint knapping demonstrations, field trips to archaeological sites, and, best of all, talking archaeology. They may not all be degreed archaeologists, but one look at the faces of the people gathered to watch a flint knapping demonstration assures one that they are all archaeologists at heart. This summer, in addition to hosting the gathering, the Cremeres opened their home to the annual board meeting of The Center for the Study of Early Man.

The Cremer event was originated 11 years ago by George Cremer, Dr. Robson Bonnicksen, and Dr. Larry Lahren. Upon seeing the interest that Cremer and other ranchers had in Montana archaeology, Bonnicksen and Lahren decided to organize a gathering which would provide an informal atmosphere for people to learn about American prehistory. What started out as a small party of five to ten people now attracts as many as 150, all by word of mouth. The an-

"A guy could get so interested in this stuff that he could forget to run his ranch," commented Norman Starr on discovering his first archaeological site.

nual barbecue provides an opportunity for people interested in archaeology to meet with professional archaeologists, ask questions, and, most importantly, to break down the barriers that often exist between professionals and the public.

As a result, the interest in archaeology in the Sweetgrass region of Montana has grown tremendously. Lahren states that he has received a number of calls at his Livingstone office from regional ranchers who have discovered sites on their land.

This interest stems, in part, from their attendance at the Cremer Ranch festivities. The overall atmosphere of the two day event is often enough to get people interested in archaeology. Demonstrations are given on flint knapping and butchering, and material from private collections is identified by the "in-house" archaeologists. On occasion a visiting professional will sign out artifacts for the weekend from his or her home museum, so that people can gain a better understanding of different types of artifacts.

Most of the people that attend Cremer's event don't belong to amateur archaeology societies; they

are ranchers and farmers interested in learning about the past.

There is no age limit to loving archaeology. Ranchers, young secretaries and children watched in awe as Bonnicksen created tools from stone. With equal fascination, people gathered around Lahren as he butchered their dinner (an antelope acquired through the Fish and Wildlife division), with the stone tools. At the flint knapping demonstration, one bright child asked if the tools could be tied to wood and used more like modern knives. With pleasure, Bonnicksen answered "yes" and went on to explain how stone knives and scrapers could be bound to bone, wood and antler for use in preparing skins and cutting meat. The child and his friends then went off to try their hand at cutting meat with stone.

Adults gathered around Bonnicksen after the demonstration wanting to know how they could become involved in archaeology. The answer to this is a multifaceted one. Many communities have local archaeological societies which distribute information, offer short courses, and are involved in on-going excavations. Volunteer organizations (such as Earthwatch) also exist which permit interested individuals to assist at sites almost anywhere in the world. Professionals are often willing to speak at schools. Lahren, in addition to talks at the local elementary school, offers a short night course for adults, which many Sweetgrass ranchers attend. And of course, the Center for the Study of Early Man provides up-to-date information on the peopling of the Americas. But one of the best ways to become involved in archaeology is to keep an eye open for potential archaeological sites and/or artifacts, and to ask questions. A striking example of public involvement is illustrated by Cremer's chance discovery of a potentially important site a few days before the barbecue.

Cremer was flying over a neighbor's ranch when he noticed terraces surrounding a dried up lake basin. Realizing the possible significance of this observation (such terraces frequently contain very old human occupation sites), Cremer contacted Norman Starr, the owner of the property, and the two ranchers drove out to look at the basin. After discovering a number of small weathered stones which appeared to be flaked, Cremer and Starr collected a small sample.

When Bonnicksen was shown the weathered stone he agreed that, at some time in the distant past, the material had been worked by human hands. The following day, a reconnaissance party consisting of archaeologists, the Center's Advisory Board and the two ranchers visited the site. Once at the site area, the crew split up to look for artifacts along the lake terraces. A number of ventifacted (weathered by wind) artifacts were found clustered along these terraces. Members of the crew agreed that Cremer and Starr



had indeed found an important Paleoindian site, and plans for surveying and preservation were initiated.

Although George Cremer lacks a formal education in archaeology, he has perhaps done more towards educating the public on the importance of archaeology than have many professionals. Since finding his first arrowhead at the age of ten, Cremer has pursued a lifelong interest in archaeology. (Rose Hynman, an amateur archaeologist and rancher from Livingston, Montana receives special mention for her contribution in fostering and developing Cremer's knowledge of Montana archaeology). Today, in addition to acting as host for the annual barbecue, Cremer can be frequently found talking to friends and neighbors about the importance of artifacts, buffalo jumps and sites that exist on their land. It was in this way that Norman Starr became interested in archaeology; interested to the extent that he wants to become actively involved in the preservation of prehistoric sites on his land.

We, as archaeologists are fortunate that people do have an interest in our subject of human prehistory. Every year members of the public bring sites to the attention of State Preservation Societies and universities. Each newly reported site enhances the potential for reconstructing and preserving prehistory.

Archaeology needs the George Cremeres and the Norman Starrs of the world. Much of this nation's archaeological resources occur on private land. It is only with the assistance and cooperation of private land owners that we will be in a position to help preserve sites for future generations. Neither professional nor amateur archaeologists can be everywhere at once; an interested public can.

—Diane Douglas