FLINT FLAKES YIELD TRACES OF ELEPHANT

Elusive Second Mastodon Delays Remote-sensing Plan

New, preliminary excavations began this summer in an area of east-central Ohio where skeletons of three extinct Ice Age mammals have been discovered. Flint tools were found there last summer with one of the skeletons that has come to be known as the Martins Creek Mastodon. Nigel Brush of the University of Akron's Center for Environmental Studies hopes to learn whether remote-sensing techniques can be used to locate additional skeletal materials.

Last summer, Dr. Brush and a crew of geology and anthropology students excavated a disarticulated mastodon skeleton from the Martins Creek site and discovered several flint flakes, some of which were among the mastodon bones (See MAMMOTH TRUMPET 8.4 "Worked Flint Found with Mastodon Bones"). Subsequent analysis confirmed traces of elephant blood on one of the flakes; study of the Martins Creek material is continuing. Current Research in the Pleistocene is publishing two papers by Brush and his colleagues about the site. These will be in Volume 11, which is due for distribution soon.

Brush said this summer's excavation was undertaken at a site near Berlin in Holmes County approximately 30 miles south of Akron and 1 mile east of the Martins Creek Mastodon site. Mastodon bones were encountered at this new site about a decade ago during the construction of a pond. Subsequent work on the pond avoided the area where the bones were found, but test excavations this summer could not relocate the skeleton. "I'm beginning to wonder if the bone was from underneath the pond," Brush said in a telephone interview. His strategy had been to relocate the bones of this mastodon, but leave them buried and then employ sonar to determine what it might show of the bone. If remote-sensing techniques locate the known mastodon bones, Brush plans to expand the survey from the known to the unknown, first surveying the landform that contained the Martins Creek Mastodon, and then surveying an area about 2 miles farther east, where the skeleton of a giant ground sloth was found during the 19th century.

The area to be examined formerly was boggy.

continued on page 8

IN MEMORIAM

H. M. WORTHINGTON: 1914–1994

With the passing of Marie Worthington on May 31, 1994, the Center for the Study of the First Americans has lost a valued and distinguished friend. She has graced the CSFA with her style, wit and unerring dedication to science. Marie was always there and ready to help. Though we are immeasurably saddened by our loss, the entire field of First American Studies will continue to benefit from her intelligence, insight and wisdom.

—Robson Bonnichsen, Director, CSFA

Hannah Marie Worthington was born Sept. 5, 1914, in Denver. Her mother was French, and she acquired fluency in the language at an early age. She attended Denver public schools and aspired to study literature at the Sorbonne in Paris. Instead of studying there, she entered the University of Denver intending to study zoology or medicine. After taking classes in her sophomore year taught by E. B. Renaud, she decided to switch to archaeology.

Dr. Worthington was graduated in 1935 and traveled to Europe, where she studied in France, England, and Spain. She studied typology at the Musée de l'Homme and Laboratoire d'Anthropologie in Paris. In the summer of 1935 she worked on French Paleolithic sites in the Dordogne region under the direction of Dr. Henri Martin. While at the Musée, Worthington met Harper Pat Kelly, who introduced her to Martin and his colleague Dr. Peyrony and American Paleo-Indian archaeologist Edgar Howard. These contacts set the stage for her association with the Museum of Natural History in Denver.

After returning to Denver later in 1935, Worthington joined the Denver Museum of Natural History as a staff archaeologist. She got what she thought would be a temporary job by arranging an exchange of French artifacts for photographs of American tools. Her salary for photographing the artifacts was $50 per month. The job became permanent, and in only two years Worthington rose to the position of Curator of Archaeology. She held this position for the next 31 years until her retirement from the Museum in 1963.

Worthington began her field work in 1936 with the excavation of a Folsom site near La Porte, Colo. She followed this with the excavations of two rockshelters in Montrose County, Colo., in 1937 and 1938. Also in 1937, Worthington attended the...

continued on page 6

INSIDE

Montana Field Work Awaits Consultations .................. 2
New Books ................................................. 2
Some Paleoindian-Elephant Links in Doubt ................... 3
New Jersey Fluted-Point Survey ............................ 3
Paleo Sites to Get Landmark Status .......................... 4
Chronistic Time With Volcanoes ............................ 4
Suggested Readings ...................................... 5

International Symposium on Early Man held in Philadelphia; it was the first of many meetings she attended throughout her career.

Next, Worthington participated in the excavation of a Fremont village site in Grand County, Utah, from 1938 to 1941. She finished her field work there in 1947.

In addition to her field work and duties at the Denver Museum, Worthington began to write the first of her highly regarded books, Ancient Man in North America, shortly after her arrival at the Museum in 1935. The book was published in 1939 and went through four editions. She fully revised the last edition, which was published in 1957, 1966. Ancient Man in North America synthesized the findings of Paleoindian scholars and is still used today. Worthington wrote the book so it could be used by professional archaeologists and lay people alike. In the preface to the fourth edition Worthington wrote:

It was felt that there might be a great many persons
New Books


Packed with a variety of papers on prehistory, dating methods, and archaeological theory, including recent advances in osteology, linguistics, and other topics relating to First Americans studies, this book grew out of the 1989 First World Summit Conference on the Peopling of the Americas at the University of Maine. It is not a "conference book", however; papers include some added since the conference. "There is a need to move beyond the graffiti of the past," which is how the editors put it in their introduction. They suggest that though there may be no single resolution that will lead to scientific advancement in Paleoamerican studies, "the search for American origins should develop viable scientific models that explain the dispersal of humans across North America, South America, and the south.

Method and Theory continues with David Meltzer's review of controversies involved with the study of American prehistory and proceeds to two papers on radiocarbon dating of bone by R.E. Taylor and Thomas W. Stafford, and a paper on the role of geoarchaeology by C. Reed Ferring.


Linguistic evidence for the Peopling of the Americas is presented in a paper by that name by Merritt Ruhlen that is followed by a paper on the implications of the history and classification of American Indian languages, by J. MacNeil. The all-important study of stone tools and toolmaking technologies is examined in a paper by David E. Young, Robson Bonnichsen, Diane Douglas, Jill McMahon, and Lise Slate, and an examination of microlithic stone membranes for identifying blood residues on artifacts is described by David C. Hyland, Jean M. Tersak, James M. Adovasio and Michael J. Siegel.

Barbecue Serves Dual Purposes

PARADISE VALLEY, Mont.—A bison barbecue to benefit the Center for the Study of the First Americans attracted more than 200 people here July 2. Karl Knuechel, Jackson Lake and George Cremer, members of the CSFA executive board, were hosts for the event, which was held at Knuechel's home. Guests feasted on roast bison, salads, beans and corn on the cob, and took part in a night of fine art works and outdoor adventures held in Knuechel's airplane hangar. A presentation by well-known wildlife photographer Tom Murphy was also featured, as were displays on CSFA research objectives and publications.

"Mother nature had perfect timing by presenting a typical Montana hail storm at about the time Tom Murphy put on a spectacular wildlife slide show in the hangar," said Knuechel. "Despite the excessive noise, the crowd enjoyed the beautiful photography." The auction was previewed by a catalog prepared by Heather Hartman and Amanda Knuechel sent to prospective guests about two weeks before the event. Besides works donated by various artists, the auction offered elk hunts, fishing trips, airplane trips and archaeological tours. Rebecca Foster, assistant director of the CSFA, said that the event was quite successful and that plans are now being made for a similar event in Oregon.

"The barbecue also presented a great educational opportunity for the Center," said Knuechel. Especially prepared visual displays explained the Center's role in excavating sites, analyzing archaeological data, and utilizing scientific breakthroughs. Knuechel expressed thanks for the many who made the event possible. He noted that Don Gimbel, CSFA Board member from Montana, was on the site two days early and prepared the hangar, chuck wagon and grounds for the event. He also cited Board member David Bobb of Ashland, Ore., and Foster for labeling auction items and bid sheets. George Cremer for donating the bison and helping with the sale; Tom Murphy for donating two prints and doing the slide show; and Allen and Barie Carter for donating fishing rights for the elk hunt.

Montana Field Work Awaits Consultations

Field work at the highly productive Mammoth Meadow Paleoindian site in southwestern Montana is scheduled this summer pending resolution with the U.S. Bureau of Land Management of various permit-relevant issues, principal investigator Robson Bonnichsen noted. The interdisciplinary team of scientists and volunteers from the Center for the Study of the First Americans and Earthwatch have been mapping the site and preparing excavation plans. Occupation in the site's two units near a source of high-grade chalcedony, a colorful flint used widely for tools, has documented that people had utilized the site for more than 11,000 years — just how much longer is the important issue that remains to be investigated.

Alan L. Schneider, vice-chair of the CSFA's Advisory Board, said that the delay at Mammoth Meadow will allow further consultation with Native Americans, the BLM, and other interested parties concerning the potential benefits and consequences of the research there. Investigation of the site has pioneered a number of new avenues of research not contemplated when current permit procedures and land use regulations were adopted. For example, hairs found preserved in the site's wet clays have firmly established the presence of animals not repre- sented in the assemblage of animal bones. Hairs of animals as diverse as mammoths and small mammals have been found, and the site also has yielded naturally shed human hairs. No human burials have been encountered at the high-altitude site.

Mammoth Meadow researchers developed at the site a flotation method of recovering the hairs and subsequently, laboratory researchers have discovered that ancient DNA can be retrieved from the bones. Information stored in DNA, one of life's principal building blocks, offers enormous potential for learning more about the people and animals that inhabited North America long ago. Because of the newness of methodologies employed by CSFA, questions have been raised concerning potential application of consultation and repatriation requirements of the Native American Graves Protection and Repatriation Act and other federal statutes. It is hoped that these concerns can be resolved so as to permit the resumption of field work in 1995.

Though field work has been held up, archaeological lab work on the site's great wealth of lithic material remains an extensive record of faunal remains continues.

We're Sorry!

We unintentionally deleted our Mammoth Trumpet data base, which left us with a no-so-up-to-date backup copy. There was some confusion surrounding the timing, circumstances and notation of the deletion, and as a result:

1. We sent out renewal notices to people who had already renewed.
2. We lost recent new subscriptions.

We apologize for the inconvenience this has caused all of our subscribers. We want to thank all of you who responded to the renewal notices with humor, understanding, and even offers of assistance with data base. We greatly appreciate getting the information needed to reconstruct the list.

If you sent us a check to subscribe or renew between April 1 and July 15, 1994, we ask that you phone or send us a note with your name, address, date, and the amount of your check. No need to send a copy of the check or the note. We are aware of anyone who became a new subscriber during this period, please let them know of the problem and have them contact us. Meanwhile, we have taken measures to minimize chances of this happening again. Thanks again for your patience.
New Jersey Fluted-Point Survey Points to Pleistocene Landforms

A survey of fluted points by the Archaeological Society of New Jersey confirms previous evidence that the location of that state's Paleoindian sites is highly predictable, based on landforms. John H. Cresson, a Middletown, N.J., contract archaeologist with a lifelong passion for stone tools, along with Anthony Bonfiglio, has been spearheading this survey, which is nearing completion. The work, a labor of love for Cresson and other members of the Archaeological Society of New Jersey chapter of the Society, suggests that makers of fluted points utilized upland features of the coastal plain and also relic wetland features created during Ice Age permafrost conditions.

"We've seen a distinct pattern associated with glacial landforms," Cresson said in a recent telephone interview, "and we've seen a natural attraction to these sites." Citing research he has been involved for more than 20 years, Cresson says there is reason to believe that Paleoindian peoples utilized watercourses, possibly as game traps. Paleoindians also utilized the coastal plain's hills or "cuesta mounts," which range in elevation from 150 to 350 feet in a band trending southeast to northwest that constitutes the drainage divide between the Delaware Basin and the Atlantic, and they frequented stream and river terraces. Cresson suggests that the cuesta landscapes may have been lookout, travel corridors, and sources of lithic material, while periglacial landforms were resource areas. Features he identifies as reli- pianges (soil-covered ice mounds raised by hydrostatic pressure in periglacial environments) and palsa (smaller but similar features raised by freezing) became thaw lakes or wetlands surrounded by low ridges in Pleistocene times. They now can be found as low, circular or oval features scattered across agricultural fields of southern New Jersey's extensive coastal plains, and they tend to be visible on both topographic and soil maps. Sites often occur on the north or southwest rims of these features, Cresson says.

Initial fluted-point discoveries tended to be on the uplands, remnants of earlier coastlines, but subsequent analysis of the location of these tools is that indicative of the earliest-known humans suggests that Paleoindians also utilized a predictable value of any landscape features. Find these landscape features, Cresson suggests, and that is where to find the Paleoindian sites.

In 1991, Tom Radi and Brian Wageman began the society's survey of fluted points, building on an earlier survey conducted by Ronald J. Mason and Herbert C. Kraf that recorded about 280 such artifacts at 46 Paleoindian biface points on New Jersey's coastal plain, the focus of the current survey. The new survey has recorded 29 additional fluted points from new sites as well as from other sites identified by the three researchers. Three of these as being from faraway sources: Plum Nellie chart from Ohio, Magnusen chart from Maine, and Catholina Cheloneci from Virginia. Eleven were made of Pennsylvania Jasper, seven of Normanskill chart, and five of an unidentified black chart; the other three were of Ooandaga chart, pebble chart and milky quartz. He says 10 of these bifaces can be categorized in morphology and technology as early Clovis types, while 14 are middle types and five are late types. A Middle periods are diagnostic of Paleoindian occupation. Though no one knows why, Paleoindian toolmakers crafted distinctive projectiles quite unlike those made later. They were thinned at the basal end by the use of shallow channels to create "flutes" on each side. Presumably the flutes allowed the points to be fitted firmly into the ends of split shafts and then secured by sinews or cordage. To practiced observers, channel flutes are as distinctive as the finished points themselves.

Identification of potential sites can alert investigators to preserve or salvage sites that are about to be developed. Cresson described one archaeological survey he did at a construction site for a large discount store on the coastal plain in Ocean County. When he recog- nized a buried dune-t endregionland- form he believed might indicate prehistoric occupation, he in- creased the number of auger holes in his survey. Sure enough, he dug up a series of artifacts that included channel flukes. Subse- quent work at the site yielded channel flukes indicating projec- tiles with very long flutes—70 to 50 mm. "We highly recommended it for preservation," he said of the site, but he isn't sure that it was prehistoric occupation, Cresson said. That recognition of landforms diagnostic of Paleo- indians has the potential to help archaeologists. Cresson said the information "hasn't sunk in yet with the administrators and the people who are managing these sites. We're losing them left and right," he said. —Dah

Landmark Status For Paleo Sites Is Goal of Program

The U.S. National Park Service is undertaking a program to identify and protect the country's earliest archaeological sites as national historic landmarks. The Paleoindian National Historic Landmark study is a cooperative project involving the National His- toric Landmarks Archaeology Committee, the Soci- ety of American Archaeologists (SAA), and state and tribal historic preservation offices.

Organizers of the project, the feasibility phase of which is due for completion Sept. 30, call Paleoindian sites the nation's most threatened as well as the most poorly understood. The SAA is working to identify sites that are particularly susceptible to damage or destruction by natural forces, development, and vandalism because they are rare, small in size and contain artifacts highly prized by collectors. Coordinators in various regions of the country will work with scholars, agencies, avocational archaeologists, and preservationists to identify all existing knowledge about Paleoindian sites. The goal will be to develop a framework to identify, evaluate, and finally designate Paleoindian sites as National Historic Landmarks.

Robson Bonfichi, Director of the Center for the Study of the First Americans, is involved with the project through the SAA. Noting the urgency of protecting Paleoindian sites, he notes that no such action has been taken until now. "There have been efforts to identify sites that have been recognized as being of importance since early 1960s."

Complex Stratigraphy Obscures Paleoindian-Elephant Association

Complexity of geologic deposits in New Jersey is making it difficult to associate fluted points with remains of elephants that have been found in close proximity. Discovery of an elephant rib in a stratum that has yielded Paleoindian-type tools at first seemed to have established the association (Mammoth Trumpet 6.1: "Discovery of Elephant Rib Provides Value Study") and appeared to be a breakthrough in the quest for the antiquity of many fossils that have been found in Pleistocene deposits in Monmouth County, N.J., and it promised to establish the age of associated artifacts.

However, subsequent research has called that confirmation into question. The problem, David C. Parris, curator of Natural History at the New Jersey State Museum, explains, is that because of the receding sea level during the Ice Age, late Pleistocene strata were deposited at lower elevations than earlier ones. Thus materials from the older, higher deposits can erode onto later, lower deposits, causing confu- sion about the chronology.

There was evidence that the brook deposits were a reworked mixture of material of differing ages, but the carefully excavated elephant rib, found in 1992 by Joe and Sandy Camburn, was in a discrete deposit of the Cape May Formation, which is likely to be Wisconsin (late Pleistocene) age. The Camburns donated the bone to the State Museum, and Parris had it dated by a radiocarbon method, the 12,000-year-old bone (GO 17879) was of an age for an elephant and an exciting age for the fluted points found elsewhere in the same stra- tum. Nearby, a fluted point had been discovered near the tooth of another giant beast, but two radiocarbon dates from peat in the same stratum were about 10,000 years younger than the age of the elephant rib. Obviously, more research was needed.

Parris organized an ongoing investigation of faunal remains to look for an answer. One project reidentified relevant material in the museum's collection, and the other analyzed the antiquity of the plentiful mammoth remains in the Pequannock area.

Michael Mills, a student at Princeton University, studied the faunal material from the stratum in ques- tion. Perhaps his most significant find was the tooth of a 500,000-year-old horse. Obviously it did not fit in a deposit with a 12,000-year-old elephant or the 2,000-

year-old peat. The horse tooth, Parris said in a recent telephone interview, "does come from the same bed." He said the study indicates the faunal remains are mostly found isolated—that a number of Pleistocene formations have been reworked by erosion. "The assemblages we're getting from the brooks there, while mostly Wisconsin to Reccent, do include material of a number of different ages." Parris was not sur- prised; he knew, for example, that shark teeth of Cretaceous age had turned up in the material.

Throughout Monmouth County, there are depos- its of varied Pleistocene age. Parris, a geologist, explains that they were deposited in terraces, the oldest of which are higher than the younger. "Since the sea was gradually receding, the ones of a more recent age are actually lower." It appears that the older of these have been providing derived material that has gone into this ultimate deposit that now yields the brook fossils. Unfortunately, that means the associations between material of known age and Paleoindian-type artifacts are now suspect.

Parris said the muskrat study indicates the depos- its in question are mostly late Pleistocene or Recent in age. That project made use of the fact that musk- rats' teeth have gradually changed in size over time. Evelin Nieb, a student at Monmouth County High Technology High School, measured muskrat teeth in the museum's collection. "She es- tablished that practically all are in fact Wisconsin to Recent," Parris says. "That's probably true of most of the fossils." The elephant rib is probably that of an American mastodon (Mammuthus americanus), the best-known of New Jersey's extinct mammals. Mammoths are rare in the state's record. Pleistocene horses, such as the Miles' study discovered, are also relatively rare in New Jersey.

Undoubtedly, the Pleistocene stratum that yielded fluted points is a complex one. The material is present all across Pleistocene time. It's just that it appears now that in these brook deposits there are fossils that are derived from a number of previously exist- ing subepochs. And that, Parris adds, makes them all the more difficult to interpret. —Dah
Chronicking Time with Volcanoes

By Stefan C. Radosевич, Ph.D.

Mount St. Helens spews silicic tephra in its 1980 eruption.

Absolute Ages

Researchers commonly obtain chronometric or "absolute" ages of volcanic material through potassium-argon or fission-track dating. Potassium, the seventh-most abundant element of Earth's crust, has one rare isotope, potassium-40, which is radioactive with a half-life of 1.25 billion years. Potassium-40 decays into calcium-40 and argon-40. Argon-40, which is held within the potassium-bearing minerals of volcanic material, is not released like calcium in eruption. Development of the mass spectrometer in 1954 enabled practical application of the potassium-argon method, developed primarily by geologists Garniss Curtis and Jack Eberhardt. There have been several refinements on the original method, the most elegant of which is the single-crystal laser-fusion system that gives ages on individual crystals. Under good conditions, margins of error may be as low as 0.5 percent.

A famous controversy surrounding the dating of a lovely East African horn (cranium ER-1470 and the KBS tuff) involved potassium-argon dating. The original date for this tuff, a volcanic ash, was asayed at 2.6-2.9 million years, making the associated fossil cranium the oldest large-brained hominid ever found. Later analysis, occurring after improvements in the potassium-argon methodology, revealed the cranium to be 1.8-1.9 million years old, causing reassessment of ER-1470's place in human evolution.

Fission-track dating is based not on decay and resulting buildup of daughter elements such as potassium-40, but on the cumulative effect of radiation on crystal structure. Isotopes of uranium in a mineral such as zircon, or in a glass such as obsidian, occasionally decay by spontaneous splitting (fission) of atomic nuclei. When the mineral or glass is properly treated in a laboratory, the resulting tracks of fission can be seen with an optical microscope and counted.

To estimate age, a sample's natural fission tracks are counted as an fission tracks in a sample that has been exposed in a nuclear reactor. The ratio of the number of tracks between sample and control is proportional to the time since the sample was last heated. Resultant dates of obsidian tools can either reveal the date of the volcanic activity that produced the obsidian or the date a tool was last exposed to direct fire.

Useful time limits for potassium-argon and fission-track dating depend on circumstances, and technological advances are likely to extend them both to more-recent and earlier times.

Other dates obtained by such methods (putative 1.25-billion-year-old rocks) drop out quickly, so that they cover even a small, often only a few square kilometers. In a study of basaltic tephra of the Oregon High Cascade, Craig Skinner and I found that, with few exceptions, such tephra present geochemically limited applications for correlating archaeological sites and eruptive events. However, silicic (glassy, silica-rich) tephra are lighter and may be blown over an area of thousands of square kilometers, making the correlation of many archaeological sites feasible. The great eruption of Mount Mazama about 7,700 years ago and the eruption of Mount St. Helens in 1980 spread silicic tephra. Differences in tephra source result in different clast (grain) sizes and varying degrees of vesicularity (bubbles contained in the clasts). Pyroclasts are divided by size into three groups: 1/16 mm to 2 mm (ash or coarse ash), 2 mm to 64 mm (lapilli), and greater than 64 mm (bomba). Pyroclasts that are lapilli or larger in size may be separated into scoria, cinders, and pumice. Pumice is usually lighter in color and will float in water, while scoria and cinders, are usually basaltic and will not float (cinders also tend to be darker in color). Clean, unworked, non-transported primary deposits of tephra are the ideal materials for either field or laboratory characterization. Field identification is based on visual physical characteristics. Chemical analysis can be made in the laboratory. Field recognition of a Mount Mazama tephra, for example, can vary depending on how close one is to Oregon's Crater Lake. The farther away one is from the volcano, the smaller the clast or grain size will be. Absolute distance of deposition for a given size and weight of clast will depend on the wind power of the blast, quantity of tephra ejected, and prevailing wind. Lapilli, the mid-sized volcanic ejecta, will be smaller the farther they are from the source. If the lapilli are rounded rather than angular, and of the same uniform small size (2-5 mm), it may be evidence that they have been transported some distance and are not a primary deposit. Secondary deposits, however, may be useful—they can at least put a minimum date on a stratum. If a particular kind of volcanic ejecta is found, it means the stratum that it is buried in cannot be older than the original eruptive event.

It should be noted that soil-forming processes will sometimes produce aggregates (called "pedds") that resemble lapilli, and may be mistaken for them. Granular and small blocky pedds can be distinguished by their "cutans" or clay coatings in well-developed soils, or by their lack of concentric weathering layers when the ped is broken open.

Silicic tephra is usually lighter colored (light-gray to tan to yellowish orange) and is easily contrasted with dark-colored, well-developed soils formed in basaltic tephra. In some arid environments, calcium carbonate horizons (often called caliche) are mistaken for tephra. If a clast does not feel gritty or if it dissolves in water, it is probably a mineral salt or gypsum. If an application of 10 percent hydrochloric acid produces significant fazing, it is probably caliche.
Suggested Readings

On Ice Age Quest

On Chronicling Time with Volcanoes

Coming Conferences

Sept. 26-Oct. 2 Seventh Congress of the International Council for Archaeozoology, Constance, Germany. Contact: Dr. M. Kokabi, Landesdenkmamt Baden-Wurttemberg, Fischerstieg 9, 78343 Gaienhofen-Hemmenhofen, Germany, or S. J. Miller (see below.)


Oct. 18-20 Symposium celebrating the 65th anniversary of the Institute of Vertebrate Paleontology and Paleoanthropology, Beijing. Systematics, evolution, biogeography, paleoecology, and biostratigraphy of vertebrates and humankind beings followed by an excursion to Zhoukoudian. Contact: Qi Zhongying, Director IVP, P.O. Box 643, Beijing, China.

Oct. 18-22 Rewriting the Pacific: Culture, frontiers and the Migration of Metaphors, Davis, CA. Contact: Kay Favel, Critical University of California, Davis, CA 95616. Fax: 916-752-8630.


Mount Mazama's great eruption was dated by radiocarbon analysis of charred wood found in this massive tephra deposit in Clearwater Canyon about 25 miles northwest of Crater Lake. This characteristic tephra, which spread over much of North America, has an age calibrated to 7,700 years B.P. This photograph shows approximately 5 vertical meters of the material.

Consultation with a geochronist or someone who does tephrochronology is a necessity if an archaeologist wants to correlate tephra strata by their chemical signatures. I am unaware of any commercial laboratories doing tephrochronology specifically, however; it is usually done by archaeologists in conjunction with field geologists, soil specialists, and geochronologists. Samples for further analysis should be taken from a section representative of the tephra as a whole. Careful examination of the bed being sampled is highly recommended to ensure that features indicating reworking or multiple origins of the tephra are not noted. Photographs, which may later be shown to a professional tephrochronologist or volcanic stratigrapher, should be taken as a record of the sampling site. At least two samples should be taken from each sampling unit, one a representative bulk sample that can later be studied for grain size, mineralogy, etc., the second a selection of the largest, least-weathered lapillus present for chemical analysis. The bulk sample should weight at least 100 grams (fist-sized or larger).

If the bed reveals internal layering, it becomes necessary to decide how many sub-samples should be collected. Based upon traits one sees in the field—color changes, clast-size changes, discontinuities in grading, etc.—each distinguishable layer should be sampled. Samples are best stored in plastic bags with resealable closures, although if the tephra is damp or wet, it must be stored in paper bags with twist tie closures until it dries out (to avoid growth of fungi, etc.). If it is very wet, you can store a sample temporarily in an open plastic bag inside a paper one.

The reliability of tephrochronology is very good, based as it is on the fundamental rules of stratigraphy. However, some problems do exist with distinguishing strata. Most significant of these problems is that tephra from different sources may be stacked one upon the other with little indication as to where the boundaries are. Tephra air-fall deposits commonly have few if any internal structures, bedding, or laminations. Color may be useful in separating the different tephras in the field, as well as variation in grading or grain size. In the lab, differences may be seen in chemical components or in varying percentages of vitric versus leitic versus crystalline components. The last two methods are perhaps the best way to determine where one tephra begins and another ends. Buried soils (palaeosols) may be distinguished from buried tephras by the presence of root traces, differently colored soil horizons that grade slowly into one another, and soil structures such as pedons.

There is no geological time limit to tephrochronology, dependent as it is upon stratigraphy. Chronometric, or absolute, time limits are those of the specific technique applied. In addition, confidence in chronometric dates derived from tephras is a function of each technique’s reliability and accuracy. Tephrochronology is not a single dating technique but rather a term encompassing multiple subfields of chronology (stratigraphy, geochemistry, volcanology) having in common a basis in the stratigraphy of volcanic ejecta. Practical application of tephrochronology requires the investigator to tailor the methods to each site, depending upon the problems presented.
To Many She Was 'The Queen'
A Memoir by C. Vance Haynes, Jr.

Between geology and archaeology I have had many interests, but no one has had more influence on my life than H. Marie Womington. Prior to reading her Prehistoric Indians of the Southwest, my connections with archaeology was little more than that of an arrowhead collector, one of several hobbies I then pursued. Her book turned my interest from that of idle curiosity to a desire to really understand the meaning and the artifacts I was finding on the surface.

Cowing up in the East, I was fascinated by arrowheads found in plowed fields or in baskets in country antique stores my parents would visit on trips from Langley Field, Va., to my father's home in Mt. Airy, N.C. Eventually I found arrowheads as my interests turned to rockhounding at Johns Hopkins and to geology at the Colorado School of Mines. Then 'military matters occupied my thoughts as the Korean conflict intensified.' It was then that I learned of the Samella Base in Albuquerque, N.M., that my attention turned once again to arrowheads. Gerald E. Shetton, a fellow officer, and his wife took me arrowhunting a few weekends, and once we found a clean site in an oil field. The following Sunday I was stationed in Frankfurt, Germany, and I met her in Munich, where she was visiting relatives. The contrast between the two worlds was staggering. I was taken for a ride in a car that had been 'very fast' and was impressed by the 'beautiful streets with their long, colorful facades.' Then I was taken to a 'simple' home in Mexico and we went on to a very beautiful and colorful city, Guadalajara. She introduced me to Alex Krieger and he encouraged me to write up the finds I was documenting in Torrance County. I went through and Coast Guard Academy, N.Y. Eventually I was transferred to Bergholz Air Force Base in Austin, Tex., and there met another mentor, E. H. Sellards, a geologist with an intense interest in archaeology. He had just completed his book Early Man in America. He also encouraged me to write up my finds, but Air Force work did not leave enough time until I was transferred to Alaska on special duty. There I had all kinds of time. Our top-secret project required working 24 hours a day two or three days at a time every month. For the rest of the month there was work to be done. So I became a prolific reader and read practically everything that had been written about 'Early Man' up to that time. I also became more and more interested in the geologic record as it related to archaeology.

The Fairbanks area further enhanced my interest in this field. The most delightful of their contained extinct fauna I found fascinating. The archeologist Ivar Skarland introduced me to Otto Geist and David Hopkins, and David introduced me to Troy Pevel. By the time I returned to Austin in the 'lower 48' I had a wonderful wife, a box of fossil ivory, and a completed manuscript on the Torrance County finds. My father introduced me to Boyd Air Force Base in Wichita Falls, Tex., passed the manuscript on to Floyo Studer; director of the Panhandle Plains Museum at Canyon. From Studer I went to Jack Hughes, who recognized the importance of the finds and encouraged me to send it to American Antiquity. It was my first rejection, but Alex Krieger said he wanted it - he was editor of the New Mexico Archaeological Society bulletin. With Marie's help and his help it was further improved and eventually published. In the spring of 1954, as I left the Air Force to return to the Colorado School of Mines by way at the blowouts of eastern New Mexico, "Doc" Sellards encouraged me to stop in Midland, Tex., long enough to meet Glen Evans. "Great idea! Before reaching Midland, I thought, 'Woo-ah! That was a 1942 Jeep in tow, developed universal joint problems that caused a half-day layover at the Ford dealer in Midland. This turned out to be the most enjoyable car repair I've ever experienced. Glen came right down and spent the rest of the afternoon talking about Quaternary geology and Early Man. He was again a geologist who was making significant contributions to understanding the world of Paleoindians.

As soon as my wife, Taffy, and I were settled in new housing at CSA , we visited Marie at the Denver Museum of Natural History. She had been encouraging me by mail, but meeting her in person was indeed a highlight. An added bonus was meeting Pete Walls, of the CSA's American Paleo- nesium--another economist with an interest in archaeology. She invited Taffy and me to join them on a trip the following weekend to the Medicine Bow area and to visit the headquarters of the leaders being John Montagne, my geologic professor at CSA, who, I met Hart Malde, Roger Haynes, E. F. Holt, and other U.S. Geological Survey geologists, devoted to Quaternary geology.

There was very little spare time while receiving a Colorado School of Mines underground education, so it was not until after I entered graduate studies at CSA that I could really devote some time to archaeology by working with the many leaders of Quaternary History. When the fourth edition of Ancient Man in North America came out in 1957, I was delighted to find that Marie had written part of the Colorado County, work. My first discovery in her laboratory was, what Frank H. R. Roberts had called 'a fossil fragment from Lindenmeier,' that I thought might be broken during manufacture. In one box of noted John Cotters' Lindenmeier finds I found a crude fluted base that matched a large fluted flake fragment in another box. When I showed these to Marie, she completely agreed with my new interpretation.

I became so interested in geology as it related to archaeology that I was spending more spare time doing consulting geology for archaeologists than mining geology consulting, the difference being my compensation for the former was pleasure and fascination rather than fees.

Marie introduced me to Joe Brew from Harvard and his students Henry and Cynthia Irwin. I enjoyed working with them at the Magic Mountain site not far from my home in Golden. It was at Magic Mountain that I began to experience archeological field techniques. Also, it was through Marie that I got to know Joe Ben Wheat.

About this time George Agogino contacted me to find out about some preceramic sites near Grants, N.M., that my former Air Force buddy Jerry Shetton and I had worked on while at Samella Base. I was interested in collecting samples for radionuclide dating because many old Paleoindian sites reported mentioned charcoal in Paleolithic levels. At Kirk Bryan's sites at Grants, we found me heartlands with charcoal. We were particularly interested in collecting charcoal from the Folsom level at Lindenmeier, and we asked Frank H. R. Roberts. He was quite enthusiastic as long we confined our collecting to arroyo-walls and did not clip up major sites. After 600-800 person hours (George said it was 700) we had collected about a teaspoon of charcoal. At Jerry Richardson's suggestion, I asked Meyer Rubin of the USGS in Washington, D.C., if we could run it, only to be told it was insufficient. With help from Marie, we secured enough money to obtain an..."
Rockefeller Foundation and led to the book, Origins, published in 1953. Among Worthington’s other publications while at Harvard is “The Story of Pueblo Pottery” written with Armita Neal and published in 1951. She was also named visiting lecturer at the University of Colorado from 1950 to 1953.

Worthington’s field work and publishing continued for more than 20 years after she graduated from Harvard. She conducted a survey in Alberta in 1955–1956 and worked on the Fraser Agate Basin and the Jurgens Cady sites in Colorado. The latter project was conducted jointly with Joe Ben Wheat.

Dr. Wheat, Curator Emeritus of Anthropology at the University of Colorado remembers his association with Worthington, which began in 1934, with fondness. “We were good friends over the years and colleagues in the sense that we were both invited to visit and authenticate archaeological sites,” Wheat said. “She was a close friend and we visited each other as families and went on trips together. Also because we were at various times in the same kind of excavation processes, we discussed results a lot. She was a consultant and discussant at times. She was a colleague who did more than just sit on the sidelines and cheer.”

Worthington’s field work in the 1940s led to the publication of Reappraisal of the Fremont Culture with a Summary of the Archaeology of the Northern Periphery in 1955. This influential book led others to reassess Southwestern prehistory. In 1956 Worthington published a definitive book with Robert Lister on the virtually unknown Uncompahgre complex in west-central Colorado.

Worthington’s increasing recognition as an expert in Paleoindian studies led her to being sought as a consultant for Paleoindian projects in Iowa, Nevada, Alaska, Nebraska, and South Dakota. From the 1950s through the 1970s, she represented the United States at many international congresses. These meetings took Worthington all over the world. She visited no fewer than 33 foreign countries and six continents. She was one of the first Western anthropologists to enter the Soviet Union in 1956 and was among the first Western archaeologists to visit the People’s Republic of China as part of the United States Academic and Scientists’ Paleolithic Anthropology Delegation in 1978.

Worthington gained more recognition in later latter years as evidenced by the many honors and awards she received. At the World Summit Conference on the Peoples of the Americas sponsored by the Center for the Study of the First Americans in 1989, she was presented the National Geographic Society’s $5,000 Franklin L. Burr Prize. Among her other awards: Guggenheim Fellow, 1970–1971; Colorado State Archaeologists Award, 1979; Society for American Archaeology, Distinguished Service Award, 1983; C. T. Hurst Award for Extraordinary Service, presented by the Colorado Archaeological Society, 1985. She received Honorary Doctor of Human Letters degrees from Colorado State University in 1977 and Colorado College in 1988. She was also appointed Curator Emeritus of Archaeology by the Denver Museum of Natural History in 1988.

In addition to her professional achievements and recognition as a scholar, Worthington is recognized by her colleagues as a pioneer in opening up archaeology to women. She became the first woman president of the Society for American Archaeology in 1986 after serving two terms as vice-president in 1980–81 and 1981–82.

Jane Stevenson Day, Chief Curator of the Denver Museum of Natural History said, “She was a major role model for many women because, of course, archaeology at the time she started into it was a very male-dominated field. She became probably the best-known woman archaeologist of her time. She did her best to encourage women in the field.”

Worthington inspired enthusiasm for archaeology in her students and colleagues alike. Because they held her in high respect and regard, they always wanted to let Worthington know how they were doing and what their latest findings were. In this way, Worthington became an unofficial information center for many Paleoindian archaeologists across the Southwest and the nation. “She was always very open and very generous to share everything they found with her and get her comments,” said George Frison. “She was kind of a clearinghouse for Paleoindian archaeology. She was very interested in what people were doing and she had a lot of protocols.”

Joe Ben Wheat agrees with Frison in his characterization of Worthington as a “clearinghouse.” Wheat said, “She was the center of this movement and was a compiler of just about everything that went on in the field. Every time somebody did something they would tell Marie and she would pass it along to the rest of us.”

Ann Johnson, archaeologist for the National Park Service in Denver, was the last in a series of professional and non-professional archaeologists who helped Worthington with her office and correspondence. According to her, Worthington kept up her role as mentor and consultant until her death. “She served as a focal point for information,” Johnson said. “People were interested in her views on the subject and she was very generous in sharing what she knew and what people had sent her with anybody who had a legitimate interest.”

There are many other sides to Marie Worthington that her friends and colleagues remember. Frison remembers the gourmand. Frison jokes, “Her philosophy can be summed up in one statement. She used to say, ‘When I die, cremate my body but be sure you don’t scatter it where it will foul up the radiocarbon dates.’”

Many who knew Worthington remember her sense of humor. Frison jokes, “Her philosophy can be summed up in one statement. She used to say, ‘When I die, cremate my body but be sure you don’t scatter it where it will foul up the radiocarbon dates.’”

Robert W. Richards

‘The Queen’

continued from page 6

analysis at isotopes, Inc. The result was the first reliable radiocarbon date for Folsom. Marie then encouraged us to publish our results in the DMNH’s Popular Series. Being asked for a publication—and by H. M. Worthington—was to me heady stuff. I began to entertain thoughts of trying to make a living at this enjoyable business.

George Aggino and I set out to solve all the Paleoindian chronological problems by collecting charcoal from old sites while at the same time looking for new ones. Things really began to happen in Wyoming. The Pacific Mammoth site was found and led to our acquaintance with Dennis Stanford from Rawlins. Jim Duguid from Balsom Buttes showed us the Brewer site at Agate Basin and told us that his father had discovered during the 1930s. We also met George Frison at that time. We had more than we could handle, so he suggested we try to get the twos interested. We didn’t have to try very hard.

Thus began a long-standing and very pleasant association.

Marie and Peter’s house was a gathering place at all times for anyone working on archaeology in the region. It was essentially the “command center” for Paleoindian studies. This went for geologists as well. It was at Marie’s that I first met John P. Miller, the last teacher of the Kirk Bryan school of geology at Harvard. Through Fred Wendrock I had already met Luna and Estella Leopold, so I was happy to learn that Luna and John Miller were close friends and collaborators. They, along with Joe Brew and Marie, encouraged me in my career of what we now call geoarchaeology by returning to academia for a Ph.D. With further encouragement from mentors at the University of Arizona, I eventually qualified in the eyes of Marie. I became even more aware of this when, in 1962, she recommended me to Dick Shurtleff as the geologist on the Tule Springs project.

Marie, more than anyone, pioneered the way for women in archaeology and never failed to encourage women. Everyone took great pride in being a part of Marie’s world and for every new find of every new season we couldn’t wait to tell Marie. Her response was invariably enthusiastic and charged with encouragement. One day, Marie said to me, “I think you might have a little trouble understanding the geology.”

Sipping scotch, Marie said to me, “I think you might have a little trouble understanding the geology.”

That night Marie and John Miller took me out to dinner. Marie said to me, “I think you might have a little trouble understanding the geology.”

C. Vance Haynes, Jr., is Regents Professor of Geosciences and Anthropology at the University of Arizona.
Ice Age Quest

Among other local landforms it displays the effects of the Wisconsin ice sheet reaching its maximum extent against the uplands of the Allegheny Plateau and then melting. The area is about 2 miles north of the terminal moraine, which marks the maximum advance of the glaciation; glacial melting periodically created lakes there. Martins Creek site is on a peninsula of land that extended into the Ice Age lake. Brush speculates that it may have been a place where large mammals came to drink, and it seems to have been a place where people cornered and killed them.

Brush and Forrest Smith, a professor of biology at the University of Akron’s Wayne College, describe the Martins Creek discoveries in their paper in Current Research in the Pleistocene.

Mingled among the mastodon bones on the southern and eastern margins of the site were deer bones and teeth. The deer bones increased in frequency to the south and east as the mastodon bones decreased in number. The highly disarticulated state of both the mastodon and the deer skeletons suggested the possibility that these animals had both been butchered. The paper goes on to describe the related discoveries of seven flint flakes, which could have served as effective butchering tools, and a flint side scraper.

Although the flint flakes had not been retouched, they were clearly waste flakes derived from flintknapping activities and were made of material that outcrops some 20 miles to the southwest. Brush and Smith note that Indiana University anthropologist Nicholas Toth has demonstrated that unmodified waste flakes could have served as very effective butchering tools (Suggested Readings).

Brush submitted the side scraper and four flakes to Margaret Newman of the University of Calgary’s Department of Anthropology for immunological analysis of possible protein residues. Brush, Smith and Newman describe that process in another paper in Current Research in the Pleistocene Vol. 11. The two of the flakes produced positive results, one for deer antler, and one for elephant antler. Laboratory materials used in the testing do not distinguish between different closely related species. Elephant antler, for example, give positive results for samples from all members of the order Proboscidea, which includes modern as well as extinct elephants.

Because flakes found in association with mastodon and deer bones show evidence of having once been bloodied by mastodon and deer, Brush and his colleagues conclude that they were probably used as butchering tools. However, Brush says he is pursuing further avenues of investigation.

Antiquity of the mastodon has not yet been established, although radiocarbon analysis is pending. Dr. Daniel C. Fisher of the University of Michigan’s Museum of Paleontology and Department of Geological Sciences is studying the bone. The skeleton was badly weathered and cracked, so recovery of it was difficult. Its initial discovery dates to 1938, when a farmer was digging a drainage ditch. The trenching machine brought to light teeth, and a geologist from the College of Wooster came to investigate. He identified the teeth, the largest of which weighed six pounds, and a femur that also had been excavated, but because the bone was poorly preserved no more excavation was attempted. The 1938 investigation did not reveal that the mastodon had been disarticulated. Contemporary accounts, including a brief item in Science, said part of the skeleton had been damaged by dynamite used in a previous ditching project about ten years earlier (see Suggested Readings). Brush presumes that preservation of the bone deteriorated even more rapidly in the intervening decades as farm machinery rolled repeatedly over the dry soil.

The mastodon bones were relatively near the surface; rib and leg bones were only 46 cm deep, and the pelvis and part of the spine were at a depth of 56 cm. Before they found the skeleton last summer Brush and his crew opened 16 excavation units each 2 m square and up to 1.5 m deep. The son of the farmer who made the 1938 discovery pointed out the location for Brush.

The giant sloth (Megaprotos jeffersoni) found two miles away in 1890 was reported to have been excavated from under more than 6 feet of sediments. Its bones were in excellent condition, and the specimen was subsequently mounted and displayed in a museum at Ohio State University. The 1938 Science report of the Martins Creek Mastodon suggested that the animals had become mired in the bog left by the filling of the glacial lake. Few, if any, scientists at that time would have speculated that the mastodon might have been butchered by humans. —DAH

UW Lab Does TL, OSL Dating

The University of Washington’s Luminescence Dating Lab has been doing thermoluminescence and optically stimulated luminescence dating on a commercial basis since 1986. Mention of this facility, which analyzes both sediments and ceramic materials, was unintentionally omitted from the article “Measuring Energy Stored in Trapped Electrons” in the last Mammoth Trumpet. Researchers wanting information should write to Jim Feathers, Luminescence Dating Lab, Department of Anthropology, DH-05, University of Washington, Seattle WA 98195, phone 206-685-1659, or fax 206-543-3285.

1993 excavations at the Martins Creek Mastodon site paralleled a drainage ditch installed in 1938. The site is near the tip of a narrow peninsula that had extended into a glacial lake.